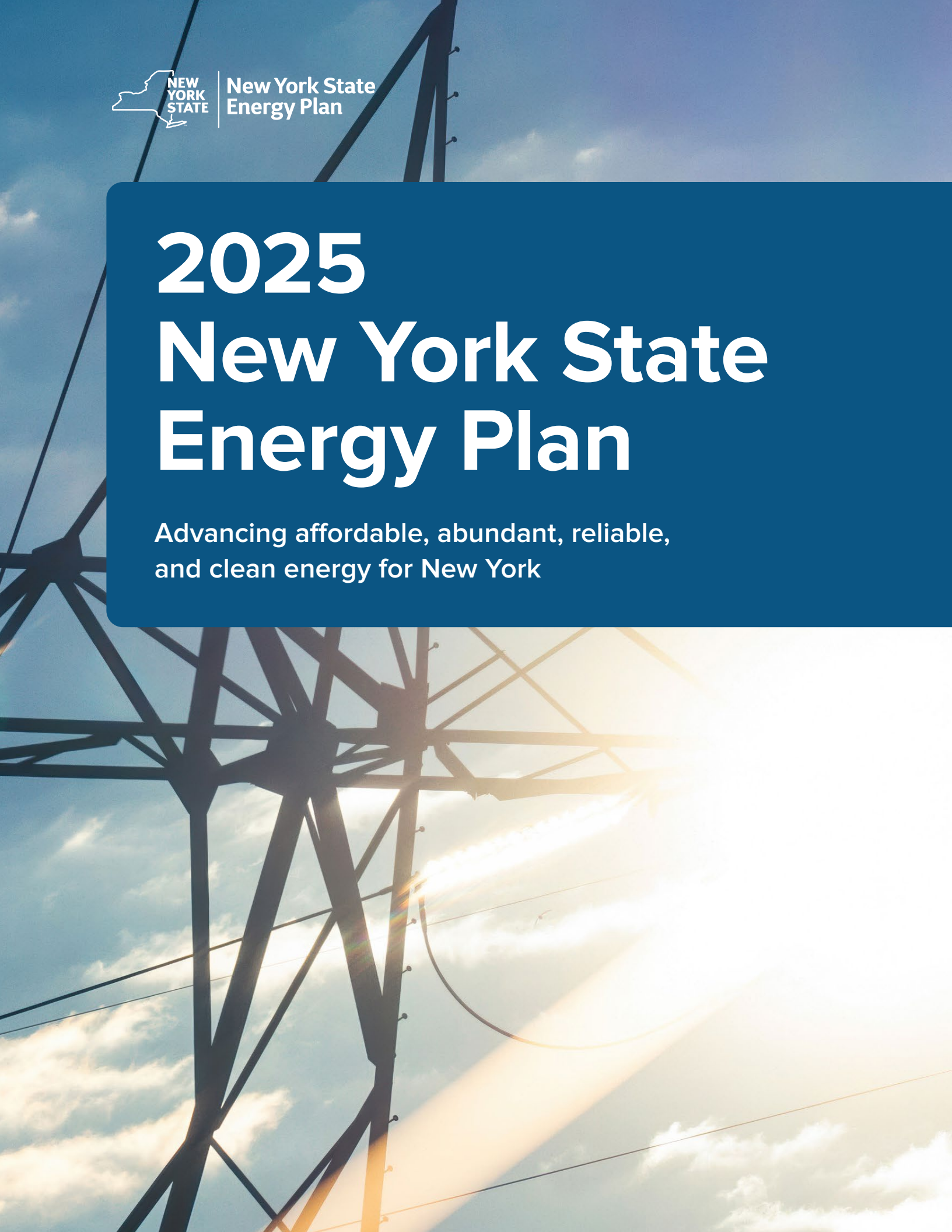

NEW YORK STATE | New York State Energy Plan

2025 New York State Energy Plan

Advancing affordable, abundant, reliable, and clean energy for New York

Letter from Governor Kathy Hochul

To my fellow New Yorkers:

As Governor, my responsibility is simple to say but difficult to deliver: keep the lights on, keep energy bills within reach, and keep our promise of a cleaner, healthier future for our children. Reliability, affordability, and sustainability guide every energy decision I make.

Let me start with what too often gets lost: New York is already a national clean energy leader.

Our grid is among the cleanest in the country. We built America's first utility-scale offshore wind project. We lead the nation in community solar. We've modernized transmission lines that were first put up in the 1940s. Our nuclear fleet continues to provide zero-emission power around the clock. Through the $1 billion Sustainable Future Program, the $4.2 billion Clean Water, Clean Air, and Green Jobs Environmental Bond Act, and record investments in efficiency and clean buildings, we're lowering bills, cutting pollution, and creating tens of thousands of good-paying jobs.

Our actions will provide cleaner air and water and more livable communities across the state. In fact, if you track New York State's emission reduction progress with the globally-utilized accounting standard that is also the norm in 48 other states, we're close to reducing greenhouse gas emissions by nearly 40% by 2030, despite federal setbacks.

We're not just claiming that clean energy can work—we're showing the country that it already does.

Being a leader means moving forward with clear eyes and common sense. This State Energy Plan is a realistic assessment of where we are and a roadmap for where we need to go. It is frank about the challenges ahead and confident in what New York can accomplish.

First and foremost is reliability. Our energy system is the backbone of our entire economy. It powers our hospitals, subways, farms, factories, and homes. And we're operating one of the oldest, most complex grids in the nation at a time when demand is rising fast. Advanced manufacturing, new housing, and exciting research all require more energy. Meanwhile, climate change is bringing storms, heat waves, and blizzards that strain our system even further. In recent years, we've come uncomfortably close to shortages. I will not risk rolling blackouts or gas outages. This Plan reflects that urgency.

Affordability is just as important. Across the state, people tell me they cannot absorb double-digit rate hikes. Seniors, young families, small businesses are all feeling squeezed. That's why we've pushed back on excessive price increase requests from utilities and energy developers and why we've demanded accountability from all of our partners.

We also have to be honest: the world has changed since many of our climate goals were set. Supply chain shortages, post-pandemic inflation, and shifting federal policy away from renewable energy have increased project costs and slowed progress nationally. Ignoring these realities would not make us more ambitious, it would make us irresponsible.

The long-term answer to affordability is not scarcity; it's building more in-state power. More clean generation. More transmission. More storage. More firm, zero-emission resources like nuclear to anchor reliability as demand grows.

This Plan embraces a much-needed all-of-the-above strategy: hydropower, solar, onshore and offshore wind, our existing nuclear fleet, advanced nuclear, energy storage with the strongest safety standards in the nation, efficiency, electrification, bioenergy, demand flexibility, and, where needed, modern gas infrastructure to keep the system stable during the transition. It presents a guidepost for greater state energy independence.

This Plan also recognizes a simple truth: energy policy is economic policy. Our ability to attract the jobs of the future depends on reliable, affordable, increasingly clean power.

And above all, this Plan keeps people at the center: lowering energy burdens, improving housing, strengthening communities, making sure clean energy choices are in reach, and ensuring a just transition for workers who have powered New York for generations.

If any state can show the nation that a clean energy transition can be reliable, affordable, and achievable, it's New York. We've done it before. We'll do it again—responsibly. We need to move forward carefully to ensure energy reliability and affordability so decades from now, New Yorkers will be able to say we left them a stronger, cleaner, and more secure energy future. I believe that this Plan will allow us to do that.

I thank the New York State Energy Planning Board, their staff, and thousands of New Yorkers who participated in the process to develop a realistic plan that maintains our goal for a zero-emission grid while moving us responsibly into the future.

Sincerely,

Kathy Hochul
Governor

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The Chair, Doreen M. Harris, President and CEO of the New York State Energy Research and Development Authority, would like to thank the members of the Energy Planning Board, their staff, and contractors for their hard work and dedication in the development of the New York State Energy Plan.

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New York State Energy Plan

Volume I

Summary for Policymakers

2025 NEW YORK STATE ENERGY PLAN

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Acronyms and Abbreviations

AGM	New York State Agriculture and Markets
BOCES	Boards of Cooperative Education Services
BRT	bus rapid transit
Btu	British thermal unit
CBA	Community Benefit Agreement
CBO	Community Based Organization
CCS	Carbon capture and storage
CES	Clean Energy Standard
CGPP	Coordinated Grid Planning Process
CJWG	Climate Justice Working Group
Climate Act	Climate Leadership and Community Protection Act (2019)
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CUNY	City University of New York
DACs	disadvantaged communities
DEC	New York State Department of Environmental Conservation
DER	distributed energy resource
DHSES	Division of Homeland Security and Emergency Services
DOE	U.S. Department of Energy
DOH	New York State Department of Health
DOL	New York State Department of Labor
DOS	New York State Department of State
DOT	New York State Department of Transportation
DPS	New York State Department of Public Service
DR	direct response
EAP	Energy Affordability Policy
EEAP	Enhanced Energy Affordability Policy
EIA	U.S. Department of Energy, Energy Information Administration
EPA	U.S. Environmental Protection Agency
EPD	Environmental Protection Declarations
ESD	Empire State Development
EUE	expected unserved energy

EV	electric vehicle
EVSE	Electrical Vehicle Supply Equipment
FERC	Federal Energy Regulatory Commission
GHG	greenhouse gas
GJGNY	Green Jobs-Green New York
GOTF	Grid of the Future
GW	gigawatt
GWh	gigawatt-hour
GWP	global warming potential
HALEU	High-Assay Low Enriched Uranium
HCR	Homes and Community Renewal
HEAP	Home Energy Assistance Program
HFC	hydrofluorocarbon
HVAC	heating, ventilation, and air conditioning
kWh	kilowatt hour
LDV	light-duty vehicle
LIHEAP	Low-Income Home Energy Assistance Program
LIPA	Long Island Power Authority
LMI	low- and moderate-income
LOLE	loss of load expectation
LSR	large-scale renewables
LTP	long-term plan
MBtu	thousand British thermal units
MHDV	Medium- and Heavy-Duty Vehicles
MMBtu	million British thermal units
MMT CO_2e	million metric tons of carbon dioxide equivalent
MW	megawatt
MWBE	Minority/Women-Owned Business Enterprises
NERC	North American Electric Reliability Corporation
NIST	National Institute of Standards
NO_X	nitrogen oxide
NPA	non-pipeline alternative
NPCC	Northeast Power Coordinating Council
NYCA	New York Control Area
NYISO	New York Independent System Operator
NYPA	New York Power Authority
DHSES	New York State Department of Homeland Security and Emergency Management
NYSERDA	New York State Energy Research and Development Authority

NYSRC	New York State Reliability Council
OJET	Office of the Just Energy Transition
ORES	Office of Renewable Energy Siting and Electric Transmission
OSW	Offshore Wind
PHMSA	U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration
$PM_{2.5}$	Particulate Matter less than 2.5 micrometers
PSC	New York State Public Service Commission
PSL	Public Service Law
RAPID	Renewable Action through Project Interconnection and Deployment
RD&D	research, development, and demonstration
RGGI	Regional Greenhouse Gas Initiative
RGRTA	Rochester-Genesee Regional Transportation Authority
RMD	Residential Methane Detector
RNA	reliability needs assessment
RNG	renewable natural gas
RPS	renewable portfolio standard
SAF	Sustainable Aviation Fuel
SAIFI	System Average-Interruption Frequency Index
SDVOB	Service-Disabled Veteran-Owned Businesses
SNAP	Supplemental Nutrition Assistance Program
SO_2	sulfur dioxide
SUNY	State University of New York
TBtu	trillion British thermal units
TEN	thermal energy network
TWh	terawatt hour
UNFCCC	United Nations Framework Convention on Climate Change
VDER	value of distributed energy resource
VMT	vehicle miles traveled
ZEC	zero-emissions credit
ZEV	zero-emission vehicle

1. Introduction

Energy is central to New Yorkers' lives. It powers the economy, keeps homes and workplaces comfortable, moves people and goods, and runs critical infrastructure. New York is one of the most energy-efficient states in the nation based on energy use per person and state economic output.[1] Additionally, our power grid is becoming cleaner. Nearly half of New York's in-state electricity generation comes from zero-emission sources[2] and many more renewable generation projects are in the pipeline.[3] Yet, like the rest of the country, New Yorkers face volatile energy prices, intensifying extreme weather, and environmental and health impacts associated with reliance on fossil fuels and aging fossil fuel infrastructure. These shared concerns do not affect all communities equally. Low-income households and otherwise disadvantaged communities are disproportionately impacted by energy cost burdens and by community and environmental health concerns like water and air pollution.[4] Disadvantaged communities (DACs) also face significant barriers to accessing clean energy choices.[5]

The 2025 New York State Energy Plan ("State Energy Plan" or "Plan") provides a 15-year outlook through 2040 with direction to guide progress toward an abundant, reliable, affordable, and clean energy system for all New Yorkers. New York's energy policy and programs support the transition to a cleaner energy system and a more productive economy that drives meaningful benefits to local communities. State actions will also help New Yorkers to manage their energy costs and to equitably participate and share in the benefits of our clean energy future. These are all goals that the State can meet, without sacrificing one for another.

The State Energy Planning Board ("Energy Planning Board" or "Board") acknowledges that at the time of developing the Plan, the energy sector faces significant uncertainty, stemming from economic pressures and a shift in political priorities and policies at the federal level. These uncertainties affect long-term planning, investment decisions, and the pace of transition to clean energy.

Like many industries, the energy sector has been impacted by the significant inflation experienced globally and in the United States, especially prevalent from mid-2021 to mid-2023. Multiple factors contributed, including the COVID-19 pandemic and subsequent

recovery and Russia's invasion of Ukraine.[6] Declared from March 2020 to May 2023, the COVID-19 pandemic led to disruptions in manufacturing, shipping, and labor availability. It also shifted consumer demand patterns; in New York, petroleum fuel use for transportation fell dramatically in 2020, with more modest declines in energy use in other sectors. As the economy and energy use recovered from late 2020 on, the combination of strong demand and ongoing supply chain bottlenecks led to upward pressure on prices. Russia's invasion of Ukraine in February 2022 triggered a sharp increase and volatility in fossil fuel prices, contributing further to inflation, as well as accelerating demand for clean energy technologies. These international dynamics interacted with preexisting factors in New York State, including infrastructure constraints, to yield periods of sharply elevated energy prices.

Consistent with broader energy sector trends, prices for some key clean energy technologies also rose globally in 2021 and 2022, due largely to higher input prices for critical minerals, semiconductors, and bulk materials such as steel and cement.[7] In New York, offshore wind (OSW) and other clean energy technologies continue to see elevated costs reflective of supply chain constraints and disruption, tight regional labor markets, and high interest rates.

The federal administration's unpredictable tariff and energy policies bring additional political and regulatory uncertainty, threatening critical federal support for clean energy development and creating barriers to private investment. This includes the current administration's rollback of tax credits provided under the Inflation Reduction Act, including the Clean Electricity Investment Tax Credit and the Clean Electricity Production Tax Credit; planned denial of permits for wind generation; and attempts to remove state-based clean car and clean truck rules. These and similar actions further increase the costs of clean energy projects and undermine market confidence and momentum.

Inflation has helped to bring a renewed focus on affordability across all aspects of New Yorkers' lives, including energy costs. At the same time, the recent volatility in fossil fuel prices has highlighted the importance of clean energy investment and energy security measures.

In this context, the State Energy Plan examines long-term energy planning considerations and offers strategies and actions for New York to make an equitable and just transition to a modernized, clean energy system that is increasingly reliant on electricity, in a manner that supports reliability and resilience, affordability, quality of life, and economic growth. The Plan overall is driven by the State's commitment to plan for and advance:

- Abundant, reliable, resilient, and clean energy for New Yorkers;
- Affordable energy for households and equitable clean energy benefits;

- Economic growth and competitiveness;
- Innovation; and
- Continued progress toward decarbonization and a clean energy economy.

Successful implementation of the Plan, like other statewide plans, will require coordination across State agencies, partnership with other levels of government and communities, and the participation of private sector entities. New York State will build on our significant progress toward a clean energy economy, such as investing in energy-efficient technologies that are saving New Yorkers money; installing over six gigawatts (GW) of distributed solar; completing South Fork Wind, and breaking ground on the Champlain Hudson Power Express, Empire Wind 1, and Sunrise Wind projects; and the $1 billion Sustainable Future Program, the largest single State Budget commitment to climate and clean energy in New York's history.

1.1. New York State Energy Planning Requirements

New York's Energy Law establishes a State Energy Planning Board to periodically develop and adopt a State Energy Plan.[8] In its consideration and development of State policies, programs, and other actions, the Board is guided by multiple goals and long-range energy planning objectives that are specified in the law. These include:

- Improving the reliability of New York State's energy systems;
- Protecting consumers from market price volatility and minimizing the cost of energy services;
- Minimizing public health and environmental impacts, in particular, environmental impacts related to climate change;
- Maximizing energy conservation, energy efficiency, and load management; and
- Supporting economic development and the ability of the state to compete economically.

Under Article 6 of the Energy Law, the State Energy Plan is to include an assessment of the ability of energy supply sources, together with the energy transmission and delivery systems, to meet forecasted energy demand for electricity and fuels for at least a ten-year period. For the current planning cycle, the Energy Planning Board decided to evaluate energy demand and supply through 2040. Furthermore, many components of this State Energy Plan dovetail with the planning requirements of the 2019 Climate Leadership and Community Protection Act (Climate Act), which set ambitious statutory targets to guide New York State's clean energy and climate agenda.

Clean Energy and Climate Targets Set by the Climate Act

Signed into law in July 2019, the Climate Leadership and Community Protection Act (Climate Act) has laid the foundation for much of the work of State agencies tasked with contributing to the transition to a clean energy economy in New York. The Climate Act sets out targets to reduce economy-wide greenhouse gas (GHG) emissions 40% by 2030 and 85% by 2050, as well as the following sector-specific targets:

- Zero-emission electricity system by 2040
- 70% renewable electricity generation by 2030
- 9,000 megawatts (MW) of offshore wind by 2035
- 3,000 MW of energy storage by 2030
- 6,000 MW of solar by 2025
- 185 trillion British thermal units (TBtu) of end-use energy savings in the buildings and industrial sectors

The Climate Act requires that at least 35%—with a goal of 40%—of the benefits of clean energy investments are directed towards disadvantaged communities (DACs). This aims to make the energy transition inclusive and equitable, providing economic opportunities, job creation, and environmental benefits to communities that have historically been overburdened by pollution.

The State Energy Plan is informed by the energy policy and program recommendations made in the 2022 New York State Climate Action Council Scoping Plan, an economy-wide climate action plan. It further builds upon and complements multiple established energy planning processes and recent State analyses, such as electricity sector grid planning, reliability needs assessment, and economic planning; winter reliability and long-term planning by gas distribution utilities; energy security and emergency planning; transportation planning; and a range of assessments for specific clean energy resources and technologies. Likewise, it integrates multiple recent and ongoing regulatory proceedings.

In synthesizing a large volume of energy-related information and analysis, the Plan provides a resource for both decision-makers and the public. The Plan further examines existing policies and recommends new actions, informed by public comment. In sum, the State Energy Plan provides broad program and policy development direction to guide energy-related decision making in the public and private sectors within New York State.

1.2. Public Input

The Energy Planning Board recognizes the value of public engagement and input to inform the development of the State Energy Plan. In addition to holding ten public Board meetings from September 2024 through December 2025, the Board solicited feedback on both a Draft Scope outlining the issues to be addressed in the Plan and on the Draft Plan itself.

The Board solicited written public comment on the Draft Scope from September 9, 2024 to December 16, 2024 and received 86 comments from organizations and over 1,800 comments from individuals (93% of which came through three comment campaigns). Organizations included environmental organizations, utilities and energy companies, labor unions, trade associations, business and real estate groups, elected officials, and community-based organizations (CBOs). Comments offered a broad range of issues, policies, and positions, consistent with the topic areas included in the Draft Scope. Comments were reviewed and incorporated into the final Scope, as adopted by the Board in March 2025, in the form of greater detail and additional or refined issues for consideration.

As agency staff developed the Draft Plan, they periodically presented interim findings and sought direction from the Energy Planning Board at public Board meetings. Board members also considered presentations from agency and external speakers on topics related to the Plan such as energy system reliability and the needs of different energy users (e.g., low- and moderate-income [LMI] households, multifamily housing, large energy users, and vehicles).

In July 2025, the Board approved the release of the Draft Plan for public comment. The Board solicited public input on the Draft Plan from July 23, 2025 to October 6, 2025 through seven in-person and three virtual public hearings, written comment, focused engagement with CBOs and other entities working in or representing disadvantaged communities, and meetings with Indigenous Nations.[9] Board members and agency staff also presented on the Draft Plan and promoted opportunities to comment on it through traditional and social media as well as at a wide range of events and other forums (e.g., industry conferences, the Great New York State Fair, Regional Clean Energy Hub convenings, and podcasts). To increase the accessibility of the information presented in the Draft Plan, six fact sheets on key Draft Plan topics were made available in multiple languages, distributed online and at public hearings.[10]

The Board experienced strong turnout at its ten public hearings on the Draft Plan, with around 1,000 people attending, nearly 450 of whom commented. To reach as many New Yorkers as possible, the Board exceeded the statutorily required six public hearings and designed a schedule to accommodate the diverse lives of New Yorkers. The Board offered

in-person and virtual hearings, midday and evening hearing times on weekdays, and one weekend hearing (added in response to input on the schedule). Hearing venues were chosen for their accessibility and located across multiple regions of the state.[11]

The Board received nearly 15,000 written comments on the Draft Plan, with over 250 from organizations and the balance from individuals (80% of which were through 13 comment campaigns).

Similar to feedback on the Draft Scope, a diverse set of stakeholders commented on the Draft Plan across verbal and written comments, with especially strong organizational participation from environmental organizations and their members, utilities and energy companies, labor unions and their members, elected officials, and trade and business organizations. A thematic summary of public comments was discussed at the November 2025 meeting of the Energy Planning Board.[12]

Public input from the above sources was carefully reviewed and considered in the development of the final Plan. The State Energy Planning Board and agency staff deeply appreciate the public's participation in New York State's energy planning process and recognize the time New Yorkers spent traveling to and taking part in public hearings, drafting written comments, organizing comment campaigns, and otherwise participating. This feedback was important to inform the final Plan and the Board encourages continued public engagement for future Plan updates.

2. New York's Energy System Today

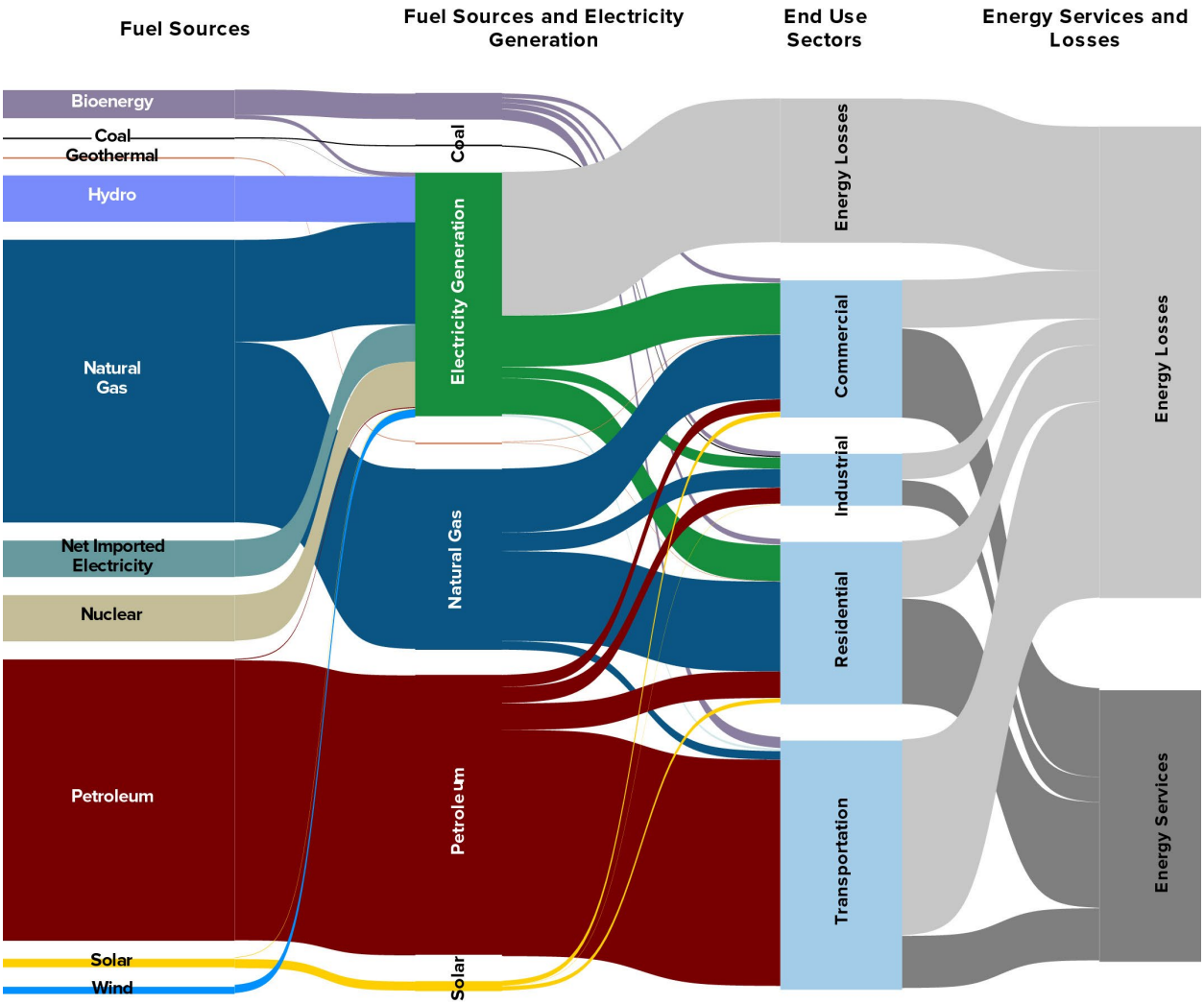
2.1. Energy Flows

The Energy Flow diagram in Figure 1 shows the primary energy sources that comprise New York State's complex energy system and how those sources provide energy to end users.[13] Electricity is considered a secondary energy source that is generated from primary energy sources such as natural gas, nuclear, and renewables. The major end-use sectors—which include the transportation, residential, commercial, and industrial sectors—consume electricity from the electric power sector as well as energy from the on-site use of fossil fuels, bioenergy, and solar energy.

As of 2023, the electric power sector and the transportation sector each consume about one-third of the state's primary energy, followed by the residential (17%), commercial (12%), and industrial (5%) sectors.Including the electricity used by each end-use sector, residential and commercial buildings combined consume 57 percent, transportation 34 percent, and industrial 9 percent of primary energy statewide. Across sectors, approximately three-quarters of New York's primary energy use comes from fossil fuels, mainly natural gas (38%) and petroleum products (38%).

The majority (63%) of primary energy used in New York State is lost or wasted during conversion from the primary energy source to a useful form, such as space heating or powering an appliance. Energy losses in the form of waste heat are particularly large for fossil fuel combustion in electricity generation and in the transportation sector.[14] Opportunities to reduce waste in the energy system include transitioning away from combustion (because losses for these sources are particularly high), reducing transmission and distribution losses in energy delivery systems, capturing and reusing waste heat, and improving the energy efficiency of final end use.

Figure 1: 2023 New York State Energy Flow – Estimated Primary Energy Consumption (3,528 TBtu)
Source: Patterns and Trends[15].



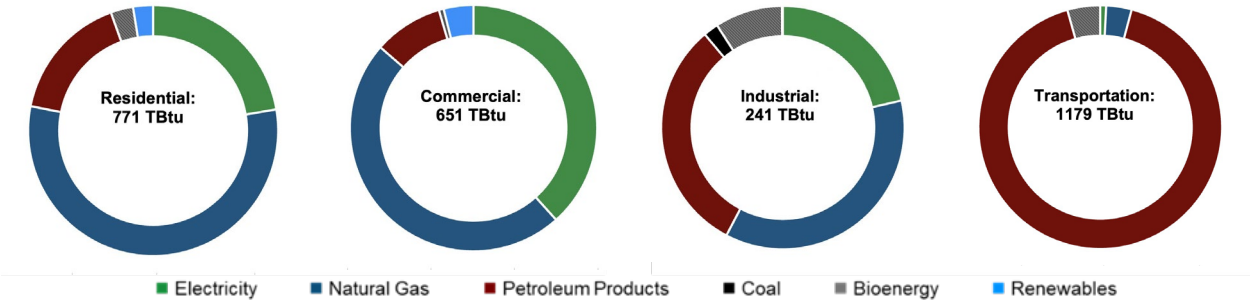
2.2. Energy Consumption by Sector

Energy consumption is also measured based on the final (or end-use) energy that consumers buy and receive, such as electricity used in their home or business, heating fuel, or gasoline at the pump.[16]

As shown in Figure 2, New York consumes a significant amount of both natural gas and electricity to heat and power its residential and commercial buildings. Heating oil, a petroleum product, is also used for heating buildings. The industrial sector draws on diverse energy sources to meet the unique demands of industrial processes, including natural gas,

electricity, petroleum products, and biomass from process waste streams. A small amount of coal use is limited to the industrial sector, but coal is no longer used for electricity generation in the state. The transportation sector relies mainly on petroleum in the form of motor gasoline, aviation fuel, and diesel.

Figure 2: 2023 New York State Final Energy Consumption by Sector and Fuel
Source: Patterns and Trends[17].



2.3. Energy Supply and Delivery

New York's energy supply and delivery systems are complex and critical infrastructure with multiple owners, operators, planning entities, and regulatory bodies operating in different regions and at different scales. New York State prioritizes robust oversight and planning for the reliable and safe operation of the electricity and natural gas systems, partners closely with industry participants in the delivered petroleum fuel sector, and works to advance cross-sector energy security and emergency preparedness. In addition to the specific agency responsibilities described for each sector below, the New York State Energy Research and Development Authority (NYSERDA) acts as New York State's Energy Office, supporting long-term planning activities, policy development and evaluation, energy technology research and deployment, energy assurance, and other key functions.

2.3.1. ELECTRICITY

New York's electric power grid is broadly divided into two components. The bulk system is a network of large generators connected to the high-voltage transmission system that transmits electricity over long distances. Distribution systems take power from the bulk system and deliver it directly to customers and their appliances.

In 2024, approximately 26 percent of New York's in-state bulk electricity generation came from renewable sources including hydroelectric, solar, and wind. Nuclear generation contributed another 21 percent. Combustion generation units, including natural gas, oil,

biofuels, and solid waste generation, produced roughly 53 percent of in-state bulk electricity.[18]

Multiple entities work together to ensure the reliable and safe operation of New York's electricity system:

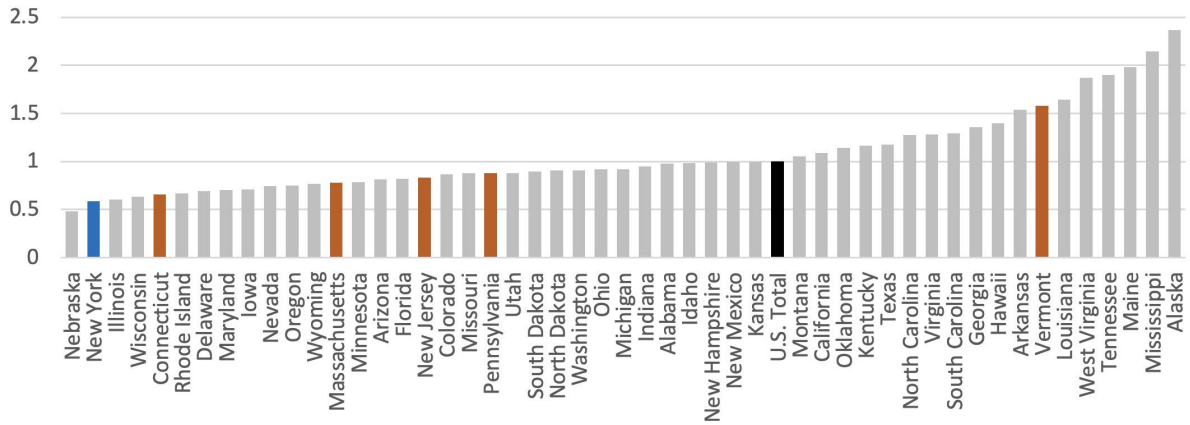
- The Federal Energy Regulatory Commission (FERC) oversees the nation's natural gas and electric power markets, bulk power system operations, and utility system planning.
- The North American Electric Reliability Corporation (NERC) and Northeast Power Coordinating Council (NPCC) develop, evaluate, and enforce reliability standards approved by FERC.
- The New York Independent System Operator (NYISO) is a not-for-profit corporation responsible for operating the state's bulk electricity grid, administering New York's competitive wholesale electricity markets, and conducting long-term planning for the state's electric power system. The New York Control Area (NYCA) is the area of the electric power system under the operational control of the NYISO.
- The New York State Reliability Council (NYSRC) develops reliability rules specifically for the NYISO and parties that transact on the state's power system.
- The New York State Public Service Commission (PSC) regulates generation and transmission siting and electric, gas, steam, telecommunications, and water utilities statewide. The PSC is responsible for ensuring that utilities provide safe and adequate service at just and reasonable rates and that utility planning, investments, and operations align with state policy goals. The New York State Department of Public Service (DPS) is the staff arm of the PSC.
- The New York Power Authority (NYPA) is the largest state public power organization in the nation, operating 17 generating facilities as well as transmission lines. NYPA supplies low-cost electricity to a statewide customer base, which includes businesses, not-for-profit organizations, community-owned electric systems and rural electric cooperatives, and government entities.
- New York's electric utilities provide electricity to consumers across the state. Six investor-owned utilities (IOUs) and one large municipal utility, the Long Island Power Authority (LIPA), provide electric service to the majority of New Yorkers. There are also forty-seven municipal electric systems and four rural electric cooperatives that buy hydropower from NYPA.

Reliability of the electricity system describes its ability to provide consistent and uninterrupted electricity. This spans the reliability of the bulk power system and the utility distribution systems.

Service on New York's bulk power system was curtailed only once in nearly two decades, during the 2003 Northeast blackout caused by factors outside of the state. The NYISO conducts near- and long-term planning to ensure that the electricity system is designed to maintain reliability, using both resource adequacy and transmission security modeling to identify future system needs.

Due to short- and long-term planning conducted by a variety of entities, New York outperforms the national average and neighboring states on key reliability metrics for electric utility customers. For example, New Yorkers experienced the second-fewest power outages (Figure 3) on average, across U.S. states.[19] However, work continues to better the state's electric grid.

Figure 3: Average Frequency of Power Outages (2023, Excluding Major Storms)
New York is shown in blue and neighboring states in red. U.S. average is in black.
Source: EIA SAIFI Values, Without Major Event Days, 2023[20]



New York's high level of reliability stems from a history of remaining vigilant, adjusting reliability standards as warranted based on experience with the system, and taking action to build infrastructure when a need arises.

2.3.2. NATURAL GAS

New York's natural gas system is physically and financially connected to a broader regional, national, and international market for natural gas and infrastructure for natural gas supply and delivery. New York is not a major producer of natural gas, so its supply mostly comes from imports delivered through a network of interstate transmission pipelines. The supply pipelines that serve New York primarily draw from production and storage areas to the southwest (Pennsylvania, West Virginia, Ohio, Alabama, Florida, Louisiana, Mississippi, and Texas), with some coming from the north (Alberta and Ontario). Gas utilities are responsible for delivering gas to end-use customers through their gas distribution networks.

The natural gas system is broadly divided into three stages or components. The upstream stage is where natural gas is extracted from the ground. The midstream stage is where natural gas is transported through large-diameter, high-pressure interstate transmission pipelines from production areas to demand centers. The midstream stage also includes large-scale natural gas storage. The downstream or distribution stage is where natural gas is delivered via lower-pressure distribution pipes to homes, businesses, and industrial users by distribution utilities.

Multiple entities work together to ensure the safe and reliable delivery of natural gas to New York residents and businesses. At the federal level:

- FERC regulates interstate pipeline siting and transportation rates.
- The U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration regulates interstate pipeline operations and maintenance with support from DPS.
- The U.S. Environmental Protection Agency plays a role in regulating the environmental impacts of natural gas operations such as methane emissions.

At the State level:

- The PSC regulates gas distribution systems and the utilities that own and operate them, consistent with the responsibilities noted above for the electricity system.
- The New York Division of Homeland Security and Emergency Services (DHSES) and DPS are responsible for winter preparedness and emergency response.
- The New York State Department of Environmental Conservation (DEC) regulates the environmental impacts of natural gas operations and pipelines including through air and water quality standards.
- New York's gas utilities provide gas to consumers. Eight IOUs and several small distribution companies and municipal utilities provide gas service to New Yorkers.

Reliability of the gas system refers to its ability to consistently deliver gas to customers without interruption. To ensure reliability, gas utilities, pipeline operators, and regulators conduct planning on multiple temporal and geographic scales. Gas planning typically involves forecasting gas demand, supply, and transmission and distribution capacity under various scenarios to ensure there is sufficient supply and infrastructure capacity to reliably meet forecast demand. Planners must also consider the physical, operational, and contractual risks associated with various supply sources, and ensure that the overall supply portfolio reduces these risks as much as possible.

Because gas demand currently peaks in winter months, corresponding with the heating season, many gas planning activities focus on winter reliability and preparedness planning. This includes ensuring utilities have enough supply to serve customers on a "design day," which is a day with extremely cold weather conditions. System operators also adopt practices, such as insulating pipes, to increase the range of conditions under which infrastructure and equipment can reliably perform.

This approach has enabled New York to achieve a high level of gas system reliability. New York will continue to maintain a reliable gas system through vigilant planning, iterative assessment of reliability standards, and investment in the system if reliability needs arise.

2.3.3. DELIVERED PETROLEUM FUELS

New York relies on imports for petroleum products, since the state has minimal oil production and no refineries. New York Harbor is an important entry point for international deliveries of fuel products into the region, as well as a market pricing point. Downstate areas, including Long Island and New York City, are served by multiple marine terminals and pipelines for bulk delivery of petroleum products. The Hudson River allows marine transportation of petroleum products from New York Harbor to terminals in the Mid-Hudson Valley and the Capital District regions. Upstate cities, including Binghamton, Syracuse, Utica, Rochester, and Buffalo, are supplied by pipelines, whereas the North Country relies on truck deliveries from upstate cities and Canada to meet demand.

Large terminals that receive and store bulk petroleum products supply smaller terminals that blend in additives and then load liquid fuels onto trucks for delivery to gas stations and buildings. Fuels, including propane and biodiesel, are also moved by rail across the state.

NYSERDA provides monitoring and emergency response, in coordination with DHSES, for the delivered petroleum fuels sector, including managing a strategic fuel reserve to ensure supply during emergencies.

2.3.4. ENERGY SECURITY AND EMERGENCY PREPAREDNESS

New York State maintains robust and interconnected plans to ensure secure, reliable, and resilient energy infrastructure and supplies. Since all critical infrastructure sectors depend on energy, this planning is essential to protect public health, safety, and welfare; minimize economic disruption; and direct energy supplies in an equitable manner among essential uses in the event of an emergency. There are two core plans that address energy security and emergency preparedness in New York State. First, the New York State Energy Emergency Plan is an integrated resource plan specifying actions in the event of an energy

or fuel supply emergency. This plan is part of and coordinated with the state's larger Comprehensive Emergency Management Plan. It provides advance notice of emergency response strategies and options to energy suppliers, energy users, and all levels of government to allow for necessary preparations before an actual emergency occurs and to maximize response speed, cooperation, and effectiveness during an energy emergency. Second, the state's Energy Security Plan provides the State, federal government, and other stakeholders with an up-to-date, comprehensive assessment of New York's energy supply chain, its energy risk profile, and its energy emergency mitigation and response measures. This plan details how the State, working with energy partners, can secure its energy infrastructure against physical and cybersecurity threats; mitigate the risk of energy supply disruptions; enhance the response to, and recovery from, energy disruptions; and ensure that the State has a secure, reliable, and resilient energy infrastructure. In addition, each county in the state maintains a comprehensive emergency management plan to address how the jurisdiction prepares for, responds to, and recovers from all types of emergencies.

State agencies routinely engage in multistate, regional, and local government collaboration regarding energy assurance planning and response. This collaboration occurs regularly and is enhanced during any potential energy disruptions, including ahead of major storms or other conditions that could affect energy markets in New York State, as well as in neighboring states. The energy industry likewise collaborates closely with the State in preparing for, responding to, and mitigating against energy emergencies, including by sharing information and managing critical energy infrastructure.

2.4. Energy Prices and Expenditures

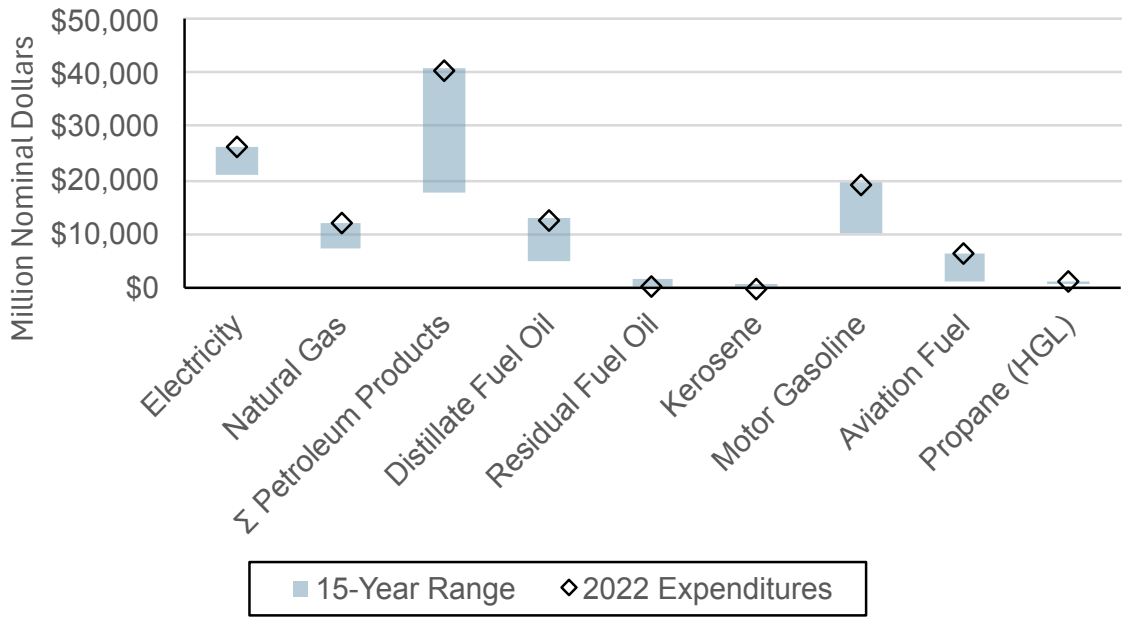
As shown in Table 1, average New York State energy prices reached high levels during 2022 due to the combination of strong demand as the global economy recovered from the COVID-19 pandemic, ongoing supply chain bottlenecks, and the invasion of Ukraine causing a sharp increase and volatility in fossil fuel prices. These global dynamics combined with state-level factors that impacted energy prices, including regional supply constraints for electricity and natural gas and aging energy infrastructure. During 2023, average New York State prices declined from 2022 levels for the most common transportation fuels (including motor gasoline, diesel, and aviation fuels) and petroleum heating fuels (including distillate and propane). Average statewide electricity and natural gas prices decreased for commercial and industrial customers from 2022 to 2023 but increased for residential customers, though the residential electricity price grew more slowly than overall inflation and the gas price tracked inflation over this period.[21]

Table 1: Average Annual New York State Residential Energy Prices (Nominal), 2014–2023
Source: Patterns and Trends[22].

Year	Electricity Residential Cents/kWh	Natural Gas Residential $/therm	Distillate Residential $/Gallon	Motor Gasoline Transportation $/Gallon
2014	20.07	1.21	3.79	3.42
2015	18.54	1.08	2.65	2.47
2016	17.58	1.05	2.28	2.18
2017	18.03	1.17	2.53	2.42
2018	18.52	1.20	2.79	2.68
2019	17.94	1.22	2.64	2.52
2020	18.36	1.24	2.16	2.15
2021	19.48	1.34	2.55	2.87
2022	22.08	1.58	3.86	3.79
2023	22.25	1.64	3.60	3.38

With elevated average energy prices, elevated expenditures follow. In 2022, New York State saw the highest total annual energy expenditure (reaching nearly $80 billion) and the highest expenditures for most fuel types in 15 years, as shown in Figure 4. Statewide expenditure for most fuel types declined in 2023 after peaking in 2022. New York's total energy expenditure was $74 billion in 2023, roughly half of which was for out-of-state expenditures ($36.8 billion).[23]

Figure 4: New York State Energy Expenditures in 2023
Source: Patterns and Trends[24]



2.4.1. RETAIL ELECTRICITY AND NATURAL GAS PRICES

Retail electricity and natural gas prices—that is, the final price paid by customers—include both supply and delivery costs as well as surcharges associated with other costs. The supply price, sometimes called the wholesale price or the commodity price, is set by competitive markets. New York's electricity and gas distribution utilities purchase electricity or gas supplies on behalf of their customers and use hedging strategies to reduce price volatility seen in the spot market commodity prices. For electricity, the supply price is determined primarily through the NYISO's energy markets; it includes costs associated with generating electricity at a specific location (where transmission constraints may increase cost), and the cost to maintain sufficient capacity to serve peak load. For natural gas, the supply price includes the cost of the gas itself, contracts to secure interstate pipeline capacity, storage costs, and transportation of the gas to the distribution utility's service area. The delivery price for electricity and gas includes the cost of distribution infrastructure (such as wires and pipelines) to bring the electricity and gas to homes and businesses, as well as utility operational expenses. Delivery rates are specific to the distribution utility serving a given area and are set by the PSC.

In New York, retail electricity and gas prices are generally higher downstate than upstate, reflecting factors that include the higher costs of building and maintaining infrastructure in the denser downstate region, and the higher supply costs in the downstate region, which experiences high demand and infrastructure constraints. Retail bills depend on both energy prices and patterns of energy usage. New York utilities annually post average monthly bill data for typical residential, small commercial, and large commercial customers.[25] Figure 5 and Figure 6 show trends for Con Edison (a utility that provides electricity and gas in the downstate region) and for National Grid (a utility that provides electricity and gas in the upstate region and gas in the downstate region), specifically for residential customers. In the typical bills shown in Figure 5, the monthly electricity bill for a single-family home upstate is comparable to that for an apartment in New York City, though the (larger) upstate home uses more than twice as much electricity.

Figure 5: Average Monthly Residential Electricity Bills
Source: DPS[26]

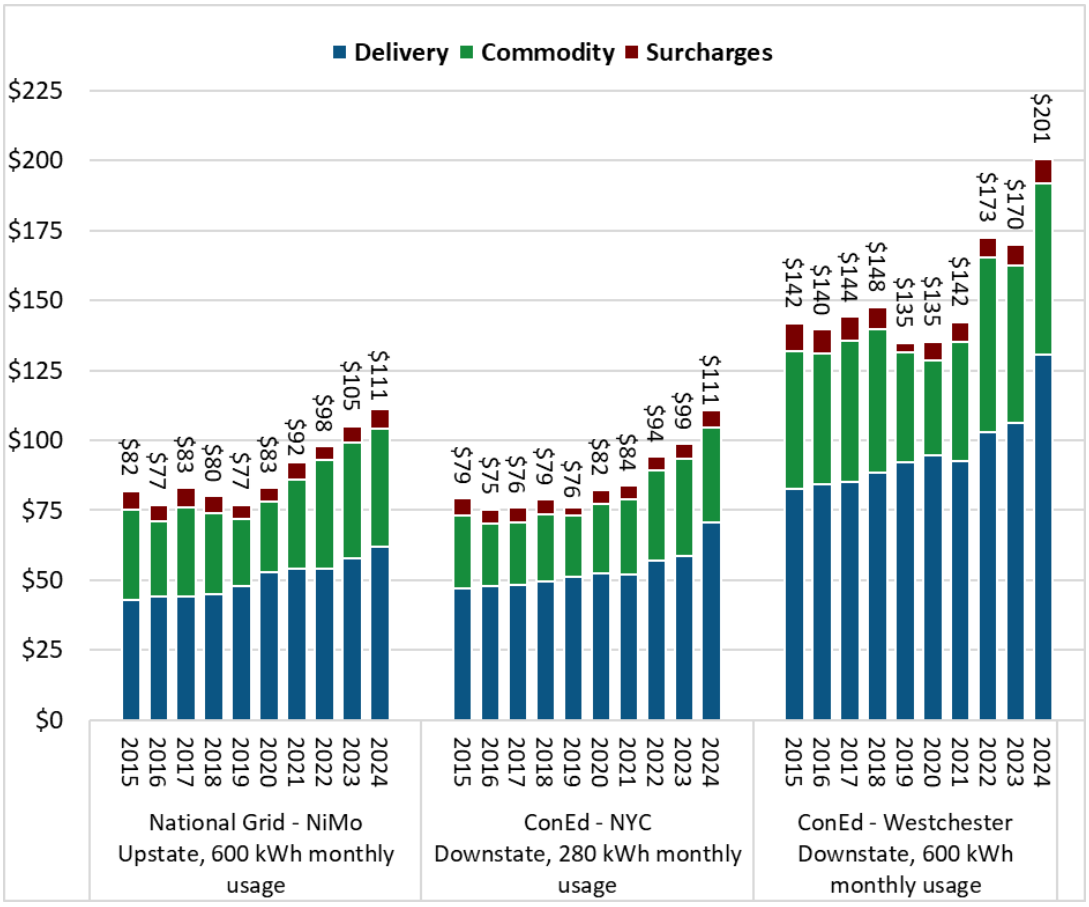
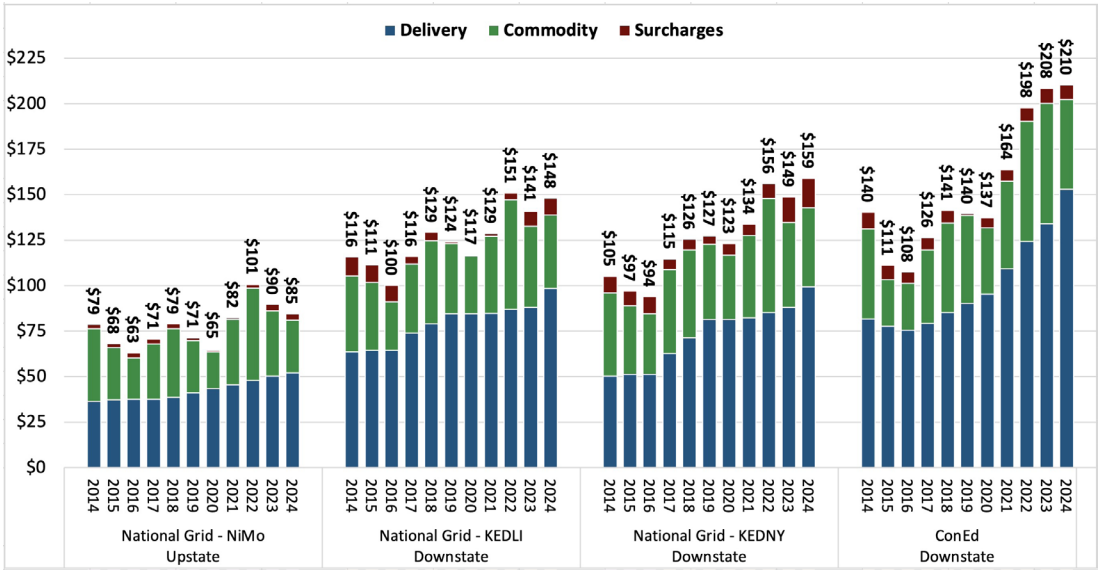


Figure 6: Average Monthly Residential Gas Bills (1,000 therm Annual Usage)
Source: DPS[27]



Many households and businesses have experienced increasing energy bills in recent years alongside growing inflation across the economy. Recent research has documented and examined price increases for natural gas and electricity as well as their underlying drivers. Although clean energy policy costs are one component of energy price increases, aging infrastructure and the impacts of extreme weather have been found to be core drivers of rising electricity prices both in New York and nationwide.[28; 29]

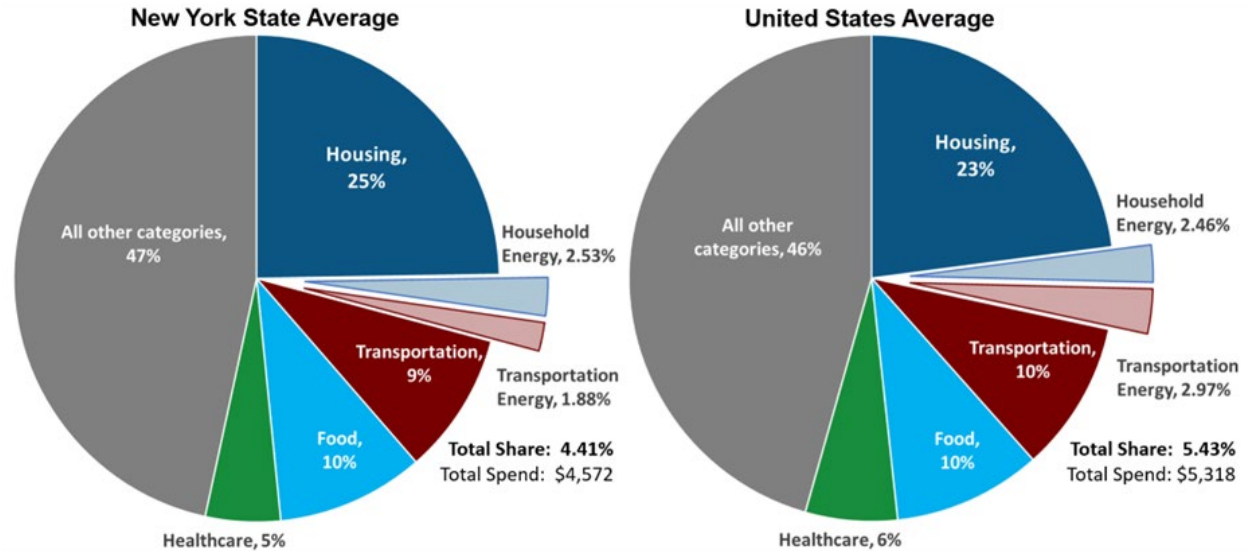
A recent report released by DPS on implementation of the Climate Act shows that PSC-approved clean energy program costs are a component of utility rates, but remain a small portion of the total customer bill across New York's electric and gas utilities for historical and projected years (2023-2029).[30] Primary drivers of increasing energy bills include core infrastructure investments for reliability and resiliency, the influence of macroeconomic and geopolitical factors that cause substantial swings in the price of fossil fuels (and in turn electricity supply costs), and costs related to property taxes, salaries and benefits for employees, and information technology. Across New York electric utilities on average, costs other than PSC-approved clean energy programs drive three-quarters of the projected bill increase for a typical residential customer between 2023 and 2029.[31]

Notably, New York is not unique in facing these challenges and has taken strides to manage the costs of policy choices on customers. A Lawrence Berkeley National Laboratory study finds that aggregated across U.S. electric IOUs and adjusted for inflation, annual spending on generation declined by nearly $10 billion from 2019 to 2024, but the nationwide increase in annual spending on transmission (+$5 billion) and distribution (+$15 billion) far exceeded these savings.[32] More discussion on cost reduction for electricity associated with clean and renewable electricity can be found in the Pathways Analysis chapter.

2.4.2. HOUSEHOLD ENERGY AFFORDABILITY

Across the U.S. and across New York, households face affordability challenges. There are many drivers of household affordability, including significant expenditures in areas such as housing, transportation, food, and healthcare. Figure 7 below shows household expenditures by category. Energy is an important affordability challenge for many households as a component of housing and transportation costs. For many LMI households, meeting energy needs can impose substantial cost burdens. The accelerated pace of recent bill increases highlights the importance of taking steps to keep energy costs manageable for New York State households.

Figure 7: Household Spending as Share of Income, New York State and United States[19]
Source: U.S. Bureau of Labor Statistics. Consumer Expenditure Surveys. 2022 & 2023[33]



To understand how energy costs impact people, it is important to look holistically at both household energy spending and transportation energy spending. Together, household and transportation energy expenditure provide a comprehensive perspective on the ways energy policy impacts household spending to meet energy needs, and provide an opportunity to evaluate tradeoffs between different consumer choices households may make. On average, roughly 2.5 percent of income goes toward household energy spending in both New York State and the U.S., while the share of income devoted to transportation energy spending is 1.9 percent in New York State and 3.0 percent in the U.S.

On a combined basis, New York compares favorably to the national average in terms of total energy spending. At $4,572 annually (comprised of $2,620 for household energy and $1,952 for transportation energy), New York households on average spend less annually on energy expenses than the national average of $5,318 (comprised of $2,411 for household energy and $2,907 for transportation energy), according to the Consumer Expenditure Survey, a longstanding measure of consumer spending across common categories of goods and services.[34]

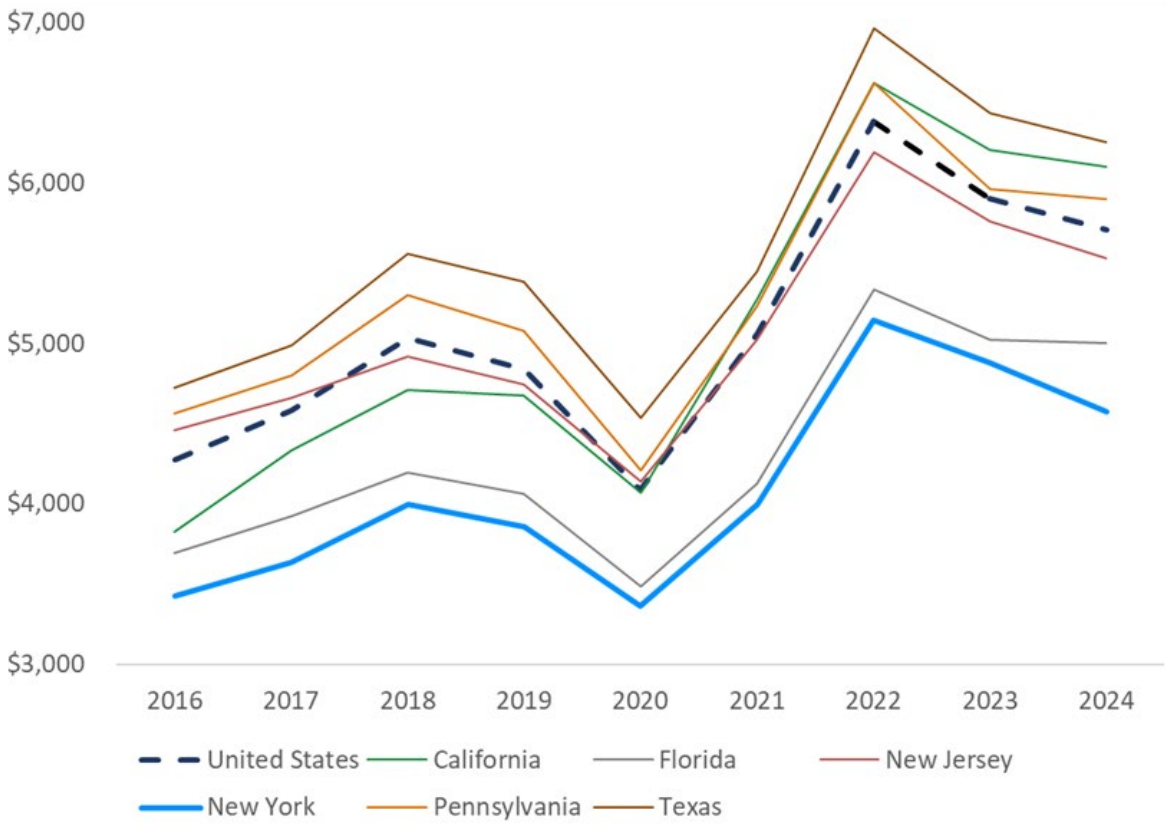
Energy prices can be higher in some parts of New York than the U.S. average, but average energy consumption is lower, leading to lower total household and transportation energy expenditures than the national average. Lower transportation energy spending offsets slightly higher household energy spending on a statewide basis in New York State. On average, New York has the lowest average household vehicle miles traveled and transportation energy expenditures as a percentage of income in the nation. Notably, there is regional variation

within the state across these metrics, with average transportation energy expenditures as a percentage of income approximately 50 percent lower downstate than it is upstate, reflecting less reliance on personal vehicles.

As noted in Figure 8, New York households also spend less on energy compared to states that are the predominant targets of outmigration from the state. That is, households migrating to these other states would expect to spend more on energy after their move. These dynamics are similar to the comparison between average New York and U.S. households above: substantially lower household transportation energy offsets higher household energy spending.

Although these State-level data serve as key indicators on an average and aggregate basis, they are not able to capture regional variation within New York State. Developing an internally consistent energy affordability dataset that can disaggregate by intrastate region is an important area for further research and analysis.

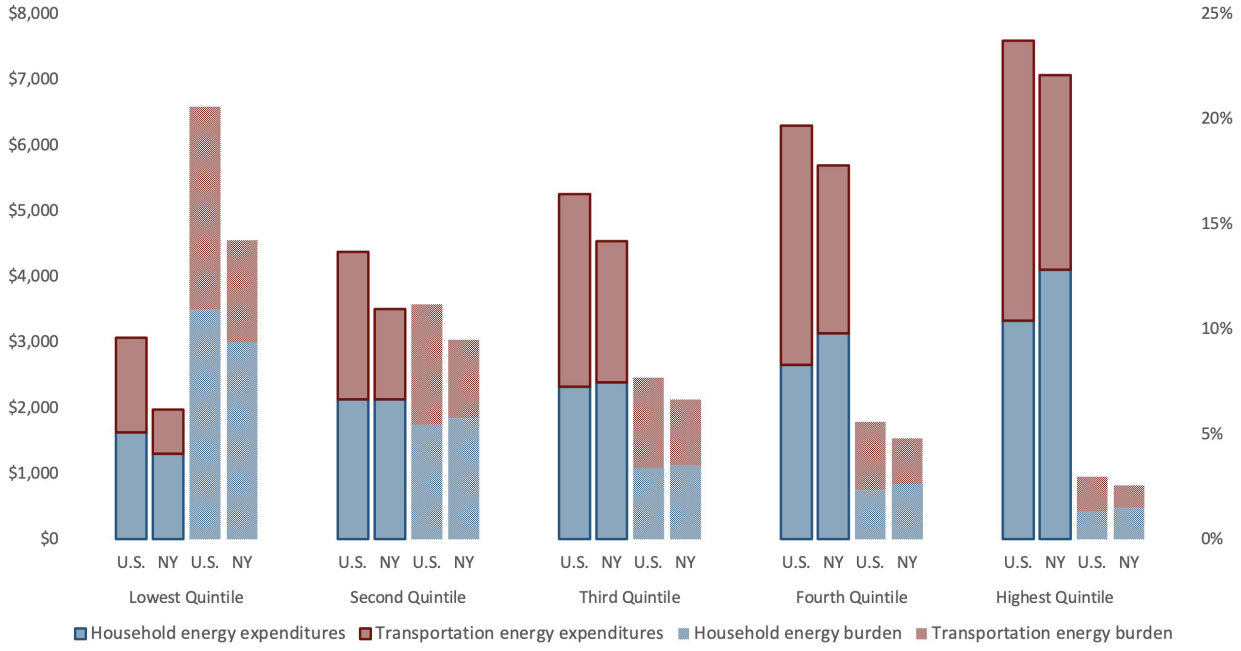
Figure 8: Total Household and Transportation Energy Cost per Household, U.S., New York State, and Top Outmigration States from New York State
Source: U.S. Bureau of Economic Analysis. Regional Data, GDP and Personal Income[35]



Across the U.S. and across New York, LMI households are more likely to experience energy affordability challenges. As shown in Figure 9 below, energy expenditures and burdens follow a pattern of lower expenditures but disproportionate burdens at lower incomes. While on average and across all income levels, total household and transportation energy expenditures are lower in New York as compared to nationally, the energy affordability needs of New Yorkers are not always being met. Energy burdens experienced by New York households in the lowest income quintile are approximately 10 percent, or four times higher than average, and transportation energy burdens experienced by the lowest income quintile are approximately 6 percent, or three times higher than average. At nearly 16 percent, the total household energy and transportation energy burdens experienced by the lowest-income households in New York State are nearly four times higher than average.

Figure 9: Household Energy and Transportation Energy Expenditures and Associated Burden by Income Quintile, U.S. and New York State

Source: U.S. Bureau of Labor Statistics. Consumer Expenditure Surveys. Quintiles of Income Before Taxes, 2022–2023[36]



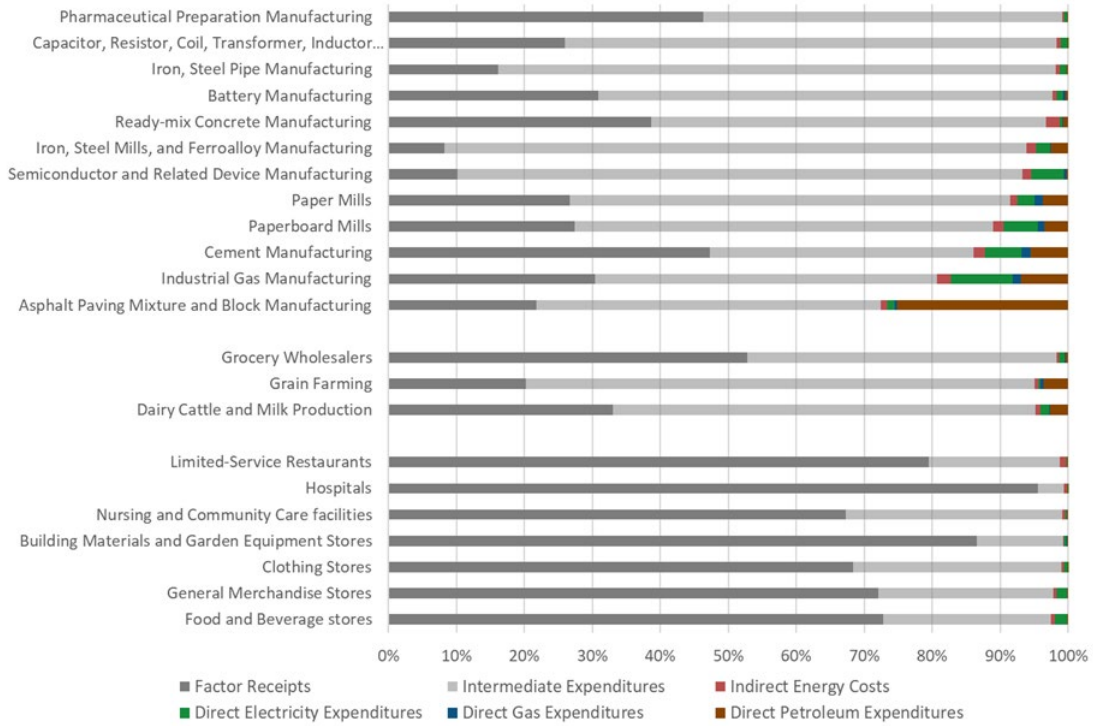
In addition to energy burden, lower-income and more vulnerable households experience energy insecurity—for example, foregoing other expenses to pay for energy, keeping one's home at an unsafe temperature, or getting behind on an energy bill—at above-average rates.[37] Indeed, at the end of 2024, nearly 1.4 million New York households were in arrears with outstanding balances on their utility bills greater than 60 days overdue, representing a total amount owed of nearly $1.9 billion. These dynamics further exacerbate disparities in health and quality of life for vulnerable populations.

2.4.3. BUSINESS ENERGY COSTS AND COMPETITIVENESS

Energy is an essential input across most sectors of the economy; however, its total contribution to business costs in New York is relatively small compared to other inputs. Costs for New York businesses are instead dominated by factor payments—primarily labor—and intermediate inputs, which include materials and services purchased by the businesses.

While energy costs that are affordable for businesses are a component of continued competitiveness for the state, the degree to which energy costs impact the competitiveness of any individual business or economic sector varies substantially with its energy intensity. Figure 10 shows energy expenditures as a share of total expenditures for a sample of New York industries. Industries can incur energy costs in two ways: energy expenses directly incurred to support operations and production, or indirect energy costs embedded in the costs of intermediate expenditures. On average, energy makes up 2 percent of total expenditures for New York businesses (excluding energy generators and utilities), and energy cost shares are at or below this 2 percent average for roughly 80 percent of the state's industries and its total manufacturing output. Just a small handful of industries, including cement, paper, asphalt, and industrial gas manufacturing, spend more than 10 percent of their expenditures on energy.

Figure 10: Energy Costs as a Share of Total Costs, Select New York Industries (2023)
Source: Analysis of IMPLAN data[38]



2.5. GHG Emissions

The New York State Statewide GHG Emissions Report is released annually by DEC. As required under the Climate Act, New York's GHG emissions accounting methodology differs from the United Nations Framework Convention on Climate Change Accounting (UNFCCC) accounting in three main ways:

- It measures emissions using a twenty-year timeframe, as opposed to the standard one-hundred-year time interval.
- It incorporates emissions from electricity generation and fossil fuel extraction and transmission that occur outside of New York State but are imported for use within the state.
- For the gross emissions inventory which is the basis of the emission reduction targets adopted in State law, combustion emissions associated with bioenergy are not considered carbon neutral and emissions and emissions benefits associated with land use are excluded.

The 2025 Statewide GHG Emissions Report[39] finds that 2023 economy-wide gross emissions totaled 354 million metric tons of carbon dioxide equivalent (354 MMT CO_2e), which represents a 14 percent reduction below the 1990 baseline and a 25 percent reduction relative to the 2005 GHG emissions peak. The energy sector accounted for approximately 73 percent of statewide emissions in 2023 (Figure 11). Under conventional UNFCCC accounting, 2023 net statewide emissions were 152 MMT CO_2e, and emissions declined 24 percent from 1990 to 2023 (Figure 12). New York saw the tenth largest percent decline in energy-related CO_2 emissions among all U.S. states over this period.[40]

Figure 11: Annual Statewide Gross GHG Emissions by Sector 1990 – 2023, Climate Act Accounting (MMT CO_2e GWP20)
Source: 2025 Statewide GHG Emissions Report[41]

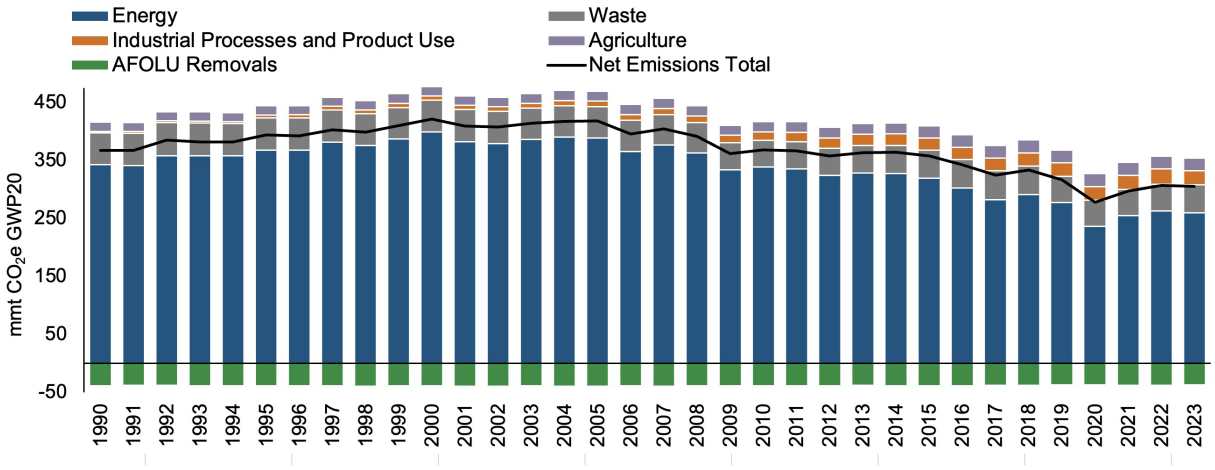
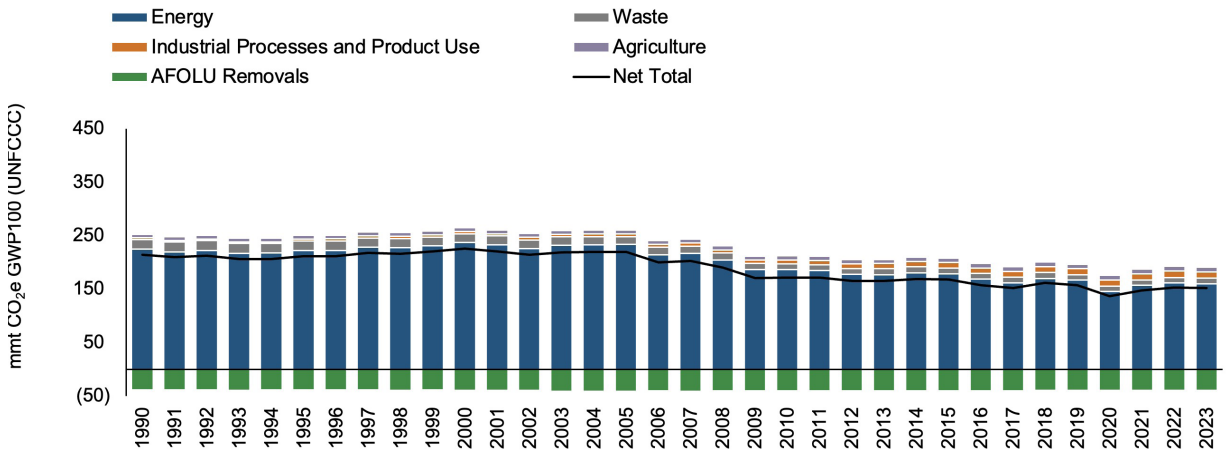


Figure 12: Annual Statewide Gross GHG Emissions by Sector, 1990 – 2023, UNFCCC Accounting (MMT CO_2e GWP100)
Source: 2025 Statewide GHG Emissions Report[42]



The electricity, buildings, transportation, industrial, and oil and gas sectors are the primary economic sectors with energy-related emissions. Under Climate Act emissions accounting in 2023, building and transportation were the highest-emitting sectors, at approximately 28 percent and 26 percent of total economy-wide emissions, respectively, followed by emissions from the electricity sector at 15 percent of statewide emissions.

According to 2025 Statewide GHG Emissions Report data, gross energy emissions declined significantly from 1990 to 2023, which saw a:

- 24 percent decrease in total energy sector emissions.
- 43 percent decrease in electricity emissions.
- 39 percent decrease in industrial energy emissions.
- 2 percent decrease in transportation energy emissions.
- 21 percent decrease in building energy emissions.

It is important to note the impacts of the COVID-19 pandemic on the energy sector when considering recent trends. Energy emissions increased between 2020 and 2023 as energy use continued to return to pre-pandemic levels. Electricity emissions additionally increased from 2021 to 2023 with the closure of the Indian Point nuclear power plant and subsequent increase in imported electricity generated from fossil fuels.

3. Meeting New York's Energy Needs through 2040

The Plan is underpinned by an analysis of possible future energy demand and supply across a range of future scenarios. Through economy-wide modeling of multiple future energy pathways for New York, this analysis simulates possible future energy systems that meet energy needs and advance policy objectives. The analysis completed for the Plan is based on assumptions set in October of 2025.

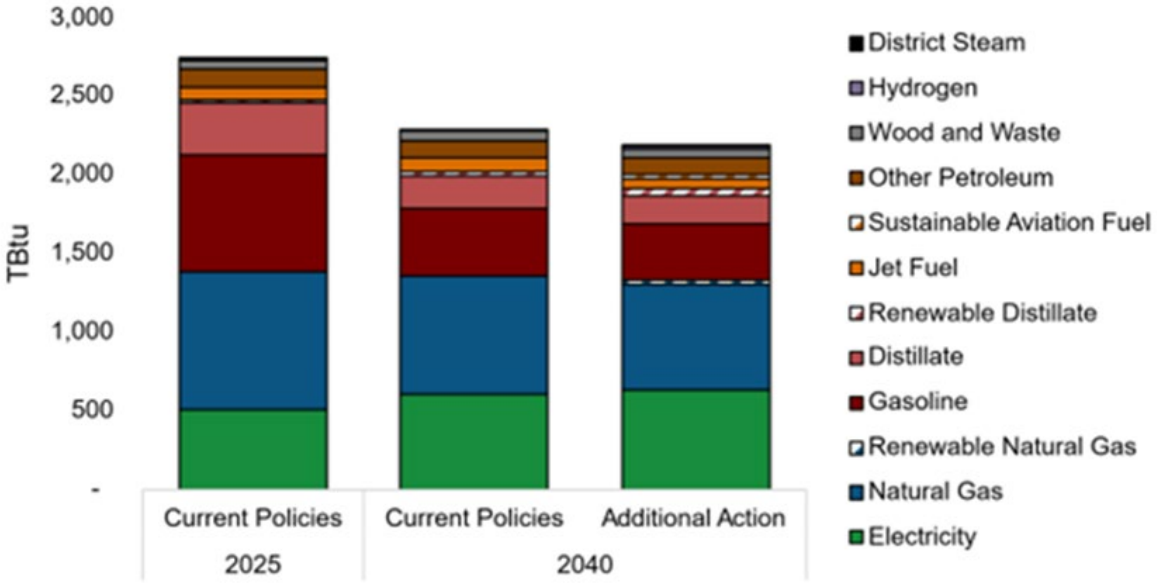
The two planning scenarios modeled include a Current Policies scenario reflecting progress consistent with enacted policies and an Additional Action scenario reflecting further acceleration of adoption of clean energy technologies from some mix of future policies. The planning scenarios include two variants for how much new nuclear and intrastate transmission capacity could be developed through 2040. The core planning scenario for the State Energy Plan is Additional Action, a forward-looking scenario that is consistent with ambitious but achievable progress.

As a reference point, the analysis also includes a No Action scenario that includes federal policies (as of October 2025) and legacy New York State policies but excludes State and local policies from 2019 onward. This scenario represents the energy system absent the Climate Act and other more recent clean energy policies. The net zero scenarios reflect what would be needed for full achievement of the 2050 emission reduction targets for comparison.

As shown in Figure 13 for the planning scenarios, the energy system undergoes a meaningful transformation in final energy demand between 2025 and 2040 even as all resources that contribute to meeting energy needs today continue to be important at the end of the planning period. By 2040, total final energy demand falls by 16–20 percent due to the adoption of energy-efficient technologies including building shell (or envelope efficiency) improvements. In the Current Policies and Additional Action scenarios, final energy served by electricity

increases from 19 percent in 2025 to 26–29 percent in 2040, and final energy served by direct fossil fuel consumption (across natural gas and petroleum fuels) decreases from 78 percent in 2025 to 63–69 percent in 2040.

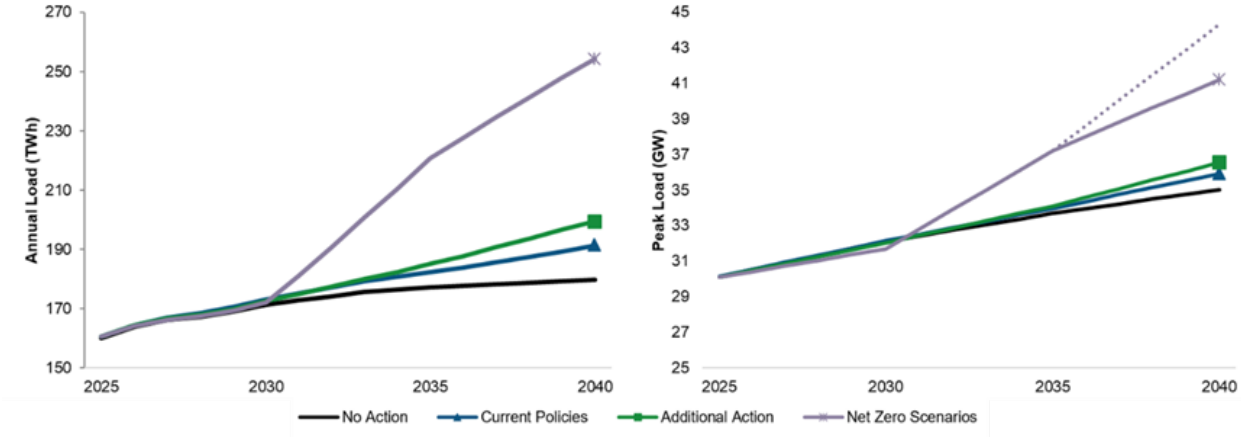
Figure 13: 2025 vs 2040 Final Energy Demand by Fuel
Source: Pathways Analysis chapter



3.1. Annual and Peak Electricity Demands

Future electricity demand is projected to grow due to new large loads and electrification of transportation and buildings. In all pathways scenarios, new large loads, such as manufacturing and data center projects interconnecting to the system, drive growing electricity demand across both annual loads and peaks (Figure 14).[43] Planning early for abundant supply for these large industrial and commercial projects can ensure continued opportunities for economic growth.

Figure 14: Annual Electric Loads in TWh (Left) and NYCA Peak Loads in GW (Right) for Each Pathway
Source: Pathways Analysis chapter



Electricity demand is also projected to grow due to electrification of transportation and buildings. Adoption of clean energy technologies, including electric vehicles (EVs), building energy efficiency, and heat pumps, is already underway, driven by consumer preferences and federal, State, and local policies and programs. As existing vehicles and heating and cooling appliances age out and are replaced, State actions—such as various transportation decarbonization initiatives and investments, heat pump incentive programs, advanced building codes, and all-electric new construction—will accelerate adoption of more efficient and electrified alternatives. By 2040, in the planning scenarios, 38–55 percent of the light-duty vehicle (LDV) stock is zero-emission vehicles (ZEVs) and 19–26 percent of housing units are heated by heat pumps.[44] These shifts can lead to further electric system growth.

3.2. Electricity Supply

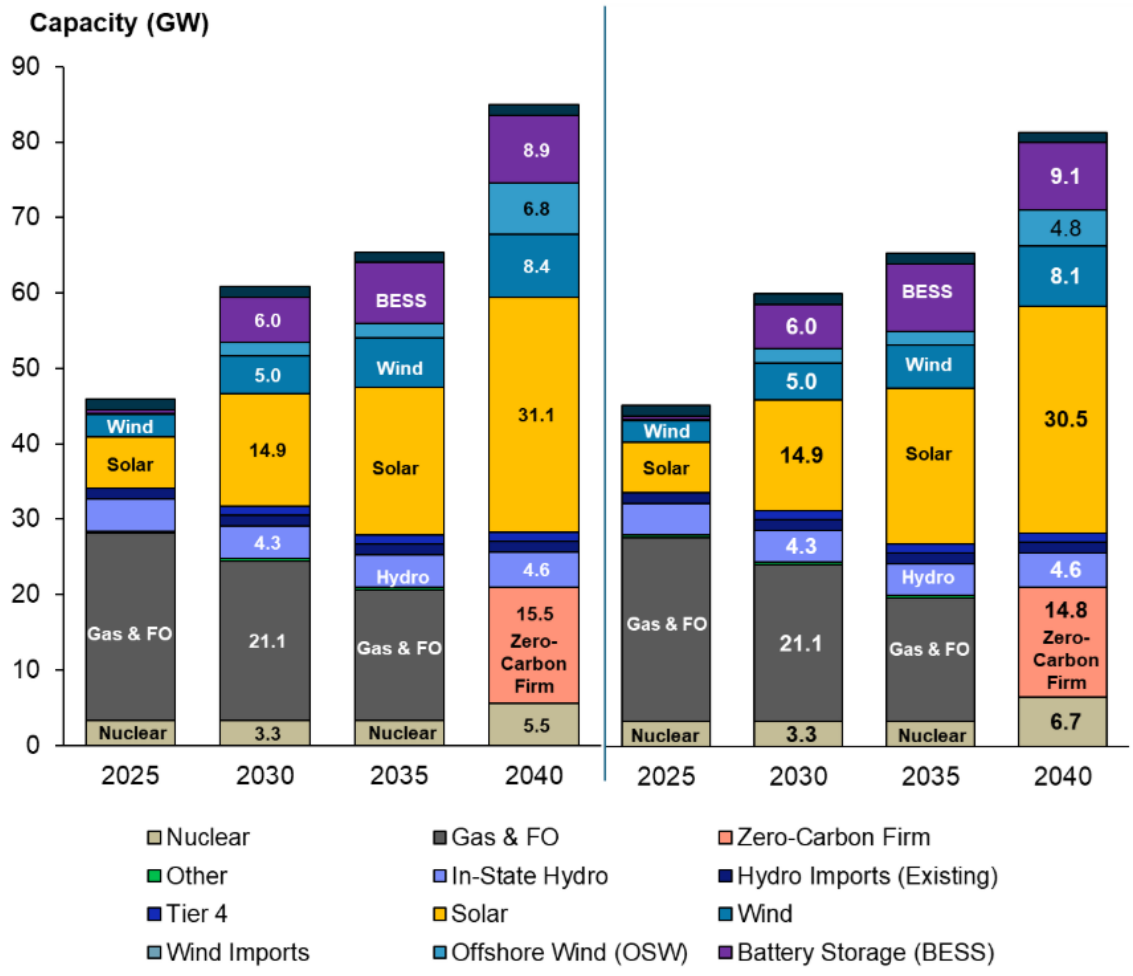
Meeting this growing electricity load while maintaining system reliability will require investments in expansion of the electricity system in all pathways. Moreover, progress toward a zero-emission electric grid will necessitate a transformation of the generation mix. This builds upon the deployment of renewables already underway from the Clean Energy Standard (CES) program.

In the core planning scenario, additions of renewable energy, nuclear, transmission, and battery storage are foundational to decarbonizing the state's electricity system. Under two variants of this scenario, by 2040, 28 GW of solar, 6 GW of land-based wind, 5–7 GW of OSW, and 2–3 GW of new nuclear would be added to New York's already decarbonizing generation mix, which add to the system's resource diversity (Figure 15, which shows total installed capacity over time). Beyond 2040, and subject to future analysis, the Energy Planning Board

anticipates growth opportunities for all technologies, including nuclear and renewables, considering load growth projections. In light of deployment uncertainty across all resources, planning and investments should rigorously pursue a mix of resources to support multiple energy futures.

Reliably integrating large quantities of variable renewable energy into the electricity system requires flexibility and balancing over multiple timescales, including sub-hourly and hourly balancing as well as ensuring that firm, dispatchable capacity is available to provide adequate amounts of power during multi-day periods of low renewable output.

Figure 15: Additional Action Electric Sector Capacity: 2.2 GW Nuclear Variant (left), 3.3 GW Nuclear Variant (right)
Source: Pathways Analysis chapter



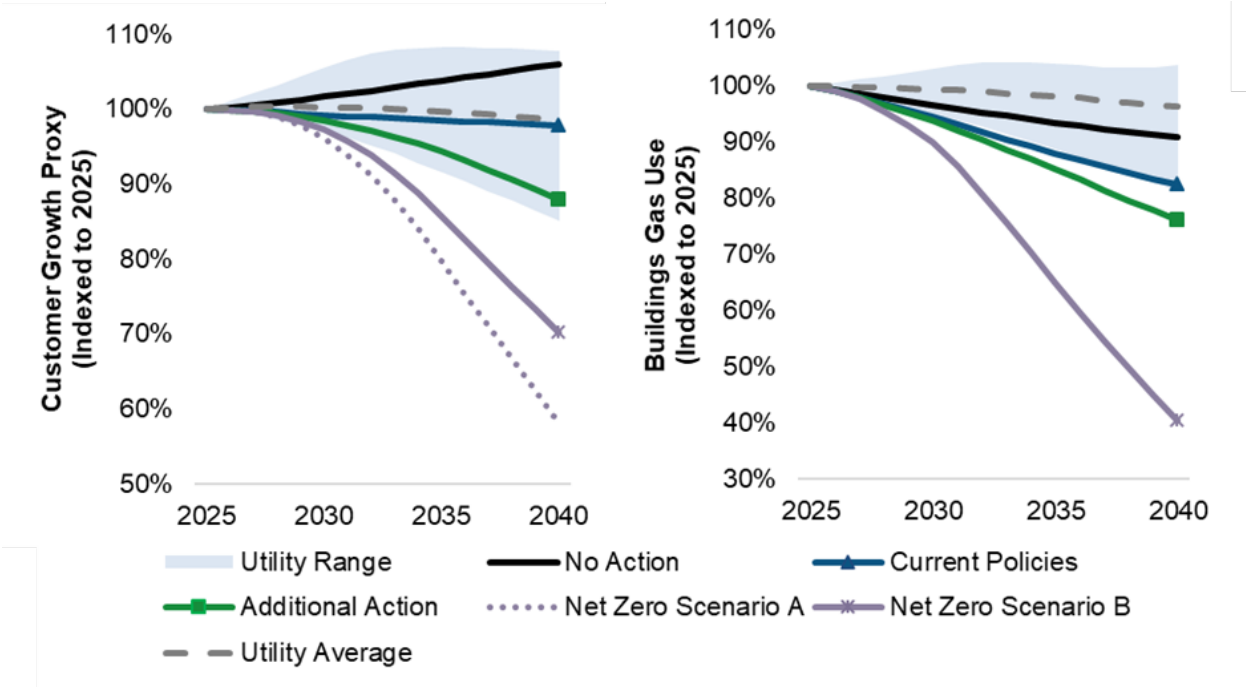
Battery storage and demand-side flexibility provide key contributions to system reliability and support the balancing of renewables with demand. Existing and new nuclear and existing hydroelectric generation provide large quantities of zero-emissions energy and firm, dispatchable capacity during prolonged periods of low renewable output.

While the State policy process for establishing the definition of zero-emission electricity generation is still underway, the modeling assumes that by 2040 the remainder of multi-day reliability needs are met by generators powered by green hydrogen. Under this assumption, the combustion generation fleet remains critical, with 15 GW of capacity available to run on hydrogen in 2040. The Pathways Analysis chapter of this Plan reports on projected combustion unit retirements over the planning period and new or repowered capacity to maintain reliability, which includes 3 GW repowered by 2035 in New York City as a result of delayed OSW buildout given federal permitting headwinds. The chapter further includes a sensitivity that explores the value of using renewable natural gas (RNG) rather than hydrogen for firm power generation, finding that the use of RNG lowers system costs and reduces deployment challenges related to infrastructure buildout, generator retrofits, increased load, and higher fuel costs for hydrogen. The size of the overall combustion fleet declines from approximately 25 GW in 2025 to 15 GW in 2040 even as peak demand increases, reflecting the reliability contributions of other new resources like the Champlain Hudson Power Express transmission project, new battery storage, new nuclear generation, and additional renewable capacity.

3.3. Natural Gas Supply and Delivery

While the electricity system is expected to grow in all scenarios, the gas system transformation is pathway dependent. In all scenarios, the gas system remains an important energy delivery system, necessitating investments for reliable ongoing provision of service. Residential and commercial consumption of natural gas declines in all cases with efficiency improvements and customers switching to heat pumps to varying degrees (Figure 16). Natural gas throughput declines even further with progress toward a zero-emission electricity system, although electric generators typically have interruptible service, which lowers their impact on overall gas system infrastructure needs. Residential gas customers grow in the No Action scenario absent more recent State action, with new construction and conversions from electric resistance and heating oil driving new connections. Residential gas customers decline over time in the remaining scenarios, reflecting the potential for heat pump programs and other State and local government actions to stem growth. However, regional variability is expected based on the findings of the utilities' Long Term Plans (LTPs), and targeted regional investment in system expansion may be needed to increase supply and meet peak demand.

Figure 16: Residential Customer Count Change (left) and Residential/Commercial Consumption (right) for All Pathways
Source: Pathways Analysis chapter

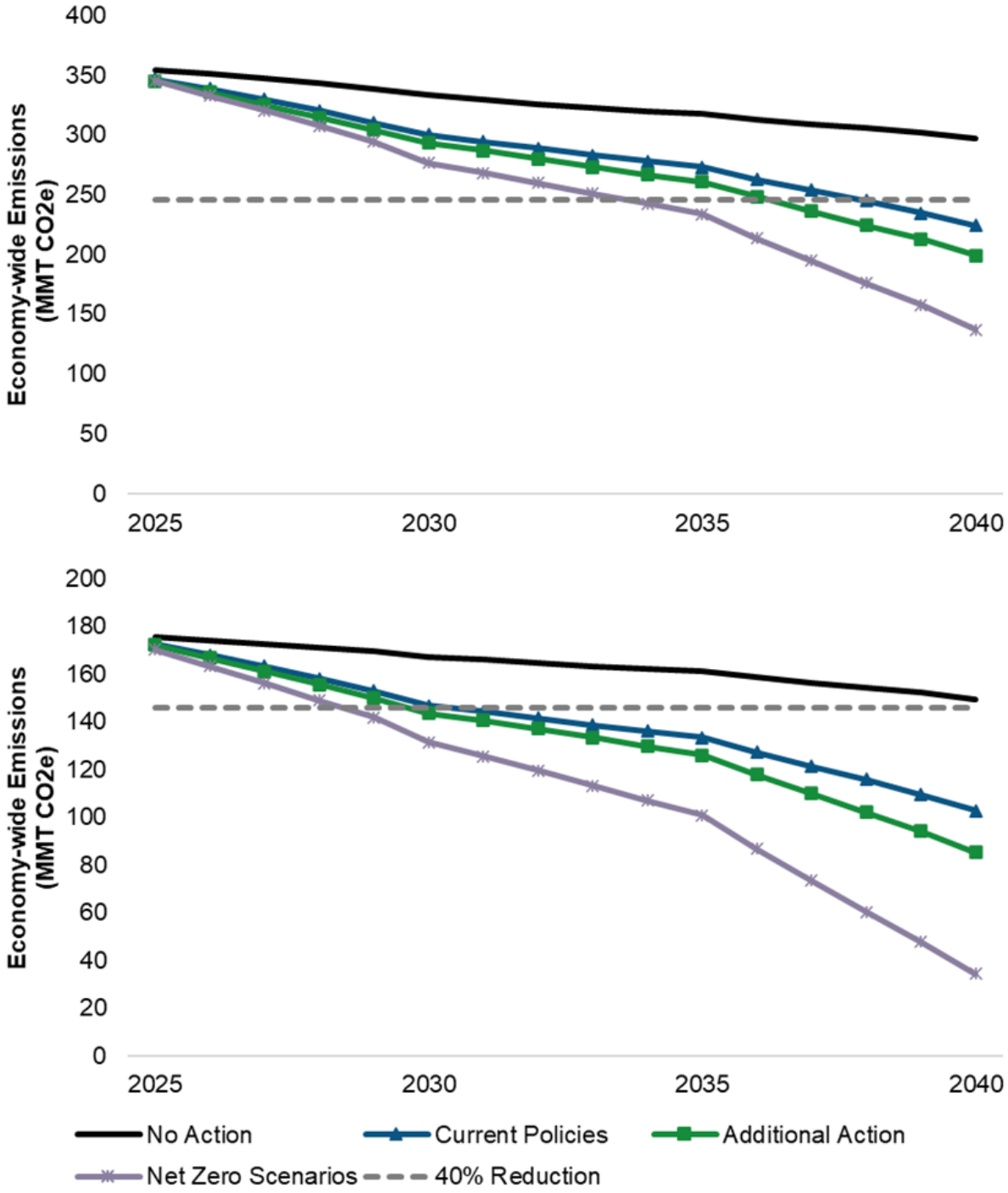


3.4. GHG Emissions

New York's economy-wide emissions today have already declined more than 14 percent from 1990 levels and 25 percent relative to 2005 peak emissions. The modeling finds that existing State policies are laying groundwork for further economy-wide emissions reductions, with significant contributions from power generation, transportation, buildings, and fugitive emissions including methane and hydrofluorocarbons (Figure 17). Under the current set of assumptions and the Climate Act GHG accounting methodology, Current Policies will hit 40 percent economy-wide emissions reduction in 2038, while Additional Action will hit 40 percent reduction in 2037. State policies mitigate some of the impacts of federal policy changes already enacted; without these State actions, emission reductions would be further delayed.

Under conventional UNFCCC accounting, a standard in many other jurisdictions, Additional Action achieves a 40 percent reduction in economy-wide emissions by 2030 and Current Policies is within 2 MMT CO_2e of the target in that year.

Figure 17: Economy-Wide Emissions for All Pathways Under Climate Act (top) and UNFCCC (bottom) GHG Emissions Accounting Methodology
Source: Pathways Analysis chapter



Achievement of the net zero economy-wide emissions target will require significant further policy action and technology development beyond what is currently contemplated, including further electrification and decarbonization in buildings and industry; pursuing electrification

and fuel-switching in on-road and non-road transportation sectors; and pursuing ambitious non-energy sector mitigation.

Due to external factors including supply chain disruptions, inflation, recent cuts to federal clean energy tax credits and incentives, and other changes in energy and tariff policy from the federal administration, there is considerable uncertainty in the timeline for progress toward emissions reductions.

3.5. Societal Costs of the Plan

Regardless of the specific future pathway for New York's energy system, continued investment to maintain and modernize existing infrastructure, replace aging equipment, and purchase fuels to meet energy needs will be necessary. The analysis found that the No Action scenario requires annual system-wide spending (including on supply- and demand-side fuel and equipment) of approximately $150 billion (in 2024$) every year through 2040. These funds support replacing end-use equipment at the end of useful life and constructing new and replacement natural gas generators to meet electricity needs, which are being transformed by new large loads and other needs. Operating fuel expenses trend downward over time because end-use equipment is expected to become more efficient.

By 2030 (Figure 18) and 2040 (Figure 19), the Additional Action scenario raises annual system-wide costs by 3 percent and 13 percent, respectively, relative to the No Action scenario. Additional Action meets over 85 percent of its investment needs every year by reallocating anticipated spending from legacy energy sources and equipment to energy efficiency and clean alternatives and by replacing spending on combustion generators with renewable generation, gas appliances with energy efficient heat pumps, and internal combustion vehicles with battery electric alternatives. In contrast, the cost premium for the Net Zero scenarios reaches over 35 percent by 2040. Recent federal policy changes have shifted costs toward New Yorkers, as tax credits and incentives for clean devices and renewable resources have been repealed. This sums to up to $31 billion through 2040 in lost federal support ($19 billion on a net present value basis). The near-term actions New York is taking to contract projects before the tax credit phase-out are essential for reducing costs to New Yorkers and ensuring ongoing industry progress. In addition to the impact of lost support, federal policy changes will drive increased costs due to tariffs and industry uncertainty impacting learning rates, and those impacts are not included in the federal policy cost shift estimated here.

Figure 18: 2030 Gross Annual Costs by Scenario (Billion 2024$)
Source: Pathways Analysis chapter
Note: *"Others" includes oil and gas system, operations and maintenance, and other direct costs.

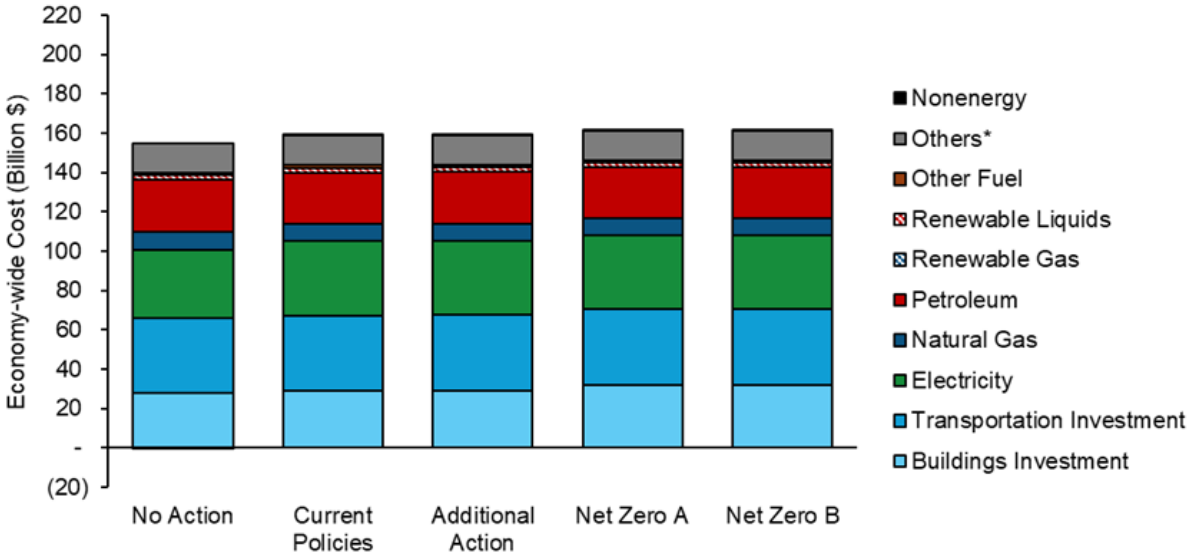
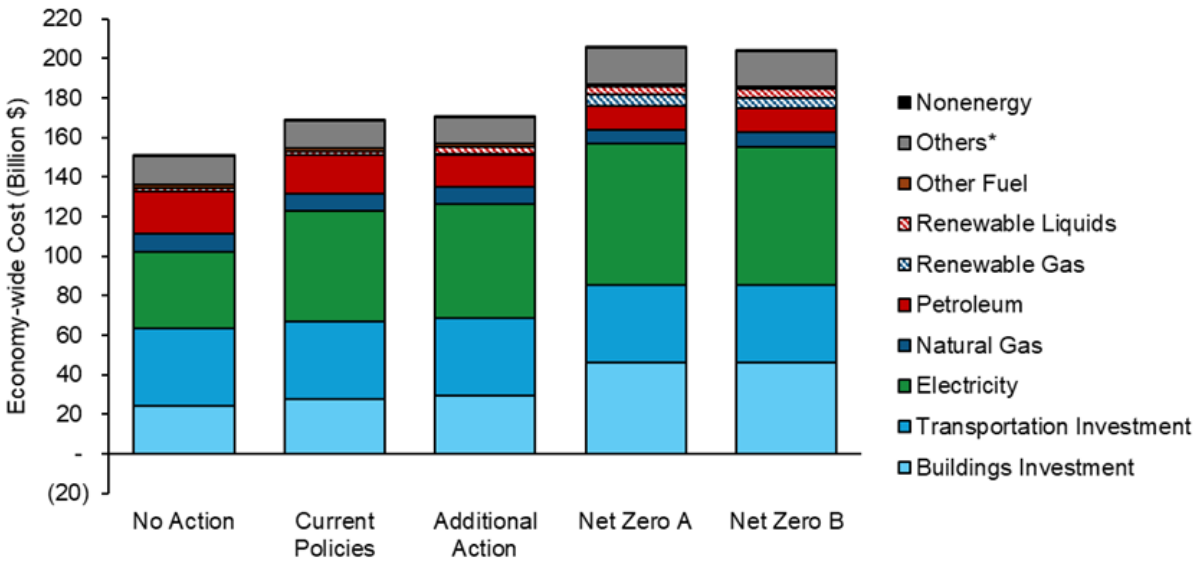


Figure 19: 2040 Gross Annual Costs by Scenario (Billion 2024$)
Source: Pathways Analysis chapter
Note: *"Others" includes oil and gas system, operations and maintenance, and other direct costs.



Across each of the scenarios, the emissions mitigation supported by State actions yields societal benefits that exceed the corresponding incremental costs in each year and in total over the planning period. The core planning case, Additional Action, sees the total net present value of net benefits reach $92 billion by 2040. These benefits grow substantially over the planning period as greater amounts of clean energy substitute for fossil fuel use across the scenarios. As shown in Figure 20, in the Additional Action scenario in 2030, incremental spending of $4 billion secures approximately $10 billion in benefits (or $6 billion

in net benefits). By 2040 (Figure 21), incremental spending of $20 billion provides benefits of $38 billion (or net benefits of $18 billion). While GHG emission reductions provide a meaningful share of the cumulative benefits over the full planning period, significant benefits are also associated with health improvements. Health improvements include estimated reduction in premature mortality and avoided lost workdays, emergency room visits, non-fatal heart attacks and more. For more information on these health benefits, see Section 6.2.

Figure 20: 2030 Annual Net Costs and Benefits by Scenario (Billion 2024$)
Source: Pathways Analysis chapter

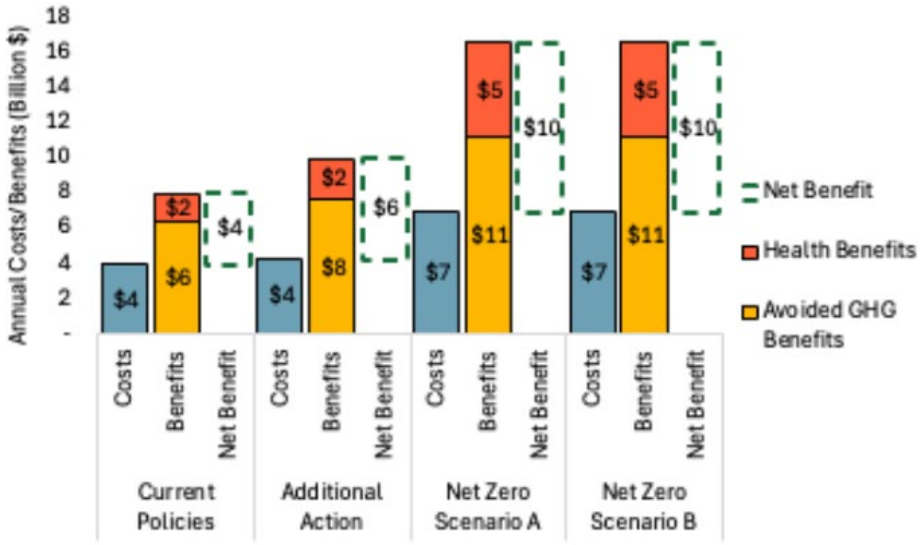
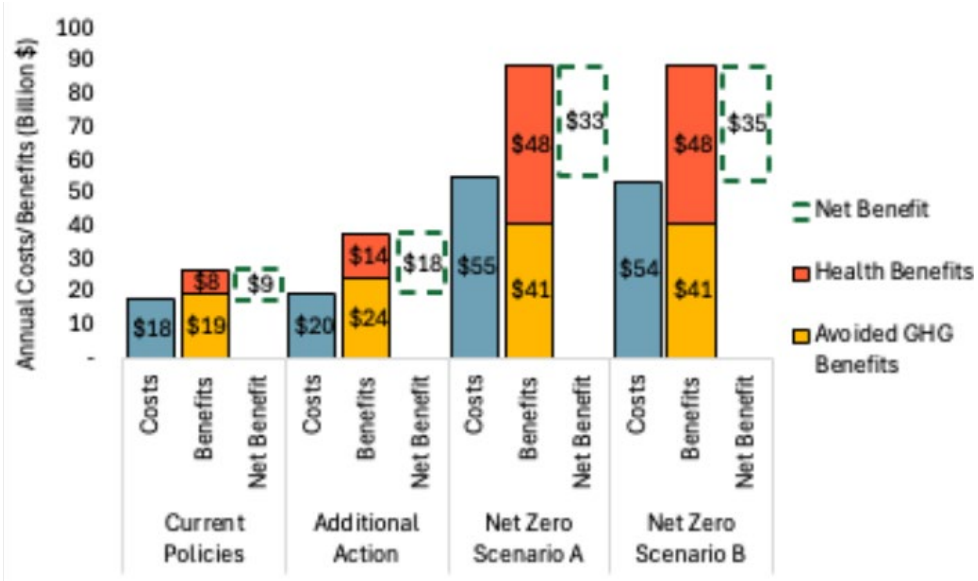


Figure 21: 2040 Annual Net Costs and Benefits by Scenario (Billion 2024$)
Source: Pathways Analysis chapter



For discussion of household energy costs, see Section 6.4.

3.6. Summary: Ability of Energy Systems to Meet Forecast Energy Demand

Across electricity, natural gas, petroleum, and alternative fuels, medium- to long-term demand forecasts are uncertain. Future demand is highly dependent on factors such as economic trends, policy shifts, technology adoption rates, and consumer behavior. To ensure that the state's energy systems are able to reliably meet demand at reasonable cost, New York State policymakers, system operators, and stakeholders will pursue planning and strategies that remain adaptable across a broad set of potential futures.

New York's electricity demand is forecast to grow significantly through 2040—a marked change from the relatively flat electricity usage over the past decade.[45] New York State is prepared to meet this growing electricity demand while maintaining system reliability and making progress toward a zero-emission grid. New York State will likewise support the reliable provision of natural gas and petroleum fuels, as all major fuels used in the state today are forecast to provide meaningful volumes of energy throughout the planning period.

The core planning scenario developed to inform this Plan projects a 24 percent increase in annual electricity demand and a 21 percent increase in peak demand by 2040 as compared to 2025. This forecast incorporates anticipated new large loads, expanded use of EVs and heat pumps, and energy efficiency upgrades that help manage load growth in buildings. There is uncertainty as to whether the continuous growth in clean energy supply resources will meet growing demand given the federal policy context, broader economic headwinds, and the need for new clean firm technologies to become commercially available. As a result, the State and electricity system operators will continue to pursue careful coordination and planning to adapt as the energy system evolves.

While the State Energy Plan provides statewide and regional forecasts and broad policy direction, multiple ongoing planning processes exist to inform specific decisions such as electricity system investments or whether a given generating unit is needed for system reliability. The NYISO conducts regular reliability planning on both a near- and long-term basis, including the biennial Reliability Needs Assessment (RNA); if the RNA identifies a reliability need for the bulk system, the NYISO issues competitive solicitations for projects to address it. Importantly, the PSC has initiated changes to the utilities' planning practices in response to clean energy policies and grid modernization needs. For example, the first statewide Coordinated Grid Planning Process (CGPP) is underway.

The scenarios modeled for this Plan suggest declining demand through 2040 for natural gas and petroleum products, though these fuels remain important energy sources. However, notable variability exists across the forecasts that each New York gas utility has developed for natural gas demand in their service area (Figure 16). As directed by the PSC, the gas utilities produced and will regularly update LTPs with gas demand and supply forecasts for multiple scenarios over a 20-year horizon. These LTPs are important to inform gas system investments because they include utility-specific attention to supply sources needed to meet peak day needs during the winter heating months, with consideration of different scenarios that allow for a variety of contingencies to meet energy needs at all times. Electric and gas system planners also need to strengthen coordination measures to ensure fuel adequacy and maintain reliability across both systems.

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Comment Process

4. Energy Plan Direction and Vision

New York has been focused and effective in building and operating an energy system that meets the needs of New Yorkers, serving as the backbone for public safety, quality of life, and economic development and job growth.

This Plan supports New York's commitment to maintain the reliability of its energy system, deliver affordable energy, and make ongoing progress toward a clean energy economy—one that uses energy efficiently, is increasingly powered by clean energy resources with lower environmental and health risks, modernizes infrastructure, fosters technology innovation, and supports family-sustaining jobs. It likewise supports New York's commitment to ensure that all communities, and especially people within historically disadvantaged communities, can participate in and will benefit from the State's clean energy transition. Meeting reliability requirements, safeguarding affordability, and advancing other State policy goals require pursuing smart energy investments and operations that are as cost-effective as possible. Broad planning goals are discussed in this section, followed by corresponding objectives and actions in Section 5.

4.1. Deliver Abundant, Reliable, Resilient, and Clean Energy

Reliable and resilient energy is critical to the well-being of every New Yorker. It runs life-saving medical equipment and communications systems, keeps buildings at safe temperatures with clean running water, and allows New Yorkers to travel and do their work without interruption. Reliability describes the ability of an energy system to consistently function and deliver energy services. Resilience is the ability of systems and communities

to anticipate, prepare for, respond to, recover from, and adapt to a disruption, with minimum damage to social well-being, public health, the economy, and the environment.

Across New York's energy systems, maintaining reliability and resilience depends on adequate supplies of energy, a robust delivery infrastructure, and planning practices that keep pace with the energy transition and changing risks from physical, natural, and cyber hazards.

A primary challenge for New York's energy system is its advancing age, which creates unique risks for reliability. The NYISO has reported, for example, that by 2028, a quarter of the state's combustion generators (by capacity) will reach an age at which most such facilities are retired. For several utilities serving the Hudson Valley and Upstate New York, 60 percent to over 95 percent of transmission structures are 70 years old or older. The oldest still-operational natural gas pipeline in New York dates to the Centennial, turning 150 years old next year. This aging infrastructure is more prone to failure, requires more costly repairs, and results in a greater environmental impact than newer technologies. Over the planning period and beyond, maintaining safe and reliable energy service will require substantial investment in New York State's aging energy infrastructure.

In the electricity sector, demand is projected to grow significantly through 2040 due to the addition of new large loads, such as manufacturing facilities, alongside growing customer preferences for the electrification of buildings, transportation, and industry. This expected load growth, combined with aging infrastructure means that planning approaches and the build out of energy infrastructure will need to become nimbler.

Both today and looking forward, resilience and adaptation efforts are critical to respond to hazards—such as hotter temperatures, more frequent and severe storms, and sea level rise—that pose significant risks to New York's energy systems. Proactive and appropriate planning as in this Plan, multi-agency energy security planning, and multiple other processes will equip New York to respond to such hazards.

4.1.1. ENERGY SOURCES AND SUPPLY INFRASTRUCTURE

New York State supports an abundant and diverse mix of energy sources and supply infrastructure, which benefits reliability and resilience by reducing the impact of energy supply disruptions. In addition, resource diversity mitigates the impact of price fluctuations for any given fuel. For example, New York's reliance on natural gas, including for power generation, coupled with limited infrastructure expansion has created vulnerabilities, especially in winter months when the gas supply system becomes constrained. These constraints contribute to higher, more volatile prices for natural gas and electricity.

Accelerating the integration of wind, solar, and other renewable energy resources into New York's energy system increases the resource diversity of the system, offering economic and reliability benefits, as well as important environmental and public health benefits from reducing the use of fossil fuels. As New York adds these new resources and as load grows, planners must expand and modernize the grid fast enough to maintain reliability, which will require streamlining processes and accelerating the pace at which infrastructure can be built. This Plan underscores the importance of New York's ambitious commitments to invest in large-scale renewables, distributed and community solar, energy storage, advanced nuclear technologies, and transmission and distribution grid infrastructure upgrades, while also recognizing the value of existing nuclear and hydropower generating facilities.

As New York looks toward 2040, the State will need to identify and integrate clean firm technologies that support the operation of a zero emissions electric grid. Clean firm resources are able to reliably and flexibly provide energy and capacity to the grid (especially when intermittent sources such as wind and solar are unavailable) and provide support services like voltage regulation. This will require innovation and complementary investments in clean firm technologies such as long-duration energy storage and advanced nuclear reactors. To maintain reliability while promoting affordability, wholesale electricity market reforms may also be needed so that capacity, reliability, reserves, and balancing services are properly valued.

Demand-side resource diversification, which includes strategies such as energy efficiency and load flexibility, also offers numerous benefits. A continued focus on energy efficiency is a bedrock strategy. When households and businesses make energy efficiency upgrades, their energy bills are immediately lower and can stay stable even as rates increase. At a system level, energy efficiency helps to avoid wasteful commitments of ratepayer funds to infrastructure that could otherwise be avoided. The Plan speaks to strategies that continue to leverage and expand the deployment of energy efficiency across fuels, as well as energy storage and other demand-side resources to lower the cost of the clean energy transition and enhance grid reliability.

All major fuels currently used in New York State are projected to continue to provide meaningful volumes of energy throughout the planning period, while the contributions of clean and renewable energy sources will grow. As clean energy resources ramp up over time, the State will maintain adequate supplies of other major energy sources. This means that through the 2040 planning period, New York will continue supporting the safe and reliable provision of natural gas and petroleum fuels to electric, residential, commercial, industrial and transportation sectors. In part this will require continued investment in the natural gas system, including guaranteeing adequate supply infrastructure to meet demands even during the coldest days and helping relieve upward pressure on gas prices that can result from infrastructure constraints. Combustion generating units will also remain essential

parts of electric grid reliability and energy affordability, and New York will seek to carefully manage the retirement of existing assets and evaluate whether there is need to invest in their repowering or in new generation that is compatible with long-term policy targets. This is the case even as New York seeks to first prioritize the continued expansion of clean energy resources, transmission upgrades, increased energy efficiency, integration of distributed energy resources (DERs), and growth in demand response participation.

4.1.2. SYSTEM INVESTMENTS AND STRATEGIC ENERGY PLANNING

Substantial investment will be needed in New York's energy systems to modernize aging infrastructure and address a range of risks and hazards, including those posed by climate change, and to meet new demands for energy that come from economic development opportunities. While the transition to clean energy will bring some incremental costs, the bulk of energy-related investments during the planning period will go to ensuring that energy services (such as heating and cooling in buildings, commuting to work, and manufacturing processes) are available when and where they are needed. In turn, these energy-system investments will provide large and long-term benefits to current and future New Yorkers.

The replacement of old infrastructure with newer infrastructure carries higher capital costs than was experienced in the past. These costs are impacting and will continue to impact utility rates. Managing the cost implications will be essential, through careful, strategic energy planning and the integration of advanced technologies. New York State is committed to providing safe and reliable energy service while taking all possible steps to buttress energy affordability.

Rather than rebuilding our energy system as it exists, new infrastructure will enable operational flexibility for the electricity system and load flexibility on the part of households, businesses, and industry. In addition, the State needs to evolve its long-term energy system planning paradigms, integrating planning for the electricity and natural gas systems. Consumer fuel choices will have meaningful impacts on the operational and financial needs of both systems. For example, as heat pumps increase in popularity, the way buildings use energy during very cold periods will impact annual and peak needs on both the electric and gas systems, impacting needed local and bulk system capacity requirements, utility revenues, and more. Moving away from planning each system in a silo will help manage overall energy system costs by planning toward joint optimization and avoiding unnecessary ratepayer commitments.

As a threat multiplier, the effects of climate change can further worsen non-climate-related impacts on the state's energy system. Layering a changing climate on factors like aging infrastructure and existing disparities will increase the risks to the system and communities.

Considering climate change in all aspects of energy system planning and identifying and hardening critical infrastructure are important cross-cutting responses. To be prepared, the State in coordination with the energy industry will continue to prioritize multi-level and multi-agency energy security and emergency management preparedness, response, and mitigation efforts.

4.2. Provide Affordable Energy to Households and Equitable Clean Energy Benefits

Affordable energy as well as broad access to energy efficiency and clean energy choices are essential for New York's continued prosperity as well as to advance community and economic development, an equitable energy transition, and other policy goals. As discussed in this Plan, future investments in our energy system should be selected, designed, and executed in a cost-effective manner to mitigate utility bill impacts and to withstand the impacts of a changing climate. Advancing equity in our energy and climate actions also means that New York is working to ensure that all communities, and especially people within disadvantaged communities, will benefit from the State's clean energy transition.

4.2.1. AFFORDABLE ENERGY FOR NEW YORK HOUSEHOLDS

Relative to the national average, New York's lower combined expenditures across household energy and transportation fuel reflect the state's broader energy efficiency. New York benefits from a longstanding commitment to programs and energy codes that reduce energy waste and from living patterns that reduce driving and household energy needs as compared to peer states. But in New York and nationally, rising energy costs, especially for electricity and natural gas, are creating energy affordability concerns that must be addressed.

Ensuring that the benefits of energy efficiency continue and extend to a greater share of New Yorkers, especially those disproportionately burdened by energy costs, is foundational to the State's energy affordability strategy. As described in greater detail in Section 6.4, the use of efficient equipment—gasoline cars and natural gas furnaces—offers the prospect of reduced energy expenses for households across all New York geographies and housing typologies. Energy efficiency standards, adopted via federal and State regulations, mean that over time, many New Yorkers can expect gradually declining real energy expenses even if rates continue to increase. Federal retreat on existing standards could jeopardize these benefits.

Even greater energy affordability benefits are available to many households if they choose even more efficient or electric equipment, such as opting for EVs or public transit or weatherizing their home. Notably, realizing these benefits will require overcoming existing barriers to entry, namely the higher capital costs associated with some clean energy options, which can be addressed, in part, through State actions such as direct financial incentives and continued public-private partnerships to support market development and innovation. The State also should be attentive to how combined household energy and transportation fuel expenses impact choices for different households in New York. For example, households that already depend on public transit, that currently heat with gas, or that currently do not pay heating bills (but may do so after a heat pump installation) merit attention to avoid negative affordability impacts for households pursuing efficient electrification. Concerted State and federal actions are needed to address the disproportionate burden of energy costs borne by many LMI households. This includes continued and expanded commitment to programs that support energy affordability, including bill assistance, Solar for All, the Low Income Home Energy Assistance Program (LIHEAP), and other programs that help families. Alongside these programs, the State should pursue strategies that ease access to these benefits for eligible households.

In 2016, the PSC established a target energy burden, or the percentage of a customer's income that is spent on energy, at or below six percent for low-income households. Since then, the PSC refined the Energy Affordability Policy (EAP) program and brought billions of dollars in utility bill relief to over one million low-income households.[46] In July 2025, the PSC adopted a new Enhanced Energy Affordability Policy (EEAP)[47] to support moderate-income utility customers who do not qualify for existing low-income energy programs, significantly broadening affordability protections beyond the existing programs. The PSC requires that New York's utilities track key data and regularly file reports related to enrollment in energy affordability programs, the level of arrears, and terminations, while DPS is exploring options to further improve visibility into utility affordability for New Yorkers.

4.2.2. ACCESS TO CLEAN ENERGY CHOICES

A related and crucial role for State policy is reducing the upfront capital costs associated with the energy efficiency and clean energy choices that households—as well as the public and commercial sector energy users—can pursue to gain a wide range of benefits, including lower energy bills, health and comfort benefits, and others. The State can reduce the upfront cost of clean energy options through a combination of innovation, market development and transformation, and incentives to offset a portion of these costs.

Continued public and private investment in EV charging infrastructure and ZEVs, coupled with actions to encourage affordable managed charging, will help make the low operating cost of EVs available for more New Yorkers. The Energy Plan further emphasizes the importance of increasing the availability and affordability of safe and convenient transportation options, including through investment in smart growth development and co-locating transit in communities.

For existing buildings, financial incentives and low-cost financing are needed to reduce the upfront costs of phased energy upgrades and to motivate New Yorkers to weatherize, cut energy waste, and install high-efficiency heat pumps. Other priorities include near-term emphasis on efficiency and electrification opportunities that see energy cost savings and support affordability; ongoing support for initiatives that build market confidence and capacity; and innovation that brings additional technology solutions to the market and lowers costs.

State financial support should prioritize multiple values and benefits, which means supporting energy efficiency alongside electrification efforts. This portfolio approach to investment planning ensures continued progress toward State goals and societal benefits, including providing air quality and health benefits and minimizing electricity system impacts from efficient electrification.

Alongside State efforts to increase access to solutions available today, support for a diverse research, development, and demonstration (RD&D) portfolio to catalyze innovation and commercialization of emerging technologies will help to expand attractive clean energy solutions and lower their cost. For example, through the Clean Heat for Challenge, New York City Housing Authority (NYCHA), NYPA, and NYSERDA have partnered to spur innovation on a packaged cold-climate heat pump product that better serves the needs of large and hard-to-retrofit multifamily apartment buildings; to date, the resulting product exceeded expectations for efficiency, price point, and resident satisfaction.[48]

4.2.3. COMMUNITY BENEFITS

There are communities within New York that have been historically overburdened by environmental pollution and harm, including from energy production, consumption, and infrastructure. The Climate Act charged the Climate Justice Working Group (CJWG) with the development of criteria to identify disadvantaged communities (or DACs) to ensure that frontline and otherwise underserved communities benefit from the state's transition to cleaner sources of energy, reduced pollution and cleaner air, and economic opportunities.

The Climate Act requires that no less than 35 percent—with a goal of 40 percent—of the investments and benefits from the State's clean energy programs accrue to DACs.

Energy affordability is a core element of energy equity. This is especially true for LMI households, given the outsized impact of energy costs on their health, well-being, and economic mobility. In addition, investments can create workforce and economic development opportunities in disadvantaged communities.

The Plan further speaks to the importance of developing clean energy programs that are tailored to meet the needs of disadvantaged communities, including low-income New Yorkers. A transformative opportunity exists to invest in and expand access to quality housing that is energy efficient, comfortable, and resilient, with a focus on support for LMI households and housing in disadvantaged communities. Across sectors, strategically targeting public investments to reduce fossil fuel combustion from transportation corridors, buildings and industry, and electricity generation in areas located in or near disadvantaged communities will improve local air quality.

The Plan also describes strategies for developing and siting energy resources in ways that reduce energy project risks, minimize land use conflicts, and benefit host communities. In the context of energy, a host community is the local population situated in an area where an energy project is developed.

4.2.4. COMMUNITY ENGAGEMENT AND INTERGOVERNMENTAL COLLABORATION

Inclusive outreach to and engagement of residents and CBOs, with robust engagement of disadvantaged communities, is central to ensuring that all communities have a voice This spans a spectrum: from increasing the accessibility of informational resources, to involving community members during project development, to facilitating engagement of community-based leaders and the public in clean energy policy development, planning, and program design.

Collaboration and partnerships among State, local, regional, Indigenous Nations, and federal entities are critical to the successful implementation of the State Energy Plan. A coordinated approach streamlines energy and climate planning and enables decision-making that appropriately considers economic growth, local planning, long-term resilience, and benefits to disadvantaged communities. Local governments are a key point of contact for community members engaging with energy-related decisions and projects, and they hold key responsibilities in land use, building codes, and infrastructure planning.

Nine Indigenous Nations reside within, or have common geographic borders with, New York State: Cayuga Nation, Oneida Indian Nation, Onondaga Nation, Saint Regis Mohawk Tribe, Seneca Nation of Indians, Shinnecock Indian Nation, Tonawanda Seneca Nation, Tuscarora Nation, and Unechoing Indian Nation. The United States formally recognizes all but Unechoing Indian Nation. The State of New York recognizes all nine Nations. Indigenous Nations are sovereign governments with their own respective governance structures and policies. Additionally, Indigenous Nations are included in the State's definition of DACs.[49] New York State is working to collaborate with Indigenous Nations regarding shared climate and energy priorities while respecting different approaches according to each Nation's policies, processes, and protocols.

4.3. Support Economic Growth and Competitiveness

4.3.1. AFFORDABLE AND ABUNDANT ENERGY

Access to reliable and affordable energy is essential to attract and develop strategic industries and to support continued economic growth, including the creation of new jobs. New York benefits from a variety of features that make it competitive for future economic development, including a skilled and educated workforce, a thriving research and innovation network, access to capital, transportation infrastructure, and plentiful water and land. Recent commitments to New York from industries as diverse as semiconductors and agribusiness show the range of sectors in which the state offers an attractive setting for business investment. These industries are typically energy-intensive and require access to reliable and affordable energy, including electricity and natural gas. It is likewise important to offer businesses long-term energy cost stability and affordability.

For business and industry in New York, energy cost as a portion of total business costs varies across economic sectors (see Section 2.4.3), and so does the impact of energy cost on competitiveness. The State is attentive to the differing impacts of energy and environmental policies for different types of New York businesses. While the State will continue to pursue general energy affordability for all economic sectors, energy-intensive and trade-exposed businesses merit focused attention to safeguard economic competitiveness. These are generally manufacturing businesses, with certain industrial sectors experiencing greater costs than others.

State economic development efforts provide complementary support for maintaining competitiveness and localizing clean energy supply chains. Identifying and developing power-ready sites to help meet the needs of large energy users is a key tool for attracting new industry, including clean energy leaders.

4.3.2. CLEAN ENERGY CHOICES

In addition, State clean energy programs are available to partner with new and existing businesses, government and institutional buildings, industrial energy users, and farms to advance cost-effective energy efficiency and electrification projects. In the near-term, technical assistance and targeted financial support are key State actions to reduce the upfront cost of clean energy options for non-residential energy users. Over the medium- and long-terms, new and emerging technologies will expand the options for decarbonization of large existing buildings, high-heat industrial processes, and other large energy users.

4.3.3. WORKFORCE DEVELOPMENT

As of 2024, over 326,000 workers are employed in New York's energy sector. More than half of these workers make up a mature and steadily growing clean energy workforce. Public and private investments into clean energy projects and workforce training have enabled New York's clean energy workforce to grow by 31 percent since 2015. With continued investments, growth is expected over the course of this plan.[50]

The clean energy transition provides substantial employment opportunities for New Yorkers. To support high quality jobs and local economic benefits, this Plan calls for continued investment in workforce development initiatives coupled with labor standards. It further recommends State support for training, outreach, and related wraparound services to increase equity in job access for workers who are from disadvantaged communities, veterans, displaced fossil fuel workers, and other priority populations.[51]

4.4. Advance Innovation

As discussed throughout this Plan, innovation helps reduce the cost of and increase the variety of energy technologies and services. State support for energy innovation (RD&D and commercialization) plays an important role in catalyzing the development and commercialization of technologies that help enable New York's energy transition.

Strengthening partnerships across New York's innovation ecosystem will foster economic development, create jobs, and provide greater leverage for State investments. New York is one of the leading clean energy innovation hubs in the country thanks to the strong, mutually beneficial partnerships across State agencies, universities, and the private sector—with the State as a critical anchor and coordinator.

Notably, the State University of New York (SUNY) system is a nationally recognized leader in clean energy research and innovation, with among the largest university-owned clean energy patent portfolios in the country, offering top-notch education and workforce development across 64 campuses, and as the host to large-scale clean energy demonstration projects.

4.5. Continue Progress Toward Decarbonization and a Clean Energy Economy

4.5.1. PLACE NEW YORK'S CLEAN ENERGY TRANSITION ON A SUSTAINABLE FINANCIAL FOOTING

New York State invests public resources to catalyze the state's clean energy transition. New York's electric ratepayers have provided significant resources via programs such as the Regional Greenhouse Gas Initiative (RGGI), the CES, the Clean Energy Fund (CEF), utility-administered programs for energy efficiency and electrification, and others. These programs have delivered critical progress and benefits that included energy savings; avoided GHG emissions and air pollution; and improved energy independence, greater resource diversity, and more, making the investments worthwhile for ratepayers and the state as a whole. Other funding sources include federal funding, direct State appropriations, the Environmental Bond Act, and the recently enacted Sustainable Future Program. These public dollars contribute to building decarbonization (including EmPower+, Clean Green Schools, thermal energy networks [TENs], and energy efficient appliances), zero emission transportation (including electric school buses, Charge Ready NY, and more), renewable energy, and other efforts.

New York State also mobilizes private investment into underserved clean energy sectors. NY Green Bank, a division of NYSERDA, identifies investment opportunities to bridge financial gaps and incentivize private capital participation in developing clean and renewable energy infrastructure. Through targeted investments, NY Green Bank and NYSERDA leverage market policy mechanisms to supplement State investments and maximize the efficient use of ratepayers' dollars, further accelerating the deployment of clean energy infrastructure, and incentivizing the adoption of energy efficiency, electrification, and clean transportation.

In addition to expanding access to risk-adjusted capital, New York State also supplements state and federal investments by further expanding access to low-cost financing and credit enhancements, aimed at mitigating consumer credit risks and reducing the long-term costs of financing the adoption of clean and energy-efficient infrastructure and technologies. By partnering with specialized financial intermediaries, credit unions, and community development financial institutions, NY Green Bank and NYSERDA continue to support all market participants with financing and direct financial support.

This Plan recognizes the benefits that a clean energy transition will provide and that securing these benefits is likely to require policy reforms described in this Plan paired with strategic investments to catalyze greater adoption. While ratepayer-funded programs will continue to provide an important building block, it is not feasible to continue increasing the number and scale of programs that electric ratepayers need to fund. Doing so would run contrary to the State's long-term commitment to energy affordability and ultimately would create a disincentive to the adoption of zero-emission end-use equipment such as electric cars, trucks and buses, and heat pumps.

New York's energy transition needs to be on a sustainable financial footing to secure wide benefits. Federal funding and permitting are essential to this objective. The State should continue to evaluate the role of market-based policy mechanisms (including RGGI, the New York Clean Air Initiative, and a clean transportation standard), which both provide a price signal to encourage clean energy choices and generate dedicated sources of funding that can be used to lower the cost of clean energy adoption and for affordability investments. Other promising options include supportive State tax policy and continued advancements in financial, lending, and insurance strategies to leverage private capital. It is possible that these and other strategies may be used in combination to maximize benefits and unlock the greatest opportunities.

Extending the reach of public investments with financial strategies that boost the availability of private capital is essential to catalyze action at scale. New York State should continue to support and partner with insurance and re-insurance companies to adapt and develop new

products aimed at mitigating risks associated with project completion, cost-overruns, long-term revenue performance, supply-chain constraints, residual value, and performance of new technologies. These products, coupled with climate premium credit programs, adaptive pricing, and climate impact reserves, could catalyze the clean energy transition by reducing financial risks and their associated costs, further unlocking private capital participation and supplementing state investments and direct financial support. For example, the availability of Residual Value Reserves may lead to a substantial reduction in the cost of leasing EVs and energy storage systems, incentivizing the expansion of secondary markets and the adoption of third-party ownership business models. Similarly, the availability of cost-overrun insurance may further reduce the overnight cost of capital-intensive energy infrastructure projects, implicitly mitigating completion and technology risks, and potentially increasing the availability of low-cost debt financing.

4.5.2. PLAN FOR ACCELERATED ACTION IN THE 2030S

Projections incorporated into the core planning case developed for this Plan represent an ambitious but achievable pace for energy transition over the next fifteen years. In the 2030s, this planning case envisions achieving 100 percent ZEV sales—a tenfold increase from 2024; heat pumps becoming the primary residential space heating choice made by consumers as they replace aging appliances; continued deployment of renewable energy alongside substantial forward progress in developing clean firm resources; increased use of waste-based alternative fuels replacing fossil fuels; and more. Measured on a like-for-like basis, the scale of energy transition and emission reductions embedded in this scenario would put New York among the leading jurisdictions globally. Achieving this level of transition will require effective implementation of the policies New York State has already enacted as well as additional actions, many of which are incorporated in this Plan, and would require support from the federal government.

Setting New York on track in the 2030s toward long-term Climate Act targets would require further policy actions, along with the development and commercialization of a number of new technologies. Incorporated below are a range of technologies and policy categories that would be needed to further accelerate the pace of energy transition above the core planning scenario. While the list below is not exhaustive, evaluating these at a minimum will be necessary over the balance of this decade to understand how and whether they should be pursued by the State in the 2030s. As the State evaluates these items, it should weigh their costs and benefits, informed by robust input from stakeholders and the public, to understand whether they are appropriate for New York and to consider whether modifications or alternatives may be preferable.

Technologies. Numerous technologies will be necessary to address end uses that today rely on fossil fuels with few available alternatives or only expensive ones. These technologies are at various places in their maturity, but each of the below needs either substantial innovation or rapid commercialization to meaningfully contribute to the energy transition. Focused attention on these technologies by the State can help address gaps in available clean energy solutions and their costs.

- Solutions to address residual emissions and energy demands in difficult to decarbonize sectors:
  - **High heat/high energy density** solutions including hydrogen clusters, nuclear, and electric furnaces and heat pumps for industrial applications.
  - **Negative emissions technologies.**
- Carbon capture and storage (CCS), in particular to address emissions likely to remain in the long-term in the industrial sector.
- Expanding clean energy solutions for difficult to address market segments:
  - **Clean heating and cooling product innovation** to lower costs and barriers to installation in existing buildings, especially for multifamily and other large buildings, paired with building shell and thermal storage solutions for higher efficiency and load flexibility.
  - **Zero emission options for heavy duty and long-distance freight,** including battery EVs paired with grid-integrated technologies to manage electricity system impacts and hydrogen fuel cells.
- Expanding the diversity of clean energy sources available to New York:
  - Expand hydrogen sourcing beyond **electrolysis,** including thermal hydrogen and hydrogen produced from waste products, to reduce electricity system impacts from production.
  - **Sustainable aviation fuels (SAF)** including a rapid expansion of commercialization and availability and expanded authority for higher blend rates.
  - **Nuclear, especially advanced nuclear options,** to provide zero-emission, firm generation.
  - Additional electricity system resources to support flexibility and reduce the need for high-cost resources, including **virtual power plants and long duration energy storage.**
- Grid modernization technologies that improve the grid's performance, increase resiliency, and help avoid unnecessary transmission buildouts, including hybrid transmission and storage solutions, expanded integration of dynamic line ratings and power flow control devices, virtual power plants, and long-duration energy storage.

Policy categories. Given the significant level of long-term emissions reductions outlined in the Climate Act, the stringency of which is amplified by New York's unique emissions accounting system, the State should continue to evaluate a range of policies to improve the economics of the energy transition, create standards for the pace of transition, and promote efficient use of energy across the economy. Policies should be evaluated for their costs and benefits, with a careful eye to implications for disadvantaged communities and LMI households. These policies may need to take into account changes in the federal government's policies and regulations. While the policy categories below or comparable alternatives are likely necessary to further accelerate the pace of energy transition in the 2030s toward the State's long-term energy goals, they are complex and would have substantial implications for citizens and businesses in New York. These concepts would need to be carefully evaluated to determine whether they should be adopted and, if so, how to manage policy design to maximize benefits, reduce disruption, and promote the affordability and reliability of energy supply.

- **As the electric grid decarbonizes,** require a transition to electric technologies with priority focus on neighborhood-scale interventions.
- **Financial and operational transition strategies** for the gas system to manage cost impacts associated with reduced system utilization while ensuring continued availability for remaining residential, commercial, and industrial customers.
- **Building energy performance standards** that would apply to defined categories of buildings, such as buildings over a certain size or rental apartments.
- **Performance standards, portfolio standards, or other approaches to increase penetration of alternative fuels** including sustainably sourced renewable diesel, RNG, and clean hydrogen to address residual combustion in industrial, transportation and building sectors, and SAF to address aviation needs.
- **Policy interventions including financial incentives to accelerate the adoption of zero-emission medium- and heavy-duty (MHD) vehicles,** potentially including measures that support early retirement of high-emitting and low-efficiency vehicles.

5. Planning Objectives and Guidance for Energy-Related Actions

This section offers objectives, strategies, and recommended actions to advance New York's clean energy transition consistent with the State Energy Law and the Vision set forth in Section 4.

5.1. Responsibly Advance Clean and Reliable Energy Resources

An abundant and diverse mix of clean energy sources increases the resource diversity of the energy system, offering economic and reliability benefits, and provides important environmental and public health benefits from reducing the use of fossil fuels. Multiple challenges need to be overcome to deploy the level of clean energy supply resources required to meet demand and preserve reliability in a low-carbon economy. While there was previously a sustained trend of decreasing costs for clean and renewable energy generation, that trend has reversed in recent years through the combined impacts of inflation, supply chain constraints, and, more recently, tariff uncertainty. There are also indications that the domestic supply of skilled workers will be constrained as New York and other states ramp up their renewable energy programs.

To support and advance the future development of renewable energy projects that are compatible with agricultural lands and forests, it is important to execute further assessment

and to continue engagement with relevant stakeholders and facilitate the integration of smart siting practices.

5.1.1. ACCELERATE THE DEPLOYMENT OF CLEAN ENERGY RESOURCES TO MEET ENERGY NEEDS

New York State continues to ensure the safety and reliability of its electricity system through a range of energy resources. This includes State support for the deployment of clean energy resources including LSR, distributed and community solar, and existing clean firm capacity resources to meet demand and preserve reliability. The State's CES encompasses multiple programs that support the development of new renewable generation as well as the maintenance of existing clean energy resources. NYSERDA is also advancing LSR generation through its OSW and Build-Ready programs. The NY-Sun program provides incentives to support the installation of distributed solar. NY-Sun achieved a statewide target of installing 6,000 MW of distributed solar early, in 2024, and it is on track to install 10,000 MW of distributed solar by 2030. New York has also become the nation's largest community solar market. In 2024, the PSC adopted a Statewide Solar for All program to further accelerate the development of distributed solar and energy storage projects while providing an additional bill credit to electric customers participating in the utility-managed Energy Affordability Program. Programs across multiple energy generation and DERs support the State's energy goals.

The State will continue to strategically navigate challenges that are affecting the pace of progress, including siting challenges and federal policy uncertainty. The 2024 Renewable Action through Project Interconnection and Deployment (RAPID) Act established the Office of Renewable Energy Siting and Electric Transmission (ORES) under DPS as the State's one-stop-shop for reviewing, permitting, and enforcing permit requirements for both major renewable energy generation and transmission facilities. At the federal level, H.R.1. (signed July 4, 2025) changed project eligibility for the Clean Electricity Investment Tax Credit and Clean Electricity Production Tax Credit. Many renewable energy projects will no longer be eligible for these credits beginning in the late 2020s and through the early 2030s, which will directly increase the cost to develop these projects.

Recommendations

- Support large-scale renewable development and increased clean energy supply by continuing clean energy procurements and leveraging additional recommendations from the CES Biennial Review process.
- Continue to build-out distributed solar through NY-Sun to achieve the statewide 10 GW target. Further leverage Statewide Solar for All as a cost-effective way to drive

additional development (above the 10 GW target) while maximizing benefits for low-income New Yorkers. Also continue to support the state's successful solar energy industry through the Value of Distributed Energy Resources (VDER) tariff and ongoing efforts to lower barriers to entry through interconnection reform.
- Ensure the effectiveness of the RAPID Act with respect to the pace of additions and local community engagement. ORES should continue to work with communities toward the timely and efficient siting of renewable energy facilities.
- Support strategies that expedite and streamline development including advancing Clean Energy Zones and leveraging NYPA's expanded authority to build renewable energy generation resources.
- Continue to support workforce development including by directing efforts to those in disadvantaged communities and fossil fuel workers transitioning to clean energy jobs.
- Continue to evaluate the State's existing clean firm capacity resources since they will be critical to achieving a zero-emissions grid.

5.1.2. ADVANCE DEMAND-SIDE SOLUTIONS AND FLEXIBLE RESOURCES

Leveraging demand response and harnessing the ability of flexible resources (as well as energy efficiency) to lower energy demand can reduce the scope and costs of infrastructure buildout. The New York PSC initiated the Grid of the Future (GOTF) proceeding in April 2024 to develop and maintain a plan that encourages investment in flexible resources to reduce infrastructure and operational costs, improve system reliability, and increase customer benefits and bill savings.

Energy storage enables the state to use existing resources more efficiently and helps to ensure energy is available when it is needed most. In June 2024, the PSC increased the Climate Act target of 3,000 MW of energy storage to 6,000 MW of energy storage by 2030 and established an interim target of 1,500 MW by 2025. Progress toward these targets is ongoing.[52] The Inter-Agency Fire Safety Working Group, with leadership from DHSES, Office of Fire Prevention and Control, NYSERDA, DEC, DPS, and New York State Department of State (DOS), has guided New York State toward the adoption of some of the nation's most robust safety standards for energy storage systems, reinforced by stringent oversight and independent third-party review.[53]

Recommendations

- Improve integration of flexible resources into grid planning and grid operations.
- Continue to evaluate the contributions of longer duration storage to enhance the reliability of the electric grid.
- Investigate opportunities for flexible resources to provide grid-forming capabilities.

- Identify opportunities to enhance energy efficiency and managed electrification measures and other building upgrades.
- Continue to lead the nation in energy storage safety.

5.1.3. SUPPORT EXISTING NUCLEAR GENERATION AND EXPLORE NEW TECHNOLOGIES

Nuclear energy provided 21 percent of in-state bulk electrical generation in 2024, and nuclear generation has been a reliable and zero-emission electricity source in New York State for decades. The current nuclear facilities are supported, in part, by the Zero Emission Credit (ZEC) program. The ZEC program, established in the Order Adopting a CES in 2016, provides a credit to existing nuclear facilities for their zero-emissions environmental attributes to enable their continued operation. Consideration of the future of the ZEC program is underway. In the ZEC program Extension Proposal released in July 2025, DPS staff propose the continuation of the ZEC program through 2049 and continuation of the current ZEC formula and cost recovery methodology (with some updates).[54]

Nuclear energy is expected to continue to play an important role in providing clean firm generation. Nuclear energy is entering a new phase of technological advancement and deployment opportunities, with performance characteristics that align with the scale of emerging energy needs. Advanced nuclear technologies are rapidly emerging with significant improvements in modularity, scale, and safety. However, many of these technologies still need significant research, development, and deployment, resulting in uncertainty in costs and timeline.

Recommendations

- Continue the ongoing evaluation of the extension of the ZEC program, and conclude this evaluation prior to any federal relicensing application deadlines, to ensure the continued operation of the existing nuclear fleet to contribute to climate goals and help maintain fuel diversity and fuel security. Any extension should be done with ratepayer protection in mind, in addition to the reliability needs of the grid. Also, identify and support safe and economic power uprate opportunities at existing nuclear facilities.
- Through the Master Plan for Responsible Development of Advanced Nuclear in New York, which has been underway since January 2025, continue to examine key considerations for advanced nuclear for long-term planning. The Master Plan process should examine the key issues raised by the January 2025 Blueprint for Consideration of Advanced Nuclear Technologies and develop recommendations for implementation of advanced nuclear technologies in the State.

- Through New York State leadership of the First Movers Initiative and other initiatives, continue to pursue multi-state collaborations to support economies of scale and de-risk new nuclear development, such as collaboration to help build out an advanced nuclear reactor orderbook, supply chains for construction of new reactors, and a trained workforce.
- Through NYPA's efforts to develop at least 1 GW of nuclear power generation and other actions, continue to pursue opportunities for early deployment action. Early deployment action should be undertaken in coordination with the Master Plan process and reflecting collaboration with other states to ensure that any deployment commitments leverage the insights and benefits from those initiatives.

5.1.4. ADVANCE STRATEGIC AND RESPONSIBLE USE OF LOW-CARBON ALTERNATIVE FUELS

Zero- and low-carbon alternative fuels, such as hydrogen, RNG, renewable diesel, SAF, and synthetic fuels, are an important complement to electrification in the State's energy transition strategy. Zero- and low-carbon alternative fuels are particularly useful in helping to decarbonize hard-to-electrify end-uses where continuing to use liquid or gaseous fuels may be necessary. These end uses could include high-heat industrial processes, supplemental and district heating, long-distance heavy-duty trucking, aviation and other non-road applications, and power generation. A recent assessment found that hydrogen, RNG, and renewable diesel (among other technologies) all could provide clean firm power to the New York State grid by 2040 but will have limited supply and high costs that require limiting use in the electricity sector to times of most extreme need.[55]

Recommendations

- In cases where electrification and zero-emission solutions are impracticable due to technological, safety, cost, or reliability constraints, low-carbon alternative fuels should be prioritized for end uses where they can deliver the greatest GHG emissions reductions with the lowest cost and environmental impact. Their use should ensure net reductions in co-pollutant emissions and avoid disproportionate impacts associated with such emissions where possible.
- New York State should prioritize the use of waste-based, locally sourced feedstocks for fuels production. Recognizing the limits of waste-based and in-state supplies, the State should remain open to regionally sourced and other low-impact feedstocks that advance global GHG reductions, with a continued emphasis on minimizing land use and environmental impacts.
- To meet State policy goals, alternative fuels will need to be produced, transported, and used in the broader energy system. The blending of hydrogen into existing

natural gas pipeline infrastructure remains untenable due to safety, integrity, and indoor air quality concerns.

- Alternative fuels and their associated GHG emissions should be strategically managed and accurately tracked as they move from production locations, both in- and out-of-state, to end-use to ensure the realization of GHG emissions reductions. Policies and tracking systems should balance rigor with feasibility to accelerate alternative fuel deployment. To claim the use of an alternative fuel, along with the associated emissions reductions, there should be a physical and contractual path linking the source of the fuel and its use location in New York.
- Life cycle analysis can inform fuel selection and State policies and programs but under State law cannot replace Climate Act Accounting which determines the amount of GHG emissions reductions from alternative fuel use that count toward New York's statutory emissions targets.

5.1.5. IDENTIFY AND INTEGRATE CLEAN FIRM TECHNOLOGIES INTO THE ELECTRICITY SYSTEM

The State will need to be strategic in identifying and integrating clean firm technologies that have the attributes necessary to support a zero-emission electric system. DPS Staff issued a November 2024 whitepaper proposing definitions of relevant terms, which is currently under consideration by the PSC.

NYSERDA, in partnership with the Electric Power Research Institute, completed in October 2025 a Zero by 40 Technoeconomic Assessment to inform the state's approach to new clean firm resources that could help reduce the potential gap between electricity demand and supply in 2040 and beyond. The study evaluates performance attributes, readiness for 2040, emissions, costs, and other considerations for each of the following technologies: hydrogen, biofuels including RNG and renewable diesel, advanced nuclear, advanced geothermal, CCS, long duration energy storage, and virtual power plants. It provides a resource for the State's ongoing assessment of viable clean firm technologies, to be conducted in conjunction with multiple State agencies. The assessment further identifies several key actions that could facilitate the readiness of these resources to achieve the scale needed for 2040, as reflected in the recommendations that follow.

Recommendations

- Be strategic in identifying and integrating clean firm technologies that have the attributes necessary to support a zero-emission electric grid. This includes taking the following actions in New York:

- Pursue a diverse set of resources, including grid-enhancing technologies to minimize the risk of overreliance on individual technologies.
- Conduct grid modeling to understand tradeoffs of relying on different resources
- Invest in innovation to enhance resource viability, and engage early with technology developers, end users, and other stakeholders to increase the likelihood of technology readiness by 2040.
- Conduct a regular assessment of options and remain flexible as new technology options come online.

5.1.6. MANAGE THE PACE OF COMBUSTION UNIT RETIREMENTS TO MAINTAIN RELIABILITY

New York's generation fleet is aging, the rate of renewable deployment is uncertain, reliability margins are shrinking, and significant levels of large loads are being added. Due to these factors, the State will need to be strategic about the pace of combustion unit retirements and/or replacements as it works toward its clean energy goals and to meet reliability needs as quickly and cost-effectively as possible. Combustion-generating units will remain essential parts of electric grid reliability and affordability, and the retirement of these units will not be able to occur until resources that provide the same grid reliability attributes are put in place. New York will seek to carefully manage the retirement of existing assets and evaluate whether there is a need to invest in their repowering or in new generation that is compatible with long-term policy targets. This is the case even as New York seeks to first prioritize the continued expansion of clean energy resources, transmission upgrades, increased energy efficiency, integration of DERs, and growth in demand response participation.

5.2. Modernize Energy System Infrastructure, Planning, and Markets

Modernizing New York's energy system infrastructure, planning, and operations is essential for energy to continue to be delivered with high levels of reliability and resilience. As discussed in Section 4, it is important to make these upgrades in a strategic and cost-effective manner.

5.2.1. ENSURE NEW YORK'S ENERGY SYSTEMS ARE SECURE AND RESILIENT

New York State is well prepared to respond to energy system hazards and emergencies via multi-level and multi-agency energy preparedness, response, and mitigation activities in coordination with industry. As climate change, aging systems, new energy demands, and the

energy transition introduce new and evolving risks to energy systems, New York's energy security planning and emergency response practices need to keep pace. Notably, future energy system investments must be designed to withstand the impacts of a changing climate and more extreme weather events.

Recommendations Across Sectors

- Continue to prioritize energy emergency preparedness and support multi-level, multi-agency energy emergency management in the State. Support related emergency planning and the implementation of response and mitigation efforts with relevant stakeholders.
- Continue applying risk- and threat-based assessment to monitor, evaluate, and respond to the changing risks and threats in New York's evolving energy system.
- Consider and identify critical infrastructure or supply points for the delivery of fuels to end-users, including in the unregulated delivered fuels system. Identify any areas of concern that may need additional support to maintain reliability and resiliency.
- Undertake additional research on climate hazards with higher uncertainty, such as changes in storm intensity, winter weather, and extreme precipitation, and impacts on energy systems.
- Conduct research on performance and effectiveness of emerging resilience and adaptation technologies for the energy system, particularly under changing climate conditions.
- Study and plan for vulnerabilities, such as through the Utility Climate Vulnerability Studies and Resiliency Plans and planning for extreme heat protections.

Recommendations for the Electricity and Gas Systems

- For the electricity system, continue to incorporate the impacts of climate change into future reliability planning scenarios. Further consider whether the current reliability-related metrics should be supplemented given the evolving nature of the grid and the increased risks of high-impact reliability events. Establishing criteria for metrics like expected unserved energy (EUE) may help supplement traditional criteria based on loss of load expectation (LOLE) by providing information about risks of long-duration outages.
- Gas utilities and planners should adopt a comprehensive perspective on gas system reliability, informed by the best available climate science, ensuring that utilities are prepared to meet peak needs and are able to continue providing service even in the event of potential disruptions to gas supply from individual points of failure.

- For the natural gas system, continue winter reliability and preparedness planning, enforce compliance with pipeline safety regulations, and ensure installation of on-system safety devices.

5.2.2. ADVANCE STRATEGIC PLANNING TO UPGRADE AND MODERNIZE ELECTRICITY TRANSMISSION AND DISTRIBUTION INFRASTRUCTURE

The State will continue to advance smart and strategic energy system planning to enhance system reliability and drive down the cost of necessary transmission and distribution system investments. These planning efforts are particularly important considering the anticipated economic development-driven load growth and long-term electrification of transportation and buildings.

Ongoing, multi-year State planning includes the CGPP and the Proactive Grid Planning Proceeding. The NYISO leads the Public Policy Transmission Planning Process and regular reliability planning, notably through its RNA and Comprehensive Reliability Plan. Energy planners also pursue efficiencies through enhanced interregional planning and collaboration on multi-state projects and with federal agencies, like what is being done through the Northeast States Collaborative on Interregional Transmission.

Recommendations

- Continue to ensure the state's planning processes provide actionable information for decision-makers regarding future system needs and cost-effective solutions.
    - Continue to strengthen collaboration between State agencies, NYISO, and utilities to enhance the Coordinated Grid Planning Process in future cycles and improve the coordination of distribution and transmission planning under the CGPP.
    - Continue progress toward the adoption of cost-saving advanced transmission technologies.
    - Enhance interregional coordination
- Continue collaborative efforts to address interconnection costs and processes.
- Consider new transmission and distribution system cost-allocation options.
- Pursue integrated system planning for both the electric and gas systems, as further elaborated in Section 5.2.5.
- In planning processes, consider the strategic location of generation and energy storage and evaluate battery storage as a transmission asset.

5.2.3. EVOLVE ELECTRICITY MARKETS AND RATES

To maintain reliability while promoting affordability, wholesale electricity market reforms are needed to appropriately value energy, capacity, reliability, reserves, and balancing services. The expected changes in the composition of electricity supply warrant consideration of how wholesale electricity markets can attract and retain an economically efficient portfolio of resources to continue to meet all system reliability needs, particularly in 2040 and beyond. The State should continue to work with the NYISO and market participants to investigate the opportunities to evolve current markets and rules over time.

New compensation structures and retail rates can also better incentivize active participation of load in markets, including flexible resources that provide grid resiliency, improve grid reliability, and drive down costs. Retail rates should allocate costs to customers in a way that avoids an inequitable cost shift to any non-participating customers while enabling the adoption of DERs.

Significant investments in the electricity system will be made in the coming decades. This Plan places emphasis on strategies and actions that the State can take to ensure that the investments are cost-effective for New York residents and businesses. The PSC and DPS work to ensure access to safe, reliable utility service at just and reasonable rates. New York employs performance-based regulation, which shifts electric and gas utility incentives from traditional cost-of-service models to performance metrics, and State regulators should continue to monitor and consider performance-based approaches to advance energy affordability and related policy goals. New York State is also advancing energy affordability through consumer protection efforts at DOS, including the Utility Intervention Unit's work to represent consumer concerns in utility rate cases, and via the PSC's EAP and EEAP and State and utility-administered incentive programs that help households and businesses adopt clean energy choices.

Recommendations

- Assess whether the current capacity market construct sends the proper incentives for the portfolio of resources that will be needed to support resource adequacy as the State transitions to a zero-emission grid.
- Explore how to support a glide-path to a zero-emission grid, such that technologies with the attributes needed to maintain reliability in 2040 are incentivized to be online and operational in the years leading up to 2040.
- Evaluate whether the current mix of ancillary services (and future planned changes from NYISO, i.e., Dynamic Reserves and Uncertainty Reserves) is adequate through 2040 and beyond.

- Examine additional reliability attributes that are not currently compensated through competitive market products, and identify a pathway for ensuring that future portfolios maintain these attributes.
- Identify additional planning or operational rules that should be further examined and potentially adjusted to support a zero-emission electric system. An example would be to examine the loss of source limitations that constrain the sizing of OSW transmission networks.
- Examine the role of electricity rates and program incentives to enable the deployment of DERs and flexible resources.

5.2.4. ADVANCE LONG-TERM GAS PLANNING AND INTEGRATED GAS AND ELECTRIC PLANNING

Declining gas system utilization—driven both by State policy and by market forces such as the availability of economically and technically viable substitutes for gas—is expected to put upward pressure on retail rates and bills, threatening affordability especially for low-income customers. This dynamic also poses risks for gas utilities and other gas sector businesses, including an increased risk of stranded assets. Enhanced gas planning practices are needed to help address these significant challenges, especially by enabling safe and strategic reductions in gas system investment while maintaining reliability and affordable energy.

Recommendations

- Continue to require New York's gas utilities to produce long-term plans and refine the LTP process and substantive requirements based on input from DPS Staff, NYSERDA, and stakeholders. In future LTPs, the PSC should require gas utilities to identify areas where the gas system will be necessary in the long-term and prioritize investment in those areas over others.
- Build on past progress to further advance integrated planning. This would include directing gas and electric utilities to develop standardized, locationally specific, and transparent joint planning practices that enable optimized energy system investments. Early efforts may focus on areas where gas and electric service are provided by the same company to ease integrated planning.
- Promote the development of data sets and analytical tools that can support integrated planning. These may include locationally granular forecasts of gas and electric system peak demand, models that link gas hydraulic analysis and electric power flow modeling, and tools that map physical components or assets of the natural gas and electric systems.

- Continue to advance investments in non-pipe alternatives (NPAs). Relatedly, the PSC should direct utilities, with support from DPS and NYSERDA, to develop planning tools and practices to enable the successful identification and deployment of NPAs to avoid investments in system extension, capacity expansion, and pipe replacements.
- The PSC should continue to direct utilities to prioritize lower cost alternatives to pipe replacement such as pipe repair and re-lining, where safe and technically feasible. DPS and NYSERDA should work with utilities to support innovation and commercialization of technologies that enable cost-effective pipe repair and re-lining.
- Gas utilities should evaluate whether their planning and investment standards properly balance reliability and affordability. Among other considerations, gas utilities' design day conditions should be informed by the best and latest available climate science, and design day demand calculations should be transparent and reflect up-to-date assumptions regarding usage per customer, including the impact of demand reduction measures. Gas utilities should continue to collaborate with relevant State agencies to assess whether their planning practices adequately account for risks of disruptions to their supply sources and, if necessary, update their planning standards. At the same time, gas planning should incorporate a comprehensive view of reliability, including ensuring the system is available to continue to provide needed service even if individual components fail.

5.3. Pursue Local, Regional, and Federal Government Collaboration

Continued collaboration among local, regional, Indigenous Nations, State, and federal entities is critical to New York's clean energy transition. Consistent communication and coordination across all levels of government enable partnerships to pursue shared clean energy goals, amplify impact, and support benefits for New Yorkers and those directed towards disadvantaged communities. Intrastate and intergovernmental collaboration further facilitates energy planning that is sensitive to regional characteristics, including with respect to differences in priorities and access to resources.

5.3.1. SUPPORT LOCAL CAPACITY TO INTEGRATE CLEAN ENERGY INTO LOCAL LAND USE PLANNING

Integrating renewable energy into local land use planning and zoning can result in more coordinated opportunities to produce and store energy and enhance community resilience. State agencies including DOS, DPS, NYSERDA, New York State Agriculture and Markets

(AGM), and the New York State Department of Transportation (DOT) are coordinating to continue delivering tools and resources that support local planning efforts.

In the area where an energy project is developed, such as a large-scale solar or wind farm, the host community is directly impacted by the project in both positive and negative ways. Many large-scale clean energy programs identify mechanisms that provide local benefits to host communities.

Recommendations

- Continue to develop local land use best practices, tools, and model local regulations for planning for and appropriate siting of renewables, battery storage, EV charging stations, and clean DERs. Provide additional educational opportunities for municipal officials, local leaders, and residents to understand the benefits of clean energy facilities, including job opportunities and meaningful coordination with host communities.
- Enhance technical assistance, data, outreach, and education on minimizing impacts of renewable energy siting on natural and working lands. Notably, continue State support for localities on solar siting and agricultural lands, including to identify and prioritize productive dual-use strategies on farmland. Integral to these efforts, continue State agency collaboration with farmers, solar developers, community members, academics, and other stakeholders.
- Collaborate with regional planning boards and counties to help localities plan, zone, and review renewable energy projects, including tools for assessing appropriate locations.
- Continue to research and share best practices for developing host community project benefits, to build on and strengthen existing efforts that support host communities to benefit from energy projects in transparent, inclusive, and locally responsive ways. Compile findings into a Best Practices Guide for community benefit agreements (CBAs), which could be used to support host communities in discussions with project developers and assist State entities in implementing programs where CBAs may apply.

5.3.2. STRENGTHEN COLLABORATION ACROSS ALL LEVELS OF GOVERNMENT

New York State should continue to seek intrastate and intergovernmental collaboration in the energy sector, including partnerships that lower the overall cost of New York's clean energy transition, promote economic growth, deliver health and environmental benefits, and enhance community resilience.

Recommendations

- Develop State capacity and engagement strategies that support cross-border issues of energy planning with Indigenous Nations. Building upon ongoing efforts, State agencies should build internal capacity and clearly articulate approaches to government-to-government consultation and engagement with Indigenous Nations within energy planning processes. This should address capacity building to remove barriers to accessing program resources and support Indigenous Nations and Indigenous Peoples to participate in and benefit from energy sector planning. Continue to leverage regional partnerships to promote strategic investment, innovative technologies, accelerate adoption, and expand clean energy workforce opportunities. These are common themes across sectors (including electricity, buildings, transportation, and others).
- Seek opportunities for federal partnerships and collaboration across all levels of government and industry. The State also should advocate for its interests at the federal level by seeking flexibility in policies that preserve state sovereignty in energy decision-making and take into account New York's unique structures, processes, and needs.
- Support accessibility to energy and climate data to support informed planning and decisions at all levels of government. With federal shifts in policy and resources, the State should continue collaborating with external partners to provide transparent data and reporting on health, environmental, and economic outcomes of the clean energy transition.

5.4. Deliver Abundant Energy Services for Economic Competitiveness

Unprecedented growth in energy demand for the industrial sector is expected in the coming years. State agencies should continue to collaborate to ensure that reliable, affordable power can be provided to the sector in a way that supports economic competitiveness as well as local communities and that aligns with the State's energy goals. Supporting economic development opportunities in the clean energy sector will further promote job growth and investments, while also localizing supply chains, reducing costs, and ensuring the availability of clean energy products.

Industrial facilities can bring jobs and economic growth to communities but also increased fuel combustion and pollution. The State should prioritize public investments that benefit

disadvantaged communities, and work to promote energy efficiency and low-emission technologies.

5.4.1. MEET THE GROWING ENERGY NEEDS OF INDUSTRY AND OTHER LARGE ENERGY USERS

Energy demand from industry is expected to grow, especially from new high-tech and energy-intensive industries. Continued State coordination and investments in reliable, clean, and affordable power are needed.

Data centers are projected to be a major driver of new industrial load. Planning considerations for large data centers are complex, as uncertainty exists around their location, long-term energy consumption, and demand flexibility. In general, expanding the electric customer base should bring in new utility revenue and spread system costs over a larger rate base. But the size of new large industrial users has raised concerns of ratepayers subsidizing these industries. New York's interconnection process for new large loads is designed to fairly allocate energy system build-out or upgrade costs to the user that necessitates such costs, consistent with "beneficiary pays" cost-causation principles.[56] The State will continue to work to align electricity market structures with the emerging dynamics of large loads and broader policy goals.

Recommendations

- Continue to advance interagency coordination and planning on generation and transmission infrastructure investments.
- Continue to pursue new rate designs and demand-side programs that provide competitive utility rates, reduce the cost of industrial electrification, and incentivize reduced or flexible usage of energy. Consider rate designs that differentiate charges based on peak and off-peak usage; incentivize flexible usage, including on-site energy generation; and value the storage and/or recycling of thermal energy.
- Leverage opportunities to stimulate the development of clean, firm energy supply by developing partnerships with energy intensive industry to explore the development of clean energy resources.
- Examine opportunities and challenges presented by emerging energy intensive subsectors, including data centers, to best accommodate new load while balancing State policy goals and targeted support to industries that create wider community, economic, and workforce benefits.
- Consider additional tools to assess risks and minimize system costs from new large loads, including revisions to interconnection processes or new cost-recovery mechanisms.

5.4.2. ATTRACT LARGE EMPLOYERS IN STRATEGIC INDUSTRIES TO NEW YORK STATE, INCLUDING ADVANCED MANUFACTURING AND CLEAN ENERGY TECHNOLOGY SUPPLY CHAINS

New York's energy system is critical for attracting strategic industries and driving the State's competitiveness. Localizing clean energy supply chains and providing power-ready sites can help the State capitalize on these high-value opportunities.

Recommendations

- Continue and enhance interagency coordination to meet the energy needs of new, large customers, thereby supporting New York's competitiveness.
- Continue supporting investments into power-ready sites for new large-scale manufacturing, with emphasis on strategic industries like semiconductors, agribusiness, transportation equipment, and other advanced manufacturing and materials processing—including related to clean energy technologies. When possible, prioritize brownfield redevelopment to leverage existing, underutilized sites.
- Identify opportunities and strategies to grow in-state clean energy supply chains, including through the development of marketing campaigns and other targeted programs.
- Continue to ensure consideration of disadvantaged communities and minority and women-owned business enterprises (MWBEs) when making economic development investments, as applicable.

5.4.3. PROMOTE ENERGY-EFFICIENT, LOW-EMISSIONS INDUSTRY

Cost-effective opportunities for industrial energy efficiency and electrification (typically for low- and medium-temperature processes) can reduce energy use and on-site fuel combustion. Support for an RD&D portfolio of emerging technologies will allow deeper decarbonization over the medium- and long-terms, targeting innovation for specific subsectors and high-temperature heat industrial processes.

Recommendations

- Continue to provide technical assistance to large industrial facilities to facilitate energy efficiency and decarbonization upgrades and to provide targeted financial support for promising investments.
- Prioritize action on process heating, given its status as the top source of industrial energy demand. Measures that can reduce energy needs include enhanced insulation and heat recycling. Electric alternatives include electric boilers, infrared heating, and

microwaves.

- Continue to support in-state RD&D for promising industrial decarbonization solutions for hard-to-decarbonize processes without market alternatives, such as high-temperature heating, carbon capture utilization and sequestration, low-emission processes for chemicals and construction materials production, and low-carbon alternative fuels.
- Pursue risk-sharing mechanisms with the federal government and industry to reduce the barriers to developing new energy sources and novel decarbonization solutions.
- Support the use of low-carbon alternative fuels in industrial subsectors that have limited capacity for electrification and prioritize proximity to the fuel source to reduce midstream transportation issues (e.g., fugitive emissions, pipeline costs) and to promote offtake clustering.
- Study the public health benefits of clean energy investments at industrial and agricultural facilities.

5.4.4. PROMOTE ENERGY-EFFICIENT, LOW-EMISSIONS AGRICULTURES

Agricultural operations can reduce costs and enhance resiliency through energy efficiency, efficient electrification, and on-site energy production. Farms often lack connectivity to the energy system and can benefit from on-site investments that reduce energy needs, result in energy production on-site, or increase grid/pipeline connectivity.

Recommendations

- Support efficient electrification systems on farms including three-phased power upgrades.
- Expand the New York State Climate Resilient Farming Program to support adaptation projects that also reduce GHG emissions or at least do not increase emissions.
- Continue to support in-state RD&D and deployment of RNG, electricity, and biogas production from on-farm waste sources, such as co-digestion of anaerobic manure and food waste for strategic and limited use. Facilitate pilot projects for small-scale digestion systems that incorporate new and innovative technologies, as well as demonstration projects for community anaerobic digestion systems for multiple farms and food waste supplies.
- Support the measurement, monitoring, and verification of energy efficiency co-benefits associated with the adoption of conservation management best practices.

5.5. Expand Access to Clean Transportation Options and Livable Communities

New York State is committed to investing in clean energy solutions that lower energy costs, reduce emissions, and build a resilient, equitable energy system, especially for disadvantaged communities that have historically borne the brunt of pollution and energy insecurity.

5.5.1. REDUCE ENERGY BURDEN FOR LOW- AND MODERATE-INCOME HOUSEHOLDS

Responsibly developed energy efficiency and clean energy policy should maximize the energy security, safety, and comfort of low-income households while reducing their energy burden. This policy objective spans across end-use sectors and is especially relevant as households face broad cost of living challenges.

For household energy costs, the PSC's EAP sets a goal of ensuring that low-income households will pay no more than six percent of annual household income toward energy bills, with major electric and gas utilities providing low-income customers with energy bill payment assistance through monthly tiered discounts. In July 2025, the PSC adopted an EEAP to extend energy bill discounts to additional households below the median income.

Recommendations

- Increase outreach within disadvantaged communities to ensure residents who are eligible for bill assistance can participate in available programs.
- Continue to simplify and streamline access to LMI programs, including those administered by the investor-owned utilities. This should include streamlining program application processes to help support New Yorkers' ability to smoothly access eligible services across agencies.
- Continue prioritizing weatherization and energy efficiency upgrades in homes as a foundational strategy for affordability and explore funding options to address structural issues that prevent home energy upgrades.
- Consider opportunities to expand or modify energy bill assistance while prioritizing strategies for lasting energy bill reductions. This should include optimizing available resources to reduce household energy burden, including bill payment assistance programs and the prioritization of weatherization and energy efficiency programs to provide long-term energy bill reductions as well as exploring opportunities to expand

participation in community solar projects or other clean energy projects that provide electric bill savings to income-eligible households and/or that benefit affordable housing or buildings in disadvantaged communities.

- Explore holistic decarbonization interventions within DACs. A multi-disciplinary approach that combines transportation decarbonization, building energy retrofits, onsite renewable energy, and relevant non-energy programs—such as health and housing—can reduce barriers and generate greater beneficial impacts than if these interventions are pursued separately.
- Maintain and expand access to transportation options, including public transit and active transportation, and address transportation mobility deserts that most severely impact LMI households and DACs.
- Conduct sustained research to better understand the dynamics of energy affordability and household experiences over time so that New York State has access to timely and relevant information and policy-relevant insights. Continue investigation and development of affordability programming and electric rate designs that can enhance LMI households' ability to manage electricity costs.

5.5.2. PURSUE OUTREACH AND ENGAGEMENT WITH REPRESENTATIVES OF DISADVANTAGED COMMUNITIES

Outreach is needed to provide clean energy benefits to residents and businesses in disadvantaged communities. Overcoming barriers like community mistrust, language access, and low program awareness requires dedicated, community-focused strategies.

Inclusive, robust engagement of disadvantaged communities in clean energy planning and program design is also essential for achieving the State's energy goals. This will help make important decisions in partnership with communities and ultimately improve access to clean energy benefits. This means engaging community leaders and residents in culturally responsive ways.

Recommendations

- Address language barriers that may hinder participation in programs by developing, regularly reviewing, and improving language access plans, building on the progress of New York State's current language access policy. Efforts may include regularly reviewing and improving language access for vital documents, translating outreach materials, and hiring multilingual staff.
- Expand community-based outreach and engagement strategies, including culturally relevant communication, face-to-face engagement, and stronger partnerships with schools, community and health centers, and local businesses.

- Consider opportunities to leverage the forthcoming Extreme Heat Action Plan's urban heat island map and DEC's Community Air Monitoring results to assist in conducting additional targeted outreach for clean energy programs such as weatherization, clean heating and cooling, solar paired with storage, Green Infrastructure, and other technologies that can support health and safety during hot weather and improved air quality.
- Sustain and expand agency staff capacity to support DAC stakeholder engagement in early-stage program design as well as in energy-related regulatory proceedings and public comment processes.
- Support technical and operational capacity-building among community-based organizations (CBOs) that serve or represent DACs, including Indigenous Nations. Expand and increase participation in energy-related planning and regulatory processes from more frontline nonprofits, faith-based institutions, CBOs, Indigenous Nation-led organizations, and Indigenous Nations that can provide input that reflects the full spectrum of DAC needs, characteristics, and health vulnerability indicators.
- Conduct robust and inclusive engagement with DACs, including Indigenous Nations, during the siting and development of large-scale energy projects, consistent with applicable regulations under the RAPID Act and the Environmental Justice Siting Law. The RAPID Act requires developers to consult with local governments and Indigenous Nations; to meet with local community members including any DAC; and to provide funds to support municipalities, local agencies, and community intervenors to participate in the process. The EJ Siting Law, amending the Uniform Procedure Act, requires DEC to consider whether issuing an applicable permit may cause or increase a disproportionate pollution burden on a DAC.

5.5.3. STRATEGICALLY DEPLOY CLEAN ENERGY TO REDUCE LOCAL AIR POLLUTION

Targeting clean energy funds to reduce air pollution from fossil fuel combustion will help address existing disproportionate air pollution burdens and prevent further inequities.

Recommendations

- Continue to advance retrofit offerings for homes and multifamily buildings that improve indoor air quality and address existing health and safety needs, with particular emphasis on advancing these measures for projects located within DACs, including Indigenous Nations, and for LMI households.

- Explore all pathways to increased deployment of medium- and heavy-duty electric trucks and buses, along with charging infrastructure where feasible, to maximize health benefits for populations living near high-traffic roadways in disadvantaged communities.
- Pursue strategies to reduce GHG emissions and air pollutants, with particular consideration to projects that are identified or informed by stakeholder groups that work in or represent DACs, such as the DAC Community Advisory Committees of the Community Air Monitoring Initiative.

5.5.4. DELIVER EQUITABLE ECONOMIC BENEFITS

Clean energy investments can be a powerful engine of economic growth across New York State, and particularly so in disadvantaged communities and among priority populations.

Recommendations

- Further synchronize workforce development programs to close equity gaps in job access for priority populations.[57]
- Continue to integrate on-the-job training opportunities and strong labor standards into transportation infrastructure and clean energy projects to expand quality workforce opportunities in DACs.
- Building on proven models, explore expanding renewable energy and energy efficiency retrofit programs that procure goods and services from MWBEs and service-disabled veteran-owned businesses (SDVOBs). For example, the State could improve coordination, vendor data management, and targeted outreach to businesses.
- In continuation of the State's work to design programs to generate equitable economic benefits for DACs, the State should expand access to program offerings that incentivize investments in DACs, including opportunities to support projects in and owned by Indigenous Nations.

5.5.5. IMPROVE INTERAGENCY COORDINATION TO STREAMLINE ACCESS TO ASSISTANCE AND RESOURCES

Greater interagency, utility, and non-profit coordination can maximize participation from and benefits to DACs from energy efficiency and clean energy programs. This can result in simpler, streamlined applications, enhance impact and synergy between programs, and minimize stakeholder fatigue from repeated engagement.

Recommendations

- Through the New York State Low-Income Energy Task Force, support cross-agency efforts to streamline application processes and work to develop a universal application for income-eligible programs serving overlapping populations.
- Pursue more consolidated funding applications for communities and local governments where doing so would streamline processes and better leverage resources for clean energy.
- Continue expanding interagency membership and collaboration within the Energy Equity Collaborative to strengthen cross-sector planning.

5.6. Expand Access to Clean Transportation Options and Livable Communities

New York's robust transportation system allows New Yorkers to get where they need to go, supporting critical activities ranging from emergency response and commerce to recreation and social connectivity. The transportation sector accounts for roughly 40 percent of final energy use in the state, as well as the majority (80%) of the statewide consumption of petroleum products in the form of motor gasoline, aviation fuel, and diesel.

The State is working to accelerate a managed transition toward a transportation system that minimizes GHG emissions while providing affordable, reliable, and healthy transportation options to all members of the traveling public and promoting sustainable land use patterns. The Energy Plan proposes the following main strategies for achieving this vision:

- Continued investment in public transit, active transportation, and other mobility options, while supporting a range of transportation preferences.
- Encouragement of smart growth development that results in compact, mixed-use neighborhoods in transit-accessible and location-efficient areas, where feasible.
- Continued support for EV adoption, including funding for charging infrastructure and incentives.
- RD&D in the use of alternative fuels in the transportation sector.
- Reduction of embodied emissions in transportation system construction.

Transportation investments should be made in recognition of the fact that DACs have historically experienced an outsized share of the negative environmental impacts of the transportation system. Targeted investments in public transit, active transportation, and

ZEV infrastructure can substantially improve air quality, workforce opportunities, and overall quality of life within these communities.

5.6.1. INVEST IN PUBLIC TRANSIT, ACTIVE TRANSPORTATION, AND OTHER MOBILITY OPTIONS

Investment in multiple modes of transportation is necessary to support diverse travel needs statewide and provide affordable, accessible options for all New Yorkers. These investments should recognize the diversity of land use patterns that exist throughout the state. For example, supporting development that provides reliable access to public transit and active transportation while linking clean transportation networks through options like shared mobility and vehicle charging hubs will make these options more viable and affordable for more New Yorkers. This, in turn, will reduce overall emissions and reliance on personal vehicles. These investments support broader initiatives that promote energy-efficient land use patterns.

Recommendations

- Expand public transit through transit service enhancements, improving affordability, connectivity, and convenience. Facilitate local and regional coordination to proactively plan for public transit needs.
- Modernize transit fleets through the broader transition to zero-emission transit buses.
- Introduce Bus Rapid Transit where there is high transit demand but without the population density or land-use characteristics to justify light rail investments.
- Support shared mobility services that provide access to affordable, flexible transportation options that connect more people to transit and provide additional options in communities with limited transit.
- Offer microtransit services, which can be more efficient than underused fixed routes by offering wider coverage (such as in rural or suburban communities) and using right-sized vehicles.
- Continue to enhance transportation planning to enable more walking and bicycling opportunities.
- Develop municipal guidance resources, such as a template for site plan and other land use regulations that localities could adopt that require developers to include active transportation and transit amenities within commercial and residential developments where feasible.
- Identify multiple metrics to measure performance on improving mobility options in New York State (e.g., transit trips, EV charging stations.)

5.6.2. ENCOURAGE COMPACT, MIXED-USE NEIGHBORHOODS IN LOCATION-EFFICIENT AREAS

Smart Growth development patterns and practices can result in communities that are less dependent on energy-intensive transportation and infrastructure, and are therefore more walkable, bikeable, and transit-accessible and less dependent on private vehicles. Strategic land use planning that facilitates compact, dense, and mixed-use communities combined with open space land conservation (including forests, farmlands, public parks, and coastal lands) will help reduce transportation-related energy use and make communities more livable, resilient, healthy, and equitable. A range of State policies and programs delivered by DOS, DOT, DEC, NYSERDA, and other agencies contribute to Smart Growth. State support for local governments for planning and investment is important to encourage sustainable, equitable, and resilient community development.

Recommendations

- Prioritize and coordinate investments in location-efficient areas to enable compact development where feasible. This could include funding infrastructure and consideration of increased subsidies for housing and mixed-use developments in location-efficient areas. This also involves coordination and communication across State, local, and regional levels to plan for and support more active transportation and public transit use.
- Develop resources to support local governments' Smart Growth development. This may include developing a guidebook to help communities navigate State programs and policies; design manual(s) for local governments and developers to advise on incorporating Smart Growth principles into neighborhoods in different contexts (such as rural, suburban, urban, and transit-oriented development); model Smart Growth local laws and best practices; and access to relevant data.
- Develop guidance for local incorporation of energy-efficient, environmentally sustainable design (e.g., green infrastructure, passive neighborhood design) into comprehensive plans, zoning regulations, capital plans, and other local government activities.
- Expand opportunities to redevelop distressed, vacant, abandoned, contaminated and brownfield areas to facilitate efficient infill development or siting of energy projects.

5.6.3. SUPPORT ZERO-EMISSION VEHICLE CHARGING INFRASTRUCTURE AND PURCHASE AND PROMOTE MANAGED CHARGING

Continued public and private investment will help make EVs a more affordable and reliable option for New York drivers. Investment in charging infrastructure in priority locations will

help reduce EV “range anxiety” by making access to charging more reliable and increasing convenience. Regulations and incentives that make zero-emission passenger vehicles and MHD vehicles, including non-road vehicles, more available and affordable for New Yorkers will help ZEVs reach price parity and widespread consumer adoption.

Charging equipment should be appropriate for the context of its use and State entities that fund charging equipment should aim for consistency in technical requirements. Public charging stations that may require payment for electricity provided should be able to meet accuracy and measurement standards so the validity of the public sale of energy can be verified and accountable. The National Institute of Standards (NIST) Electrical Vehicle Supply Equipment Program (EVSE) establishes key standards for equipment testing.

While New York’s electric utilities have introduced managed charging programs to encourage residential and commercial EV charging during off-peak hours, participation in these programs has been mixed. The state’s electric ratepayers would benefit from greater uptake of these programs and related vehicle-grid interactive technologies that reduce electric grid impacts and turn EVs into grid assets.

Recommendations

- Light-duty EVs:
  - Continue, and expand where possible, existing programs that support both Level 2 charging and DC fast charging. Coordinate charging programs across agencies to develop consistent EV charging technical standards and application processes and to prioritize transparency and support for charging stations in strategic locations.
  - Expand efforts to encourage local governments to adopt best-practice EV charging station permitting policies.
  - Continue to fund the Drive Clean Rebate and look for opportunities to increase its impact and cost-effectiveness through higher, more targeted incentives, as feasible. Evaluate adding incentives for LMI buyers of new and used EVs.
- Medium- and heavy-duty EVs and non-road vehicles:
  - Continue the ongoing MHD EV Make Ready proceeding under the PSC and development of a proactive investment strategy for utility upgrades supporting EV infrastructure. Consider expanding Make Ready efforts to incorporate non-road vehicle needs.
  - Identify and fund opportunities for installing MHD EV charging stations at public truck parking locations.

    - Further investigate shared public site business models for MHD charging and work to remove any barriers to enabling the construction and possibly make-ready financial support for these types of sites.
    - Expand availability of funding for fleet electrification plans, as feasible, and fund EV charging installations for public fleets, like school buses, transit buses, and State and municipal fleets.
    - Continue to develop specific resources to assist school bus fleets in their electrification process and assist school districts to complete individualized fleet electrification plans.
    - Expand funding for MHD EV incentives, as feasible, and enhance eligibility for existing programs, focusing on priority market segments where zero-emission solutions are commercially available and phasing in additional market segments as they become commercially available.
    - Study options for regulatory approaches to achieve higher MHD EV adoption.
    - Pilot approaches for reducing MHD EV residual value risk in the financial sector through partnerships with the private sector. Collect and analyze usage, efficiency, and charging data associated with MHD EVs to provide better information about vehicle performance and economics to the market.
    - Undertake further in-state demonstrations and market and fleet studies for non-road market segments, which will help expand understanding of the energy needs for these hard-to-electrify sectors. This includes farm vehicles, construction equipment, maritime vessels, and other sectors that face challenges including high equipment cost, relatively low turnover, and often grid-constrained locations
- Managed charging:
    - Continue to advance load management and managed charging programs to increase participation and effectiveness. Efforts should include education and program design for easier and more beneficial participation and should expand opportunities for flexible EV load, including through vehicle-to-grid systems.
    - Consider ways to allow emerging technologies, such as wireless charging and charging paired with on-site energy storage, to participate in managed charging programs, while taking into consideration project benefits and costs. Further investigate effective managed charging and technologies that support vehicle-grid interaction to maximize the ratepayer benefits of transportation electrification and minimize the cost of installing charging equipment to power EVs.

5.6.4. SUPPORT RD&D FOR THE USE OF ALTERNATIVE FUELS IN THE TRANSPORTATION SECTOR

Investment in alternative fuels can play a role in the reduction of transportation GHG emissions. While a shift to electrification and zero-emission fuels is the sector priority, other fuels like renewable diesel and biodiesel can be an effective option in harder-to-electrify market segments and can provide a pathway to include more subsectors in achieving emissions reductions.

Recommendations

- Perform further in-state demonstrations of in-service hydrogen fuel cell vehicles and fueling infrastructure. Continue working with local authorities to demonstrate the safety of hydrogen fuel cell vehicles.
- Perform additional research to bring down the cost of hydrogen fueling infrastructure and generation or transportation of hydrogen for use as a transportation fuel.
- Continue to encourage demonstration-scale and larger applications of advanced biofuels in New York, including SAF and renewable diesel, with published test results of the performance of these fuels.
- Consider additional research and in-state pilot projects for zero emission non-road applications, especially for large emitters operating in populated areas, such as construction equipment, marine port equipment, and intermodal facilities.

5.6.5. REDUCE EMBODIED EMISSIONS IN CONSTRUCTING THE TRANSPORTATION SYSTEM

Clear and cost-effective opportunities exist for reducing embodied emissions associated with construction materials when new transportation infrastructure projects are built or renovated. Because transportation construction materials are often sourced locally, especially aggregates as well as other materials, these measures could promote reduced energy use and emissions associated with in-state manufacturing and transportation of these materials. Environmental Product Declarations (EPDs) are the most common way of quantifying and reporting the emissions impacts of a product. As part of New York State's commitment to lead by example under Executive Order 22, State projects are accounting for embodied emissions in procurements associated with capital projects and reporting on data to increase transparency and provide data to inform future decision.

Recommendations

- Collect better life cycle embodied carbon data for covered materials to identify the best opportunities for achieving material performance and emission reductions.
- Update material specifications in a manner that supports industry and construction performance and drives scale and progress toward lowering embodied carbon emissions in high volume construction materials.
- Coordinate with other states and jurisdictions on standardized reporting requirements and methods used in EPDs.
- Support market development of technologies and firms to produce affordable, low-carbon materials within New York State.

5.7. Expand Access to Healthy, Efficient, and Low-Emission Homes and Buildings

New York State's buildings are as varied as their surrounding communities. Upgrading the structures where New Yorkers live, work, and learn offers unique challenges as well as significant opportunities. Modernizing and decarbonizing buildings will deliver comfort, health and safety, resiliency, and economic benefits to New Yorkers. In particular, the energy transition provides an opportunity to invest in and expand access to quality housing, with a focus on support for LMI households and buildings in disadvantaged communities.

This Plan recommends five main strategies as central to improving and decarbonizing New York's buildings sector, keeping buildings comfortable, prioritizing affordability, and supporting the reliability of the grid and gas system:

- Prioritizing energy efficiency and weatherization.
- Advancing efficient electrification to reduce on-site fossil fuel use.
- Continuing innovation and market development for new and emerging clean building technologies.
- Enabling demand management and load flexibility at scale.
- Reducing embodied GHG and refrigerant emissions.

In existing buildings, a phased approach to capital investments is an effective way to manage the associated cost and disruption. In large buildings, Resource Efficient Decarbonization is a proven approach to strategic capital planning that creates a path toward efficiently decarbonizing buildings. This model provides a repeatable process to help alleviate space constraints, optimize peak thermal capacity, increase operational efficiencies, utilize waste

heat, and reduce the need for oversized electric thermal energy systems, creating retrofit cost compression. A similar approach can be taken in smaller buildings and homes, by weatherizing to improve comfort and reduce heating and cooling costs, and by upgrading to energy-efficient and electric appliances as old appliances become unreliable (but before an emergency replacement is needed).

5.7.1. PROVIDE FINANCIAL INCENTIVES AND AFFORDABLE FINANCING FOR ENERGY UPGRADES IN BUILDINGS

Energy efficiency and decarbonization upgrades deliver significant value to building owners and occupants but upfront and operating cost barriers persist. For existing buildings, financial incentives and affordable financing can reduce upfront costs and motivate New Yorkers to make energy upgrades in buildings. New York State currently invests over $1 billion annually in public funds for State- and utility-administered customer incentives and financing offerings that help make energy efficiency and decarbonization solutions more available and affordable. Well-established policies and programs are in place to help New Yorkers lower energy use and save on energy bills and to assist residents and business owners in understanding, planning, and paying for energy upgrades.

Recommendations

- Continue to offer financial incentives to reduce upfront costs and motivate New Yorkers to make energy upgrades in buildings, supporting strategic measures that result in energy load reduction and enable decarbonization through weatherization, heat recovery, and electrification.
- State- and ratepayer-supported incentives should prioritize support for energy upgrades in existing buildings that are likely to deliver both energy and cost savings.
- Explore expanding access to affordable financing programs such as Green Jobs-Green New York (GJGNY), and continue offering financing products aimed at unlocking local private capital and enabling below-market-rate consumer lending programs.
- Ensure the efficient and effective rollout of the three-part rate design (customer charge, contract demand charge, and daily as-used demand charge) adopted by the Commission under the standby rate proceeding.

5.7.2. PRIORITIZE SUPPORT FOR ENERGY UPGRADES IN LOW- AND MODERATE-INCOME HOUSING

State support for LMI households and buildings in disadvantaged communities to make energy-related upgrades will help make homes and communities healthier places to live, while addressing historical inequities. NYSERDA, New York State Homes and Community Renewal

(HCR), and LIPA—in coordination with the utilities and the New York State Office of Temporary and Disability Assistance—provide State leadership in administering ratepayer, RGGI, federal, and State funding across residential LMI programs like EmPower+, the Weatherization Assistance Program, and the Affordable Multifamily Energy Efficiency Program. These programs support energy efficiency and electrification solutions that will help LMI New Yorkers save energy and money, increase comfort, and improve the quality of their homes.

Recommendations

- Continue to prioritize and coordinate public support across energy and housing programs to address energy performance and housing quality for LMI housing and buildings in disadvantaged communities. In State and utility-administered programs that support energy upgrades in LMI housing, focus on weatherization in the near-term.
- Explore all funding sources that could support energy upgrades and non-energy improvements that are necessary before the installation of energy measures in LMI housing, including health and safety upgrades.
- Continue to support opportunities for LMI residents and buildings in DACs to pair electrification with solar energy to benefit both the building owner and residents.
- Coordinate on policy, programs, and strategies to advance and preserve housing affordability as part of the State's effort to decarbonize buildings, and consider updates to policies that enable equitable electrification for regulated affordable housing.

5.7.3. TRANSFORM THE MARKET FOR EFFICIENT AND LOW-CARBON BUILDING TECHNOLOGIES

Building market confidence and capacity and encouraging innovation will expand decarbonization solutions across various building types. Market development support is needed to help expand the clean energy workforce and support existing supply chain actors and businesses in adapting to effectively deliver clean energy technologies, all while building awareness and confidence in clean heating solutions among consumers and contractors. Existing initiatives are providing technical assistance and financial support, engaging consumers and the supply chain, and supporting workforce development and training to enable the delivery of energy efficiency and clean energy solutions.

Additionally, public investments, coordinated with strategic public-private partnerships, are critical to spur further technological innovation, demonstration, and commercialization and to help bring emerging solutions to the market and lower costs. This is especially the case for hard-to-decarbonize building types or specific energy uses in buildings.

Recommendations

- Through GJGNY, continue to provide free audits for single family residential and small business applications, and consider opportunities to scale virtual remote audits.
- Continue to cost-share technical assistance and energy planning that provides actionable information for how larger, more complex buildings can cost-effectively decarbonize over time following the Resource Efficient Decarbonization model.
- Continue to support workforce development and training for critical growing building occupations.
- Continue to engage key weatherization and heat pump supply chain actors—including manufacturers, distributors, and contractors—to streamline delivery models and help build confidence in heat pump products while improving availability of heat pump products for both residential and larger-scale heat pumps in New York State.
- Explore providing midstream and upstream incentives to motivate local distributors of heating and air conditioning equipment to stock a range of modern heat pump products at affordable prices, increasing availability and consumer choice to support the sale of efficient heat pumps for homes, small and midsized businesses, and public buildings.
- Continue State support for innovation and in-state demonstration for drop-in decarbonization solutions—in partnership with portfolio owners that can deploy equipment at scale—that are cheaper than existing solutions and significantly streamline the design/installation phase of a heating, ventilation, and air conditioning (HVAC) project.
- Accelerate technology transfer, product testing, and commercialization to make it easier to bring emerging solutions for efficient electrification to market in New York State. Also, support the development of growth-stage companies and capital partners to scale clean energy solutions and new business models.
- Continue to support innovation for technologies that can help decarbonize steam production, including industrial heat pumps, low-carbon alternative fuels, electric boiler systems, and thermal and electric storage solutions. Also, continue to evaluate potential demonstrations as well as permitting updates that could enable the implementation of emerging low-carbon steam production technologies.
- Support market development of technologies and the development of New York industries to produce affordable, low-carbon materials. Integrate embodied GHG considerations, including the use of EPDs, into programs that are designed to bring awareness to sustainable building practices. Seek to advance partnerships with other states to increase demand for low-emissions construction materials.

5.7.4. COORDINATE EFFICIENT BUILDING ELECTRIFICATION WITH ENERGY SYSTEM PLANNING

Coordinated efforts with electric grid, gas, and steam system planning are needed to enable a shift beyond building-by-building conversions to low-networked solutions, including TENS. Enabling efficient, community-scale decarbonization will be important in unlocking strategies such as TENs, neighborhood redevelopment plans, area-based thermal energy planning, and other integrated planning approaches, while taking into consideration the avoided costs of gas system maintenance. Integration of energy efficiency and electrification projects with neighborhood redevelopment and master planning should be prioritized, so that decarbonization is central when redevelopment, replacement, and total rehabilitation occur.

Recommendations

- Develop a Thermal Energy Network Roadmap for New York State that explores the overall role TENs could play in support of the State's building decarbonization goals and that identifies market and other barriers faced by viable TENs development, while identifying a set of holistic solutions in the near-term and midterm to address these barriers.
- Advance the analysis of TENs. Topics for study include geospatial analysis to identify areas of the state that may be most viable for TENs (to support mapping of thermal demand and thermal resources) and to improve public access to thermal resource data. Analysis should also help to understand the impacts, benefits, and tradeoffs for the energy system of investing in TENs versus standalone building decarbonization strategies.
- Continue to advance regulatory framework development for TENs in a manner that provides increased market understanding and certainty as to what regulations will require and for which types of systems. This is especially integral for multi-user (non-campus) TENs.
- Explore the role of area-based thermal energy planning and resources that support municipalities and communities to identify locations with high potential and local support for TENs.

5.7.5. SUPPORT REGULATORY FRAMEWORKS

Regulatory frameworks are important to drive broad and sustained improvements in building energy performance, and supporting load flexibility, and to reduce emissions from building operations, equipment, and construction materials.

Advanced and zero-emission codes for new construction help improve comfort, indoor air quality, and resilience while shifting buildings away from fossil fuels. State appliance and product standards are lowering energy usage as existing residential and commercial buildings upgrade their equipment, and they can further help promote demand flexibility, even with uncertainty around federal standards. Improved access to building energy consumption data provides actionable insights to identify the best opportunities for achieving energy cost savings and emissions reductions. Lessening the environmental impact of the buildings sector also requires managing refrigerants and embodied carbon.

Recommendations

- Continue efforts to provide customers with readily available access to their energy consumption data, with tools to aggregate and automate the process of sharing this data.
- Continue to support the education and development of new tools, training, and resources for local governments to help support the successful implementation of new code requirements.
- Continue to recommend reduced energy use intensity as part of the next iteration of the Energy Code to continue reducing energy use in new and substantially renovated buildings. The agencies should also continue to track and evaluate the need for further code improvements that support the safe rollout of ultra-low global warming potential (GWP) refrigerants and consider the incorporation of embodied emissions requirements.
- Support training and/or certifications for industry technicians, system designers, and other stakeholders on proper use of alternative refrigerants and best practices for leak detection, reclamation, and market development for reclaimed refrigerants. Also provide technical assistance and market support for the transition to low- and ultra-low-GWP refrigerants.
- Advance research and demonstration to enable adoption of the next generation of low- and ultra-low-GWP refrigerants.

5.7.6. ENCOURAGE RESILIENT BUILDINGS

Buildings of all ages, functions, and locations across New York State are vulnerable to the impacts of climate change, and investments should consider associated long-term risks. Making design decisions in both new and existing buildings that align buildings' and building components' life cycles with future climate projections and expected hazards will lead to more cost-effective, sustainable, and future-ready buildings that can support many generations of use.

A variety of programs are available to support homeowners in proactively preparing for future conditions. HCR has expanded the Resilient Retrofits Program, a combination of low-interest loans and grants to LMI single-family homeowners whose homes are in flood-prone areas or have been damaged due to heavy rainfall. This program enables them to render their homes more resilient to flood damage and, if desired, to decrease their GHG emissions by improving the energy efficiency or electrification of the home. HCR is also administering federal disaster recovery funding that goes beyond damage repair to support resilient investments for future storms. NYSERDA has begun to incorporate forward-looking climate projections into competitively awarded programs to encourage efficient and resilient buildings in multifamily, single-family, commercial, and industrial sectors.

Recommendations

- Explore pairing weatherization/energy efficiency measures with resilience measures in State- and utility-administered clean energy programs. Such measures should include backup power solutions and should inform broader community and building-level resilience strategies that can meet community safety and passive survivability needs in acute situations.
- Explore and consider piloting a “resiliency first” energy storage incentive; prioritizing the ability of an energy system to withstand and recover from disruptions, such as power outages, natural disasters, or other emergencies; starting with critical community serving public sector facilities.
- Consider investing in energy-efficient resilience hubs that incorporate clean energy resources, especially in disadvantaged communities that are vulnerable to climate change.

5.8. Grow Clean Energy Jobs

New York’s energy workforce is essential to the safe and reliable construction and operation of our energy system. The State’s energy system is also a meaningful job creator and driver of economic growth. As the system transitions, new economic opportunities will emerge. To meet its clean energy goals, New York will need to rapidly deploy new energy infrastructure, adopt new technologies, accelerate building decarbonization activities, and efficiently manage existing systems. These goals can only be met by growing and supporting a well-trained workforce to carry out transformational work across the entire energy system. As the clean energy sector grows in New York State, so too do clean energy job opportunities for New Yorkers.

In New York, clean energy jobs are among the fastest growing employment sectors. While clean energy jobs make up just 2 percent of the employed statewide workforce—more than 184,000 clean energy jobs—the number of clean energy jobs increased roughly 27 percent over the last decade, exceeding statewide job growth. Significant job growth can be expected to continue as clean energy industry investments expand, though the most impacted sectors and sub-sectors will shift and evolve as new technologies emerge and others mature. To create high-quality jobs and local economic benefits, this Plan recommends continued investment in workforce development initiatives coupled with labor standards.

5.8.1. EXPAND CLEAN ENERGY SECTOR WORKFORCE TRAINING AND CURRICULA

Continued State investments into workforce development programs and related services are essential to provide the scale and speed of workforce training needed for the clean energy transition. Strategically developed workforce development programs can build up the capacity of skilled workers so that the State can meet the needs of its clean energy ambitions. Extensive coordination is needed to ensure that the career pipeline will materialize for these trained workers.

NYSERDA serves as the leading State agency responsible for promoting clean energy workforce development, alongside key clean energy workforce training initiatives at the New York State Department of Labor (DOL), SUNY and City University of New York (CUNY), Empire State Development (ESD), NYPA, and others. State investments support employers in "upskilling" their employees through additional training, micro-credentials, and certifications; facilitate the placement of entry-level workers with jobs, apprenticeships, or paid internships; connect fossil fuel workers with opportunities to pivot to the clean energy economy; and provide wraparound services to employees (such as transportation and tuition assistance).

Recommendations

- Identify opportunities to incentivize and bolster workforce training participation in key occupations where shortages are projected, such as technicians, construction trades, and manufacturing.
- Workforce development efforts should also prioritize: expanding the capacity of the energy efficiency workforce and the development of installation and operation skills for high-efficiency HVAC equipment; expansion and operations of EV charging infrastructure; a growing demand for building and maintaining new transmission and distribution infrastructure; further investments in energy storage and distributed and large-scale solar, wind, and thermal energy networks; and building up transferable skills that would support future nuclear development.

- Continue funding Direct Entry and pre-apprenticeship programs that support clean energy projects, including identifying any need for additional long-term State funding.
- Expand clean energy career awareness initiatives in K-12 schools and initiatives to provide educational resources.
- Continue and expand investments into clean energy career training curriculum on SUNY/CUNY campuses and Boards of Cooperative Education Services across the state.
- Continue coordinating across State agencies to streamline evaluation of workforce development programs in the clean energy sector, facilitate study of related career pathways, modernize civil service titles to meet clean energy labor demands within State jobs, and support faster and better results from clean energy programs.

5.8.2. STRENGTHEN PARTNERSHIPS ACROSS NEW YORK'S INNOVATION ECOSYSTEM

Improved program awareness and accessibility can facilitate equitable participation of workers from DACs in the clean energy workforce. By prioritizing the accessibility of workforce trainings, the State can improve DAC representation within the clean energy workforce and deliver benefits of the transition to these communities. Accessibility can be improved by partnering with trusted community organizations, ensuring DAC representation among trainers and educators, tailoring communications campaigns to specific communities, and providing wraparound services, such as childcare, transportation, and job placement and mentorship. State support, such as small business loans, technical assistance, and incubator programs, can also facilitate small businesses, MWBEs, SDVOBs, startups, and residents from DACs to enter the clean energy industry.

Recommendations

- Consider launching new statewide communications campaigns to promote inclusive participation in clean energy careers.
- Continue to identify and pursue opportunities to fund and expand access to wraparound services.
- Expand clean energy training programs in correctional facilities.
- Further study and track the representation and retention of individuals from DACs in clean energy jobs, especially individuals who have completed State-funded training.

5.8.3. SUPPORT A JUST TRANSITION FOR WORKERS

The State is committed to creating pathways for New Yorkers to move into new, high-quality clean energy jobs and to support those transitioning out of fossil-fuel-based employment or

other energy sectors impacted by the State's energy policy. Currently, there are roughly 75,000 jobs in fossil fuel electric-generation plants, the natural gas distribution system, the transportation and storage of delivered fuel, and other related fossil fuel jobs. Many of these positions will transition to new energy roles with little or no adjustment on the part of the workers. Other workers, however, are likely to experience displacement. For example, gas station utilization is declining as drivers shift to home charging. To support a just transition for energy workers, it is essential to develop safety nets for workers at risk of job loss due to energy transition policies. New York created the Office of Just Energy Transition (OJET) under DOL to guide the State's programs in this area.

Well-designed workforce and labor policy can promote a just transition for these workers through a combination of proactive investments into retraining, upskilling, or offering the right of first refusal for workers transitioning into clean energy fields. The State can also provide protective measures for fossil fuel workers who are negatively affected by the State's climate policy but for whom transitioning to a clean energy field is not possible, such as compensation and benefits through a bridge to retirement program. All just transition programs should be created and implemented with input from the most impacted workers.

Recommendations

- Undertake research to assess the employment impacts of transitioning subsectors, in particular natural gas distribution, and to better inform how to design and prioritize just transition policies.
- Research and estimate the potential impacts of safety net measures that support workers negatively impacted by climate policies. Such measures could include wage guarantees, bridge to retirement, transitional opportunities, or support for communities facing plant closures.
- Consider a Just Transition Fund, with dynamic support from multiple sources, that could support safety net measures.

5.8.4. IDENTIFY OPPORTUNITIES TO FURTHER HIGH-QUALITY ENERGY JOBS

Labor standards for energy projects are a key tool to improve the quality of life of workers, minimize inequality, and generate local economic benefits. For example, prevailing wage requirements can ensure that minimum pay standards are met, while Project Labor Agreements and Labor Peace agreements ensure the rights of organized workers are protected. Safety regulations can protect workers from dangerous working conditions, such as extreme weather and other unsafe working conditions. Labor standards also lead to high-quality work products, the result of standardized training and high productivity.

Additionally, Buy America provisions can drive economic growth, and good wages for energy sector workers can bolster affordability for workers and their families. However, the clean energy industry is highly varied, and there is no one-size-fits-all set of labor standards that will guarantee high job quality.

New York should continue to implement policy that improves job quality for clean energy projects, by encouraging a combination of union labor, prevailing wage standards, Project Labor Agreements, Labor Peace Agreements, community benefits plans, workplace health and safety requirements, or Buy American standards, as applicable. Relatedly, the State should assess the coverage of labor standards across energy sectors and identify opportunities to expand labor standards as well as other policies to ensure job quality, such as ensuring on-the-job safety, regular pay, opportunities to aggregate smaller projects, and access to benefits, especially for energy projects supported through State funding.

Recommendations

- Undertake research that analyzes the labor standards that apply to clean energy jobs. This analysis should identify gaps in federal or State labor standard coverage and consider policy actions that can ensure clean energy jobs are high quality.

5.9. Grow Innovation in the Clean Energy Economy

New York's clean energy goals have already helped to catalyze a robust clean energy industry. The State currently boasts one of the largest, most mature clean energy workforces, advanced markets for clean energy technologies, and extensive research and innovation hubs. Public and private investment in clean energy companies has been significant: between 2022 and 2024, investments averaged $6.1 billion, a roughly 50 percent increase compared to the 2021 to 2023 period.[58] Growth can be expected to continue as New York remains committed to expanding existing markets and fostering the growth of emerging technologies.

New York also holds one of the most robust innovation ecosystems in the U.S., ranked third nationally in both clean energy and technology sector jobs based on the U.S. Department of Energy's U.S. Energy and Employment Jobs Report[59] and U.S. Bureau of Labor Statistics,[60] and second in total research and development spending.[61] Investing in education, outreach, and innovation for clean energy technologies can ensure that New York has the capacity to develop yet-to-be scaled technology solutions that can enable the State to meet its energy goals.

The State is committed to continuing to support this vibrant ecosystem to increase the supply of reliable and clean energy sources, lower GHG emissions, and ensure clean energy affordability and accessibility throughout the state. As part of these efforts, New York is also committed to integrating the priorities, needs, and participation of disadvantaged communities (including but not limited to, the siting of demonstration sites, project participation, and in benefits assessments). New York also seeks to build on the success of prior investments and coordination activities that have brought numerous beneficial technologies like building sensors and controls for more efficient heating and cooling, ground source heat pumps, grid responsive technologies for dynamic load management, alongside growth of key local energy ecosystems, in battery storage, OSW, and management.

5.9.1. SUPPORT R&D, DEMONSTRATION, AND COMMERCIALIZATION FOR CLEAN ENERGY TECHNOLOGIES

New York's energy innovation strategy is supported by programs administered by NYSERDA, ESD, NYPA, and SUNY, alongside the broader innovation ecosystem that includes industry, utilities, national labs, academic and financial institutions, non-profits, and community organizations. NYSERDA supports research and development, demonstrations, commercialization, and the broader innovation ecosystem, in clean energy focus areas including grid modernization, power generation and storage, and technologies that support buildings, transportation, and industry, with an emphasis on ensuring reliability and resilience across the energy system. ESD runs New York Ventures and other technology accelerators. NYPA's Advanced Grid Innovation Lab (AGILe) enables digital testing of transmission, distribution, DER technologies, and cybersecurity under a broad range of scenarios. SUNY is a nationally recognized leader in clean energy research and innovation, with among the largest university-owned clean energy patent portfolios in the country. The system is comprised of 64 schools, with three campuses focused specifically on clean energy research and innovation: the Stony Brook Advanced Energy Research and Technology Center, the University at Buffalo RENEW Institute, and the Binghamton University S3IP Center of Excellence.

Sustained support for innovation throughout the demonstration, commercialization, and market adoption phases plays an important role. These later stages are essential to effectively integrating beneficial clean technologies into the energy system. Although continued investment in research remains important for long-term innovation, state commercialization programs can help advance later-stage technologies and support carbon reduction goals while minimizing economic disruption.

Recommendations

- Continue to invest in in-state Research, Development, and Demonstration (RD&D) aligned with key priorities and needs identified across all energy sectors to accelerate the deployment of beneficial technologies, increasing performance and reducing costs.
- Continue to support commercialization activities, startup growth, and bringing market-ready products and businesses to New York State.
- Continue to commission studies and performance evaluations to provide objective information to the public on the trade-offs in cost, performance, environmental benefits, and policy compatibility of emerging and existing energy technologies.

5.9.2. STRENGTHEN PARTNERSHIPS ACROSS NEW YORK'S INNOVATION ECOSYSTEM

The State's innovation ecosystem is also comprised of many critical, non-governmental players, including private research laboratories, investors, national labs, military facilities, IOUs, and others. State programs are designed to leverage existing funding, partnerships, and expertise, as well as to play a coordinating role in driving clean energy innovation. As New York welcomes new industry partners into the state, coordination among regional and statewide technology partnerships is critical to continue driving innovation, attracting new talent and industry, and supporting our energy needs.

Recommendations

- Continue to strengthen and formalize partnerships across the entire New York State innovation ecosystem. This includes working with public and private organizations and universities to accelerate deployment of key energy technologies, and activities such as developing strategic market roadmaps and matching appropriate sites with first-of-a-kind demonstrations that have potential for widespread replication.
- Coordinate with universities and community organizations to consider development of a set of effective and feasible best practices for integrating the priorities, needs, and participation of disadvantaged communities that can include demonstration sites, project participation, and project benefits assessments.
- Build upon successful models to leverage combined market share and economies of scale to accelerate cost reductions and market adoption of key energy technologies.

5.9.3. HARNESS THE STATE'S CLEAN ENERGY TECHNOLOGY EDUCATION PIPELINE

Investing in the State's clean energy technology education pipeline can ensure that the talent needs for the growth and evolution of New York industries are met. New York's education system serves as the linchpin of the State's clean energy research and innovation portfolio, not only providing education and workforce development but also driving research and commercialization efforts and hosting large-scale demonstration projects.

Recommendations

- Continue to prioritize and expand the SUNY clean energy research and education portfolio, in addition to continuing to identify opportunities to leverage SUNY's expansive physical footprint (111 million square feet of conditioned space or 40% of the state's footprint, including 54,000 acres) to support clean energy demonstration sites.
- Continue to leverage SUNY's climate research task force model to develop and advance a clean energy research strategy that builds on ongoing research programs across multiple SUNY campuses.

6. Impacts of the Plan

This section assesses impacts associated with the implementation of the State Energy Plan with respect to economic impacts, health and environmental quality, and energy costs for households.

6.1. Economic Impacts: Energy Jobs

Over the 2025 to 2040 planning period, the Plan's core planning scenario (Additional Action[62]) is expected to generate meaningful economic benefits for New York. The Additional Action scenario is expected to generate over 80,000 net jobs—a 17 percent increase—over the planning period (see Table 2). The electricity and buildings sectors experience notable growth, jointly adding more than 98,000 net jobs, driven by sizeable investments into clean electricity generation, building efficiency and electrification, and clean transportation. The employment expansion in these sectors is nearly five times the projected decline in the transportation and fuels sectors that are driven by decreased spending for vehicle maintenance, fueling stations, and other fossil fuel-related subsectors.

Table 2: Additional Action Scenario Jobs
Source: Ecnomic Impacts: Jobs Analysis chapter

Sector	2025	2030	2035	2040	Change 2025 to 2040	
Electricity	133,618	173,353	173,050	192,963	59,345	44%
Buildings	170,700	194,415	200,360	209,565	38,866	23%
Transportation	136,671	133,248	128,992	121,500	(15,171)	-9%
Fuels	30,603	29,815	28,917	27,878	(2,726)	-9%
Total	**471,592**	**530,831**	**531,319**	**551,905**	**80,314**	**17%**

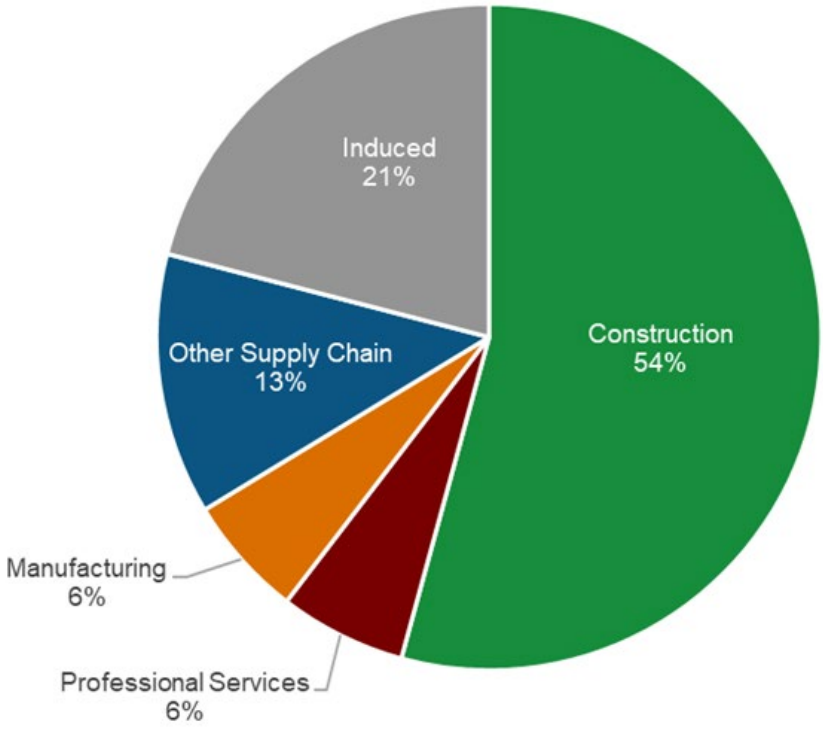
Through 2040, roughly two-thirds of the projected new employment in the electricity sector is concentrated in zero-emission power generation, namely in solar, wind, and nuclear generation. Another quarter of new electric sector jobs are in electric distribution. This growth meaningfully outpaces projected displacements in fossil-fuel generation. While jobs in

fossil-fuel generation plants decrease, this is also offset by some plants converting to a clean firm power source. In the buildings sector, job growth is expected in both the commercial and residential subsectors, with notable increases in the residential shell subsector, where jobs are expected to grow nearly fourfold to support increased investments in decarbonizing New York's housing stock.

Within the two net growth sectors, the electricity sector and the buildings sector, over half of the added jobs are in the construction industry. About a fifth are jobs induced across other industries, and the balance are in other supply chain work (including operations and related work), manufacturing, and professional services (see Figure 22).

Notably, even as the core planning scenario projects a decline in natural gas consumption across the economy, there is a continued need for the hiring of new gas workers over time to maintain the workforce necessary to guarantee adequate and safe service. When considering likely investment needs over the planning horizon and worker age and retirement dynamics, the natural gas distribution subsector will see relatively flat total jobs but the need to recruit over 2,000 new workers to replace projected retirements by 2040.

Figure 22: Net Job Growth by Industry, Growth Sectors (Electricity and Buildings) (2025 – 2040)
Source: Economic Impacts: Jobs Analysis chapter



6.2. Public Health Impacts

The economy-wide energy policies included in the Plan's core planning scenario (Additional Action) would lead to lower air pollutant emissions, improvements in statewide air quality, and ensuing public health benefits.

The health analysis estimates public health benefits from lower exposure to fine particulate matter less than 2.5 micrometers ($PM_{2.5}$) concentrations at the community scale and lower exposure to ozone concentrations at the county scale. Lower exposure to $PM_{2.5}$ and ozone concentrations from the Additional Action scenario is projected to result in health benefits for all communities statewide, and benefits are expected to increase over time from 2025 to 2040.

By 2040, the Additional Action scenario is projected to result in approximately 1,000 avoided premature mortality cases per year and to annually avoid over 400 nonfatal heart attacks and approximately 1,300 emergency room visits for asthma (Figure 23). In total, over the 2025-2040 planning period, the Additional Action scenario is estimated to avoid approximately 6,500 cases of premature mortality, over 2,700 nonfatal heart attacks, and over 8,700 emergency room visits for asthma. These projections represent statistical estimates of health benefits based on modeled changes in air pollution exposure, reflecting risk reductions across populations, rather than definitive outcomes for specific individuals.

Figure 23: Annual Avoided Public Health Impacts in 2040 from Lower $PM_{2.5}$ and Ozone Concentrations Under Additional Action

Health Effect	Avoided Cases in 2040	Fraction in DAC Areas (from $PM_{2.5}$)
Geographic Population of Disadvantaged Communities in New York:		37%
Scenario	Additional Action	0% 25% 50% 75%
Premature Mortality	1,000	50%
Nonfatal Heart Attacks	430	48%
Hospitalizations	280	50%
Acute Bronchitis	450	50%
Respiratory Symptoms	14,100	50%
Emergency Room Visits, Asthma	1,300	72%
Asthma Exacerbation	8,600	50%
Minor Restricted Activity Days	280,000	49%
Work Loss Days	48,000	49%

While all New Yorkers would benefit from reduced pollution, air quality improvements are projected to be greater in DAC areas than in non-DAC areas, leading to greater health benefits in DACs. In New York City, while there would be local differences, DACs and non-DACs would experience similar average improvements in air quality. In addition, for all health outcomes, DACs have higher existing levels of health conditions, which is another reason DACs would experience a greater proportion of the health benefits. While geographic DACs account for 37 percent of the State's population, 48–72 percent of the health benefits are expected to accrue in these communities in the Additional Action scenario, depending on the health outcome. For example, DACs are expected to experience 72 percent of the avoided emergency room visits for asthma under the Additional Action scenario (Figure 23). Higher benefits within DAC areas are expected in all areas of the state.

The statewide value of the health benefits associated with the Additional Action scenario is estimated to reach $14 billion annually by 2040, for a total cumulative value of $52 billion (net present value 2024$) from 2025 through 2040 due to lower exposure to ozone and $PM_{2.5}$. All areas of the state are projected to experience health benefits, with the most benefits accruing in urban areas where population and air pollutant emissions are greatest. In each region of the state, DAC areas are expected to receive a larger share of the value of benefits relative to their fraction of the population in the region, and statewide, 50 percent of the monetary health benefits would accrue to geographic DACs. Accounting for differences in population, DAC areas would experience approximately 70 percent higher benefits than non-DAC areas.

Under the Additional Action scenario, most statewide benefits would result from lower emissions from buildings and on-road vehicles, with the total benefits from lower emissions in these sectors increasing from 2025-2040. Benefits per capita in DAC areas from the use of SAF are more than double the benefits compared to non-DAC areas.

Cumulative physical and monetary health benefits from the Additional Action scenario are estimated to be approximately 60 percent greater than the Current Policies scenario. Projected cumulative benefits from Net Zero B are approximately triple the Additional Action scenario.

Federal energy policies are projected to impact the public health benefits experienced by New York State. Compared to the Current Policies scenario, cumulative public health benefits would have been approximately 50 percent higher through 2040 if federal energy policy rollbacks as of October 2025 had not occurred. Further federal policy rollbacks could potentially decrease cumulative health benefits by approximately 30 percent relative to the Current Policies scenario. These differences amount to thousands of cases of premature mortality, nonfatal heart attacks, and other public health impacts. Overall, current federal

policies may have set back public health benefits that may have been achieved by 2040 by 4 years, and further rollbacks could result in the same level of benefits being set back beyond 2050.

6.3. Environmental Impacts

New York State's air pollution control and clean energy programs are contributing to improving air quality and environmental benefits for communities and ecosystems across the state. Over the past twenty years, market forces, economic drivers, and the implementation of federal, State, and local clean energy and energy-related air quality policies have resulted in substantially reduced emissions and decreases in concentrations of ambient air quality pollutants. In addition to the health benefits associated with cleaner air, the observed decreases in sulfur dioxide (SO_2) and nitrogen oxides (NO_X) have significantly reduced acid (rain) deposition across New York. Ecosystems are slowly recovering, and many are now able to support more diverse and abundant wildlife and associated recreational opportunities.

These trends in air pollution reductions and associated benefits are projected to continue under each of the energy pathway scenarios modeled for this Plan.

New York State has a robust regulatory framework for identifying and mitigating environmental impacts associated with energy development, generation, transmission, and use. The energy modeling performed for this plan identifies increasing amounts of solar, storage, OSW, and onshore wind for electricity generation by 2040. The most pronounced impacts from the deployment of large-scale clean energy sources are associated with the conversion of mostly undeveloped lands to energy generation. The most land-intensive energy generation source is solar energy, which requires approximately 5 acres per MW of capacity.

New York State has developed and continues to refine strategies for procuring and permitting energy resources to reduce risks to ecosystems and wildlife and to avoid or minimize land use conflicts. Relatedly, the State is actively investing in research and monitoring related to the environmental implications of new and emerging technologies or fuels, siting and mitigation practices, and dual-use opportunities. For example, New York State is funding research on solar energy development to produce data on environmental impacts and species use, crop and grazing potential, regional impacts on farmland and agricultural economies, and optimal siting design considerations for large solar projects. In addition, the State conducted extensive environmental and fisheries data collection as part of the New York State Offshore Wind Master Plan to inform an understanding of environmental sensitivities and user conflicts associated with potential OSW areas.

These types of early investments in data collection can reduce environmental and project risks, help to inform construction windows and permit conditions, and accelerate project timelines. New York State convenes multiple stakeholder groups to inform and advise on issues associated with energy development. These stakeholder groups have proven successful in identifying areas to advance research to inform responsible energy development policies.

6.4. Affordability Impacts

The household energy affordability analysis assesses household and transportation energy expenditures for household profiles and journeys that are representative of scenarios from the economy-wide pathways analysis.

The analytic approach starts with technology and measures characterization data and technology adoption over time from the economy-wide pathways model, supplements this with household scale data (such as household energy and transportation energy demand) and energy price projections and calculates household and transportation energy demand and expenditures.[63]

The analysis includes household profiles for three income levels (low-, moderate-, and average income) across three regions of New York State (Upstate, Downstate, and New York City), for a total of nine profiles. For each household profile, future household and transportation energy expenditures are calculated for four illustrative journeys involving different technology mixes and fuel types, ranging from more reliant on fossil-fueled heating and transportation to more reliant on efficient electric heating and transportation.

Household journeys:[64]

- **Starting Point:** Fossil fueled heating and transportation with average existing equipment
- **Conventional Replacement:** Fossil fueled heating and transportation with new, more efficient equipment
- **Moderate Efficient Electrification:** Some electrification of heating and transportation, with basic building envelope (or shell) efficiency measures
- **High Efficient Electrification:** More electrification of heating and transportation, with basic or medium building envelope efficiency measures, and efficient electric appliances

6.4.1. KEY ANALYSIS TAKEAWAYS

Energy-saving measures, such as weatherization and building envelope efficiency, efficient appliances and equipment, fuel-efficient vehicles and EVs, and transit use can lower overall household and transportation energy expenditures. Households pursuing these measures are likely to see gradually declining rates of energy consumption and energy spending in real dollar terms over time due to the combined impacts of adopting more efficient equipment. The nature and extent of these cost savings differ by profile, with dynamics that vary across regions, building types, and income levels.

The analysis shows significant opportunities for households to lower transportation energy expenditures. For driving households, both conventional replacement with a more fuel-efficient option and vehicle electrification can lower transportation energy spending relative to the average starting point, and vehicle electrification can further reduce transportation energy spending relative to conventional replacement outside of NYC. In addition, households well-served by transit, including in NYC, can keep overall energy costs lower than average by minimizing or avoiding transportation energy expenditures.

Household energy expenditures vary across profiles and journeys. Households that heat with a delivered fuel, such as heating oil, can realize substantial savings from efficient electrification. For households that use natural gas heating, household energy costs could increase with heat pump adoption; however, the combined impacts of heat pump adoption, building envelope efficiency, and more efficient lighting and appliances can lower household energy expenditures.

Although households pursuing efficient electrification may experience lower combined operating costs, the analysis shows these households would see a net cost increase relative to a conventional replacement journey when including the combined up-front costs for vehicles, heating systems, efficient appliances, and building envelope measures.

6.4.2. ENERGY AFFORDABILITY CONCLUSIONS

Across the U.S. and New York, households face affordability challenges. Energy is an important affordability challenge for many households, as a subset of housing and transportation costs. For many LMI households meeting energy needs can impose substantial cost burdens. To understand how energy costs impact people, it is important to look comprehensively at both household and transportation energy spending, which is lower in New York than the national average, as well as lower than the top outmigration states from New York.

LMI households are more likely to experience energy affordability challenges. Across the U.S. and New York, although LMI households on average use less energy and spend less on energy than higher income households, their combined energy burdens are still often many times greater. In addition, lower-income households and vulnerable populations experience energy insecurity at above average-rates. These dynamics further exacerbate disparities in health and quality of life.

Energy-saving measures, such as building envelope efficiency, efficient appliances and equipment, fuel-efficient vehicles and EVs, and transit use, can lower overall household energy costs. Many households pursuing these measures are likely to see net reductions in operating costs due to the combined impacts of a variety of efficiency measures, including efficient electrification, on household and transportation energy spending. For some LMI households, such as transit-dependent households and those that do not currently pay a heating bill, continued attention will be needed to advance overall energy cost reductions when pursuing efficient electrification.

Policy and market solutions that focus on lowering up-front costs and other barriers to adoption for a range of energy efficiency and efficient electrification measures have the potential to enable households to realize more affordable operating costs. This can, in turn, help to alleviate energy insecurity and energy burdens.

Glossary of Key Terms

Active Transportation
Active Transportation includes human-powered modes of transportation—walking, bicycling, and operating a wheelchair—along with small-scale electric vehicles such as e-bikes and e-scooters (also known as “micromobility”).

Adaptation
In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; the process by which a system moves toward resilience.

Advanced Clean Cars II (ACC II)
A regulation adopted by New York State that will require all new passenger cars and trucks sold in New York State to be zero-emissions by 2035.

Advanced Clean Trucks (ACT)
A regulation adopted by New York State that requires manufacturers of vehicles greater than 8,500 pounds to sell an increasing number of zero-emission vehicles (ZEVs) in New York State.

Agricultural Sector
Grows crops, raises livestock, and harvests plants and animals from their natural habitats.

Agrivoltaics
The simultaneous use of land for solar photovoltaic power generation and agricultural production of crops, livestock, and livestock products.

Alternative Fuels
Alternative Fuels: Liquid or gaseous fuel derived from biomass or clean energy such as biodiesel, renewable natural gas (RNG), renewable diesel, hydrogen, sustainable aviation fuel (SAF), and synthetic fuels.

Apprenticeship Utilization
A requirement that a certain percentage of labor hours for a given project be performed by Registered Apprentices.

Biogas
Biogas is gas resulting from the decomposition of organic matter, most commonly under anaerobic conditions (such as in a landfill, manure storage, or wastewater recovery facility). The principal constituents are methane and carbon dioxide. Some end-uses can use biogas directly as a fuel source with minimal processing, though its lower energy density and purity compared to conventional natural gas or renewable natural gas precludes it from most end-uses.

Biofuel
Fuels produced from biomass such as plants or organic wastes.

Biodiesel
Biodiesel is produced from vegetable oils, animal fat, and recycled cooking oil. It is a liquid fuel that can be blended with conventional diesel but cannot entirely replace it. Biodiesel can be blended in most applications that use diesel.

Brownfield Opportunity Area Program
Created to support community planning for the reuse and redevelopment of known or suspected contaminated areas.

Brownfield
A former industrial or commercial site where future use is affected by real or suspected environmental contamination.

Building Shell Upgrades
Upgrades to a building protecting the interior from outside temperatures and moisture to cut energy use and enhance indoor comfort through measures such as air sealing, insulation, and window upgrades. Also called building envelope upgrades.

Bulk Power System
Operated by the New York State Independent System Operator (NYISO), which generally consists of transmission lines operating at 230 kilovolt (kV) and above and certain lower voltage facilities, which the NYISO manages to ensure system reliability. The bulk power system in New York State consists of approximately 4,100 miles of high-voltage transmission lines.

Bulk Terminal
Petroleum facility designed for the storage and distribution of refined petroleum fuels such as heating oil, motor gasoline, diesel and other products.

Capacity Factor (in the context of power generation)
Measures the ratio of a power plant's actual generation relative to the maximum amount it could generate annually if producing at full capacity without any interruption.

Carbon Capture Utilization and/or Storage (CCUS/CSS)
Technologies capture carbon dioxide (CO_2) emissions from large sources, like power plants and industrial facilities, or directly from the atmosphere, which is then either repurposed or stored. Also called carbon capture and sequestration.

City Gate
The point at which gas utilities or local distribution companies take operational responsibility for safely and reliably transporting gas to customers.

Clean Energy Worker (job)
Any energy worker (job) that is directly involved with work related to the following clean energy sectors: renewable electric power generation; grid modernization and energy storage; building decarbonization and energy efficiency; renewable fuels; and clean and alternative fuels transportation.

Climate Act
New York's Climate Leadership and Community Protection Act (Climate Act) was signed into law in July 2019.

Climate Justice
Justice that links development and human rights to achieve a human-centered approach to addressing climate change, safeguarding the rights of the most vulnerable people and sharing the burdens and benefits of climate action and its impacts equitably and fairly.[1]

Climate Justice Working Group (CJWG)
This body was created by the Climate Act and is composed of representatives from environmental justice communities across the state, including three from New York City, three from rural areas, and three from urban communities in upstate New York. It also includes

1 "Principles of Climate Justice," Mary Robinson Foundation – Climate Justice, https://www.mrfcj.org/principles-of-climate-justice/, accessed December 8, 2025.

representatives from the New York State Departments of Environmental Conservation (DEC)—which chairs the CJWG—Health (DOH), Labor (DOL), and the New York State Energy Research and Development Authority (NYSERDA).[2] The Climate Act requires the CJWG to establish criteria to identify disadvantaged communities for the purposes of: (1) emissions reductions (greenhouse gases and co-pollutants), (2) regulatory impact statements, and (3) the allocation of investments related to the Climate Act.[3]

Climate Mitigation
A human intervention to reduce emissions or enhance the sinks of greenhouse gases. (See also "Greenhouse Gas Mitigation").

Climate Resilience
A system's ability to anticipate, prepare for, respond to, recover from, and adapt to a disruption, such as an extreme climate hazard, with minimum damage to social well-being, public health, the economy, and the environment.

Combustion (in the context of power generation)
Generators that burn fuel, often gaseous or liquid, to produce electricity. Within the State Energy Plan, potential combustion fuels include natural gas, renewable natural gas, fuel oil, and hydrogen.

Commercialization
Commercialization programs help bring beneficial energy technologies and services to market through technical assistance, financing, customer discovery, and further product development.

Community Air Monitoring (CAM) Initiative
The Climate Act required DEC to develop a CAM program to identify and measure air pollution in priority DAC locations that have the highest potential exposure burdens to air pollutants.[4] DEC used mobile air monitoring to conduct street-by-street assessments in 10 disadvantaged communities. Using these results, community input, and other data, DEC is identifying air pollution sources and prioritizing areas of concern near sensitive sites such as schools and nursing homes. To guide this process, DEC established Community Advisory Committees (CACs) in each of the 10 disadvantaged communities. These CACs will collaborate with DEC, the CJWG, and other state agencies to develop strategies aimed at reducing air pollution in disadvantaged communities.

2 N.Y. ECL § 75-0115 (2019).
3 N.Y. ECL § 75-0111(1)(b).
4 N.Y. ECL § 75-0115 (2019)

Community Lifelines
The most fundamental services in the community that, when stabilized, enable all other aspects of society to function. They include Safety and Security; Health and Medical; Energy; Communications; Transportation; Food, Hydration, Shelter; Hazardous Materials and Water Systems.

Consequence
The effect of the loss or degradation of an energy infrastructure asset on energy supply or service, and the associated indirect impacts of those losses on society.

Conventional Fuels
The fossil fuel that is typically used today, such as conventional diesel, conventional jet fuel, conventional natural gas.

Co-Pollutant Emissions
Air pollutants that are a byproduct from combustion of fossil fuels and most alternative fuels. These include fine particulate matter ($PM_{2.5}$), nitrogen oxides (NO_X), volatile organic compounds (VOC), sulfur dioxide (SO_2), and various toxic compounds. These pollutants contribute to a range of health issues, including respiratory conditions, asthma, heart attacks, and other serious illness.

Cross-Sector Interdependency
One energy sector (electricity, gas or liquid fuel) relying on another energy sector; for example, the electric sector has a cross-sector interdependency with the natural gas sector.

Decommissioning
The final process of safely closing and dismantling a facility or equipment after its operational life such as a power plant, nuclear facility, or natural gas infrastructure.

Demand Response
Programs that encourage customers to reduce consumption during periods of high demand, sometimes by shifting demand from high load periods to periods of lower demand. These programs are typically administered by utilities.

Design Day Demand
The expected consumption of natural gas by a gas utility's firm service customers on a design day.

Direct Entry Program
New-York-State-approved apprenticeship preparation programs that can help workers get the skills they need to meet the minimum requirements of a New York State Registered Apprenticeship program. Successful participants have a direct opportunity to interview with a sponsor of a New York State Registered Apprenticeship Program. Direct Entry providers are required to have agreements with New York State Registered Apprenticeship program sponsors to ensure the availability of jobs with those sponsors. Direct Entry Programs cannot charge tuition.[5]

Disadvantaged Communities
The Climate Act defines disadvantaged communities as communities that bear burdens of negative public health effects, environmental pollution, impacts of climate change, and possess certain socioeconomic criteria, or comprise of high-concentrations of low- and moderate-income households. Disadvantaged communities are identified using criteria as established by the Climate Justice Working Group.[6] On March 27, 2023, the Climate Justice Working Group voted to approve the disadvantaged community criteria.[7] Indigenous Nations and Indigenous Peoples are included in the disadvantaged community criteria as individual members of census tracts as counted by the U.S. Census Bureau in counts of American Indian and Alaska Native population (a selected indicator) and as citizens of sovereign Nations or residents of Nation-owned territory if the Nation-owned territory (either sovereign territory or owned) exceeds five percent of the area of a census tract.

Dispatchable Emissions-Free Resources (DEFRs)
Firm electric generation resources that can be rapidly turned on or off, or adjusted as needed, to meet electricity demand with low to no emissions. Note a formal definition of eligibility is still being developed in the Public Service Commission (PSC) Zero by 40 Proceeding. These may be needed to provide electricity during extended periods of high demand and/or low renewable generation, such as winter weeks with increased heating loads from heat pumps coupled with lower renewable output, when short-duration storage would be insufficient to meet demand. Some DEFRs can also provide zero-emission energy outside of challenging days and weeks.

Distributional Equity
Refers to the fair distribution of the benefits and burdens of energy policies and programs.

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5 "Apprenticeship Direct Entry," DOL, accessed July 1, 2025, https://dol.ny.gov/direct-entry.
6 N.Y. ECL § 75-0101(5) (2019).
7 "Disadvantaged Communities Criteria," New York State Climate Act, https://climate.ny.gov/Resources/Disadvantaged-Communities-Criteria, accessed December 5, 2025.

In an equitable energy system, all communities receive a fair share of clean energy investments, job opportunities, cost savings, and pollution reductions.[8]

Ecosystem
A dynamic complex of plant, animal (including human), and microorganism communities interacting with each other and the nonliving environment as a functional unit.

Ecosystem Services
Benefits people obtain from an ecosystem.

Efficient Electric Heat Pumps
Include ground source heat pumps and heat pump water heater systems that meet or exceed the U.S. Environmental Protection Agency's ENERGY STAR specification, as well as cold climate air-source heat pumps, packaged terminal heat pumps, and variable refrigerant flow products that meet or exceed standard specifications for heat pumps that are best suited to heat efficiently in cold climates.

Efficient Electrification
Electrification of a building with an adequately efficient thermal envelope to conserve energy use, keep occupants comfortable, and enable an efficient electric heat pump system to operate effectively.

Electric Peak Demand
The highest actual average hourly load that occurred during a calendar year. Given that the electric transmission and distribution systems are designed and built to serve peak load, reducing peak demand is important for improving system efficiency, reducing wholesale electricity prices, and delaying the need for additional infrastructure.

Electric Vehicles (EVs)
Vehicles powered by electricity from an external source stored onboard in a battery, including both battery-electric vehicles (BEVs), which run exclusively on electricity, and plug-in hybrid electric vehicles (PHEVs), which run exclusively on electricity for a limited range and then are powered by an internal combustion engine.

Embodied Emissions
The total greenhouse gas emissions generated throughout the entire life cycle of a product,

8 American Council for an Energy-Efficient Economy, Energy Equity: Conceptual Framework, January 2021, https://www.aceee.org/research-report/e2101.

particularly emphasizing the stages before its operational use. This includes the extraction of raw materials, manufacturing, transportation, construction, and disposal at the end of its life.

Emergency
A serious, unexpected, and often dangerous situation requiring immediate action.

Endangered
Under the Endangered Species Act (ESA), plant and animal species that may be in danger of extinction throughout all or a significant portion of their range.

Energy Burden
Percentage of gross income that a household spends on energy. It is calculated by dividing the average housing energy cost by the average annual household income. When a household is described as energy burdened, that generally means it spends more than six percent of household income on energy.[9]

Energy Insecurity
The inability to meet basic energy needs. It may mean having to choose between energy and other expenses, keeping your house at an unsafe or unhealthy temperature to save expenses, or being unable to pay energy bills.

Energy Justice
The goal of achieving equity in both the social and economic participation in the energy system, while also remediating social, economic, and health burdens on those communities historically disadvantaged by the energy system. Energy justice in New York centers the concerns of disadvantaged communities and aims to make energy more accessible, affordable, clean, and democratically managed for all communities. The practitioner and academic approaches to energy justice emphasize these process-related and distributive justice concerns.[10]

Environmental Justice
The fair treatment and meaningful involvement of all people regardless of race, color, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including a racial, ethnic, or socioeconomic group, should bear a disproportionate share of the negative

9 "Low-Income Energy Affordability Data (LEAD) Tool" U.S. Department of Energy, https://www.energy.gov/scep/low-income-energy-affordability-data-lead-tool, accessed December 8, 2025.
10 "Section 1 – Defining Energy Justice: Connections to Environmental Justice, Climate Justice, and the Just Transition," Initiative for Energy Justice, n.d., https://iejusa.org/section-1-defining-energy-justice/.

environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies.[11]

Energy Security Planning and Emergency Preparedness
Plans and actions that ensure a reliable and resilient supply of energy that protects public health, safety, and welfare while minimizing economic disruption. Energy Security Planning identifies, assesses, and mitigates risks to energy infrastructure and plans for, responds to, and recovers from events that disrupt energy supply. New York State Energy Emergency Preparedness includes energy emergency planning and response as well as energy security risk and mitigation planning through the New York State Energy Emergency Plan and the New York State Energy Security Plan.

Energy Worker (Job)
Any worker (job) that is directly involved with the research, development, production, manufacture, distribution, sales, implementation, installation, maintenance, or repair of components, goods, or services related to the energy system. These workers also include supporting services including but not limited to consulting, finance, tax, and legal services related to energy.

Fine Particulate Matter ($PM_{2.5}$)
Airborne particles less than 2.5 micrometers in diameter, can travel into the lungs, infiltrate the bloodstream, and cause cardiovascular and respiratory health effects. $PM_{2.5}$ is directly emitted from combustion sources (primary $PM_{2.5}$) and also forms in the atmosphere through reactions of precursor pollutants, including nitrogen oxides (NO_X), sulfur dioxide (SO_2), ammonia (NH_3), and volatile organic compounds (VOCs).

Firm Service
Service for natural gas customers who lack alternatives to natural gas consumption and require uninterrupted delivery of gas. Residential and small commercial customers typically receive firm gas service.

Fossil Fuel Workers (jobs)
Any energy worker (job) that is directly involved with work related to energy derived from fossil fuels, including electric generation, delivered fuels, internal combustion vehicles, and natural gas distribution.

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11 Commissioner Erin M. Crotty "Commissioner Policy 29, Environmental Justice and Permitting," (NYSDEC, last updated March 19, 2003), https://dec.ny.gov/regulatory/guidance-and-policy-documents/commissioner-policy-29-environmental-justice-and-permitting.

Fossil Fuels
Fuels produced from the decay of prehistoric organic materials. These fuels can be liquid (example: petroleum) or gaseous (example: natural gas).

Green Infrastructure
Measures that strategically utilize plantings, soils, and other media to capture and treat stormwater by relying on the natural processes of filtration, infiltration, and evapotranspiration.[12] Green Infrastructure can also help cool communities and mitigate the urban heat island effect.[13]

Greenhouse Gas Mitigation
A human intervention to reduce emissions or enhance the sinks of greenhouse gases. (See also "Climate Mitigation".)

Greenhouse Gas
Gases that trap some of the Earth's outgoing energy, thus retaining heat in the atmosphere. This heat trapping, known as the greenhouse gas effect, alters climate and weather patterns at global and regional scales. Greenhouse gases include carbon dioxide, methane, nitrous oxide, and certain synthetic chemicals, such as fluorocarbons and sulfur hexafluoride.

Hazard Mitigation
Any sustained action taken to reduce or eliminate long-term risk to life and property from hazard events. It is an on-going process that occurs before, during, and after disasters and serves to break the cycle of damage and repair in hazardous areas. More generally, mitigation is the action of reducing the severity, seriousness, or painfulness of a risk.

Home Rule
The Home Rule form of government exercised by local governments (counties, cities, towns, and villages) is authorized by Article IX of the New York State Constitution.[14] as implemented through the enactment of statutes like the Statute of Local Governments and the Municipal Home Rule Law. Statutes like these outline and otherwise grant a range of powers and the procedures for their exercise, including the ability of cities, towns, and villages to regulate land use and zoning and the ability of all local governments to enact local laws, undertake comprehensive planning, own and maintain municipal property and roadways, and levy local

12 "About Green Infrastructure," U.S. Environmental Protection Agency, (EPA), February 13, 2025, https://www.epa.gov/green-infrastructure/about-green-infrastructure.
13 "Reduce Heat Islands," U.S. EPA, April 22, 2025, https://www.epa.gov/green-infrastructure/reduce-heat-islands.
14 N.Y. Const. art. IX, § 2, https://dos.ny.gov/system/files/documents/2025/01/constitution-january-1-2025.pdf.

taxes. Because cities, towns, and villages control most zoning and land use decisions, the State typically assumes an advisory and funding role with land use planning.

Household Income Strata

- **Low-income** includes households with incomes at or below 60 percent of State Median Income.
- **Moderate-income** includes households with incomes above 60 percent but below 80 percent of State Median income or Area Median Income, whichever is higher.
- **Average income** uses the average income of a household in an analysis region to represent households with incomes that fall above the low- or moderate-income range.

Hybrid Heat Pump

A heat pump system installed that is not sized to meet the full heating load of the building, requiring the use of a supplemental heating system during the coldest hours of the year.

Hydrogen

Hydrogen is an energy carrier that is typically produced via thermal processes, using high temperatures, or electrolytic processes, using water and electricity. Hydrogen can be used for many end-uses and is either combusted or used in fuel cells to provide electricity. Hydrogen can also be converted to synthetic fuels (see below) Hydrogen is only considered a zero-emission fuel if its production does not include the use of fossil fuels (e.g., electrolysis powered by renewable energy).

Indigenous Knowledge

A body of observations, oral and written knowledge, innovations, practices, and beliefs developed by Indigenous peoples through interaction and experience with the environment. It is applied to phenomena across biological, physical, social, cultural, and spiritual systems. Indigenous knowledge can be developed over millennia, continues to develop, and includes understanding based on evidence acquired through direct contact with the environment and long-term experiences, as well as extensive observations, lessons, and skills passed from generation to generation.[15] Coordination with Indigenous Nations, and the respectful incorporation of Indigenous knowledge should honor Indigenous Nation sovereignty.

Indigenous Nations

Refers to any State- or federally-recognized Indigenous Nations (as indicated on the New York State Office of Parks, Recreation & Historic Preservation “Indigenous Nation Areas of

15 “Overview—Indigenous Knowledge and Traditional Ecological Knowledge,” U.S. National Park Service, last modified June 26, 2024, https://www.nps.gov/subjects/tek/description.htm

Interest in New York State" map[16]), Nation-owned parcels, current reservation boundaries, or lands held in trust by the federal government for that Indigenous Nation. Nine Indigenous Nations reside within, or have common geographic borders with, New York State: Cayuga Nation, Oneida Indian Nation, Onondaga Nation, Saint Regis Mohawk Tribe, Seneca Nation of Indians, Shinnecock Indian Nation, Tonawanda Seneca Nation, Tuscarora Nation, and Unkechaug Indian Nation. The United States formally recognizes all but the Unkechaug Nation. The State of New York recognizes all nine Nations.[17]

Industrial Sector
Businesses focused on the mass production of goods, often involving machinery, technology, and a significant workforce.

Innovation Ecosystem
Innovation ecosystems are communities of interacting stakeholders engaged in producing, enhancing, and creating novel methods, products, and processes.

Installed Capacity
The amount of electric power that can be generated in the state.

Installed Reserve Margin
The amount of generation capacity that must be in place to ensure an acceptable level of reliability. The IRM is measured by the amount of generation and other capacity resources above 100% of forecasted peak load that must be available to serve all customers without interruption.

Interruptible Service
Service for natural gas customers who can employ an alternative fuel or cease consumption of natural gas entirely when requested to do so by the gas utility (often at a particular cold temperature threshold). Customers receiving interruptible service pay reduced distribution rates.

Intra-Sector Interdependency
One part of an energy sector (electricity, gas or liquid fuel) relying on or controlled by another part of the energy system within the same sector; for example, the liquid fuel inventory in

16 "Indigenous Nation Areas of Interest in New York State" New York State Office of Parks, Recreation & Historic Preservation , last updated August 2024, https://www.arcgis.com/home/item.html?id=59341d9537b54e439e2581e5ef468ad2.

17 New York State Climate Justice Working Group (CJWG) and New York State Department of Environmental Conservation (NYSDEC), 2023 Disadvantaged Communities Criteria Final Report, (New York State Climate Action Council, January 14, 2025), https://climate.ny.gov/-/media/Project/Climate/Files/Disadvantaged-Communities-Criteria/Technical-Documentation-on-the-Disadvantaged-Communities-Criteria---Final-Version.pdf.

New York has an intra-dependency with refinery production and pipeline operations in the Gulf states.

Investment/Production Tax Credit (ITC/PTC)
U.S. federal tax credits designed to promote clean energy development. The ITC provides a tax credit based on a percentage of the upfront investment cost to build eligible renewable energy projects. The PTC offers a tax credit based on the amount of electricity a qualifying renewable facility generates over time. Credits deployed and extended under the Inflation Reduction Act have since been significantly changed as a result of H.R. 1.

Joint Utilities (JU)
The Joint Utilities are comprised of Central Hudson Gas and Electric Corporation, Consolidated Edison Company of New York, Inc. ("Con Edison"), New York State Electric & Gas Corporation, Niagara Mohawk Power Corporation d/b/a National Grid ("National Grid"), Orange and Rockland Utilities, Inc. and Rochester Gas and Electric Corporation. Together, the Joint Utilities provide electric service to over 13 million households, businesses, and government facilities across New York State.

Labor Peace Agreement
Agreements between employers and a union limiting certain actions from both sides for a specified period of time. Labor peace agreements may require management to remain neutral and not interfere in any union organizing, and the union to avoid strikes or other activities that could seriously interrupt workplace operations.[18]

Life Cycle Analysis (LCA)
Evaluates the potential environmental impacts associated with a product, process, or service throughout its entire life cycle.

Light Water Reactors (LWRs)
A term used to describe reactors using ordinary water as a moderated coolant.[19]

Light-Duty Vehicles
On-road vehicles under 8,500 lbs. gross vehicle weight rating (GVWR), Class 1 and 2a, per the U.S. Environmental Protection Agency (US EPA) classification system.

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18 "Climate Jobs Institute," School of Industrial and Labor Relations at Cornell University, accessed July 20, 2025, https://www.ilr.cornell.edu/climate-jobs-institute.

19 U.S. Nuclear Regulatory Commission (NRC). Glossary. https://www.nrc.gov/reading-rm/basic-ref/glossary.html#S

Liquid Fuels
Another name for delivered fuels. A group of fuels that, at surface temperatures, are in the liquid phase with little or no pressurization, as a result, these fuels can be transported by a variety of modes.

Load Factor
Load factor is a measure of the degree of uniformity of demand over a period of time, usually one year, and equivalent to the ratio of average demand to peak demand expressed as a percentage. It is calculated by dividing the total energy provided by a system during a period by the product of peak demand during the period and the number of hours in the period.[20]

Load Serving Entity
A retail electric service provider (e.g., a utility) that is obligated to procure or purchase wholesale electricity to serve its end-use customers.

Local distribution company
A gas utility. LDCs are responsible for building and maintaining a local pipeline system that delivers natural gas to end use customers, such as businesses and homes, after receiving gas from a transmission pipeline at the city gate or another source.

Location-efficient Areas
Compact and resilient neighborhoods that offer walkability, a mix of uses, proximity to daily destinations, and reduced reliance on automobiles.

Low-carbon Fuels and Energy Sources
Produce significantly fewer greenhouse gas emissions during their lifecycle compared to traditional fossil fuels.

Managed Charging
The practice of controlling the speed and/or time at which an EV is charged for the purpose of minimizing charging during times of peak electricity usage and minimizing charging costs for the EV driver.

Manufacturing Sector
Encompasses firms that transform raw materials into finished goods.

20 North American Energy Standards Board Wholesale Electric Industry Glossary.

Medium- and Heavy-Duty Vehicles
On-road vehicles over 8,500 lbs. gross vehicle weight rating (GVWR), Class 2b through 8, per the U.S. Environmental Protection Agency (US EPA) classification system.

Megawatt Electrical
The electric output capability of a power plant.

Microcredentials
Flexible and compact academic credentials created to meet specific workforce needs that are taught by faculty. Often credit bearing, these empower individuals with essential skills, knowledge and practical experience in high-demand fields and are designed to be stackable and build into degrees.

Micromobility
Any low-speed, human or electric-powered transportation device, including bicycles, scooters, electric-assist bicycles (e-bikes), electric scooters (e-scooters), and other small, lightweight, wheeled conveyances.

New York Control Area
The New York Control Area (NYCA) is comprised of eleven geographic zones (also referred to as "load zones") from western New York (Zone A) through Long Island (Zone K).[21]

New York State Energy Emergency Plan
An emergency response plan outlining State activities and responsibilities in response to an energy emergency. The scope includes emergency response planning and coordination with federal and industry partners; it does not identify the major risks to the current energy system or include longer-term resilience or mitigation activities. It is an annex to the State's Comprehensive Emergency Management Plan.

New York State Energy Security Plan
A plan focused on identifying and protecting the state energy systems by providing a detailed, comprehensive risk assessment of critical energy infrastructure and cross-sector interdependencies and providing a framework for evaluating risk mitigation approaches to enhance reliability and end-use resilience.

Nuclear Generations
Nuclear technology discussions often refer to "generations" of nuclear designs, with current

21 New York Independent System Operator (NYISO) Comprehensive Reliability Plan. 2023. https://www.nyiso.com/documents/20142/2248481/2023-2032-Comprehensive-Reliability-Plan.pdf

operating large LWRs referred to as “Gen II” or “Gen III.” Newer advanced technologies are categorized as either “Gen III+,” defined as large or small modular light water reactors that offer improved economics and safety over conventional large light water reactors, or “Gen IV,” defined as small modular reactors (SMRs) or microreactors that offer improved sustainability, economics, safety, and proliferation and use non-water coolants. Gen IV technologies include high temperature gas reactors, liquid sodium metal reactors, and molten salt reactors.

Operational Flow Order
A mechanism used in the natural gas industry to manage and maintain the operational integrity of a pipeline system. It requires shippers to balance their gas supply with their customers’ usage on a daily basis, within a specified tolerance band, to prevent system imbalances and potential operational issues.

Ozone
A respiratory irritant when it reaches elevated concentrations in surface air. Ozone is not emitted directly into the air, rather it is produced by chemical reactions between NO_X and VOCs in the presence of sunlight. Ozone is most efficiently formed on hot sunny days in areas with high concentrations of emission sources.

Pathways Model
An economy-wide stock rollover model that calculates stocks, sales, energy use, and greenhouse gas emissions from transportation, buildings, industry, and other sectors, and captures interactions among measures to create a detailed picture of the energy system through 2050.

Petroleum Fuels
Another name for crude oil. This liquid extracted from wells is a mixture of organic molecules that can be separated into specific fuels through a refining process. Petroleum fuels include fuels such as diesel, gasoline, kerosene, and propane.

Phased Electrification
Projects wherein the building electrification process is carried out over time. This staged approach aims to electrify most or all a building’s energy systems while minimizing disruptions to building operations and occupant experience. This may be a multifamily or commercial building where certain units of the building are converted to electric heat pumps for space heating (e.g., at the time of tenant turnover), or as part of a phased more comprehensive renovation project. This may also result in instances where full electrification of the building may not be possible due to available electric capacity or limitations related to customers’ capital cycles.

Pre-apprenticeship Program
Programs or a set of services designed to prepare individuals to enter and succeed in an apprenticeship program. By definition, a pre-apprenticeship program has a documented partnership with at least one apprenticeship program. Pre-apprenticeships help individuals meet the entry requirements for apprenticeship programs and ensure they are prepared to be successful in their apprenticeship.[22]

Prevailing Wage
A wage standard required by federal and State law for publicly funded or publicly assisted projects. Prevailing wages define the hourly wages, benefits, and overtime rates for a particular geographic area, for a particular trade, as determined by the United States Department of Labor or the New York State Department of Labor (DOL). In New York State, the DOL's Bureau of Public Work and Prevailing Wage Enforcement is responsible for enforcement of state prevailing wage requirements.[23]

Priority Populations
These include veterans; individuals with disabilities; low-income individuals, whose household's total income is below or at 60 percent of the State Median Income or whose household has been determined eligible for or is receiving assistance through the Home Energy Assistance Program, Temporary Assistance for Needy Families, Supplemental Nutrition Assistance Program, or other human service benefit programs; incumbent or unemployed fossil fuel workers; previously incarcerated individuals; 16- to 24-year-olds who are enrolled in or have completed a comprehensive work preparedness training program such as those offered by Boards of Cooperative Education Services, technical high schools, Conservation Corps, YouthBuild, and AmeriCorps; homeless individuals; and single parents.[24]

Procedural Equity
Fair and transparent processes used for decision-making, resource allocation, and policy development. Decision makers create inclusive and accessible processes for developing and implementing clean energy programs such that all stakeholders have equitable access to participate.[25]

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22 "Workforce Development and Training Definitions," New York State Energy Research and Development Authority (NYSERDA), 2025, https://www.nyserda.ny.gov/All-Programs/Clean-Energy-Workforce-Development-and-Training/Resources/Definitions.
23 "Bureau of Public Work and Prevailing Wage Enforcement," New York State Department of Labor (DOL), accessed July 20, 2025, https://dol.ny.gov/bureau-public-work-and-prevailing-wage-enforcement.
24 NYSERDA, "Definitions."
25 American Council for an Energy-Efficient Economy, Energy Equity: Conceptual Framework, January 2021, https://www.aceee.org/research-report/e2101.

Project Labor Agreement
Labor Law §222(1) provides that a project labor agreement (PLA) is a pre-hire collective bargaining agreement between a contractor and a bona fide building and construction trade labor organization establishing the labor organization as the collective bargaining representative for all persons who will perform work on a public work project, and which provides that only contractors and subcontractor who sign a pre-negotiated agreement with the labor organization can perform work.

RECAP Model (Resource Adequacy)
A loss-of-load-probability model designed to evaluate the resource adequacy of electric power systems, including systems with high penetrations of renewable energy and other dispatch-limited resources such as hydropower, energy storage, and demand response.

Regional Planning Commission
(Also referred to as a committee, board, or council) is a quasi-governmental body that supports municipalities within a defined region by providing planning, coordination, and technical assistance. These organizations help local governments, often facing capacity constraints, address issues that cross jurisdictional boundaries, including transportation, land use, environmental sustainability, economic development, and regional infrastructure.[26]

Registered Apprenticeship Program
Programs that offer standardized training for workers to learn the skills and abilities they will need to be a fully functioning journey worker in a specific trade/occupation. They utilize an "earn-while-you-learn" model, including a minimum of 2,000 hours of paid on-the-job training combined with related instruction, often provided in a classroom and/or lab setting. They can be operated by a single employer or a group of employers, and with or without the participation of a labor union. In New York State, programs must be registered with the New York State Department of Labor.[27]

Reliability
The energy system's ability to function consistently during normal conditions. In many cases, adaptation strategies that improve resilience also have the benefit of improving reliability.

Renewable Diesel
Renewable diesel is interchangeable with conventional diesel. It is typically produced by

26 A list of regional planning commissions within New York State can be found at https://dos.ny.gov/planning-organizations
27 "Registered Apprenticeship: A Different Kind of Higher Ed.," DOL, accessed July 2, 2025, https://dol.ny.gov/apprenticeship/overview.

hydrotreating, combining fats and hydrogen at high temperatures. Renewable diesel can be used as a drop-in replacement for any application that uses diesel.

Renewable Natural Gas
Renewable natural gas (RNG) is biogas that has been processed and upgraded to a higher methane content with less impurities and can be used as a drop-in replacement of natural gas in end-uses such as the power sector, industrial processes, buildings, and transportation.

Research, Development, and Demonstration (RD&D)
RD&D includes basic and applied research, development of new products or services (including modification to existing products, services), and demonstration of benefits and risks in a real-world setting.

Resilience
The capacity to withstand or to recover quickly from negative events such as natural disasters, climate change, and other threats/hazards.

RESOLVE Model (Capacity Expansion)
An electricity resource planning model that identifies optimal long-term electric generation and transmission investments subject to reliability, policy, and technical constraints.

Resource Efficient Decarbonization
A phased approach to eliminating greenhouse gas emissions from large buildings in cold climates that creates a path toward cost-effective decarbonization.

Risk
The potential for the loss or degradation of energy supply or services, and the associated indirect impacts of those losses on society, resulting from the exposure of energy infrastructure to a threat.

Risk Mitigation Strategy
A proactive approach to enhance the State's energy reliability and end-use resilience through which Risk Mitigation Measures are identified, evaluated, and potentially prioritized for implementation.

Sales Share (in the context of the Pathways model)
The percent (%) of building or transportation stock units purchasing equipment in a given year that adopt the target technology (e.g., residential housing units purchasing equipment in a given year that adopt the target technology such as high-efficiency heat pumps as the primary heating system or efficient shell packages).

Sensitivity (in the context of the Pathways model)
A modeling case built off an existing scenario with a targeted variable(s) changed to explore specific questions on the future of the energy system. Examples of sensitivities run for the Final State Energy Plan include "Zero Carbon Firm" and "Federal Policies" sensitivities. These differ from the scenarios within the model that change multiple variables to reflect potential energy futures of these updated variables acting at the same time.

Small Modular Reactors (SMRs)
Smaller, more advanced nuclear reactors that offer improved sustainability, economics, safety, and proliferation and use non-water coolants.

Smart Growth
An approach to planning and development that supports and integrates equity, economic vitality, environmental sustainability, energy, public health, healthy aging, and climate resilience to create livable, sustainable communities for people of all ages, incomes, backgrounds, and abilities.[28, 29]

Spot Market / Spot Price
A market where assets are traded for immediate delivery and payment. (As contrasted with futures markets, where transactions are settled at a future date).

Sprawl
The development of low-density, automobile-dependent development that spreads beyond urbanized areas into rural and natural landscapes. It often results in inefficient land use and loss of agricultural and open lands while also stretching and straining water, transportation, and energy infrastructure, as well as other municipal services.

Stock Share (in the context of the Pathways model)
The percent (%) of building or transportation stock units that are present in the economy in a given year, as a percentage of the total building or transportation stock units of a given category (e.g., the number of light-duty battery electric vehicles on the roads as a share of total light-duty vehicles on the road).

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28 These Smart Growth principles guide the New York State Department of State's Smart Growth Community Planning Program and are informed by the original principles developed by the Smart Growth America Network and the criteria outline in the State Smart Growth Public Infrastructure Policy Act

29 Smart Growth Network and U.S. Environmental Protection Agency, This Is Smart Growth, April 2014, https://www.epa.gov/sites/default/files/2014-04/documents/this-is-smart-growth.pdf; State Smart Growth Public Infrastructure Criteria, New York State Senate, Environmental Conservation, Chapter 43-B, § 6-0107 (2015), https://www.nysenate.gov/legislation/laws/ENV/6-0107.

Strike Price
A predetermined fixed price at which the owner of an option can buy or sell an underlying asset.

Subsidized Affordable Housing
Housing that is affordable because of government subsidy. This can include, but is not limited to, housing units receiving support under the U.S. Department of Housing and Urban Development programs (e.g., Section 8 Housing Choice Voucher, tenant-based vouchers, project-based vouchers, and HOME), including units owned or overseen by Public Housing Authorities.

Supplemental Heat
A heating system that is installed or left in place to complement a heat pump heating system that is not sized to meet the full heating load of the building, providing heat to supplement the main heating system during the coldest hours of the year.

Sustainable Aviation Fuel (SAF)
Sustainable Aviation Fuel is typically produced from biomass waste and fats/greases/oils. It is a newer alternative fuel that can be blended with conventional jet fuel.

Synthetic Fuel
Synthetic fuels are produced by combining hydrogen and carbon dioxide using renewable energy. Synthetic natural gas and other liquid synthetic fuels such as renewable diesel and SAF can be produced.

Thermal Energy Network
A network of equipment and pipes that connects multiple buildings together to thermal energy sources such as geothermal, surface water, waste heat, and the air, to provide space heating, cooling, and domestic hot water. This technology can be an effective way to reduce energy costs and greenhouse gas emissions from a set or groups of buildings at scale.

Threat
Anything that can damage, destroy, or disrupt energy systems, including natural, technological, human/physical, and cybersecurity events.

Threatened
Under the Endangered Species Act, plant and animal species that are likely to become endangered within the foreseeable future.

Transit-Oriented Development (TOD)
Dense, pedestrian-oriented, mixed-use development located near (usually within a quarter- or half-mile radius) of direct transit access. Transit-oriented development integrates multiple mobility modes, including walking, biking, micromobility, and various forms of public transit, to provide residents with convenient and efficient transportation options beyond personal vehicles.

Transportation Demand Management (TDM)
Managing demand is about providing travelers, regardless of whether they drive alone, with travel choices, such as work location, route, time of travel and mode. In the broadest sense, demand management is defined as providing travelers with effective choices to improve travel reliability.

Transportation Energy Burden
Percentage of gross income that a household spends on energy for transportation. It is calculated by dividing the average transportation energy cost by the average annual household income.

Transportation Systems Management and Operations (TSMO)
Focuses on operational improvements that can maintain and even restore the performance of the existing transportation system before extra capacity is needed.

Upstream Emissions (in the context of fossil fuel production)
Out-of-state greenhouse gas emissions associated with the extraction, transmission, and use of fossil fuels imported into the State.

Vehicle Miles Traveled (VMT)
The amount of travel for all vehicles in a geographic region; calculated by adding up all miles driven by all motorized vehicles.

Vehicle-Grid Integration
Vehicle-to-Grid (V2G) technology allows EVs to both draw electricity from the electric grid to charge the EV's battery and also discharge the EV's battery to sell power back to the electric grid.

Vulnerability
The susceptibility of an energy infrastructure system to damage, loss, or degradation caused by a threat due to weaknesses within the system or due to the system's dependence on critical supporting systems or material, technical, or workforce resources affected by the threat.

Weatherization
Protecting a building's interior from outside temperatures and moisture to cut energy use and enhance indoor comfort through measures such as air sealing, insulation, and window upgrades.

Wetlands
An area that is saturated or inundated by water, either surface or ground, at a frequency and duration sufficient to support vegetations adapted to saturated soil condition.[30]

Zero by 40 (or 0x40)
New York State Climate Act target for zero-emission electricity.

Zero-Emissions Vehicles (ZEVs)
Vehicles powered by energy sources that result in no tailpipe emissions, such as battery-electric vehicles (BEVs) and hydrogen fuel cell electric vehicles (FCEVs). Plug-in hybrid electric vehicles (PHEVs), which run exclusively on electricity for a limited range and then are powered by an internal combustion engine, are also considered ZEVs under certain regulations.

30 New York State Department of Environmental Conservation (DEC), Wetlands, accessed July 11, 2025, https://dec.ny.gov/nature/waterbodies/wetlands#:~:text=Wetlands%20(swamps%2C%20marshes%2C%20bogs,life%20in%20saturated%20soil%20conditions.

Endnotes

1 "New York State Energy Profile: Analysis." U.S. Department of Energy, Energy Information Administration (EIA), last updated January 16, 2025, https://www.eia.gov/state/analysis.php?sid=NY.

2 Renewable energy generation including hydroelectric, wind, solar, and nuclear energy generation as of 2024. New York Independent System Operator (NYISO), 2025 Load & Capacity Data Report (Gold Book) (NYISO, April 2025), https://www.nyiso.com/documents/20142/2226333/2025-Gold-Book-Public.pdf.

3 See "Renewable Generation" in the Climate Act Dashboard at http://climate.ny.gov/dashboard.

4 On energy cost burden, see Section 2.4.2. in this volume and the Energy Affordability Impacts Analysis chapter of this Plan. On air pollution, see: Abdulrahman Jbaily, Xiaodan Zhou, Jie Liu, Ting-Hwan Lee, Leila Kamareddine, Stéphane Verguet, and Francesca Dominici, "Air pollution exposure disparities across US population and income groups." Nature 601, no. 7892 (2022): 228-233, https://doi.org/10.1038/s41586-021-04190-y. Also: Paul Mohai, , David Pellow, and J.T. Roberts. "Environmental Justice." Annual Review of Environment and Resources, Vol. 34 (2009): 405-430, https://www.annualreviews.org/content/journals/10.1146/annurev-environ-082508-094348.

5 New York State Energy Research and Development Authority (NYSERDA), New York State Department of Environmental Conservation (DEC), and New York Power Authority. New York State Disadvantaged Communities Barriers and Opportunities Report, 21-35. NYSERDA Report 21-35, December 2021. https://climate.ny.gov/-/media/Project/Climate/Files/21-35-NY-Disadvantaged-Communities-Barriers-and-Opportunities-Report.pdf.

6 Vasquez, Leonardo. "Unpacking the Causes of Pandemic-Era Inflation in the US (Summary of NBER Working Paper 31417 featured in print Digest)," National Bureau of Economic Research, September 1, 2023, https://www.nber.org/digest/20239/unpacking-causes-pandemic-era-inflation-us.

7 International Energy Agency (IEA), World Energy Investment 2023. IEA, May 25, 2023. https://www.iea.org/reports/world-energy-investment-2023.

8 New York State Energy Law § 6-102 (Consol. 2014).

9 More detail on how agency staff engaged these community-based organizations and Indigenous Nations and high-level takeaways from this engagement is available at https://energyplan.ny.gov/Process/Energy-Plan-Process.

10 Fact sheets for the New York State Energy Plan are available in English, Bengali, Chinese (Simplified and Traditional), Haitian, Korean, Russian, Spanish, and Yiddish.

11 Public hearings were held in cities across the State: Buffalo, Rochester, Albany, Poughkeepsie, New York City (Brooklyn and the Bronx), and Stony Brook.

12 New York State Agency Staff, "Summary of Public Comments on the Draft State Energy Plan," (presented to the State Energy Planning Board, Albany, NY, November 13, 2025).

13 Data for Figure 1 and Sections 2.1 and 2.2 are sourced from: NYSERDA. Patterns and Trends: New York State Energy Profile 2009–2023 (NYSERDA, December 2025); NYSERDA, "Patterns and trends: New York State energy profile dashboard," NYSERDA December 2025, https://www.nyserda.ny.gov/About/Publications/Energy-Analysis-Reports-and-Studies/Patterns-and-Trends. Primary data sources are the U.S. EIA State Energy Data System (SEDS) and the NYISO Load & Capacity Data Report (Gold Book).

14 In primary energy terms, renewable sources can appear smaller because they are diluted by the wasted energy that comes along with combustion.

15 NYSERDA. Patterns and Trends: New York State Energy Profile 2009–2023.

16 Since end-use energy consumption accounts for the energy that reaches the ultimate consumers in the residential, commercial, industrial, and transportation sectors, the data reported in Figure 2 excludes electrical system energy losses and includes estimated electricity generated by customer-sited (or behind-the-meter) solar.

17 NYSERDA. Patterns and Trends: New York State Energy Profile 2009–2023.

18 NYISO, 2025 Gold Book.

19 Reliability of the electric distribution system is measured based on power interruptions that last longer than five minutes. The U.S. EIA maintains data on metrics that include System Average-Interruption Frequency Index, measuring the number of electric interruptions per year the average customer experienced. Major storms are excluded from the data cited because a utility's control is more limited over severe weather.

20 U.S. EIA SAIFI data, Without Major Event Days, 2023.

21 NYSERDA. Patterns and Trends: New York State Energy Profile 2009–2023.

22 NYSERDA. Patterns and Trends: New York State Energy Profile 2009–2023.

23 NYSERDA. Patterns and Trends: New York State Energy Profile 2009–2023.

24 NYSERDA. Patterns and Trends: New York State Energy Profile 2009–2023.

25 New York State Department of Public Service (DPS). "Average monthly bill data from utility companies." Ten year historic average monthly bill data for typical customers is available for electric utilities at https://dps.ny.gov/electric-utility-ten-year-historic-average-monthly-bill-data-typical-customers and for gas utilities at https://dps.ny.gov/gas-utility-ten-year-historic-average-monthly-bill-data-typical-customers.

26 DPS. "Average monthly bill data from utility companies."

27 DPS. "Average monthly bill data from utility companies."

28 DPS. Second CLCPA Informational Report. September 18, 2025. Filed in New York State public Service Commission (PSC Case 22-M-0149), https://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7b40075E99-0000-C639-832F-142B5C387BBD%7d.

29 Ryan Wiser, Eric O'Shaughnessy, Galen Barbose, Peter Cappers, and Will Gorman. "Factors influencing recent trends in retail electricity prices in the United States. The Electricity Journal 38, no. 4 (October 2025), https://emp.lbl.gov/publications/factors-influencing-recent-trends.

30 DPS. Second CLCPA Informational Report.

31 DPS. Second CLCPA Informational Report.

32 Wiser et al. "Factors influencing recent trends in retail electricity prices in the United States."

33 Consumer Expenditure (CE) Surveys. New York and U.S.: 2022 & 2023, Distributed by U.S. Bureau of Labor Statistics (BLS), accessed October 30, 2025, https://www.bls.gov/cex/tables.htm#geo. For consistency between State-level and U.S. data, values reported are an average of 2022 and 2023.

34 Ibid. CE data is used to characterize combined household and transportation energy expenditures, as well as associated energy burden, transportation burden and combined household and transportation burden. The CE data has several key features that make it useful for this analysis: It is an internally consistent data set that situates energy expenditures within household spending more broadly and includes both household energy and transportation fuel spending. Although not identical, energy burden

calculated using CE data is broadly in line with other approaches to calculating energy burden, such as the approach based on census data used in the Low-Income Energy Affordability Data tool, a commonly used federal government resource for understanding energy burden.

35 U.S. Bureau of Economic Analysis, Regional data, GDP and personal income, distributed by U.S. Bureau of Economic Analysis, accessed October 30, 2025, https://www.bea.gov/itable/regional-gdp-and-personal-income.

36 U.S. BLS. Consumer Expenditure Surveys. New York: Quintiles of Income before taxes, 2022-2023 and US: Quintiles of Income before taxes, 2022 & 2023. Accessed 10/30/25, https://www.bls.gov/cex/tables.htm#geo.

37 U.S. Census Bureau, Household Pulse Survey, accessed April 16, 2025: https://www.census.gov/data/experimental-data-products/household-pulse-survey.html; U.S. EIA, Residential Energy Consumption Survey, accessed April 16, 2025: https://www.eia.gov/consumption/residential/data/2020/. Households experiencing higher than average rates of energy insecurity from this data include lower income households, minorities, people with disabilities, women, larger households, and households with children.

38 Based on analysis conducted for NYSERDA by BW Research. Data is from IMPLAN for calendar year 2023, from the State Industry Balance Sheets, Commodity Demand, and Social Account Matrix.

39 DEC, 2025 Statewide GHG Emissions Report (DEC, 2025), https://dec.ny.gov/environmental-protection/climate-change/greenhouse-gas-emissions-report#Report.

40 U.S. EIA. State Carbon Dioxide Emissions Data, Table 1 - State energy-related carbon dioxide emissions by year, distributed by U.S. EIS, accessed November 12, 2025. https://www.eia.gov/environment/emissions/state/.

41 DEC. 2025 Statewide GHG Emissions Report (DEC, 2025).

42 DEC. 2025 Statewide GHG Emissions Report (DEC, 2025).

43 Large loads include new large industrial and commercial projects as included in NYISO, Gold Book.

44 In the Pathways Analysis chapter of this Plan, Section 3, reports on projected equipment sales and stocks over time across the buildings and transportation sectors. For the buildings sector, sales and stock shares are defined as the percent of building stock units (commercial square feet or residential housing units) that adopt a technology (e.g., high-efficiency heat pumps as the primary heating system or efficient shell packages).

45 NYISO, 2025 Gold Book.

46 PSC Case 23-M-0298, In the Matter of Budget Appropriations to Enhance Energy Affordability Programs, Case 14-M-0565, Proceeding on Motion of the Commission to Examine Programs to Address Energy Affordability for Low Income Utility Customers, Order Authorizing Energy Bill Credit (Issued and Effective: February 15, 2024).

47 PSC Case 14-M-0565, Proceeding on Motion of the Commission to Examine Programs to Address Energy Affordability for Low Income Utility Customers, Case 23-M-0298, In the Matter of Budget Appropriations to Enhance Energy Affordability Programs, Order on Procedures for Implementing Enhanced Energy Affordability Program (issued and effective: September 19, 2025).

48 Bonomo, Jordan. "NYCHA's CH4A Pilot," (presented at a Building Energy Exchange event on the Clean Heat for All initiative, January 16, 2025). https://be-exchange.org/wp-content/uploads/2025/01/20250116_CleanHeat_Slides-UPDATED.pdf.

49 Climate Justice Working Group and DEC, 2023 Disadvantaged Communities Criteria Final Report, (New York State Climate Action Council, January 14, 2025) https://climate.ny.gov/-/media/Project/Climate/Files/Disadvantaged-Communities-Criteria/Technical-Documentation-on-the-Disadvantaged-Communities-Criteria---Final-Version.pdf.

50 NYSERDA, 2024 Clean Energy Industry Report" (NYSERDA, 2024), www.nyserda.ny.gov/About/Publications/New-York-Clean-Energy-Industry-Report.

51 Consistent with NYSERDA's Workforce Development and Training Definitions, Priority Populations include: veterans; individuals with disabilities; low-income individuals, whose household's total income is below or at 60% of the State Median Income, or whose household has been determined eligible for or is receiving assistance through the Home Energy Assistance Program, Temporary Assistance for Needy Families, Supplemental Nutrition Assistance Program, or other human service benefit programs; incumbent or unemployed fossil fuel workers; previously incarcerated individuals; 16- to 24-year-olds who are enrolled in or have completed a comprehensive work preparedness training program such as those offered by Boards of Cooperative Education Services, technical high schools, Conservation Corps, YouthBuild, and AmeriCorps; homeless individuals; and single parents.

52 DPS. "2025 State of Storage in New York: Annual Energy Storage Deployment Report." April 15, 2025. Filed in PSC Case 18-E-0130—In the Matter of Energy Storage Deployment Program.

53 “New York’s Inter-Agency Fire Safety Working Group,” NYSERDA, accessed June 2025, https://www.nyserda.ny.gov/All-Programs/Energy-Storage-Program/New-York-Inter-Agency-Fire-Safety-Working-Group.

54 PSC, Case 15-E-0302—Proceeding on Motion of the Commission to Implement a Large-Scale Renewable Energy Program and a Clean Energy Standard, DPS Staff Zero-Emissions Credit Program Extension Proposal (issued July 31, 2025), https://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={20FE6198-0000-CF2B-A36D-8B6869CF6E5E}.

55 Electric Power Research Institute, Zero by 40 Technoeconomic Assessment, Final Report (NYSERDA, September 2025), https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Publications/Energy-Analysis/Zero-x-40-Technoeconomic-Assessment.pdf.

56 NYISO. Open Access Transmission Tariff, Section 31.5 Cost Allocation and Cost Recovery, Section 31.5.4.2 Cost Allocation Principles, accessed November 4, 2025.

57 Priority Populations consistent with NYSERDA’s Workforce Development and Training Definitions.

58 NYSERDA, 2024 Clean Energy Industry Report” (NYSERDA, 2024), www.nyserda.ny.gov/About/Publications/New-York-Clean-Energy-Industry-Report.

59 U.S. Department of Energy’s (DOE) Office of Energy Jobs, United States Energy and Employment Report 2024 (DOE, October 1, 2024), www.energy.gov/policy/us-energy-employment-jobs-report-useer.

60 The Technology Sector in New York City, Report # 10-2023 (Office of the New York State Comptroller, October 2022), New York City. www.osc.ny.gov/files/reports/osdc/pdf/report-10-2023.pdf.

61 National Center for Science and Engineering Statistics, Survey of federal funds for research and development, distributed by National Science Foundation (NSF), https://ncses.nsf.gov/ surveys/federal-funds-research-development/2022-2023.

62 The jobs and the public health impact analyses estimate the impacts of the 2.2 gigawatt Nuclear Variant of the Additional Action scenario.

63 The analysis focuses on energy expenditures and includes a sensitivity that also considers equipment costs.

64 A more detailed description is available in the affordability impacts chapter and appendices. Both efficient electrification journeys include building weatherization/shell efficiency retrofits, which are critical for realizing affordable operating costs.

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Key Terms Used in This Chapter

FOR THE COMPLETE GLOSSARY ➜

Bulk Power System: Operated by the New York Independent System Operator (NYISO), which generally consists of transmission lines operating at 230 kilovolts and above and certain lower-voltage facilities, which the NYISO manages to ensure system reliability. The bulk power system in New York consists of approximately 4,100 miles of high-voltage transmission lines.

Electric Peak Demand: The highest actual average hourly load that occurs during a calendar year. Given that the electric transmission and distribution systems are designed and built to serve peak load, reducing peak demand is important for improving system efficiency, reducing wholesale electricity prices, and delaying the need for additional infrastructure.

Installed Capacity: The amount of electric power that can be generated in the state.

Installed Reserve Margin (IRM): The IRM represents the amount of generation capacity that must be in place to ensure an acceptable level of reliability. The IRM is measured by the amount of generation and other capacity resources above 100 percent of forecasted peak load that must be available to serve all customers without interruption.

Joint Utilities (JU): The Joint Utilities comprise Central Hudson Gas and Electric Corporation, Consolidated Edison Company of New York, Inc. (“Con Edison”), New York State Electric & Gas Corporation, Niagara Mohawk Power Corporation d/b/a National Grid (“National Grid”), Orange and Rockland Utilities, Inc., and Rochester Gas and Electric Corporation. Together, the Joint Utilities provide electric service to over 13 million households, businesses, and government facilities across New York State.

Load Factor: Load factor is a measure of the degree of uniformity of demand over a period of time, usually one year, and equivalent to the ratio of average demand to peak demand expressed as a percentage. It is calculated by dividing the total energy provided by a system during a period by the product of peak demand during the period and the number of hours in the period.[1]

1 North American Energy Standards Board Wholesale Electric Industry Glossary.

Load-Serving Entity (LSE): A retail electric service provider (e.g., a utility) that is obligated to procure or purchase wholesale electricity to serve its end-use customers.

The New York Control Area: The New York Control Area (NYCA) is comprised of eleven geographic zones (also referred to as "load zones") from western New York (Zone A) through Long Island (Zone K).[2]

Strike Price: The strike price is a predetermined fixed price at which the owner of an option can buy or sell an underlying asset.

2 NYISO Comprehensive Reliability Plan. 2023. https://www.nyiso.com/documents/20142/2248481/2023-2032-Comprehensive-Reliability-Plan.pdf

Key Findings → Electricity

The availability of reliable electric power at reasonable rates is the backbone of New York's economy and critical to public health and safety. Economic growth, changes in demand patterns, and environmental policy objectives drive changes in both the electric supply portfolio and the State's power delivery systems. These changes must be managed within the constraints imposed by federal and State reliability requirements while protecting New York ratepayers. New York has successfully managed significant system changes over the last decade, but the pace of decarbonization and the emergence of new sources of energy demand present significant challenges. This chapter provides an overview of the State's electricity sector, policies, and programs and recommends continued and additional actions to build and operate an electricity system that meets the needs of New Yorkers.

- **New York State is supporting energy diversity, leading the deployment of clean energy resources and taking all necessary steps to meet demand and preserve reliability and affordability.** The State should continue to support the deployment of clean energy resources, including renewable resources and nuclear, and strategically navigate challenges (including federal policy uncertainty and siting and permitting hurdles) that affect the pace of progress.

- **Rising electricity costs are creating energy affordability concerns that must be addressed.** Future investments in our energy system should be selected, designed, and executed in a cost-effective manner to mitigate utility bill impacts and to withstand the impacts of a changing climate.

- **The State should continue to leverage and expand the deployment of storage and demand-side resources**, including energy efficiency measures and flexible technologies, to help mitigate the need to build new, costly infrastructure, lower the cost of the clean energy transition, and enhance grid reliability.
- **The State will need to be strategic in identifying and integrating clean firm technologies** that have the attributes necessary to support the achievement of a zero-emissions electric grid by 2040.
- **Continued State action to advance smart and strategic energy system planning is critical** to enhance system reliability and drive down the cost of necessary generation, transmission, and distribution system investments. These planning efforts are particularly important considering the anticipated economic-development-driven load growth and long-term electrification of transportation and buildings.
- **The State should continue to evaluate wholesale market and retail rate structures** to ensure they properly value and compensate new energy resources and market services and prioritize energy affordability for consumers. This will attract and maintain the resources and services needed for the future electric grid.

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1. Overview

The availability of reliable electric power at reasonable rates is the backbone of the State's economy and critical to public health and safety. Economic growth, changes in demand patterns, and environmental policy objectives do and will continue to drive changes in both the electric supply portfolio and the State's power delivery systems. These changes must be managed within the constraints imposed by federal and State reliability requirements while protecting New York ratepayers. New York has successfully managed significant system changes over the last decade, but the pace of decarbonization and the emergence of new sources of energy demand present significant challenges.

1.1. Electric Industry Participants and Regulatory Oversight Organizations

This section describes the key participants in the electric power sector.

The electric industry in New York today is comprised of investor-owned utilities, governmental utilities, generation companies, transmission-only companies, and energy service companies (ESCOs). The roles of each of these as participants in the energy sector are regulated by the Federal Energy Regulatory Commission (FERC) and/or the Public Service Commission (PSC). In the late 1990s, New York's investor-owned utilities sold their major generation assets to independent power companies, while retaining their transmission and distribution delivery systems and customer service functions. Independent power producers now own and operate most of the power plants that supply the electricity consumed in the State. Other industry participants include governmental utilities, such as the New York Power Authority (NYPA), the Long Island Power Authority (LIPA), municipally owned electric utilities, and rural electric cooperatives. In addition, since the early 2000s, independent transmission companies have had a significant role as developers and owners of new bulk power transmission facilities.

The **PSC** regulates the State's electric, gas, steam, telecommunications, and water utilities and is charged by law with the responsibility of setting rates and ensuring the provision of safe and reliable service in New York. The PSC exercises its regulatory oversight primarily through utility rate cases, where it sets performance requirements and establishes the rates utilities are allowed to charge their customers, among other things. Additionally, the PSC has important powers to oversee reliability and to require the construction of facilities, when necessary. The PSC employs performance-based regulation, which shifts utility incentives from traditional cost-of-service models to performance metrics. The utilities are granted the opportunity to earn through earnings adjustment mechanisms (EAMs), with excess revenues shared with ratepayers. The utilities are penalized for poor performance related to certain issues through negative revenue adjustments (NRAs).

FERC is the federal agency that regulates wholesale sales of hydroelectric power, electric, gas, and oil and sets rates for transmission in interstate commerce. Among other electric energy-related responsibilities, the U.S. Energy Policy Act of 2005 gave FERC additional responsibilities in the areas of interstate electric transmission siting and planning. Section 215 of the Act expanded FERC's authority to include oversight and enforcement of mandatory reliability rules developed and administered by the North American Electric Reliability Corporation (NERC) (see below).

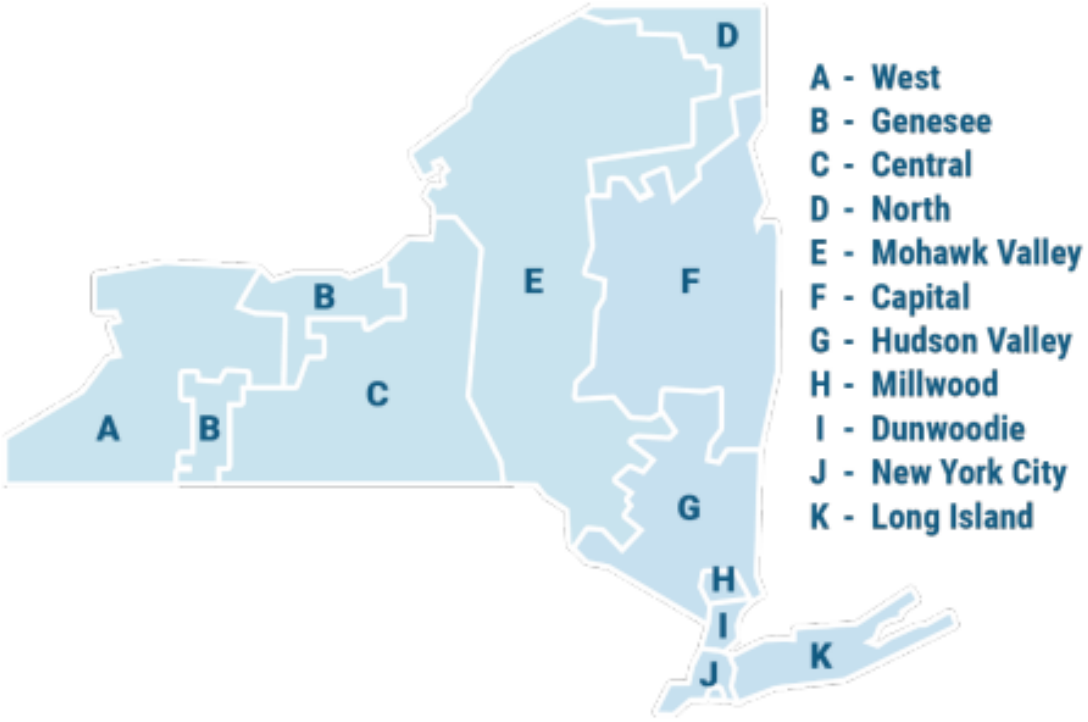
The **New York Independent System Operator, Inc.** (NYISO) is the FERC-approved entity established in 1999 as the transmission system operator and administrator of wholesale energy markets for New York. The NYISO is organized as a not-for-profit corporation governed by an independent board of directors consisting of ten members with varying backgrounds in the power industry, environment, and finance. The NYISO performs its functions in accordance with its FERC-approved tariffs.

The NYISO provides the platform for wholesale sales of electric energy and related services provided by generators and other market participants. The utilities, in their role as Load Serving Entities (LSEs), purchase the energy and services needed to serve their customers in the NYISO markets.

The New York Control Area (NYCA) is comprised of eleven geographic zones (also referred to as "load zones") from western New York (Zone A) through Long Island (Zone K).[1] A map of the NYISO load zones is shown in Figure 1.

Figure 1: NYISO Load Zone Map

Source: NYISO Comprehensive Reliability Plan[1]



NERC is an independent not-for-profit corporation with the responsibility to ensure the reliability of the North American bulk power system through the establishment and enforcement of reliability standards. NERC oversees eight regional reliability entities that encompass the interconnected power systems of the contiguous United States, Canada, and a portion of Baja California in Mexico. NERC's activities outside of U.S. boundaries related to the reliability of the bulk power system are recognized and overseen by the appropriate governmental authorities in that country.

The **Northeast Power Coordinating Council (NPCC)** is a not-for-profit corporation responsible for promoting and enhancing the reliability of the international, interconnected bulk power system in northeastern North America. NPCC's regional entity division operates under a delegation agreement with NERC. Its geographic region includes the State of New York and the six New England states as well as the Canadian provinces of Ontario, Québec, New Brunswick, and Nova Scotia. NPCC establishes regional reliability criteria that may be more specific or more stringent than NERC's reliability standards. NPCC responsibilities include:

- Development of regional reliability standards and regional-specific criteria, compliance assessment, monitoring, and enforcement;
- Administration and enforcement of continent-wide and regional standards in coordination with NERC; and
- Coordination of system planning, design, operations, and reliability assessment among member planning areas, transmission owners (TOs), and others.

The **New York State Reliability Council (NYSRC)** was approved by FERC as part of the establishment of the NYISO and the wholesale markets. Pursuant to Section 215 of the Federal Power Act, the State of New York may promulgate and enforce reliability standards that are more specific or more stringent than NERC standards or NPCC criteria so long as those standards do not degrade reliability outside of New York. The NYSRC's rules set forth requirements that are more stringent or specific than either NERC standards or NPCC criteria and are adopted by the PSC. The NYSRC is also responsible for the establishment of the annual statewide installed reserve margin (IRM) for the New York power system. The IRM represents the amount of generation capacity that must be in place to ensure an acceptable level of reliability. The IRM is measured by the amount of generation and other capacity resources above 100 percent of forecasted peak load that must be available to serve all customers without interruption. Both FERC and the PSC approve the IRM. The NYISO uses the IRM to establish the amount of generating capacity that must be located within certain transmission-constrained regions (such as New York City and Long Island).

Transmission Owners are the investor-owned utilities, public authorities, or independent transmission providers that own transmission services under FERC-approved tariffs and State regulatory oversight. Investor-owned utilities are responsible for developing local transmission plans to provide safe and reliable service within their franchise areas that meet State, regional, and national reliability standards and/or criteria.

2. State of the Sector and Progress Report

The following section describes energy use and demand, the supply mix, and pricing in New York during the 2014–2024 period.

2.1. Electricity Requirements: Annual Usage and Peak Demand

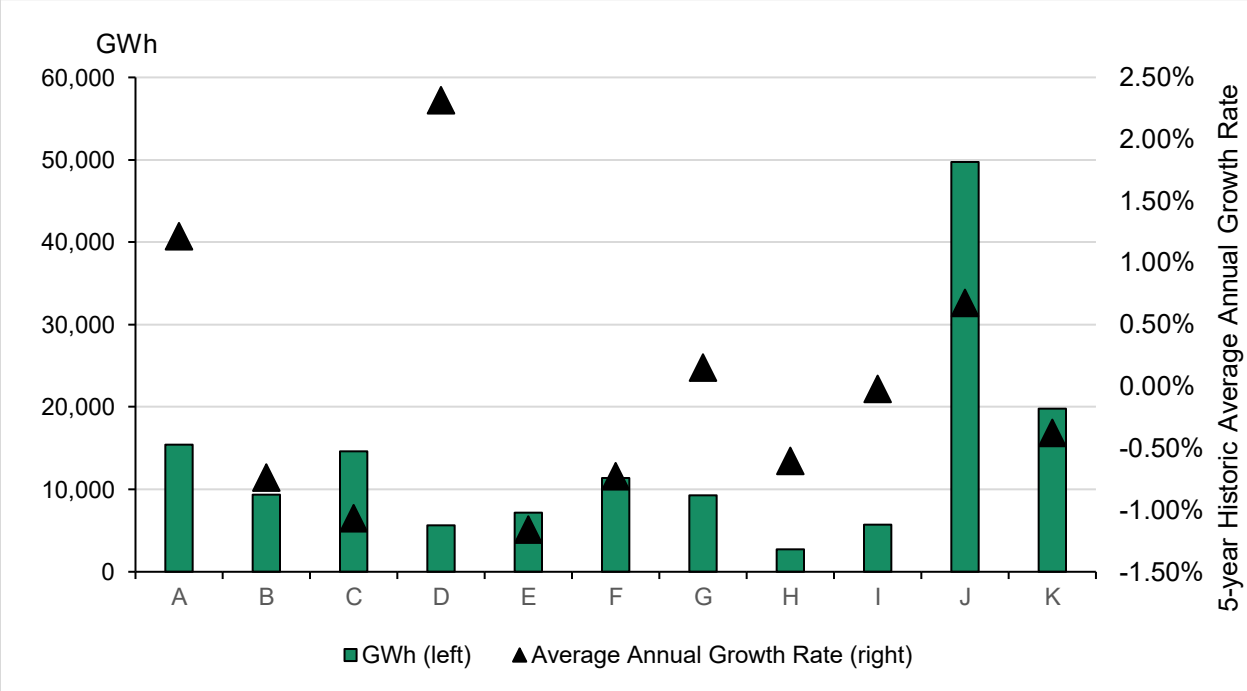
New York's recent electricity usage and peak demand are described below along with data on the average 5-year growth rate (2020 through 2024) of these parameters.

2.1.1. Electricity Usage

As noted above, New York State is divided into eleven load zones. Figure 2 shows electric energy usage in these NYCA load zones for year 2024, and the 5-year historic average annual growth rate for each. This provides both a snapshot of usage in 2024 along with recent trends in energy usage over the period 2020-2024. For example, Zone G (Hudson Valley) consumed approximately 9,286 gigawatt hours (GWh) of energy and experienced a 0.2 percent average annual increase in consumption over the 5-year period. Positive average annual growth is evident when looking at the statewide consumption, with a growth rate of 0.1 percent. Zone J (New York City) usage increased by an average of 0.67 percent, while Zone K (Long Island) usage decreased by 0.38 percent annually during this 5-year period (Figure 2).

Figure 2: New York State 2024 Zonal Electricity Usage and 5-Year Growth Rate

Source: NYISO 2025 Load and Capacity Data Report[3]

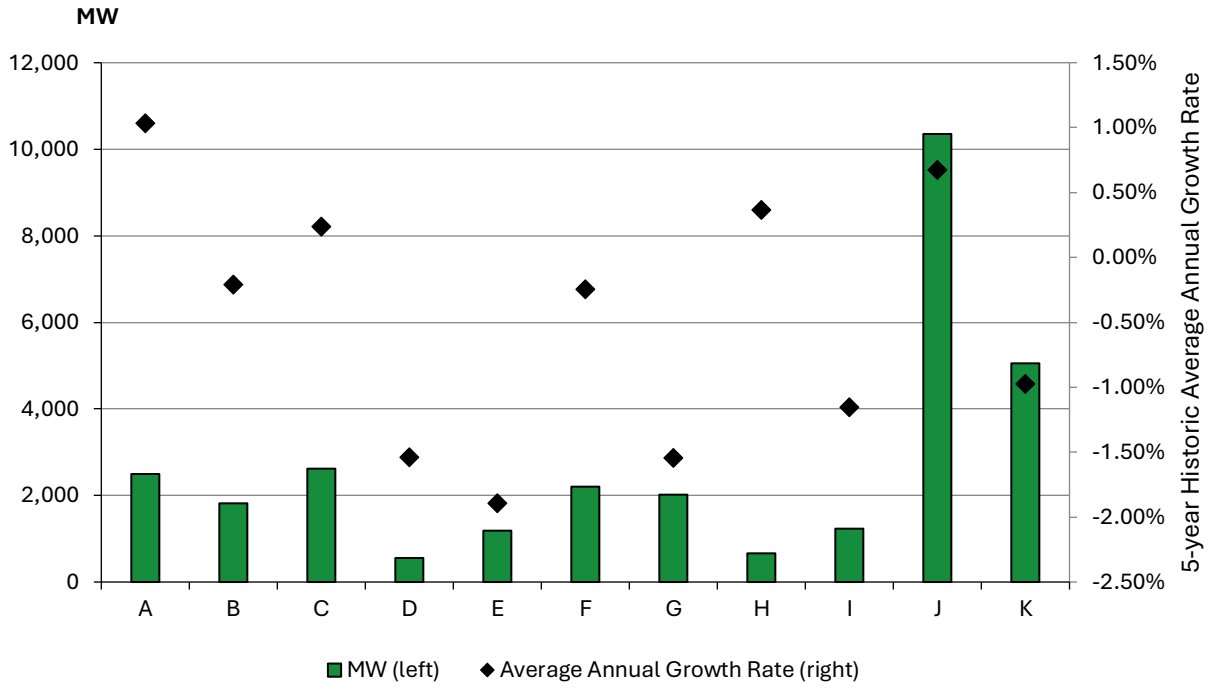


2.1.2. Electric Peak Demand

The electric peak demand is the highest actual average hourly load that occurred during a calendar year. Given that the electric transmission and distribution systems are designed and built to serve peak load, reducing peak demand is important for improving system efficiency, reducing wholesale electricity prices, and delaying the need for additional infrastructure.

Figure 3 shows the 2025 electric peak demands for each of the NYCA load zones and the average annual 5-year growth rate of peak demand for each zone. No individual zone experienced significant positive peak demand growth, with the majority of load zones seeing negative peak demand growth and no individual load zone peak increasing more than 0.14 percent annually.

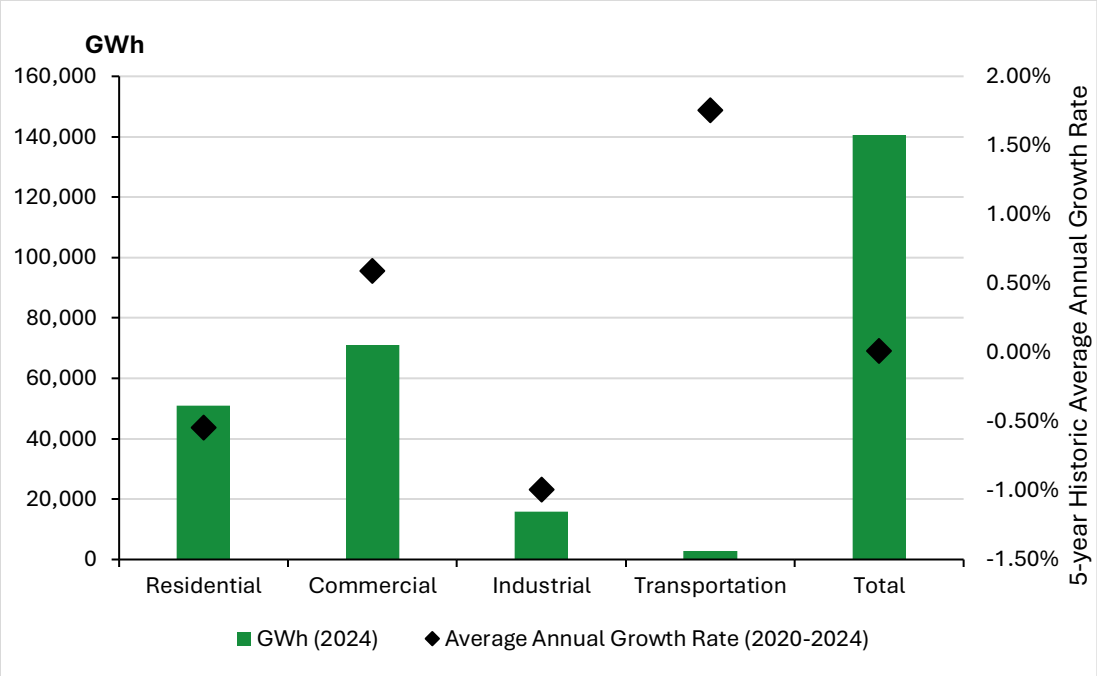
Figure 3: New York State 2024 Zonal Electric Peak Demand and 5-Year Growth Rate
Source: NYISO 2025 Load and Capacity Data Report[3]



2.1.3. Electricity Sales by Customer Sector

Figure 4 depicts 2024 New York electricity sales by sector, with the 5-year average annual growth for each sector also shown. Sales in the commercial sector made up approximately 51 percent of total sales in 2024, compared to approximately 49 percent in 2020. For all sectors combined, sales increased by an average of 0.01 percent over the 5-year period.

Figure 4: New York State 2024 Electric Sales by Sector and 5-Year Growth Rate
Source: EIA[2]



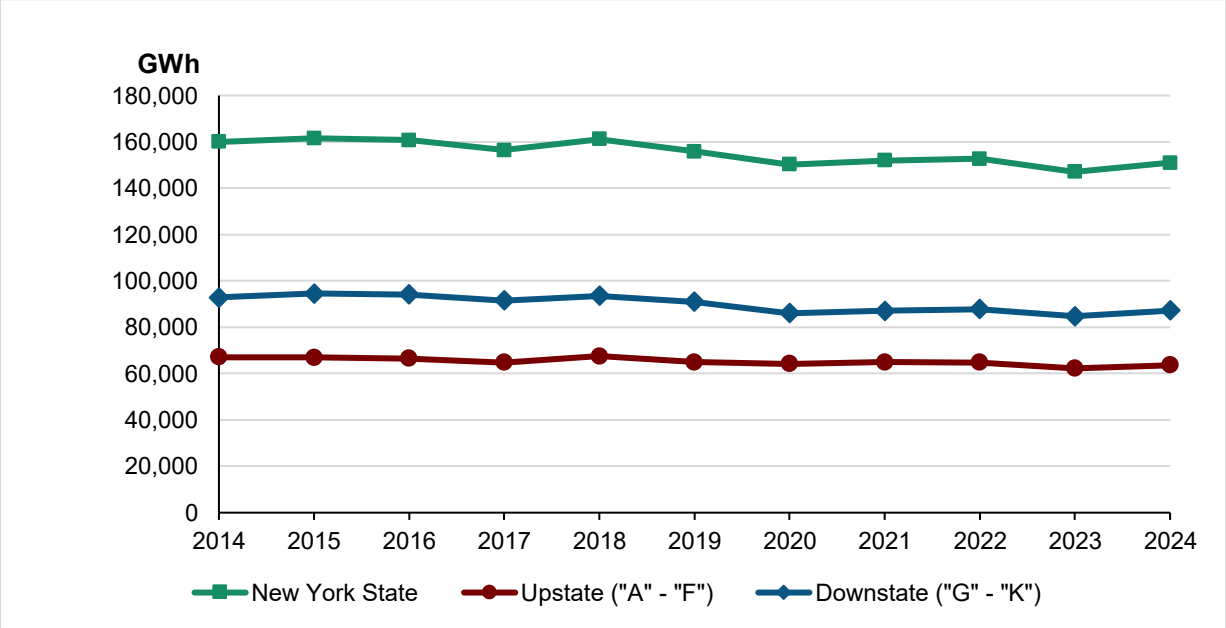
2.1.4. Trends in Annual Electricity Usage

Figure 5 shows the slight downward trend in historical electric energy usage for upstate, downstate and the entire New York State between 2014 and 2024.[3] On average, the statewide or NYCA electric energy usage decreased by 0.6 percent annually; this trend remains constant even when broken down by geographic region.

For the past ten years, energy usage in Load Zones J and K (New York City and Long Island, respectively) has consistently accounted for 46 percent of electric energy usage statewide. While energy usage in Zones J and K has decreased by a total of 4,500 GWh over the past ten years, the change is marginal. Use has effectively stayed flat over such period.

Figure 5: Annual New York State Electric Energy Usage, 2014 – 2024

Source: NYISO 2025 Load & Capacity Report[3]

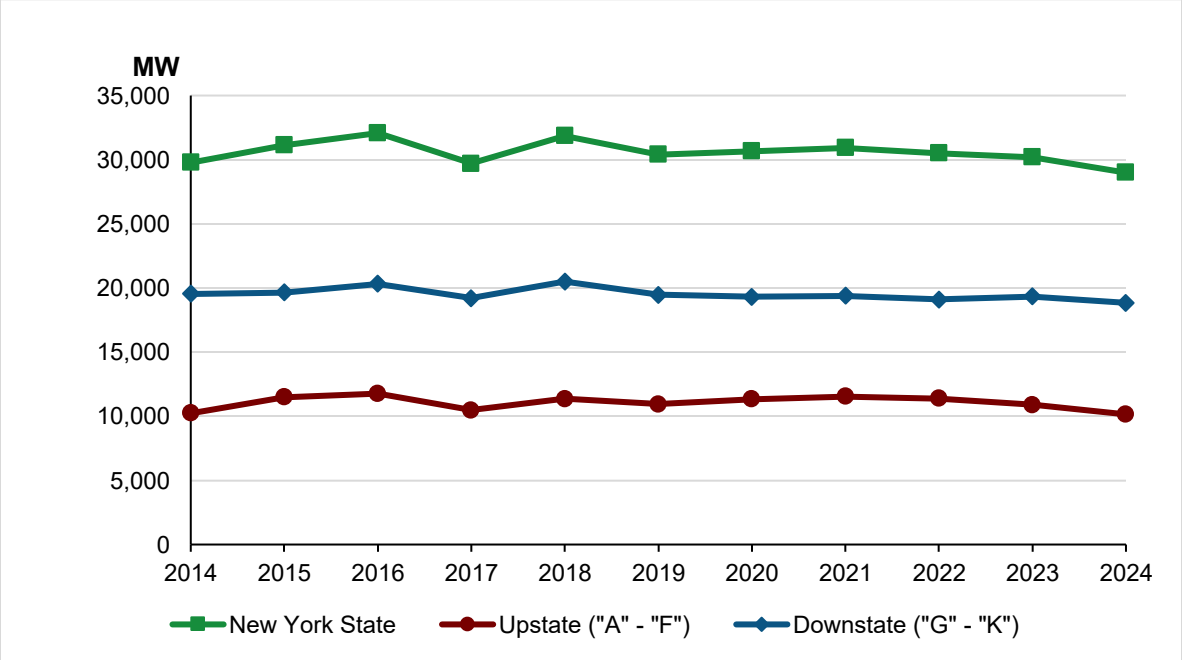


2.1.5. Trends in Peak Demand

Figure 6 illustrates the upstate, downstate, and statewide annual electric peak demands from 2014 through 2024.[3] While statewide electric energy usage declined by an average of 0.6 percent annually over that period, the statewide electric peak demand declined by an average of 1.1 percent over the same period. It should be noted, however, that the all-time NYCA historic electric peak demand (33,956 megawatts [MW]) occurred at the outset of this measurement period, in 2013.

Figure 6: New York State Annual Electric Peak Demand, 2014–2024

Source: NYISO 2025 Load & Capacity Report[3]

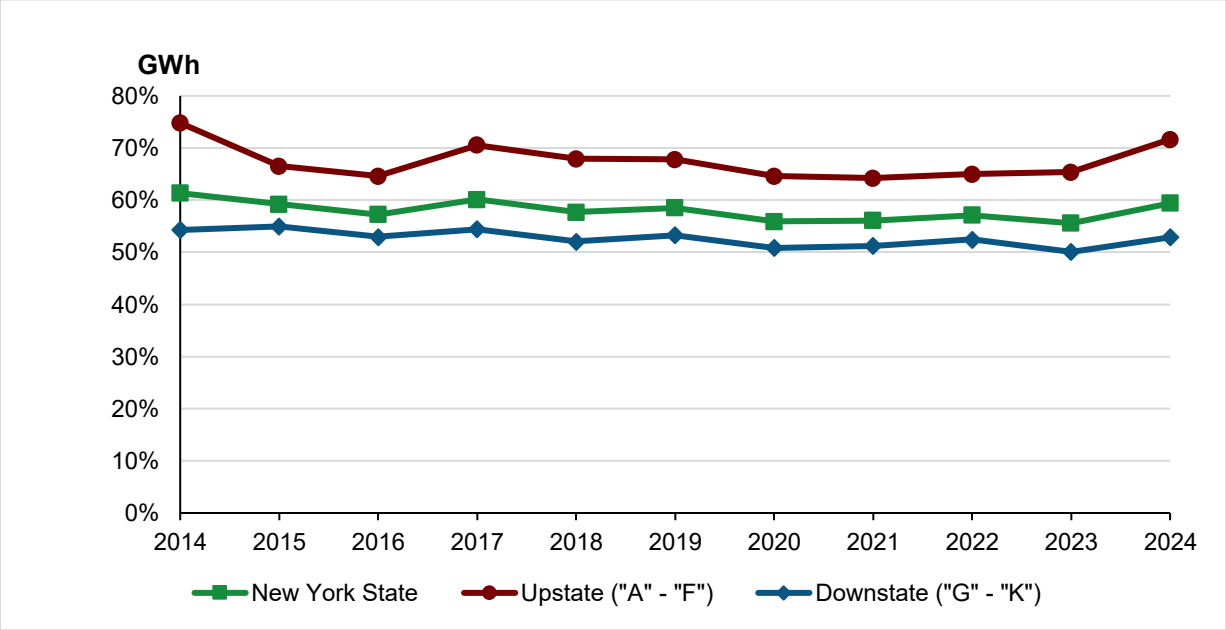


2.1.6. Load Factor

Load factor is a measure of the degree of uniformity of demand over a period of time, usually one year, and equivalent to the ratio of average demand to peak demand expressed as a percentage. It is calculated by dividing the total energy provided by a system during a period by the product of peak demand during the period and the number of hours in the period.[4] A high load factor indicates high utilization of a system's equipment and is a measure of efficiency. Figure 7 shows the load factor trends statewide and for upstate (Zones A through F), and downstate (Zones G through K) from 2014 to 2024.[3] Expanding programs for mandatory hourly pricing, demand response, and advanced metering are being pursued to improve the load factor throughout the State.

Figure 7: New York State Annual Load Factor, 2014–2024

Source: NYISO 2025 Load & Capacity Report[3]



2.2. Electricity Supply

This section provides a current snapshot of the generation and storage resources available to meet electricity usage and demand requirements in New York. The data shown below indicates that New York's electricity system is supported by a diverse fuel mix, with clean firm resources (i.e., nuclear and hydroelectric generation), growing renewable contributions, and dual-fuel flexibility to ensure system reliability as the State advances the decarbonization of the electric system and its clean energy agenda.

2.2.1. Generation Mix

New York's electricity generation sector is comprised of the following types of generation facilities:[5]

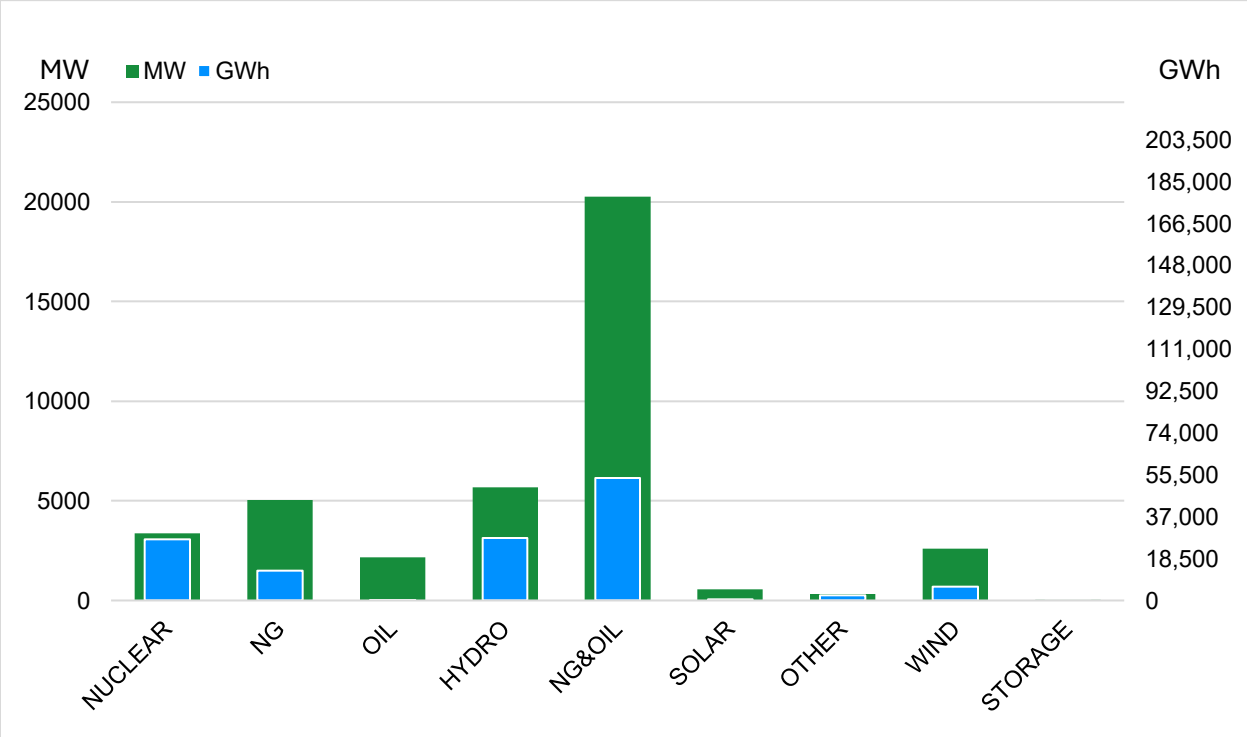
- Fossil fuel-fired
- Nuclear
- Hydropower
- Wind
- Solar
- Energy storage

In 2024, renewable resources, including hydroelectric, wind, and solar accounted for approximately 26 percent of the State's in-state electricity generation. Meanwhile, nuclear resources contributed about 21 percent of the in-state electricity generation. Combustion sources, including natural gas, oil, alternative fuels, and solid waste generation, produced roughly 53 percent of in-state electricity generation. Figure 8 below illustrates New York's 2025 Summer generating capability in MW and the 2024 energy production in GWh by fuel type.[3] It also reflects the average capacity factor[6] for each type of generation.

Figure 8 also reflects that New York's nuclear facilities had the highest aggregate capacity factor (92 percent) of all fuel types in 2024. Nuclear and hydroelectric units are often considered to be "base load" units. Base load units are generally less sensitive to wholesale electricity market clearing prices, largely due to the lower fuel costs inherent to these units. However, in recent years, due to relatively low natural gas prices, more natural gas plants function as "base load" units, operating at higher capacity factors than in previous years.

Figure 8: New York State 2025 Generation Capacity and 2024 Energy Production Type by Fuel

Source: NYISO 2025 Load and Capacity Data Report[3]



Generators fueled by natural gas or oil (NG, Oil, and NG & Oil shown in the figure below) accounted for 69 percent of New York's summer generating capability (MW). However, these units accounted for only 51 percent of total in-state energy production (MW hours [MWh]) resulting in an aggregate capacity factor of 28 percent.

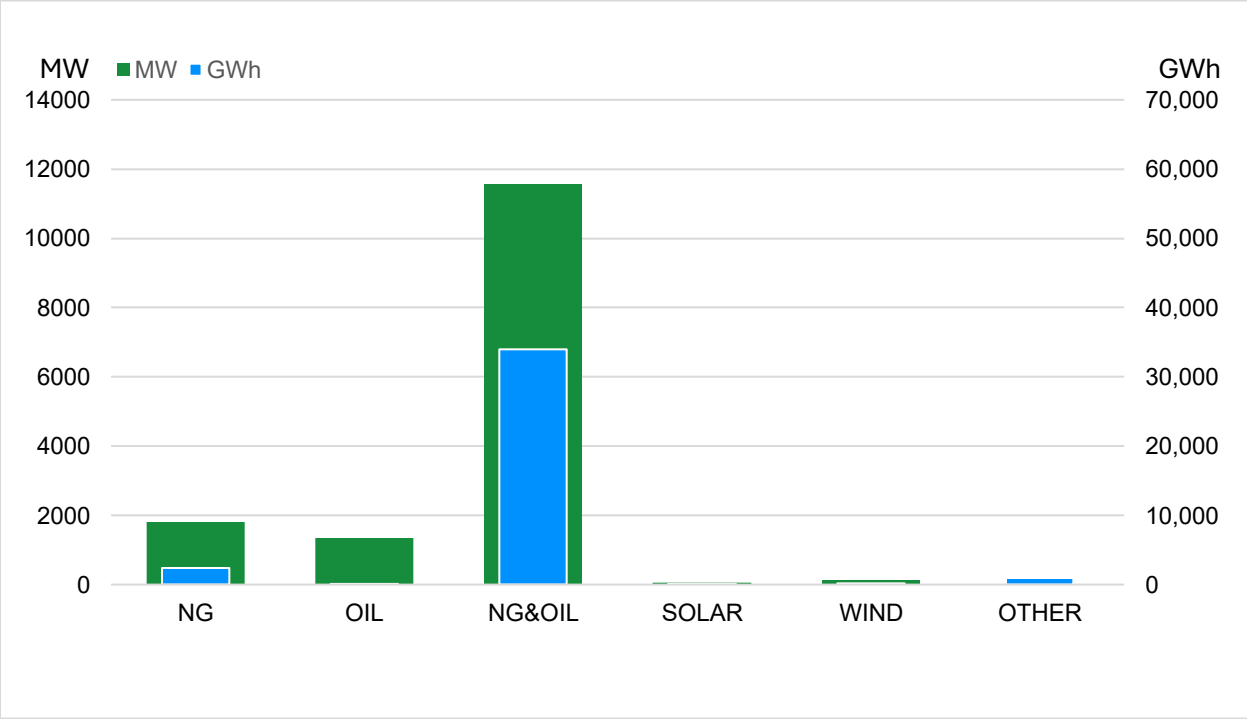
The State's fleet of fossil-fuel-based generation includes more than 10,000 MW, about 25 percent of the State's total generating capacity, that has been in operation for more than 50 years; 7 percent of in-State generation comes from these units. As discussed in the NYISO 2025 Power Trends Report, the aging fleet is concerning given the ongoing ability for these units to provide essential reliability services to the grid at a time when reliability margins are shrinking.[7]

In 2025, the summer generating capability of generators in New York was 37,699 MW. Figure 9 shows the combined 2025 Summer generating capability in MW in Load Zones J and K (New York City and Long Island, respectively) and the 2024 energy production in GWh by fuel type, as well as each fuel type's

aggregate capacity factor. Ninety-seven percent of energy production in New York City and Long Island is fueled by natural gas, oil, or both and most of the generators have dual-fuel capability, i.e., they can burn both natural gas or oil, signifying the importance of having the ability to shift to oil should there be natural gas delivery problems in New York City and Long Island.

Figure 9: New York City and Long Island 2025 Generation Capacity and 2024 Energy Production by Fuel

Source: NYISO 2025 Load and Capacity Data Report[3]



Fuel Diversity

New York has a diverse fuel mix. This diversity can benefit the State by mitigating the impacts of supply disruptions for any given fuel source, and by mitigating price volatility due to fuel price fluctuations. This, however, is not the case in New York City and on Long Island, which rely heavily on gas-fired generation, although most of those units are also able to burn oil.

Half of New York fossil fuel generation capacity facilities can burn at least two fuels. If the supply source for one fuel is disrupted, these units can burn an alternate fuel. This diversity provides New York consumers with a resilient electricity supply, should one fuel supply source be compromised, particularly at a time of high end-user demand on the electric system.

2.2.2. Electricity Supply Trends

Figure 10 shows the generation by fuel type over the period 2014 to 2024.[8] Note that this data differs from that shown in Section 2.3.1. Where that data represents all the in-state generation, the data in this section reflects all of the electricity needed to meet in-state demand (i.e., includes net interchange of imports/exports from neighboring regions). In 2024, renewable resources accounted for approximately 23 percent of the State's electricity needed to meet load, up from 19 percent in 2014. Meanwhile,

nuclear resources contributed about 18 percent of the electricity needed to meet load in the State, compared to 27 percent in 2014. This decrease in nuclear resources is attributed to the closing of the Indian Point nuclear facility between 2020 and 2022. Fossil fuel generation, including natural gas, oil, and dual fuel generation, contributed more than 45 percent of statewide electricity needed to meet load in 2024, compared to 39 percent in 2014. The reliance on coal has decreased significantly in recent decades, with the last remaining coal-fired power plant closing in 2020, following the New York State Department of Environmental Conservation's (DEC) adoption of revisions to 6 NYCRR Part 251 in 2019 to establish carbon dioxide (CO_2) emission limits for existing power plants. Net imports make up the remaining 13 percent of electricity needed to meet load in 2024, compared to 15 percent in 2014.

Figure 11 shows the installed capacity (ICAP) by fuel type from the period 2014 to 2024.[9] In 2024, renewable resources accounted for approximately 23 percent of the State's ICAP, compared to 19 percent in 2014. Fossil fuel generators make up the majority of capacity in the State, at 67 percent of capacity in 2024, compared to 66 percent in 2014. Most of the fossil fuel capacity is made up of dual fuel (natural gas and oil) units. Nuclear units make up 9 percent of capacity in 2024, compared to 14 percent in 2014. As noted above, this drop in capacity is attributed to the closing of the Indian Point nuclear facility that took place between 2020 and 2022. Additionally, since 2019 there have been 4,315 MW of generator deactivations and 2,274 MW of additions and uprates.[10]

Figure 10: New York State Annual Electricity Generation by Fuel Type, 2014–2024

Source: NYISO Power Trends Reports, 2014–2024[10]

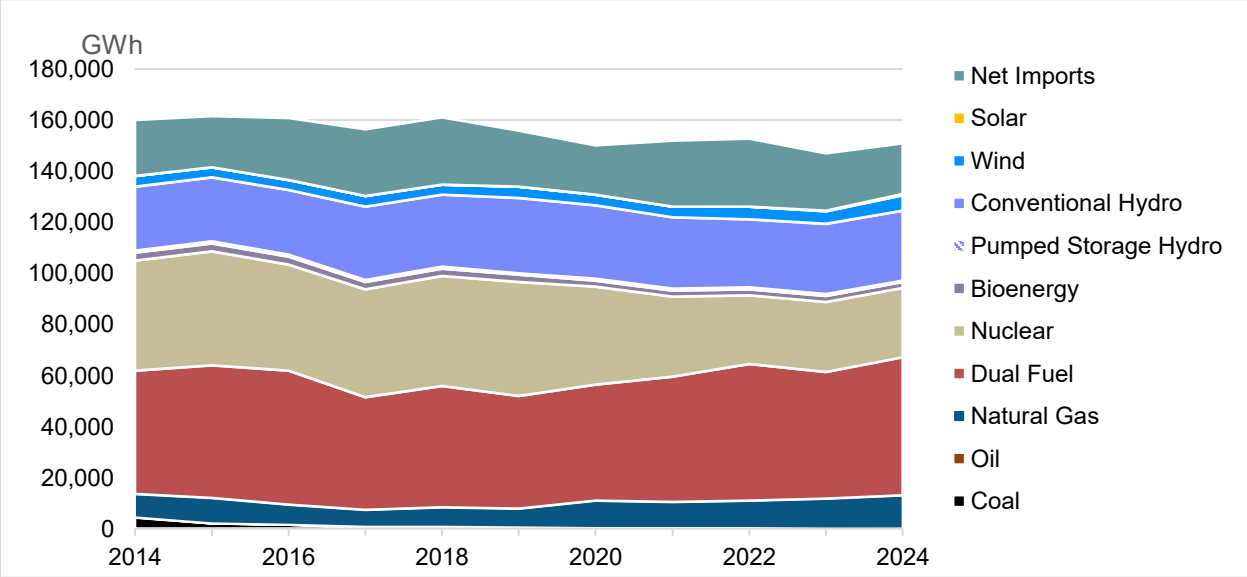
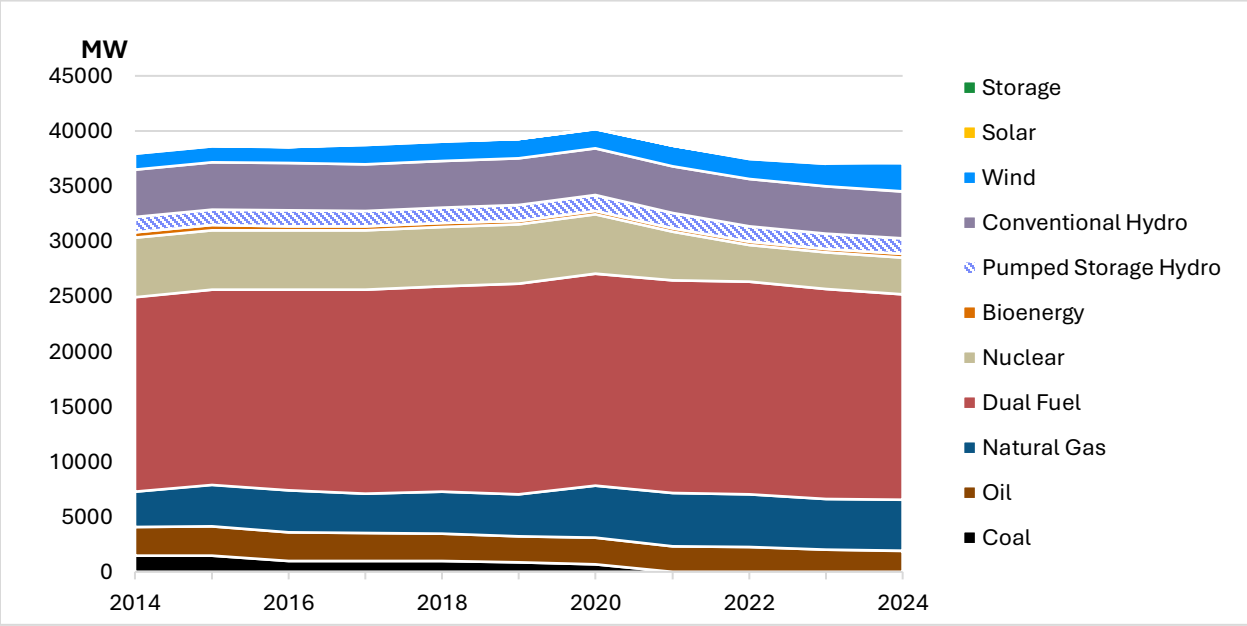


Figure 11: New York State Annual Electric Capacity by Fuel Type, 2014–2024

Source: NYISO Capacity and Load Data Reports, 2015–2025[11]



2.3. Transmission and Distribution

The State's transmission and distribution networks are designed to support a reliable and resilient electric system in New York State.

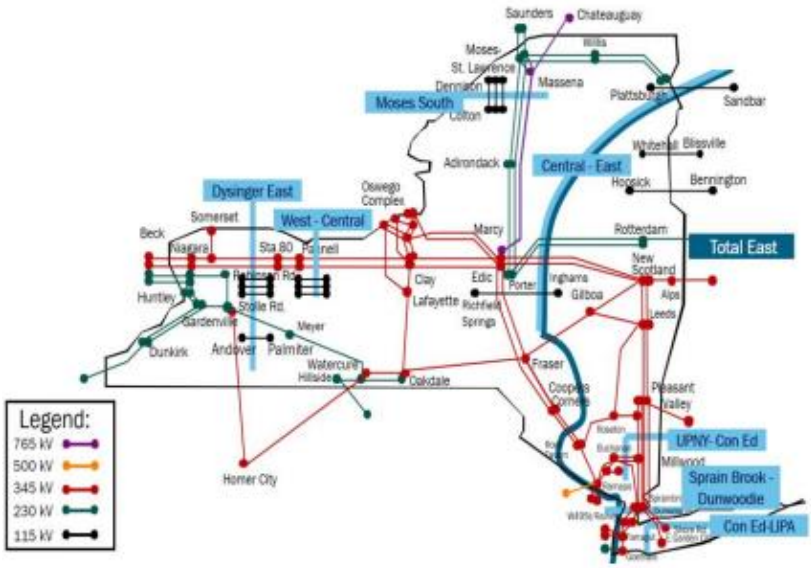
2.3.1. Transmission

Electric power transmission occurs between an electric generation station and a substation where the voltage is reduced, allowing it to be distributed either to a sub-transmission system or directly to a distribution system serving customer loads, neither of which is generally considered part of the bulk power system. The energy delivered to the bulk transmission system is normally transmitted at relatively high voltages to minimize power losses along the way. Bulk power typically is transmitted over long distances through overhead power lines, although in New York City underground circuits are used. The New York transmission system consists predominantly of alternating current (AC) transmission lines, similar to what exists in most of the U.S. Only a small portion of the New York system consists of direct current (DC) facilities.

Figure 12 displays the "bulk power system" operated by the NYISO, which generally consists of transmission lines operating at 230 kilovolts (kV) and above and certain lower voltage facilities, which the NYISO manages to ensure system reliability. The bulk power system in New York consists of approximately 4,100 miles of high-voltage transmission lines. The facilities that are not considered part of the NYISO-operated system include approximately 7,000 miles of 138-kV and 115-kV transmission lines.

Figure 12: New York State Bulk Power System – NY Internal Interfaces

Source: NYISO Power Systems Fundamentals[12]



The blue highlighted lines in Figure 12 display key transmission interfaces, which are groupings of transmission lines over which transfer capability is determined (note: not all NYCA interfaces are shown).[13] Interface limits can create constraints on the flow of power, and some interfaces impact the flow of power more compared to others. The transfer capability is the measure of the ability of interconnected electrical systems to reliably move power from one area to another over all transmission facilities (or paths) between those areas under specified system conditions.

The electric system is designed such that high-voltage, high-capacity lines are used to move power around the State. Closer to customer load, lines are operated at lower voltages and carry less electricity. While the higher-voltage lines deliver power across large areas, the lower-voltage lines generally consist of local distribution grids. This design tends to keep local problems isolated, so that a low-voltage system problem in one municipal or geographic area will not affect customer service in another. However, the bulk power system is closely interconnected; in the event of a system response to a large disturbance on the bulk power system in Florida, for example, effects can be seen in New York. This characteristic gave rise to the need for reliability standards that establish planning and operating protocols for the bulk power system, with the goal of preventing local system disturbances cascading into a neighboring system.

The NYISO and individual utilities work together to monitor and control the electric system constantly. System operators ensure that electricity production is instantaneously balanced with electric demand and that the system is operated reliably. Reliable operation of the system is guided by established rules that specify voltage, thermal, and other limits within which the system must be maintained. While the goal is to serve load at all times, even under contingency situations, i.e. unexpected equipment failure, the operating rules are designed to interrupt load temporarily, if necessary, to prevent physical damage to the system.

2.3.2. Distribution

The State's electric utilities are responsible for operating and maintaining their respective distribution systems to supply electricity to meet their customers' needs. Distribution systems are designed as either radial or network systems and can be located either overhead or underground.

Radial distribution systems consist of several primary circuits extending radially from a distribution substation. The radial system is principally an overhead system and subject to interruptions caused by tree contact, accidents, and lightning. It should be noted, however, that service interruptions on the radial system are mitigated by fusing and reclosers that isolate customers downstream from the fault. Customer impact can be mitigated further by isolating the cause of the outage through manually reconfiguring the circuit through field ties. In some instances, utilities have installed switching equipment that automates the reconfiguration process. Advances in technology are making automation more cost-effective and will be used more in the future.

A network system is most frequently found in high-load-density metropolitan areas because a dense population of customers affords the economical design and installation of redundant parallel lower voltage feeder cables, network transformers, and protective relays. By design, the network systems are more reliable than radial systems because service interruptions generally occur only when there is a failure within the connection to the customer, erroneous construction activities, or when the substation supplying the network suffers a complete collapse in its ability to serve the load. Consolidated Edison Company of New York, Inc.'s (Con Edison) extensive underground system is an example of such a network.

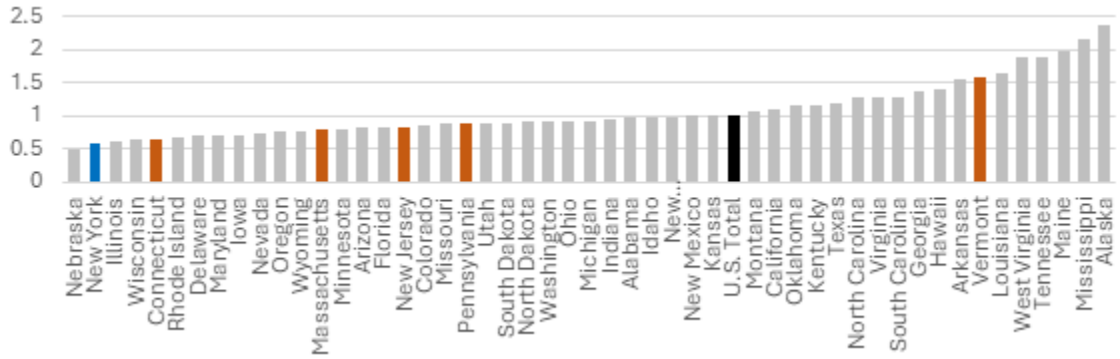
2.4. Reliability

Reliability of the electricity system describes its ability to provide consistent and uninterrupted electricity. This spans the reliability of the bulk power system and the utility distribution systems.

Service on New York's bulk power system was curtailed only once in nearly two decades, during the 2003 Northeast blackout, which was caused by factors outside of the state. The NYISO conducts near-term and long-term planning (described below) to ensure that the electricity system is designed to maintain reliability, using both resource adequacy and transmission security modeling to identify future system needs. Due to short- and long-term planning conducted by a variety of entities, New York fares better than the national average and neighboring states on reliability metrics for electric utility customers. For example, New Yorkers experienced the second-fewest power outages (Figure 13) on average, across U.S. states.[14] However, work continues to improve the statewide electric grid.

Figure 13: Average Frequency of Power Outages (2023, Excluding Major Storms)
Source: EIA System Average-Interruption Frequency Index Values, Without Major Event Days, 2023

Note: New York is shown in blue and neighboring states in red. U.S. total is in black.



2.5. Electricity Cost Trends

The wholesale price of electricity varies over time and at different scales (i.e., at monthly and annual intervals); retail prices also have the potential to be volatile, largely driven by swings in the price of natural gas. The PSC requires that regulated utilities maintain supply portfolios in order to reduce commodity volatility in the prices charged to their residential, small commercial, and industrial customers. The supply portfolios include a combination of fixed hedges, indexed hedges, and, where applicable, their own generation; the balance of the supply portfolio is made up through spot market purchases.

It is important to note that electric market prices are dependent on present market conditions, and the utilities under PSC jurisdiction have no control over the market price. The cost of electricity is determined largely by the energy and capacity markets administered by the NYISO. As discussed above, the utilities do have the ability to mitigate the month-to-month volatility of end-use supply prices for their mass-market customers through hedging and their supply rate mechanisms. The end-use full-service mass market residential supply rate mechanisms have some flexibility, through the ability to

spread large reconciliations over more than one month, a practice that utilities have utilized more frequently in the last several years.

The PSC requires the regulated electric utilities measure and monitor the price volatility of their supply portfolios and file quarterly reports. The Department of Public Service (DPS) regularly meets with each utility to discuss its hedging plan for the upcoming year as well as for future years. Such efforts to mitigate volatility have been consistently successful as the utilities' electric supply portfolio has consistently experienced less volatility as compared to the market.[15] This trend is expected to continue in future years.

This section provides an overview of wholesale energy market price and retail energy cost trends over the last 15 years to show the evolution of price and costs during this time period.

2.5.1. Wholesale Energy Market Prices

Since 1999, wholesale electricity prices have been determined primarily through the NYISO's energy markets. These Locational Based Marginal Prices (LBMP) in the NYISO grid consist of three key components: the Marginal Energy Price, the Marginal Loss Price, and the Marginal Congestion Price. These are described below.

- **Marginal Energy Price.** Represents the cost of producing the next unit of electricity to meet system demand at a specific location—essentially the price of electricity at the "reference point" (load-weighted average of system node prices).
- **Marginal Loss Price.** Captures the cost of transmission losses along the path to the load, caused by heat dissipation and other factors.
- **Marginal Congestion Price.** Reflects the cost associated with delivering electricity to a specific location when there are transmission constraints or congestion.

The data reported in Table 1 illustrates wholesale price trends since 2010 and shows a decline over that period, driven largely by declines in the price of natural gas. In 2022, there was a spike in natural gas prices which, in turn, caused wholesale prices to increase. Also, transmission congestion at the Central East interface results in a difference in prices in Zone E and Zone F that was driven by a larger transmission congestion component of the LBMP in Zone F. However, these historical trends are not necessarily indicative of how wholesale prices may evolve in the future.

Table 1: Annual Average Day-Ahead Zonal Electricity Prices (nominal $)

Note: Values were developed using NYISO day-ahead prices, weighted by total load as a proxy.

	A	B	C	D	E	F	G	H	I	J	K	NYS
2010	$40.43	$43.13	$44.17	$41.19	$46.27	$51.88	$54.43	$55.57	$55.25	$58.63	$64.77	**$53.35**
2011	$38.80	$41.58	$42.46	$39.36	$44.15	$48.06	$51.94	$52.84	$52.47	$56.07	$64.53	**$51.13**
2012	$32.38	$33.65	$34.16	$31.21	$35.18	$38.56	$39.88	$40.55	$40.42	$41.25	$53.56	**$39.90**
2013	$39.49	$39.33	$40.87	$35.79	$42.03	$53.23	$53.21	$54.29	$53.52	$55.30	$70.33	**$51.58**
2014	$49.16	$49.95	$52.99	$52.04	$55.41	$65.96	$64.70	$68.32	$63.65	$64.03	$73.14	**$61.23**
2015	$32.24	$29.52	$31.11	$26.59	$32.43	$40.91	$40.62	$42.05	$40.38	$40.73	$50.02	**$38.71**
2016	$27.52	$21.93	$23.10	$17.51	$22.97	$30.72	$30.43	$31.00	$30.56	$31.37	$39.98	**$29.73**
2017	$26.44	$24.58	$25.44	$20.55	$25.76	$32.91	$33.01	$33.87	$33.33	$34.73	$40.03	**$31.90**
2018	$34.22	$31.70	$32.91	$25.59	$33.26	$40.10	$39.39	$40.73	$39.50	$42.04	$48.96	**$39.26**
2019	$26.62	$21.67	$22.99	$18.80	$23.75	$29.21	$28.27	$29.07	$28.72	$30.16	$34.96	**$28.27**
2020	$18.97	$16.81	$17.19	$12.96	$17.17	$22.28	$21.48	$22.16	$21.82	$22.45	$30.54	**$21.61**
2021	$32.74	$30.61	$31.42	$23.24	$31.66	$46.20	$42.79	$44.08	$43.55	$44.35	$59.38	**$41.65**
2022	$59.82	$59.77	$61.82	$48.59	$64.50	$100.17	$88.46	$90.06	$88.85	$89.20	$103.13	**$81.54**
2023	$26.69	$27.50	$28.48	$24.61	$29.46	$38.67	$35.42	$36.16	$35.71	$35.50	$44.45	**$34.15**
2024	$33.89	$34.86	$36.37	$33.38	$38.35	$41.30	$40.94	$41.91	$41.03	$41.38	$47.88	**$40.10**

2.5.2. Wholesale Capacity Price Trends

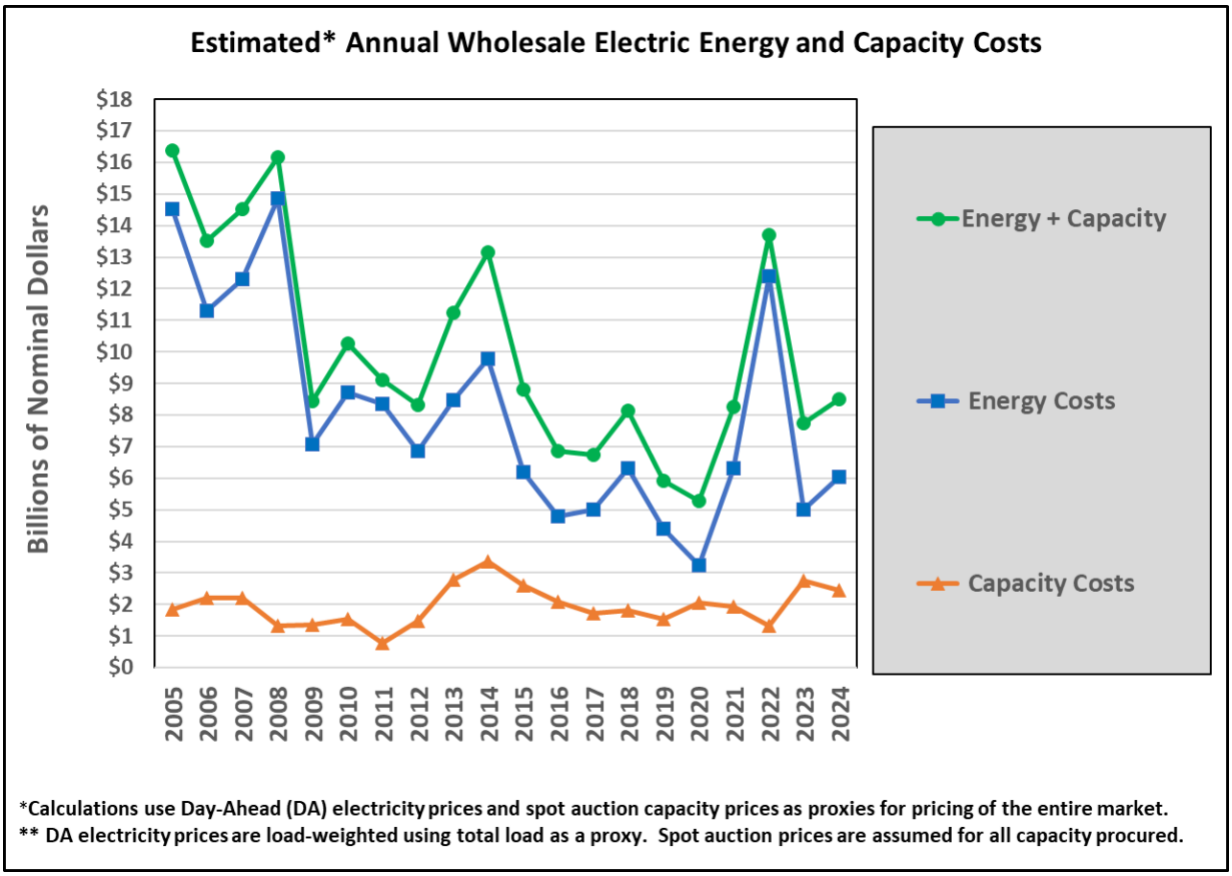
To ensure resource adequacy, the NYISO administers an ICAP market. Capacity suppliers commit to being available to serve load when called upon. The NYISO requires sufficient seasonal capacity to serve peak-load reliably. To accomplish this, LSEs, i.e., utility affiliates and ESCOs that supply electricity to end-use customers, are required to acquire capacity at least equal to their forecast peak load plus a required reserve margin (established annually) to ensure that sufficient resources exist to serve peak load. The current statewide minimum capacity requirement from May 2025 through April 2026 is 124.4 percent of forecasted peak load. Due to transmission constraints that limit the ability of upstate generation to serve downstate load, LSEs serving New York City, Long Island, and the Lower Hudson Valley must acquire a portion of their capacity from local generation. The current minimum locational requirements from May 2025 through April 2026 for New York City, Long Island, and the Lower Hudson Valley are 78.5 percent, 106.5 percent, and 78.8 percent of forecast peak load, respectively.[16]

Market participants can choose to buy or sell the required capacity either through bilateral contracts or through voluntary strip, monthly, or spot auctions. The strip auctions are held biannually and cover all six months of the capability period. The monthly auctions allow for trading in any of the future months of that capability period. To enforce the purchase requirements, LSEs that do not procure enough capacity voluntarily through the strip or monthly auctions, or via bilateral transactions, must purchase the rest at a price determined in the spot auction, which is held at the end of each month, for the upcoming month's capacity.

Figure 14 depicts the trends in the overall annual cost of energy and capacity. These trends reflect the volatility of wholesale market prices and show that, since 2005, energy and capacity costs have decreased significantly overall.

Figure 14: Estimated Annual Wholesale Electric Energy and Capacity Costs

Source: NYISO



2.5.3. Retail Electricity Cost Trends

Wholesale prices are a component of customers' total electric bills. To get insight into customers' total electric bill at the retail level, the New York utilities are required to report on what the average annual bill was for a typical customer within each of the three major rate classes/components. The typical bill is broken down into the three major components: Delivery, Commodity (or Supply), and Surcharges. This information is updated and provided each year and includes the most recent historic year as well as the nine preceding years.

DPS provides direct links to each utility's website page that contains the ten-year historic average monthly bill data for typical customers receiving service under the Residential, Small Commercial / Industrial, and Large Commercial / Industrial classes.[17]

While retail bills do differ from utility to utility, it is informative to look at the trends for a downstate utility and an upstate utility, specifically for residential customers. For example, bills for residential customers in Con Edison (CECONY) and Niagara Mohawk Power Corporation d/b/a National Grid (National Grid), respectively, are shown below in Figure 15 and Figure 16.

Figure 15: Average Monthly Residential Bill - Con Edison (280 kWh monthly usage)

Source: DPS[17]

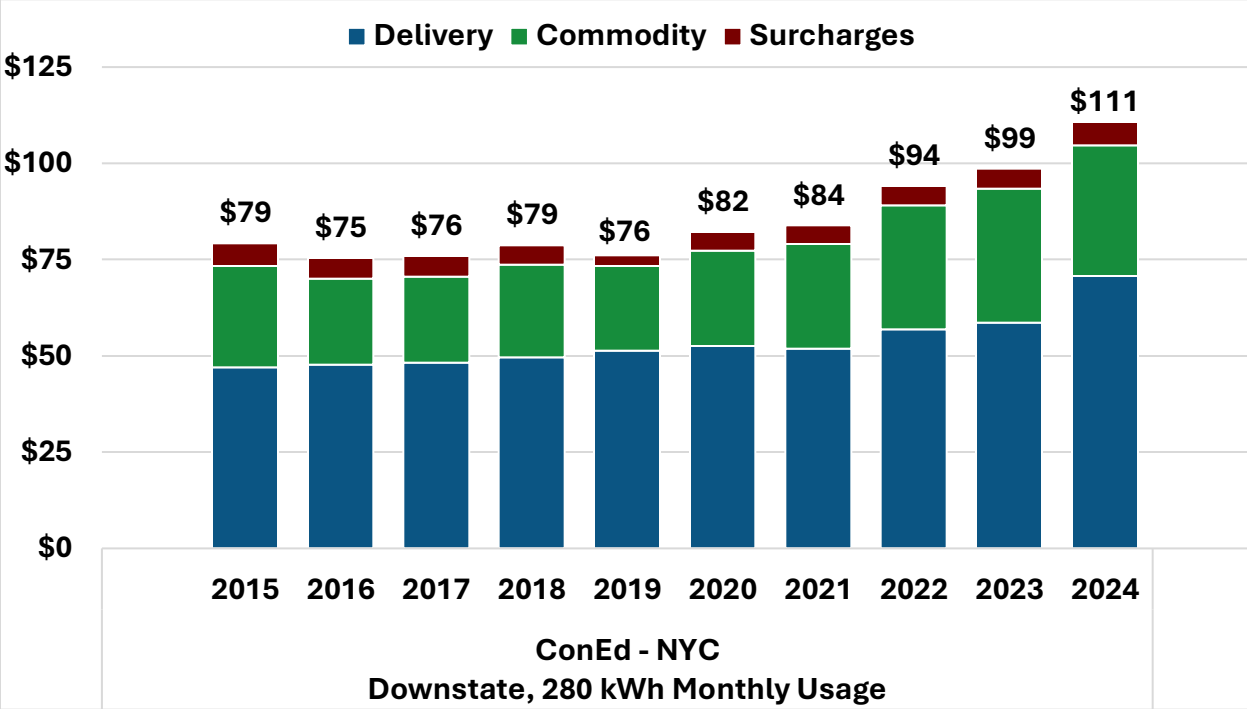
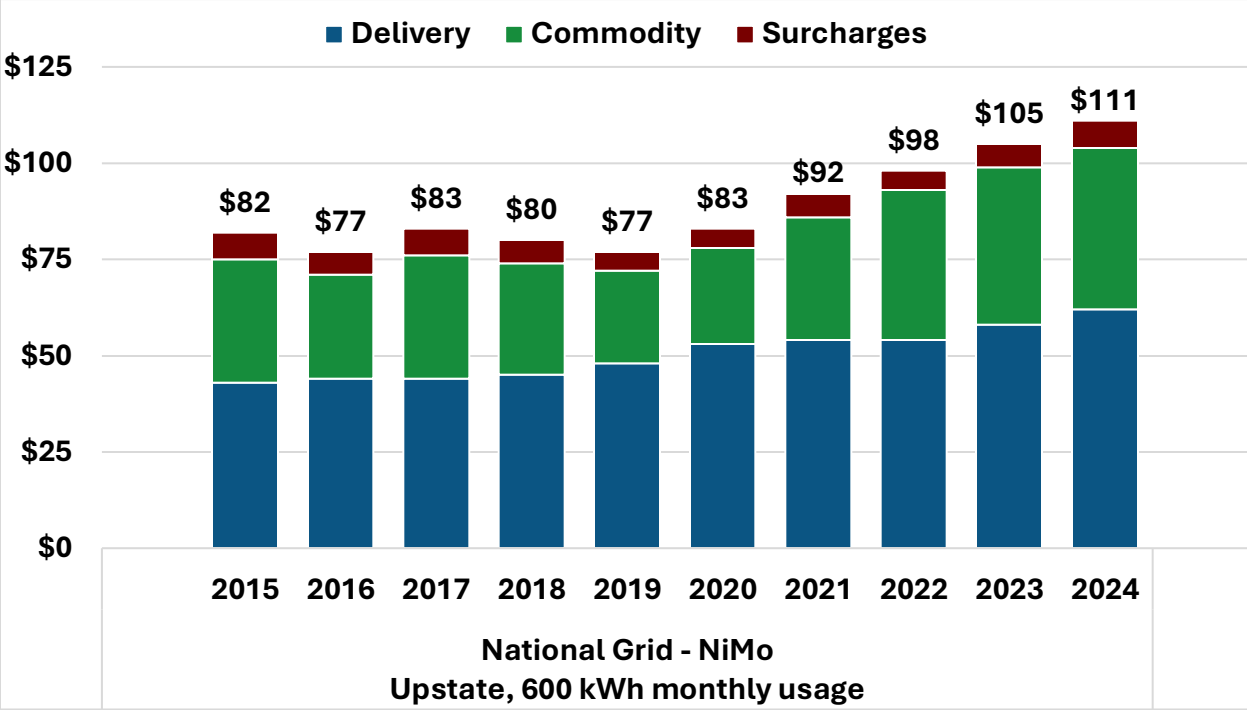


Figure 16: Average Monthly Residential Bill – Niagara Mohawk d/b/a National Grid (600 kWh monthly usage)

Source: DPS[17]



2.6. Key Electricity Sector Requirements and Targets

2.6.1. Public Service Law (PSL) Requirements

Efforts to develop, maintain, and operate the electric system are driven by longstanding requirements codified in the PSL and in the PSC's regulations. These rules and regulations govern the PSC's regulatory oversight of the utilities, independent power producers, ESCOs, and other market participants to ensure safe, reliable, and affordable electric service.

Several goals for the electricity sector are codified in the PSL as explained further in this section. PSL §65(1) grants the PSC authority to ensure that "every electric corporation and every municipality shall furnish and provide such service, instrumentalities and facilities as shall be safe and adequate and, in all respects, just and reasonable." The same section also requires that charges for electric service "shall be just and reasonable and not more than allowed … by order of the [PSC]." The PSC has further authority under PSL §66(5) to "prescribe the safe, efficient and adequate property, equipment and appliances thereafter to be used, maintained and operated for the security and accommodation of the public" whenever the PSC determines that the utility's existing equipment is "unsafe, inefficient or inadequate."

2.6.2. Reliability Requirements

A comprehensive system of reliability rules established by NERC, the NPCC, the NYSRC, and the PSC govern the planning and operation of the electric system, including the operations of generators. These rules drive the characteristics of the system in several ways. For instance, the rules require the New York

State bulk power system to meet a "loss of load expectation" (LOLE) that is less than or equal to an involuntary load disconnection (i.e., insufficient capacity to meet customer demands) that is not more frequent than once in every 10 years, or 0.1 day per year. In this context, a system is considered adequate if the probability of having insufficient transmission and generation to meet expected demand is equal to or less than this LOLE of 0.1 day per year. This LOLE requirement is used in specialized computer model simulations to derive the needed minimum installed generation capacity above forecast peak demands, referred to as IRM. For example, a system with a 10 percent minimum IRM and a forecast peak load of 1,000 MW would require 1,100 MW of total installed generation capacity to reliably serve the system peak load.

2.6.3. Climate Leadership and Community Protection Act (Climate Act) Economy-wide and Electricity Sector Targets

New York has been a leader in building clean energy generation for over 20 years, since adoption of the 2002 State Energy Plan. In 2004, the PSC established an incentive program to support new renewable generation projects under the Renewable Portfolio Standard (RPS).

On August 1, 2016, the PSC replaced the RPS Main Tier program with the Clean Energy Standard (CES) through the Order Adopting a Clean Energy Standard (2016 CES Order). The CES includes a Renewable Energy Standard (RES) and a Zero-Emissions Credit (ZEC) requirement. The RES established a Tier 1 program under which NYSERDA was authorized to procure eligible new large-scale renewables (LSR) projects and a Tier 2 maintenance program to provide financial support for existing renewable facilities. The ZEC program was intended to support certain nuclear power facilities and is also referred to as Tier 3. The PSC has also since authorized a Tier 4 program intended to deliver renewable energy into New York City and an offshore wind (OSW) program to further supply New York State with renewable energy.

In 2019, the Climate Act was signed into law. The Climate Act increased and extended the goals set out in the 2016 CES Order by establishing: (1) the State's LSEs should procure at least 70 percent of New York State electric load from renewable energy resources by 2030; and (2) the "statewide electrical demand system" should "be zero-emissions" by 2040. The Climate Act also includes technology-specific targets for OSW, solar, and energy storage resources, specifically a 9-gigwatt (GW) target for OSW by 2035, a 6-GW target for distributed solar by 2025, and a 3GW target for energy storage resources by 2030. In addition to the electric-sector specific targets established in the Climate Act, the Climate Act also established economy-wide targets for New York to reduce economy-wide greenhouse gas (GHG) emissions by 40 percent by 2030 and 85 percent by 2050 from 1990 levels.

In furtherance of the Climate Act's call for a zero-emission "statewide electrical demand system" by 2040, the PSC initiated a process in 2024 to determine what actions are appropriate to pursue the 2040 target. The DPS decided that the first step in that process should be to develop definitions of key terms not expressly defined in the Climate Act, specifically: "statewide electrical demand system" and "zero emissions." Progress toward defining key terms is discussed further in Section 2.7.2. Further steps beyond the adoption of key definitions will include adoption of a methodology for characterizing the potential gap between expected demand and supply eligible to participate in the power sector under the target; designation of particular resources as eligible to participate; and, building on those foundational

elements, programmatic measures to facilitate, to the extent necessary, resources not yet deployed or supported by existing infrastructure in New York State.

2.6.4. Energy Efficiency Targets

Energy efficiency is a cornerstone of the State's strategy to promote affordable clean energy solutions for consumers, reduce electricity demand, and address the Climate Act targets. Participants in energy efficiency programs enjoy the direct benefits of lower energy consumption in addition to the system-wide benefits. As codes and standards are updated, all market participants enjoy more efficient homes and products.

A variety of programs administered by NYSERDA and investor-owned utilities in New York State help New Yorkers make clean energy and energy efficiency upgrades. LIPA and NYPA also implement complementary clean energy and energy efficiency programs.

The New Efficiency New York recommendations, adopted by the PSC in a December 13, 2018 order, established a 2025 energy efficiency target of 185 trillion British thermal units of cumulative annual site energy savings. The Climate Act later adopted this energy efficiency target into law.

The State has made progress on its energy efficiency targets, described in more detail in the Buildings chapter of this Plan.

2.6.5. Affordability Considerations

New York State acknowledges that there is a growing energy affordability crisis—bills are increasing, and many households are struggling to pay their monthly utility bills.

While New York's grid continues to serve New Yorkers with reliable power, key structural trends require continued attention and a strategic approach: the aging of the existing generation fleet and utility infrastructure; the rapid growth of demand, including large loads and electrification targets; and challenges in developing new dispatchable resources. New York has a significant amount of utility infrastructure that is rapidly approaching, or at the end of, its useful life. The thousands of miles of aging utility poles, substations and other equipment, plus investments to develop new and maintain existing generation resources (of which our existing generation is among the oldest in the country), will require spending billions of dollars to ensure system reliability and increase system resiliency. For example, approximately 17% of New York State Electric and Gas Corporation's (NYSEG) electric system relies on 3,146 miles of aging underground cable systems with average ages of 25 to 100 years. Nearly 37% of Rochester Gas & Electric Corporation's (RG&E) electric system relies on 3,061 miles of underground systems that include cables over 100 years old.[18]

The replacement of old infrastructure with newer infrastructure carries higher capital costs than was experienced in the past. These costs are impacting, and will continue to impact, utility rates. The consequence of inaction means jeopardizing the reliability and safety of our energy system. New York State is committed to providing safe and reliable service while taking all possible steps to buttress energy affordability. As energy costs and system investments evolve, the State continues to balance clean energy progress with ratepayer protection. The programs and reporting mechanisms below demonstrate

how DPS and the utilities are working to maintain equitable access to essential services, particularly for low- and moderate- income households, while promoting transparency, data driven oversight, and alignment with New York's broader affordability and clean energy targets. While the Climate Act is not the main driver of energy bill increases, it nonetheless does contribute to those increases That is why New York, specifically the PSC, is continuously evaluating impacts given increasing energy affordability concerns.

DPS recently issued its Second Informational Report on the Implementation of the Climate Act, which further describes some of the factors contributing to utility bill increases.[19] The report highlights the macroeconomic realities that are placing upward pressure on utility bills as greater exposure to global commodity markets is driving increased variability in energy supply costs and demand for the equipment that is necessary to build, maintain, and service the energy infrastructure in New York State continues to grow. Specifically, in 2023, 10–30% of a New York utility customer's (e.g., National Grid and Con Edison) electric delivery bill was for non-income taxes versus the 8% national average of peer utilities.[20]

Energy Affordability Program (EAP)

In 2016, the PSC established a target energy burden, or the percentage of a customer's income that is spent on energy, at or below six percent for low-income households. Since then, the PSC has refined the EAP program[21] and brought relief to over 1 million low-income households with billions of dollars in utility bill relief.[22] In July 2025, the PSC adopted a new Enhanced Energy Affordability Program (EEAP)[23] to support moderate-income utility customers who do not qualify for existing low-income energy programs, significantly broadening affordability protections beyond the existing programs.

The PSC requires the utilities to track key data and file reports related to enrollment in energy affordability programs, the level of arrears, and terminations. These utility EAP Monthly Reports are filed in Case 14-M-0565[24] and monthly Collection Reports are filed in Case 91-M-0744.[25] DPS is exploring options to improve visibility into utility affordability for New Yorkers. To ensure comprehensive reporting, DPS Staff continues to engage with the EAP Working Group to identify additional data and insights that are included in the bi-annual reports. The most recent report was filed in February 2025 under case 14-M-0565.[26]

Energy Efficiency and Beneficial Electrification for the Low- to Moderate-Income (LMI) Market Segment

The PSC has prioritized energy efficiency in the LMI market segment, including for affordable housing. Housing authorities are working to balance the need to create and preserve affordable housing with the need to improve the energy performance of units. In May 2025, the PSC authorized over $300 million annually to support energy efficiency and building electrification programs in the LMI market segment for 2026–2030. This funding will be used for incentive programs and the provision of technical assistance, which are available to affordable housing developments that pay into the System Benefits Charge. Specifically, $160 million of the $300 million is dedicated to affordable multifamily housing.

2.7. Programs and Policies

This section describes the programs and policies currently in place to support the achievement of New York's clean energy and climate goals in a reliable and cost-effective manner.

2.7.1. The CES

By focusing on low-carbon energy sources, such as solar, wind, and hydropower, the CES brings investment, economic development, and jobs to New York State. The CES features two primary mechanisms – the RES and ZEC requirements. The RES and ZEC programs both require every LSE in the state to procure Renewable Energy Certificates (RECs) and ZECs.

The CES is currently comprised of the following programs:

- **Tier 1** – Aims to increase new renewable energy development in New York State. Eligible Tier 1 resources include generators of electricity that use the following technologies: solar thermal, solar photovoltaics (PV), land-based wind (LBW) and OSW, hydroelectric, geothermal electric, geothermal ground source heat, tidal energy, wave energy, ocean thermal, and fuel cells that do not utilize a fossil fuel resource in the process of generating electricity, which entered commercial operation on or after January 1, 2015.
- **Tier 2 Maintenance** – Provides targeted, adequate, and prudent support to New York's existing renewable resources to ensure their continued operations. Eligible Tier 2 maintenance generators include run-of-river hydroelectric facilities (10 MW or less) and wind resources that entered commercial operation prior to January 1, 2015.
- **Tier 3** – Places a value on New York's upstate nuclear plants that avoid the emission of over 15 million tons of CO_2 per year. New York State's LSEs must purchase ZECs from NYSERDA every year. This annual obligation is based on an LSE's proportional amount of statewide load in each compliance year.
- **Tier 4** – Supports combined renewable generation and new transmission infrastructure to increase the delivery of renewable energy into New York City and reduce reliance on fossil fuels.
- **OSW** – Advances the responsible and cost-effective development of up to 9,000 MW of OSW energy by 2035, including investments in ports, manufacturing and supply chains, and workforce training to support the growing OSW industry.

Together, these programs support the deployment of renewable electricity generation in New York State. These resources provide benefits that go beyond their environmental impacts. For instance, OSW could provide energy where it is needed in New York City while helping to avoid congestion and reduce the need for new transmission, while solar helps to meet summer peak energy needs. The State has also been successful in employing new strategies for programs, including the Tier 1 program, such as the Indexed REC, a contracting mechanism where REC's price is tied to wholesale market prices and is designed to lower costs for consumers by hedging against market volatility.

Procurements

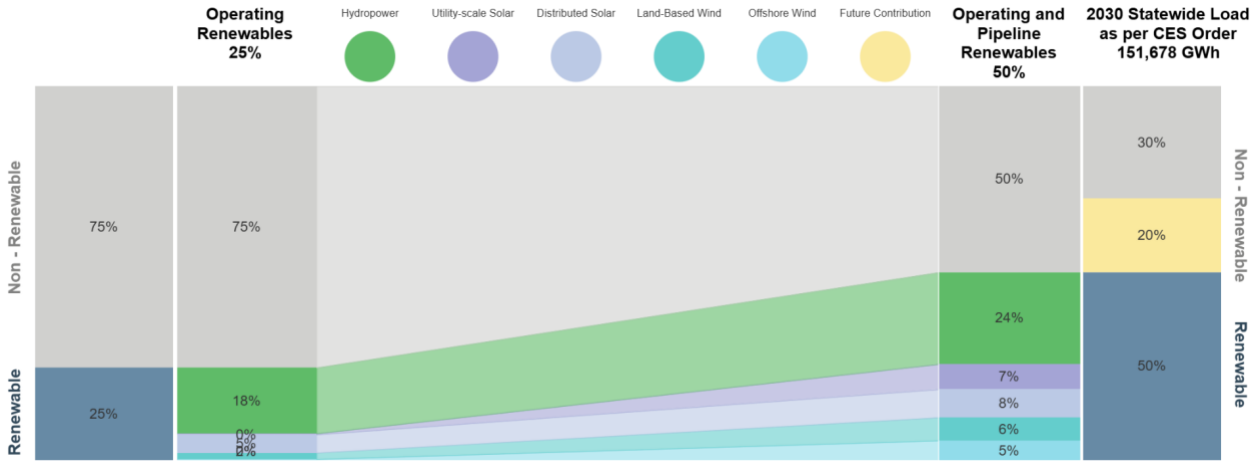
The Climate Act Dashboard[27] is designed to keep New Yorkers apprised of the State's progress toward the Climate Act targets with metrics updated regularly throughout the year. As of June 6, 2025, the Climate Act Dashboard as depicted in Figure 17 indicates the State's current operating renewables meet 25 percent of the projected 2030 statewide load. Adding renewable generation under development to that

figure indicates a combined potential to meet 50 percent of the projected load, which equates to 71 percent of the 2030 target. This total incorporates all renewable generation in the State, including distributed solar and baseline renewables.

Figure 17 shows New York's operating renewables (left) for installed renewable generation, which include operating plus pipeline projects, both contracted and under development, alongside projections of statewide load and generation mix (right). Data to report progress is assembled from multiple sources and a data source summary is available from the Climate Act Dashboard.[27] Though there are some exceptions, operating renewables generally reflect the latest New York Generation Attributes Tracking System (NYGATS) compliance year while pipeline values generally reflect NYSERDA contracts as published in the Large-Scale Renewable Projects Open NY dataset.[28]

Figure 17: New York State Operating and Pipeline Renewable Electricity Generation (June 2025)

Source: Climate Act Dashboard[27]



Tier 4 of the CES

Tier 4 RECs were established by the PSC on October 15, 2020, as part of the CES.[29] Tier 4 RECs are specifically targeted to increase renewable energy delivery into New York City (Zone J). Eligible projects must either be located within the city or deliver renewable energy to a Zone J delivery point via a new transmission interconnection established after the October 15, 2020 CES Order was promulgated. The Champlain Hudson Power Express (CHPE) transmission line that will deliver hydropower into New York City is currently under construction and anticipated to enter commercial operation in 2026.

2.7.2. Zero Emissions Target: Defining Key Terms

November 2024 White Paper

In May 2023, the PSC initiated a process focused on the Climate Act's 2040 power sector target. [30] In November 2024, DPS Staff issued a white paper proposing definitions of the key terms discussed above.[31] As DPS explained, that white paper reflects legal analysis of the terms and their context. It aims to lay the foundation for further action with respect to "zero emissions by 2040" by clarifying the statutory language.

The white paper first examines issues related to the scope of application for the 2040 target, specifically "the statewide electric demand system" and its relationship to the PSC's jurisdiction over participants in the power sector. The analysis focuses on how that scope applies to resources located outside of New York or "behind the meter." DPS concludes that emissions attributable to electric imports must be considered and recommends that some but not all behind the meter resources come within the scope of the target's application.

The white paper then addresses issues related to the "zero emissions" target itself, considering the types of emissions regulated under the 2040 target and finds that they are GHGs only, not other pollutants. It considers which emissions-related activities should be considered under the target and recommends that the PSC consider the GHG emissions associated with fuel production and resource operation but not other activities, such as resource construction. The paper also considers the interpretation of the term "zero," recommending that it be understood as distinct from "net zero" and interpreted as prohibiting any generation resource that emits GHGs. Finally, it examines whether fuel cells that do not consume fossil fuels qualify as "zero emissions" resources and recommends that they be included in that definition.

The white paper also acknowledges the limiting implications of its proposed definitions and advises the PSC to regularly assess progress toward the 2040 zero-emissions target. In line with the need to characterize any potential reliability gap between future electricity demand and eligible supply of zero-emissions resources, the paper recommends ongoing evaluation to ensure alignment between policy goals and capabilities.

Zero by 40 Technoeconomic Assessment

In October 2025, NYSERDA published the Zero by 40 Technoeconomic Assessment final report (The Assessment).[32] The Assessment was conducted by the Electric Power Research Institute and evaluates seven candidate dispatchable, emissions-free (clean firm) resources that could help to reduce the potential gap between electricity demand and supply in 2040 and beyond. The Assessment examines key features of each technology considered and identifies various aspects of their potential and limitations that are relevant to consider in New York State's context. The following is the list of technologies that were evaluated:

- Hydrogen
- Alternative fuels, including renewable natural gas (RNG) and renewable diesel
- Advanced nuclear
- Next-Generation geothermal
- Carbon capture and sequestration
- Long duration energy storage (LDES)
- Virtual Power Plants (VPP)

The Assessment found that all seven candidate resources could serve complementary roles in a 2040 grid but that no single technology alone can meet the statewide needs for clean firm power. Instead, a mix of technologies will best meet statewide needs, maximize benefits, and minimize the risk associated with overreliance on any one resource. Recognizing that different technologies bring unique attributes to the grid that suit them to different use cases and regions of New York, the report categorizes the seven technologies into three categories: Low-Capacity Factor, High-Capacity Factor, and Gap Rightsizing.

Low-Capacity Factor resources include hydrogen and alternative fuels. They are duration-unlimited (assuming fuel availability) and have fast ramping capabilities that will play a vital role on days with the most extreme system needs. They will be needed throughout New York State. However, limited fuel availability and high fuel costs will limit their utility beyond peaking power.

High-Capacity Factor resources such as advanced nuclear, next-generation geothermal, and carbon capture paired with natural gas can help meet growing loads, reduce the need for buildout of some intermittent renewables and mostly idle peaking plants, diversify the energy mix, and provide inertia and other critical grid services to support a grid increasingly dependent on variable renewables. However, High-Capacity Factor resources all face long lead times that will require prompt action to achieve deployment before 2040 and siting constraints that may require complementary transmission upgrades to be able to serve downstate load.

Gap-rightsizing resources like LDES and VPPs do not produce new electricity but can balance supply and demand and reduce the need for upgrades to transmission and distribution infrastructure. These resources have siting flexibility, are modular, and have shorter lead times which makes them valuable to deploy early.

Overall, the Assessment indicates that a mix of resources will be critical to meeting the State's needs. Achieving the 2040 target will require early action towards deploying long lead time technologies, investment into innovation to mature technologies and enable breakthroughs, and maintaining flexibility to adapt to an evolving grid.

The Zero by 40 Technoeconomic Assessment provides several insights into the clean, firm potential in New York State. The bullets below describe select interpretations of the report:

- In addition to renewables and short duration storage, LDES and VPPs should be deployed early to maximize the ability to avoid relying on more expensive dispatchable emission-free resources (DEFR) options. However, LDES and VPPs alone are not enough to meet statewide DEFR needs.
- Different regions of New York will have different DEFR needs and suitability. Downstate faces the most siting constraints. It will be critical to strike the right balance of resources with more siting flexibility to meet downstate energy and reliability needs.
- Advanced nuclear could serve a critical role in meeting load growth by providing firm, baseload power to complement the renewables serving the bulk of energy needs statewide. Nuclear faces fewer infrastructure hurdles compared to technologies like hydrogen and carbon capture and storage and does not face the same geologic challenges that geothermal does. However, nuclear projects face long lead times and uncertain costs, which means that prompt action will be

essential to achieving deployment before 2040. Governor Hochul has recognized this and has directed NYPA to develop and construct an advanced nuclear power plant in Upstate New York. New York is also conducting a series of studies under the umbrella of the Master Plan for Responsible Advanced Nuclear Development in New York. A focus of these studies will be on how to address the challenges and take advantage of opportunities identified in the Zero by 40 Assessment.

- Hydrogen faces significant infrastructure challenges. The most cost-effective way to supply the amount of hydrogen required to meet statewide reliability needs would be with a statewide hydrogen pipeline network, but pipelines face significant permitting hurdles, long lead times, and siting constraints that render them an unlikely solution for 2040. In the absence of a pipeline, more modular transport options like trucking would be required but face logistics and cost challenges that are potentially prohibitive at this scale, requiring more than 200 trucks to enter New York City per day just to meet the bare minimum of peaking needs. Additionally, as New York's economy seeks to decarbonize, demand for emissions-free electricity will increase, which could lead to a shortfall of the electricity needed for electrolysis to produce hydrogen. Given these findings from the Technoeconomic Assessment, green hydrogen alone cannot be expected to fill the gap between electricity demand and supply in 2040.
- RNG is a drop-in replacement for natural gas and therefore does not face the same infrastructure challenges as hydrogen because it can leverage existing transportation and storage infrastructure. RNG is therefore a promising alternative to hydrogen as a Low-Capacity Factor resource. As a result of the Climate Act's unique GHG accounting methodology, RNG is not allowable as a zero-emissions resource to contribute to a 2040 grid. Even though it captures and repurposes methane that would otherwise be released into the atmosphere, the combustion of RNG results in GHG emissions and the Climate Act does not consider lifecycle emissions reductions.

2.7.3. Energy Efficiency

Energy efficiency is central to promoting affordable clean energy solutions for consumers, reducing electricity demand, and advancing the State's energy goals. To manage the impacts of widespread electrification on the State's electric grid, it will be essential that buildings make significant investments in energy efficiency. Related State initiatives are discussed in the Buildings chapter of this Plan.

2.7.4. Clean Heat Program

The New York State Clean Heat Program, which launched on April 1, 2020, provides customers, contractors, and other heat pump solution providers with a consistent experience and business environment throughout New York State. The New York State Clean Heat Program supports a consistent statewide heat pump program designed to achieve the State's ambitious heat pump goals and build the market infrastructure for a low-carbon future. Since the program's launch, there have been 58,992 projects with over 4,527,000 million British thermal units of savings.[33] See the Buildings chapter of this Plan for additional information on the New York State Clean Heat Program.

2.7.5. Clean Transportation Program

In New York State, transportation accounts for about one-third of statewide GHG emissions. Creating a transportation system that reduces emissions while increasing connectivity and access to jobs, schools, and services requires scaling up existing solutions, such as zero-emission vehicles (ZEVs), while developing innovative technologies for hard-to-electrify modes of transit. New York State has several programs to support electric vehicle (EV) adoption including the EV Make Ready Program, the NYSERDA Clean Transportation Program, EVolve NY, the Drive Clean Rebate, and the New York Truck Voucher Incentive Program. For example, NYSERDA's Clean Transportation Program provides incentives, funding opportunities, and technical assistance to advance several low-carbon modes of transportation, including public transit, biking, walking, and light-, medium-, and heavy-duty ZEVs, such as battery electric and hydrogen fuel cell vehicles. The transition to ZEVs is underway, supported by increasing vehicle choice and public charging infrastructure availability. Converting to ZEVs is not just good for the environment – it also reduces the total cost of vehicle ownership through lower fuel and vehicle maintenance costs. All of New York State's transportation-related initiatives are discussed in greater detail in the Transportation chapter of this Plan**.**

2.7.6. Energy Storage

Energy storage plays a crucial role in advancing the State's climate targets and cost-effectively managing grid resources. As renewable power sources like wind and solar provide a larger portion of New York's electricity, storage will allow clean energy to be available when and where it is most needed.

On December 28, 2022, in compliance with the periodic review requirements of the PSC's Order Establishing Energy Storage Goal and Deployment Policy and to consider an expanded 6 GW energy storage target, DPS and NYSERDA jointly filed New York's Energy Storage Roadmap: Policy Options for Continued Growth in Energy Storage (Roadmap). The Roadmap made recommendations aimed at achieving a 6 GW target and concluded that updating the target was necessary to ensure that the pace of energy storage development is sufficient to meet the State's energy needs. After re-examining proposed program costs and budgets detailed in the Roadmap, DPS and NYSERDA filed an updated Roadmap in March of 2024 to reflect the new cost estimates and proposed budgets.

In June of 2024, the PSC issued an Order increasing the Climate Act target of 3,000 MW by 2030 to 6,000 MW in that same time frame and established an interim target of 1,500 MW by 2025. The Order also directed NYSERDA to establish new incentive programs for energy storage installations at all levels of the electric system: residential, retail, and bulk. NYSERDA has filed Implementation Plans and is in the process of launching these new incentive programs.

On February 14, 2025, the PSC approved, with modifications, NYSERDA's Retail and Residential Energy Storage Program Implementation Plan. The Implementation Plan specifies how 200 MW of residential storage will be supported with $100 million in incentives, and 1,500 MW of retail storage will be supported with $675 million in incentives.

The PSC then approved, with modifications, the draft Bulk Energy Storage Program Implementation Plan on March 21, 2025. NYSERDA will support the development of 3,000 MW of new bulk energy storage

facilities in New York. The Bulk Energy Storage Program uses an innovative Index Storage Credit incentive modeled in part on the REC and Offshore Wind Renewable Energy Credit utilized in CES programs administered by NYSERDA.

On July 28, 2025, NYSERDA launched the first of three annual bulk energy storage solicitations authorized by the PSC. The solicitation, known as ISCRFP25-1,[34] is conducted in steps where proposers were required to submit Step One Eligibility Applications by September 4, 2025. Proposers that receive a Notice of Qualification will have an opportunity to submit a Step Two Bid Proposal with Non-Price and Price Phases. The Non-Price Submission deadline is December 11, 2025 and the Price Submission deadline is January 29, 2026. Awards will be announced following the Price Submission deadline.

There are currently more than 1,400 MW of operational, contracted, or awarded energy storage in New York, including 80 MW of bulk energy storage installed as of March 2025. NYSERDA expects the pipeline of projects in development to increase as the new incentive programs open and begin issuing awards.

In line with State policy, the Residential, Retail, and Bulk Energy Storage programs will direct benefits to the State's disadvantaged communities. A minimum of 35 percent of program funding for energy storage projects will be located in areas of the state to benefit disadvantaged communities by reducing reliance on high-emitting peaking plants, and a minimum of 35 percent of procurements for bulk and off-site retail energy storage projects will be located in NYISO capacity Zones G through K.

2.8. Siting and Permitting

Jurisdiction over siting energy infrastructure facilities is shared among federal, State, and local governments. The siting of electric generation is primarily a State and local responsibility. The siting of electric transmission facilities is also primarily the responsibility of the State, although federal law gives FERC backstop siting authority under limited circumstances.[35]

2.8.1. Renewable Action Through Project Interconnection and Deployment (RAPID) Act

Signed into law on April 20, 2024, the RAPIDRAPID Act[36] repealed the prior generation siting regime established in Executive Law §94-c, repealed PSL Article VIII, and enacted a new PSL Article VIII entitled "Siting of Renewable Energy and Electric Transmission" (Article VIII). The RAPID Act transferred the Office of Renewable Energy Siting (ORES) from the Department of State (DOS) to the DPS, adding new functions, powers, duties, and obligations related to major electric transmission siting. The RAPID Act ensures that ORES is now the one-stop-shop for reviewing, permitting, and enforcing permit requirements for both major renewable energy generation and transmission facilities. The overarching objective of the RAPID Act and the accompanying regulations at 16 NYCRR Part 1100 is to avoid, minimize, or mitigate, to the maximum extent practicable, the potentially significant adverse environmental impacts related to the construction and operation of those facilities.

The RAPID Act also prioritizes early, ongoing consultation with local agencies and enables host communities to engage in the permitting process through intervenor funding. Specifically, the Act requires developers to provide proof of consultation with local governments and Indigenous Nations before they submit an application to ORES and funds to support municipalities, local agencies, and community intervenors to participate in the process. The Act also requires meetings with local

community members, including any disadvantaged community identified in the project study area. These siting processes are and will continue to be inclusive and designed to ensure meaningful participation.

In October 2025, DPS published a revised rulemaking for the draft RAPID Act regulations, which triggered an additional 45-day public comment window before the regulations could be finalized.[37] The revised rulemaking resulted from a full public comment process including 20 in-person public comment hearings at 11 locations around the State, and two virtual public comment hearings. This extensive public participation process included multiple opportunities for comment from municipalities, community members, environmental organizations, and industry stakeholders. Many of the revisions that will be included in the final regulations will be directly informed by the input from these commenters. The final regulations will ensure that the ORES can streamline permitting while ensuring projects are carefully reviewed and balanced with critical environmental and community considerations including impacts to the environment, natural resources and agricultural land.

2.8.2. Consideration of Disproportionate Pollution Burden

Signed into law in December 2022, the Environmental Justice Siting Law addresses the siting of certain environmental facilities with the aim of ensuring that no community bears a disproportionate pollution burden. The Environmental Justice Siting Law requires consideration of whether an action may cause or increase a disproportionate pollution burden on a disadvantaged community as part of the State Environmental Quality Review process. This law complements already existing processes under PSL Article VIII (described above) and Article 10, which govern the siting and permitting of energy generating facilities with a capacity of 25 MW or more. PSL requires comprehensive evaluation of environmental and public health impacts.

2.9. Distributed Energy Resources

Distributed energy resources (DERs) are energy generation and storage facilities located on the distribution network. They are generally subject to the requirements of the Standardized Interconnection Requirements (SIR) and capped at 5 MW per project. Deployment of clean DERs complements the State's efforts to deploy LSRs and provides value to the electric grid by providing electricity generation close to end users, increasing efficiency, assisting with enhancing grid resiliency, and potentially reducing the need for costly transmission investments. From 2010 through 2024, the capacity of DERs interconnected with the electric grid increased by 4,640 percent, from 107 MW to 5,086 MW.[7]

2.9.1. Interconnection Process

DERs depend on an efficient and transparent interconnection process. The PSC has taken steps over time to improve project developers' experience with the SIR and continues to monitor concerns through the Interconnection Policy and Interconnection Technical Working Groups. Based on working group inputs, the PSC has recently made changes under Case 24-E-0621 that aim to streamline interconnection timelines, improve utility cost estimates, and address permitting-related delays. These changes allow solar developers to satisfy financial assurance requirements for distribution upgrades using Letters of Credit in place of cash deposits, lowering upfront capital requirements. In addition, a PSC ruling in 2024

upheld cost certainty for developers by denying a utility request to retroactively assign $11 million in upgrade expenses to previously approved projects. In response to DER developers' concerns with study timelines, DPS and NYSERDA are investigating compliance with SIR deadlines in Case 24-E-0145 and will propose any necessary rule changes. Collectively, these measures help stabilize the solar development environment while advancing the State's climate and clean energy goals. Furthermore, these measures created a launch pad for a robust, healthy, and self-supporting solar industry.

2.9.2. Value of Distributed Energy Resources (VDER)

DERs receive compensation for their energy production through the value of DER methodology (VDER, or the Value Stack), introduced in 2017 as a replacement compensation methodology to the existing Net Metering and Remote Net Metering laws. A 2019 Order further reformed the Value Stack. The Value Stack provides temporal and locational price signals, compensating DER based on when and where they inject energy into the distribution network. Developers see price signals and target installations in areas that provide the greatest benefits to the grid and therefore where price signals are highest. The elements of the Value Stack include:

- **Energy (LBMP)**, representing a project's contribution for providing energy to the grid. It is calculated based on the NYISO's day-ahead hourly price for the project's zone, adjusted for transmission and distribution losses.
- **Capacity (ICAP)**, representing a project's contribution to reducing the State's peak hour of load. It is calculated based on the NYISO's monthly auction prices for the applicable area of the state.
- **Environmental Value (E-Value)**, representing the clean energy attributes (RECs) of a renewable project. By default, the distribution utility claims the environmental attributes of a VDER project's generation, and compensates the project owner with the e-value, currently set at $31.03/MWh. Projects have the option to permanently opt out of receiving the e-value and instead receive non-transferable RECs which can be retired in NYGATS.
- **Demand Reduction Value (DRV)**, representing a project's contribution to preventing or deferring upgrades to the local distribution network. DRV rates are set by utilities based on Marginal Cost of Service studies. Individual VDER generators lock in their DRV rate for ten years and are compensated based on their grid exports during a utility-defined peaking window.
- **Locational System Relief Value (LSRV)**, similar to DRV, representing a project's contribution to preventing or deferring local upgrades to the local distribution network in utility-defined areas. VDER generators in LSRV zones lock in their LSRV rate for ten years and are compensated for their grid exports during utility call events.
- **Market Transition Credit (MTC)** and **Community Credit (CC)** are a utility-administered subsidy for early-adopter community distributed generation projects. Each utility provides several tranches of MTC and CC capacity with declining incentive rates, where eligible projects would lock in a per-kWh rate for all generation over a 25-year term. The MTC and CC allocations have been fully subscribed and are no longer available for new projects.

As of the end of 2024, there were 2,373 Megawatt Alternating Current (MWac) of solar and 231 MW of energy storage systems operational and receiving compensation under VDER.[38]

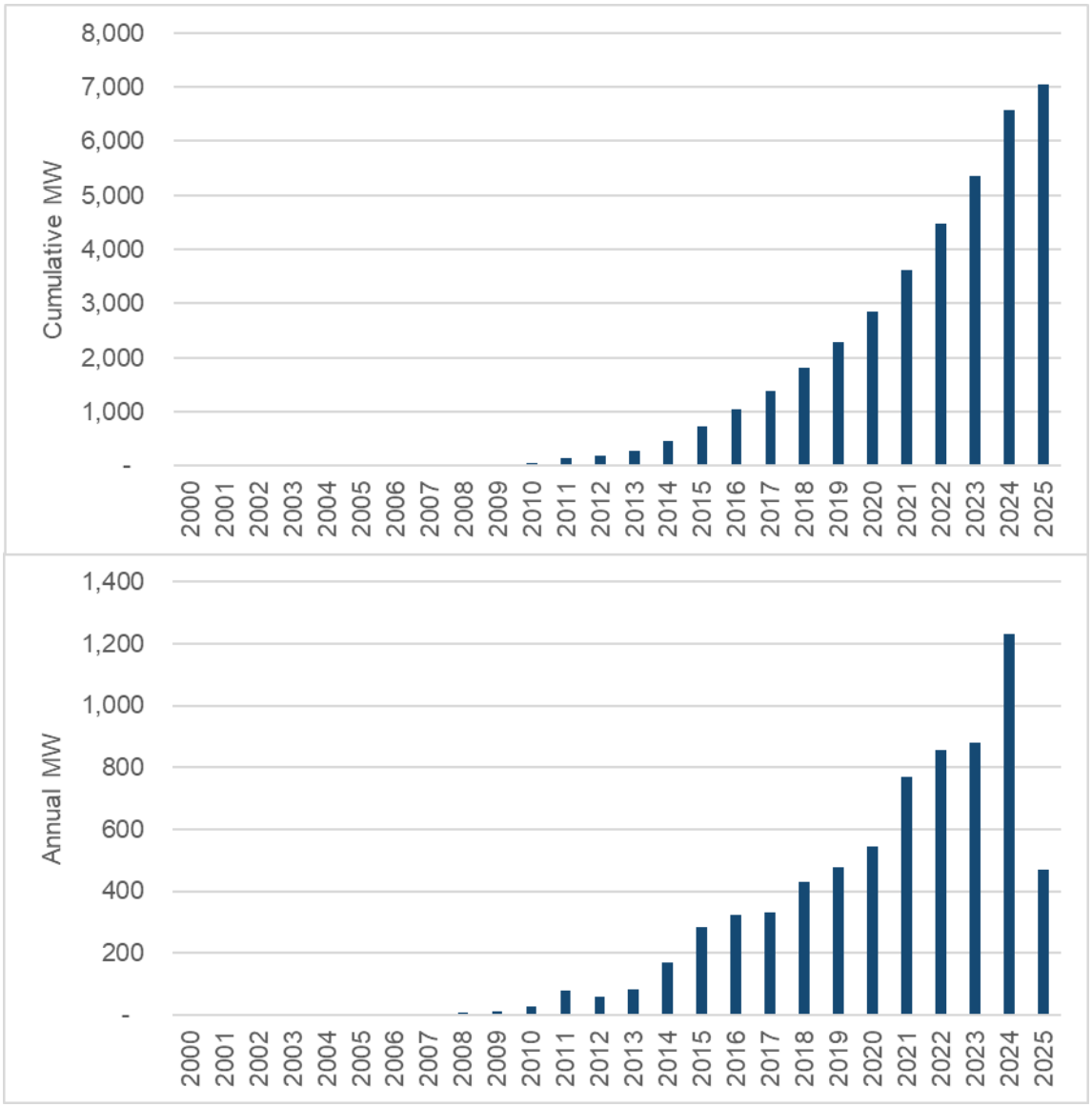
2.9.3. Distributed Solar

The NY-Sun Program was launched in 2012 as an initiative to significantly increase the amount of customer-sited solar power installed annually in New York. Distributed solar can provide utility bill savings to homes and businesses and can be flexibly sited on roofs, brownfields, and parking canopies. When coupled with energy storage, distributed solar can provide grid services by storing clean energy that can be dispatched during periods of high grid demand.

As of December 2024, the NY-Sun Program has provided $1.97 billion in incentives to support the installation of 6,587 megawatts direct current (MWdc)[39] of distributed solar statewide, leveraging over $9.98 billion in private investment (see Figure 18 below)[40]. The NY-Sun incentive varies by market segment (residential / small commercial / commercial / industrial / community), and by region. The NY-Sun incentive is structured as a declining MW block, where incentives gradually step down as the market grows. The Long Island incentive blocks closed out for residential projects in 2016 and for non-residential projects in 2019.

Figure 18: Cumulative and Annual Distributed Solar Capacity Additions (MW).

Source: Statewide Solar Dashboard[40]



NY-Sun offers incentives for solar projects for homes and businesses, community solar projects, projects built on brownfields or landfills, and for solar projects that use prevailing wage labor or provide benefits to LMI households as well as disadvantaged communities. NY-Sun is supported by a robust quality assurance/quality control program, including vetting of contractors and field and photo inspections of a representative sample of projects.

The Climate Act set a statewide target of installing 6,000 MW of distributed solar by 2025. This was codified by the May 2020 PSC Order Extending and Expanding Distributed Solar Incentives. The target was later expanded to 10,000 MW of distributed solar by 2030, by the PSC's Order Expanding NY-Sun

Program, issued in April 2022. Both Orders were preceded by roadmaps and analysis filed by NYSERDA with consultation from DPS.

In October 2024, NYSERDA announced that NY-Sun had achieved the 6,000 MW target over one year ahead of schedule.[41] An additional 3,200 MW of projects are currently at an advanced stage of development with NYSERDA incentives awarded.

The overall budget for NY-Sun is $3.267 billion. On April 24, 2025, the PSC recognized the NY-Sun Program's success in establishing a mature and self-sustaining distributed solar market and adopted the phase-out of the ratepayer-funded up-front incentives currently provided by NY-Sun following the achievement of the 10 GW target.[42] The PSC also directed that surplus NY-Sun Program funding be utilized to procure an estimated additional 500 MW beyond the 10 GW target for the benefit of low-income customers.

Distributed Solar contributes meaningfully to New York State's energy targets with over 1,220 MW installed in 2024 alone. The cumulative ICAP is composed of

- 1,870 MW of residential-scale projects (defined as projects up to 25 kilowatts [kW]),
- 638 MW of small commercial-scale projects (defined as projects above 25 kW and below 750 kW), and
- 4,080 MW of commercial/industrial/community scale projects (defined as projects >750 kW).

New York has become the nation's largest community solar market,[43] and now has over 3,182 MW of installed and operational community solar.[44] New York State continues to support the growth of distributed solar energy through a combination of policy directives, regulatory actions, and market-based reforms aimed at increasing deployment and lowering project costs. For example, in 2025 DEC issued the Solar Photovoltaic Projects (fewer than 25 MW) General Permit (GP-0-25-004) effective July 25, 2025, to streamline the permitting process for qualifying projects by allowing them to bypass individual permit applications under specific conditions.[45]

In 2024, the PSC adopted the Statewide Solar for All program to further accelerate the development of distributed solar and energy storage projects. The Statewide Solar for All program is administered by each of the investor-owned utilities that serve electric customers participating in the PSC's EAP, which provides utility bill discounts to low-income households. This program provides an additional electric bill credit to EAP customers who reside in a disadvantaged community, with the ultimate goal of delivering a minimum of $40 in annual bill credits to more than 800,000 households once the program reaches full maturity.

Statewide Solar for All is a community solar model that negates the need for expensive and time-consuming customer acquisition on behalf of the project developer. This allows projects to provide a greater discount to project subscribers.

Statewide Solar for All builds on lessons learned from the NYSERDA and National Grid Expanded Solar for All pilot program. Expanded Solar for All solicited two rounds of project applications, with 300 MW of

community solar projects participating. Many Expanded Solar for All projects are currently under construction and will provide bill discounts to approximately 160,000 National Grid EAP customers.

2.9.4. Distributed Energy Storage

Distributed energy storage (behind the meter) is a growing market segment. As of the end of 2024, there were approximately 349 MW of distributed energy storage installed in New York State, composed of a mix of commercial scale and residential projects.[46]

Commercial projects receive compensation through the Value Stack, utility demand response programs, and/or utility Non-Wires Alternatives programs. Many commercial energy storage systems are paired with solar, especially upstate, although a growing number of "standalone" storage systems are being developed downstate. Approximately 215 commercial-scale storage systems (297 MW) were installed as of the end of 2024.

Residential energy storage is an emerging market. By the end of 2024, there were 5,978 residential-scale (25kW and smaller) storage projects installed in New York. PSEG-Long Island and Con Edison have residential dynamic load management programs that provide compensation for residential storage that discharges during utility peak events, but many customers purchase storage for the ability to maintain power during grid disruptions.

In June 2024, the PSC approved an Order Establishing Updated Energy Storage Goal and Development Policy,[47] which established an energy storage target of 6 GW by 2030. The Order included $775 million in funding for distributed storage incentives to be administered by NYSERDA.

2.9.5. Other Distributed Energy Resources

As of the end of 2024, the following additional DERs were interconnected to the distribution network of the IOUs:[48]

- 9.3 MW of distributed wind, located primarily upstate
- 13.0 MW of combined heat and power installations, located primarily upstate
- 21.8 MW of distributed hydroelectric generation, located primarily upstate
- 43.2 MW of distributed fuel cells, located primarily in Con Edison's service territory

Due to technical and economic market barriers, these technologies have not seen the same level of deployment as solar and battery energy storage.

2.10. Transmission System Planning

Significant investments in New York's transmission and distribution infrastructure will be necessary to ensure reliability, accommodate growing demand, and deliver renewable resources to loads. This section provides an overview of the processes underway to proactively plan for these system needs. More complete details about New York's transmission and distribution system planning processes can be found in the New York State Transmission and Distribution Systems Reliability Study and Report.[49]

2.10.1. State Coordinated Grid Planning Process (CGPP)

In 2020, the New York State Legislature passed the Accelerated Renewable Energy Growth and Community Benefits Act (Accelerated Renewables Act), which includes a requirement to plan for the bulk and local transmission and distribution upgrades that will be required to facilitate achievement of the renewable energy targets set forth in the Climate Act.[50]

In response to the Accelerated Renewables Act, the PSC directed the utilities to develop a CGPP as a mechanism for statewide, long-term transmission planning. There are a few key stakeholders central to the CGPP process including the investor-owned electric utilities, the NYISO and NYSERDA. The CGPP also includes an opportunity for input from other relevant and interested parties including NYPA, LIPA and other stakeholders such as environmental and industry groups through the Energy Planning Advisory Council.[51] The modeling and studies contemplated for the CGPP are intended to provide a comprehensive view of electricity system needs, with a focus on the impacts of decarbonization but not limited to them, and to identify the upgrades required to address the evolution of the energy system. The process is intended to repeat on a three-year cycle. The first cycle of the CGPP is on schedule to conclude at the end of 2025 and will provide a portfolio of transmission and distribution upgrade proposals for the PSC's review.

2.10.2. NYISO Comprehensive System Planning Process

The NYISO implements a suite of transmission planning processes known as the Comprehensive System Planning Process. The Comprehensive System Planning Process has four components including the Local Transmission Planning Process (LTPP), the Reliability Planning Process, the Economic Planning Process, and the Public Policy Transmission Planning Process (PPTPP).

2.10.3. LTPP

Each TO in New York State is required to plan for the needs of its local transmission system through the LTPP.[52] As part of their planning obligation, the TOs perform transmission security studies for the facilities in their transmission areas according to all applicable criteria. Links to the TO's LTPPs can be found on the NYISO's website. The LTPP provides inputs for the NYISO's reliability planning studies.

2.10.4. Reliability Planning

The NYISO conducts reliability planning on both a near-term and long-term basis to ensure that the system is designed to maintain reliability, using both resource adequacy and transmission security modeling to identify any future system needs. The NYISO has three primary reliability planning studies including:

- **Short-Term Assessment of Reliability (STAR):** This study examines future electricity system needs over a five-year future, focused on addressing needs arising in the first three years, and is conducted quarterly in direct collaboration with TOs.
- **Reliability Needs Assessment (RNA):** This biennial study examines long-term reliability needs occurring four to ten years into the future, incorporating TO's long-term plans. If the RNA identifies a need, the NYISO issues competitive solicitations for projects to address reliability needs and requires TOs to propose backstop transmission solutions.

- **Comprehensive Reliability Plan (CRP):** This study is also conducted biennially and reports on the results of the RNA and the STAR interim assessments. The CRP includes the appropriate solutions to any reliability needs identified in the RNA.

In October 2025, the NYISO issued its Q3 STAR Report.[53] The report identified reliability needs as early as summer 2026 in New York City and Long Island. While some investments are underway to address this near-term gap, the report highlights potential reliability needs that require near-term intervention. A solicitation by the NYISO for additional resources is forthcoming and the DPS will closely watch these actions to ensure adequate supply and demand solutions come online in time to preserve reliability standards.

The NYISO STAR report highlights a deeper, structural reliability challenge. New York has been retiring more generation than it has added to the grid since 2020, while also seeing a significant increase in electric demand. New York has faced significant inflation and supply chain issues impacting the State's ability to build new, clean generation. Now, there are unprecedented headwinds from the federal government.

New York State has recognized that there are challenges related to the current procurement model and market mechanisms needed to bring the kind of power projects we need to fruition. In turn, the PSC launched a holistic review of solicitation practices to ensure the efficient and cost-effective achievement of the State's clean energy ambitions. This review also includes an evaluation of how existing wholesale capacity and energy market designs may need to be modified to better align with clean energy procurement mechanisms.[54]

2.10.5. Economic Planning

In parallel to reliability planning studies, the NYISO has had responsibility for performing the Congestion Assessment and Resource Integration Study (CARIS), an assessment of economic congestion for future resource portfolios based primarily on planned additions and retirements and long-term changes in demand, fuel prices, and other economic factors.

The CARIS process has been superseded by the System and Resource Outlook, which builds on the former CARIS process by conducting capacity expansion modeling to examine a broader set of potential futures.

Capacity expansion modeling consists of least-cost optimization to select future resource portfolios that minimize total investment and operating costs, while meeting reserve margin and local capacity requirements, as well as any policy targets. The resource portfolios selected in the capacity expansion model are then assessed using a nodal production cost model, which simulates the operational costs of the generation portfolio at a higher level of temporal and spatial granularity, representing security-constrained economic dispatch across the entire transmission network. This two-pronged modeling process is used to identify areas of future congestion where there may be economic opportunities for new transmission, under varying economic and policy scenarios.

2.10.6. PPTPP

The PPTPP is the process by which the NYISO evaluates and selects transmission solutions to satisfy a transmission need driven by public policy requirements. The process was developed in consultation with NYISO stakeholders and the PSC and approved by FERC under Order No. 1000. The NYISO is responsible for administering the PPTPP and the PSC has responsibility for identifying the transmission needs that require solutions. Both incumbent and independent transmission developers may propose projects in response to an identified need.

The NYISO conducts the PPTPP on a two-year cycle. Additionally, the PSC may declare a Public Policy Transmission Need (PPTN) and trigger a solicitation for transmission solutions at any time, independent of the NYISO's biennial planning process.

Under the PPTPP, the NYISO Board of Directors has selected four projects for cost allocation through the NYISO's tariff:

- Western New York (Empire State Line) – In service
- AC Transmission Segment A (Central East Energy Connect) – In service
- AC Transmission Segment B (Segment B Knickerbocker-PV) – In service
- Long Island Need (Propel Alternate Solution 5 Early-stage development) – target in-service date: May 2030

2.10.7. Transmission System Planning for Clean Energy Development

As outlined above, transmission planning in New York falls into two general categories: reliability and economic / long-term planning. This section discusses several key initiatives underway to support the buildout of transmission system to support clean energy development in New York State.

Following the passage of the Accelerated Renewables Act, the PSC took several steps to implement forward-looking transmission planning. In addition to establishing the CGPP, these steps included the publication of the 2021 Power Grid Study, which included scenarios for transmission needed to facilitate the achievement of near-term Climate Act targets, long term decarbonization, and the integration of OSW.

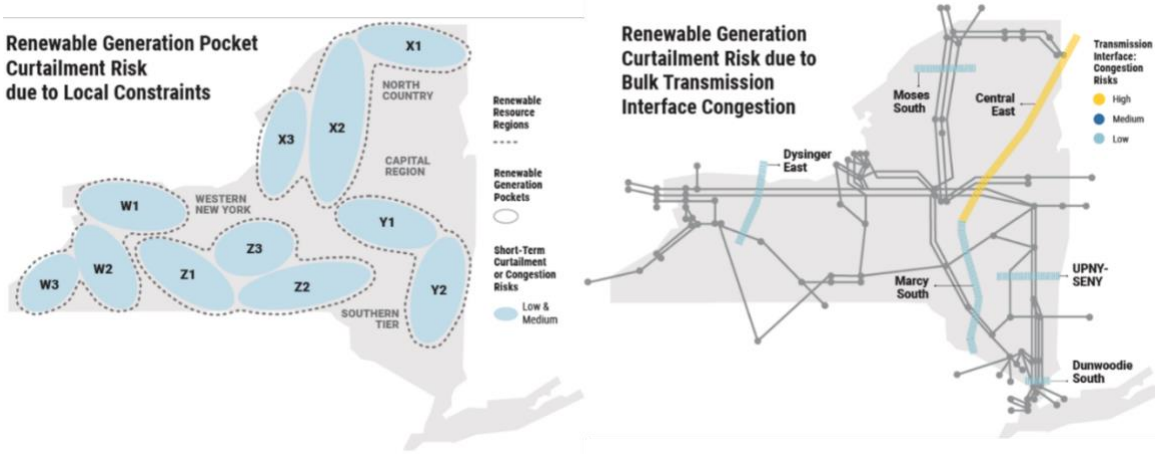
The Power Grid Study informed further PSC actions and identified key areas for near term transmission development. The PSC addressed the Power Grid Study's recommendations for transmission investments through a number of actions that include: (1) approval of Phase 1 Projects proposed by the utilities that bring reliability benefits with ancillary climate benefits; (2) approval of Climate Act transmission projects (Phase 2 projects) needed to unbottle renewable energy in three targeted regions of the State; (3) adoption of the Tier 4 program and authorization for development of two Tier 4 transmission lines to deliver clean, firm energy into New York City; (4) authorization for Con Edison's development of a Clean Energy Hub in Brooklyn to support both reliability needs and the interconnection of future OSW resources; (5) the creation of the CGPP described above; and (6) initiating a PPTN solicitation to identify upgrades to the Long Island system needed to enhance system reliability. In addition, the PSC initiated a

second PPTN solicitation for transmission infrastructure to deliver up to 8 GW of offshore wind generation to New York City, also recommended in the Power Grid Study, but terminated it in 2025 in response to the federal government's halting of OSW permitting programs. Given the significant federal policy uncertainty with respect to OSW, it is increasingly unlikely that New York State will reach the Climate Act's target of 9 GW by 2035.

Many of these approved investments unlock renewable generation pockets to enable the integration of renewable energy where it is currently limited or being curtailed due to transmission constraints. These locations have been identified by the NYISO's System Resource Outlook economic planning process. Figure 19 outlines these renewable generation pockets and indicates likely areas of future constraints on the local and bulk transmission systems.[55] The approved projects include a project led by NYPA, the Northern New York Project (also known as Smart Path Connect), and many of the Phase 1 and Phase 2 projects across New York. The total estimated value of these approved investments is approximately $8 billion. These enhancements, which substantially improve the State's transmission system capability, are progressing through design and construction and are scheduled to enter operation between 2030 and 2033.

Figure 19: Renewable Generation Pockets and Local and Bulk System Constraints

Source: NYISO 2023–2042 System and Resource Outlook[55]



As noted above, the second cycle of CGPP will produce transmission investment proposals considering a 2035–2040 timeframe horizon.

2.10.8. Interconnection

The NYISO interconnection process ensures open access to the transmission grid for new generators, transmission projects, and certain large loads seeking to connect. Most proposed new projects must adhere to the NYISO interconnection process.[56] The process determines, among other things, what system upgrades are needed to permit new projects to connect to the transmission system and to ensure deliverability of their energy output.

Applicants undergo a series of engineering studies to assess potential transmission system impacts and identify any necessary system upgrades and their associated costs. If a project seeks Capacity Resource Interconnection Service (CRIS) rights, the studies also evaluate how much capacity it can reliably deliver. Both the length of time needed to study a project's impacts, and the costs of the resulting system upgrades have impacted and continue to impact the pace at which new renewable resources are added to the portfolio.

In August 2024, the NYISO implemented a new "Cluster Study" process to help expedite the interconnection process for applicants, consistent with the regulatory reforms by FERC under its Order 2023.[57] Under this new Cluster Study process, the NYISO will evaluate groups of interconnection requests collectively rather than individually, to reduce the time for NYISO, utilities, and developers as compared to the NYISO's former procedures.[58]

2.10.9. Advanced Technology Working Group

The PSC's Order on Power Grid Study Recommendations also directed the creation of the Advanced Technology Working Group, which is a DPS-overseen working group that explores the role of additional transmission and distribution system solutions in parallel to the CGPP proceeding. Utilities may be able to lower their costs by implementing cost-effective advanced transmission technologies (ATTs). Technologies under consideration include but are not limited to those outlined in Table 2.

Table 2: Examples of Advanced Transmission Technologies

Source: Advanced Technology Working Group

Hardware: Equipment and infrastructure that can increase efficiency, capacity, or reliability of the transmission system.	**Grid-forming inverters:** An inverter that controls its output voltage, allowing it to contribute to maintaining system frequency.
	Synchronous condensers: Use of generator equipment to provide inertia and voltage support, without providing power.
	Advanced conductors and tower designs: Conductors with lower thermal expansion rate allowing for higher power flow.
	Dynamic line rating systems: Integration of sensors and/or additional monitoring and controls software to calculate the safe operating capacity of a transmission element in real time.
	Storage-as-transmission: utilization of battery storage to provide transmission system services, such as congestion relief, curtailment reductions, and/or grid stability/voltage support.

	Power flow controllers: power electronics that vary reactance on the line to enhance control of power flow.
Software and Operations: Programs and procedures that are applied to operations to improve transmission and distribution system efficiency.	**Topology optimization:** finds optimal re-routing of power flows to minimize system congestion, leveraging switching of circuit breakers.
	Distributed energy resource management systems: Centralized platform to monitor, forecast, and control grid-connected DERs in real-time.
	Volt/VAR optimization: optimization process for managing voltage levels and reactive power to increase grid efficiency.
	Remedial action schemes: set of operational measures designed to take corrective actions in response to a detection of predetermined system conditions.

2.11. Distribution System Planning

Electric distribution utilities maintain local distribution systems to ensure the reliable operation of the grid. Key considerations in distribution planning include replacing aging systems, upgrading infrastructure to serve expected load growth, and preparing for and responding to extreme weather events.

Recent changes in the drivers of distribution system needs have prompted the PSC and the utilities to make changes in distribution planning practices.

2.11.1. Proactive Planning Process

In 2024, the PSC initiated a proceeding to establish a Proactive Planning Process focused on planning for the State's electric distribution grid infrastructure needs, driven by the increasing electrification of buildings and vehicles.[59] The PSC directed the investor-owned utilities to develop a framework for timely and cost-effective grid upgrades in anticipation of rapid load growth. This initiative aims to ensure that utilities coordinate across service territories and leverage best practices to support New York's clean energy and climate goals, as outlined in the Climate Act.

In May 2025, the PSC approved 29 projects that cost-effectively address near-term electrification needs to enable building and transportation electrification. These 29 projects were selected based on stringent criteria for need, cost-effectiveness, and urgency to protect New York ratepayers. By unlocking 642 MW of capacity upgrades, these projects avoid the risks of both overbuilding and underbuilding, both of which can drive up long-term costs for consumers. Importantly, these investments average approximately $1 million per MW, substantially more affordable than the cost of building new

generation. The PSC's action also delivers near-term funding certainty to utilities, enabling them to move forward with construction in a cost-conscious and timely manner.

In September 2025, the PSC adopted the Modified Planning Framework, which incorporates feedback from a wide range of stakeholders. The Framework standardizes utility planning processes statewide by building uniform data, methods and assumptions to guide utility investments. The Modified Planning Framework includes enhanced load forecasting that accounts for the impact of DERs on future demand. The Framework also evaluates how DERs and advanced technologies, such as grid-enhancing technologies (GETs), can be leveraged to meet emergent grid infrastructure needs at the lowest cost.

This bottom-up Framework will be integrated with the broader, top-down analysis occurring in the CGPP to produce results that allow the PSC to consider all grid upgrade needs simultaneously.

2.12. Flexibility and Demand Response

Flexibility and demand response are essential components of New York's strategy. They allow for the optimization of our grid resources, in turn enhancing system reliability and affordability. Demand response programs allow customers to play an active role in grid operations by shifting or reducing load during periods of peak demand. When coupled with other flexibility measures—through storage, controllable loads, and advanced grid management—these efforts not only strengthen the resiliency of the grid but also lower overall costs for consumers by lowering the costs to maintain and expand the energy system.

2.12.1. Wholesale Demand Response Programs at the NYISO

At the wholesale level, the NYISO administers a variety of demand response programs. The Emergency Demand Response Program and the ICAP – Special Case Resource Program—support the reliability of the NYCA. Both programs are designed to reduce power consumption by directing demand-side resources to reduce load or to use qualified local generators to remove load from the system during grid emergencies or when reserve shortages are anticipated or actually occur. All NYCA loads are eligible to take part in these programs. Aggregators enroll demand side resources and coordinate with the NYISO to notify Resources when the NYISO deploys demand response. The NYISO also offers the following economic demand response programs: the Day-Ahead Demand Response Program (DADRP) in the energy market, and the Demand-Side Ancillary Services Program (DSASP) in the ancillary services market. The DADRP allows NYCA loads to offer their load reductions into the Day-Ahead Market (DAM) to supply energy. This program allows flexible loads to effectively increase the amount of supply in the market and moderate energy prices. The DSASP provides program participants with an opportunity to offer their load curtailment capability into the DAM and/or Real-Time Market to provide operating reserves and regulation service.

Progress related to the NYISO demand response programs can be found in the NYISO 2024 Annual Report on Demand Response Programs.[60]

2.12.2. Utility Demand Response Programs

In New York State, utility demand response programs are administered by the State's investor-owned utilities with DPS oversight. These programs, collectively referred to as Dynamic Load Management

(DLM), are designed to reduce peak electricity demand, in turn lowering energy and capacity costs, reducing infrastructure investments and enhancing grid resiliency and reliability. There are four DLM programs predominantly designed to engage commercial and industrial customers: the Commercial System Relief Program (CSRP), the Distribution Load Relief Program (DLRP), the Term-DLM Program, and the Auto-DLM Program.[61] The CSRP and Term-DLM Program provide day-ahead notification to meet the need for reducing peak demands during the highest forecast demand days of the year. The DLRP and Auto-DLM Program are rapid response programs requiring participants to reduce load with significantly shorter notice duration – two hours before the beginning of an event for the DLRP, and within 10 minutes of notification for the Auto-DLM Program. The Term-DLM Program and Auto-DLM Program include program features designed to be attractive to energy storage facilities, including multi-year fixed payments to customers who agree to curtail load during forecasted peak periods and premium payments compared to those available through the CSRP and DLRP. The premium payments and longer contract terms available under the Term-DLM Program and Auto-DLM Program come with non-performance penalties, however, whereas the CSRP and DLRP do not. The investor-owned utilities also have programs designed to fit the needs of residential customers, with "Bring Your Own Thermostat" programs to allow utility control of participating customer smart thermostats. The PSC has also recently issued an order directing the investor-owned utilities to implement new "Bring Your Own Battery" programs designed to engage the residential energy storage market.

2.12.3. Electric Vehicle Managed Charging Program

In January 2023, the PSC issued the Demand Charge Alternatives Order and directed the Joint Utilities (JU) to develop and implement a suite of immediate and near-term solutions to provide operating cost relief to commercial customers with significant EV charging loads. The Order required the development of rates specifically for commercial EV charging, referred to as EV Phase-In Rates. These rates were:

- Designed to be available to all commercial customers with a charging ratio greater than or equal to 50 percent, specifically the customer's maximum EV supply equipment charging capacity (in kW) must be equal to or greater than 50 percent of the maximum site demand;
- Designed on a revenue-neutral basis to recover the full embedded cost of each applicable service class; and
- Based on a four-tiered rate structure, based on the customer's load factor, that gradually increases the revenue collected through a demand charge. This rate structure included the development of a Time of Use (TOU) energy charge, which was required to include an off-peak energy charge component, an on-peak energy charge component, and a seasonal four-hour super-peak energy charge component.

The JU filed their EV Phase-In Rates on July 18, 2023. In October 2024, the PSC approved the EV Phase-In Rates proposed by Con Edison, Orange and Rockland Utilities, Inc. (O&R), NYSEG, and RG&E. The PSC rejected the five-hour super-peak period-based EV Phase-In Rates proposed by Central Hudson Gas & Electric Corporation (Central Hudson) and National Grid and directed those utilities to implement four-hour super-peak period-based EV Phase-In Rates. The PSC directed the utilities to implement the EV

Phase-In Rates no later than 12 months from the effective date of the Order and directed the utilities to make an implementation filing before the EV Phase-In Rates become available to customers. The PSC established a minimum level of outreach for customers participating in the Demand Charge Rebate Program and Commercial Managed Charging Program use-case-specific adder incentives, as these program components will end shortly after full implementation and availability of the EV Phase-In Rates.

See the Transportation Chapter for more information on EV charging.

2.12.4. Time-Varying Rates

Advanced Metering Infrastructure, DERs (smart thermostats, connected appliances, and battery storage), and enabling technologies could help customers automatically respond to TOU pricing. These rates are a form of time-varying pricing that reflect the cost of providing electricity during different hours of the day. Under a TOU rate, the cost of electricity during high-demand, or peak, hours is more expensive than during low-demand, or off-peak, hours. A simple TOU rate would have separate rates for peak and off-peak periods. TOU rates align rates with the cost of service and send price signals to customers to disincentivize consumption during times of peak demand. TOU may also prompt customers to invest in self-generating technologies. These technologies can reduce system peak demand and avoid utility investments in additional capacity resources. Roughly two percent of residential customers are currently enrolled in TOU rates, though LIPA is transitioning residential customers to a default TOU rate.[62] Under this time-varying rate, utilities charge different rates for electricity based on the time of day and the season, with peak rates during weekday afternoons (3-7 p.m.) and lower off-peak rates during evenings, weekends, and holidays.

2.13. Grid of the Future (GOTF) Proceeding

The PSC initiated the GOTF proceeding on April 18, 2024, to identify and make use of opportunities to draw on as-yet untapped flexibility of demand available from various types of resources and technologies. In November 2024, the DPS filed the Grid Flexibility Study which provides an assessment of the cost-effective, achievable potential for grid flexibility in New York in 2030 and 2040. The Study includes a robust discussion of 16 flexibility levers—including automated solutions and behavioral responses—that can be activated to optimize grid resources. The State's existing demand response programs are mentioned, with an eye towards the potential for new flexibility programs like EV managed charging and vehicle to grid arrangements to provide capacity during peak hours. Following the Study, in March 2025, DPS filed the First Iteration of the GOTF with the PSC.[63] The plan will serve as an important step towards building out the programs, policies, local and bulk system digital infrastructure, grid infrastructure, and operating practices needed to efficiently meet the State's clean energy and climate goals. DPS is now developing the final, updated plan, which will be released in the middle of 2026.

2.14. Planning for and Interconnecting Large Loads

DPS and the NYISO conduct several near- and long-term planning processes to evaluate the system impacts of forecasted future demand.

Over the past few years—and especially in the last 12 months—New York State has seen a surge in large load interconnection requests. Most of this activity is concentrated in northern and western New York

and driven primarily by data center development, although some reflects broader economic growth initiatives. States across the country are experiencing similar surges, with hundreds of gigawatts of new load expected nationwide in the next five years. However, what makes planning challenging is that these forecasts can change rapidly.

New York State is proactively monitoring this evolving situation and leveraging its existing process—while identifying new tools—to manage future demand without jeopardizing grid safety or reliability, as well as energy affordability impacts to other consumers. New York's load planning process is designed such that added energy system costs are managed to be as cost-effective as possible and fairly allocated to the user that necessitates potential system build-out or upgrade costs, consistent with "beneficiary pays" cost-causation principles. However, the State recognizes that such loads may trigger other system costs or impacts not captured by this accounting and is committed to reducing and fairly managing these costs, based on analyzing these dynamics, following ongoing research, and monitoring market dynamics and successful approaches in other jurisdictions. With the unprecedented number of new large load proposals, New York State is continuing to evaluate the processes to date and is committed to refinement to protect consumers.

See the Economic Development, Industry and Agriculture chapter for more information on the interconnection of large loads, including data centers.

2.15. Consumer Protection Measures and Consumer Complaints

The Home Energy Fair Practices Act (HEFPA), enacted in 1981 and amended in 2002, provides residential energy customers, including electric customers, with protections for applications for service, billing and payments, and disconnections.[64]

If a customer fails to pay overdue bills, the utility may turn off the customer's service after it has given the customer notice in writing that it plans to shut off service and has waited 15 days to allow the customer an opportunity to pay the overdue bill or make a payment agreement on the overdue amount. If the customer has not paid a bill, an agreement installment payment or a deposit payment, the utility must send a Final Termination Notice before it can turn off service. This Notice can be sent 20 days after the date payment was due. After the notice has been sent, the utility must allow 15 days to resolve the problem before it can shut off the customer's service. If the customer makes a payment by a check that is rejected by the bank, the utility can shut off service without sending another notice. Utilities can shut off service only between the hours of 8 a.m. and 4 p.m. Monday through Thursday.

There are situations where a customer may not have paid a bill, but where the utility cannot shut off service, including during the cold weather period between November 1 and April 15. More details on consumer protections for residential and non-residential customers can be found on the PSC website.[65]

During the COVID-19 pandemic, legislation was enacted to provide temporary protections for essential utility and municipal services.[66] Under this law, if a utility customer experienced a change of financial circumstances due to the pandemic, utilities and municipalities could not shut off the customer's service for nonpayment, must reconnect service within 48 hours, and must offer the customer a deferred payment agreement to pay any balance due. In January 2021, legislation was passed that extended the

moratorium on utility termination of services 180 days after the COVID-19 state of emergency was lifted or until December 31, 2021, whichever was later.[67]

While these temporary protections provided crucial relief for millions of households, utility arrears have continued to grow since the start of the pandemic. From 2020 to 2024, the total number of residential customers in arrears greater than 60 days grew from approximately 1.03 million to approximately 1.37 million and the amount of arrears grew from approximately $900 million to approximately $1.8 billion. Customers and amounts in arrears vary year over year depending on a multitude of factors, including accruals related to the COVID-19 pandemic, on-budget relief from one-time State funding and/or other State programs, access to federal programs, and seasonal weather impacts. Monthly arrears reports are posted by the utilities under Case 91-M-0744.[68]

As authorized by HEFPA, the PSC provides a process to handle consumer complaints about utility service.[69] DPS staff work with customers and utilities to intake, investigate, and resolve complaints and advise and support the PSC.

2.16. Environmental Regulations

The following is a partial list of environmental regulations and policies that impact the electricity system directly or indirectly. In addition to the Regional Greenhouse Gas Initiative (RGGI) and the DEC Peaking Unit rule described below, the Transmission and Distribution Systems Reliability Study and Report[49] provides a summary of all regulations that impact the electricity sector in New York, representing a range of federal, State, and local policies affecting air emissions, permitting, and alignment with the State's clean energy targets.

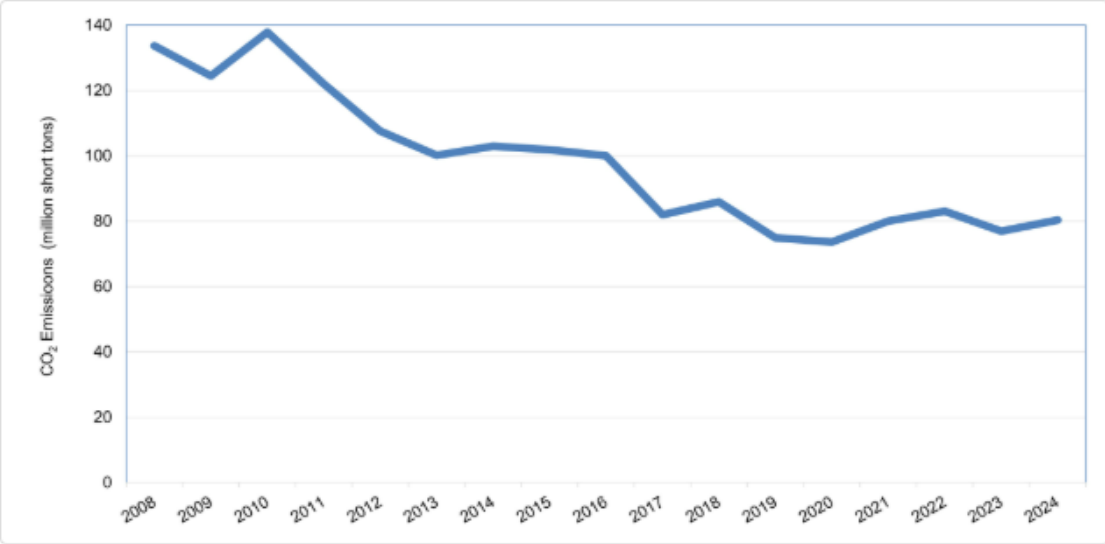
2.16.1. The RGGI

The RGGI – a coalition of states that now includes Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont – was the first mandatory market-based emissions trading program in the U.S. to reduce CO_2 emissions, and the first anywhere to use the cap-and-invest model to reduce GHG emissions from electric power generation and result in savings for electricity customers. In New York State, the RGGI is implemented by DEC through 6 NYCRR Part 242, CO_2 Budget Trading Program. The administration and implementation of CO_2 allowance auctions and programs provided for in 6 NYCRR Part 242 is implemented by NYSERDA through 21 NYCRR Part 507, CO_2 Allowance Auction Program.

Figure 20 shows the change in CO_2 emissions from the power sector since RGGI's inception in the ten fully participating RGGI states (Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey,[70] New York, Rhode Island, and Vermont). CO_2 emissions from these states have fallen by 46 percent compared to a 2006-2008 baseline, faster than the emissions reduction across the U.S. as a whole.

Figure 20: CO_2 Emissions in the RGGI 10 States

Source: Regional Greenhouse Gas Initiative, Inc.[71]



States participating in the RGGI conduct periodic, comprehensive program reviews to evaluate their impacts, set future program goals, and consider updates to evolve the program. This review process is critical to the RGGI's ongoing success. Each program review includes consideration of state-specific emission reduction requirements, public meetings to gather input on program design, and technical analysis and modeling of the region's economy and electricity sector. The First and Second Program Reviews, completed in 2012 and 2017, respectively, resulted in changes that have strengthened and improved the RGGI's market-based system, providing emissions and health benefits to the region while keeping electricity prices stable and contributing jobs and economic growth.

The 10 states participating in the RGGI released the results of their Third Program Review on July 3, 2025.[72] States agreed to strengthen their regional CO_2 emissions cap through 2037, starting in 2027, and establish new mechanisms to protect energy affordability.

2.16.2. DEC Peaking Unit Rule

On December 11, 2019, DEC adopted a regulation (6 NYCRR Subpart 227-3) to reduce NOx emissions from simple cycle combustion and regenerative combustion turbines (CTs). These turbines are often referred to as "peaking units" because they are electricity generating units that tend to operate during periods of high electricity demand to maintain grid stability. The regulation includes a reliability provision that allows the NYISO, the local transmission/distribution owner, or the PSC to designate a unit as a reliability resource. Being designated a reliability resource allows the unit operational flexibility if it is unable to meet certain implementation deadline requirements while a solution to the reliability concern is put in place. As of May 1, 2025, 37 "peaking" units have retired. The retired peaking units represent 1 GW of older fossil-fuel-fired generation and a significant reduction of pollution. In addition to shutdowns, additional emission controls were installed on units, totaling 466.8 MW.[73]

2.17. New York GHG Emissions Trend

GHGs from the electricity sector were 54 mmt CO_2e (GWP20) in 2023, representing 15% of total statewide emissions. GHG emissions from the electricity sector decreased 43% between 1990 and 2023, largely due to the notable decrease in residual fuel and coal use. Electricity emissions increased by 14.1 percent between 2019 and 2023, even as electricity sales were 4.2 percent lower. This increase is likely due to a decrease in nuclear generation, as New York saw the closure of Indian Point and a subsequent increase in gas and petroleum fuel use for electricity production during this time.[74]

2.18. Cybersecurity

Cyberattacks on the energy sector have increased substantially in the past twenty years, and they continue to grow in frequency and sophistication. The energy sector (particularly the electric grid) is one of the sectors most frequently targeted by malicious cyber actors. The U.S. Department of Energy (DOE) reports that attacks and threats against the electric grid doubled in 2023 and, as 2024 unfolded, the intelligence community warned that state-sponsored threat actors have been strategically pre-positioning themselves for years to disrupt operations across critical infrastructure sectors in the event of a geopolitical or military conflict.[75]

In the context of cybersecurity, DPS oversees utilities through its Office of Resilience, Utility Security, Nuclear Affairs, and Emergency Preparedness (OREP). OREP has specific personnel assigned to the Utility Security Section (USS) with cybersecurity oversight responsibilities. The core mission of the USS is to ensure that the critical facilities of regulated utilities are protected from possible malicious threats and manageable risks. The USS has deemed approximately 285 utility facilities as “critical” to the reliable operation of electric, gas, water, and telecommunication services in the state based on predefined criteria. There are over 1,000 additional sites and facilities recorded in the USS catalog, which is updated twice a year at minimum. USS staff regularly conducts thorough inspections and audits of the physical and operational technology cybersecurity postures of regulated utility facilities, sites, and assets. USS also annually audits the protection of personally identifiable information (PII) at eight electric, gas, and water utilities. The USS oversees both cyber and physical security preparedness and conducts inspections and audits of cybersecurity posture for those facilities, sites, and other assets. For more information on these efforts, see the Energy Security Planning and Emergency Preparedness chapter of this Plan.

In 2022, the New York State Legislature passed, and Governor Hochul signed into law, a bill that became PSL § 66(30). That legislation expanded the PSC’s authority to further regulate cybersecurity via the promulgation of rules and regulations directing gas or electric corporations to develop cybersecurity tools for their industrial control systems. As the PSC develops a regulatory framework, the ever-evolving and varied threats underscore the need for cybersecurity regulations that balance several important goals—they must be strong enough to ensure the resilience of the gas and electric distribution systems of the State and to provide for the protection of PII; they must be agile enough to grow and adapt to new threats; and they must ensure compliance does not jeopardize New York’s progress towards achieving its clean energy targets.

3. Outlook (2025–2040)

This section describes scenarios for how the electric grid may evolve over the next 15 years, based on assumptions related to future electricity demand and insights into the current and emerging resources that may be deployed to meet the anticipated demand. As is typical for studies of this kind, a scenario approach is useful because it bounds the various possible futures, providing directional information to system planners since the precise configuration of the actual future system is uncertain.

The primary source of the information reported here in these projections is electric system modeling conducted by NYSERDA; hereafter referred to as the Pathways Analysis. For more detailed information see the Pathways Analysis chapter of this Plan. In addition, this discussion leverages information from similar studies, such as the modeling performed for the first cycle of the CGPP.

This section highlights findings from key components of the Pathways Analysis and reviews the barriers and challenges associated with the accomplishment of these future outcomes. More details about this analysis can also be found in the Pathways Analysis chapter of this Plan.

3.1. Modeling the Future

Electrification coupled with clean electricity is expected to be a central pillar of addressing the ambitious economy-wide GHG reduction targets by 2050. The objective of the Pathways Analysis is to develop scenarios for the State Energy Plan that capture and account for how various strategies interact across sectors. The various scenarios help inform the impact of differing levels of policy action on New York's energy needs.

To address the many uncertainties inherent in predicting the future energy system, the Pathways Analysis examines scenarios representing a range of state policy actions. An overview of all scenarios examined is provided below in Table 3.

Table 3: Pathways Analysis Scenarios

Scenario	Description
No Action	Includes federal incentives (as of Q3 2025) and legacy New York State policies but excludes the Climate Act and more recent additional State and local policies.
Current Policies*	Current progress toward achievement of enacted State and local policies (e.g., Clean Energy Standard, building code updates, Advanced Clean Cars/Trucks).
Additional Action*	All actions included under Current Policies scenario plus additional progress toward adoption of clean technologies through a mix of future programs and investments aligned with recommendations in the State Energy Plan.
Net Zero A and B	Accelerates adoption of clean energy technologies in all sectors toward achievement of economywide net zero by 2050. Net Zero A emphasizes all electric space heating while Net Zero B assumes greater use of supplementary gas heating systems.
* In these scenarios, nuclear is projected to play a significant role in reaching New York's zero-emissions requirements and is often accompanied by transmission to deliver part of its power to meet downstate loads. This analysis examined the portfolio impacts of multiple sensitivities that varied how much new nuclear and transmission capacity can be developed in the next 15 years. One variant ("3.3 GW Nuclear") allows for greater expansion of nuclear (+3.3GW) and intrastate transmission capacity, even beyond the Governor's ≥1 GW NYPA nuclear target, while another variant ("2.2 GW Nuclear") assumes a smaller amount of incremental nuclear (+2.2 GW) and transmission headroom is available. More details of these constraints can be found in the Pathways Analysis chapter. This chapter includes results for both of these variants for the Additional Action scenario.	

This document focuses primarily on the Additional Action scenario, with brief coverage of the No Action and Current Policies scenarios. Together, these three scenarios illustrate the incremental impacts of State and local policies and programs.

Over the last several months, expectations for the evolution of New York's electric sector have shifted significantly. The first and largest changes occurred at the federal level. These included the passage of H.R.1 of the 119th Congress, which eliminated tax credits for renewable resources under the Inflation Reduction Act for most of the modeling horizon; the introduction of tariffs on many of the commodities and components used in power sector equipment; and new siting and permitting barriers on federal lands and waters. These changes resulted in meaningful cost increases across the board, though with particular impacts on renewable and storage resources. In light of these cost increases and informed by a parallel zero emissions technology analysis that NYSERDA conducted,[76] Final State Energy Plan scenarios also include some new resources and considerations. Most notably, new nuclear is included as a candidate resource in all policy-compliant scenarios, and cases further explore transmission expansion potential.

While the future of federal clean energy and emissions programs remains uncertain, this analysis includes federal policy as of September 2025. In addition, data updates, including a more recent renewables supply curve, updated zero-carbon firm resource costs, updated transmission representation, and State policy updates regarding nuclear energy availability have been incorporated into the electric supply model. For more details, please see the Pathways Analysis chapter.

The No Action scenario provides a baseline against which to measure the impact of State policy. The Current Policies scenario is meant to illustrate the impact of current market characteristics and enacted New York State policies, while the Additional Action scenario shows the impact of current and future State action to promote consistent, gradual improvement in market penetration of clean energy technologies. This is meant to describe an ambitious but attainable level of achievement.

To illustrate the significant impact of federal policy uncertainty, two sensitivities of the Current Policies scenario were run. One sensitivity modeled the increased amounts of clean energy if federal policy had stayed as it was in December 2024 and had not been rolled back; this is the Pre-Rollback sensitivity. A second sensitivity modeled the effects on clean energy deployment from additional potential federal headwinds; this is the Further Rollback sensitivity. For more details of these sensitivities and the key findings associated with them, see the Pathways Analysis chapter.

The Pathways Analysis has been conducted with the best available information, assumptions, forecasts, and modelling approaches, and provides the best possible means of comparing the outcomes that would result from different approaches to shaping New York's electric and energy system for the future. It will need ongoing updating and refreshing as policy and economic realities evolve, including but not limited to federal policies, supply chains, costs, load growth, general economic circumstances, and other external forces, to ensure the best achievement of New York's reliability and affordability goals.

Components of the load forecasts associated with those scenarios are discussed in the next section, and information related to the supply mix that resulted from the capacity expansion analysis is in the subsequent section. See the Pathways Analysis chapter of this Plan for more information.

3.2. Electricity Demand

The Pathways Analysis generates load forecasts using a bottom-up stock rollover methodology that simulates the gradual turnover of energy-consuming equipment across sectors such as buildings, transportation, and industry. The model tracks the existing stock of technologies by vintage and fuel type, accounting for their efficiency and expected lifetimes. It calculates annual retirements based on these lifetimes and introduces new sales to replace retiring units and meet additional demand. The energy demand for each year is determined by combining the number of devices in operation with their respective efficiencies, reflecting both legacy and newly adopted technologies. This approach captures the lag between new technology adoption and its full impact on energy consumption, providing a realistic projection of load growth over time.

In addition to modeling energy demand through stock rollover in sectors like buildings and transportation, the model addresses non-stock loads, such as those in the industrial sector. For these sectors, the model utilizes activity-based projections, where energy demand is calculated based on expected levels of industrial activity. This allows the model to account for energy consumption in industries where equipment lifespans are variable or data on equipment stocks is limited, ensuring a comprehensive representation of energy demand across all sectors.

New York is expected to experience a significant increase in demand over the next decade, driven by both electrification and the interconnection of new large loads. These large loads include data centers, semiconductor manufacturing plants, and green hydrogen production plants. The 2025 Gold Book indicated that large load facilities could contribute up to 19,200 GWh of additional annual energy consumption, 2,567 MW of summer peak demand, and 2,600 MW of winter peak demand in New York State by 2035; the Pathways Analysis includes the impacts of these incremental large loads across all modeled scenarios.[77]

Multiple studies have examined the potential impacts of warming temperatures on electricity demand, including NYISO's Climate Change Impact Study and NYSERDA's Climate Impacts Assessment.[78,79] Climate change is projected to lead to increases in both the frequency and magnitude of extreme summer temperatures, which will in turn drive an increase in summer peak demand. The NYSERDA Climate Impacts Assessment also concluded that the resulting impacts on the New York energy system will be highly dependent on the extent of New York State's investments in building decarbonization. In addition to reducing GHG emissions, investments in energy efficiency and the adoption of efficient heat pumps will mitigate the impacts of extreme summer warming on cooling demand in buildings.

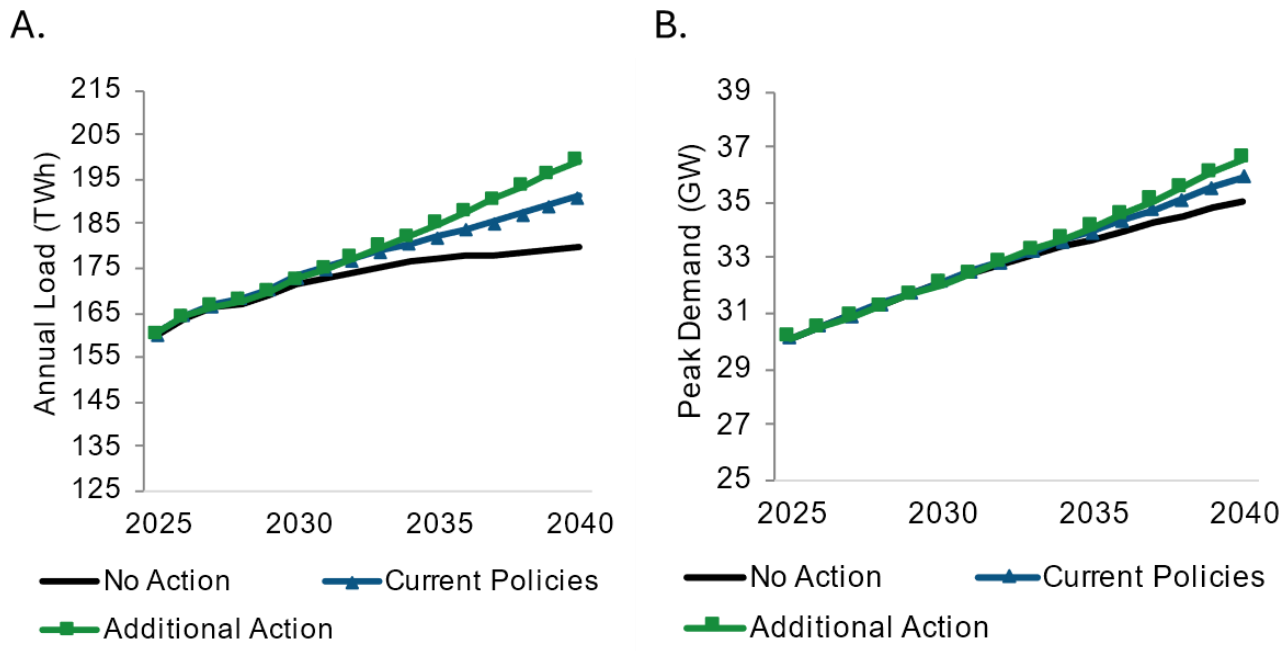
Climate change and extreme weather events present reliability challenges in both winter and summer. In the winter, although climate change is projected to increase ambient temperatures, the electric system must grow to meet electrified end uses in buildings and addressing winter reliability needs will remain a priority. This reliability need is acute given the limited availability of certain resources during times of

high heating demand. During extreme cold weather events, natural gas is prioritized for residential and commercial heating, which can restrict the fuel supply to a significant portion of natural gas-fired power plants in New York State. While many downstate generators have dual-fuel capability (the ability to switch to oil), this still presents a logistical and environmental challenge. Furthermore, periods of high heating demand often coincide with reduced output from renewable resources; solar power is unavailable during early morning, evening, and overnight heating peaks, and wind power can be variable and experience lulls. There is also still significant uncertainty associated with how climate change may impact extreme cold weather events such as polar vortices. The Pathways Analysis aligns with the NYSERDA Climate Impacts Assessment in capturing load impacts of increased warming during summers in the 2040 through 2050 period, but this impact is relatively muted in the time frame of the State Energy Plan, which is focused on energy infrastructure through 2040.

Figure 21 shows the annual electric loads (A) and peak demand (B) across the No Action, Current Policies, and Additional Action scenarios, through 2040. All scenarios see significant load growth in the near term, driven primarily by large loads, while both the Current Policies and Additional Action scenarios see continued load growth driven primarily by transportation electrification. Similarly, all of these scenarios see increased peak demands through 2040. Note all scenarios remain summer peaking through 2040.

Figure 21: A) Annual Electric Loads and B) Annual Peak Demand

Source: Pathways Analysis Chapter



3.3. Electricity Supply

The RESOLVE model used within the Pathways analytical process is a linear optimization tool designed to inform long-term electricity resource planning. It co-optimizes generation, energy storage, and transmission investments alongside system operations to identify least-cost portfolios that meet specified policy and reliability constraints over a multi-year horizon. The model simulates operations on a representative subset of days to capture key system dynamics while maintaining computational efficiency. It incorporates detailed representations of candidate resources, including their costs, performance characteristics, and development potential, allowing for comprehensive analysis of various investment strategies.

In modeling New York's energy future, the RESOLVE model incorporates a set of near-term constraints and long-term options to reflect policy mandates and system realities. Through 2028/2029, planned resource additions are fixed. In the core policy cases (Current Policies, Additional Action, and Net Zero scenarios) the modeling assumptions also include the achievement of the following State targets: 10 GW of distributed generation PV by 2030, 6 GW of energy storage by 2030, and a 1 GW new nuclear target by 2040.[80] Due to evolving federal policies that have limited OSW development, the policy cases do not include the 9 GW by 2035 OSW target. The model also includes key transmission projects such as the CHPE and the Propel NY Energy project selected in response to the Long Island PPTN. Licenses for existing nuclear facilities are assumed to be extendable through 2050. Considering resource build limitations and increased loads, the model aligns with the CES Biennial Review, projecting the procurement schedule of CES resources through 2035.

All existing thermal units are represented, specified by type, expected heat rate, and prime fuel. All announced retirements as well as those impacted by the DEC NO_x rule retire in accordance with projections in the NYISO Gold Book. All other existing units are given a 60-year total operating lifetime, after which they must retire, though units can also be retired economically earlier than 60 years. When thermal units retire, the model can choose how best to replace that capacity with available new-build resources. In some cases, thermal sites are repowered with new CTs or combined cycle gas turbine (CCGT) plants (if this repowering occurs in 2040 it is with hydrogen, as discussed below). In other cases, their energy, capacity, and ancillary services are met by a mix of other resources.

Beyond 2028/2029, RESOLVE allows for the construction of new resources, including in-state solar, LBW, OSW, brownfield or greenfield nuclear, and transmission lines within the State to alleviate intra-zonal constraints. The availability of in-state renewable resources is limited and aligned with the supply curve analysis developed by NYSERDA. The feasibility of building new nuclear and transmission is tested using the "2.2 GW Nuclear" and "3.3 GW Nuclear" sensitivities in the Current Policies and Additional Action scenarios, described in more detail in the Pathways Analysis chapter. This analysis contains estimates and projections on resource availability, site locations, and site and technology characteristics for a range of LSR energy technologies. The resources captured in this analysis are utility-scale solar photovoltaics (UPV), LBW, and OSW. The supply curve identified the statewide technical potential of more than 75 GW of UPV, 15 GW of LBW and approximately 20 GW of OSW. The OSW capacity only considers the existing lease areas from the Bureau of Ocean Management.[81] The Supply Curve analysis is focused on technical

potential and does not account for evolving State or federal policies (including the federal government's indefinite pause on issuing new or renewed permits or approvals for OSW projects[82]), market dynamics or public acceptance that would impact the ability to develop these resources.

To facilitate meeting the 0x40 emissions target, the model assumes the availability of firm, zero-emissions power from CTs and CCGTs operating on hydrogen. The model assumes that natural gas turbines that would be online in 2040 (meaning they have not yet reached the end of their operating lifetime) can be converted to hydrogen units in the 2035-2040 timeframe, at a cost of 25 percent of the capex of a new unit. The model also has the option to purchase new turbines that can burn hydrogen, again at a cost premium of 25 percent higher than the cost of a natural gas equivalent alternative. While the majority of the hydrogen zero-emissions firm power in 2040 is from conversions of existing units, there are a small number of new units also built in the 2040-time frame. It is assumed that 50 percent of the hydrogen is produced via in-state electrolysis, while the remaining 50 percent is imported from green hydrogen plants, with associated costs accounting for necessary pipeline and storage infrastructure.

Furthermore, the model incorporates demand-side flexibility by assuming a certain degree of load flexibility in light-duty vehicles and water heating, consistent with the levels of ambition outlined in New York's Grid Flexibility Study.[83] This flexibility allows for more efficient integration of renewable resources and enhances the overall reliability of the energy system.

The model selects to build additional transmission capacity between Zones I and J, enhancing upstate to downstate zonal interties. The pace and scale of buildout varies depending on the transmission and nuclear sensitivity selected, but the upper range of additional I to J intertie expansion ranges from 822 MW in the Additional Action scenario to 1,250 MW in the Current Policies scenario, reaching the estimated right-of-way limit by 2040. These transmission additions and upgrades enable more power to flow from upstate and relieve some of the local capacity requirements in Zone J. Note that the transmission results in this analysis are meant to be illustrative and are not meant to represent a precise number in the context of a long-term transmission planning study or provide a specific, detailed solution for a specific transmission upgrade path. Nevertheless, the results do provide an indication of the economic and reliability benefits that transmission can provide the bulk system, especially in the constrained downstate zones.

The next section describes the resource mix in the Additional Action cases. Table 4 summarizes the ICAP, while the energy mix is depicted in Table 5.

Table 4: Total Installed Capacity (MW): Additional Action through 2040

Source: Pathways Analysis Chapter

	3.3 GW Nuclear				2.2 GW Nuclear		
Fuel Type	**2030**	**2035**	**2040**		**2030**	**2035**	**2040**
Nuclear	3,326	3,326	6,656		3,326	3,326	5,546
Gas & Fuel Oil (FO)	21,142	16,617	-		21,142	17,296	-
Zero-Carbon Firm	-	-	14,797		-	-	15,467
Biomass	334	334	-		334	334	-

In-State Hydro	4,264	4,264	4,614		4,264	4,264	4,614
Hydro Imports (Existing)	1,432	1,432	1,432		1,432	1,432	1,432
Hydro Imports (New)	1,250	1,250	1,250		1,250	1,250	1,250
Wind	4,973	5,810	8,080		4,973	6,568	8,415
Wind Imports	-	-	-		-	-	-
Offshore Wind	1,870	1,870	4,809		1,870	1,870	6,782
Solar	14,877	20,927	30,524		14,877	19,609	31,081
Battery Storage	6,000	9,068	9,068		6,000	8,079	8,938
Pumped Storage	1,411	1,411	1,411		1,411	1,411	1,411

*Under a Zero GHG target, all Gas capacity is assumed to be able to run on Hydrogen. FO Capacity is not allowed to run or provide reserves, so only units which operate on natural gas or dual-fuel can be converted; FO-only units are assumed to retire by 2040.

Table 5: Annual Fuel Mix (GWh): Additional Action through 2040

Source: Pathways Analysis Chapter

	3.3 GW Nuclear				**2.2 GW Nuclear**		
Fuel Type	**2030**	**2035**	**2040**		**2030**	**2035**	**2040**
Nuclear	26,221	26,193	55,405		26,221	26,193	45,589
Gas & Fuel Oil	50,179	46,703	-		50,257	46,977	-
Zero-Carbon Firm*	-	-	3,889		-	-	4,065
Biomass	2,781	2,759	-		2,781	2,775	-
In-State Hydro	27,320	27,320	29,643		27,320	27,320	29,643
Hydro Imports (Existing)	10,161	10,161	10,189		10,161	10,161	10,189
Hydro Imports (New)	10,403	10,403	10,431		10,403	10,403	10,431
Wind	14,779	17,472	24,761		14,779	19,855	25,785
Wind Imports	-	-	-		-	-	-
Offshore Wind	7,467	7,467	19,253		7,467	7,467	27,156
Solar	23,405	34,198	50,866		23,405	31,821	51,778
Battery Storage*	(266)	(671)	(674)		(277)	(598)	(665)
Pumped Storage*	(14)	(64)	(161)		(11)	(75)	(191)
Imports**	7,782	13,685	20,607		7,752	13,387	21,774
Exports	(11,117)	(13,294)	(20,607)		(11,157)	(13,353)	(21,774)
Load	169,101	182,331	203,602		169,101	182,331	203,779

*Battery and pumped storage values here are net; due to parasitic losses this results in below-zero annual fuel mix results, but these resources' availability during hours of low renewable availability are key to meet resource adequacy and reliability
**Hydro Imports from Canada are included in the generation mix table and are therefore not included in the Imports row.

3.3.1. Role of Renewables in Decarbonization of Electricity Sector

The role of renewable electricity continues to grow throughout the study period, with renewable energy growing from providing 36 percent of annual load in 2025 to providing 71-76 percent of annual loads in 2040 (note that zero carbon electricity grows from 53 percent in 2025 to 100 percent in 2040). Meeting growing loads and peaks while working towards achieving 2040 emissions constraints and maintaining reliability requires a significant buildout of a diverse set of resources. Distributed solar is built out in line

with achievement of the 10 GW by 2030 target (note that target is set in DC terms while the table above is in AC). Between 2030 and 2040 the model chooses to continue building a significant quantity of solar. As discussed previously, the model is not constrained to meet the State 9 GW OSW target due to federal policy headwinds; however, the model still does find value in building out offshore wind, achieving 5-7 GW of OSW capacity by 2040. Also, 8 GW of LBW is built by 2040. It is important to note that the significantly higher capacity factor of OSW shows it providing more energy than LBW even while having less overall capacity (3.3 GW Nuclear).

3.3.2. Reliable Integration of Renewable Resources

To reliably integrate large quantities of intermittent resources into the New York electricity system, wind and solar output must be balanced with customer demand on multiple timescales, with different resources providing contributions to system reliability needs over each timescale.

Role of Flexible Resources

Resources such as flexible end-use loads and energy storage play a critical role in providing ramping capabilities and in balancing renewables with customer loads. Batteries can charge during times of high renewable output and discharge during times of lower renewable output or high customer demand, and batteries can also help meet ramping needs and reserve requirements. Dynamic end-use flexibility also has similar potential to help if customers are incentivized to shift their demand to times of highest renewable output or to times of low system demand. As seen in the capacity mix, the model meets the State's 6 GW energy storage target by 2030 and continues to build further capacity beyond, achieving a penetration of over 9 GW of battery storage by 2040. While flexible loads contribute hundreds of MW of peak load reductions in the Additional Action scenario by 2040, battery storage provides even greater peaking capacity.

Role of Firm Capacity

In addition to increased system flexibility, analyses have consistently identified a need for clean firm capacity – in addition to the State's existing hydro and nuclear facilities – to maintain system reliability while achieving a zero-emissions grid. Clean firm capacity could be provided by multiple different resources, as described in the Zero by 40 Technoeconomic Assessment. Different kinds of firm resources can support the grid in different ways (see Section 2.6.2). High-capacity factor resources include advanced nuclear and can provide firm, baseload power to complement renewables. Low-capacity factor firm resources include hydrogen and would be deployed during times of the most extreme need, similar to today's peaker plants. Firm resources will be needed during prolonged periods of low renewable output, when short-duration energy storage resources can be quickly depleted. For example, during cold winter weeks, electricity demand will be high as a result of the electrification of building heating needs, and winter months also often coincide with extended periods of low renewable output. During a week with persistently low solar and wind generation, additional clean firm capacity is needed to avoid a significant shortfall.

High-capacity factor clean firm capacity could be provided by new nuclear deployments such as the 1 GW project that Governor Hochul directed NYPA to build. In the core analyses, 2.2 – 3.3 GW of new nuclear is selected by 2040 to help meet load growth and decarbonization goals.

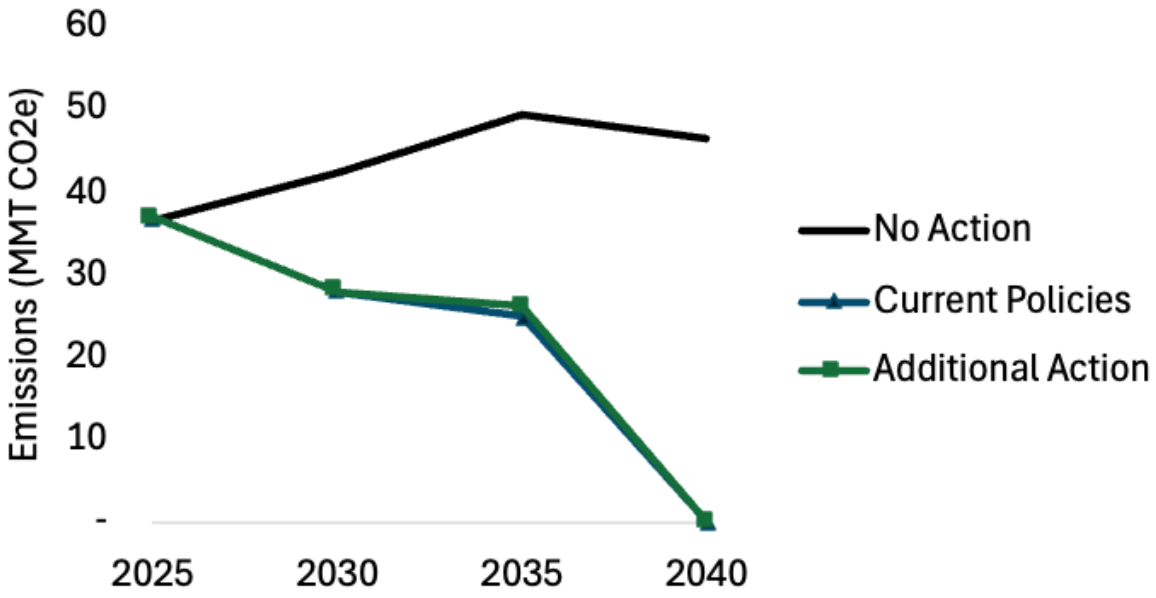
The low-capacity factor clean firm capacity is assumed to be provided by hydrogen CTs and/or CCGTs in the core analyses, with a sensitivity exploring other options such as RNG (see the Pathways Analysis chapter). While the capacity for these resources is significant, with a need of 14.8 – 15.5 GW of zero-carbon firm generation in 2040, the annual energy output from these units is much lower, due to the significantly more expensive fuel (green hydrogen in the core cases) that those clean firm resources use.[84] Nevertheless, they are critical to meet grid reliability, especially in extended periods of high load and low renewables generation. Ultimately, a mix of zero-carbon firm technologies will best meet statewide needs, maximize benefits, and minimize the risk associated with overreliance on any one resource, as described in the Zero by 40 Technoeconomic Assessment.

3.4. GHG Emissions

Due to the significant growth in renewable energy and clean firm resources in line with progressing towards achievement of 0x40 electric sector targets, the Additional Action and Current Policies scenarios assume achievement of significant power sector decarbonization, as seen in Figure 22, below. This graph depicts the CO_2 emissions from in-state generation resources through 2040 for these scenarios.

Figure 22: Annual In-State Power Sector Emissions

Source: Pathways Analysis Chapter



3.4.1. Protections for Disadvantaged Communities

Under the Climate Act, the Climate Justice Working Group (CJWG) was tasked with defining what constitutes a disadvantaged community in New York State. Based on criteria that were adopted by the CJWG on March 27, 2023, 35 percent of census tracts in the State are defined as disadvantaged communities. The CJWG is required to convene at least annually to review and, if necessary, adjust the criteria based on new data and scientific findings. The CJWG voted in February 2025 to update the data sources for the disadvantaged community criteria; as a result, an updated map is expected to be

released in the latter part of 2025. The Climate Act requires New York to prioritize reductions of GHG emissions and co-pollutants in disadvantaged communities.[85]

3.5. Impacts of Climate Change on Electric Supply

Warming temperatures may also impact the availability and performance of generating resources, including solar PV generators and thermal generators.[86] The available power output of a solar panel declines as a function of panel temperature, thus leading to reduced performance during heat waves. The available power output of CTs declines as a function of ambient temperature, and thermal generators are also historically more prone to outages during extreme cold and extreme heat conditions. The impact of warming temperatures on electricity generation is a factor to consider through mid-century and beyond, but in the planning horizon of the State Energy Plan (through 2040) the impacts are likely to be relatively muted and not a core driver of electric sector supply build or dispatch.

3.6. Key Findings from Pathways and Related Studies

A number of key learnings from the Pathways Analysis are consistent with key findings from other recent studies, including the forthcoming NYSERDA/GE Holistic Grid Reliability Study and the State Scenario examined under the first cycle of the CGPP.[87]

1) **Each of these scenarios include on the order of 40 – 55 GW of solar and LBW and significant levels of transmission additions are needed to support it.**

For instance, the Stage 1 analysis of the current CGPP cycle on the State Scenario estimated that approximately 20 GW of additional local transmission headroom could be needed upstate by 2040 to achieve this level of buildout. More insights about this will come from the upcoming stages of the current CGPP cycle. As further described below, analysis from the three studies indicates that additional bulk transmission would also likely be necessary in order to deliver zero emissions energy to downstate New York.

2) **The system will need on the order of 20 – 25 GW of firm clean capacity to replace the existing fossil fleet**

The Pathways Additional Action case builds approximately 20 GW of clean firm capacity (consisting of a combination of thermal generation using hydrogen, nuclear generation, and energy storage, after considering the Effective Load Carrying Capability of energy storage) to replace the existing fossil fleet. The annual load and peak demand including energy storage charging for this scenario in 2040 is 203 TWh and 37 GW, respectively.

Comparable results were observed in the Grid Performance Gaps Study.[88] In the resource adequacy analysis, this study found that approximately 25 GW of firm capacity is needed to replace the existing fossil fleet. This analysis included a forecasted 2040 annual load and peak demand including energy storage charging of 247 TWh and 44 GW, respectively.

The State Scenario under the CGPP had similar outcomes with approximately 25 GW of firm capacity needed to replace the existing fossil fleet (consisting of a combination of thermal generation using hydrogen and energy storage, after considering the Effective Load Carrying Capacity of energy storage).

This scenario included a forecasted 2040 annual load and peak demand, including energy storage charging of 253 TWh and 45 GW, respectively.

3) Additional transmission between upstate and downstate is observed to be beneficial

Another finding that is consistent among the three studies is that additional upstate-downstate transmission is likely to have value. These studies identified notable uncertainty related to the addition of clean firm capacity downstate and that transmission could help mitigate this risk. In the Additional Action scenario, the value of transmission is demonstrated by the model's economic deployment of approximately 822 MW of new transmission between Zones I and J. The results are not reflective of a detailed investment-level analysis, but they are indicative of the potential opportunity for additional bulk transmission to play an important role.

New York's CGPP (see Section 3.7.2) is designed to holistically analyze supply, demand, and the configuration of the electric network to systematically identify the specific needs that best achieve cost-effectiveness for affordability, reliability, and clean energy deployment. The New York utilities are expected to complete the necessary analyses and file their report by the first quarter of 2026. For potential identified bulk needs, competitive solicitation for solutions could follow under the NYISO processes.

- **Additional deployment of flexible resources between upstate and downstate is observed to be beneficial, on the order of 9,000 MW by 2035 and 2040.**

A further finding that is consistent among the three studies is that further deployment of battery storage and dynamically responsive end-user load is likely to have value. In the Additional Action scenario, the value of battery storage is demonstrated by the model's economic deployment of approximately 9,000 MW of new battery storage by 2035 and 2040, beyond meeting the State's 6 GW energy storage target by 2030. Additionally, dynamic flexible loads contribute hundreds of MW of peak load reductions in the Additional Action scenario by 2040. The results are not reflective of a detailed investment-level analysis, but they are indicative of the potential opportunity for additional flexible resources to play an important role.

3.7. Transmission and Distribution

As the energy supply portfolio changes and as electrification proceeds, New York's transmission and distribution grid will need to be expanded to ensure that energy is delivered to customers across the State with the necessary level of reliability.

3.7.1. Near-Term Outlook

New York State has already begun investing in its transmission and distribution infrastructure in response to climate policy. In 2020, the State passed the Accelerated Renewables Act, which mandated new efforts to identify system upgrades needed to meet Climate Act targets and provided authority to expedite certain upgrades. To implement these directives, the PSC opened a proceeding that to date has led to action on both near- and long-term transmission infrastructure needs. While the CGPP will identify

long-term transmission system needs, the PSC has also approved approximately $8 billion in transmission investments that are designed to support the integration of renewable energy sources.

FERC Order 2023 and Interconnection Reform

In July 2023, FERC issued Order 2023 to address delays in renewable generation deployment caused by historically backlogged interconnection queues.[89] Key reforms introduced in this Order include shifting from a “first come, first served” approach to a “first ready, first served” process, where generators must demonstrate commercial readiness to advance through the interconnection process. The order also mandates a cluster study approach, evaluating multiple generators together rather than individually, and implementing standardized, transparent, and timely interconnection procedures. Other provisions include allowing co-located resources like batteries and renewables to share an interconnection request and considering GETs in transmission planning. On April 17, 2025 FERC largely accepted the NYISO’s tariff modifications implementing Order 2023, and the first cluster study is underway. These changes are expected to accelerate the deployment of new generation and shape future grid development.

In addition to FERC Order 2023, other recent interconnection developments have focused on addressing the reliability of inverter-based resources. NYSRC's Reliability Rule B.5, effective as of June 2023, establishes interconnection standards for large inverter-based resources, requiring compliance with Institute of Electrical and Electronics Engineers 2800-2022 standards to ensure reliable performance in New York's grid.[90] This rule responds to issues seen in other states, where inverter-based resources failed to maintain reliable operation. FERC's Order 901, first established in 2021, further emphasizes the need to address gaps in existing reliability standards for inverter-based resources, directing NERC to develop new or modified standards in areas like data sharing, model validation, and performance requirements.[91] These actions aim to enhance the reliability of inverter-based resources as they become a larger part of the energy mix, ensuring that the grid can integrate them safely and efficiently.

Phase 1 and Phase 2 Transmission Projects

In 2020–2021, the PSC and NYSERDA conducted the Power Grid Study, which assessed the State's transmission system and its capacity to meet renewable energy targets under the Climate Act. The study found that the existing transmission infrastructure is well-equipped to support the State's 2030 target of 70 percent renewable electricity generation. The study also highlighted that longer-term clean energy and climate targets of the Climate Act present new transmission needs, necessitating proactive planning. DPS has distinguished between Phase 1 and Phase 2 transmission projects and directed efforts to ensure that the State transmission system is prepared to meet Climate Act targets in 2030 and beyond.

Phase 1 projects encompass critical upgrades to the transmission system that are already planned to maintain grid reliability, resilience, and to accommodate expected renewable energy growth through 2030. These projects are focused on strengthening existing infrastructure to handle current needs and to meet 2030 targets. Phase 2 projects are driven by the broader requirements of the Climate Act after 2030. These projects aim to accommodate the influx of LSR energy generation, in particular OSW.

Distribution Investments

Utility investments and expenditures play a crucial role in maintaining and enhancing the reliability of transmission and distribution systems while balancing affordability for customers and enabling economic development. Utilities are also required to publish Distributed System Implementation Plans and five-year capital investment plans that detail ongoing and future efforts to modernize the grid, improve system performance, and prepare for extreme weather. The five-year capital investment forecasts submitted by New York's major utilities—NYSEG, RG&E, Central Hudson, National Grid, Con Edison, and O&R—show substantial planned spending on reliability and resiliency projects, including breaker replacements, system hardening, automation, substation upgrades, and storm response measures. Further details on these plans and specific projects are provided in the 2025 Transmission and Distribution Reliability Study.[49]

3.7.2. Long-Term Outlook

Transmission System Planning

CGPP

New York has initiated changes to the utilities' planning in response to decarbonization policies. The first statewide long-term CGPP cycle is underway. Staff expects the utilities to complete the work and file their report by the first quarter of 2026. The CGPP report will include proposals for local transmission investment and may identify bulk system needs. A second CGPP cycle will commence after the PSC reviews the results of the first, which will produce an updated portfolio of needs and solutions.

FERC Order 1920

Issued in May and November of 2024, FERC Orders 1920 and 1920-A mark the first major update to regional transmission policy in over a decade.[92,93] These orders respond to rising electricity demand forecasts and unresolved issues from previous efforts, such as Order 1000. The goal is to increase planning efficiency, reduce fragmentation, and align cost allocation to encourage transmission investment. Key requirements include five-year planning cycles, scenario-based planning for a 20-year horizon, and the evaluation of transmission portfolios rather than individual projects. Additionally, planners must consider right-sizing projects, coordinate with state entities, and incorporate emerging technologies like grid-enhancing tools.

Order 1920-A further refines these processes by requiring transmission providers to include State input in scenario planning and cost allocation. It allows providers to create additional scenarios as needed, ensuring robust and transparent planning. Together, these orders aim to improve transmission system planning, facilitate interregional coordination, and support the clean energy transition while maintaining just and reasonable electricity rates. The NYISO's deadline for filing its compliance tariff covering the regional requirements is April 30, 2026, and for interregional requirements, it is June 14, 2027.

Northeast States Collaborative on Interregional Transmission

New York participates in other grid planning activities with an interregional and even national focus. These include exercises with DOE, processes at the Independent System Operator/Regional Transmission

Organization Council, and multi-state discussions under the Northeast States Collaborative on Interregional Transmission.

Initiated in June 2023, the Northeast States Collaborative on Interregional Transmission is a coalition of representatives from ten states focused on improving coordination in interregional transmission planning.[94] The collaboration aims to lower costs for ratepayers, enhance system reliability, and support State energy policies. The member states signed a memorandum of understanding on July 9, 2024, formalizing their commitment to work together on these objectives.

On October 1, 2024, the Collaborative published a white paper on High Voltage Direct Current (HVDC) Equipment Standardization and Supply Chain Considerations for Offshore Wind Transmission.[95] The paper outlines four key benefits of standardizing HVDC equipment: minimizing supply chain challenges by enabling manufacturers to focus on a single standard, maximizing the potential for future networking of OSW lines, accelerating domestic supply chain investment, and encouraging the adoption of global HVDC standards for more efficient and cost-effective projects.

In April 2025, the Collaborative issued a Strategic Action Plan that identifies specific steps that state, regional, and federal policymakers can take to pursue interregional transmission solutions to reduce costs for consumers and make energy systems more secure. The plan outlines a range of actions to improve interregional transmission planning processes across three different grid planning regions in the Northeast. Key near-term actions include issuance of a Request for Information (RFI) for potential interregional transmission projects that provide reliability benefits and cost savings for consumers. The plan also identifies transmission equipment standardization efforts to support a unified and comprehensive approach to transmission investments.[96]

Distribution System Planning

Building and vehicle electrification are large drivers of anticipated load growth in the State. To keep pace with the infrastructure additions in line with the Additional Action scenario, it is anticipated that electrification will drive over 7 GW of electrification load growth through 2040

Proactive Planning Proceeding

In the Proactive Planning proceeding, the PSC directed investor-owned utilities to develop a framework for timely and cost-effective grid upgrades in anticipation of the rapid electrification of buildings and transportation in New York State. The proactive planning process will integrate with the CGPP to address anticipated load increases from sectors like transportation and heating, facilitating a comprehensive approach to grid modernization.

3.7.3. Impacts of Climate Change on Transmission and Distribution Infrastructure

As discussed in the Climate Change Adaptation and Resiliency chapter of this Plan, extreme heat, changes in precipitation, and other climate hazards are stressing the State's energy infrastructure and will only increase with the changing climate. In response to these impacts, in February 2022, Governor Hochul signed into law an act that added a new subdivision 29 to PSL §66, requiring the major utility corporations to submit a Climate Change Vulnerability Study (CCVS) and a Climate Change Resilience Plan (CCRP) to the PSC.

The utilities' CCVSs each analyzed a common core set of climate hazards (high temperature, flooding, wind, and ice) to their service area geography and system. All utilities also considered extreme events in their CCVSs, such as extreme snow and ice accumulation, heat waves, extreme winds, or deluge rainfall. The CCVSs then used planning scenarios to inform their resilience investments, as well as qualitative and quantitative assessments to map climate exposure and vulnerability to different hazards. The CCVSs informed the CCRPs later filed with the PSC.

The utilities' CCRPs contained various programs and projects to address adaptation and resiliency. For example, to address extreme heat impacts, the CCRPs proposed testing emerging technologies to mitigate heat-related illnesses among utility workers and requiring the purchase of transformers using increased ambient temperature specifications. For flooding and precipitation impacts, the CCRPs proposed installing higher flood walls at substations in high-risk areas, and relocating or rebuilding substations located in an area with a history of flooding. To protect against wind and ice impacts, the CCRPs proposed strengthening overhead lines with the use of spacer cable systems, trimming around overhead lines, and targeted undergrounding of overhead distribution lines susceptible to tree, wind, and ice damage. Lastly, the CCRPs sought to address extreme events by hardening overhead circuits that supply critical facilities, creating storm response facilities to serve as central staging areas, and accelerated smart grid distribution automation.

In December 2024, the PSC acted on the first iteration of the utilities' CCVSs and CCRPs and recognized, in alignment with the law, that utility climate adaptation and resilience would be an iterative process requiring plan updates every five years and ongoing engagement with stakeholders.[97]

4. Themes and Recommended Actions

New York has been focused and effective in building and operating an electric system that meets the needs of New Yorkers, serving as the backbone for economic development and job growth, and public health, welfare, and safety. Even as challenges mount—the COVID-19 pandemic's lingering economic impact, the actions of the new administration in Washington D.C, the increasing need to reinvest in our legacy electric infrastructure, the increasing need to meet the growing demand for power, and the burden of increasing utility bills—New York must continue to maintain the reliability of the grid, protect consumers and advance its clean energy objectives. This means ensuring smart investments and operations (and policies and programs that support them) that are as cost-effective as possible in meeting the reliability and climate objectives of the State. To ensure affordability, we must manage costs.

- **New York State is supporting energy diversity, leading the deployment of clean energy resources and taking all necessary steps to meet demand and preserve reliability and affordability**. The State should continue to support the deployment of clean energy resources, including renewable resources and nuclear, and strategically navigate challenges (including federal policy uncertainty and siting and permitting hurdles) that affect the pace of progress.
- **Rising electricity costs are creating energy affordability concerns that must be addressed.** Future investments in our energy system should be selected, designed, and executed in a cost-

effective manner to mitigate utility bill impacts and to withstand the impacts of a changing climate.

- **The State should continue to leverage and expand the deployment of storage and demand-side resources**, including energy efficiency measures and flexible technologies, to help mitigate the need to build new, costly infrastructure, lower the cost of the clean energy transition and enhance grid reliability.
- **The State will need to be strategic in identifying and integrating clean firm technologies** that have the attributes necessary to support the achievement of a zero-emissions electric grid by 2040.
- **Continued State action to advance smart and strategic energy system planning is critical** to enhance system reliability and drive down the cost of necessary generation, transmission, and distribution system investments. These planning efforts are particularly important considering the anticipated economic-development-driven load growth and long-term electrification of transportation and buildings.
- **The State should continue to evaluate wholesale market and retail rate structures** to ensure they properly value and compensate new energy resources and market services and prioritize energy affordability for consumers. This will attract and maintain the resources and services needed for the future electric grid.

4.1. Accelerate the Deployment of Clean Energy Resources to Meet Grid Needs

New York State will continue to ensure the safety and reliability of its electricity system through a range of energy resources. As outlined below, there are several challenges and opportunities that must be considered to achieve the level of supply that will be necessary to advance the State's clean energy targets.

4.1.1. Key Considerations

Supply Chain Trends and Workforce Needs

Like most industries, clean and renewable energy generation has been impacted by significant macroeconomic pressures over the last several years—including the effects of COVID-19, inflation, high interest rates, supply chain disruptions and, more recently, tariff uncertainty. These pressures have reversed the trend of decreasing costs of the preceding years.

In addition to competing in a global supply market, New York needs to attract an adequate labor pool to support the pace of clean energy development statewide. However, there are indications that the domestic supply of skilled workers will be constrained. New York State—namely NYSERDA, NYPA, and the New York State Department of Labor (DOL)—has developed and/or funded training programs to strengthen the skilled workforce. See the Clean Energy Jobs and a Just Transition chapter of this Plan for more detail on the State's workforce development initiatives to support clean energy jobs.

Cost, Permitting, and Federal Regulation and Policy

High upfront costs, siting and permitting challenges, and federal regulatory uncertainty affect the pace of clean energy resource deployment, slowing it down relative to the pace needed to meet the State's clean energy and climate goals on the schedule established by statute. Recent federal policy developments underscore the fact that the State's progress is inextricably linked to federal government positions on energy infrastructure siting, tax credits, and international trade policy.

H.R.1., signed on July 4, 2025, changed project eligibility for the Clean Electricity Investment Tax Credit and Clean Electricity Production Tax Credit. Many projects will no longer be eligible for these credits beginning in the late 2020s and through the early 2030s, which will directly increase the cost to develop these projects.

For more information on the cost impacts, please see the Pathways Analysis chapter.

Community Acceptance and Land Use Issues

New York State is tasked with balancing renewable energy project development with the protection and enhancement of its agricultural lands and forests. To support and advance the future project development of renewable energy projects that are compatible with agricultural lands and forests, it is important to engage regularly with relevant stakeholders and facilitate the integration of smart siting practices. This necessitates adopting siting strategies and project procurement practices aimed at mitigating adverse effects on these key natural resources. Simultaneously, there is a need to maximize the co-benefits and synergies that can be derived from integrating these land uses. See the Buildings chapter of this Plan for more information on synergistic land use strategies.

Recommendations

- **Support large-scale renewable development and increased clean energy supply by continuing clean energy procurements and leveraging recommendations from the CES Biennial Review process.** The PSC issued an order in May 2025 on the CES Biennial Review report and recommended several changes to adjust the current procurement process to reflect current market conditions and to maintain progress on building new, clean energy generation in a way that preserves reliability and meets the State's energy affordability objectives.[98] One specific change was to increase the annual procurement target for NYSERDA's Tier 1 land-based renewable energy program from 4,500 to 5,600 GWh of renewable energy. The CES Biennial Review report outlines the various challenges impacting the rate of procurement including supply chain costs, inflation, and most recently, federal action that threatens the entire renewable energy industry and impacts the trajectory towards achieving the 2030 targets. Moreover, expected increases in statewide electric load will continue to increase the level of operational renewable resources necessary to meet the State's supply objectives. Taking all this into consideration, the Biennial Review sets forth recommendations to modify the CES solicitations to maintain progress towards meeting Climate Act targets as expeditiously and cost effectively as possible.[99] Overall, the CES Biennial Review process is focused on securing mature projects that will help the state pursue energy abundance while being protective of ratepayers.

- **Continue to build-out distributed solar through NY-Sun to achieve the 10 GW target and leverage Statewide Solar for All as a cost-effective way to drive additional development while maximizing LMI benefits.** New York's distributed solar market has evolved into a self-sustaining industry through long-term programs like NY-Sun, which gradually scaled down incentives while expanding deployment. In April 2025, the PSC made updates to the NY-Sun program that reflect the program's success in building one of the strongest distributed solar markets in the country. The PSC redirected ratepayer funds to other policy matters, including critically needed energy efficiency programs, and provided funds to incentivize 500 MW of additional solar projects that directly benefit low-income customers above the statewide 10 GW target. Beyond the on-going support for the industry through NY-Sun, New York's successful solar energy industry will continue to benefit from supportive programs, including Statewide Solar For All, the Value of Distributed Energy Resources, and continuing efforts to lower barriers to entry through interconnection reform.

- **Ensure the effectiveness of the RAPID Act.** New York has implemented significant improvements to permitting processes that are critical to the development of new renewable energy facilities. In pursuit of this goal, the State should continue to engage with communities—through effective communication and public outreach—to support the siting and acceptance of these facilities, including strong communication and public outreach. ORES should continue to work with communities to ensure the timely and efficient siting of renewable energy facilities.

- **Support strategies that expedite and streamline development including advancing Clean Energy Zones and leveraging NYPA's authority to build renewables.** New York State should continue to leverage NYPA's capabilities under their expanded authority to build renewable energy generation resources. The State may also consider allowing utility ownership of clean energy resources in discrete arrangements, where there is evidence that utility ownership can expedite the pace and cost-effectiveness of clean energy investments.

  Additionally, to enable the deployment of the clean energy resources at the scale needed to meet our energy transition goals and unlock economic growth, the State should encourage the development of regional concentrations of clean electric generation paired with transmission. The PSC directed DPS to explore the concept of Clean Energy Zones in a May 2025 order.[100] Proactively coordinating generation and transmission development in a Clean Energy Zone can reduce developers' construction and interconnection risks and costs, thereby lowering costs paid by electric customers. This approach also has the co-benefits of allowing for greater community engagement and ensuring that economic development and power sector initiatives are aligned to advance the State's clean energy and climate goals.

- **Continue to support workforce development by directing efforts to those in disadvantaged communities and fossil fuel workers transitioning to clean energy jobs.** In addition to competing in a global supply market, New York will need to attract an adequate labor pool to meet its 70 percent renewable energy target. However, there are indications that the domestic supply of skilled workers will be constrained as New York and other states continue to ramp up

their renewable energy programs. Trends in the clean energy workforce and future anticipated labor needs are further discussed in the Clean Energy Jobs and a Just Transition chapter of this Plan.

New York State—namely NYSERDA, NYPA, and DOL—has developed and/or funded training programs to strengthen the skilled workforce, including targeted efforts in disadvantaged communities. However, the ultimate success of these initiatives is hard to predict, and therefore the availability of skilled workers may impact project development well into the future. For more information on workforce training initiatives see the Clean Energy Jobs and a Just Transition chapter of this Plan.

Moving forward, strong coordination between NYSERDA, DOL (in particular, DOL's Office of Just Energy Transition), and other State entities will be essential to ensuring the necessary financial support for workforce development. In addition, such coordination can ensure that new and existing worker-support related to the transition away from fossil fuel electric generation sources is well-executed and supports a just transition for the State's energy workforce. For example, the State should focus on training and support services for the workforce at existing fossil fuel power plants that are slated for retirement or may be in the near-term.

- **Continue to evaluate the State's existing clean firm capacity resources since they will be critical to achieving a zero-emissions grid.** Clean firm technologies will be necessary to maintain reliability as the State progresses towards its 2040 "zero emissions" target for the electric system. New York's existing nuclear and hydroelectric baseload units provided 44 percent of New York's in-state electricity in 2023. As mentioned earlier, New York's existing nuclear facilities had the highest aggregate capacity factor (94 percent) of all fuel types in 2023. Ensuring these facilities continue to operate in a cost-effective manner is critical not only to progressing towards the 2040 "zero emissions" target, but to fuel diversity and the State's economic development goals as well. In June 2025, Governor Hochul directed NYPA to develop a zero-emission, advanced nuclear facility in upstate New York. The Governor's directive is for NYPA to develop at least 1 GW of new nuclear energy capacity. As described in greater detail in the Nuclear chapter of this Plan, in July 2025, DPS filed a white paper with the PSC that outlines the continued need for the State's existing nuclear power generation resources and proposes the continuation of a ZEC program to support the extended operation of these resources.

  In October 2024, the PSC created a new h-Value set at 75 percent of the current e-Value available under the VDER tariff for distributed generation projects for hydroelectric generation facilities in service before January 1, 2015, sized up to and including 5 MW in capacity, and that operate and register with the local utility as a Community Distributed Generation project.[101] In May 2025, the PSC made further modifications to the CES by providing hydroelectric facilities participating in the CES Tier 2 Maintenance Program with longer ten-year contract terms to allow these facilities to access better financing options to address repair expenses.[102] The State should continue evaluating what policies may be necessary to ensure the continued operation, and deliverability of electricity into the State, of both small- and large-scale hydroelectric

facilities through the Large-Scale Renewable Energy Program and CES and VDER proceedings, respectively.[103] An example of a policy fit for reevaluation would be the PSC's directive to DPS in the May 2025 CES Biennial Review Order to revisit repowering requirements under CES Tier 1, including the potential removal of the 15 percent increase in generation for hydroelectric facilities requirement.

- **Continue to evaluate the impact of large load customers and take necessary steps to support consumers.** This new era of demand growth has shed light on the challenges of planning for new large loads. New York State—spanning partners across DPS, ESD, NYPA, NYSERDA, among others—is identifying best practices to equitably support its economic development and energy objectives. New York State is strategically positioned with a single-state independent system operator at the NYISO and will continue to be innovative and flexible in its approaches to make changes in response to evolving conditions.

- **The State will need to be strategic about the pace of combustion unit retirements and/or replacements as it works to pursue achievement of its clean energy targets.** New York's generation fleet is aging, the rate of renewable deployment is uncertain, reliability margins are shrinking, and significant levels of large loads are being added. Due to these factors, the State will need to be strategic about the pace of combustion unit retirements and/or replacements as it works towards its clean energy goals and to meet reliability needs as quickly and cost-effectively as possible. Combustion generating units will remain essential parts of electric grid reliability and affordability. Retirement of these units will not be able to occur until resources that provide the same grid reliability attributes are put in place.

  Additionally, there are specific considerations with respect to the small clean power plants, or "peaking units," owned and operated by NYPA. By 2030, NYPA will cease production of electricity at its peaking units unless the closure of any specific facility would result in increased emissions in a disadvantaged community or the facility is needed for reliability.[104]

  With these strategic and statutory considerations, New York will seek to carefully manage the retirement of existing assets and evaluate whether there is need to invest in their repowering or in new generation that is compatible with long-term policy targets. This is the case even as New York seeks to first prioritize the continued expansion of clean energy resources, transmission upgrades, increased energy efficiency, integration of distributed energy resources, and growth in demand response participation. The State will continue its efforts under the 0x40 Proceeding and CGPP. These processes will not only help to evaluate whether there will be sufficient clean firm resources available by 2040 that meet the proposed definition in the DPS white paper defining key terms in PSL §66-p, but also consider what approaches would promote emissions reductions**,** affordability, and reliability.

4.2. Advance Demand-Side Solutions and Flexible Resources

The transformation of New York's electricity sector will require carefully balancing the variety of generation resources and changing patterns of demand to maintain system reliability. The State will

continue to leverage and expand the deployment of distributed solar and demand-side resources, including energy efficiency measures and flexible technologies, to lower the cost of the clean energy transition and enhance the reliability of the grid.

4.2.1. Key Considerations

Value of Demand Response and Flexible Resources in Reducing Infrastructure Needs

Leveraging demand response and harnessing the ability of flexible resources to lower energy demand can provide a unique opportunity to potentially reduce the scope and costs of infrastructure buildout. The PSC initiated the GOTF proceeding in April 2024 to unlock innovation and investment to deploy flexible resources—such as DERs and VPPs—to achieve the State's clean energy and climate goals at a manageable cost and at the highest levels of reliability. The objectives of the proceeding are to develop and maintain a plan that encourages investment in flexible resources to reduce infrastructure and operational costs, improve system reliability, and increase customer benefits and bill savings.

Market/Technical Potential of Demand-Side Solutions and Flexible Resources

The first major deliverable of the GOTF proceeding was the New York Grid Flexibility Potential study submitted January 31, 2025.[105] The study concluded that New York's 2040 grid flexibility potential is more than six times the State's current capability and equates to around 25 percent of the 2040 net system peak demand.

In looking at the cost, the study noted that all modeled grid flexibility options will be cost-effective by 2040 due to their value in a highly decarbonized power system. On the benefits side, the study found that by 2040, grid flexibility could avoid nearly $3 billion per year in power system costs, much of which could be used to compensate participants, with a portion retained as cost savings for all ratepayers. These benefits come in several forms, one being the distribution deferral value which is significant in locations with potential capacity constraints due to load growth. In addition, default dynamic pricing could result in 700 MW to 1,800 MW of demand reduction and provide all customers with an opportunity to save money.

The opportunities for grid flexibility come in several forms as well; for example, EV charging represents the single largest opportunity for grid flexibility, while over 200 MW of behind-the-meter battery flexibility could be unlocked in New York City when the permitting process is finalized. The report also noted that heat pump flexibility could play an important role in addressing winter resource adequacy concerns, though further technical development and experimentation are needed.

Although all New York utilities have significant grid flexibility potential, there are barriers that need to be addressed to reach the scale of grid flexibility expansion discussed in the report.

Value of Energy Efficiency and Managed Electrification Measures

Investing in energy efficiency and managed electrification measures, such as heat pump installations and building shell improvements, are important considerations to manage overall system costs, avoid capital investments in the grid, and ultimately reduce customers' monthly bills. These measures have the co-benefits of improving comfort and health at home (see the Buildings chapter of this Plan for more information).

Recommendations

- **Improve integration of flexible resources into grid planning and grid operations.** The State should continue progress through the GOTF proceeding to evaluate how aggregating DERs and VPPs can provide additional value for grid management and flexibility. Through this proceeding, the State should consider the potential role of regulation and financing mechanisms to advance the development of flexible resources.

- **Continue to evaluate the contributions of longer duration energy storage to enhance the reliability of the electric grid.** The Energy Storage Roadmap demonstrated that energy storage with a duration of eight hours or longer provides additional reliability and renewable integration value, particularly as the State gets closer to achievement of a zero-emissions electricity system. In recognition of this value for longer duration resources, the Bulk Storage Implementing Order[106] directed NYSERDA to include a 20 percent target for energy storage resources with durations of eight hours or longer. The State should continue to evaluate this target and the resulting deployment of longer-duration resources as projections for future system needs evolve in the coming years.

- **Investigate opportunities for flexible resources to provide grid-forming capabilities.** In 2023, NERC recommended that all new battery storage installations have grid-forming capabilities, which can contribute to system stability when needed by providing voltage control in response to system disturbances in a manner similar to traditional generators. The Midcontinent Independent System Operator (MISO) has recently proposed a framework that would eventually establish equipment standards for new battery storage systems in the region to be equipped with grid-forming inverters.[107] New York should continue to investigate the current capabilities of today's technologies and should consider whether a similar framework is warranted.

- **Identify opportunities to enhance energy efficiency and managed electrification measures and other building upgrades.** Energy efficiency and managed electrification are important measures to help manage overall system costs. These measures help reduce peak demand on the electric grid and will ensure that the State does not build excess capacity of renewable generation assets to meet a higher peak demand and increase the risk of those assets being underutilized. Energy efficiency and enhanced building load management can also help businesses reduce costs through energy use reduction and assist in reducing the frequency of dual-fuel fossil fuel generation facilities from having to switch to oil during periods of peak demand—thereby reducing GHG emissions. The Transportation and Buildings chapters of this Plan elaborate further on these opportunities.

- **The State needs to continue to lead the nation in energy storage safety.** Following fire incidents at energy storage facilities in Jefferson, Orange, and Suffolk Counties, Governor Hochul announced the creation of a nation-leading Inter-Agency Fire Safety Working Group in 2023 to ensure the safety and security of facilities across the state and also directed the Division of Homeland Security and Emergency Services, Office of Fire Prevention and Control, NYSERDA, DEC, DPS, and DOS to lead the Working Group to independently examine energy storage facility

fires and safety standards.[108] The Working Group gathered information from incidents and advice from experts to help prevent fires and ensure emergency responders have the necessary training and information to prepare and deploy resources in the event of a fire. Additionally, the Working Group has been collaborating with national labs and other nation-leading subject matter experts to review all existing codes and testing procedures pertinent to the development and electrification of battery energy storage systems.

NYSERDA worked with subject matter experts and a variety of interested stakeholders to provide feedback on a draft Fire Code Recommendations Report produced by the Working Group, which provided a final report to the New York State Fire Prevention and Building Code Council and DOS staff; the latter released a Notice of Proposed Rule Making in March 2025 containing proposed code language intended to reflect the recommendations.

4.3. Support Investments in New Clean Firm Technologies

The deployment of clean firm technologies will be necessary to maintain reliability as the State progresses towards its 2040 "zero emissions" target for the electric system. In October 2025, NYSERDA published the Zero by 40 Technoeconomic Assessment, which evaluates clean firm resources that could help reduce the expected gap between electricity demand and supply in 2040 and beyond. The study evaluates and compares potential resources across a number of criteria, including technological and commercial readiness, cost and performance characteristics, geographic suitability and scalability for 2040, and emissions and other considerations. It provides a resource for the State's ongoing assessment of viable clean firm technologies, to be conducted in conjunction with multiple State agencies. The key takeaways from the Zero by 40 Technoeconomic Assessment are discussed in Section 2.7.2.

The Zero by 40 Technoeconomic Assessment identifies several key actions that could facilitate the readiness of these resources to achieve the scale needed for 2040. Those recommendations are summarized below.

Recommendations

The State will need to be strategic in identifying and integrating clean firm technologies that have the attributes necessary to support a zero-emission electric grid. This includes taking the following actions in New York:

- Pursue a diverse set of resources to minimize the risk of overreliance on individual technologies.
- Start early to increase the likelihood of readiness by 2040.
- Invest in grid-enhancing technologies early to minimize the need for backstop resources.
- Invest in innovation to enhance resource viability.
- Develop strategies across industries for unlocking key resources with infrastructure hurdles.
- Engage early with technology developers, end users, and other stakeholders.
- Conduct grid modeling to understand tradeoffs of relying on different resources.

- Conduct a regular assessment of options and remain flexible as new technology options come online.

4.4. Continue to upgrade and modernize the State's transmission and distribution infrastructure

4.4.1. Key Considerations

As the energy supply portfolio changes and as electrification proceeds, New York's transmission and distribution systems will need to be modified to ensure that energy is delivered to customers across the State with high levels of reliability and resilience. Meeting that challenge will require focused long-term planning to produce cost-effective grid upgrades and expansion. New York must complete the first cycle of CGPP and consider reforms for deployment in future cycles that will support the cost-effective expansion of the system.

Recommendations

- **Continue to ensure the State's planning processes provide actionable information for decision-makers regarding future system needs and cost-effective solutions.** It is essential that electric system planning delivers sound recommendations for system investment. There are several avenues that could be explored, discussed below.

- **Continue to strengthen collaboration between NYISO and Utilities to enhance CGPP process.** The NYISO and the utilities have different but complementary roles in planning for the grid. In general, the NYISO has responsibility under its FERC tariffs for the bulk system while the utilities manage their local transmission and distribution systems. A regulatory jurisdiction-based approach risks misalignment of planning results. Rather, the roles of the utilities and the NYISO must be synchronized to ensure that transmission investments represent overall cost-effective solutions for New York ratepayers. Future cycles of the CGPP should improve the level of collaboration and exchange between NYISO and utility planners.

- **Improve coordination of distribution and transmission planning under the CGPP.** As envisioned by the PSC, the CGPP is intended to assess system needs at all levels, including distribution. The Proactive Planning proceeding focuses specifically on improvements to distribution planning. These recommendations will be passed into the CGPP as they are developed and vetted and future CGPP cycles will provide improved insight into distribution system needs.

- **Continue progress towards adoption of cost-saving advanced transmission technologies.** The State should continue to support the efforts of the Advanced Technologies Working Group and integrate effective solutions with the CGPP planning process and in rate cases. At the federal level, FERC Order 1920 imposes similar requirements on the NYISO for the consideration of ATTs alongside conventional transmission solutions. These important efforts should be harmonized and to ensure that transmission solutions are designed to capture the cost benefits of ATTs.

- **Enhance interregional coordination.** Planners should consider what potential efficiencies may be gained through enhanced interregional planning and collaboration on multi-state projects. In

the same vein, partnerships with interested federal agencies should be focused on streamlining the permitting processes for projects that have a federal component, such as offshore transmission, to reduce project risk and cost. Similarly, enhanced inter-state and federal collaboration, like the efforts of the Northeast States Collaborative on Interregional Transmission (see Section 3.7.2) could lead to proactive approaches to supply chain management.

- **Continue collaborative efforts to address distribution interconnection costs and process.** Both the costs of interconnection and the efficiency of the interconnection process are challenges to DER deployment. Most of the interconnection reforms initiated to date, including the measures described above, were developed through collaborative stakeholder processes. DPS and NYSERDA should continue their commitment to identifying solutions in these forums. In addition, DPS should consider the results of the PSC's metrics proceeding, which specifically focuses on recent cost and utility performance concerns and propose changes to solve obstacles identified there**.** [109]

- **Consider new cost allocation options for transmission and distribution system infrastructure.**

    - Transmission Cost Allocation: New York ratepayers bear the costs of both maintaining the electric transmission system and the costs of expansion of the system for both reliability and decarbonization. As the State invests in transmission build out accounting for any cost exposure to ratepayers, the State should also consider new approaches to funding and cost-allocating the infrastructure that is needed to meet climate objectives to limit increased cost to ratepayers for funding these investments.

    - Distribution Cost Allocation: The PSC, based on results of the CGPP and the Proactive Planning proceeding, should identify and consider alternative cost allocation options for funding distribution system capacity upgrades. For example, over the last few years, the PSC took action to update the rules for sharing the costs of infrastructure upgrades required to interconnect DERs, referred to as Cost Sharing 2.0. The new rules significantly reduce up-front cost to developers for all projects that share in the need for an upgrade and improve the time for upgrades to be completed.[110] In conjunction with the upcoming review of Cost Sharing 2.0, the PSC should consider whether to introduce new options for funding the distribution system expansion that is needed to support the State's goals for electrification and DERs to balance costs to developers, users, and ratepayers for funding these system investments.

- **Pursue integrated electricity and natural gas system planning.** Proactive long-term and integrated planning are needed to ensure efficient investment in the electric and natural gas systems and reduce the stranded asset risk given the projected decline in gas system usage. Longer planning horizons, closer coordination with electric utilities, prioritization of non-pipeline alternatives, and more proactive demand management, especially in extreme conditions are all needed to reduce gas system capital investment safely and strategically. Planning and investment standards need to be evaluated to ensure that they remain suitable as the climate and patterns

of consumer demand change. See the Natural Gas chapter of this Plan for more details on Integrated Electricity and Natural Gas System Planning.

- **Consider ways to coordinate transmission deployment and the strategic use of energy storage.** The State should continue to evaluate ways to further coordinate energy storage and transmission solutions through the CGPP and other planning processes. In addition, the State should support the NYISO completing its Storage as Transmission Project in 2025,[111] calling for a new Market Design allowing energy storage to meet a transmission need arising from an N-1-1 contingency event.

4.5. Evolve Electricity Markets to Meet the Future Needs of a Clean Electricity System

4.5.1. Key Considerations - Wholesale

There are currently numerous market structures and related planning processes that provide market signals related to energy, capacity, and ancillary services. However, there is a need to review and evolve current markets and rules to ensure they maintain reliability, foster energy affordability, and support the advancement of clean energy objectives.

The Climate Act targets 70 percent of electricity supply to be comprised of renewable resources by 2030, and that by 2040, electricity supply be comprised entirely of zero-emitting resources. These significant changes in the composition of electricity supply warrant consideration of how wholesale electricity energy, capacity, and ancillary service markets can attract and retain an economically efficient portfolio of resources to continue to meet all system reliability needs, particularly in 2040 and beyond.

Recommendations

- **The State should continue to work with the NYISO and market participants to further investigate the opportunities described below and any other ideas to evolve current markets and rules to ensure they maintain reliability, promote energy affordability, and achieve clean energy objectives.**

- **The State should examine what incentives are needed to attract and retain the portfolio of technologies needed to support resource adequacy as the State transitions to a zero-emissions electric system.** New York should assess whether the current NYISO capacity market construct sends the proper incentives for the portfolio of resources that will be needed in the transition and to support a reliable, fully decarbonized grid. The State should also evaluate whether/how to support a glide-path to a fully decarbonized grid, such that technologies with the attributes needed to maintain reliability in 2040 are incentivized to be online and operational in the years leading up to 2040.

- **The State should examine the potential need to identify additional market attributes, and provide the proper related incentives, to attract needed grid flexibility and other system services.** As the installed capacity in New York is increasingly comprised of intermittent and limited-duration resources, New York should evaluate incentives to ensure that the system maintains sufficient grid flexibility and other system services (i.e., from resources like energy

storage, flexible demand, dispatchable emission free resources). This can include an assessment of whether the current mix of ancillary services (and future planned changes from NYISO, i.e., Dynamic Reserves and Uncertainty Reserves) is adequate through 2040 and beyond, or whether adjustments to existing products will be needed and/or whether additional services and market products will need to be defined.

The State may also examine additional reliability attributes that are not currently compensated through competitive market products and identify a pathway for ensuring that future portfolios maintain these attributes, either through adaptation of administrative procedures and/or regulated backstops, new market products, or some combination of market and administrative mechanisms. Within the identified pathway(s), this evaluation should ensure that advanced transmission technologies can be considered and evaluated on a level playing field with generation and energy storage technologies.

- **The State should identify additional planning or operational rules that should be further examined and potentially adjusted in order to support a zero emissions electric system.** New York State should continue to identify additional planning or operational rules to support a zero emissions electric system. An example of this would be to examine the "Loss of Source" limitations that constrain the sizing of offshore wind transmission networks. Currently, grid operators in the United States typically do not allow for connection of projects of greater than 1,200 MW in New England, with slightly larger projects allowed in New York and PJM, known as the "Loss of Source" or "Single Largest Contingency" limit. As part of its involvement in the Northeast States Collaborative on Interregional Transmission, New York is evaluating modifying this "Loss of Source" limit to allow for integration of a new OSW construction technology, a 525 kV platform design. This new platform design would allow for larger wind farms (2,000–2,400 MW) reducing the number of shore crossings necessary to bring OSW onshore, thereby reducing the environmental impact of OSW projects. New York State should also address other regulatory barriers to interregional transmission as identified in the Northeast States Collaborative on Interregional Transmission Strategic Action Plan.

4.5.2. Key Considerations - Retail

Significant investments in the electricity system will be made in the coming decades, across electricity supply, demand, and transmission and distribution infrastructure. The other themes in this section discuss strategies and actions the State can take to ensure that these investments are cost-effective for existing customers. As noted, the PSC and DPS work to ensure access to safe, reliable utility service at just and reasonable rates. New York State is also advancing energy affordability through consumer protection efforts at DOS, including the Utility Intervention Unit's work to represent consumer concerns in utility rate cases, and through the PSC's EAP and EEAP and a range of State and utility-administered incentive programs that help households and businesses adopt clean energy choices.

In addition, new compensation structures and retail rates can better incentivize active participation of load in markets, including flexible resources that provide grid resiliency, improve grid reliability, and drive

down costs. It is critical that retail rates allocate costs to customers in a way that avoids an inequitable cost shift to any non-participating customers while enabling adoption of DERs.

Rates

Rate design can have a significant impact on a customer's decision to adopt a DER. DPS should ensure the efficient and effective rollout of the three-part rate design (customer charge, contract demand charge, daily as-used demand charge) adopted by the PSC under the standby rate proceeding. This includes the development and availability of tools necessary to evaluate the impact of such rates on various use cases. Evaluation of the LIPA default TOU program should be examined to determine if such an approach should be applied statewide to encourage DER deployment and usage.

DPS should continue to evaluate the VDER compensation method to ensure it accurately reflects the value provided by DERs and that it reflects the avoided costs of the local utility that is paying for the credits. This includes the setting of the DRV and LSRV using a revised methodology based on the latest marginal cost of service study.

DPS should continue to monitor current performance-based regulation rules to determine if additional EAMs or NRAs may be necessary to drive adoption of DERs and provide affordability benefits to consumers.

Incentives

Future DER program incentives should continue to be leveraged to stimulate high-benefit DER projects, including those that serve LMI and disadvantaged communities. The GOTF proceeding will be the forum for the development of additional incentive mechanisms.

Recommendations

- **Examine the role of electricity rates and program incentives to enable deployment of DERs and flexible resources.**

4.6. Increase system resilience to climate change and extreme weather

4.6.1. Key Considerations

Reliability Metrics

Establishing criteria for metrics like expected unserved energy (EUE) may help supplement traditional LOLE metrics by providing information about risks of long-duration outages. ISO-New England is currently exploring the development of a Regional Energy Shortfall Threshold to identify risks during extreme weather events, particularly over prolonged winter periods. The Electric Reliability Council of Texas has recently adopted a multi-criteria reliability standard that captures the frequency, duration, and magnitude of expected outages.

Additionally, current requirements for reducing energy shortfall risk in New York are defined administratively by the NYISO (e.g. New York City and Long Island's fuel oil requirements[7]). Supplemental criteria for metrics like EUE could be used to determine whether the same level of reliability is maintained even as those specific requirements may be adjusted as the resource mix evolves. Fuel availability will also be incorporated into the NYISO's capacity accreditation framework in future cycles.

Capacity accreditation aligns capacity market compensation and participation eligibility with regional marginal contribution to specific reliability needs based on the performance and availability of resources.

Utility Climate Change Vulnerability Studies

As discussed in Section 3.7.3, the utilities are required to file CCRPs and CCVSs with the PSC. The CCRPs and CCVSs include planning scenarios to inform resilience investments and assessments to map climate exposure and vulnerabilities to different hazards. DPS will continue to work closely with the utilities to evaluate performance and periodically update their plans, and the CCRPs and CCVSs will continue to be considered by the PSC to determine the necessary investments needed to enhance electric system resiliency.

Recommendations

- **Consider whether the current reliability-related metrics should be supplemented given the evolving nature of the grid and increased risks of high-impact reliability events.** New York should consider whether the current reliability-related metrics (i.e. LOLE) should be supplemented given the evolving nature of the grid and the increased risks of high-impact reliability events. Establishing criteria for metrics like expected unserved energy may help supplement traditional LOLE-based criteria by providing information about risks of long-duration outages. As fuel availability will be incorporated into the NYISO's capacity accreditation framework, additional consideration should be given to whether this adjustment to capacity accreditation provides sufficient incentives and compensation to resources for attributes needed to ensure energy adequacy and resilience to extreme weather events from both a planning and operational perspective (e.g., compensation for fuel storage capabilities).
- **Continue to incorporate the impacts of climate change into future planning scenarios.** The Reliability Needs Assessment is already moving towards a scenario-based approach to reliability planning and contains an analysis of higher and lower demand scenarios for informative purposes. However, climate-driven changes in demand are not currently incorporated into these scenarios and could potentially be an additional layer to these scenarios in the future. For example, if temperatures continue to rise, that could put additional upward pressure on summer peak demand, which could lead to additional reliability challenges or an identified shortfall materializing more quickly than projected. The State should continue to pursue the incorporation of the impacts of climate change into future scenario planning to ensure that investments in energy system infrastructure are robust to a broad range of plausible futures.

[1] New York Independent System Operator (NYISO) Comprehensive Reliability Plan. 2023. https://www.nyiso.com/documents/20142/2248481/2023-2032-Comprehensive-Reliability-Plan.pdf

[2] U.S. Energy Information Administration (EIA). "Sales and direct use of electricity to ultimate customers by sector, by provider, 2014 through 2024 (megawatt hours)," accessed November 21, 2025. https://www.eia.gov/electricity/annual/html/epa_02_02.html.

[3] NYISO 2025 Load & Capacity Data Report. 2025 https://www.nyiso.com/documents/20142/2226333/2025-Gold-Book-Public.pdf

[4] North American Energy Standards Board Wholesale Electric Industry Glossary.

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[6] The capacity factor is a measure of how much a power plant actually generates electricity compared to its maximum potential output.

[7] NYISO 2025 Power Trends Report. 2025. https://www.nyiso.com/power-trends.

[8] NYISO Power Trends Reports, 2016–2024. Note that the solar generation shown in Figure 10 refers only to utility-scale solar photovoltaics (UPV), and not behind-the-meter solar

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[13] Ibid.

[14] The reliability of the electric distribution system is measured based on power interruptions that last longer than five minutes. The EIA maintains data on metrics that include the System Average-Interruption Frequency Index, measuring the number of electric interruptions per year the average customer experienced, and the System Average Interruption Duration Index, measuring the number of minutes of interruptions that the average customer experienced. Major storms are excluded from the data cited because a utility's control is more limited over severe weather.

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[19] Case 22-M-0149, Proceeding on Motion of the Commission Assessing Implementation of and Compliance with the Requirements and Targets of the Climate Leadership and Community Protection Act (Climate Act), Second Informational Report on Overall Implementation of the CLCPA (filed September 18, 2025).

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[21] Case 14-M-0565, Proceeding on Motion of the Commission to Examine Programs to Address Energy Affordability for Low Income Utility Customers, Order Approving Energy Affordability Guarantee Pilot (issued and effective August 15, 2024).

[22] Case 23-M-0298, In the Matter of Budget Appropriations to Enhance Energy Affordability Programs, Case 14-M-0565, Proceeding on Motion of the Commission to Examine Programs to Address Energy Affordability for Low Income Utility Customers, Order Authorizing Energy Bill Credit (issued and effective: February 15, 2024).

[23] Case 14-M-0565, Proceeding on Motion of the Commission to Examine Programs to Address Energy Affordability for Low Income Utility Customers; Case 23-M-0298, In the Matter of Budget Appropriations to Enhance Energy Affordability Programs, Order on Procedures for Implementing Enhanced Energy Affordability Program (issued and effective September 19, 2025).

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[62] Brattle Group. New York's Grid Flexibility Potential - Volume I: Summary Report, available at: https://www.brattle.com/wp-content/uploads/2025/02/New-Yorks-Grid-Flexibility-Potential-Volume-I-Summary-Report.pdf

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[68] Case 91-M-0744, Proceeding on Motion of the Commission to Examine the Collection Practices of the Major Gas and Electric Utilities in New York State to Identify Ways to Reduce Losses Due to Uncollectibles While Maintaining a High Level of Customer Service.

[69] PSL §43.

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[71] RGGI, Inc. "Emissions," accessed November 2025. https://www.rggi.org/allowance-tracking/emissions

[72] RGGI, Inc., "RGGI states announce results of third program review," July 3, 2025, https://www.rggi.org/sites/default/files/Uploads/Press-Releases/Press_Release_Program_Review_Announcement.pdf.

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[74] DEC. 2025 Statewide GHG Emissions Report. https://dec.ny.gov/environmental-protection/climate-change/greenhouse-gas-emissions-report#Report.

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[81] Bureau of Ocean Energy Management. "New York Bight," accessed July 2, 2025, https://www.boem.gov/renewable-energy/state-activities/new-york-bight.

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[98] Case 15-E-0302, Proceeding on Motion of the Commission to Implement a Large-Scale Renewable Program and a Clean Energy Standard, Order Adopting Clean Energy Standard Biennial Review as Final and Making Other Findings (issued May 15, 2025).

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[111] Katherine Zeollmer. NYISO. "Storage as Transmission" presentation, May 20, 2025, available at: https://www.nyiso.com/documents/20142/51501157/Storage%20as%20Transmission%20052025%20icap.pdf/03ddda46-18a4-bf92-d04e-5191d17771bc.

New York State Energy Plan

VOLUME II | Our Energy Systems

Nuclear

02

2025 NEW YORK STATE ENERGY PLAN

Key Terms Used in This Chapter

FOR THE COMPLETE GLOSSARY ➜

Light Water Reactors (LWRs): A term used to describe reactors using ordinary water as a moderated coolant.[1]

Small Modular Reactors (SMRs): Smaller, more advanced nuclear reactors using either water or non-water coolants and which offer improved sustainability, safety, and proliferation, along with a lower overall investment.

Nuclear Generations: Nuclear technology discussions often refer to "generations" of nuclear designs, with current operating large LWRs referred to as "Gen II" or "Gen III." Newer advanced technologies are categorized as either "Gen III+," defined as large or small modular light water reactors that offer improved economics and safety over conventional large light water reactors, or "Gen IV," defined as small modular reactors or microreactors that use non-water coolants and offer improved sustainability, safety, and proliferation, along with a lower overall investment. Gen IV technologies include high temperature gas reactors, liquid sodium metal reactors, and molten salt reactors.

Megawatt Electrical (MWe): The electric output capability of the nuclear power plant.

Decommissioning: The radiological clean-up and dismantling of a nuclear facility has four basic aspects: radiological cleanup and removal, fuel storage, non-radiological cleanup and removal, and site restoration.

1 U.S. Nuclear Regulatory Commission (NRC). Glossary. https://www.nrc.gov/reading-rm/basic-ref/glossary.html#S

Key Findings → Nuclear

Nuclear power plants have provided reliable and zero-emission electricity in New York for decades. Nuclear energy is entering a new phase of technological advancement and deployment opportunities—with performance characteristics that align with the scale of emerging energy needs.

The State's current nuclear facilities are supported, in part, by the Zero Emission Credit (ZEC) program. Nuclear energy is expected to continue to play an important role in providing clean firm generation. Advanced nuclear technologies are rapidly emerging with significant improvements in modularity, scale, and safety. However, many of these technologies still face barriers, including a need for real-world deployment experience, resulting in uncertainty in costs and timeline. This chapter provides an overview of the State's operating nuclear power plants and opportunities for new advanced nuclear, outlines current regulations and major initiatives underway, and recommends continued and additional actions.

- **The State should evaluate the extension of the ZEC program prior to any federal relicensing application deadlines** to ensure the continued operation of the existing nuclear fleet to help meet State climate goals as well as maintain fuel diversity and fuel security. Any extension should be done with ratepayer protection in mind, in addition to the reliability needs of the grid.

- **Through its Master Plan for Responsible Advanced Nuclear Development (Master Plan), the State should continue to examine key considerations for advanced nuclear for long-term planning.** Advanced nuclear technologies present themselves as a potentially important opportunity to help address the needs of expected load growth, achieve a zero-emissions grid, and unlock further economic development opportunities in New York. The State should proceed with the development of the Master Plan, which has been underway since January 2025. The Master Plan process should examine the key issues raised by the January 2025 Blueprint for Consideration of Advanced Nuclear Technologies and develop recommendations for the implementation of advanced nuclear technologies in New York State.

- **Through its leadership of the First Movers Initiative and other initiatives, the State should continue to pursue multi-state collaborations in moving project development forward.** To achieve economies of scale and de-risk new nuclear development, collaborating with other states can help build out an advanced nuclear reactor orderbook, supply chains for construction of new reactors, and a trained workforce for construction and plant operations, among others. The State should continue to engage on a multi-state level through the National Association of State Energy Officials (NASEO)/Gateway for Accelerated Innovation in Nuclear (GAIN) First Movers Initiative.

- **Through NYPA's efforts to develop at least 1 gigawatt (GW) of nuclear power generation and other actions, the State should continue to pursue opportunities for early deployment action.** The State's zero-emissions by 2040 target is urgent, especially when viewed relative to the long development timelines of nuclear projects. Early development efforts are therefore important. The State is already undertaking examples of such early deployment action through NYPA's role to develop 1 GW of advanced nuclear power generation as per Governor Hochul's direction in June 2025 and the New York State Energy Research and Development Authority's (NYSERDA) support for an early site permitting funding application by Constellation. Early development efforts should be undertaken in coordination with the Master Plan process and reflect collaboration with other states to ensure that any deployment commitments leverage the insights and benefits from those initiatives.

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1. Overview

Nuclear power plants have provided reliable and zero-emission electricity in New York for decades. The current nuclear facilities are supported, in part, by the Zero Emission Credit (ZEC) program. Nuclear energy is expected to continue to play an important role in providing clean firm generation. Advanced nuclear technologies are rapidly emerging with significant improvements in modularity, scale, and safety. However, many of these technologies still need significant research, development, and real-world deployment experience, resulting in uncertainty in costs and timeline.

1.1. Commercial Nuclear Power in New York

There are currently four operating commercial nuclear power plants in New York State – James A. FitzPatrick (FitzPatrick), R.E. Ginna (Ginna), Nine Mile Point Unit 1, and Nine Mile Point Unit 2. Together, these plants generate 3.3 gigawatts (GW) of electricity, representing 21 percent of New York's total electricity and over 27 million megawatt-hours of emissions-free electricity per year. These upstate New York plants provide 2,100 direct jobs during normal operations, 3,000 supplemental jobs during refueling outages, and have an indirect/ancillary/net employment impact of 25,000 jobs.[1] The plants contribute significant economic benefits to their local communities through the tax base, permanent jobs, and the influx of traveling workers during refueling outages.

Regulation and oversight of nuclear power plants primarily rest with the federal government. The U.S. Nuclear Regulatory Commission (NRC) regulates the construction, operation, and decommissioning of all commercial nuclear power plants in the United States and has jurisdiction over nuclear safety and security. The Federal Energy Management Agency (FEMA) provides state and local agencies with relevant and executable radiological emergency preparedness (REP) planning, training, and exercise guidance. In addition to the federal government, New York State also plays a significant role. NYSERDA serves as the State's nuclear coordinator and central liaison to the NRC; the New York State Department of Public Service (DPS) maintains lightened regulation over the plants; the New York State Department of Environmental Conservation (DEC) is the lead agency for environmental permitting, environmental contamination, and radiological emergency recovery; the New York State Department of Health (DOH) is the lead agency for public health issues and radiological emergency response; the New York State Division of Homeland Security and Emergency Services is the lead agency for emergency preparedness and security; and the New York State Department of State administers regulatory review programs for coastal and inland waterways.

1.2. Advanced Nuclear Technologies

While there has been minimal deployment of new nuclear generation over the past decades, both in the U.S. and globally, interest has markedly increased in recent years driven largely by current and expected load growth. Today's nuclear fleet in New York State consists entirely of large light water reactors (LWRs). New nuclear development is predominantly focused on a new generation of advanced nuclear technologies that are characterized by enhanced design, operational, and safety features.

Nuclear technology discussions often refer to "generations" of nuclear designs, with current operating large LWRs referred to as "Gen II" or "Gen III." Newer advanced technologies are categorized as either

"Gen III+," defined as large or small modular LWRs that offer improved economics and safety over conventional large LWRs, or "Gen IV," defined as small modular reactors (SMRs) or microreactors that use non-water coolants and offer improved sustainability, safety, and proliferation, along with a lower overall investment. Gen IV technologies include high-temperature gas reactors, liquid sodium metal reactors, and molten salt reactors. Large-scale reactors produce greater than 300 megawatts (MW), SMRs are typically designed to produce between 51 and 300 MW, and microreactors produce 1 to 50 MW. The small size of SMRs and microreactors may make them suitable for use in remote locations and behind-the-meter applications.

Beyond providing firm electric energy and capacity, advanced nuclear plants have a wide variety of applications, including waste heat that could be used for district heating. Some advanced nuclear reactors, such as high-temperature gas reactors, could supply high-quality heat for industries—including chemical manufacturing, steel production, hydrogen production, and other high-energy-demand sectors that are difficult to electrify. Hydrogen production, in particular, is a promising application for all types of advanced nuclear, with one white paper indicating that four different advanced reactor designs could produce hydrogen through high-temperature steam electrolysis.[2]

All nuclear reactors are required to incorporate safety systems that can control the fission reaction in the event of irregular operating conditions, ensure the adequate cooling of fuel, and prevent the release of radioactivity into the environment. Advanced reactors offer the potential for safer designs that incorporate passive safety features to shut the reactor down safely without the need for operators to take manual action after the loss of electrical power or reactor coolant, or another malfunction.[3] Rather than relying on human intervention and mechanical pumps and other devices, these systems employ the natural laws of physics to function, using convection and gravity to relieve pressure and lower temperature.

1.3. Planning for Advanced Nuclear in New York

Within the context of expected load growth, decarbonization goals, and a continued focus on unlocking economic development opportunities, New York State is in the process of developing a Master Plan for Responsible Advanced Nuclear Development in New York (the "Master Plan"). In January 2025, NYSERDA published a Blueprint for Consideration of Advanced Nuclear Energy Technologies (the "Blueprint") that sets out the scope of issues to be considered throughout the Master Plan process.[4] The development of the Master Plan will provide a framework for in-depth examination of the key issues raised by the Blueprint and develop recommendations for the implementation of advanced nuclear technologies in New York State. In June 2025, Governor Hochul called upon the New York Power Authority (NYPA) to develop at least 1 GW of zero-emission advanced nuclear power in Upstate New York to support a reliable and affordable electric grid. In addition, New York is co-leading the multi-state "First Movers Initiative," started earlier this year with ten other states, to help explore opportunities for cooperation and risk-sharing on advanced nuclear development. These efforts are expanded upon later in this chapter.

2. State of the Sector

This section provides an overview of the existing nuclear fleet in New York State and the ZEC program that supports the ongoing operation of these facilities. Current regulations pertaining to emergency preparedness, security, plant decommissioning, and waste management at existing nuclear plants are discussed, as well as opportunities for hydrogen production and workforce development to support the existing fleet.

2.1. Existing Nuclear in New York

As an emissions-free source of baseload electric power, New York's current nuclear power plants continue to play an important role both in the ongoing process to decarbonize New York's electricity supply and in maintaining grid stability. New York State's nuclear plants were responsible for 22.2 percent of energy production statewide as reported in November 2024, a drop from 34 percent in 2019 following the closure of the Indian Point nuclear power plant. In addition to diversifying the State's fuel portfolio, these nuclear plants also hold the highest capacity factor (98.1 percent in 2024) when compared to all other power generation in the state.

There are four operating nuclear power plants in New York State today: Nine Mile Point Units 1 and 2, FitzPatrick, and Ginna. Table 1 provides a summary of basic information about the plants. Indian Point Unit 1 operated from 1962 until 1974, when it was permanently shut down, and Indian Point Units 2 and 3 operated until 2020 and 2021, respectively.

Table 1: Operating Nuclear Power Plants in New York State

Source: Nuclear Energy Institute[5]

Plant	Operator	Location	Size / Capacity Factor	License Expiration	License Renewal Application Deadline
FitzPatrick	Constellation Energy Generation, LLC	Town of Scriba, Oswego County	831 MWe 96.4%	Oct 2034	Oct 2029
Ginna	Ginna Nuclear Power Plant, LLC (Constellation)	Town of Ontario, Wayne County	580 MWe 94.5%	Sept 2029	Sept 2026
Nine Mile Point Unit 1	Nine Mile Point Nuclear Station, LLC (Constellation)	Town of Scriba, Oswego County	621 MWe 91.9%	Aug 2029	Aug 2026
Nine Mile Point Unit 2	Nine Mile Point Nuclear Station, LLC (Constellation)	Town of Scriba, Oswego County	1,272 MWe 98.1%	Oct 2046	Oct 2041

2.2. Zero Emission Credit Program

New York State supports existing nuclear facilities through the ZEC program. Established in the Order Adopting a Clean Energy Standard in 2016, this program provides a credit to existing nuclear facilities for their zero-emissions environmental attributes to enable their continued operation.[6] The credit, set by the Public Service Commission (PSC), is based on the difference between the social cost of carbon and electricity prices. New York's investor-owned utilities and other energy suppliers (collectively, "Load Serving Entities," or LSEs) must purchase the percentage of ZECs that represents the portion of the electric energy load served by the LSE in that year. LSEs make ZEC purchases by contract with NYSERDA

and recover the costs from ratepayers through commodity charges on customer bills. The PSC deemed the ZEC program as the best way for the State to preserve the nuclear facilities' environmental attributes while staying within the State's jurisdictional boundaries. The ZEC program expires in March 2029.

Consideration of the future of the ZEC program is underway in the PSC's Clean Energy Standard proceeding. DPS Staff released the Zero-Emissions Credit Program Extension Proposal (White Paper) on July 31, 2025 that evaluates how any continuation of the ZEC program should be structured.[7] The White Paper proposes the continuation of the ZEC program from 2029 to 2049 to enable the existing nuclear fleet to operate through the full subsequent license renewal period for Ginna and Nine Mile Point Unit 1. The White Paper also proposes the continuation of the current ZEC formula and cost recovery methodology with some updates to the inputs used to determine the ZEC for each tranche. As part of the proceeding, DPS issued the Draft Supplemental Generic Environmental Impact Statement for Zero-Emissions Credit Program Extension in September 2025 for public comment.[8]

2.3. Hydrogen Production

As one example of potential nuclear applications beyond power generation, New York is already demonstrating that nuclear power can produce clean hydrogen. Nine Mile Point Nuclear Station began producing hydrogen in March 2023 as a demonstration project supported by the U.S. Department of Energy (DOE).[9] The hydrogen, produced using a proton exchange membrane electrolyzer, is currently being used within the facility for existing operational needs. Furthermore, NYSERDA awarded a grant to Nine Mile Point to help demonstrate long-duration energy storage using a hydrogen-powered fuel cell.[10] There are a further three nuclear power plants in the United States that are also demonstrating hydrogen production.[11]

2.4. Workforce Development

New York's existing nuclear power plants require a trained workforce across their operational lifecycle. The workforce would need to grow further in case of new advanced nuclear power development, both for construction and operation. University programs are a key component in nuclear workforce development. NYSERDA is supporting federal grant applications by Rensselaer Polytechnic Institute (RPI) for ongoing development of nuclear power operations education, nuclear safety training, and other nuclear workforce development programs in New York. RPI is home to a new reactor operations simulator and digital control room that is unique to universities in the Northeast region.

2.5. Emergency Preparedness

New York State maintains emergency management plans for all hazards and specific plans for radiological hazards; both types of plans are relevant to nuclear power. New York law requires the State to develop a Comprehensive Emergency Management Plan (CEMP) (see NYS Executive Law, Article 2-b, Section 22), which includes a base plan that identifies the all-hazards preparedness, response, and recovery activities of the State. The CEMP is supplemented by numerous performance-based, functional, and hazard-specific annexes that provide multi-agency response activities to employ specific functions, respond to risks, and deliver a broad array of capabilities. The CEMP is developed in coordination with agencies that comprise the State Disaster Preparedness Commission. Each of the plans that fall under

the CEMP are implemented in a targeted, multi-agency approach that leverages the full capabilities of the State. The CEMP is updated at least once per year and is tested with a greater frequency via exercises and real-world events.

In addition to the all-hazards CEMP, New York State has additional regulations specifically to protect its citizens from ionizing radiation. DOH is the designated State agency of primary responsibility for radiation (New York State Public Health Law Sections 201, 206).

NYS Executive Law, Article 2-b outlines State requirements specific to REP. The law provides that counties are the first line of defense in handling emergencies and are subject to an assumption of responsibility by the State pursuant to a State Declaration of Disaster Emergency (see Executive Law, Section 24).

FEMA maintains the REP Program Manual, a living, non-binding guidance document for offsite response organizations that incorporates required federal regulatory elements and interprets planning standards and criteria contained in NUREG-0654-FEMA-REP-I: "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Fixed Nuclear Facilities." The current REP Program Manual is dated December 2023.[12]

New York State Executive Law, Article 2-b, Section 29-c specifically focuses on radiological preparedness in the context of State and local disaster preparedness. It requires any NRC licensee of a nuclear electric generating facility to be liable for an annual fee to support State and local governmental responsibilities under accepted REP plans related to the facility operated by such licensee. These fees are directed for the purchase, installation, maintenance, and operation of equipment used by State and local governments to monitor and record the potential and actual presence of radioactive materials within the appropriate planning radius from a nuclear electric generating facility; the purchase, storage, and distribution by the State of equipment, drugs, or other material for the purpose of protecting public health and safety; and for personal services, administrative costs, and contractual services. Additionally, the fee provides for emergency services personnel training and supports the development, exercise, and implementation of emergency preparedness and response plans.

Local government planning is based on the principle that all emergencies start and end locally. As such, local planning efforts include a variety of activities specifically designed and implemented to protect citizens from radiation exposure. These activities include establishing reception centers, school reception centers, personnel monitoring centers, evacuation planning methodologies, and a robust (pre-event) public information campaign. These centers and activities are managed through a pre-identified command and control structure established at the county-level of government. New York State Executive Law, Article 2-b, Section 23 requires that all counties in the State also possess a CEMP (described above) that includes the basic tenets for how they will prepare for, respond to, and recover from an emergency within their jurisdiction. The number and type of hazard-specific annexes each county's CEMP varies across the state depending upon their risks and the evolution of their planning programs.

2.6. Security

The cyber and physical security of New York's nuclear power plants are regulated by the NRC. Specifically, Title 10 of the NRC Code of Federal Regulations (10 CFR), Part 73—"Physical Protection of

Plants and Materials"—establishes an exhaustive list of standards for physical and cyber security at nuclear plants.

NRC regulations are enforced by four regional offices, with New York falling under the jurisdiction of Region I. Employees from these regional offices conduct oversight of plant security through in-depth, well-documented facility inspections as part of the NRC's Reactor Oversight Process (ROP). The ROP requires inspectors to conduct quarterly plant assessments based on inspection findings and performance indicators. If the NRC finds a nuclear power plant is noncompliant with mandatory standards, it may issue a Notice of Violation to the plant and can impose civil penalties as outlined in Section 234 of the Atomic Energy Act of 1954, as amended.

The NRC completes annual performance assessments, and every six months, each plant receives either a mid-cycle review letter or an annual assessment letter along with an NRC inspection plan. The NRC evaluates plant performance by analyzing two distinct inputs: inspection findings from the NRC's inspection program and performance indicators reported by the licensee.

2.7. Waste Management

The operation of commercial nuclear power plants results in the generation of high-level nuclear waste, known as spent nuclear fuel (SNF), and low-level radioactive waste. Waste generated by nuclear fission remains radioactive for many years after it is produced, with some elements remaining radioactive for thousands of years. Proper handling, storage, and disposal are critical to ensuring public safety.

Currently, nearly all SNF from New York nuclear plants is managed on-site at the generation facility, in the form of solid spent fuel rods stored in deep pools of water for approximately 10 years after generation, and then placed in steel-lined concrete casks on the reactor site. While on-site storage is intended to be temporary (the NRC licenses on-site storage in pools and dry casks for 120 years from the plant's initial startup), there are no available permanent disposal sites in the United States, and virtually all nuclear fuel used for electricity generation still sits at the facilities where it was generated. The dry cask model has been successful in preventing waste leakage; the NRC reports that, nationwide, dry cask storage has released no radiation that affected the public or contaminated the environment.[13] Yet, as dry casks approach their maximum licensing period, the risks of their failure increase. The federal government has paid over $7 billion to nuclear utilities and reactor owners in legal settlements for failing to take possession of their fuel waste and, therefore, requiring owners to continue to store the spent fuel on-site.

Waste remains on-site at more than a hundred reactor sites across the nation, including the four active New York State facilities, the Indian Point decommissioning site, and the Western New York Nuclear Service Center (West Valley), with no pathway for ultimate disposal. Nonetheless, nuclear waste volumes are currently small compared to waste from other industries.

- Nuclear power contributes less than 0.5 percent of the total hazardous waste shipped annually in the United States.[14]

- The U.S. generates 2,000 metric tons of SNF per year, less than half the volume of an Olympic-sized swimming pool.[15]
- Since the 1950s, the United States has accumulated 90,000 metric tons of SNF, which could fit on a football field at a depth of less than 10 yards.[16]
- A 1,000-megawatt electrical (MWe) nuclear reactor produces about 3 cubic meters of high-level waste annually, whereas a similarly sized coal plant produces 300,000 metric tons of hazardous coal ash each year.[17]

While the DOE is the federal agency with ultimate responsibility for spent fuel disposal, and it has begun a consent-based siting process to identify one or more federal consolidated interim storage facilities for the nation's SNF, it is constructive for New York to continue to advocate for appropriate long-term disposal options for nuclear waste.[18]

2.8. Decommissioning

Decommissioning, the radiological clean-up and dismantling of a nuclear facility, has four basic aspects: radiological cleanup and removal, fuel storage, non-radiological cleanup and removal, and site restoration. Given the complexities inherent in safely and efficiently decommissioning nuclear reactors, multiple state and federal agencies possess regulatory authority over nuclear facilities.

In recent years and through PSC proceedings and orders, New York State has worked to promote and advance the public interest by gaining decommissioning assurances from nuclear plant owners. These include, among others, requiring significant financial assurance and financial reporting to the State, confirming site restoration commitments as well as State cleanup standards for residual radiation, and increasing the notice time for potential closures, providing for prompt and comprehensive decommissioning and restoration of the New York sites.[19]

Through the ongoing decommissioning of the Indian Point site, which began in 2021, New York has worked to identify and fill regulatory gaps. For example, when NRC no longer stationed resident inspectors at the decommissioned site, New York State hired its own inspector to report to Indian Point daily and provide a regulatory, boots-on-the-ground presence during active decommissioning. In addition, New York's Indian Point Decommissioning Oversight Board (DOB) advises on and assesses the decommissioning of the Indian Point nuclear power plant. The DOB's primary goals are to advocate for the protection of the financial, environmental, and physical interests of the communities affected by the decommissioning, as well as the interests of the current workforce. These examples are further supplemented by the Joint Proposal signed by DPS staff, NYSERDA, DEC, the Office of the Attorney General of New York, local governments, Holtec Decommissioning International, and others to ensure that the public's interests are protected during decommissioning of the site.[20]

3. Outlook (2025 – 2040)

This section provides an outlook for nuclear power in New York State over the next 15 years. The section first considers opportunities for new advanced nuclear to help the State meet its increasing electricity demand and Climate Act targets. Next, the section outlines several relevant considerations for the

development of new nuclear, including recent federal investments; regulatory requirements for new reactors; and opportunities for collaboration with the federal government, states, and industry to de-risk investments and share knowledge.

3.1. The Opportunity for New Advanced Nuclear

New York is expected to experience a significant increase in demand over the next decade, driven by both electrification and the interconnection of new large loads. These large loads include data centers, semiconductor manufacturing plants, and green hydrogen production plants. Concurrent with this increase in electric demand, analyses have identified a need for dispatchable, emissions-free resource capacity—in addition to the State's existing hydroelectric and nuclear facilities—to maintain system reliability while achieving a 100 percent zero-emissions grid. These resources are particularly needed during prolonged periods of low renewable output, when short-duration storage resources can be quickly depleted. The Electric chapter of this Plan further describes the various scenarios for how the electric grid may evolve over the next 15 years, based on assumptions related to future electricity demand and insights into the current and emerging resources that may be deployed to meet the anticipated demand.

As discussed in the Electricity chapter of this Plan, the PSC is currently considering the full range of technologies that can contribute to the zero emissions by 2040 target including advanced nuclear energy, with a view to determining appropriate actions.[21] As part of the PSC's process, NYSERDA released the Zero by 40 Technoeconomic Assessment (the Assessment) in October 2025. The Assessment evaluated seven dispatchable, emissions-free resources, including advanced nuclear, and analyzed each resource's performance attributes, readiness for 2040, emissions, costs, and other considerations.[22]

The Assessment examined three main reactor categories characterized by coolant type, fuel, moderator, and size: large LWRs, light water small modular reactors (lwSMRs), and non-water-cooled reactors. The Assessment found that advanced nuclear reactors can contribute essential zero-emission capacity and grid services to support a decarbonized grid and that advanced nuclear technologies have advantages in their high energy density, economic and workforce development opportunities, and lack of greenhouse gas emissions and co-pollutants. However, new advanced nuclear deployment also faces challenges such as long lead times and uncertain costs. Large LWRs are at a higher readiness level and are expected to be cheaper per kilowatt in the near future compared to SMRs. However, a new project could take 10–12 years to deploy, underscoring the importance of early planning. To date, lwSMRs and non-water-cooled reactors have only been deployed in limited examples outside the U.S. In the long run, lwSMRs and non-water-cooled reactors are expected to have shorter project lead times, greater siting flexibility, and lower overall investment costs with potential long-term cost reductions. But the magnitude of project lead time and cost savings is uncertain and attention to development strategies would be needed for timely deployment by 2040.

Historically, large LWRs have performed the role of providing reliable, grid-tied, baseload power rather than load-following due to high capital-to-operating cost ratios and current market and regulatory paradigms.[23] While emerging lwSMRs and non-water-cooled reactors could offer greater potential to load-follow and provide select other grid services, regulatory and market changes would be needed to

fully realize these capabilities. The primary drivers for deploying grid-tied advanced nuclear reactors are replacing fossil-fuel baseload generation with clean, firm power and meeting load growth.

The updated Final Pathways analysis incorporates the 1 GW NYPA nuclear directive[24] and allows additional new nuclear within build limits by 2040 (see Pathways chapter for a description of model scenarios and assumptions). The updated analysis indicates that, alongside renewables and storage, new nuclear can be an attractive solution to support a zero-emission electric grid, as needed, accompanied by additional transmission to deliver part of its power to meet downstate load. The analysis includes a range of 2.2–3.3 GW of new nuclear by 2040 in two variants of the Additional Action case. The availability of nuclear helps to lower system costs compared to a sensitivity where no new nuclear is available. Given the uncertainty about how much new nuclear and additional transmission could be built by 2040, pursuing a diverse mix of zero-emission resources minimizes the risk of overreliance on individual technologies.

In addition to providing baseload power, nuclear energy provides an opportunity to meet the rising power needs from large industrial loads. In addition, microreactors (<50 MWe) could replace high-emitting energy sources, like diesel engines, in smaller off-grid applications, including in remote communities or for specific commercial or industrial operations. Advanced nuclear could also support non-power applications. Buildings, transportation, and industry consume significant thermal energy. Non-water-cooled reactors, capable of reaching 800°C, could support industrial process heat, petrochemicals, and low-carbon hydrogen production.[25] However, the suitability of advanced nuclear reactors for these applications depends on the required temperatures and co-location feasibility, as heat cannot be transported across long distances. Siting near industrial facilities poses safety and regulatory challenges, especially if hazardous materials are involved.[26] These factors create additional hurdles related to siting, emergency planning, and regulatory approvals. While non-power applications present additional revenue and deployment opportunities, they are not the focus of this chapter.

Nationally, there is increased commercial activity around both existing and new advanced nuclear. For example, Google has inked advanced nuclear and fusion deals with Kairos, [27] Elementl Power,[28] and Commonwealth Fusion Systems.[29] Amazon has agreed to develop 5 GW of X-Energy SMRs, starting with an initial four-unit plant with Energy Northwest.[30] Two data center operators, Equinix and Oracle, have also reached development agreements with SMR vendors.[31] Meta has released a request for proposals to help it develop 1–4 GW of nuclear generation by the early 2030s, indicating that it is exploring both conventional-scale and SMR projects.[32] Regarding existing plants, Constellation has an agreement with Meta for the offtake of Clinton Clean Energy Center's full output, which will enable its continued operation through the subsequent license renewal,[33] and Amazon Web Services' data centers have signed a power purchase agreement for energy from the Susquehanna nuclear plant.[34] Several decommissioned nuclear plants nationally are undergoing restarts, including the Palisades Energy plant owned by Holtec,[35] Three Mile Island Unit 1 as part of a deal between Constellation and Microsoft,[36] and the Duane Arnold Energy Center is part of a deal between NextEra and Google.[37]

3.2. Federal Investments in Nuclear

There has been significant federal activity in support of existing and new nuclear energy in recent years. The Infrastructure Investment and Jobs Act appropriated $2.477 billion for the DOE's Advanced Reactor

Demonstration Program. Tax credits for new and existing nuclear facilities were also included in the Inflation Reduction Act (IRA). Existing facilities—those that began supplying electricity to customers before August 16, 2022—are eligible for the Zero-Emission Nuclear Power Production Credit (45U). Assuming prevailing wage and apprenticeship (PWA) requirements are met, the value of the credit is 1.5 cents per kilowatt-hour (kWh). This credit can be reduced depending on the market price of electricity, state and local subsidies, or failure to comply with PWA requirements. New nuclear facilities—those placed in service after December 31, 2024—are eligible for either the Clean Electricity Production Tax Credit (45Y), a 10-year credit of up to 1.5 cents/kWh if PWA requirements are met, or the Clean Electricity Investment Tax Credit (48E) valued at 30 percent if PWA requirements are met. Facilities claiming 45Y or 48E may also be eligible for the Domestic Content Bonus and Energy Communities Bonus. For nuclear energy, these tax credits were broadly maintained in the 2025 budget reconciliation bill with a new bonus of 10 percent for advanced nuclear facilities claiming 45Y and located in "nuclear communities." These federal tax credits can result in significant utility bill savings for New York consumers by reducing the amount of ratepayer funding needed to support the continued operation of the existing nuclear facilities.[38]

The IRA also included $700 million for the DOE to develop supplies of high-assay low-enriched uranium (HALEU) needed for some advanced reactor designs. The Accelerating Deployment of Versatile, Advanced Nuclear for Clean Energy Act of 2024 (ADVANCE Act) included provisions on advanced reactor licensing reviews, licensing of nuclear non-electric applications, fusion energy regulation, demonstration of advanced reactors at DOE sites, regulatory requirements for microreactors, and NRC efficiency. Additionally, the Price-Anderson Act, under which the NRC indemnifies new reactors against damage to the public caused by major accidents, was extended through the end of 2065.

In addition to federal legislation, the current federal administration issued several executive orders in May 2025 targeting nuclear energy development and nuclear energy programs at the NRC, DOE, and the U.S. Department of Defense.[39] Most recently, the U.S. Department of Commerce and Westinghouse and its parent companies, Brookfield and Cameco, announced a federal investment in Westinghouse to enable supply chain development and deployment of the Westinghouse AP1000 and AP300 reactor design.[40] The U.S. Army also announced a plan to supply military bases with microreactors.[41]

3.3. Regulatory Framework for New Reactors

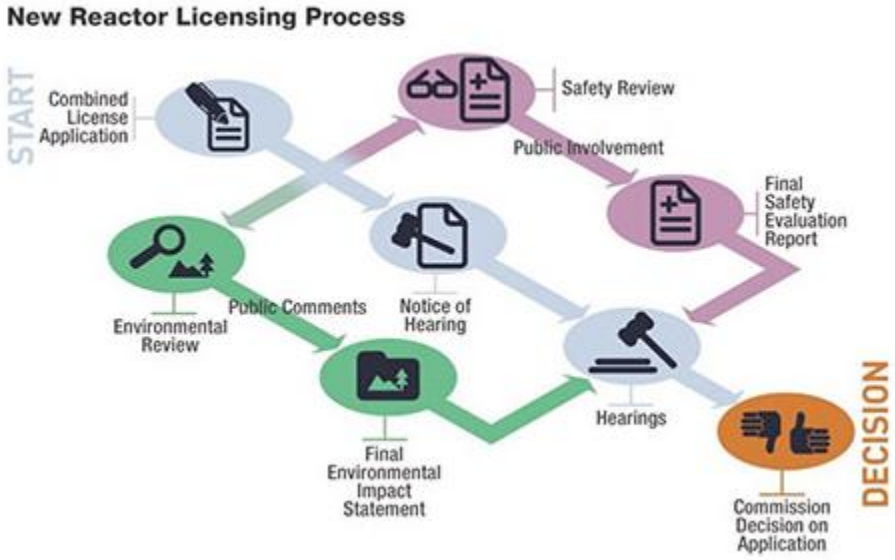
Any new nuclear reactor in New York State is currently required to go through a complex set of approvals by the NRC before it can be constructed and operated. The reactor design itself must be certified by the NRC. Once the NRC approves a nuclear power plant design, the certification is valid for 40 years from the date of issuance and can be renewed for an additional 40 years.[42] Currently, the NRC has certified only a small number of advanced nuclear reactor designs, most notably the Westinghouse AP1000 (1,000 MW) and the NuScale US600 SMR (50 MW per unit), which both employ LWR technology.

The NRC provides several paths for approval of siting, construction, and operation, giving project developers flexibility in how to approach the licensing process. Within those paths, NRC reviews safety, environmental, and financial considerations for all projects.

10 CFR Part 50 is the NRC's traditional two-step licensing process that involves first obtaining a construction permit followed by an operating license. 10 CFR Part 52 offers a more streamlined approach with a combined operating license that merges construction and operating approvals into a single step (see figure below). Both Parts 50 and 52 are primarily designed for large LWRs and contain prescriptive requirements based on decades of design and operating experience.

Figure 1: New Reactor Licensing Process

Source: United States Nuclear Regulatory Commission[43]



A new 10 CFR Part 53 is currently under development and aims to provide a voluntary, alternative regulatory framework specifically designed for licensing future commercial nuclear plants, including advanced reactors. Part 53 is intended to be risk-informed and technology-inclusive, focusing on high-level safety goals rather than prescribing specific design features. This approach potentially allows for greater flexibility in meeting safety requirements, accommodating a wider range of advanced reactor technologies and innovative designs. New York State submitted comments to the NRC on the proposed Part 53 rulemaking in February 2025. NRC's rulemaking schedule currently anticipates issuance of a final Part 53 no later than the end of 2027, as required by the federal Nuclear Energy Innovation and Modernization Act.

The NRC also offers developers the option to apply for an early site permit, which addresses site safety, environmental protection, and emergency preparedness issues independent of a specific nuclear reactor choice and nuclear plant design. The early site permit application must address the safety and environmental characteristics of the site and evaluate potential obstacles to developing an acceptable emergency plan. Resolving site-specific issues early in the process offers developers the benefit of a reduced timeline for construction and operating license reviews and can provide a level of confidence in a project's viability.

NRC regulations for physical and cyber security of nuclear power plants, as described above in Section 2.6, will similarly be important and apply to any new advanced nuclear plants. As discussed, these

standards include physical security programs and contingency plans for nuclear material and cyber security measures to protect cyber systems from unauthorized access, theft, misuse, or damage of nuclear materials and facilities. Proactive security measures can be incorporated in the design of the plant, be part of operating practices, and include the capability to respond to intrusion or attack.[44] Continued partnerships and collaboration with oversight and permitting agencies, law enforcement, and emergency responders on any federal changes to regulations, licensing, and permitting issues around security at nuclear facilities will continue as advanced nuclear develops and the grid evolves. The NRC, supported by cyber security experts from DOE national laboratories and American universities will be a critical partner in developing any further security guidance pertaining specifically to advanced nuclear technologies.

4. Themes and Recommended Actions

4.1. Ensuring the Continued Operation of the Existing Nuclear Fleet

As noted in Table 1, three of the State's existing nuclear facilities are nearing the end of their operating license. The ZEC program also expires in March 2029, near the time that the first two operating licenses expire at Ginna and Nine Mile Point Unit 1. While the PSC is currently considering the future of the program in its Clean Energy Standard proceeding, a comparison between the Additional Action and No Action scenarios from the Pathways analysis of this Plan points to the importance of maintaining the existing nuclear fleet. Under the Additional Action scenario, existing nuclear plant licenses are extended from 60 to 80 years, and the State's nuclear generation capacity at existing generators remains steady at 3,326 MW through 2040. Under the No Action scenario, nuclear licenses are not extended, which could be the case absent continued support, resulting in decommissioning of the existing plants as they reach their retirement age. Nuclear generation capacity from existing generators under No Action decreases by 1,199 MW in 2030 and by 2,043 MW in 2040, contributing to higher natural gas capacity and generation in the No Action case. These results illustrate the importance of ensuring the continued operation of the existing nuclear fleet to help meet the State's zero emission by 2040 target.

In addition to the ZEC program, additional considerations for the State's existing nuclear fleet are outlined below.

4.1.1. License Extension

Nuclear plants receive an initial license from the NRC to operate for 40 years and are eligible to apply for extensions in 20-year increments. License renewal beyond license year 60, known as a subsequent license renewal, is being actively pursued by many operating plants in the United States. All operating nuclear plants in New York are currently in their first 20-year extension (40- to 60-year operating term) and are expected to apply for subsequent 20-year extensions for the 60- to 80-year term. The NRC requirements for subsequent license renewal beyond year 60 are nearly identical to the process for license extension beyond year 40, requiring licensees to review the systems, structures, and components within NRC jurisdiction and demonstrate how the continued safety of those systems will be monitored and maintained during the license renewal period.

NRC normally requires license renewal applications to be submitted five years prior to a plant's license expiration date. The two New York plants with the earliest license expiration in 2029 are Nine Mile Unit 1 and Ginna. While under Exelon ownership, Exelon requested, and NRC granted, exemptions to the license renewal application timelines for Nine Mile Unit 1 and Ginna, shortening the application period to three years. Exelon's exemption application projected a need to begin license renewal application preparation approximately two years before application submission (see Table 2). The other two New York plants, FitzPatrick and Nine Mile Unit 2, have license expirations in 2034 and 2046, respectively.

Table 2: Nuclear Power Plant License Renewal Application Timelines

Notes:
[1] Explicitly stated in Exelon exemption request
[2] Extrapolated based on Exelon estimate under normal requirements

Facility	License Expiration	Original Renewal Application Deadline	Exelon Projected Application Prep Start/Business Decision to Renew[1]	Application Deadline under Approved Exemption	Assumed Application Prep Start/Business Decision to Renew[2]
Nine Mile Unit 1	Aug 2029	Aug 2024	April 2022	Aug 2026	April 2024
Ginna	Sept 2029	Sept 2024	June 2022	Sept 2026	June 2024

4.1.2. Managing Aging Plants

For licensees to ensure continued safe operation, monitoring and protecting against deficiencies inherent to plant aging will be a significant undertaking. As part of the license renewal process, the NRC reviews the safety and technical requirements for an extended license term, and the renewal is based on the NRC's assessment of the plant's operational safety, including environmental protection, being assured during the 20-year extension period.[45] The license renewal process considers primarily passive structures and components; however, their degradation may not be as readily apparent as the degradation of active structures and components.[46] One particular challenge is that it is not yet possible to predict the time for the onset of passive structure and component degradation.[47] However, the technical community has identified a number of challenges for plant operation beyond 60 years, including the possible onset of previously known degradation mechanisms that have not yet been observed, the acceleration of degradation already observed during the previous years of operation, and the emergence of new mechanisms particularly related to the operation beyond 60 years.[48] Therefore, as the owners and operators of New York's existing facilities consider their license renewal applications from 60 to 80 years, the NRC and the companies must work to develop a proactive and robust aging management program to ensure continued safety and reliability.

4.1.3. Power Uprates

When the NRC licenses a commercial nuclear power plant, it sets limits on the maximum power output for the reactor core.[49] However, commercial reactors are typically designed with excess capacity to allow

for a potential uprate of this power output.[50] The NRC has approved power uprates for some of New York's nuclear facilities in the past, including, for example, a 48 MWe uprate for Nine Mile Point 2 in 1995, a 14.1 MWe uprate for Indian Point 3 in 2002, and a 49.5 MWe uprate for Indian Point 3 in 2005.[51] As electricity demand continues to grow, New York should work with the companies to identify and support safe and economic power uprate opportunities at the existing nuclear facilities.

Recommendations

- The PSC should continue to conduct its ongoing evaluation of the extension of the ZEC program and conclude this evaluation in a timely manner, prior to any federal relicensing application deadlines, to ensure the continued operation of the existing nuclear fleet to help meet State climate goals. In addition, the preservation of New York State's existing upstate nuclear facilities will help to maintain fuel diversity and fuel security in the State. Any extension should be done with ratepayer protection in mind, in addition to the reliability needs of the grid.
- The State should identify and support safe and economic power uprate opportunities at its existing nuclear facilities.

4.2. In-depth Examination of Advanced Nuclear

Recognizing the opportunity for new advanced nuclear described above, New York State began the process of developing a Master Plan, starting with the publication by NYSERDA of the Blueprint[52] in January 2025. The Blueprint recognized that any action to pursue new advanced nuclear technology development in New York State requires consideration and assessment of a wide range of issues:

- Technological and Commercial Readiness: While large LWRs have operated commercially for decades, this is not the case for SMRs and advanced nuclear technologies more broadly in the United States. Many of these designs still need to receive regulatory approval from the NRC. Project development is at varying levels of maturity, and in most cases finance and investment decisions have not yet been finalized, with perceived and acceptable commercial risk levels still under consideration. In addition to the technical and commercial readiness of specific reactor designs, corresponding fuel requirements also differ and the readiness of the fuel supply for each new reactor type varies. Understanding all these factors is important to decide what advanced nuclear technology options may be suitable for New York.
- Economic Growth: The commercial environment may provide new opportunities well-suited for potential new nuclear power. Advanced nuclear technologies could support new economic development opportunities that require large sources of power such as semiconductor fabrication plants and data centers. Industry is currently exploring potential co-location of advanced nuclear reactors at large offtaker sites and power purchase agreements to help secure the considerable financing required for new reactor licensing and construction.
- Safety: The U.S. commercial nuclear industry has a strong safety record, and advanced reactors offer the potential for even safer designs that could reduce both the likelihood and consequences of core damage events. For instance, advanced technologies take advantage of passive safety features that cause a reactor to shut down safely without the need for operators

to take remedial action after the loss of electrical power or reactor coolant. A full understanding of these features of advanced nuclear technologies and of NRC regulation and the broader regulatory context is important to ensure that deployment of such technologies only proceeds based on a shared understanding of the robust safety features of these designs.

- Climate Resiliency: The nuclear industry has established seasonal and extreme weather readiness programs and procedures that provide a systematic and cross-functional approach to prepare for changing weather. As the State examines opportunities for new advanced nuclear development, it is critical to ensure existing and potential future nuclear facilities plan for resilient operation using localized forward-looking projections of climate hazards out to an appropriate multi-year timescale, including in the consideration of facility siting. These efforts can proactively anticipate, evaluate, plan for, and implement mitigative measures, as necessary, to minimize future impacts to plant operations from climate change.

- Siting and Community Readiness: The NRC has a predefined list of siting criteria that address reactor design/power, engineering standards used; probability of accidental release of radiation; passive and inherent safety features; meteorological, geological, and hydrological conditions at the site; and population density. Consideration of these criteria is a prerequisite to determining where any advanced nuclear projects might be sited. Assessing community readiness and the strength of community support will also be an important part of the siting process in New York State. Project proponents should follow best practices for any new energy facility and robust stakeholder engagement, which includes communicating early and often, as well as promoting knowledge exchange, transparency, and two-way dialogue with host communities. Where new technologies will be implemented, the State, researchers, and industry partners also have important roles in facilitating information sharing. The State could also consider initiatives aimed at identifying willing communities and preparing them to host nuclear facilities.

- Cost and Financing: Cost and financial risk are key concerns for developing new advanced nuclear plants. For any technology, including advanced nuclear, first-of-a-kind deployment costs will be relatively high and uncertain. Costs and cost uncertainties will tend to decrease with learning and supply chain development when progressing toward “nth-of-a-kind” deployment. The State should assess the roles the various partners in advanced nuclear projects can and should play to jointly manage and overcome those cost challenges and risks so that financing becomes feasible especially for first-of-a-kind projects. The key project partners in these structures include project developers, funders, suppliers, buyers of the energy generated by the plant, the federal government and State government. Facility financing should also be sufficient to offset costs to local governments for hosting the facility, including for emergency preparedness. Additionally, the State supports decommissioning financing that separates decommissioning funds for radiological decommissioning from site restoration to reduce the risk of overruns during decommissioning.

- Supply Chain: A well-established global supply chain exists for at least the Gen III+ LWR equipment, components, and materials, though both gaps in the supply chain and economic

opportunities for leveraging and strengthening New York's nuclear supply chain capabilities should be assessed. Many developers of new advanced nuclear are developing new suppliers for their designs, although more project commitments are needed to solidify the development path. Nearly all the non-water-cooled reactors will need new supply chains to produce HALEU fuels and the supply of HALEU is currently a bottleneck for advanced nuclear reactors coming online and proving their technological readiness. Efforts are being made to re-onshore part of the fuel supply chain, though commercialization of HALEU production in the United States is still being developed. To prepare for the construction and operation of advanced nuclear in New York, opportunities should be identified to expand current firms or establish new manufacturing facilities that can produce essential nuclear components and obtain the necessary certifications for new and existing plants to encourage in-state production.

- Workforce: Strengthening the State's nuclear workforce is an important component of preparing for potential future deployment of advanced nuclear technologies. While national craft labor shortages are impacting the construction industry more generally, emphasizing the development of craft labor presents an opportunity to create many new high-paying construction jobs statewide. Training an expanded workforce will require partnerships with local organizations, including universities and technical colleges. The State can potentially alleviate construction and operating labor supply issues by developing apprenticeship and pre-apprenticeship programs and instituting craft labor contracting policies to attract and maintain employees.
- Fusion Reactors: Fusion reactors use a fundamentally different type of nuclear reaction from all prior and existing nuclear plants including, the new Gen III+ and Gen IV reactor designs, which all rely on nuclear fission, the splitting of atoms. Fusion is a nuclear reaction that releases atomic energy by fusing two atoms (typically forms of hydrogen) into a larger, nonradioactive atom such as helium. This process can release large amounts of energy sufficient to make steam for electrical turbines or heat for other uses, though this capability has not yet been successfully demonstrated. Several companies are pursuing commercial fusion and making progress toward the goal of net positive power output. Some of these companies aspire to commercialization timelines that make them relevant for the State to consider as part of its further energy planning.
- Waste Generation and Disposal: Many advanced nuclear designs incorporate increased fuel efficiency and waste reduction, and recycling waste fuel from advanced reactors is also being researched. While significant economic and cost barriers must be addressed, there are technologies seeking to increase the circularity of the nuclear fuel cycle. The use of HALEU and advanced fuel forms in many non-water-cooled reactors will result in waste with different volumes, compositions, and disposal challenges that can introduce unique waste management considerations given the limited experience in handling diverse waste streams and the potential need for new processing and disposal methods. Traditional waste management processes and costs may not be analogous to the waste from advanced nuclear. Further assessment is needed in respect of the management and disposal of nuclear waste streams from SMRs.

As stated in the Blueprint publication, the Master Plan comprising studies on the above topics is expected to be completed by the end of 2026.

Recommendations

- Through its Master Plan, which has been underway since January 2025, the State should continue to examine key considerations for advanced nuclear for long-term planning. The Master Plan process should examine the key issues raised by the Blueprint[53] and develop recommendations for the implementation of advanced nuclear technologies in the State. The topics should include technology feasibility; regulatory, safety, siting, and waste; environmental and climate justice; policy options, including risk-sharing; supply chain, workforce, and economic development; research and development; and fusion.

4.3. Multi-State Collaboration for Advanced Nuclear Reactors

Many of the issues under consideration in the Master Plan process also present themselves for action that extends beyond New York. This is especially the case with respect to cost and financing issues. An important opportunity to help manage these challenges is to pursue a "pipeline" of projects, enabling risk reduction, economies of scale and resulting cost reductions. This could take the form of combining in-State advanced nuclear developments with other states' developments. In addition, New York has the opportunity to participate in national activities, designed to lead to technology demonstrations and supply chain development, to both boost the availability of the supply chain and workforce and, at the same time, identify and pursue opportunities for cultivation of local labor forces and supply chain niches in New York.

For advanced nuclear, NYSERDA co-chairs two multi-state nuclear initiatives. In 2023, the National Association of State Energy Officials (NASEO) partnered with the National Association of Regulatory Utility Commissioners (NARUC) to form the NASEO-NARUC Advanced Nuclear State Collaborative (ANSC) with 32 member states.[54] The ANSC convenes state officials to exchange information related to the planning and deployment of new advanced nuclear generation.

In early 2025, NASEO partnered with the DOE's Gateway for Advanced Innovation in Nuclear (GAIN) to form the NASEO Advanced Nuclear First Mover Initiative,[55] a multi-state initiative on nuclear energy focused on risk-sharing, driving down costs, and accelerating market adoption, co-led by New York State. The Initiative includes a group of 11 states along with key private sector partners, the DOE, and Idaho National Laboratory. Its primary purpose is to facilitate public-private partnerships for advanced nuclear market adoption leading to a reduction in financial and technology risks, support deployment policies, develop knowledge of supply chain needs, streamline permitting processes, coordinate procurement agreements, and identify new financing structures.

Collaborations with other states, as well as Ontario (Canada), offer opportunities to build on regional momentum to strengthen nuclear supply chains, share best practices, and support the responsible development of advanced nuclear technologies.

Recommendations

- Through its leadership of the First Movers Initiative and other initiatives, the State should continue to pursue multi-state collaborations in moving project development forward. The State should explore collaboration opportunities with other states to develop a nuclear supply chain and workforce that can support the economies of scale necessary to reduce the nuclear deployment cost curve.
- The State should explore options for developing a shared orderbook for new nuclear deployment. An orderbook is a series of committed orders for the same nuclear reactor design and can help to develop supply chains, accelerate building, and reduce costs.

4.4. Opportunities for Early Deployment Action

New and continued investments in zero-emissions technologies will be critical for meeting the State's increased electricity load and zero emissions by 2040 target. As outlined above, the development of new advanced nuclear is an area of opportunity to help the State meet its targets. In parallel with ongoing initiatives to assess the larger potential of advanced nuclear in the state, New York should support risk-informed early development and deployment efforts to catalyze the advanced nuclear industry in the near-term.

A significant step to pursue early deployment action was taken on June 23, 2025, when Governor Hochul called upon NYPA to develop and construct one or more zero-emission advanced nuclear power plants in Upstate New York totaling at least 1 GW of generating capacity to support a reliable and affordable electric grid.[24]

As a further example of an early deployment action, NYSERDA is supporting Constellation's pursuit of federal planning grant funding that would support its efforts to seek an early site permit for the addition of one or more new advanced nuclear reactors at its Nine Mile Point site in Oswego County.[56] An early site permit is granted by the NRC for future development of a nuclear power plant and is valid for 10–20 years. This early-stage preparatory work is consistent with the exploratory approach of the ongoing Master Plan process to study the potential role of advanced nuclear to meet the State's energy objectives and its reliability, economic growth, affordability, and placement within the State's larger decarbonization strategy.

Recommendations

- Through NYPA's efforts to develop at least 1 GW of nuclear power generation and other actions, the State should continue to pursue opportunities for early deployment action. Early deployment action should be undertaken in coordination with the Master Plan process and reflect collaboration with other states to ensure that any deployment commitments leverage the insights and benefits from those initiatives.

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New York State Energy Plan

VOLUME II | Our Energy Systems

Natural Gas

03

2025 NEW YORK STATE ENERGY PLAN

Key Terms Used in This Chapter

FOR THE COMPLETE GLOSSARY ➜

City Gate: The point at which gas utilities or local distribution companies (LDCs) take operational responsibility for safely and reliably transporting gas to customers.

Demand Response: Programs that encourage gas customers to reduce consumption during periods of high demand, sometimes by shifting demand from high load periods to periods of lower demand. These programs are typically administered by natural gas utilities.

Design Day: The specific extremely cold conditions that gas utilities use to plan for supply adequacy and reliability. Design day is typically based on the coldest actual day experienced in a gas utility's service territory and is often expressed in terms of "heating degree days."

Design Day Demand: The expected consumption of natural gas by a gas utility's firm service customers on a design day.

Firm Service: Service for natural gas customers who lack alternatives to natural gas consumption and require uninterrupted delivery of gas. Residential and small commercial customers typically receive firm gas service.

Interruptible Service: Service for natural gas customers who can employ an alternative fuel or cease consumption of natural gas entirely when requested to do so by the gas utility (often at a particular cold temperature threshold). Customers receiving interruptible service pay reduced distribution rates.

Local Distribution Company (LDC): A gas utility. LDCs are responsible for building and maintaining a local pipeline system that delivers natural gas to end use customers, such as businesses and homes, after receiving gas from a transmission pipeline at the city gate or another source.

Spot Market: The market for buying and selling natural gas for immediate or very near-term delivery, usually for a period of 30 days or less. Transactions in the spot market reflect real-time supply and demand conditions and are not governed by long-term contracts.

Spot Price: The current price of natural gas in the spot market. Spot prices can fluctuate daily based on weather, demand, supply availability, and other market dynamics.

Units: Measuring and Quantifying Natural Gas

Natural gas is measured and quantified using both volumetric units and energy-based units depending on the context.

Commonly used volumetric units include cubic feet (cf), hundred cubic feet (ccf), thousand cubic feet (Mcf), and billion cubic feet (Bcf).

Commonly used energy-based units include British thermal units (Btu), million British thermal units (MMBtu), trillion British thermal units (TBtu), therms (th), and dekatherms (dth).

Utility meters measure the volume of natural gas that customers consume. Utilities then apply a conversion factor—often referred to as the "heat content" or "therm factor"—to convert the metered volume into an energy value for billing purposes.

Some unit conversions are provided below:

- 1 Mcf = ~1.037 MMBtu or ~1.037 dth (varies slightly by gas composition)
- 1 MMBtu = 1,000,000 Btu = 1 dth = 10 th
- 1 MMBtu = 1 dth = ~293.07 kWh

For a general sense of scale, a typical residential customer in New York uses ~100–140 dth per year and ~1 dth on a peak day. A 350 MW combined cycle electric generating plant uses ~54,000 dth per day (assuming 100 percent capacity factor), and about 12,000,000 dth per year (assuming 60 percent capacity factor).

Key Findings → Natural Gas

New York residents and businesses currently use natural gas for many important energy services such as space and water heating, cooking, commercial and industrial processes, and electricity generation. In 2023, natural gas accounted for 38 percent of primary energy consumption statewide. While the natural gas sector is entering a transitional period, New York will continue to meet a substantial portion of its energy needs with natural gas through at least 2040. This chapter provides an overview of the State's natural gas sector, policies, and programs and recommends continued and additional actions to proactively adapt to changing demand while ensuring safe, reliable, and affordable service.

- **While natural gas consumption may continue growing in the near-term, demand is expected to decline over the long-term.** Diffusion of energy efficiency and electric technologies for space heating, water heating, cooking, and other energy services will drive down gas consumption.
- **State policies, regulations, and programs should support this transition while also safeguarding energy affordability.** The gas industry, policymakers, and regulators need to proactively adapt to this evolving energy landscape to ensure safe, reliable, and affordable service.
- **Gas system planners must continue to ensure safety and reliability, addressing persistent risks and hazards while also addressing emerging challenges.** Even as New York decarbonizes, the gas system will continue to play a large role in New York's energy system through the 2040 planning period, so it must remain reliable and resilient to risks such as extreme weather, a shifting climate, and disruptions to natural gas supply.

- **Proactive long-term and integrated planning are needed to ensure efficient investment in the natural gas system and to reduce stranded asset risk, given the projected decline in gas system utilization.** Longer planning horizons, closer coordination with electric utilities, prioritization of non-pipe alternatives (NPAs), and more proactive demand management (especially in extreme conditions) are all needed to reduce gas system capital investment safely and strategically. Planning and investment standards need to be evaluated to ensure that they remain suitable as the climate and patterns of consumer demand change.

- **Innovative cost recovery mechanisms may be needed to maintain the operational viability of gas utilities, ensure energy affordability, and improve alignment between cost causation and cost allocation, while supporting safe and reliable operation.** Potential approaches include accelerated depreciation of gas infrastructure, rate design reforms, securitization of legacy costs, and cost sharing with non-gas-ratepayer entities.

- **Alternative fuels can play a role in decarbonizing the gas sector and should be implemented strategically.** Renewable natural gas (RNG) sourced from sustainable feedstocks can reduce statewide emissions and support broader decarbonization of the agriculture and waste sectors. Clean hydrogen is also expected to have a role in New York's decarbonization, specifically for clean firm electric generation or onsite industrial use. Claims that "certified" or "differentiated" gas reduces upstream methane emissions must be substantiated before these fuels can be incorporated into the State's strategy to decarbonize the gas sector.

- **A just transition for gas sector workers and businesses is a State policy priority.** The State should work closely with utilities and labor organizations to ensure gas sector workers have access to continued economic opportunities throughout the clean energy transition. Additional research is needed to determine the most effective workforce interventions.

- **The gas transition should be strategically managed to ensure disadvantaged communities (DACs) have equitable access to clean energy and are not unduly burdened financially or otherwise.** Proactive planning, including targeted deployment of clean energy technologies, will be essential to protect customers in DACs from adverse impacts and to ensure they benefit from the energy system transition.

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1. Overview

New York residents and businesses currently use natural gas for many important end uses. In 2023, New York used approximately 1,350 trillion British thermal units (TBtu) of natural gas, accounting for 38 percent of the state's primary energy consumption. Natural gas provided 71 percent of residential, 75 percent of commercial, 46 percent of industrial, 42 percent of electricity generation, and 3 percent of transportation energy consumption.[1] In 2024, natural-gas-fired generation accounted for 62 percent[2] of New York's electricity-generating capacity.[3] Over 5 million New York residents and businesses use natural gas for space and water heating, cooking, commercial and industrial processes, electricity generation, and as a raw material for manufacturing fertilizers, plastics, and petrochemicals.

New York's use of natural gas is expected to decline by 2040 in all scenarios of future energy pathways developed for the State Energy Plan, resulting from a combination of State and local policy as well as shifting customer preferences towards electric substitutes. While the extent of this decline varies depending on the scenario, in all scenarios New York continues to meet a substantial portion of its energy needs with natural gas through at least 2040. As such, it is essential that the natural gas system remains safe, reliable, and affordable for customers.

To achieve these goals, New York must strategically manage the transition toward a reduced reliance on natural gas. This requires continued operational vigilance, particularly in response to emerging climate-related risks, as well as robust long-term and integrated planning and expanded use of non-pipeline alternatives (NPAs) to promote efficient gas system maintenance investment. New York will need to make dedicated efforts to ensure a just transition for gas sector workers and businesses, low- and moderate-income (LMI) customers, and disadvantaged communities (DACs), ensuring that the benefits of the energy transition are shared equitably. The gas transition will also require the strategic use of alternative fuels to reduce greenhouse gas (GHG) emissions, policies to enable neighborhood-scale energy planning, and potentially, innovative cost recovery mechanisms that maintain the operational viability of gas utilities while supporting long-term energy affordability.

2. State of the Sector and Progress Report

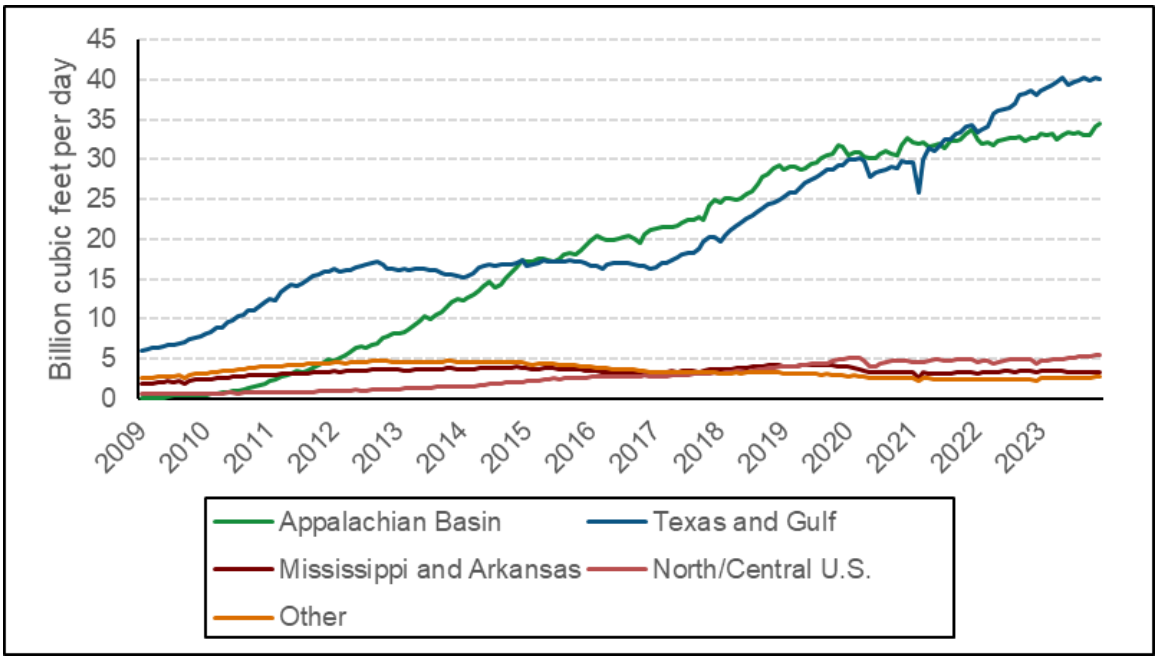
2.1. New York Natural Gas Supply and Demand Overview

2.1.1. Production

New York's use of natural gas is situated within a broader regional, national, and international competitive market with corresponding industries for natural gas supply, storage, transmission, and distribution. U.S. production of natural gas increased over the past 15 years as new oil and gas production technology and horizontal drilling have increased the industry's ability to extract gas, especially from shale formations. The rapid increase in shale gas production from the Appalachian Basin, comprised of the Marcellus and Utica shale formations, has become an important source of natural gas for the Northeast. Figure 1 depicts the rapid growth in Appalachian shale production starting in 2010 and growing to over 30 billion cubic feet (Bcf) per day in the early 2020s.

Figure 1. U.S. Shale Formation Natural Gas Production Estimates

Source: Energy Information Administration[4]



New York is not a major producer of natural gas. In 2023, New York produced approximately 8.2 tBtu of natural gas, about 0.02 percent of U.S. natural gas production or 0.6 percent of New York's annual gas demand.

2.1.2. Supply and Delivery

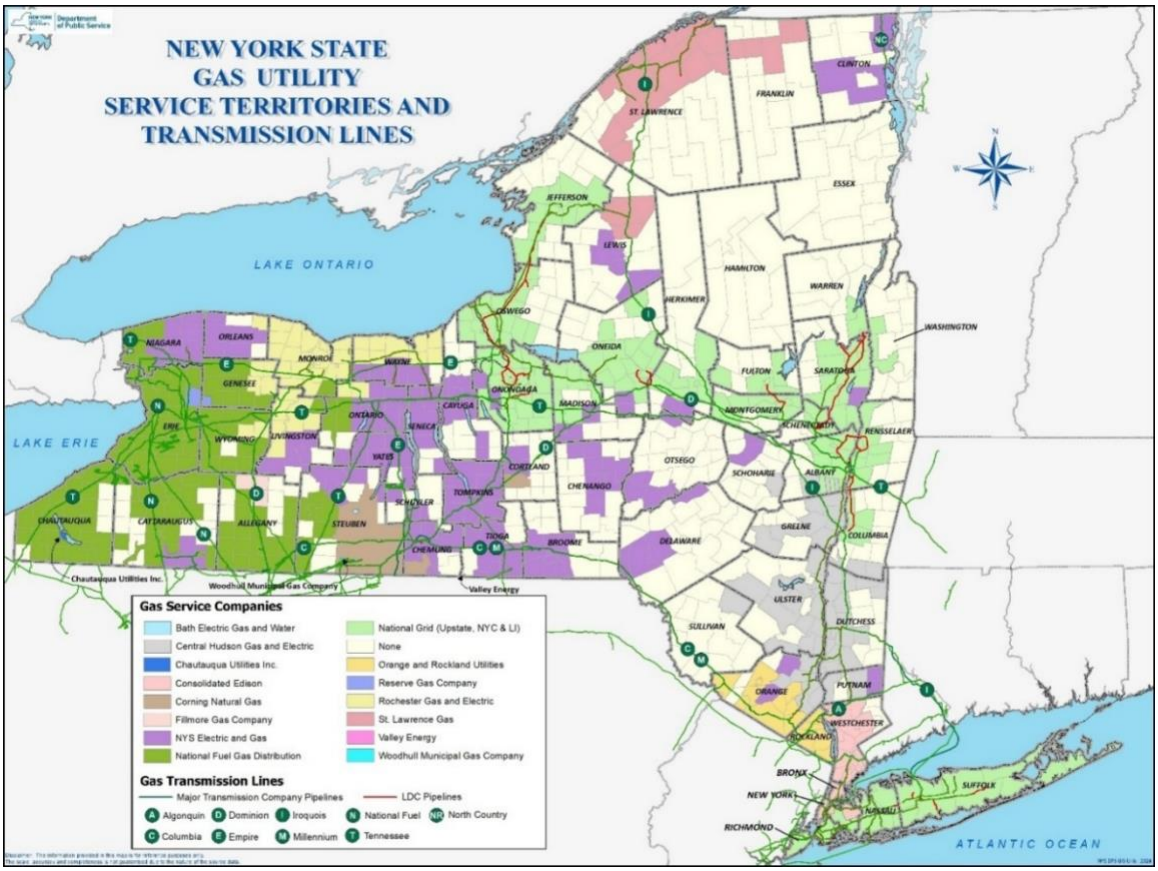
Because New York State produces a limited amount of natural gas in-state, its gas supply primarily comes from imports. Natural gas is delivered to New York through a network of interstate transmission pipelines.

The upstate region is served by the following gas utilities: Central Hudson Gas and Electric Corporation (CHGE), Corning Natural Gas Corporation (Corning), National Fuel Gas Distribution Corporation (NFG), Niagara Mohawk Power Corporation d/b/a National Grid (NMPC), New York State Electric & Gas Corporation (NYSEG), Rochester Gas and Electric Corporation (RGE), Liberty Utilities (St. Lawrence Gas) Corp. (Liberty Utilities), and several small distribution companies and municipal utilities. These utilities primarily source gas from the following interstate pipelines: Columbia, Eastern, Empire, Iroquois, Millennium, National Fuel Gas Supply Corporation, Tennessee, and TransCanada.

The downstate region (Long Island, New York City, and Westchester, Orange, and Rockland Counties) is served by the following gas utilities: The Brooklyn Union Gas Company d/b/a National Grid NY (KEDNY), KeySpan Gas East Corporation d/b/a National Grid (KEDLI), CHGE, NYSEG, Consolidated Edison Company of New York, Inc. (Con Edison) and Orange & Rockland Utilities, Inc. (O&R). These utilities primarily source gas from the following interstate pipelines: Iroquois, Millennium, Tennessee, Texas Eastern, TransCanada, and Transcontinental (see Figure 2).

Figure 2. New York State Gas Utility Service Territories and Transmission Lines

Source: DPS



The pipeline systems serving New York primarily source natural gas from production and storage regions southwest of New York, including from the Marcellus and Utica regions, as well as the Gulf Coast states. Iroquois and TransCanada transport gas from the north, providing a reliability benefit through supply diversity.

Gas utilities or local distribution companies (LDCs) are responsible for procuring gas supply on behalf of their customers, delivering gas to customers from the city gate[5] and keeping their distribution systems balanced by matching demand with supply. Each LDC's specific supply portfolio depends on factors that are unique to its service territory. Generally, supply portfolios primarily comprise firm capacity on interstate pipelines and natural gas storage. Pipeline systems build up natural gas storage during the lower-demand seasons, i.e., spring, summer, and early fall. Natural gas storage facilities are typically underground, using caverns formed in old salt beds or depleted natural gas or oil wells. While some storage facilities used by New York's LDCs are located in western New York, the majority are located in the Marcellus and Gulf regions.

During periods of peak demand, LDCs often draw from a wider range of supply sources, referred to as "peaking services," that are typically purchased at a premium. These may include additional purchases from interstate pipelines, withdrawals from storage, compressed natural gas (CNG), or liquefied natural gas (LNG). Several of the State's gas utilities also currently receive local supplies of renewable natural gas (RNG) or conventional

natural gas. If these sources are not sufficient to meet demand, LDCs can implement demand control measures such as directing tiered classes of interruptible customers to stop using natural gas in favor of pausing operations or switching to secondary fuels, such as fuel oil, until the service interruption ends. Peaking services and demand management are used to ensure reliability during cold weather or contingency events.

2.1.3. Demand

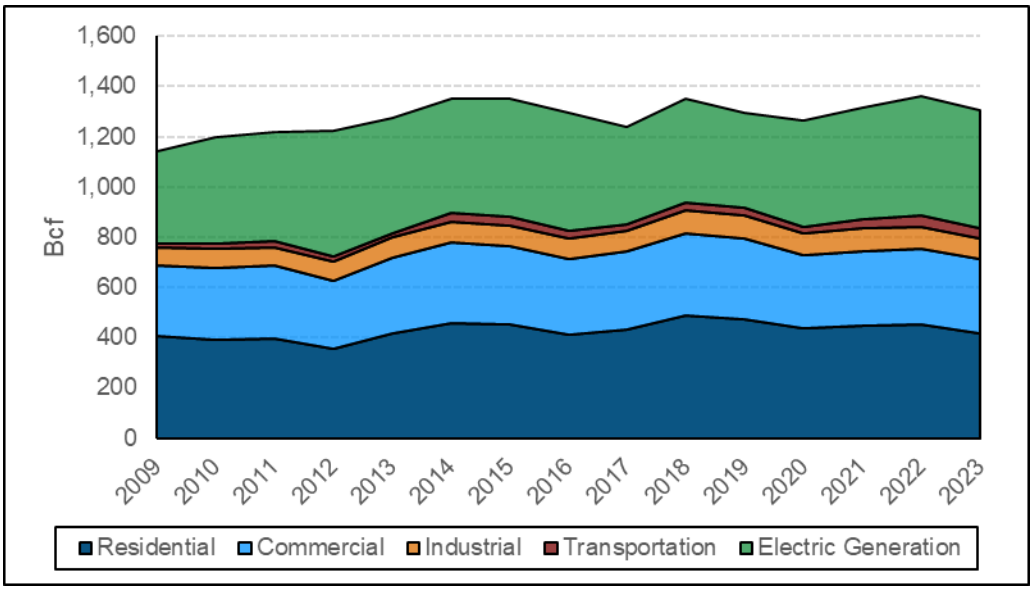
New York has approximately 5 million natural gas customers, 92 percent of whom are residential.[6] In 2023, New York consumed approximately 1,306 Bcf of natural gas, accounting for 4 percent of gas consumption nationwide.[7] Demand for natural gas is greatest during the winter season due to demand related to space heating and a relatively low-demand summer season. Annual demand for natural gas in New York has historically peaked on the coldest days in winter.

Figure 3 shows a 15-year summary of natural gas consumption in New York State by sector. In recent years, natural gas consumption in the power generation sector has increased as New York's generation mix has shifted from coal to gas and, with the closure of the Indian Point generating station, from nuclear to gas. In the building sector, gas consumption has also risen as many buildings have switched from heating oil and other fuels to heating with gas, in part due to New York City policies that encouraged fuel switching. At the same time, growing investments in building energy efficiency, weatherization, and electrification are placing downward pressure on gas demand in the building sector, a dynamic that is expected to continue and likely accelerate in the years ahead.

Natural gas demand in the building sector currently peaks in the winter, driven by the use of gas-fired boilers and furnaces for space heating. By contrast, gas demand in the power generation sector currently peaks in the summer, corresponding to increased electricity consumption to serve air conditioning for space cooling. However, gas also continues to play a critical role in meeting electric demand in the winter months, providing fuel for generator demand. New York gas demand forecasts are discussed below in Section 3.

Figure 3. New York State Natural Gas Consumption Summary

Source: NYSERDA, Patterns and Trends[8]



2.1.4. Regulation and Oversight

The Federal Energy Regulatory Commission (FERC) regulates interstate pipelines' siting and transportation rates, while the U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA) regulates interstate pipeline operations and maintenance. In New York, the Department of Environmental Conservation (DEC) issues Clean Water Act Section 401 Water Quality Certifications (WQCs) and the Department of Public Service (DPS) monitors safety-related conditions and oversees system reliability, acting as an agent of PHMSA. DPS also works with the New York Division of Homeland Security and Emergency Services (DHSES) on winter preparedness and emergency response. The New York State Energy Research and Development Authority (NYSERDA) collects, analyzes, and disseminates information on gas consumption and markets as part of its energy market intelligence function.

The New York State Public Service Commission (PSC) regulates gas distribution systems and the utilities that own and operate them. The PSC is responsible for ensuring that utilities provide safe and adequate service at just and reasonable rates, and that utility planning, investments, and operations align with State policy goals. For instance, as discussed below in Section 2.3.2, the PSC assesses whether its decisions would be inconsistent with or would interfere with the attainment of statewide GHG emission targets established under the 2019 Climate Leadership and Community Protection Act (Climate Act). The PSC also oversees a range of energy policies and programs that benefit New Yorkers, including those supporting weatherization, clean heat, and energy affordability.

In addition to the issuance of WQCs, DEC plays a key role in the oversight of natural gas sector emissions and environmental permitting. DEC is responsible for permitting new natural gas wells and regulating emissions of methane and volatile organic compounds from natural gas infrastructure. The department's

work is central to ensuring that emissions from the sector align with the GHG reduction targets established in the Climate Act, supporting the State's broader climate and environmental goals.

2.2. Gas Prices Overview

Retail natural gas prices paid by end users include two primary cost components—supply and delivery. The supply price, sometimes referred to as the commodity price, is influenced by a competitive market and includes the cost of the gas itself, interstate pipeline capacity contracts, storage facilities, and the cost of transporting the gas to the LDC's city gate. As noted above, FERC sets interstate pipeline transportation rates, although many pipeline capacity contracts feature negotiated rates. Supply is typically priced at a particular gas hub, also known as a "liquid point." New York's gas utilities typically purchase supply (on behalf of their customers) with its cost tied to a particular index, such as "first of month" or "liquid point" pricing, and deploy hedging strategies to reduce volatility seen in spot market prices.

The delivery or distribution price includes the cost of distribution pipelines ("mains" and "services") used to transport gas from the LDC's city gate to end users, as well as the cost of supporting infrastructure such as compressors, regulator stations, meters, and utility operational expenses. Delivery rates are specific to the gas distribution utility serving a given area. Distribution delivery rates are set by the PSC and can include the costs of efficiency and affordability programs as well as property taxes.

Retail prices—the final price paid by end users—include both supply and delivery costs as well as surcharges and credits associated with other costs. This section reviews historical supply prices at hubs that are relevant to New York and retail rates for New York's gas distribution utilities.

2.2.1. Supply Prices

Natural gas is a commodity bought in a competitive market. Like most markets, supply and demand directly influence prices. As customer demand increases, so do prices and the incentive for producers to ramp up production. Similar to how gasoline prices tend to increase in warmer months as people travel more, natural gas prices typically increase in the winter when demand for gas for heating is higher. Except for geopolitical global events that have impacted prices, such as the Ukraine war, natural gas futures have largely traded in the $2-$4/MMBtu range over the last 15 years.

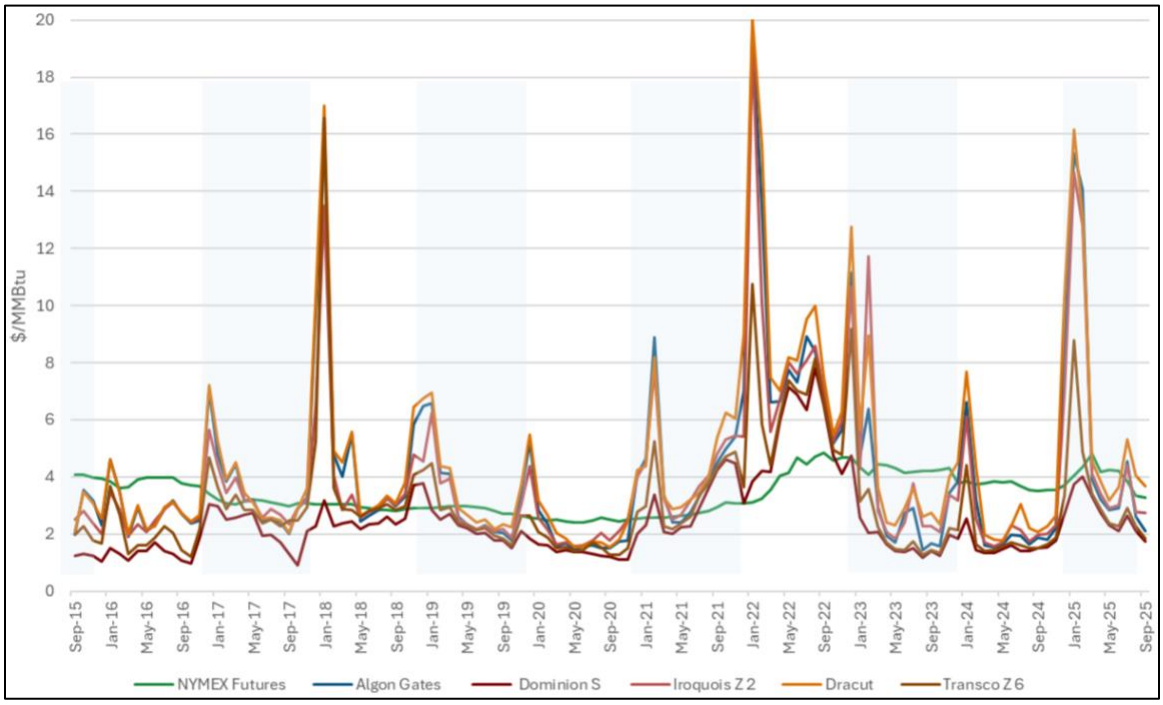
The structural composition of the natural gas system and New York's diverse geography also impact natural gas retail prices. For example, the interstate pipelines serving the downstate region are constrained, so when demand increases, downstate commodity spot prices are significantly impacted. However, the interstate pipelines serving western New York are less constrained and, accordingly, their spot prices are less impacted by increases in demand.

Daily gas prices can be volatile, reflecting near-term changes in demand (which is frequently temperature-driven). LDCs engage in hedging to mitigate volatility for mass-market customers. Utility hedging programs are intended to mitigate dramatic spot market volatility, especially during times of unexpected high demand. The PSC has a gas purchasing policy that requires gas utilities to mitigate price volatility experienced by core customers (i.e., customers who do not have alternatives to LDC-provided gas service). LDCs can manage price volatility through storing purchased gas supplies to deliver during

future high price periods (a physical hedge) or through purchasing options that guarantee future delivery of gas at a set price that is not subject to subsequent price increases (a financial hedge).

Figure 4. Historical Average Monthly Prices at Key Hubs Serving New York (2015–2025)

Source: S&P Global



2.2.2. Retail Prices

As discussed above, natural gas retail prices include both supply and delivery costs as well as surcharges. The figures below show historical average monthly gas bills grouped by utility for upstate residential (

Figure 5), downstate residential (Figure 6), upstate small commercial (

Figure 7), and downstate small commercial (Figure 8) end users. The figures show that average retail bills are generally higher downstate than upstate, reflecting several factors that include the higher costs of building and maintaining infrastructure in the more densely developed and populated downstate region and the higher commodity cost of gas downstate (which is a gas-supply-constrained region).

Figure 5. Upstate Average Monthly Residential Gas Bills, 1000 Therms Usage (2015–2024)

Source: DPS[9]

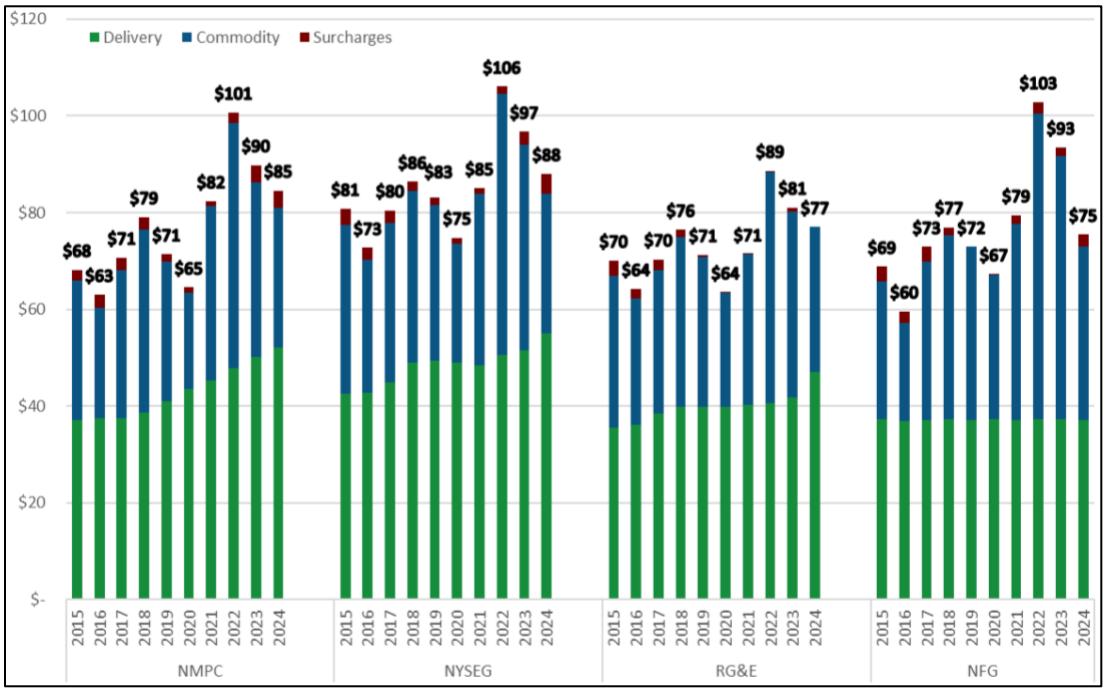


Figure 6. Downstate Average Monthly Residential Gas Bills, 1000 Therms Usage (2015-2024)

Source: DPS [9]

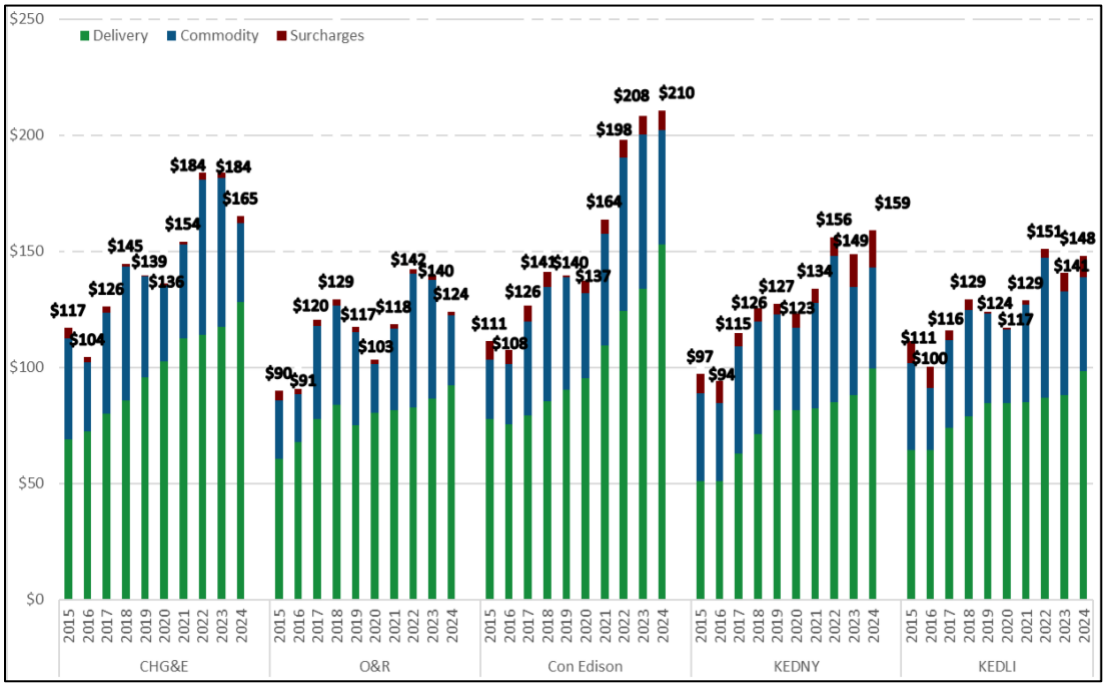


Figure 7. Upstate Average Monthly Small Commercial Gas Bills, 4000 Therms Usage (2015-2024)

Source: DPS [9]

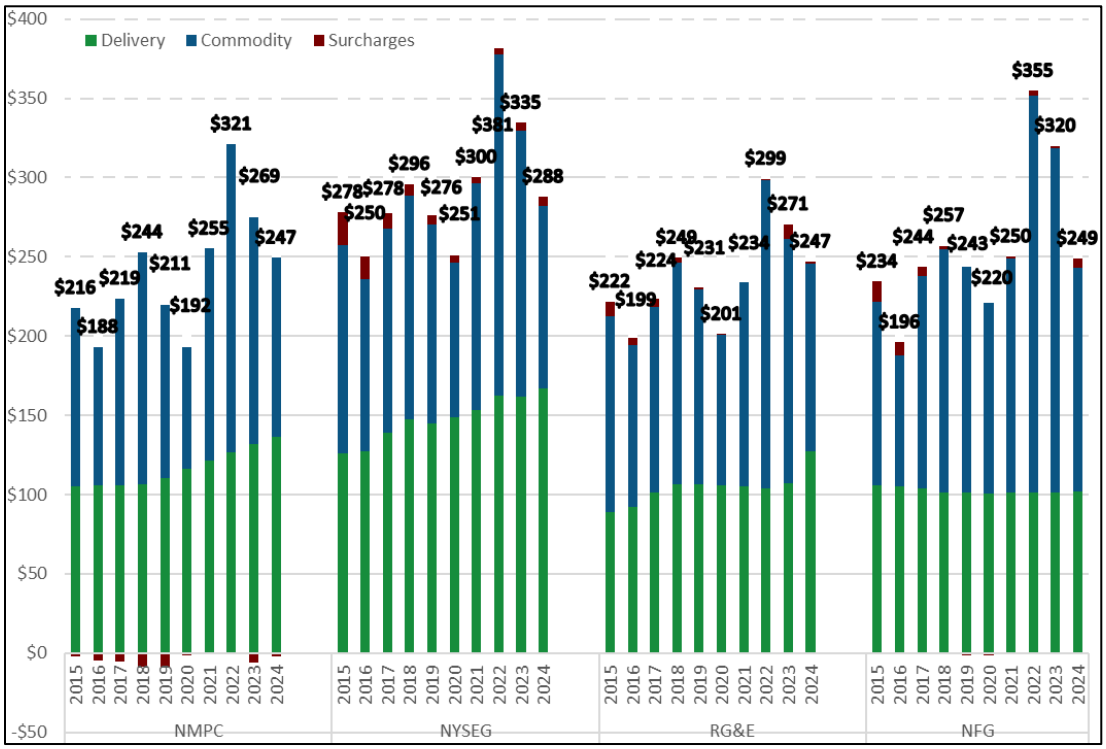
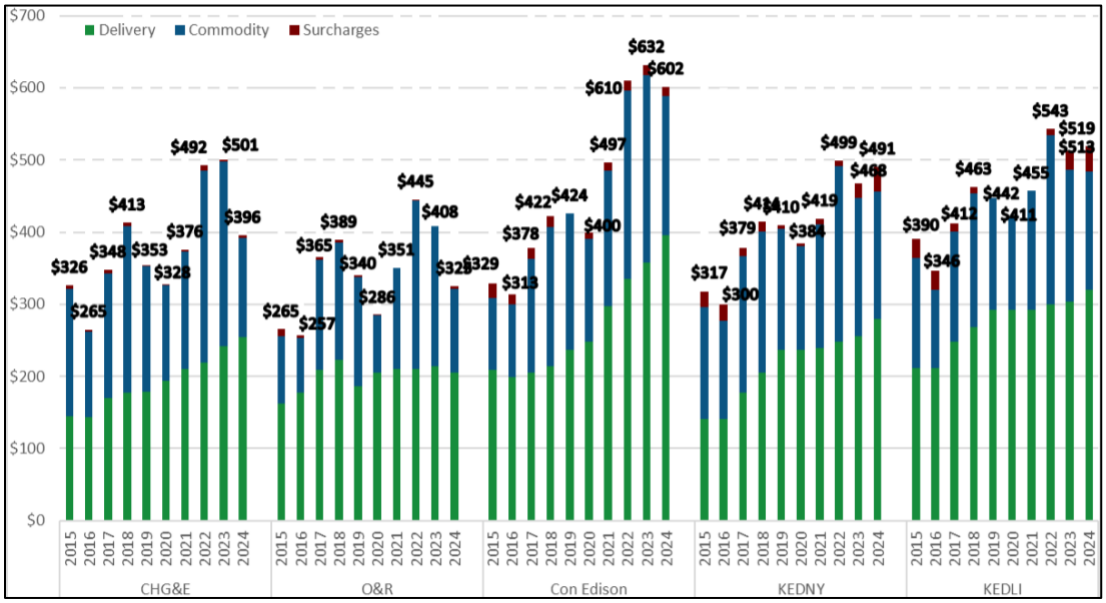


Figure 8. Downstate Average Monthly Small Commercial Gas Bills, 4000 Therms Usage (2015-2024)

Source: DPS [9]



2.3. Current Gas System Planning Practices, Laws, Regulations, and Programs

2.3.1. Gas Planning

Gas planning is necessary to ensure the provision of essential energy services to New York residents and businesses. Gas planning also helps evaluate and advance progress toward New York's GHG emission reduction targets, programmatic targets, and other policy priorities.

Gas planning occurs in multiple contexts and on multiple time and geographic scales. It generally involves forecasting gas demand, supply, and transmission and distribution capacity under various scenarios to ensure there is sufficient supply and infrastructure capacity to reliably meet forecast demand. Because gas demand currently peaks in winter months, corresponding with the heating season, many gas planning activities focus on winter reliability and preparedness planning.[10]

Gas planning may identify the need for investments to replace existing infrastructure that is aging or damaged or to meet demand growth with new infrastructure. Forecast demand can also be met through investment in alternatives to gas system infrastructure through demand-side measures or other competitive market solutions, often referred to as NPAs. LDCs can also actively manage demand during peak demand periods through the use of interruptible service classes, which limit certain customers' consumption, and issuing system alerts, which direct natural gas transporters to manage gas flows to prevent imbalances that can lead to system pressure issues or disruptions.

If an LDC forecasts that demand in a given area will exceed the system's capacity to meet that demand due to supply constraints, the LDC may impose a moratorium on new gas connections to help ensure that the LDC can continue to deliver gas reliably to existing gas customers. In such circumstances, utilities must comply with the PSC's moratorium management procedures, which are intended to ensure that moratoria are invoked, managed, and released in a fair, equitable, and transparent manner for all consumers, including those in DACs.[11]

Annual Winter Reliability and Preparedness Planning

Each year, DPS assesses the readiness of New York's natural gas system to meet customer energy needs for the upcoming winter. This includes reviewing the LDCs' forecasts of firm demand under extreme cold weather, or "design day" conditions, and their supply portfolios to ensure they have sufficient capacity to meet that demand. DPS also evaluates LDCs' hedging programs and provides estimates of average winter heating bills for gas customers across the state. DPS presents its findings to the PSC at its October monthly session.

Design day demand is the amount of gas that utilities or suppliers forecast their firm customers would need on an extremely cold day. While methodologies vary, utilities typically define their design day conditions as at or near the coldest actual weather historically experienced in their region(s). As such, gas utilities' definitions of design day conditions vary throughout the state from average daily temperatures of between 0°F and -20°F. Design day demand is used for measuring the peak amount of gas that utilities must be prepared to deliver to ensure reliability. This makes design day demand the foundational engineering design criteria for reliable physical operation of the system and capacity planning at all levels—supply, transmission, and distribution.

Rate Cases

Gas utilities operate as regulated natural monopolies in New York. As described above, utility delivery rates include all the costs that the utility incurs to own, operate, and maintain its system to provide customers with utility service. Delivery rates are established through a formal legal process referred to as a rate case.[12] A rate case begins when a utility requests to increase the delivery rates it charges customers. The utility files expert testimony describing why its proposed rate increases are necessary. DPS performs extensive evaluations of the proposed capital investments, operating expenses, and resulting delivery rates proposed by utilities in their rate filings to determine what level of investment and rates are justified. DPS recommends to the PSC an appropriate balance of funding to ensure safe, reliable service while maintaining just and reasonable rates. Intervening parties, such as those representing customers, can also make recommendations in a rate case. Based on the evidence presented by the parties—DPS Staff, the LDC, and any intervenors—the PSC issues a final decision on the rate proceeding.

Gas Planning Order (20-G-0131)

On May 12, 2022, the PSC issued its "Order Adopting Gas System Planning Process" in Case 20-G-0131, which created the currently effective long-term gas system planning process and simultaneously closed its "Proceeding on Motion of the Commission to Examine Policies Regarding the Expansion of Natural Gas Service."[13] Both of these actions were, in part, in response to the enactment of the Climate Act. The Gas Planning Order established a process to modernize LDCs' planning practices to focus on maintaining reliability, ensuring affordability, and reducing emissions as the State transitions to alternative energy sources.

The Planning Order requires LDCs to file long-term gas plans (LTPs) every three years, covering twenty-year planning periods. The LTPs are staggered to ensure stakeholders have adequate time to engage on each individual LDC. Each LTP involves significant effort to educate stakeholders on the design, operation, and planning requirements of natural gas systems. The first LTP was filed by NFG, and the PSC has now considered LTP filings by NFG, Con Edison/O&R, NYSEG/RGE, CHGE, and KEDLI/KEDNY/NMPC.[14] Corning and Liberty Utilities have filed final LTPs that will be considered by the PSC in the coming months.[15]

The first round of LTPs generally outlined LDCs' strategies for advancing energy efficiency, building electrification, and demand response programs, such as residential "Bring Your Own Thermostat" initiatives, along with other NPAs, including targeted electrification efforts. The plans also address the potential integration of alternative fuels, such as RNG, into the LDCs' gas systems. In addition, the LTPs include long-range supply and demand forecasts, capital investment plans, gas peaking supplies, hydraulic modeling, potential bill impacts, and benefit-cost ratio analysis for various scenarios over a 20-year horizon.

2.3.2. Current Laws and Regulations

As outlined above in Section 2.1.4, the gas sector must adhere to regulations and oversight related to safety, reliability, cost, and environmental impacts—including impacts from GHG emissions. The key laws and regulations relevant to New York's natural gas sector are described in more detail below.

Federal

At the federal level, several agencies are involved in establishing and enforcing rules and regulations that apply to the natural gas system with the aims of safeguarding public health, environmental quality, worker safety, and market fairness. This section describes key agencies and current policies; however, future federal policy regarding regulation and oversight of the natural gas sector is uncertain.

PHMSA implements standards for pipeline safety, including requirements for periodic inspection, testing, and reporting to ensure the integrity of gas pipelines.[16] For example, in 2019, PHMSA promulgated a rule requiring pipeline operators to reconfirm (by 2035) the maximum allowable operating pressure of all gas transmission pipeline segments that do not have traceable, verifiable, and complete records.[17] This process is intended to ensure that pipelines continue to operate within safe limits over time and under varying conditions.

The U.S. Environmental Protection Agency (EPA) plays a role in regulating the environmental impacts of natural gas operations, such as methane emissions. For example, the EPA is responsible for developing regulations, establishing emissions measurement and verification protocols, and supporting enforcement related to the fee on gas system methane emissions established in the Inflation Reduction Act. In addition, the EPA's Supplemental Methane Emissions Rule enhances its existing requirements for leak detection, repair protocols, and other emissions mitigation measures to reduce direct GHG emissions from the natural gas sector.[18] However, this rule is under review by the current administration.

As discussed in Section 2.1.4, FERC oversees the economic regulation and permitting of interstate natural gas pipelines.[19] FERC ensures pipelines are built and operated in a competitive and transparent marketplace; as part of this authority, it reviews and approves major investments in pipeline infrastructure and establishes tariffs (i.e., rates for gas transmission) and reliability standards. FERC is responsible for balancing the interests of consumers with those of gas pipeline owners and operators, while promoting accountability and market fairness.

State

Numerous provisions of the Public Service Law (PSL) and Transportation Corporations Law (TCL) guide the PSC and utilities' actions in relation to natural gas service and the recovery of the costs of providing that service. Certain provisions of the Climate Act also inform the regulation of gas service. Some important provisions from these portions of New York law are identified and summarized below.

Section 30 of the PSL declares that "the continued provision of all or any part of such gas, electric and steam service to all residential customers without unreasonable qualifications or lengthy delays is necessary for the preservation of the health and general welfare and is in the public interest."[20] This statement of policy does not, itself, create a right or obligation, but it does give a clear direction to the PSC to enable such service through its oversight of utilities.

Under current statutes, Section 31 of the PSL and Section 12 of the TCL establish an obligation on utilities to provide gas service to residential and commercial applicants that request it and generally not to charge applicants for the first hundred feet of whatever main or service line extensions are required to

supply that service. Regulations implementing these statutory requirements are codified by 16 NYCRR Part 230, which spells out their features in detail.

16 NYCRR Part 229 describes standards related to the heating value, purity, chemical composition, and other characteristics of gas injected into the gas distribution system. This includes both conventional natural gas as well as RNG.

Section 65 and other provisions of the PSL require gas corporations to provide safe service. Section 66-u of the PSL establishes pipeline safety protocols and directs utilities to present an annual report on pipeline safety and performance measures. 16 NYCRR Part 255 discusses pipeline safety measures in greater detail.

Section 68 of the PSL requires utilities to seek a certificate of public convenience and necessity from the PSC before constructing gas plant or commencing operation pursuant to a previously unexercised local franchise. It also establishes conditions for the grant of such certificates.

Article VII of the PSL governs New York's process for reviewing and siting natural gas infrastructure projects within New York State, such as pipeline expansions or new gas storage facilities. The Article VII process requires that projects' potential impacts on the environment, safety, and community are evaluated to determine potential adverse effects prior to approval. The process also includes opportunities for public participation through hearings to ensure local community concerns can be identified.

The Climate Act adds GHG emissions and local pollution impacts in DACs to the list of topics that the PSC is required to consider when it makes decisions about natural gas infrastructure and service. For example, §7(2) of the Climate Act requires state agencies, including the PSC, to consider whether their decisions "are inconsistent with or will interfere with the attainment of statewide greenhouse gas emissions limits." §7(3) directs state agencies to not disproportionately burden disadvantaged communities and directs them to prioritize reductions of greenhouse gas emissions and co-pollutants in disadvantaged communities. The PSC has determined that a §7 analysis is needed in a wide variety of decisions, notably including rate cases that authorize rate recovery of LDC investments.

DEC is also responsible for several regulations related to the natural gas sector. These include:

- 6 NYCRR Part 203, through which DEC regulates methane and volatile organic compound emissions (i.e., fugitive emissions) from natural gas sector sources. Emissions are controlled through requirements for maintenance, continuous leak detection, and repair if a sufficiently significant leak is identified;
- 6 NYCRR Parts 552 to 554, through which DEC regulates permits to drill, deepen, plug, or convert gas wells. DEC also regulates well drilling practices, spacing, and reporting requirements;
- 6 NYCRR Parts 555 and 556, through which DEC regulates operating practices for active natural gas wells and the plugging and abandonment of retired natural gas wells; and
- Clean Water Act, Section 401, WQC.

2.3.3. Laws and Programs That Affect the Gas System

Some policies and programs that target other sectors but have important interactions with or effects on the gas system are noted below. Additional policies and programs related to efficiency and building electrification are discussed in the Buildings chapter of this Plan.

The New Efficiency: New York program authorizes utilities to recover the costs of energy efficiency and weatherization investments at customer premises. By reducing overall energy use and natural gas consumption, the program plays a key role in supporting the State's decarbonization goals. The Climate Act codified the program's primary target, a reduction of 185 TBtus of end-use energy consumption by 2025, relative to a business-as-usual baseline.

The State's Code Council has adopted Uniform and Energy Codes that prohibit the installation of fossil-fuel equipment and building systems in new buildings, with some exceptions. Because the codes apply only to new construction, and buildings tend to have long lifetimes, the resulting reduction in gas demand is expected to be modest in the near term but grow over time. It is also important to note that select uses (e.g., manufacturing facilities, hospitals, agricultural buildings, emergency backup power, commercial food establishments, laundromats, wastewater treatment) are exempt from these code requirements.

The Utility Thermal Energy Networks and Jobs Act of 2022 aims to support the development of thermal energy networks (TENs) by utilities—including gas utilities—using the same workforce that gas utilities currently employ to install, operate, and maintain pipes that deliver natural gas to customers. The PSC is implementing the Act's provisions through Case 22-M-0429. This implementation includes steering pilot projects through several stages of planning, design, and development, as well as the drafting of regulations, based on insights gleaned from the pilot projects, to govern the development and operation of TENs more generally.

3. Outlook (2025 –2040)

3.1. Pathways Analysis

This section describes expectations for how the gas sector may evolve over the next 15 years based primarily on the Pathways Analysis conducted for the State Energy Plan and informed by other studies regarding the future of New York's gas system, including gas utilities' long-term plans. Given the inherent uncertainty of forecasting over a multidecade horizon, the Pathways Analysis takes a scenario approach. These scenarios reflect a range of levels of State policy action to illustrate the impacts of different policy approaches, including interactions across sectors. A brief description of the core scenarios developed for the State Energy Plan is provided below (Table 1).

Table 1. Summary of Scenarios in the Pathways Analysis

Scenario	Description
No Action	Includes federal incentives (as of Q3 2025) and legacy New York State policies but excludes the Climate Act and more recent additional State and local policies.
Current Policies	Current progress toward achievement of enacted State and local policies (e.g., Clean Energy Standard, building code updates, Advanced Clean Cars/Trucks).
Additional Action	All actions included under Current Policies scenario plus additional progress toward adoption of clean technologies through a mix of future programs and investments aligned with recommendations in the State Energy Plan.
Net Zero A and B	Accelerates adoption of clean energy technologies in all sectors toward achievement of economy-wide net zero by 2050. Net Zero A emphasizes all electric space heating while Net Zero B assumes greater use of supplementary gas heating systems.

The discussion in this section focuses primarily on the Additional Action scenario which is intended to describe an ambitious but attainable level of achievement under foreseeable policy actions and market transformation. A more detailed description of the methodology, design, and results of these scenarios can be found in the Pathways Analysis chapter of this Plan.

3.2. Demand

The natural gas sector is entering a period of significant change. Over the next fifteen years, market forces, a warming climate, and policy advancing the state's GHG emission reduction targets are expected to induce a decline in gas system utilization. As discussed in Section 2.1.3, the electric generation, residential, and commercial sectors use the most natural gas in New York. Each of these sectors will be subject to significant downward pressure on gas consumption.

In the electric generation sector, natural gas and dual fuel (natural gas and oil) generators currently account for nearly half of annual in-state electricity production. As described in greater detail in the Electricity chapter of this Plan, while aggregate demand for electricity is expected to rise significantly due to transportation and building electrification and the interconnection of new large electric loads, the role for natural gas-fired power plants is expected to decline over time as New York deploys clean energy resources and advances toward the clean electricity targets set forth in the Climate Act.

In residential and commercial buildings, space heating comprises the largest use of gas. Demand for space heating is expected to decline over time as the climate warms.[21] For instance, Con Edison has projected that its natural gas business could experience an estimated 33 percent decrease in winter energy sales by 2050 as a result of a warming climate (i.e., not from changes in demand due to electrification or efficiency).[22] In addition, shifting consumer preferences and State and local policy supporting efficiency and electrification are also expected to drive reductions in gas consumption. For example, new, zero-emission building and energy codes prohibit the installation of fossil-fuel equipment and building systems in new buildings, with some exceptions. Federal appliance standards and State building codes promote improvements in energy efficiency. State incentives for heat pumps and energy

efficiency will continue to drive reductions in gas consumption in buildings. The future of federal appliance standards is uncertain and expected to have far-reaching effects.

In the Additional Action scenario, the share of residential housing units with upgraded building envelopes is expected to rise from 6 percent currently to 45 percent (3.3 million households) by 2040. This scenario also sees the share of housing units with heat pumps used as the primary heating source rise from around 5 percent currently to 26 percent (2.0 million households) in 2040, the majority of which are full load heat pumps. While the specific level of clean energy deployment varies across the scenarios in the Pathways Analysis, all scenarios see a shift from gas-fired appliances toward electric appliances.

As shown in Figure 9 and Figure 10, these trends result in declining gas consumption across all State Energy Plan scenarios. The combination of declining gas system utilization with an ongoing need for significant investment in system maintenance and modernization creates challenges for affordability and necessitates thoughtful policy and planning approaches to strategically manage the gas transition. In the Additional Action scenario, gas throughput to non-electricity generation declines by nearly 24 percent by 2040. Notably, there may be significant regional variation in gas consumption trends, requiring gas infrastructure investments to be assessed on a case-by-case basis. For instance, under its LTP reference cases, Con Edison projects an 18 percent decline in throughput from 2025 to 2040, whereas NFG projects a 10 percent increase and NMPC projects a 1.7 percent increase over the same period.

Figure 9. Gas Consumption by Scenario

Source: Pathways Analysis

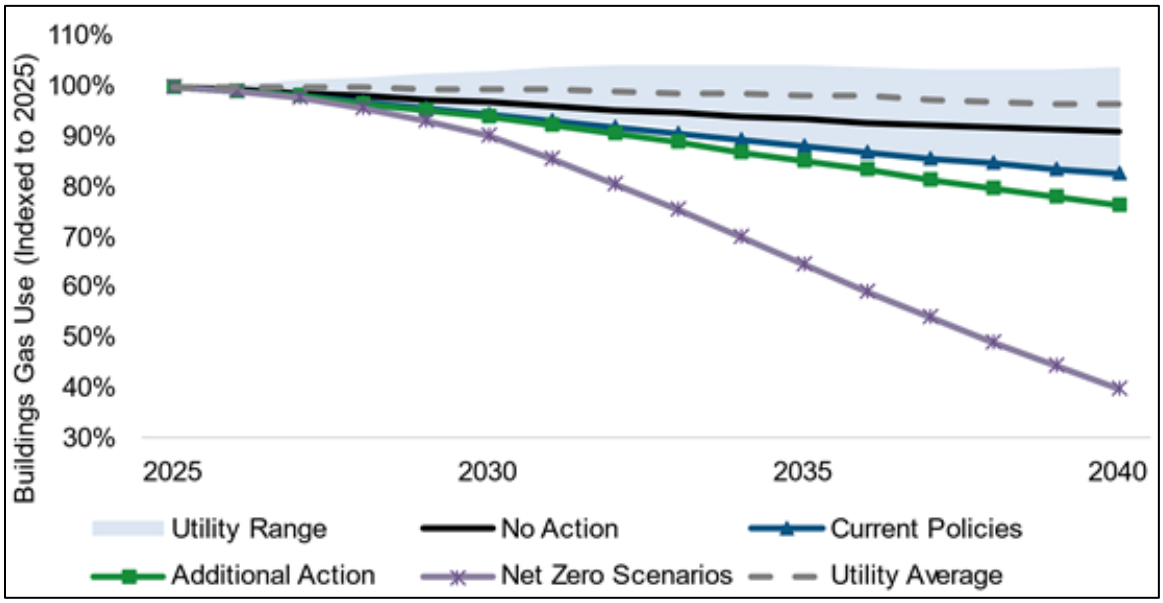


Figure 10. Gas Throughput Percentage Change vs. 2025 (Excl. Power Sector)

Source: Pathways Analysis

Gas Throughput (Tbtu) % Change vs. 2025 (excl. power sector)			
Scenario	2030	2035	2040
No Action	-3.3%	-6.5%	-9.1%
Current Policies	-5.6%	-12%	-17%
Additional Action	-6.2%	-15%	-24%
Net Zero Scenario A	-9.9%	-35%	-59%
Net Zero Scenario B	-9.9%	-35%	-59%

In addition to declining throughput or energy in the gas system, the number of customers connected to the gas system is also expected to decline as some customers fully electrify their end uses. This decline is expected to occur at a slower pace than the decline in gas system throughput. Consequently, the amount of gas used per customer will likely decline over time as customers adopt energy efficiency measures and partially electrify. As shown in Figure 11 and Figure 12, the number of residential gas customers is expected to decline by 12 percent by 2040 in the Additional Action scenario. However, as with throughput, the trend for customer count is expected to vary by region. For example, under its LTP reference cases, Con Edison projects that its customer count will decline by 11 percent from 2025 to 2040, while NFG projects that its customer count will increase by 4.7 percent and NMPC projects that its customer count will increase by 4.6 percent over the same period.

Figure 11. Residential Gas Customers by Scenario

Source: Pathways Analysis

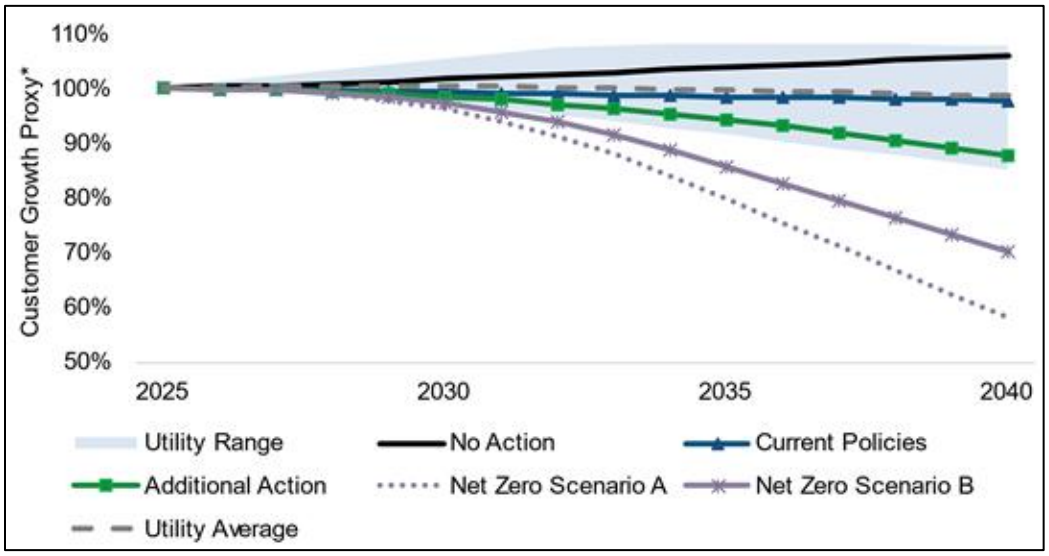


Figure 12. Gas Customer Count Percentage Change vs. 2025

Source: Pathways Analysis[23]

Residential Gas Customers % Change vs. 2025			
Scenario	2030	2035	2040
No Action	1.7%	3.8%	6.0%
Current Policies	-0.8%	-1.5%	-2.2%
Additional Action	-1.5%	-5.7%	-12%
Net Zero Scenario A	-3.8%	-20%	-42%
Net Zero Scenario B	-2.8%	-14%	-30%

3.3. Alternative Fuels

The source of gas flowing through the gas distribution system is also expected to change over time in some scenarios. Currently, virtually all gas delivered by the gas distribution system is sourced from fossil fuels. While the supply of low-carbon alternative fuels is expected to be limited, necessitating a continued focus on efficiency and clean electrification as the pillars of the State's decarbonization strategy, RNG can play a role in reducing emissions on the gas system. In the Additional Action scenario, incremental policies support the deployment of 24 Tbtu of RNG or 3.4 percent of the energy delivered by the gas distribution system in 2040. The production, delivery, and prioritization of alternative fuels is discussed in greater detail in the Low-Carbon Alternative Fuels chapter of this Plan.

Figure 13. RNG in the Gas System by Scenario

Source: Pathways Analysis

RNG Energy (TBtu) and Blend %		
Scenario	2040	
	TBtu	% Blend
Baseline	0	0%
Current Policies	0	0%
Additional Action	24	3.4%
Net Zero Scenario A	109	33%
Net Zero Scenario B	109	33%

4. Themes and Recommended Actions

4.1. Reducing Natural Gas Use

Under both Current Policies and Additional Action, statewide natural gas system throughput and customer counts are projected to decline by 2040—though specific regions within New York may see growth in the near term. Net Zero Scenarios A and B result in steeper declines in both gas system throughput and customer counts. While overall decline is projected in all cases, natural gas will continue to be an important fuel source through 2040 and likely beyond (see Figure 14).

Figure 14. Range of Reductions in Gas System Use Under Pathways Analysis Scenarios by 2040

Source: Pathways Analysis

Range of Reduction	Current Policies & Additional Action	Net Zero Scenarios A and B
Residential Customer Count	2% - 12%	30% - 42%
Residential Throughput	19% - 28%	60%
Commercial Throughput	16% - 18%	58%

A reduction in statewide natural gas consumption, if realized, would end approximately two decades of expansion in system use. As discussed in greater detail below, the pivot requires a different planning, regulatory, financial management, and ratemaking paradigm than currently exists. The PSC's Gas Planning Order and the resulting long-term gas planning process described above (see Section 2.3.1) constitute an important initial step toward creating this new paradigm.

Recommendations

- The PSC and supporting agencies should continue to reform the regulations that govern gas planning, investment, and ratemaking to facilitate a safe, reliable, and affordable gas system. Specific changes, discussed in greater detail in the following sections, include but are not limited to:
    - enhanced resiliency planning;
    - long-term planning;
    - integrated electric and gas system planning;
    - innovative cost recovery mechanisms;
    - evaluation of the potential expanded use of alternative fuels;
    - continued exploration of whether "certified" or "differentiated" gas reduce emissions;
    - strategically managing the gas transition for gas sector workers and businesses; and
    - strategically managing the gas transition for DACs.

4.2. Planning for Safety, Reliability, and Resiliency

As demonstrated in Sections 2 and 3, gas provides a wide range of essential energy services to New York residents and businesses and is expected to continue to do so through at least 2040 in all scenarios, even as decarbonization efforts continue. It is therefore imperative that the gas system remains safe, reliable, and resilient to both ongoing and emergent risks driven by climate change.

For a detailed discussion of the threats to and vulnerabilities of New York's energy sector (including the gas system), cross-sector interdependencies, and strategies to ensure resilience, see the Energy Security Planning and Emergency Preparedness chapter and the Climate Change, Adaptation, and Resiliency chapter of this Plan. In 2024, the New York State Climate Impacts Assessment (NYSCIA) was released to investigate and document how climate change is affecting New York's communities, ecosystems, and economy based on the latest science, data, and models. The NYSCIA's Energy chapter contains a detailed discussion of how climate change is expected to affect the energy sector.[24] A limited discussion with a particular focus on the gas system is provided below.

Extreme cold. Extreme cold temperatures can affect the natural gas supply system by freezing fluid handling equipment, compressors, valves, and other equipment when gas demand is at its highest. Extreme cold can also affect road conditions impacting the ability of trucks to safely deliver CNG. Historically, major disruptions to New York's natural gas supply due to extreme cold temperature, have been infrequent. However, recent Winter Storms Uri, Elliott, and Enzo all produced extreme cold weather events that led to disruptions in gas delivery systems. While extreme cold temperatures will continue to occur, extremely cold days are expected to occur less frequently.[25] New York's gas transmission and distribution system owners and operators can and do implement standard practices, such as insulating pipes, to protect gas infrastructure from freezing.

Temperature variability. Much of the gas system's infrastructure is underground, where it is partially insulated from variations in air temperature. While this provides a resiliency benefit, temperature fluctuations can still pose a risk to gas system infrastructure. For instance, increased variability in winter temperatures could increase the frequency of freeze-thaw cycles, as well as frost heaves in certain areas, impacting brittle underground infrastructure. In addition, some gas infrastructure is typically above-ground and must be resilient to temperature extremes. For example, extreme heat may require greater cooling needs at compressor stations.

Precipitation, flooding, and sea level rise. Flooding associated with heavy precipitation is expected to occur more frequently and with greater intensity in New York over time.[26] Flooding can pose an increased risk of washouts or circumstances where water will infiltrate pipes and cause service interruptions by affecting the movement of gas through the pipes and by reducing system pressure. Infiltration is especially a concern with low-pressure systems that contain gas mains made from cast iron or uncoated/bare steel pipes that can be prone to leaks. Flooding can occur even in non-coastal regions. For example, in 2011, Hurricane Irene resulted in major flooding throughout the Catskill and Adirondack mountains as well as Vermont, causing approximately 1,300 customers to lose gas service. In addition, as sea level rises, groundwater levels may also rise, increasing the exposure of underground infrastructure to groundwater, which can lead to corrosion in unprotected systems.

High winds and tornados. High winds can damage above-ground facilities like compressor stations, metering, and regulation stations. In addition, power outages caused by wind-related damage may impact electric compressor operations.

Human error. Accidental strikes to underground pipelines during maintenance or construction activities can cause leaks. Valves that are left open accidentally or operated without proper adherence to safety regulations can increase the risk of leaks or explosions.

Cyber and physical attacks. There are interdependencies between the energy system and the information system. Attacks from malicious actors on information systems can disrupt operations that ensure safe and reliable energy delivery. Physical gas system assets, particularly those above-ground, can also be targeted for attack by malicious actors.

Potential exposure to disruptions that occur outside of New York. Because New York imports most of its natural gas supply from out-of-state, extreme weather events or other disruptions that impact "upstream" gas supply infrastructure can affect the state. For instance, in December 2022, Winter Storm Elliott affected New York as well as several nearby states and parts of Canada. During that storm, frigid temperatures caused outages at natural gas wellheads due to freezing equipment, leading to a 16 percent reduction in natural gas production in the U.S.[27] The largest gas production declines (23 percent to 54 percent) occurred in the Marcellus and Utica Shale formation areas. These conditions nearly resulted in a gas outage event in New York City with Con Edison and National Grid experiencing reliability-threatening low pressures on one of the interstate gas pipelines they rely upon for supply. The potential for upstream extreme weather events to impact the reliability of New York's energy system underscores the importance of maintaining a diverse energy portfolio—both in terms of geography and fuel types—as part of the State's strategy for energy reliability planning.

All supply sources can be vulnerable to varying degrees to the physical risks described above. In addition, some sources of supply, like peaking services, can carry renewal risks in that utilities may not be guaranteed access to that supply after their current contracts expire.[28] Given these risks, utilities and the State must ensure that the gas system has access to a portfolio of supply sources that, in the aggregate, provides a high degree of reliability and resiliency. Such a portfolio reduces the likelihood that an individual supply source's vulnerabilities will result in service disruptions to customers.

Recommendations

- DPS, DHSES, NYSERDA, utilities, and other stakeholders should continue to perform the actions described below to support a reliable and resilient gas system. Where appropriate and possible, efforts should also be enhanced.
    - Conduct emergency planning for hazards in advance. Processes like the State Comprehensive Emergency Management Plan, the State Hazard Mitigation Plan, the State Energy Emergency Plan, and cross-sector coordination in advance of seasonal peaks in energy demand are essential for identifying, understanding, and developing and implementing risk reduction strategies for potential hazards to the energy system.

  - Coordinate between responsible parties. Close coordination among energy and telecommunication providers, emergency responders, and local governments can improve response time and effectiveness in the event of energy losses caused by extreme weather. Mobilizing logistics, supply chains, and personnel in advance can also increase resiliency.
  - Ensure continued compliance with pipeline safety regulations. Pipeline regulations promulgated by PHMSA, the PSC, and DEC are intended to ensure safe operation of the gas system.
  - Upgrade infrastructure and install on-system safety devices. Replacement of leak-prone pipes (LPP) can proactively reduce the risk of leaks and the risk of water infiltration from flooding. Installation of residential methane detectors can reduce the risk that leaks on customer premises go unnoticed. Excess flow valves on gas service lines reduce leakage and risks to customers in the event of a significant leak or damage.
  - Enhance demand management. Risks and impacts of disruptions to gas supply and delivery can be mitigated through solutions that increase end users' capacity to reduce their reliance on gas generally or during periods of disruption or high demand (e.g., energy efficiency, demand response, backup fuels, and resilient electrification of heat using cold climate air-source heat pumps, ground-source heat pumps, or TENs).
  - Maintain a diverse supply portfolio. This can include geographically diverse supply sources, gas storage, and avoiding overreliance on interruptible supply contracts, which may not be available during extreme weather events. The State should also ensure the supply portfolio and associated infrastructure are appropriately resilient to contingencies and other risks (see Section 4.3.4).

- Study and plan for climate change vulnerabilities. Dedicated studies to evaluate utility systems' vulnerabilities to climate risks can be used to develop resiliency plans to address those vulnerabilities. Electric utilities and joint gas and electric utilities are required to complete climate change vulnerability studies to evaluate infrastructure, design specifications, and operational processes at risk from climate change.[29] Gas utilities could also conduct climate change vulnerability studies and develop resiliency plans with a particular focus on how extreme events can affect upstream and midstream elements of the gas system.
  - Use the best available climate models and weather data for energy planning. Incorporating weather forecasts into gas system operational planning and utility emergency response can ensure the appropriate range of conditions are evaluated as discussed below (see Section 4.3.4).

4.3. Planning for Efficient Investment

The gas sector is entering a period of significant change, driven by market forces (including the emergence of technically and economically viable electric alternatives for many services currently

provided by gas) and policy supporting the achievement of statutory GHG emission reduction targets. These changes are expected to induce a decline in gas system utilization by 2040, thus reversing the continuous expansion of the gas system seen in past decades.

Declining gas system utilization, whether driven by market forces or policy imperatives, poses a threat to the State's goal of affordable energy. Multiple long-term gas planning studies have shown that scenarios in which gas system utilization declines significantly tend to result in large increases in gas distribution rates and correspondingly large increases in gas bills among customers remaining on the gas system.[30] Notably, in such scenarios, many of the customers remaining on the gas system may be those who cannot afford the upfront cost of electrification (even if they would be better off over time, financially, by electrifying). Thus, low- and moderate-income (LMI) customers and customers in DACs may be particularly at risk.

Declining gas system utilization also poses significant risks for businesses and employees who work, directly or indirectly, in the gas sector. If a significant number of customers depart the gas system and the customers who remain cannot bear the full cost of maintaining the gas system, there is a risk that utility investments in the gas system become "stranded," meaning the utility may not be able to recover the cost of those investments from its customers.

Enhanced gas planning practices (discussed below in Sections 4.3.1 through 4.3.4) are needed to help address these significant challenges, especially by enabling safe and strategic reductions in gas system investment.

4.3.1. Long-Term Planning

As described above (see Section 2.3.1), the PSC's May 2022 Gas Planning Order initiated a process requiring gas utilities to develop LTPs covering a 20-year horizon. All utilities in the state have submitted final LTPs. The PSC has issued orders addressing LTPs from NFG, Con Edison/O&R, NYSEG/RGE, CHGE and KEDLI/KEDNY/NMPC and is still considering the LTPs of Corning and Liberty Utilities.

These LTPs have consolidated several important planning functions, including:

- Modeling future demand under various scenarios;
- Identifying supply sources, including peaking services;
- Assessing supply constraints and investment needs to maintain supply adequacy;
- Highlighting opportunities for terminating supply contracts, where feasible;
- Projecting the effects of and need for energy efficiency, electrification, and demand response;
- Evaluating the potential role of alternative fuels;
- Estimating customer bill impacts under different scenarios; and
- Identifying barriers to achieving State policy goals such as decarbonization, including potential regulatory or policy changes needed.

While these planning functions are foundational, they can be augmented and improved upon to fully realize the PSC's vision for "a modernized gas planning process that is comprehensive, suited to forward-looking system and policy needs, *designed to minimize total lifetime costs*, and inclusive of stakeholders."[31] To adequately plan for the anticipated decline in gas system utilization, utilities should be required to identify which portions of their service territories will remain part of the gas network over the long term and which may transition away from gas service. Relevant considerations include whether an area contains customers with difficult-to-electrify end uses such as high-temperature process loads, and the cost, if any, of electric system upgrades that would be required to electrify customers in the area.

Making this differentiation is essential because it allows utilities, the PSC, and stakeholders to distinguish between:

(a) Areas where continued investment in the natural gas system presents a low risk of stranded assets and may be appropriate for future deployment of alternative fuels; and

(b) Areas where the natural gas system may be reduced or eliminated allowing resources to be directed toward full electrification, TENs, or other solutions.

In short, this differentiation is necessary to support the type of multidecade infrastructure investment prioritization necessary to ensure the safety, reliability, and affordability of the State's energy systems.

Indeed, the PSC has underscored this need in LTP proceedings. For example, the PSC directed Con Edison and O&R "to develop a specific definition of hard-to-electrify customer sectors" and "to include pilot projects for directing low-carbon fuels to these customers in their next rate case filings and in their next long-term plan filing."[32] The PSC has emphasized that identifying where hard-to-electrify buildings are located is "essential in developing a long-term view of which pipes are critical in supplying fuel to these buildings and would help stakeholders and regulators better understand which regions or neighborhoods are forecasted to remain on the gas network and which regions and neighborhoods are forecasted to be potentially electrified."[33] Similarly, in PA Consulting's review of Central Hudson's LTP, it recommends that Central Hudson "develop a holistic geographical view to determine which customers and use cases are most or least likely to remain on the gas network over time, and which areas could electrify between now and 2050."[34] PA notes that this would allow Central Hudson to develop "a directional view on the geographical footprint of the gas system over time" to identify "no-regrets" investments, and that this "would assist in [Central Hudson's] multi-decade prioritization of gas system investment decisions."[35]

The second cycle of LTPs, which is expected to begin in December 2026 with NFG's second LTP, presents an opportunity to strengthen this approach. By clearly distinguishing areas where long-term investment in the gas system will be needed from areas where it can be avoided, utilities can better align their planning and investment strategies with the policy goals outlined in this State Energy Plan.

Recommendations

- The PSC should continue to require New York's gas utilities to produce LTPs and should refine the LTP process and substantive requirements based on input from DPS Staff, NYSERDA, and

stakeholders. In future LTPs, the PSC should require gas utilities to identify areas where the gas system will be necessary in the long-term and prioritize investment in those areas over others.

4.3.2. Integrated Energy System Planning

Historically, natural gas and electric utilities' planning practices have been largely independent from one another even in areas where electric and gas service is provided by the same parent company. This was adequate when demand trajectories for natural gas and demand for electricity were largely unrelated. The emergence of electrification—which can provide energy services frequently met by natural gas today like space heating, water heating, and cooking—as a primary strategy for reducing GHG emissions constitutes a fundamental change in which demand for natural gas and electricity is expected to be much more closely linked.

Accordingly, investment in both systems at all scales, will also be more closely related. For instance, if customers on a particular section of the gas system electrify, this may enable the gas utility to reduce or avoid investment in that part of the gas system. However, this can only be achieved if the corresponding portion of the electric system is able to accommodate increased electric demand. In some cases, focusing electrification efforts on ground-source heat pumps and TENs, which contribute less to peak electricity demand than air-source heat pumps, can enable more efficient energy system investment. TENs can also promote neighborhood scale electrification and efficiency by linking sources of waste heat to customers with thermal energy needs and by integrating thermal storage to shift load at scale. Broadly, ensuring both efficient investment and reliability depends on closer coordination between electric and gas system planners. This is sometimes referred to as integrated energy system planning or integrated planning.

More integrated planning is essential to guide an efficient and equitable energy transition. Integrated planning is not a single action or tool. Rather, it requires reforming utility practices and analytical tools to incorporate relevant information from both the gas and electric systems, along with customer-level insights, across all planning scales.

Integrated planning will require the development of new datasets and analytical tools. Key components of this approach may include but are not limited to:

- Restructuring utility planning teams to support joint responsibility for gas and electric planning;
- More robust data sharing between electric and gas utilities;
- Linking gas hydraulic analysis and electric power flow modeling;
- Improved mapping of gas and electric system assets; and
- Identifying priority electrification zones, including those that could be suitable as TENs, based on sections of the gas system that can be strategically downsized and sections of the electric system capable of supporting increased load.

Collectively, these and other strategies can help minimize total investment by optimizing the entire energy system to maintain safe and reliable energy service rather than managing the gas and electric systems in isolation.

Existing Initiatives

Existing proceedings such as the long-term gas planning proceeding (20-G-0131) and the proceeding on utility thermal energy networks (UTENs) (22-M-0429) are advancing progress on integrated planning. Other efforts include, but are not limited to, the following examples:

- Central Hudson LTP – identified areas where gas system investment may be needed in the next decade and overlaid projected winter electric system headroom to find where gas system investment could be avoided or deferred without straining the electric grid.[36] Central Hudson then developed proposed electrification and demand response portfolios to provide the necessary peak load reduction needed.[37] These analyses required the development of new datasets (e.g., locationally granular electric and gas demand forecasts) and analytical tools (maps overlaying gas and electric system load).

- NYSEG/RGE LTP – the PSC directed NYSEG/RGE to adopt a "joint-planning approach across their electric and gas companies to develop the most cost-effective and efficient solutions for customers and the Companies to support strategic downsizing and increase electrification."[38] NYSEG/RGE has a single team that works on both NPAs and non-wires alternatives.

- National Grid – electric and gas planning asset management teams began exploring integrating energy planning in 2022.[39]

- Avoided Cost of Gas Working Group – the PSC established a working group in 2022 to develop best practices for calculating the avoided cost of gas. The working group may produce information useful for integrated planning, such as indices that can be used by gas utilities and stakeholders to evaluate the trade-offs between investments in the gas system and investments that enable reductions in gas system usage.

- Utility Thermal Energy Networks and Jobs Act (UTENJA) – UTENJA was passed in 2022, and enables utilities to invest in, own, and operate UTENs. It also created a framework to conduct UTEN pilots that will help New York utilities gain experience developing thermal networks and help the regulators establish a supportive regulatory framework for UTENs. UTENs may emerge as an important component of an integrated planning strategy because they can enable electrification with lower impact on peak electricity demand. UTENs and TENs are discussed more in the Buildings chapter of this Plan.

While these efforts represent important progress on integrated planning, more work is needed. In the coming years, electric and gas utilities will need to fully integrate planning practices to ensure coordinated and strategic investments in their systems. By enabling utilities and other stakeholders to consider interdependencies between the gas and electric systems, integrated planning can identify the infrastructure investments that maximize beneficial outcomes such as avoiding or deferring investment,

improving system reliability, improving customer choice, and reducing emissions. The PSC and DPS staff will have an essential role in guiding the development of integrated planning practices.

Recommendations

- The PSC, with support from DPS staff and NYSERDA, should build on past progress to further advance integrated planning. This could include directing gas and electric utilities to develop standardized, locationally specific, and transparent joint planning practices that enable optimized energy system investments. Early efforts may focus on areas where gas and electric service are provided by the same company to ease integrated planning.

- NYSERDA and DPS staff should work with utilities, local governments, and other agencies and stakeholders to promote the development of datasets and analytical tools that can support integrated planning. These may include locationally granular forecasts of gas and electric system peak demand, maps of thermal resources, models that link gas hydraulic analysis and electric power flow modeling, and tools that map physical components or assets of the natural gas and electric systems. These datasets and analytical tools should be made publicly available where possible, with appropriate confidentiality protections for critical energy infrastructure data, to enable non-utility stakeholders to contribute to integrated planning efforts.

4.3.3. Non-Pipe Alternatives

Non-pipe alternatives (NPAs) refer to alternatives to traditional investments in the gas system. NPAs typically involve investments in energy efficiency, electrification, demand response, and/or alternative fuels or other peaking supplies. New York's utilities have established initial practices to evaluate NPA opportunities, but NPA implementation has been limited to date. For instance, as of November 2025, only 12 of the 2,394 sections of gas main that Con Edison identified as suitable to be assessed for NPA feasibility and cost-effectiveness have been completed as NPAs.[40] Only five of the 41 potential NPA projects Central Hudson identified between 2019 and 2024 have been completed as NPAs; 20 had insufficient customer interest, 11 were deemed unsuitable for NPA, and five are in progress or planning phases.[41]

More widespread deployment of NPAs is needed to enable safe and strategic reductions in gas system investments. Accordingly, utility planning practices should evolve to support NPA deployment. Indeed, the PSC's Gas Planning Order stated that "LDCs should integrate NPAs into their standard gas system planning processes, both in the context of specific avoidable projects in a particular area of the distribution system, and system-wide to reduce overall demand and the need for infrastructure investment."[42] Subsequent Commission orders on individual gas utility LTPs have directed utilities to take further action and refine their approaches to NPA identification and deployment.[43]

To successfully implement an NPA, utilities must ensure customers' energy needs can be met without additional investment in the gas system. NPAs can be categorized based on the type of gas system investment they are intended to avoid: system extension, capacity expansion, or pipeline replacements.[44] Each category requires a distinct planning approach as outlined below.

NPAs to Avoid System Extension to New Customers

This type of NPA requires providing potential new gas customers with an alternative to gas service, thereby avoiding investment to extend the natural gas system. Notably, it is already common practice for New York's gas utilities to inform customers requesting gas service about the availability of electric alternatives and incentives to electrify. Nonetheless, gas utilities in New York State have been adding approximately 20,000 new customers per year in recent years, in a combination of new construction and conversions from other heating fuels.

To improve the effectiveness of NPAs that avoid new customer connections, utilities and NYSERDA could identify those that are likely to request new gas service, such as those currently using oil or propane for heating, and proactively market electrification or electrification-readiness upgrades, highlighting opportunities for cost savings.

NPAs to Avoid Capacity Expansion to Meet Demand Growth

This type of NPA requires reducing forecast peak demand under design day conditions through demand reduction portfolios or alternative sources of peaking supply like CNG, thereby avoiding the need for investment to increase the capacity of the natural gas system.

To successfully implement this type of NPA, gas utilities must begin by identifying locations where additional capacity may be needed in the future. This assessment must be conducted with sufficient lead time to allow for the development and implementation of demand reduction portfolios before new capacity infrastructure is needed. Utilities must also ensure that the local electric system has sufficient capacity to support additional electric load resulting from these demand-side measures. As noted in Section 4.3.2, some gas utilities in New York have begun identifying this type of NPA opportunity by developing locationally granular demand forecasts.

Once utilities have identified locations where additional capacity may be needed, they must develop and implement demand management portfolios. These may be comprised of demand response, energy efficiency, electrification, and (if they are not delivered through the constrained portion of the gas delivery system) alternative or backup fuels. Notably, customers do not need to fully disconnect from the gas system for this type of NPA to be successful.

Utilities and demand management service providers need to increase their capability to quickly develop portfolios that can reliably reduce demand during peak periods. To that end, it may be necessary to develop new strategies, programs, and enabling policies to limit customer gas demand during extreme cold weather events. In locations where these strategies are implemented, utilities could lower their estimates of usage-per-customer and, by extension, their design day demand forecasts, enabling cost reductions via the deferral or avoidance of gas system investment.

To prevent inefficient investment in the gas system, utilities should continue to refine strategies to identify and implement this type of NPA. This will involve developing standardized, transparent analytical tools to identify these NPA opportunities and enhanced practices for deploying targeted demand management. The PSC, DPS staff, and NYSERDA should help guide and support this work.

NPAs to Avoid Pipe Replacements

Pipe replacement constitutes a large share of gas utilities' capital expenditures, with utility forecasts indicating that it will represent 40 percent of annual investment through 2028. The majority of this investment (79 percent) is to replace leak-prone pipes (LPP). In 2015, the PSC encouraged LPP replacement, stating that this "would increase gas safety and reliability, modernize gas transmission and distribution assets, and benefit the environment."[45] While the total amount of LPP has declined since then, substantial amounts remain, particularly in downstate regions. Fully replacing LPP is expected to cost tens of billions of dollars, underscoring the value of NPAs that avoid the need for pipe replacement. Indeed, the PSC directed gas utilities to identify "locations of specific segments of LPP that could be abandoned in favor of NPAs" within their LTPs.[46]

However, implementing NPAs in place of LPP replacement presents significant challenges:

1. A pipe segment can only be abandoned if all connected customers choose to fully electrify their gas uses or adopt another alternative to gas.
2. Some segments are hydraulically necessary to serve downstream customers, even if no customers are directly connected to the segment.
3. The corresponding electrical network must have sufficient capacity, or may require upgrades, to accommodate the additional load.

To address these challenges, utilities must identify LPP segments that may be suitable for this type of NPA. Segments on the edge of the gas network, with fewer customers or fewer customers per mile, and where the electric system has sufficient capacity, are generally more technically and economically viable NPA candidates.

Historically, gas utilities have not accounted for these factors to prioritize which LPP segments should be replaced. Replacement priority has primarily been based on physical factors that impact the likelihood of leakage.[47] While these physical risk factors need to be considered, utilities should also incorporate NPA suitability into their prioritization framework to avoid unnecessary investment in gas infrastructure.

Advancing this approach will require new datasets and analytical tools to support the identification of this type of NPA. Research and innovation are already underway. For example, a spatially granular analysis of alternatives to gas pipe replacement was recently conducted in Holyoke, Massachusetts,[48] and a study conducted for the California Energy Commission aimed to develop an analytical framework for targeted electrification and strategic decommissioning.[49] These studies both found that segment-level analysis using site-specific data can identify segments where targeted electrification and strategic decommissioning could generate cost savings (relative to pipe replacement), especially in sites with fewer customers per mile of gas main. While these studies offer a proof of concept, utilities will need to play a more active role in scaling up this type of work.

Once a utility identifies LPP segments as promising for this type of NPA, the utility must deploy a proactive and well-planned approach. Because full customer electrification is required before a segment can be abandoned, project timelines may need to span a decade or more. A phased approach, beginning

with site identification, customer relationship development, building assessments, electrification-readiness upgrades, and electric grid upgrades if needed, can lay the ground for gradual whole-building electrification and gas system decommissioning. Over time, this approach will enable a more strategic and cost-effective transition while maintaining safety and reliability.

Pipe Repair and Re-Lining

Another strategy for reducing unnecessary investment in the gas system is for utilities to pursue lower cost alternatives to pipe replacement, such as pipe repair or re-lining, when safe and technically feasible. For example, National Grid's 2024 Gas Distribution Integrity Management Plan for its Massachusetts service territory describes programs and technologies that "extend the useful life of large diameter distribution piping."[50] CISBOT (Cast Iron Sealing Robot), which has been used in New York for years, makes it possible "to seal more than 80 joints from one excavation without shutting down the main," and re-lining "extends the life of the pipeline for more than 50 years" and can be "the most cost-effective way to recondition the existing pipelines, reduce costs and minimize disruptions to the public" in congested metropolitan areas.[51] Technologies that enable pipe repair and re-lining should continue to be evaluated and implemented when possible. Such strategies are most appropriate in areas with leaking pipes or LPP that may become suitable for decommissioning in the medium-term, but that still have customers connected to the gas system. While these alternatives may be temporary, they can serve as a lower-cost bridge until customers can migrate off the gas system and decommissioning becomes possible.

Capital investments in the gas system create long-term obligations to recover the costs of those investments, contributing to the risk that natural gas will become unaffordable for customers remaining on the gas system as the State decarbonizes. Utilities must avoid such investments as much as possible through proactive planning for NPAs as described above.

Recommendations

- The PSC should continue to require that gas utilities prioritize investments in NPAs.
- The PSC should direct utilities, with support from DPS staff and NYSERDA, to develop planning tools and practices to enable the successful identification and deployment of NPAs to avoid investments in system extension, capacity expansion, and pipe replacements.
- The PSC should direct utilities to continue to prioritize lower-cost alternatives to pipe replacement such as pipe repair and re-lining, where safe and technically feasible. DPS staff and NYSERDA should work with utilities to support innovation and the commercialization of technologies that enable cost-effective pipe repair and re-lining.

4.3.4. Planning Standards

Gas utilities design their systems to ensure they can reliably deliver enough gas to meet the peak demand that their firm customers may require. As discussed in Section 2.3.1, to do so, they forecast the amount of demand that would be expected during extremely cold conditions. This is referred to as design day demand. In areas where design day demand exceeds the system's ability to provide supply and an NPA is not viable, utilities invest in expanding the gas system's capacity to ensure reliability. While

methodologies vary, utilities typically define design day conditions as at or near the coldest actual weather historically experienced in their region. This investment standard has helped ensure a very reliable gas system in New York. Gas system reliability is critical both because the gas system provides essential services to New Yorkers (e.g., home heating) and because restoring service after a disruption to gas service is very complex, time-consuming, labor-intensive, and costly (substantially more so than an electrical outage affecting a similar number of customers). As such, it is appropriate to use conservative standards for planning and investment.

While a conservative approach is certainly warranted, investments required to ensure system reliability under extreme conditions have accompanying costs. Indeed, in the context of LTP proceedings, the PSC has noted that "employing design day criteria for reliability planning is conservative, in that design day conditions are unlikely to occur in a given winter. For this reason, employing a reserve margin on top of design day conditions may impose unnecessary costs on ratepayers."[52] Accordingly, it is also appropriate to consider whether utilities' planning and reliability criteria strike the proper balance between the need for conservatism and the imperative to avoid imposing unnecessary costs on ratepayers.

Notably, the NYSCIA, which provides detailed projections of the impacts of climate change across the state through the 2080s, projects a declining incidence of extreme cold weather events (days below 0°F) across all regions statewide in the coming decades.[53] Supplemental analysis performed for this Plan, provided as an appendix to this chapter, extended this research to focus specifically on utilities' design day conditions. The research found that design day conditions are projected to occur less frequently, or not at all, in the coming decades. While further research in this area is warranted—including regarding how climate change may impact jet streams, which can create regional extreme cold weather ("polar vortex") conditions—these findings suggest that utilities could evaluate whether their current design day definitions appropriately balance reliability and affordability.

Furthermore, when forecasting demand under design day conditions for investment planning purposes, utilities should use up-to-date assumptions regarding usage-per-customer that reflect the impact of demand reduction measures (energy efficiency, building shell improvements, partial and full electrification, and demand response).

In addition to planning for potential peak demand through design day planning, gas system planners must also account for the potential disruptions to key sources of supply, or contingency risk. As discussed above (see Section 4.2), disruptions that impact "upstream" gas supply infrastructure can affect New York. Also, parts of New York's gas system are particularly constrained and rely on peaking services that can be expensive, capacity constrained, or potentially less reliable than other sources of supply. For example, the downstate region presently has a high reliance on CNG trucking to meet design day demand. While gas system planners consider these risks, there is not currently a uniform standard for evaluating gas system contingency risk. Accordingly, utilities should continue to collaborate with relevant State agencies to evaluate whether current planning practices adequately account for contingency risk.

Recommendations

- Gas utilities should evaluate whether they properly balance reliability and affordability. Definitions of design day conditions should be informed by the best and latest available climate

science, and design day demand should reflect up-to-date assumptions regarding usage-per-customer, including the impact of demand reduction measures. Design day demand calculations should be transparent.

- In addition, utilities should continue to collaborate with relevant State agencies to assess whether their planning practices adequately account for contingency risk and, if necessary, develop a contingency planning standard.

4.4. Evaluate Approaches to Manage Gas System Affordability and Support NPA Viability

Existing policies limit the tools and flexibility available to the PSC to proactively manage gas system costs and safe operation as a potentially growing share of customers opt to switch from gas service to efficient electrification. If customer counts begin to decline, then existing limits on the PSC's latitude to direct and manage the gas system transition will create long-term affordability risks for customers. If capital investments in the gas system that might otherwise be avoided continue, the costs of those investments must be recovered from fewer remaining customers and reduced gas sales.

Recommendations

- The PSC should continue to evaluate and develop new approaches to strategically manage gas system affordability, including costs borne by ratepayers resulting from system expansion or incomplete customer participation in NPAs.

4.5. Cost Recovery Mechanisms

Several of the utilities' LTPs have identified scenarios in which customer count and throughput are forecast to decline faster than annual utility revenue requirements—especially in scenarios with significant reductions in gas system use—resulting in steeply rising unit gas costs and compromising energy affordability.[54] In such scenarios, without proactive management, energy costs for customers with substantial remaining gas demand (i.e., customers that do not electrify all or part of their energy needs currently met using gas) will increase, potentially to unacceptably high levels. The high upfront cost of electric alternatives to gas appliances poses a barrier to electrification, especially for low-income customers—even in cases where the customer might otherwise be financially better off over time by electrifying. This could place an untenable cost burden on low-income customers.

Rising gas prices can also create risks for owners and operators of the gas system. If retail gas prices rise, the attractiveness of electric alternatives increases, driving electrification among customers who can afford to do so. Customer departures further increase rates and energy bills, encouraging more of the remaining customers to exit the gas system. If enough customers disconnect from the gas system, gas utilities' customer bases may no longer be large enough to recover costs needed to maintain the gas system while keeping gas rates affordable, creating stranded asset risk. This risk is particularly significant for gas-only utilities. This dynamic must be avoided to ensure a well-managed, gradual gas system transition that is not disruptive to remaining customers or the operational viability of gas utilities.

In addition to adopting practices to ensure that utilities only make necessary investments in the gas system, as described above (see Section 4.3), it will also be necessary to ensure that gas system costs are

allocated in a manner that reflects cost causation principles[55] and ensures energy affordability. Innovative cost recovery practices can support gas utility operations while helping to protect customers, especially LMI customers, from unaffordable energy costs.

There are many potential cost recovery practices that can support equitable cost allocation, some of which are outlined below. The approaches listed below are not currently recommended for implementation, but are a framework for further discussion and refinement. These mechanisms may not be necessary or advisable to implement under all potential gas system futures. Rather, they should be evaluated on an ongoing basis to determine whether, individually or collectively, they can help address an emergent need. Novel cost recovery practices could include, and may not be limited to, the following:

Accelerated depreciation. If the number of gas customers declines over time, the remaining costs for investments in the gas system that have not yet been depreciated will be recovered from a declining pool of remaining ratepayers, increasing their rates and bills. Accelerated depreciation is a practice in which utilities depreciate assets more rapidly than the traditional straight-line methodology. This mitigates energy cost burdens for the future customers remaining on the system and reduces stranded asset risk. Trade-offs accompany this approach, as it increases near-term costs for ratepayers. Accelerated depreciation can also improve alignment between cost recovery and system use by having utilities' annual depreciation expense gradually decline with gas system utilization. Notably, as part of its Gas Planning Order, the PSC directed New York gas utilities to prepare a "study that examines both the structure of accelerated depreciation and its potential impact on ratepayers."[56] The issue of accelerated depreciation has also been considered by utilities, stakeholders, and the PSC in recent gas rate cases and LTP proceedings.

Changes to rate design. If patterns of residential gas use change substantially, it may be necessary to modify gas rate design to ensure that cost recovery continues to reflect cost causation. For instance, if a high proportion of remaining customers connected to the gas system partially electrify (i.e., by partially electrifying their heating or by fully electrifying their heating but retaining gas for other end uses like cooking), then gas system throughput will decline faster than gas system costs. Under the current ratemaking paradigm, gas distribution rates would need to increase to cover utilities' annual revenue requirements and support safe and reliable operation. Increasing distribution rates would result in substantially larger bill increases for high-usage customers (i.e., customers that have not electrified at all) than for low-usage customers (i.e., customers that have partially electrified). In this scenario, cost recovery would not reflect cost causation because utilities incur similar costs in some categories costs to serve low-usage customers and high-usage customers (e.g., pipe costs associated with customer connections and system reinforcement costs associated with meeting peak demand), but would charge high-usage customers much more. In such a scenario, recovering a greater share of utility revenue requirements from low-usage customers, for example via higher fixed charges (and commensurately less from volumetric charges) or via special volumetric rates for partially electrified customers, could realign cost recovery with cost causation. This approach could also protect customers who have not been able to adopt partial electrification measures from undue energy cost burdens, a group that may disproportionately be lower-income.

Securitization. If a utility asset is no longer used and useful, it may no longer be appropriate to recover its undepreciated book value or associated utility shareholder equity returns from customers. In such cases, the remaining undepreciated book value of the asset could be securitized. Securitization enables utilities to recover the cost of capital by issuing bonds backed by future dedicated, non-bypassable utility charges. Because these charges are highly stable, the resulting bonds typically receive high credit ratings enabling lower financing costs than equity or traditional debt. This functionally replaces utility shareholders' regulated rate of return on equity with a lower bond coupon rate. Securitization could benefit both utilities and customers by moderating rates while enabling utilities to recover prudently incurred investments. However, to date, New York State has only authorized utility securitization for storm recovery costs. The use of securitization for traditional utility costs would need to be closely evaluated separately.

Electric benefit payments. In a future in which electric system demand peaks during the winter, customers who retain gas service to meet their peak heating needs provide a benefit to electric ratepayers. Retention of gas service can reduce the electric system's peak demand during the coldest hours of the year. In this way, remaining gas customers help to avoid the need for incremental investment in electricity generation and distribution capacity that would have been needed to meet a higher peak demand had those customers been fully electrified. For example, under the Pathways Analysis scenarios, the difference between Net Zero Scenario A and Net Zero Scenario B's electric peak demand is 3 GW in 2040. A higher electric peak demand would require substantial additional investments in electric generation, transmission, and distribution infrastructure. This electric sector benefit enabled by greater reliance on the gas system during the coldest hours of the year would not be compensated under the current cost recovery paradigm. Providing compensation to gas ratepayers for a share of this net benefit would reduce cost burdens on remaining gas ratepayers and improve the financial viability of a low-throughput gas system.

Affordability constraint. If the cost management strategies noted above are insufficient to provide long-term price and financial stability to a declining gas system, it may be necessary to impose limits on customer energy bills. While this approach would grant customers some protection from rising rates, it would also necessitate the establishment of an alternative mechanism to ensure utilities can recover prudently incurred costs. How such an affordability constraint and alternative cost recovery mechanism could be structured is highly uncertain.

In scenarios with steeply declining gas system usage, the practices described above could, if designed and implemented with great care, help allocate energy system costs in a manner that better reflects cost causation, supports customer affordability, and protects the financial health of the gas industry. While these cost recovery practices could be beneficial, they may have complicated or even unintended effects. As such, additional research is needed to understand their potential implications.

Recommendations

- DPS staff and NYSERDA should research innovative cost recovery practices to evaluate their risks as well as how they could support the operational viability of gas utilities, ensure energy

affordability, and improve alignment between cost causation and cost allocation across various scenarios.

4.6. Alternative Fuels

As described in the Low-Carbon Alternative Fuels chapter of this Plan, low-carbon alternative fuels are an important component of New York's clean energy transition, providing opportunities for emissions reductions in difficult-to-electrify settings while supporting emission reductions in non-energy sectors such as waste and agriculture.

4.6.1. Renewable Natural Gas

The Pathways Analysis conducted for the State Energy Plan envisions a role for RNG in a variety of settings, including replacing fossil natural gas in all end uses where gas is still used in 2050. However, supplies of low-carbon alternative fuels, including RNG, are limited and should be strategically deployed to difficult-to-electrify end uses such as industrial applications where high heat is needed, supplemental heat in uniquely cold geographies and certain building typologies, and other targeted uses. Where new infrastructure is built to enable the interconnection of RNG supplies, the State should work to ensure that the associated cost impacts to ratepayers are minimized. In addition, RNG should be sourced from sustainable feedstocks, and care should be taken to prevent unintended dual claims of associated emission reductions or environmental benefits consistent with policy recommendations in the Low-Carbon Alternative Fuels chapter of this Plan.

Recommendations

- The PSC, NYSERDA, the Department of Agriculture and Markets, and utilities should explore strategic use of RNG, prioritizing opportunities that maximize emission reductions and economic development in New York's waste and agricultural sectors.
- RNG sourced from sustainable feedstocks should be strategically deployed in difficult-to-electrify end uses.

4.6.2. Hydrogen

Hydrogen is likely to play a strategic role in New York's clean energy transition as a potential emission reduction pathway in select applications. However, wide-scale use of hydrogen to replace natural gas faces significant safety, health, affordability, and operational challenges. New York's natural gas distribution system is highly complex, and many of the physical assets that comprise it are several decades old. As such, retrofitting gas infrastructure to ensure hydrogen could be transported safely within the existing gas distribution system would be expensive. In addition, blending gas into the natural gas distribution system poses risks to customer health and safety and to customer-sited piping, appliances, and equipment that may not be hydrogen-compatible. Accordingly, blending hydrogen into the natural gas distribution system is infeasible and is not a pathway New York will pursue.

Utilities are encouraged to evaluate opportunities to strategically deploy hydrogen in clusters of difficult-to-electrify customers such as high-heat industrial facilities or facilities on constrained portions of the electricity system. This type of deployment, which can be served by limited and dedicated hydrogen

distribution infrastructure (separate from the general natural gas distribution system) may be worthwhile. Utilities, regulators, and other stakeholders should continue to conduct research on the most strategic and cost-effective uses of hydrogen, pilot projects, and similar efforts.

Recommendations

- Given the potential for negative impacts and high costs, New York should continue to not blend hydrogen into the natural gas distribution system. If warranted by future research and pilot projects, hydrogen may be strategically deployed in targeted settings, such as clusters of dedicated users with unique energy needs.

4.6.3. "Differentiated" and "Certified" Gas

"Differentiated" gas, sometimes called responsibly sourced gas, refers to gas products that claim to have lower upstream methane emissions based on their supply source. When such products are paired with third-party verification of emissions data, they may be referred to as "certified" gas.

There are active efforts to develop robust, consistent standards for the measurement and verification of emission reduction claims. This includes work by the United Nations Environmental Program's Oil and Gas Methane Partnership 2.0 and by independent non-profits. In addition, the Department of Energy Office of Fossil Energy and Carbon Management's International Measuring, Monitoring, Reporting, and Verification Working Group is working with key domestic and international gas sector stakeholders to promote reliable, consistent information on GHG emissions and intensity associated with natural gas.[57]

While New York recognizes these efforts, at this time, it is not clear that these products' emission reduction claims are fully verifiable or consistent with New York's GHG inventory methods. In addition, an operator of a natural gas well, storage facility, or compressor station that reduces its losses in the form of methane emissions also improves its own profitability. In order to receive a higher purchase price for differentiated gas, such operators should demonstrate measures that exceed New York's regulations. Accordingly, further development and engagement from researchers and industry are needed before differentiated gas can be used to claim emission reductions for the purposes of the State GHG Inventory, inventories required of regulated entities, compliance with emissions reduction targets, or other official uses.

New York is currently carefully studying differentiated gas's potential as a decarbonization strategy, including through limited procurement pilots at multiple gas utilities in the state. Work in this area may yield a promising path for quantifying upstream emission reductions and supporting procurement of lower-emissions gas supply. In that case, New York is well-situated as a significant importer of natural gas to provide leadership in requiring gas suppliers to adhere to robust upstream emissions reporting requirements.

Recommendations

- Certified gas and other types of differentiated gas products should not be differentiated in the State's annual GHG inventory nor should the State currently accept claims that these types of gas reduce upstream methane emissions in other GHG reporting contexts. Agencies should continue monitoring developments in this field and, if sufficient progress is made, develop upstream

emissions reporting and procurement standards for gas suppliers that demonstrate verifiable, additional emissions reductions.

4.7. Strategically Managing the Gas Transition for Gas Sector Workers and Businesses

New York's gas sector is estimated to currently employ over 12,000 people across the electric power generation, fuels, and distribution sub-sectors and includes jobs in construction, manufacturing, utilities, extraction, wholesale trade, professional services, and other industries.[58] The gas system will continue to play a large role in meeting New York's energy needs through at least 2040 in all scenarios, indicating an ongoing need for a robust gas sector workforce. In the near- and medium-term, the gas system's operational and maintenance requirements are expected to remain relatively steady. Over the long-term, as New York's progress toward deep decarbonization advances, there will be a need to strategically downsize the gas system, which is expected to impact the gas sector workforce. This transition is expected to take place on a multi-decade time scale.

The precise impacts of the clean energy transition on the gas sector workforce are uncertain and warrant further study. For instance, the need to strategically manage the gas transition may create additional economic and job opportunities in some sub-sectors while decreasing opportunities in other sub-sectors. Also, to the extent that the need for certain functions currently provided by the gas sector workforce is expected to decline, it will be critical to identify economic opportunities for workers engaged in those functions, including potentially as part of the broader clean energy workforce. In some cases, gas sector workers may be able to leverage existing expertise. For example, TENs projects can help enable a pipe-to-pipe transition for fossil fuel workers into the clean energy sector. In other cases, training to support the reskilling may be necessary. More detailed analysis of the clean energy transition's potential impacts on the gas sector's workforce, as well as interventions to promote economic opportunity, is needed. The Department of Labor's (DOL) Office of Just Energy Transition is engaged in supporting gas sector workers during the long-term transition. Labor unions and utilities will also play an important role in supporting this transition. The Clean Energy Jobs and a Just Transition chapter of this Plan discusses proposed future research in this area in greater detail.

Recommendations

- DOL, DPS, NYSERDA, and the State's Regional Economic Development Councils should work closely with utilities and labor organizations to leverage gas sector employees' existing skills in the growing clean energy sectors to maximize economic opportunity for current gas sector workers.
- DOL and NYSERDA should conduct research to assess the employment impacts of changes in the energy sector on fossil fuel sector workers, including in the gas sector, to support the development of just transition policies, as discussed in the Clean Energy Jobs and a Just Transition chapter of this Plan.

4.8. Strategically Managing the Gas Transition for Disadvantaged Communities

An unmanaged natural gas system transition poses significant health, affordability, and equity risks to DACs.

- Health. Combusting natural gas within homes can increase the concentration of carbon monoxide (CO), methane (CH_4), formaldehyde (CH_2O), benzene (C_6H_6), nitrous oxide (N_2O), and nitrogen dioxide (NO_2), which can pose hazards to human health particularly when there is insufficient ventilation.[59] If DACs do not have equitable access to electric alternatives, they may face disproportionate public health burdens from indoor air pollution.
- Affordability. As gas system usage declines and customers depart the gas system, the costs of maintaining the gas system will fall on remaining customers unless remedial action is taken. This could place a disproportionate energy cost burden on LMI customers and residents in DACs.
- Equity. There is a risk that DACs will not have equitable access to clean energy building upgrades such as weatherization, energy efficiency, and heat pumps, or to economic or employment opportunities associated with the clean energy transition.

New York should pursue strategic interventions to mitigate these risks throughout the gas transition.

- Program outreach. Clean energy program administrators should engage trusted community-based organizations to help reach businesses and households within DACs. Administrators should also develop communication materials that address language barriers and conduct targeted outreach within DACs.
- Program design. Programs should also be designed to address potential barriers to DAC participation. This may include incentives that cover upfront capital costs, low- or no-interest financing mechanisms, and exploring and integrating funding that can support non-energy building improvements, including health and safety upgrades that are necessary to install energy efficiency and electrification measures.
- Affordability programs. New York should continue to prioritize funding for and enrollment in programs designed to ensure customer energy affordability.
- Neighborhood-scale planning. Where appropriate, as part of their long-term planning, utilities should prioritize planning and deployment of affordable, neighborhood-scale clean solutions within DACs.

These topics are discussed in greater detail in the Environmental and Climate Justice chapter and the Buildings chapter of this Plan.

Recommendations

- NYSERDA and utilities should continue to integrate clean energy program design elements that ensure DACs and LMI customers have equitable access to clean energy upgrades.

Appendix

1. Introduction

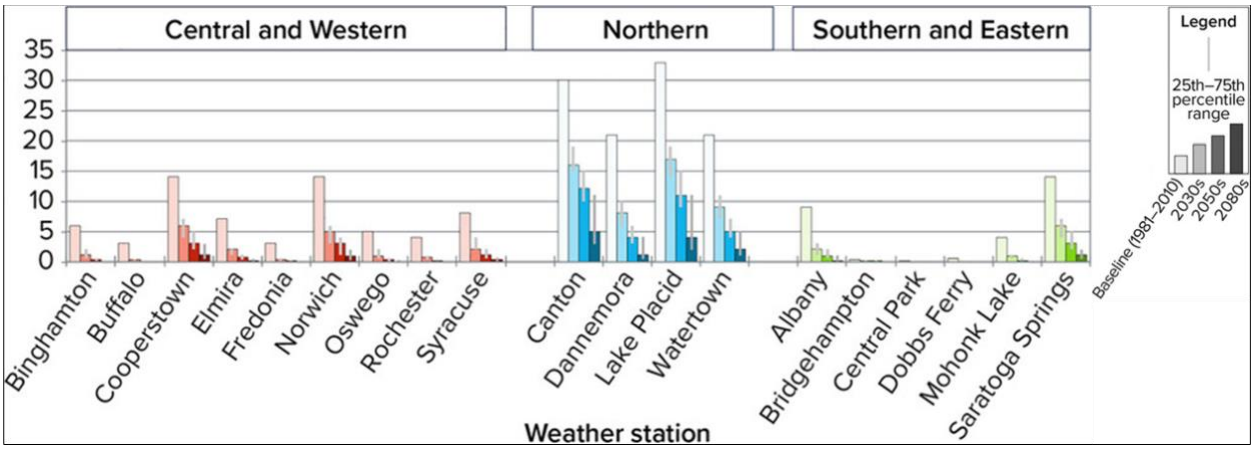
Climate change is affecting numerous sectors across the state including, but not limited to, public health and energy. Within the energy sector, warming conditions may change not only energy demand, but also the materials needed for critical infrastructure, and the conditions that must be planned for, sometimes referred to as design criteria.

Across New York State, annual average temperatures have increased by over 2.5°F since 1900, and temperatures are projected to rise between about 5°F and 11°F by the end of the century.[60] While rates of warming vary regionally, all 27 stations included in the New York State Climate Impacts Assessment (NYSCIA) experienced warming for the 1901 to 2022 time period.[61] The average rate of warming was approximately 0.20°F/decade. During this same period, winter warming occurred at 0.33°F/decade which is nearly double the rate of the other seasons.[62]

Warming temperatures can impact the frequency of cold weather extremes (*e.g.*, number of days with average or minimum temperature below a particular threshold). The 2024 NYSCIA analysis included an assessment of extreme weather, including extreme cold, designated as the number of days below 0°F. The analysis found a pronounced decline in the number of days projected to meet this cold threshold across all regions of the state over time.

Figure A-1. Extreme Cold Weather Events in New York Forecast Through the 2080s – Days Below 0°F

Source: NYSCIA[63]



Building on NYSCIA analysis, additional analysis was conducted for the State Energy Plan to develop projections based on design day conditions (DDC) used by natural gas utilities in New York State, which range from a daily average temperature of 0°F to -20°F. The analysis sought to identify:

1) The minimum average daily temperature projected to occur in future time periods.
2) The number of times DDC are projected to occur in future time periods.

2. Data and Methodology

The data used in this analysis comes directly from NYSCIA.[64] Weather stations used in this analysis were selected to correspond to weather stations that New York's gas utilities use to define their DDC as shown in the table below.

Table A-2. Weather Stations and Utility Design Day Conditions

Weather Station	Utility	Design Day Definition[1]
Central Park	Con Edison KEDNY, KEDLI	0°F[2]
White Plains/Dobbs Ferry[3]	O&R	0°F[2]
Poughkeepsie	NYSEG (Brewster, Goshen) CHGE	-6°F -8°F
Buffalo	NFG NYSEG (Lockport)	-9°F
Albany	NMPC	-10°F
Syracuse	NMPC	-10°F
Rochester	RGE	-10°F
Binghamton	NYSEG (Binghamton, Olean)	-10°F
Burlington/Dannemora[4]	NYSEG (Plattsburgh, Lowville)	-20°F

1. Design day conditions are defined as a day on which the average temperature at the relevant weather station equals the indicated temperature. Average daily temperature is calculated as the average of the maximum and minimum temperature each day.
2. Con Edison and Orange & Rockland define their DDC as an average temperature of 0°F with an average windspeed of 10 mph.
3. Orange & Rockland uses the White Plains weather station to define its DDC. The White Plains weather station was not included in the NYSCIA extreme weather projections, so this analysis used the Dobbs Ferry weather station as a proxy for climate projections.
4. NYSEG uses the Burlington weather station to define its DDC for the Plattsburgh, Lowville area of its service territory. The Burlington weather station was not included in the NYSCIA extreme weather projections, so this analysis used the Dannemora weather station as a proxy for climate projections.

For each weather station, a baseline period (1980/81-2024/25) was evaluated to assess the coldest observed daily average temperature and how past conditions compare to DDC. In addition, climate conditions were projected for each weather station through 2100 using the same station-based methods, baselines, percentiles, scenarios, and time periods used in the development of climate projections for NYSCIA.[65] 16 global climate models (GCMs) from the latest iteration of the World Climate Research Programme's Coupled Model Intercomparison Project were used to assess two shared socioeconomic pathways (SSPs) emissions scenarios, SSP2-4.5 and SSP5-8.5, producing 32 sets of climate model outputs.

3. Results

3.1 Historic Weather Data

This analysis reviewed the coldest average daily temperature at each weather station from winter 1980/81 to winter 2024/25 (45 years). The coldest day experienced was during or before winter 1984/85 for all weather stations except Binghamton, whose coldest day was winter 1993/94. Several utilities did not experience design day conditions in the past 45 years: Con Edison, KEDNY, KEDLI, NMPC-Albany, and RGE. Others experienced design day conditions once: O&R, CHGE, NFG, and NYSEG at its Brewster/Goshen, Lockport, and Binghamton/Olean areas. Two experienced design day conditions twice: NMPC-Syracuse (1980/81, 2003/2004) and NYSEG-Plattsburgh/Lowville (1980/81, 2022/2023). Table A-3 summarizes each weather station's coldest days and provides utilities' DDC definitions for comparison.

Table A-3. Coldest Average Daily Temperature by Weather Station (1980/81 to 2024/25)

Weather Station	Utility	Coldest Tavg (Winter)	Design Day Definition
Central Park	Con Edison KEDNY, KEDLI	3.5°F (1984/85)	0°F
White Plains	O&R	-0.5°F (1981/82)	0°F
Poughkeepsie	NYSEG (Brewster, Goshen) CHGE	-8°F (1980/81)	-6°F -8°F
Buffalo	NFG NYSEG (Lockport)	-9°F (1981/82)	-9°F
Albany	NGrid (NMPC)	-8.5°F (1980/81)	-10°F
Syracuse	NGrid (NMPC)	-12°F (1980/81)	-10°F
Rochester	RGE	-7°F (1981/82)	-10°F
Binghamton	NYSEG (Binghamton, Olean)	-10°F (1993/94)	-10°F
Dannemora	NYSEG (Plattsburgh, Lowville)	-25°F (1980/81)	-20°F

Figures A-4 to A-12 show the coldest daily average temperature at each weather station for each winter from 1980/81 to 2024/25. The figures also depict utilities' DDC for comparison and a linear trendline. All weather stations show a positive trend for the temperature of the coldest day each winter. The rate of increase ranges from 0.10°F/year to 0.18°F/year.

Figure A-4: Coldest Average Daily Temperature Winter 1980/81 to 2024/25 – Central Park

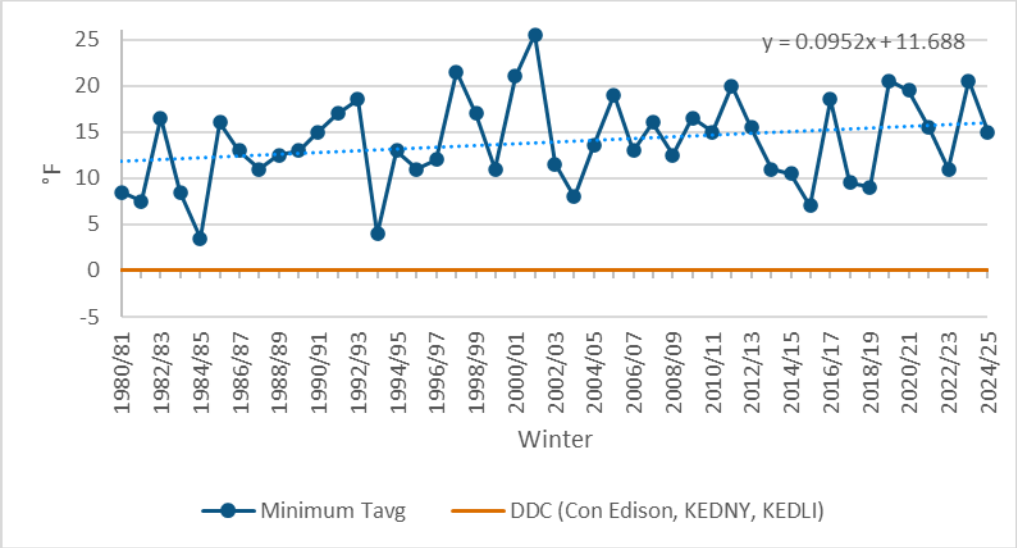


Figure A-5: Coldest Average Daily Temperature Winter 1980/81 to 2024/25 – White Plains

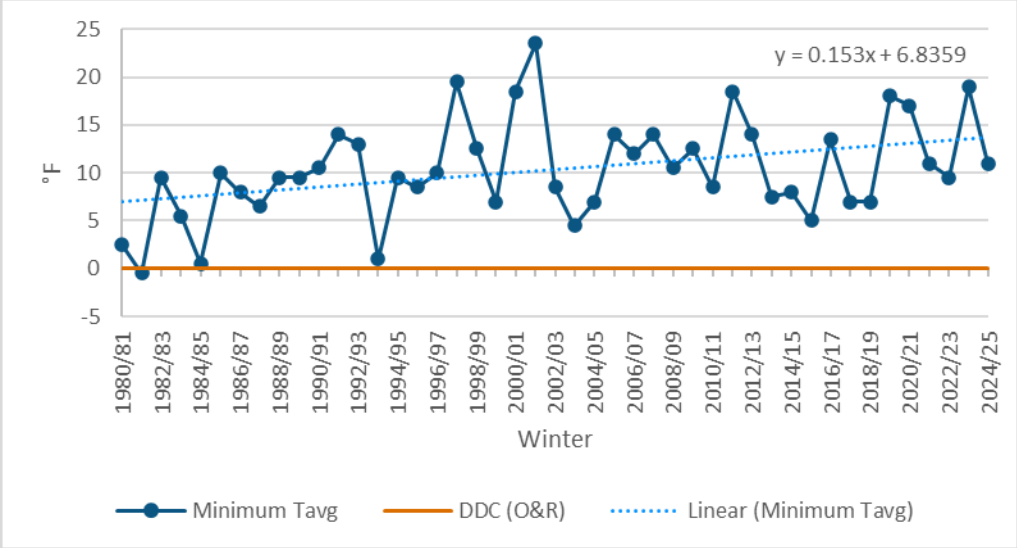


Figure A-6: Coldest Average Daily Temperature Winter 1980/81 to 2024/25 – Poughkeepsie

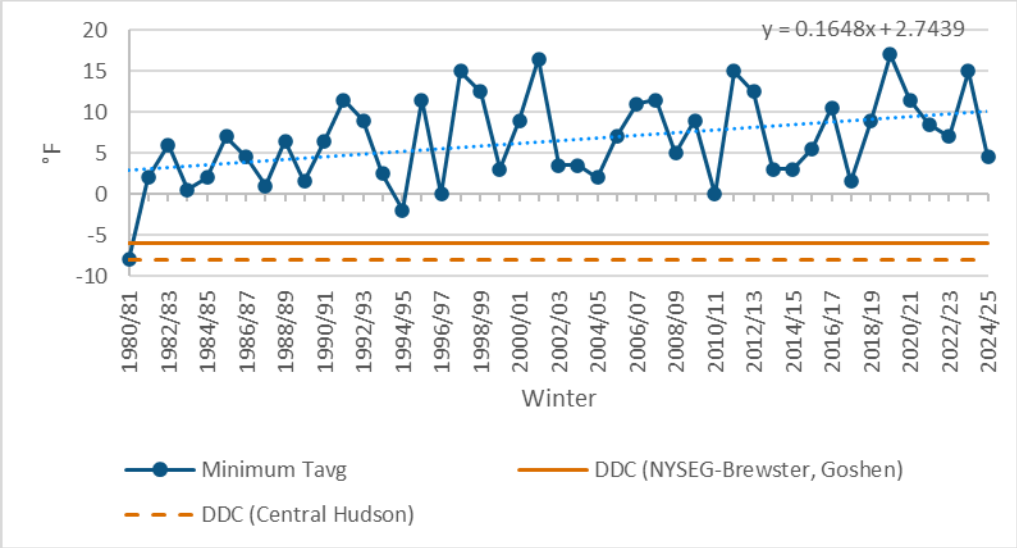


Figure A-7: Coldest Average Daily Temperature Winter 1980/81 to 2024/25 – Buffalo

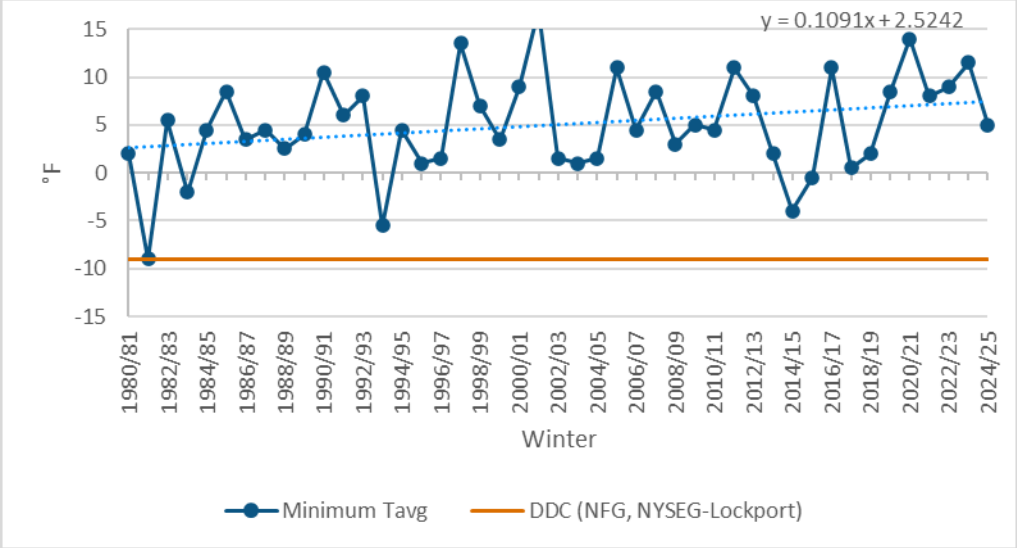


Figure A-8: Coldest Average Daily Temperature Winter 1980/81 to 2024/25 – Albany

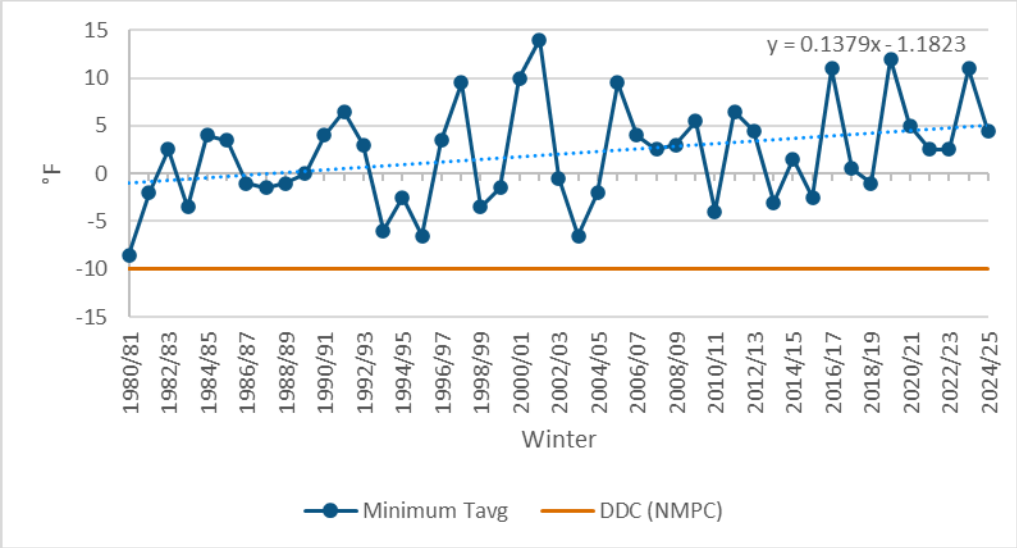


Figure A-9: Coldest Average Daily Temperature Winter 1980/81 to 2024/25 – Syracuse

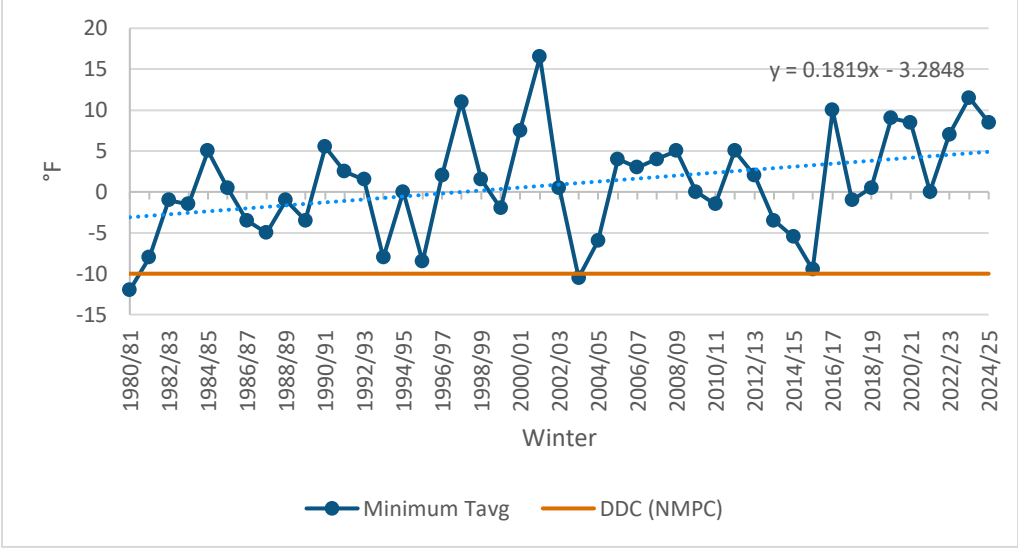


Figure A-10: Coldest Average Daily Temperature Winter 1980/81 to 2024/25 – Rochester

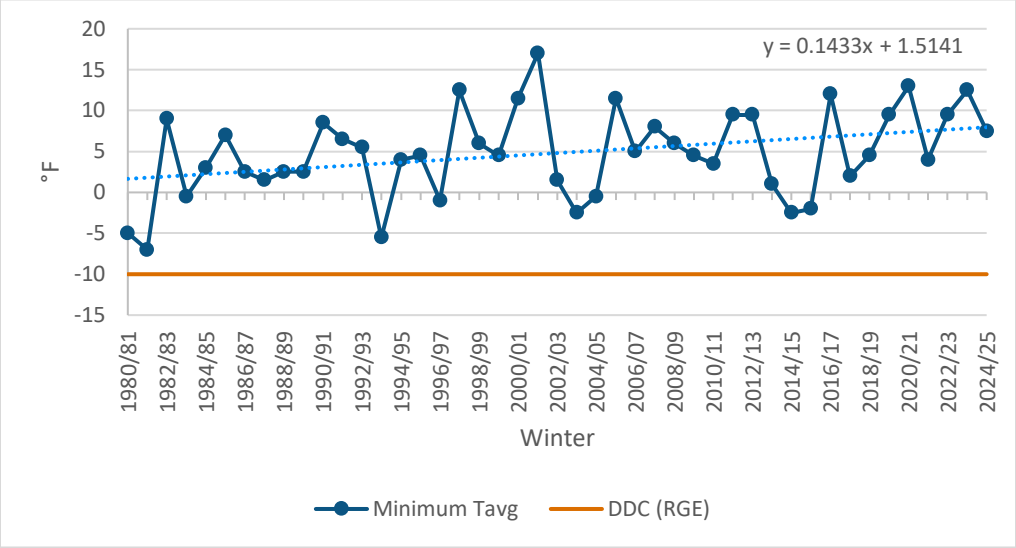


Figure A-11: Coldest Average Daily Temperature Winter 1980/81 to 2024/25 – Binghamton

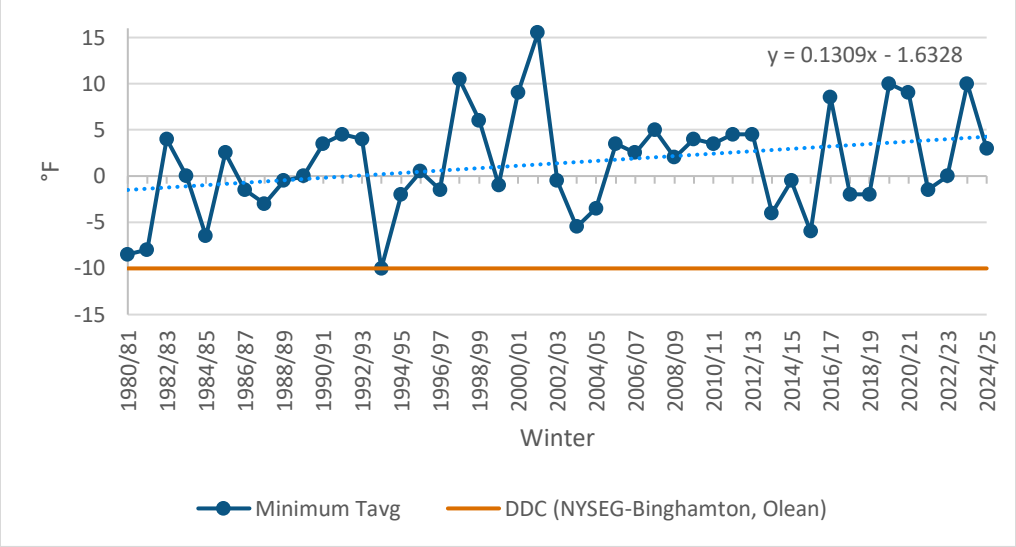
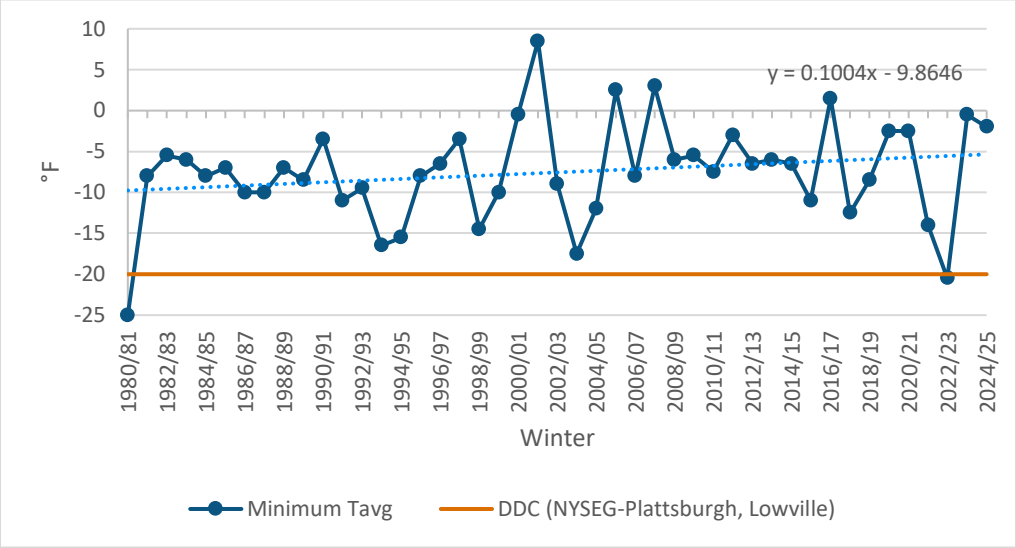


Figure A-12: Coldest Average Daily Temperature Winter 1980/81 to 2024/25 – Dannemora



3.2 Projected Weather Data

The analysis projected future climate conditions using 16 GCMs and two SSPs, producing 32 sets of climate model outputs for each weather station. This approach makes it possible to reflect a range of future climate conditions which is important due to the inherent uncertainty in long-term climate projections. Results are presented as percentiles. For clarity, for a given weather station and time period, the 50th percentile corresponds to the climate model outputs that reflect the median amount of warming. The 10th percentile corresponds to the climate model outputs with less warming (*i.e.*, 90% of climate model outputs indicate more warming than the 10th percentile).

Results are presented as 30-year periods centered on a decade. For example, the “2030s” corresponds to the 30-year period from 2020-2049 and the “2080s” corresponds to the 30-year period from 2070-2099. In the tables below, projections in which the coldest average daily temperature is at or below a utility’s DDC are indicated in blue font and shading. Dannemora is the only weather station that meets this criterion. It does so only for the 10th percentile climate model outputs for the 2030 and 2040 time periods indicating that most climate models’ outputs do not project that utility DDC will be reached in future periods.

Figure A-13: Coldest Projected Average Daily Temperatures (°F) – Central Park **(DDC = 0℉)**

Central Park	10th	25th	50th	75th	90th
2030s	5.9	8.2	9.5	10.6	12.2
2040s	7.0	9.5	10.5	12.3	14.6
2050s	7.6	10.4	11.9	13.4	16.0
2060s	9.4	11.4	13.4	15.5	17.6
2070s	10.8	12.3	14.2	17.5	20.2
2080s	11.7	13.1	16.9	19.3	24.0

Figure A-14: Coldest Projected Average Daily Temperatures (°F) – Dobbs Ferry **(DDC = 0℉)**

Dobbs Ferry	10th	25th	50th	75th	90th
2030s	4.66	6.69	7.98	9.14	10.67
2040s	5.62	8.01	9.01	10.78	13.06
2050s	6.13	8.86	10.43	11.86	14.54
2060s	7.79	9.9	12.01	13.97	16.09
2070s	9.29	10.83	13.53	15.98	19.18
2080s	10.15	11.6	15.83	17.82	22.49

Figure A-14: Coldest Projected Average Daily Temperatures (°F) – Poughkeepsie **(DDC = -6℉, -8℉)**

Poughkeepsie	10th	25th	50th	75th	90th
2030s	-3.86	-2.97	-1.65	-0.54	2.34
2040s	-3.14	-1.59	-0.17	2.14	4.09
2050s	-1.73	-0.75	1.44	3.3	5.78
2060s	-1.19	0.49	3.78	4.89	7.29
2070s	0.18	0.97	5.01	6.63	10.34
2080s	1.24	2.25	6.54	8.75	14.62

Figure A-15: Coldest Projected Average Daily Temperatures (°F) – Buffalo **(DDC = -9℉)**

Buffalo	10th	25th	50th	75th	90th
2030s	-4.47	-3.09	-2.05	-0.33	2.59
2040s	-3.09	-1.55	-0.05	2.11	3.91
2050s	-1.71	-0.43	1.32	3.45	7.45
2060s	-0.31	0.97	4.09	6.03	9.18
2070s	0.46	2.06	6.01	9.01	12.64
2080s	1.17	3.94	7.86	11.38	18.8

Figure A-16: Coldest Projected Average Daily Temperatures (°F) – Albany **(DDC = -10℉)**

Albany	10th	25th	50th	75th	90th
2030s	-3.34	-2.39	-0.82	0.86	2.83
2040s	-2.59	-0.71	0.93	3.73	5.13
2050s	-1.45	0.38	2.85	4.94	6.83
2060s	-0.53	1.38	4.86	7.08	9.72
2070s	1.02	2.33	5.43	9.64	13.73
2080s	2.03	3.53	7.87	11.54	18.3

Figure A-17: Coldest Projected Average Daily Temperatures (°F) – Syracuse **(DDC = -10℉)**

Syracuse	10th	25th	50th	75th	90th
2030s	-5.92	-5.09	-3.38	-1.79	0.15
2040s	-4.9	-3.32	-1.62	0.62	2.3
2050s	-3.41	-2.07	0.03	1.93	5.17
2060s	-2.28	-1.37	2.31	4.37	7.16
2070s	-1.25	0.1	3.32	6.74	11.3
2080s	-0.13	1.28	5.26	9.28	17.2

Figure A-18: Coldest Projected Average Daily Temperatures (°F) – Rochester **(DDC = -10℉)**

Rochester	10th	25th	50th	75th	90th
2030s	-2.67	-1.17	0.01	1.66	4.59
2040s	-1.43	0.18	1.9	4.11	6.06
2050s	0.36	1.31	3.31	5.22	9.45
2060s	1.88	2.6	6.22	8.06	11.18
2070s	2.95	3.78	7.64	11.01	14.64
2080s	3.27	5.63	8.64	13.38	20.8

***Figure A-19: Coldest Projected Average Daily Temperatures (°F) – Binghamton* (DDC = -10°F)**

Binghamton	10th	25th	50th	75th	90th
2030s	-5.34	-4.59	-3.41	-1.35	-0.29
2040s	-4.44	-2.9	-1.81	0.58	2.35
2050s	-2.91	-1.57	0.02	1.57	5.52
2060s	-1.78	-0.99	1.7	4.37	7.63
2070s	-0.75	0.26	3.23	7.17	11.62
2080s	0.07	1.59	5.01	9.36	15.6

***Figure A-20: Coldest Projected Average Daily Temperatures (°F) – Dannemora* (DDC = -20°F)**

Dannemora	10th	25th	50th	75th	90th
2030s	-21.31	-19.84	-17.95	-16.24	-13.63
2040s	-20.31	-18.76	-15.72	-14.06	-11.41
2050s	-19.1	-16.75	-14.28	-11.87	-9.08
2060s	-18.08	-15.4	-11.97	-9.76	-6.25
2070s	-16.73	-15.01	-11.34	-7.07	-2.61
2080s	-15.94	-13	-7.67	-4.05	2.02

4. Conclusion

As discussed in Section 4.3.4, gas system reliability is critical both because the gas system provides essential services to New Yorkers (e.g., home heating) and because restoring service after a disruption to gas service is very complex, time-consuming, labor-intensive, and costly (substantially more so than an electrical outage affecting a similar number of customers). As such, it is appropriate to use conservative standards for planning and investment. This analysis seeks to provide context for how utilities' DDC compare to historical and projected cold weather conditions in their service areas.

Looking historically, this analysis found that utilities' DDC were reached infrequently—occurring between zero and two times in the past 45 winters, depending on the utility service territory. The analysis also found a consistent warming trend for the coldest average daily temperature observed over the past 45 winters, suggesting that DDC may be less likely to occur than in the past.

Looking forward, the majority of climate model outputs project that DDC will not occur in future periods. While these findings are informative, they should not necessarily be interpreted to indicate that it is not possible for DDC to occur. For instance, existing research methods are limited in their ability to project how jet streams (that can create extreme cold weather conditions) will be impacted by climate change. That said, the results of this analysis show that occurrences of days where average temperature meets the DDC criteria are rare in the current climate and are projected to become even more rare in the future. Utility planners and regulators should consider this information when developing and implementing their reliability, planning, and investment standards.

[1] New York State Energy Research and Development Authority (NYSERDA). "Patterns and trends: New York State Energy Profile Dashboard," accessed December 9, 2025: https://www.nyserda.ny.gov/About/Publications/Energy-Analysis-Reports-and-Studies/Patterns-and-Trends.

[2] This number includes generation by both natural gas power plants and dual fuel (natural gas and oil) power plants.

[3] New York Independent System Operator (NYISO) 2025 Load & Capacity Data ("Gold Book"). https://www.nyiso.com/library.

[4] Energy Information Administration (EIA), "Dry shale gas production estimates by play," accessed December 9, 2025: https://www.eia.gov/naturalgas/data.php.

[5] City gates designate the point at which gas utilities or LDCs take operational responsibility for safely and reliably transporting gas to customers.

[6] EIA. "Number of consumers." Accessed December 9, 2025: https://www.eia.gov/naturalgas/data.php.

[7] NYSERDA. "Patterns and Trends: New York State Energy Profile 2009 – 2023."

[8] *Ibid*.

[9] Department of Public Service (DPS). "Average monthly bill data from utility companies," accessed July 1, 2025, https://dps.ny.gov/electric-utility-ten-year-historic-average-monthly-bill-data-typical-customers.

[10] Because many power plants are gas-fired and electric demand peaks in the summer, there is also a seasonal summer gas demand peak for power generation—though this is lower than the winter gas demand peak. Gas demand for winter heating needs is generally considered firm demand whereas electric generators tend to rely on less costly interruptible capacity and supply, which is widely available in the summer.

[11] DPS Case 20-G-0131, *Order Adopting Moratorium Management Procedures*, May 12, 2022.

[12] Underlying commodity prices are set by the market, not regulated by the Public Service Commission (PSC). However, the PSC influences supply prices paid by retail customers through policies that apply to gas purchases utilities make on behalf of customers, like the hedging requirements described above.

[13] DPS Case 20-G-0131, *Order Adopting Gas System Planning Process*, May 12, 2022 ("Gas Planning Order").

[14] DPS Case 22-G-0610, *Order Implementing Long-Term Natural Gas Plan with Modifications*, December 14, 2023 ("NFG LTP Order"); DPS Case 23-G-0147, *Order Regarding Long-Term Natural Gas Plan and Requiring Further Actions*, September 20, 2024 ("Con Edison/O&R LTP Order"); DPS Case 23-G-0437, *Order Regarding Long-Term Natural Gas Plan and Directing Further Actions*, January 23, 2025 ("NYSEG/RGE LTP Order"); DPS Case 23-G-0676, *Order Regarding Long-Term Natural Gas System Plan and Directing Further Actions*, July 17, 2025 ("CHGE LTP Order"); DPS Case 24-G-0248, *Order Regarding Long-Term Natural Gas Plan and Requiring Further Actions*, September 18, 2025 ("National Grid LTP Order").

[15] DPS Case 24-G-0629, *In the Matter of a Review of the Long-Term Gas System Plan of Corning Natural Gas Corporation*; DPS Case 24-G-0630, *In the Matter of a Review of the Long-Term Gas System Plan of Liberty Utilities (St. Lawrence Gas) Corp*.

[16] 49 USCA § 60101 et seq.; 49 CFR Part 190 et seq.

[17] 49 CFR §§ 191, 192. www.federalregister.gov/documents/2019/10/01/2019-20306/pipeline-safety-safety-of-gas-transmission-pipelines-maop-reconfirmation-expansion-of-assessment.

[18] 40 CFR § 60. https://www.federalregister.gov/documents/2024/03/08/2024-00366/standards-of-performance-for-new-reconstructed-and-modified-sources-and-emissions-guidelines-for.

[19] 15 USCA § 717 et seq.

[20] Public Service Law §30.

[21] Sandra Meier et. Al. "New York State Climate Impacts Assessment Chapter 06: Energy." *Annals of the New York Academy of Sciences* 1542, no. 1 (2024): 341-384 (p. 358). Available at: https://doi.org/10.1111/nyas.15191.

[22] *Ibid*., p. 359.

[23] Pathways data uses residential Heating Ventilation, and Air Conditioning (HVAC) gas connections as a proxy for customer growth, while the utility range reflects aggregate residential and commercial data due to the lack of disaggregated data across all utilities.

[24] *Ibid*., pp. 341-384.

[25] *Ibid*., p. 348.

[26] *Ibid*., p. 354.
[27] *Inquiry into Bulk-Power System Operations During December 2022 Winter Storm Elliott*. Federal Energy Regulatory Commission, FERC, NERC, and Regional Entity Staff Report (October 2023).
[28] National Grid LTP Order, p. 40.
[29] See "Proceeding on Motion of the Commission Concerning Electric Utility Climate Vulnerability Studies and Plans" (Case 22-E-0222).
[30] See, for example, *NFG Final LTP* (Figure IV GHG Emission Reductions and Cost Impacts, p. 74), filed July 17, 2023 in Case 22-G-0610; *ConEd/O&R Final LTP* (Figure 60 Deep Electrification Pathway Gas System Rate, p. 91), filed November 29, 2023 in Case 23-G-0147; *NYSEG/RGE Final LTP* (Figure VI-7 Bill Impacts for Scenarios and LTP, p. 106), filed April 26, 2024 in Case 23-G-0437; *NGrid Final LTP* (Section 8.3 Bill Impact Analysis p. 144-153), filed March 7, 2025 in Case 24-G-0248.
[31] Gas Planning Order, p. 9 (emphasis added).
[32] Con Edison/O&R LTP Order, p. 44.
[33] *Ibid.*
[34] DPS Case 23-G-0676, PA Consulting Report Prepared for DPS, *Final Report on Central Hudson's Final Gas System Long-Term Plan*, p. 90. January 14, 2025.
[35] *Ibid.* pp. 90-91.
[36] DPS Case 23-G-0676, *Central Hudson Final Gas System Long-Term Plan, Appendix A: 20-Year Historical Trend Gas Forecasts and Location-Specific Gas Distribution Costs*, November 21, 2024.
[37] DPS Case 23-G-0676, *Central Hudson Final Gas System Long-Term Plan, Appendix C: Non-Pipe Alternative Assessment*, November 21, 2024.
[38] NYSEG/RGE LTP Order, p. 71.
[39] National Grid and Rocky Mountain Institute, "Non-pipeline alternatives: Emerging opportunities in planning for U.S. gas system decarbonization," (May 2022) accessed December 9, 2025, https://www.nationalgridus.com/media/pdfs/other/CM9904-RMI_NG-May-2024.pdf.
[40] DPS Case 22-G-0065, Con Edison Non-Pipes Alternatives Implementation Plan, pp. 31-44. November 17, 2025.
[41] DPS Case 17-G-0460, Central Hudson Non-Pipeline Alternatives Annual Report, pp. 13-14. December 2, 2024.
[42] Gas Planning Order, p. 6.
[43] See, for example, Con Edison/O&R LTP Order, p. 57; CHGE LTP Order, p. 60.
[44] See, for example, National Grid and Rocky Mountain Institute, "Non-pipeline alternatives: Emerging opportunities in planning for U.S. Gas System Decarbonization." (May 2022), p. 10, accessed December 9, 2025: https://www.nationalgridus.com/media/pdfs/other/CM9904-RMI_NG-May-2024.pdf, p. 6.
[45] DPS Case 15-G-0151, *Order Instituting Proceeding for a Recovery Mechanism to Accelerate the Replacement of Leak Prone Pipe*, April 17, 2015, p. 2.
[46] Gas Planning Order, p. 39.
[47] These physical factors include pipe material, age, diameter, pressure, length, coating type and condition, leak history, corrosion, soil type, and proximity to buildings. In addition, to reduce the cost and frequency of disruptions, utilities also often coordinate with municipalities to replace LPP segments when streets are already being opened up for other work.
[48] University of Massachusetts Amherst Energy Transition Institute. "Equitable energy transition planning in Holyoke Massachusetts: A technical analysis for strategic gas decommissioning and grid resiliency," (2023). ETI Reports. 2. Available at: https://doi.org/10.7275/enzr-5311.
[49] Aryeh Gold-Parker, Claire Halbrook, Helen Mejia, Allison Lopez, Fangxing Liu, Jared Landsman, and Amber Mahone. 2024. "An analytical framework for targeted electrification and strategic gas decommissioning: Identifying potential pilot sites in Northern California's East Bay Region." *California Energy Commission*. CEC-500-2024-073. Available at: https://www.energy.ca.gov/publications/2024/analytical-framework-targeted-electrification-and-strategic-gas-decommissioning.
[50] *National Grid Massachusetts Distribution Integrity Management Plan Revision 13*, pp. 145-146. Effective 08/02/2024. https://fileservice.eea.comacloud.net/FileService.Api/file/FileRoom/19846034.
[51] *Ibid*.

[52] NYSEG/RGE LTP Order, p. 37-38.

[53] Lamie, C., Bader, D., Graziano, K., Horton, R. John, K., O'Hern, N., & Spungin, S. (2024). Chapter 2: New York State's Changing Climate, Figure 2-10, p. 20. New York State Climate Impacts Assessment [Interim version for public release]. Accessed December 9, 2025: nysclimateimpacts.org/explore-the-assessment/new-york-states-changing-climate.

[54] *Supra* endnote 30, at 23.

[55] The cost causation rate design principle states that costs should be allocated to those who directly cause them to be incurred.

[56] Gas Planning Order, p. 61.

[57] See, for example, https://www.energy.gov/fecm/greenhouse-gas-supply-chain-emissions-measurement-monitoring-reporting-verification-framework

[58] Department of Energy. *2024 U.S. Energy and Employment Report*. https://www.energy.gov/policy/us-energy-employment-jobs-report-useer.

[59] N. Seltenrich. "Clearing the Air: Gas stove emissions and direct health effects." *Environmental Health Perspectives*, 132, no. 2 (2024). https://ehp.niehs.nih.gov/doi/10.1289/EHP14180.

[60] Christopher Lamie, Daniel Bader, Kathryn Graziano, Radley Horton, Kecil John, Natalie O'Hearn, Sophia Spungin, and Amanda Stevens. "New York State Climate Impacts Assessment Chapter 02: New York State's Changing Climate," *Annals of the New York Academy of Sciences* 1542, no. 1 (2024) 91-145. https://doi.org/10.1111/nyas.15240.

[61] *Ibid*.

[62] Bader, D., & Horton, R. (2023). *New York State Climate Change Projections Methodology Report.* Prepared for the New York State Climate Impacts Assessment. NYSERDA.

[63] NYSCIA Chapter 02: New York's Changing Climate, Figures 2-10.

[64] Weather data was acquired from the National Oceanic and Atmospheric Administration's global historical climatology dataset. https://www.ncei.noaa.gov/cdo-web/search?datasetid=GHCND and https://www.ncei.noaa.gov/products/land-based-station/global-historical-climatology-network-daily.

[65] NYS Climate Change Projections Methodology Report 2023, see Section 4. Climate Projections.

New York State Energy Plan

VOLUME II | Our Energy Systems

Petroleum Fuels

04

2025 NEW YORK STATE ENERGY PLAN

Key Terms Used in This Chapter

FOR THE COMPLETE GLOSSARY ➜

Bulk Terminal: Petroleum facility designed for the storage and distribution of refined petroleum fuels such as heating oil, motor gasoline, diesel, and other products.

Petroleum Fuels: Another name for crude oil. This liquid extracted from wells is a mixture of organic molecules that can be separated into specific fuels through a refining process. Petroleum fuels include fuels such as diesel, gasoline, kerosene, and propane.

Liquid Fuels: Another name for delivered fuels. A group of fuels that, at surface temperatures, are in the liquid phase with little or no pressurization, as a result, these fuels can be transported by a variety of modes.

Fossil Fuels: Fuels produced from the decay of prehistoric organic materials. These fuels can be liquid (example: petroleum) or gaseous (example: natural gas).

Alternative Fuels: Liquid or gaseous fuel derived from biomass or clean energy such as biodiesel, renewable natural gas (RNG), renewable diesel, hydrogen, and sustainable aviation fuel (SAF).

Key Findings → Petroleum Fuels

New Yorkers rely on petroleum fuels such as diesel, gasoline, propane, and kerosene for transportation, electricity generation, heating homes and buildings, and industry. New York has an extensive infrastructure network to deliver these fuels across the state. New Yorkers will continue to rely on petroleum fuels and related infrastructure while the energy transition continues. This chapter provides an overview of the State's petroleum fuels sector and recommends continued actions to maintain reliability, resiliency, and delivery of fuels across the sector.

- **Consumption of petroleum products has declined compared to historical use as a result of the adoption of energy efficient technologies, growth in natural gas consumption, introduction of alternative fuels, and federal and New York State policies.** However, select liquid fuels such as motor gasoline, distillate fuel oil (heating and diesel), and propane still have strong demand statewide. Petroleum fuels are widely used in New York for transportation, home heating, and industrial uses.
- **Petroleum fuels will continue to provide a meaningful volume of energy in New York State through the 2040 planning period, delivered through a complex supply chain to serve all sectors of the economy.** Continued support for fuel resilience and monitoring is essential to support critical petroleum infrastructure and industry actors.
- **Targeted low-carbon alternative fuel use within the existing petroleum system can help to lower greenhouse gas (GHG) emissions while maintaining reliability and resiliency through the clean energy transition.** Policies or programs supporting alternative fuels will need to be flexible and allow for the integration of new or different alternative fuels as technologies and fuel supplies become available in order to maximize GHG emissions reductions. Leveraging existing petroleum system infrastructure will help to increase alternative fuel use while minimizing costs and other impacts and maintaining reliability.

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1. Overview

Petroleum fuels have been an energy source for transportation, heating homes and buildings, industrial processes, and electricity generation, in modern usage, for at least a century and a half. The ability for petroleum fuels to be easily transported and their wide variety of uses has led to the development of an extensive infrastructure network in New York State to deliver these fuels to end-users.

Through the 2040 planning period addressed in this Plan, end-users will continue to rely on petroleum fuels and their established supply chains to maintain energy reliability and deliverability, while the adoption of alternative fuels and electrification increases.

2. State of the Sector

2.1. Petroleum Use in New York State

The end-use sectors of petroleum fuel use in New York include:

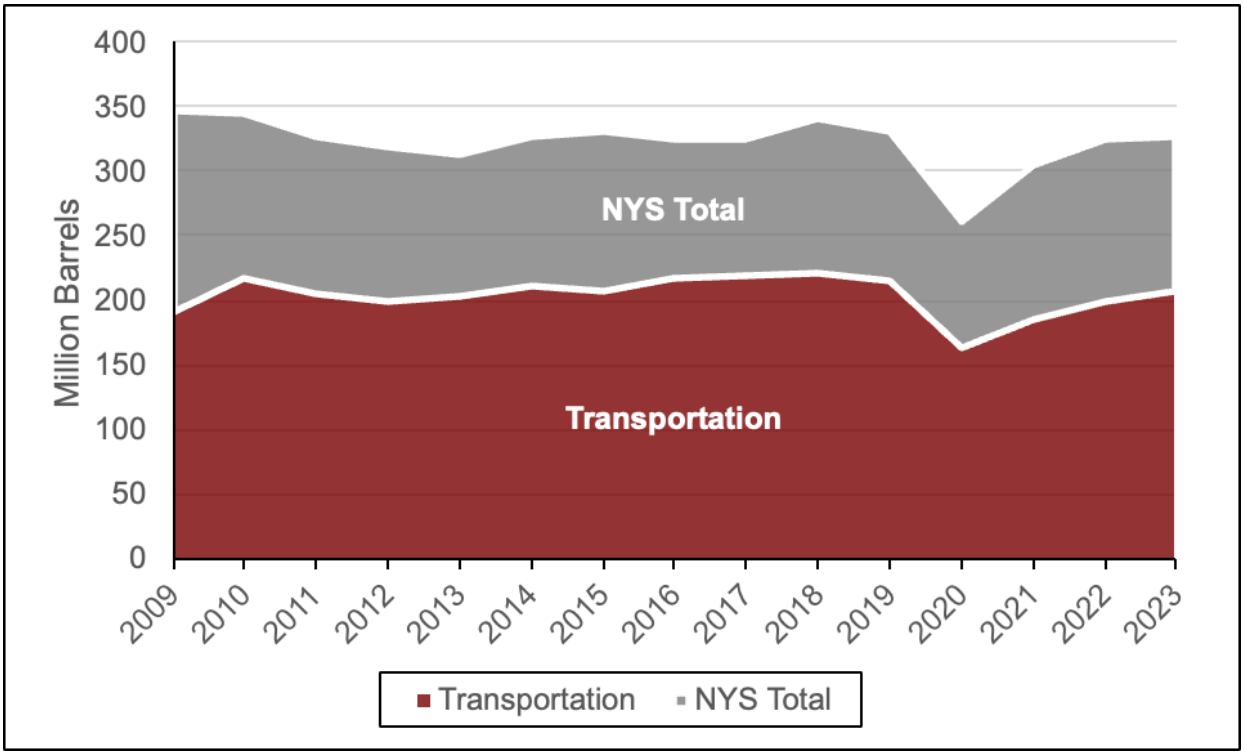
- Transportation
- Electricity Generation
- Residential
- Commercial
- Industrial

The following sections discuss these fuel-use sectors in more detail.

According to U.S. Energy Information Agency (EIA) estimates, New York State is the fourth-largest petroleum fuel market in the nation, spending approximately $37.7 billion in 2023 across all sectors.[1] Figure 1 compares the historical consumption of petroleum fuels in the transportation sector to total petroleum consumption in New York State. It shows the continued importance of petroleum products, and also that the transportation sector represents the most significant consumption of petroleum products statewide.[2]

Figure 1: New York State Total and Transportation Petroleum Consumption

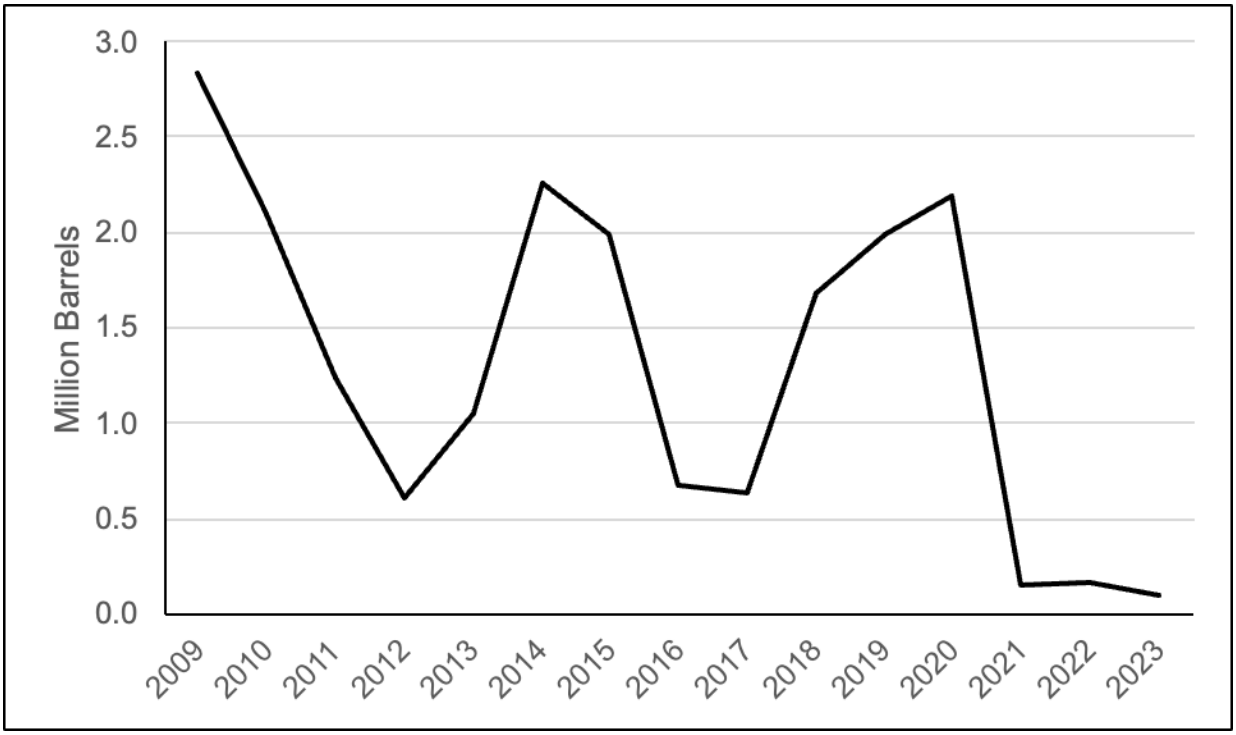
Source: Patterns and Trends[2]



In 2023, total petroleum products accounted for approximately 0.3 percent of the fuel mix used for electricity generation in New York State. Although petroleum once played a much larger role in electricity generation, particularly prior to the early 2000s, its use has steadily declined over the past two decades as shown in Figure 2. This downward trend is due to increased adoption of natural gas and renewable energy sources. As of 2023, the most significant use of petroleum fuels for electricity generation was limited to dual-fuel generation facilities, which are required to switch to a secondary petroleum fuel (e.g., distillate or residual fuel oils) under certain conditions, such as during extreme cold temperatures.

Figure 2: New York State Total Petroleum Consumption for Electricity Generation

Source: Patterns and Trends[2]



2.2. Petroleum Fuels Supply in New York State

Oil production in the state is limited and primarily located in Allegany, Cattaraugus, Steuben, and Chautauqua counties. In 2023, New York State produced approximately 251,000 barrels of crude oil, which represents a fraction of a percent of the state's total consumption.[2] New York State has no petroleum refineries.

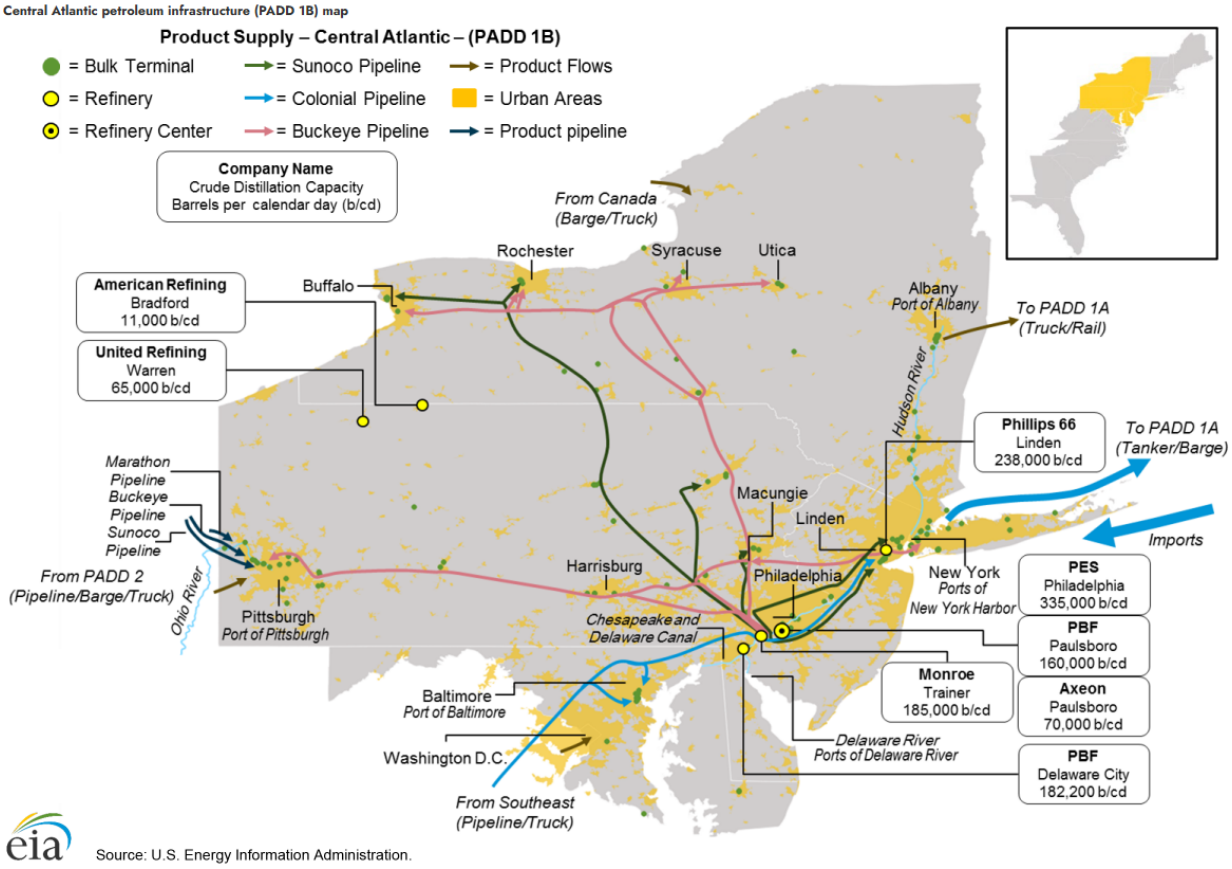
2.3. Petroleum Fuels Infrastructure and Supply Chain in New York State

Globally, petroleum fuels follow a complex supply chain and rely on a number of different modes of transportation, including pipelines, rail, marine vessels, and trucks.

These modes of transportation are responsible for moving petroleum fuels from other U.S. states as well as internationally across the global supply chain. New York State has no petroleum refineries, so it relies on these modes of transportation to import petroleum products into New York or to export petroleum extracted in New York to another state for refining. Figure 3 presents a map of New York State's, and neighboring states' petroleum product infrastructure.

Figure 3: Map of New York State Petroleum Fuels Infrastructure

Source: EIA Map of Petroleum Energy Infrastructure and Resources



As Figure 3 shows, the State relies on pipeline and marine delivery for bulk delivery of petroleum products. Rail and trucks are also essential for regional and local deliveries, including international transport of some fuel types from Canada directly in-state. Several key aspects of New York State's petroleum delivery infrastructure are important to understand in more detail:

- Downstate areas, including Long Island and New York City, have a number of terminals; however, storage is limited and more recently a pair of terminals have permanently closed. The deliveries of petroleum products by pipeline and marine vessels are essential to meet the demand of this high-population area.
- The Hudson River is a critical resource for marine transportation of petroleum products from New York Harbor into the Mid-Hudson Valley and the Capital District regions. Terminals in Newburgh and Albany are responsible for accepting and distributing the fuels that are delivered along the Hudson River.
- Access to New York Harbor allows international deliveries of fuel products into the region and represents an important market pricing point.

- Terminals in and near Binghamton, Syracuse, Utica, Rochester, and Buffalo are supplied by pipelines that transport petroleum products from Pennsylvania.
- The Kiantone Pipeline transports crude oil from Canada to the Warren, Pennsylvania refinery for processing.
- The Enterprise Pipeline brings oil and propane from Pennsylvania to terminals in the Finger Lakes and Central New York regions before terminating in Selkirk, which serves as a hub for propane delivery to New England states.
- North Country end-users (i.e., those located north of Albany and Syracuse) rely on truck deliveries from Albany, Syracuse, and Canada to meet their demand.

Alternative fuels introduce unique challenges that require proactive planning to address logistical and infrastructure differences. Delivering these fuels to end users often involve different handling, storage, and distribution requirements than conventional fuels, along with tailored supply chain strategies. Please see the Alternative Fuels chapter of this Plan for more information.

Petroleum storage capacity in New York State is an important and evolving concern. Over the past 15 years, 187 facilities listed as Major Oil Storage Facilities in the New York State Department of Environmental Conservation Bulk Storage Database have been reclassified as "closed / unregulated."[3] While some facilities do switch ownership, there have been facilities being sold with plans to transition the property to other uses. The downstate region is particularly vulnerable to shrinking storage availability due to the value of the underlying land. However, any loss of storage changes the supply chain and puts more pressure on pipelines, rail, and trucks to move the fuels, especially during extreme conditions.

3. Trends in Petroleum Fuel Use and Spending in New York State

This section provides an overview of historical and current trends in petroleum fuel consumption, prices, and expenditures, including sectoral summaries. Each year, NYSERDA publishes *Patterns and Trends: New York State Energy Profiles*, a compilation of energy statistics and data for New York State. This State Energy Plan draws from the most recent statewide data available at the time of publication. For most current figures and expanded datasets, readers are encouraged to consult the publication.[2]

3.1. Petroleum Fuels Consumption

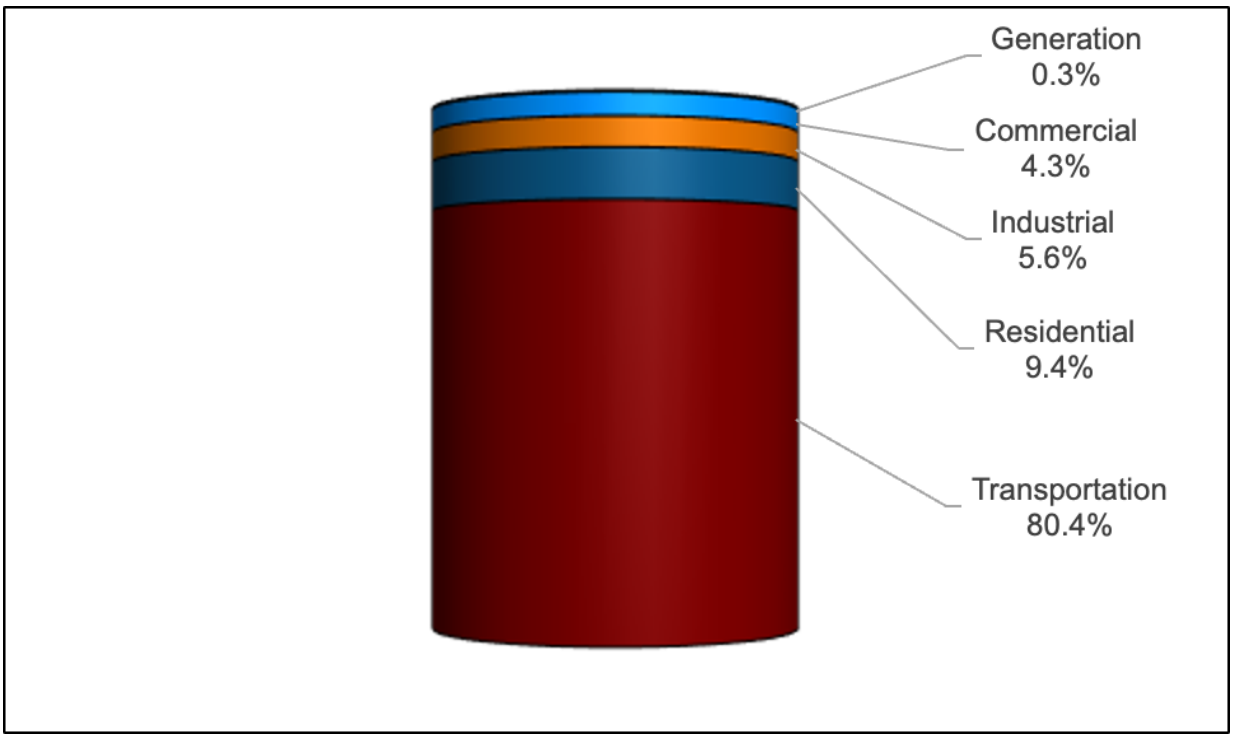
The following sections examine specific petroleum fuels, such as distillate and residual fuel oils, kerosene, propane, gasoline, and aviation fuels, including background, sector-level consumption patterns, and regional breakdowns where data is available.

Petroleum fuels play a significant role in New York's energy system, accounting for approximately 38 percent of final energy use by fuel type in 2023.[2] Of the 3,528 TBtu of final energy consumption in New York State in 2023, petroleum products accounted for 1,340 TBtu. (There is a small amount of petroleum fuels used in the electricity sector for reliability purposes that is not considered here.) As shown in Figure

4, transportation dominates petroleum use, representing greater than 80 percent of total petroleum fuel use.

Figure 4: New York State 2023 Consumption of Conventional Petroleum Fuels by Sector

Source: Patterns and Trends[2]



3.2. Petroleum Prices and Expenditures

Petroleum fuels are consumed around the world and the international market and supply chains for these fuels were established to keep up with consumer demand. With demand changes by season, shifts in sub-national, national, or international policy, and other factors, the price for these fuels change dependent on the available supply. The following subsections present fuel-specific discussions on the prices and expenditures statewide for these petroleum fuels.

- For the State Energy Plan, the most recent statewide data available for energy estimates are as of 2023. For liquid petroleum fuels, 2023 expenditures declined despite the increase in consumption, partially due to the historically high prices during 2022 and the decline in prices in 2023.
- Petroleum fuel prices in 2023 were less than the prior year, contributing to lower expenditures despite increasing consumption. Additionally, the Russian invasion of Ukraine impacted the global supply chains as sanctions significantly limited energy products exported from Russia in 2022. As the global supply chains stabilized during 2023, prices responded with declines however, most prices did not reach pre-COVID price ranges.

3.3. Consumption and Price Patterns by Fuel

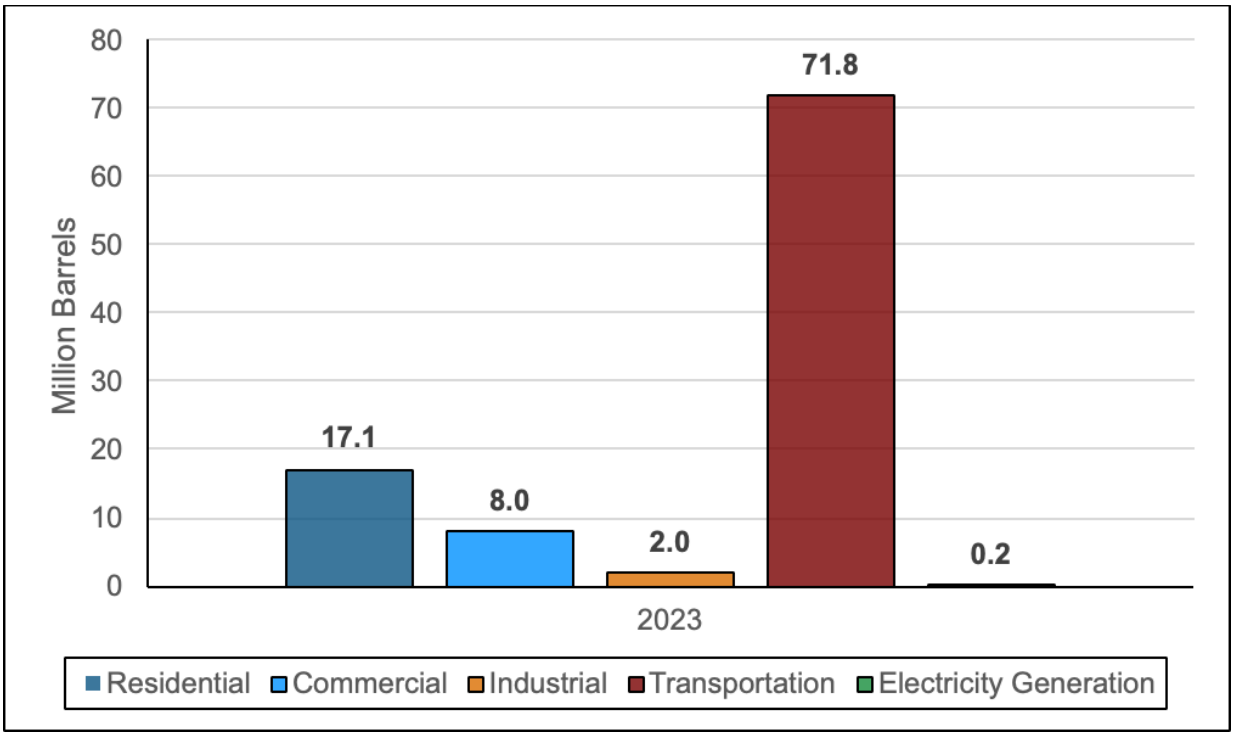
3.3.1. Distillate Fuel Oils

Consumption

Distillate fuel oils represent a specific refined product that has a wide range of uses. In New York State, distillate fuel oils are primarily used for transportation as diesel and for heating homes and buildings (residential and commercial sectors) as heating oil. There is still some distillate fuel oil used for electricity generation, though this is mostly limited to the rare times when dual fuel generators must be interrupted from using natural gas as their primary fuel source and switch to a secondary fuel, which is usually a distillate or residual fuel oil (e.g., in extreme weather conditions). ***Figure 5*** presents the sectoral consumption for 2023.[2]

Figure 5: New York State Consumption of Distillate Fuel Oil by Sector

Source: Patterns and Trends[2]

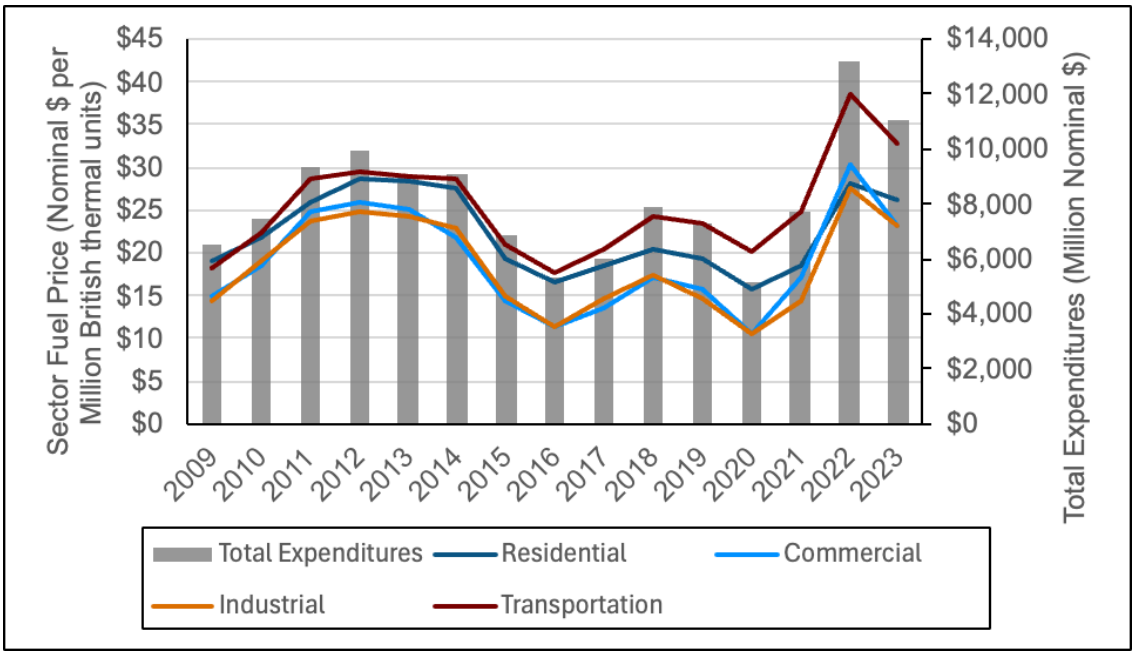


Prices and Expenditures

Figure 6 presents a 15-year summary of distillate fuel oil prices by sector in addition to the total statewide expenditures on this fuel type. Distillate fuel oil prices and expenditures declined in 2023 after global supply chains and market dynamics were able to adjust for global conflicts.

Figure 6: Distillate Fuel Oil Sectoral Prices and Total Expenditures Summary

Source: Patterns and Trends[2]



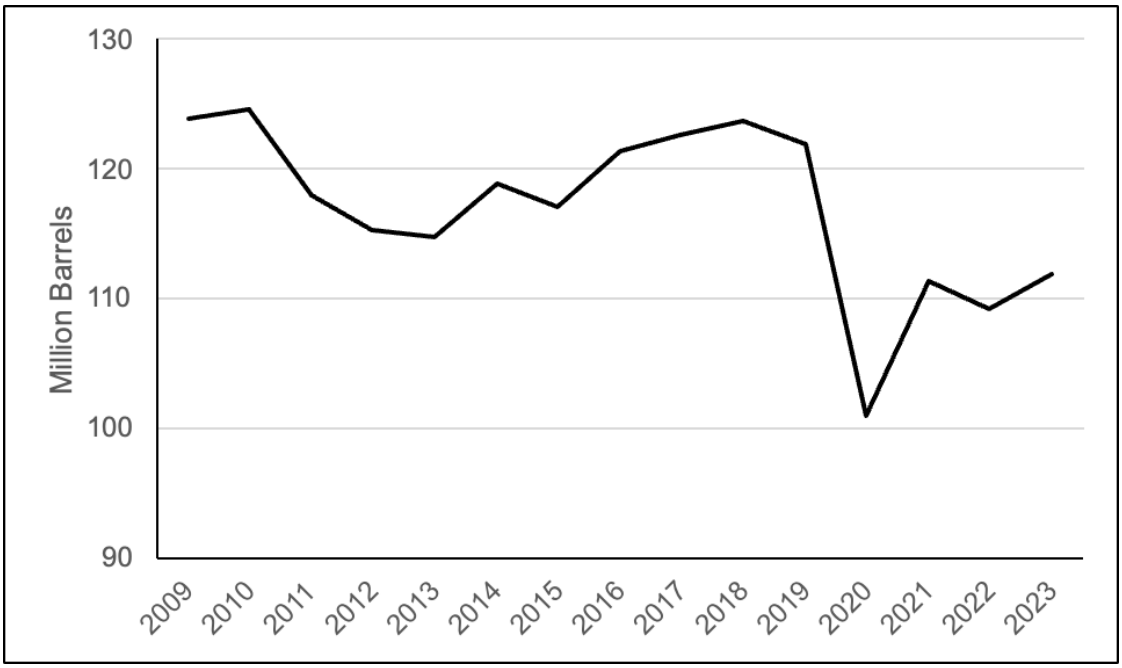
3.3.2. Motor Gasoline

Consumption

Motor gasoline is consumed by cars and trucks with internal combustion engines and is primarily used in the transportation sector for on-road vehicles, though there is some use in a variety of yard equipment and recreational vehicles. **Figure 7** presents a 15-year history of motor gasoline consumption statewide.

Figure 7: New York State Consumption of Motor Gasoline (Excluding Ethanol)

Source: Patterns and Trends[2]



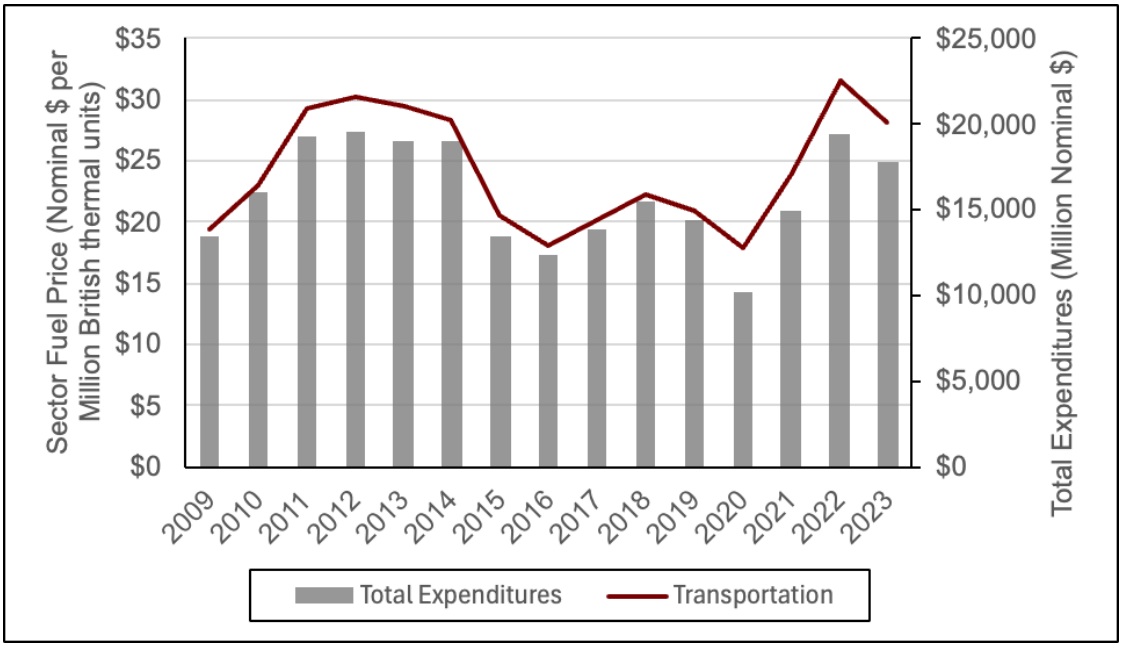
As highlighted in **Figure 7**, consumption of motor gasoline in 2023 increased compared to 2022.

Prices and Expenditures

Motor gasoline prices and expenditures reflect blended motor gasoline and ethanol, since that is the actual consumable fuel on the market. Additionally, since this fuel is transportation-sector-focused, there is only one sector to evaluate. Figure 8 presents the 15-year summary for this fuel.

Figure 8: Motor Gasoline (including Ethanol) Sectoral Prices and Total Expenditures Summary

Source: Patterns and Trends[2]



3.3.3. Aviation Fuel

Consumption

Aviation fuel is another transportation-sector-specific fuel. Aviation fuel is a collective term describing jet fuel and aviation gasoline. With the very specific end-use of these fuels, the combined aviation fuel is a critical fuel for airports statewide. Figure 9 presents a 15-year history of aviation fuel consumption statewide.

Prices and Expenditures

Aviation fuels showed similar trends to other petroleum product prices and expenditures discussed above. There was a general price decline during 2023, resulting in lower expenditures when compared to 2022, despite an increased consumption of these fuels.

Figure 9: New York State Consumption of Aviation Fuels

Source: Patterns and Trends[2]

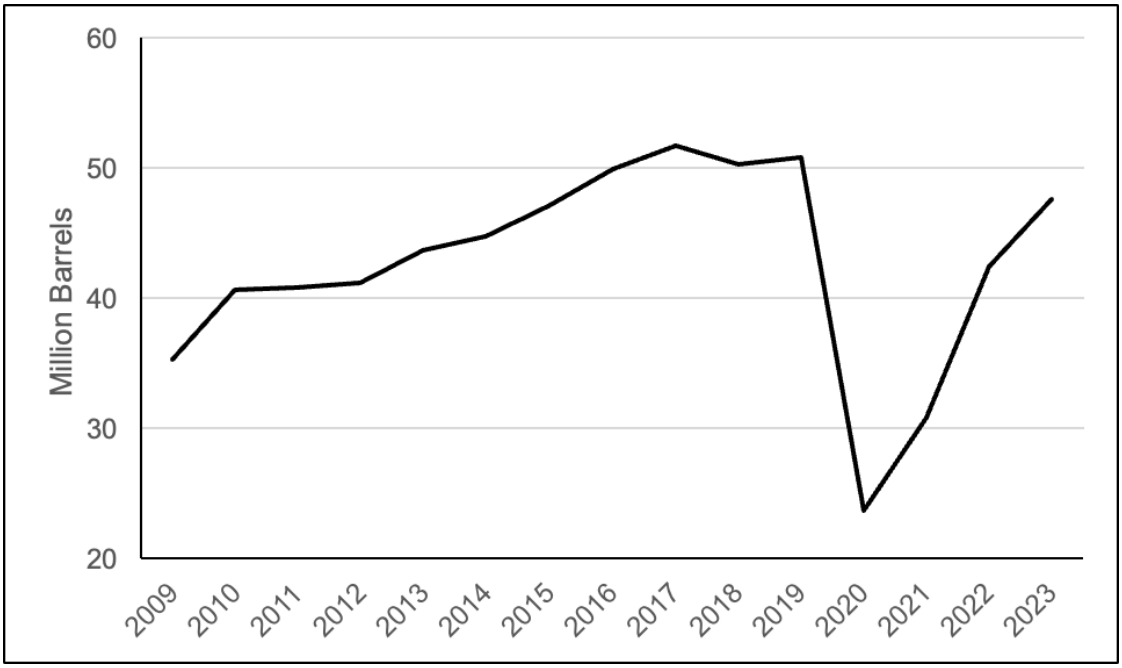
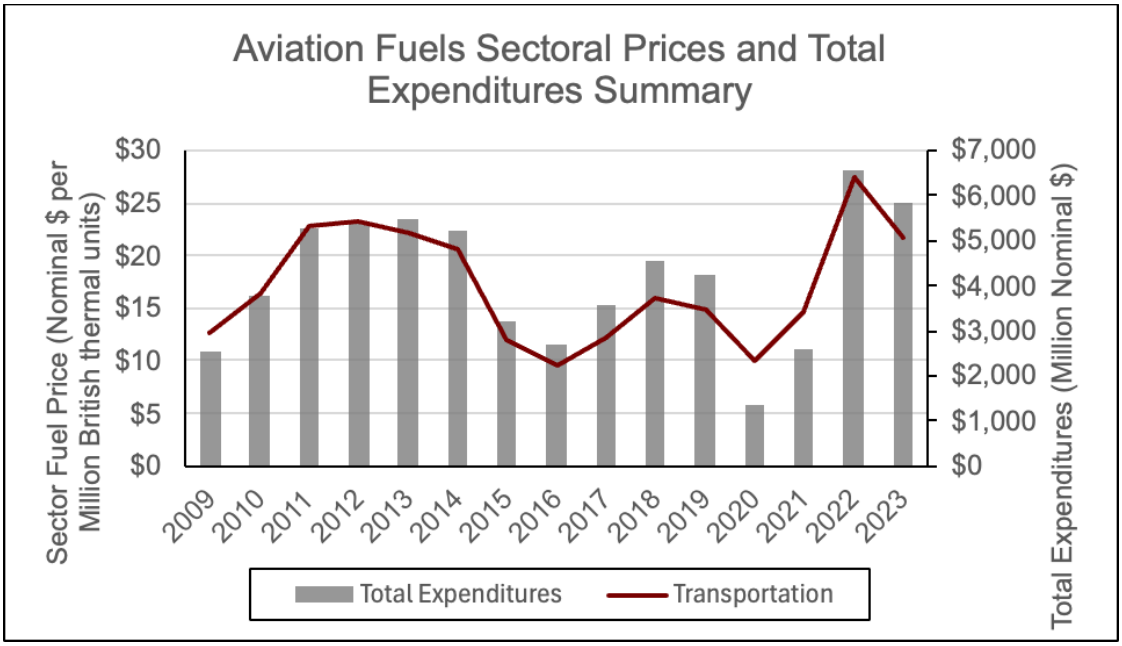


Figure 10: Aviation Fuels Sectoral Prices and Total Expenditures Summary

Source: Patterns and Trends[2]



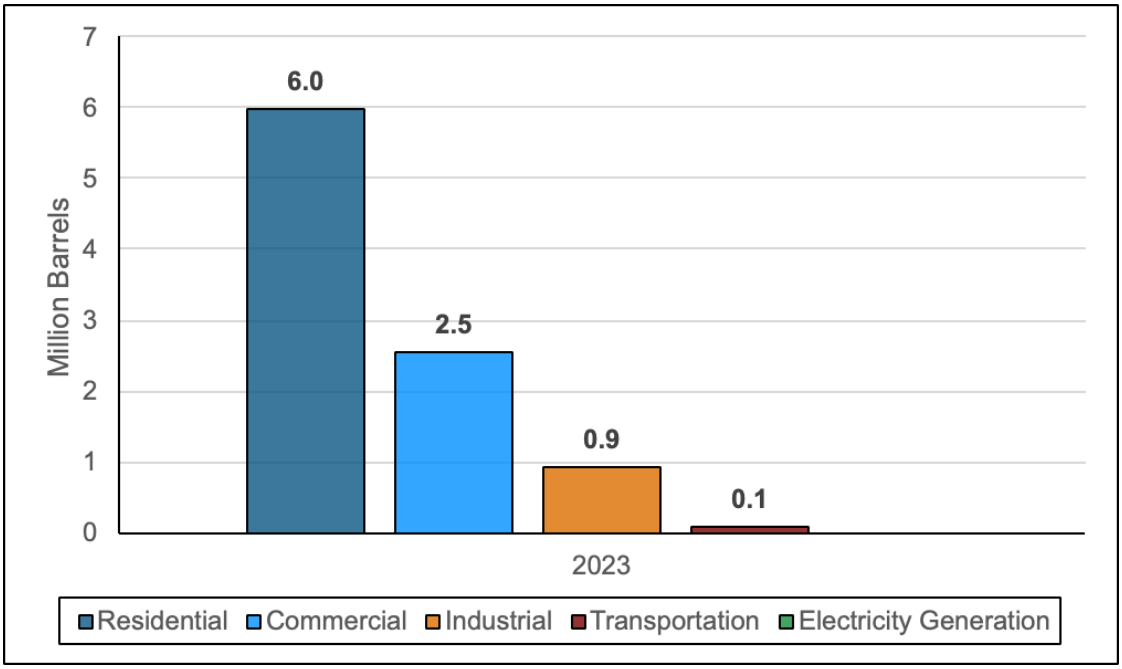
3.3.4. Propane

Consumption

For New York State, propane (also known as hydrocarbon gas liquids) represents a fuel for home heating, hot water, and cooking where natural gas may not be available, and consumers turn to deliverable fuel options. Propane is consumed by all sectors except for electricity generation, the greatest in the residential sector. Figure 11 presents a sectoral summary for 2023 propane consumption.

Figure 11: New York State Consumption of Hydrocarbon Gas Liquids (Propane) by Sector

Source: Patterns and Trends[2]

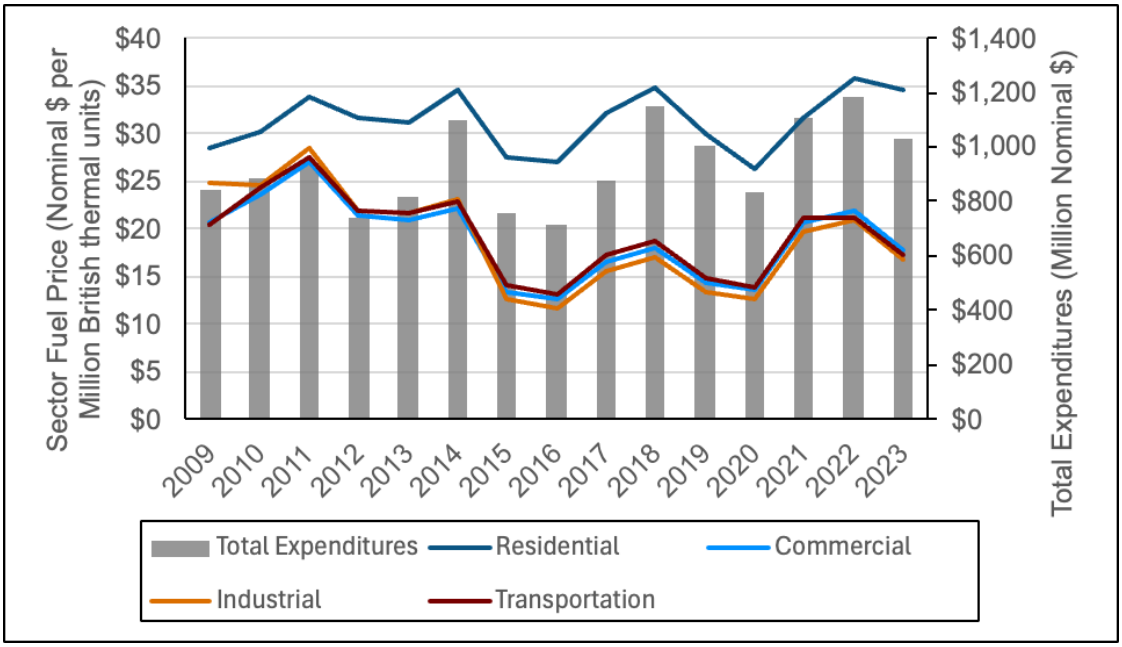


Prices and Expenditures

Propane markets responded similarly to other petroleum fuels. Figure 12 illustrates that propane prices and expenditures declined in 2023 compared to 2022.

Figure 12: Hydrocarbon Gas Liquids (Propane) Sectoral Prices and Total Expenditures Summary

Source: Patterns and Trends[2]



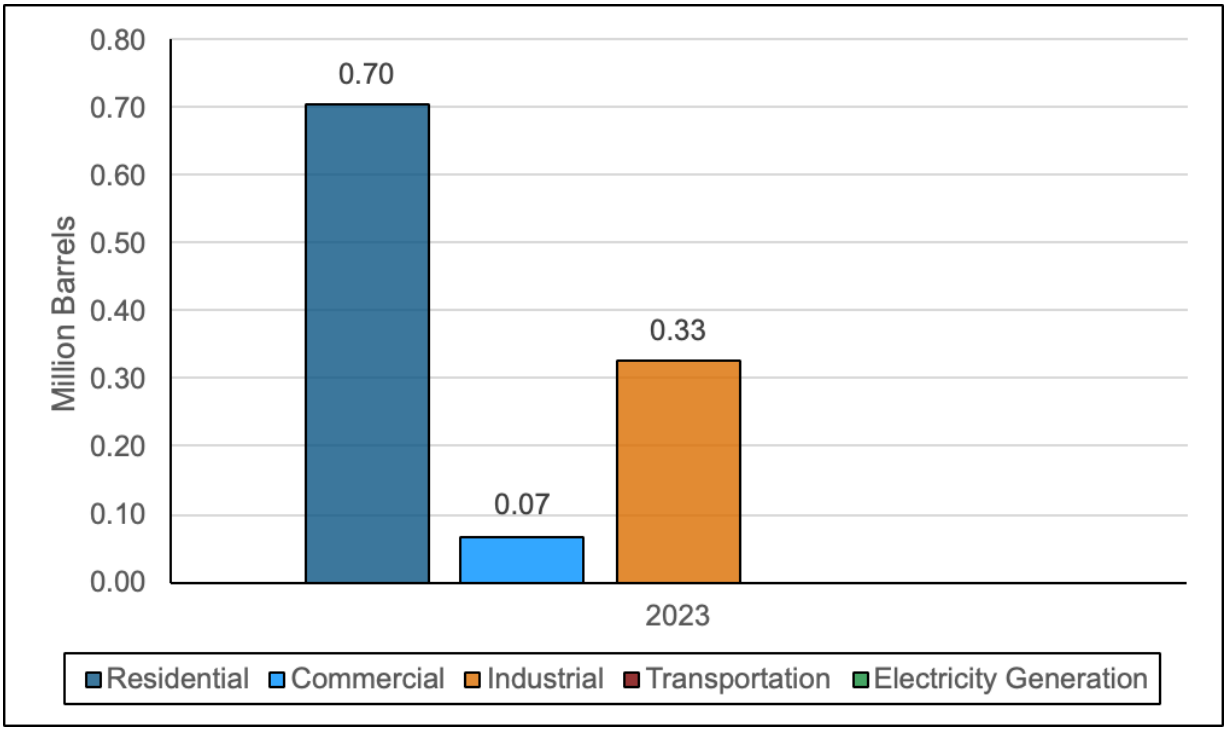
3.3.5. Kerosene

Consumption

Kerosene use is primarily in the residential sector as a heating fuel, though kerosene is also consumed by the commercial and industrial sectors to produce heat. Over the past 15 years, kerosene consumption has declined statewide. Figure 13 presents a sectoral summary of statewide kerosene consumption for 2023.

Figure 13: New York State Consumption of Kerosene by Sector

Source: Patterns and Trends[2]



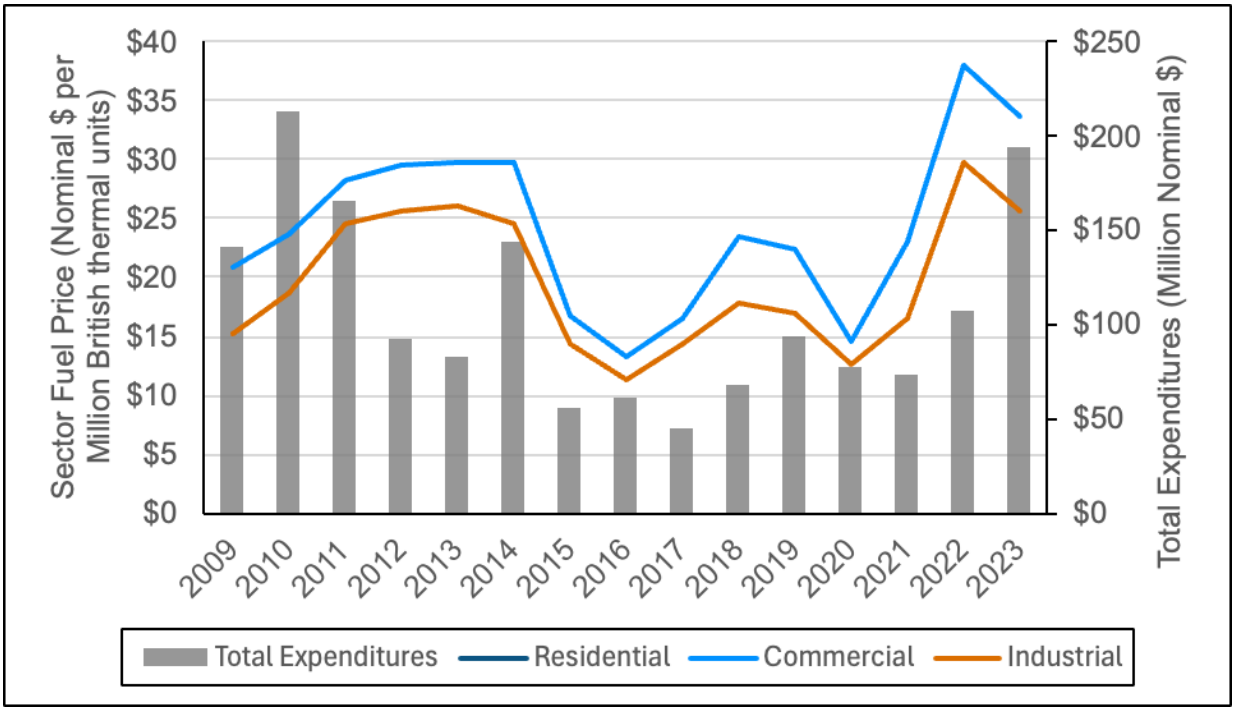
Prices and Expenditures

Kerosene consumption statewide declined over the past 15 years. While there are still limited uses for some building heating and industrial processes, kerosene is transitioning into a specialty fuel. The prices and expenditures, presented in Figure 14 for this fuel over the past 15 years have similar trends compared to other petroleum products. Despite the price fluctuations, expenditures for kerosene statewide have been largely consistent

Figure 14: Kerosene Sectoral Prices and Total Expenditures Summary

Source: Patterns and Trends[2]

Note: Residential and commercial sector prices for kerosene are the same.



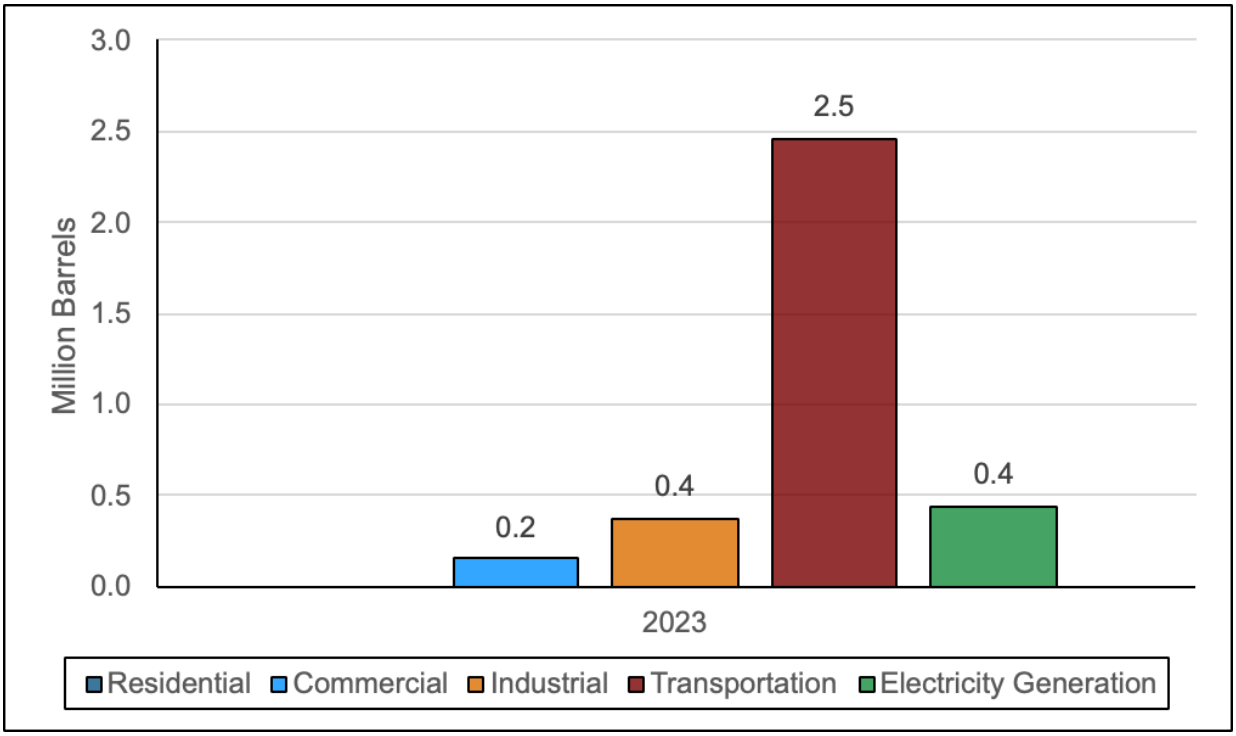
3.3.6. Residual Fuel Oils

Consumption

Residual fuel oil is a general classification for heavier distillate oils, generally known as Fuel Oil Number 5 and Number 6.[4] The statewide consumption of these fuels has declined over the past 15 years and is generally limited to the transportation sector as a bunkering fuel for marine vessels—but some consumption also takes place for select uses in other sectors. The industrial and electricity generation sectors were the second greatest in-state consumer of residual fuel oil during 2023. The fuel was typically used for industrial processes or as a secondary fuel when natural gas is temporarily interrupted or for smaller "peaker" generation plants that operate when demand is high. Additional consumption occurs in the commercial sector to heat buildings. Figure 15 presents the consumption of residual fuel oil by sector statewide in 2023. Overall, residual fuel oils are similar to kerosene and becoming a boutique or specialty fuel due to the limited and declining uses statewide.

Figure 15: New York State Consumption of Residual Fuel Oil by Sector

Source: Patterns and Trends[2]



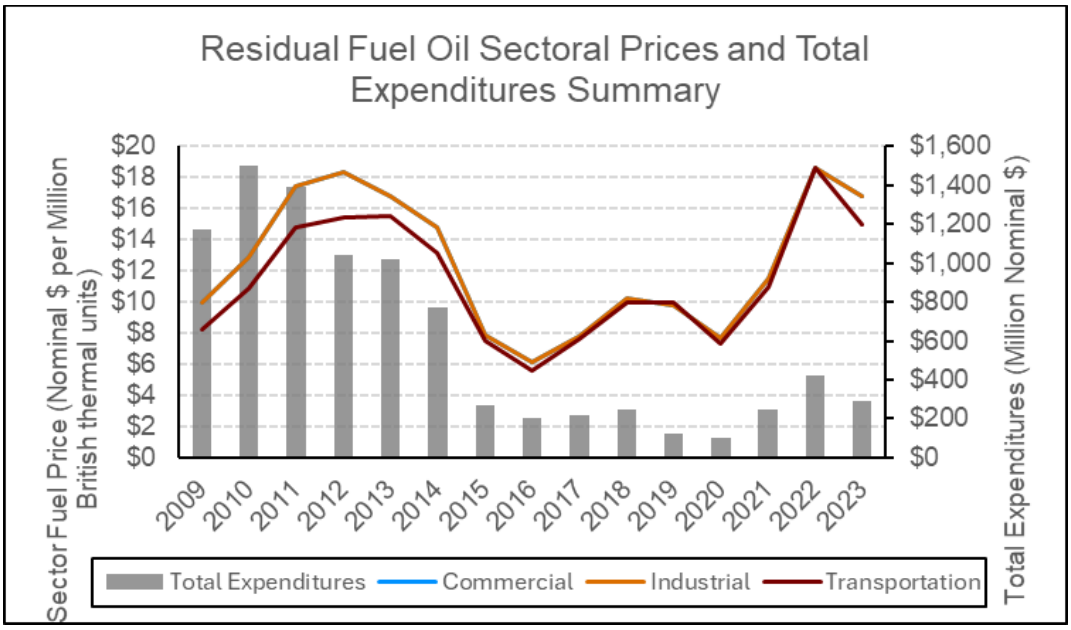
Prices and Expenditures

Figure 16 summarizes the prices by sector and the total expenditures statewide. In contrast to kerosene, a clear plateau in the total expenditures is observed after 2014, despite price fluctuations. In 2023, there was a decline in both price and expenditure for residual fuel oils, following the broad trend for petroleum fuels in 2023.

Figure 16: Residual Fuel Oil Sectoral Prices and Total Expenditures Summary

Source: Patterns and Trends[2]

Note: Prices for commercial and industrial sector were the same.



3.3.7. Low-Carbon Alternative Fuels

Low-carbon alternative fuels represent fuels that are developed using biomass feedstocks and are not derived from crude oil. Examples of alternative fuels in use today are ethanol and biodiesel.

As a result of federal and State regulations, alternative fuels such as ethanol and biodiesel were introduced as blending components with conventional fuels to offset the volume of conventional petroleum product utilized, but also to introduce a lower-carbon fuel to the fuels being consumed.

These alternative fuels represent the application of new research and testing for fuels to maintain the established reliability and supply chains of petroleum products, while also replacing volumes of the conventional petroleum fuels with a lower carbon fuel product. For more information, please see the Low-Carbon Alternative Fuels chapter of this Plan.

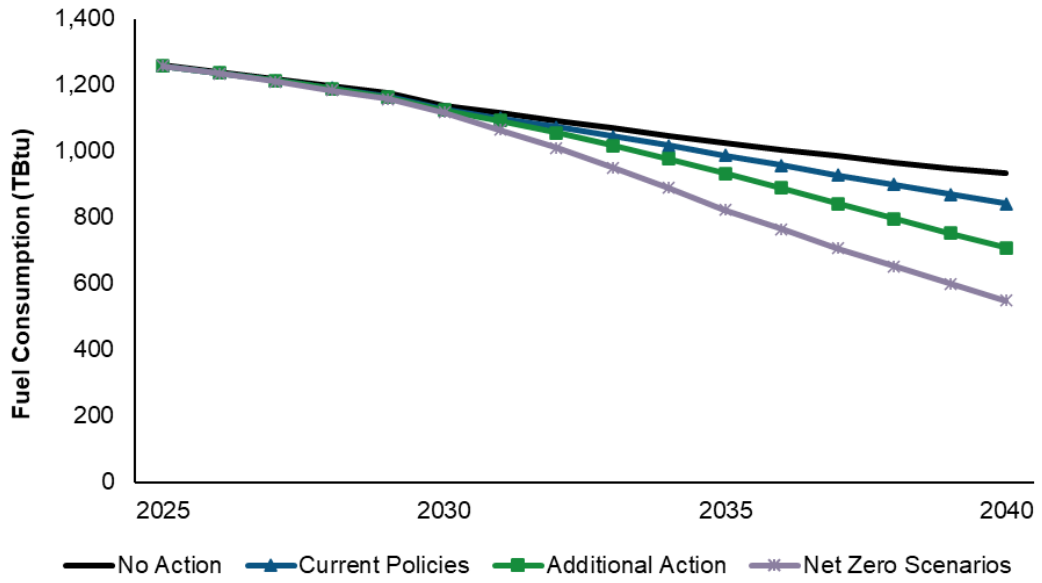
4. Outlook (2025 – 2040)

The Pathways Analysis planning scenarios project a steady decline in fossil fuel consumption between 2025 and 2040. Petroleum fuel use decreases approximately 46 percent from 2025 to 2040 in the Additional Action Scenario (Figure 17). The general decline in liquid fuels consumption through 2040 is attributed to increased efficiency for end-use technologies along with growing electrification options, primarily in the transportation and buildings sectors. However, petroleum fuels will still meaningfully contribute to the energy system in 2040, accounting for approximately 31 percent of final energy demand by fuel type in the Additional Action scenario. Though alternative fuel use does increase during this timeframe, it still only

represents a fraction of the total fuel use in 2040 (see the Low-Carbon Alternative Fuels chapter of this plan for more information).

Figure 17: Petroleum Fuel Consumption across all Scenarios 2025 – 2040

Source: Pathways Analysis



5. Themes and Recommendations

Over the next 15 years, petroleum fuels will remain critical to maintain reliability as New York State decarbonizes the energy sector. The petroleum sector will need to:

- Manage and maintain the existing petroleum infrastructure and businesses to continue to provide reliability and resiliency.
- Support transportation, storage, and delivery of low-carbon alternative fuels.

5.1. Maintain Reliability & Resiliency

New York State receives the petroleum fuels needed for everyday energy use through a complex supply chain. It is essential that this infrastructure is maintained to ensure continued resilience, reliability, and deliverability of these fuels in the face of both average and extreme weather conditions.

Recommendations

- **Continue to monitor and report on petroleum fuels supply, markets, and supply chain information**, providing transparent and up-to-date information for consumers and policymakers in New York State. Petroleum fuels industry stakeholders managing in-state fuels terminals should be required to report volumes of petroleum products, including alternative fuels, that are received and delivered at a regular interval.

- **Evaluate the supply chain for petroleum fuels to consider and identify critical infrastructure** or supply points for the delivery of fuels to end-users, which are necessary for keeping New York fueled. Identify any areas of concern that may need additional support in order to maintain critical reliability and resiliency across the sector.

5.2. Integration of Alternative Fuels

To increase the production and delivery of alternative fuels, New York State will need to consider new and flexible approaches to support market growth. There also is an opportunity to support industry stakeholders in efforts to establish safe and efficient methods of transporting alternative fuels into and throughout New York.

Recommendations

- **Consider approaches to build on existing policy to support the integration of alternative fuels**, similar to the bioheat blending mandate that currently aims at increasing the supply of biodiesel in New York State. Any new or expanded approaches will need to be flexible and allow for the integration of new or different alternative fuels as technologies and fuel supplies become available to enable alternative fuel use and maximize GHG emissions reductions.
- **Engage petroleum industry stakeholders in developing alternative fuel policy options, including to consider opportunities to leverage the existing petroleum infrastructure and system.** While similar to conventional petroleum products, there are limitations (in some instances) on how alternative fuels can move or be delivered from production to end-users. Supply chain considerations should be evaluated, including opportunities for the retrofit of existing infrastructure to enable greater alternative fuel use.

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1 State Energy Data System. *State Profiles and Energy Estimates Table E18: Petroleum and natural gas price and expenditures estimates, ranked by state, 2022*, distributed by the EIA, accessed January 2025, https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep_sum/html/rank_pr_pa_ng.html&sid=US.

2 *Patterns and Trends - New York State Energy Profile* New York State Energy Research and Development Authority, 2025, https://www.nyserda.ny.gov/About/Publications/Energy-Analysis-Reports-and-Studies/Patterns-and-Trends.

3 New York State Department of Environmental Conservation, *Bulk Storage Database*, distributed by New York State Department of Environmental Conservation, accessed March 2025 https://appfactory.dec.ny.gov/DERExternalSearch/BulkStorageSearch.

4 Energy Glossary, *Residual fuel oil*, distributed by the EIA, accessed February 2025 https://www.eia.gov/tools/glossary/index.php?id=residual%20fuel%20oil.

New York State Energy Plan

VOLUME II | Our Energy Systems

Low-Carbon Alternative Fuels

05

2025 NEW YORK STATE ENERGY PLAN

Key Terms Used in This Chapter

FOR THE COMPLETE GLOSSARY ➜

Alternative Fuels: Liquid or gaseous fuel derived from biomass or clean energy, such as biodiesel, renewable natural gas, renewable diesel, hydrogen, sustainable aviation fuel, and synthetic fuels.

Biogas: Biogas is gas resulting from the decomposition of organic matter, most commonly under anaerobic conditions (such as in a landfill, manure storage, or wastewater recovery facility). The principal constituents are methane and carbon dioxide. Some end-uses can use biogas directly as a fuel source with minimal processing, though its lower energy density and purity compared to conventional natural gas or renewable natural gas precludes it from most end-uses.

Co-Pollutant Emissions: Air pollutants that are a byproduct from combustion of fossil fuels and most alternative fuels. These include fine particulate matter ($PM_{2.5}$), nitrogen oxides (NO_X), volatile organic compounds (VOC), sulfur dioxide (SO_2), and various toxic compounds. These pollutants contribute to a range of health issues, including respiratory conditions, asthma, heart attacks, and other serious illnesses.

Conventional Fuels: The fossil fuel that is typically used today, such as conventional diesel, conventional jet fuel, conventional natural gas.

Renewable Natural Gas (RNG): Renewable natural gas is biogas that has been processed and upgraded to a higher methane content with fewer impurities and can be used as a drop-in replacement of natural gas in end uses in areas such as the power sector, industrial processes, buildings, and transportation.

Biodiesel: Biodiesel is produced from vegetable oils, animal fat, and recycled cooking oil. It is a liquid fuel that can be blended with conventional diesel but cannot entirely replace it. Biodiesel can be blended in most applications that use diesel.

Renewable Diesel: Renewable diesel is interchangeable with conventional diesel. It is typically produced by hydrotreating, which involves combining fats and hydrogen at high temperatures. Renewable diesel can be used as a drop-in replacement for any application that uses diesel.

Sustainable Aviation Fuel: Sustainable Aviation Fuel is typically produced from biomass waste and fats/greases/oils. It is a newer alternative fuel that can be blended with conventional jet fuel.

Hydrogen: Hydrogen is an energy carrier that is typically produced via thermal processes, using high temperatures, or via electrolytic processes, using water and electricity. Hydrogen can be used for many end-uses and is either combusted or used in fuel cells to provide electricity. Hydrogen can also be converted to synthetic fuels (see below.) Hydrogen is only considered a zero-emission fuel if its production does not include the use of fossil fuels (e.g., electrolysis powered by renewable energy).

Synthetic Fuels: Synthetic fuels are produced by combining hydrogen and carbon dioxide using renewable energy. Synthetic natural gas and other liquid synthetic fuels such as renewable diesel and Sustainable Aviation Fuel can be produced.

Key Findings → Low-Carbon Alternative Fuels

Zero- and low-carbon alternative fuels, such as hydrogen, renewable natural gas (RNG), renewable diesel, sustainable aviation fuel (SAF), and synthetic fuels, are an important complement to electrification in the State's energy transition strategy. Zero- and low-carbon alternative fuels are particularly useful in helping to decarbonize hard-to-electrify end uses where continuing to use liquid or gaseous fuels may be necessary, for example in agriculture and industry, marine, aviation, and long-distance trucking. Low-carbon alternative fuels could also support electric system reliability by supplementing electricity supply during peak periods, such as to meet peak winter heating demand. This chapter provides an overview of the State's approach to low-carbon alternative fuels, outlines major initiatives underway, and recommends continued and additional actions.

- **Low-carbon alternative fuels are an important complement to electrification in the State's clean energy transition strategy.** In cases where electrification and zero-emissions solutions are impracticable due to technological, safety, cost, or reliability constraints, these fuels should be prioritized for end uses where they can deliver the greatest greenhouse gas (GHG) emissions reductions with the lowest cost and environmental impact. The deployment of low-carbon alternative fuels should also ensure net reductions in co-pollutant emissions and avoid disproportionate impacts on disadvantaged communities associated with such emissions. Since supply of these fuels will be limited, analysis indicates that low-carbon alternative fuels are best directed toward targeted and high-impact applications in transportation, supplemental heating, agriculture and industry, and the power sector—areas where full electrification may not yet be practical to maximize environmental benefits and GHG emissions reductions.

- **Alternative fuels should be carefully managed to realize GHG emissions reductions.** GHG emissions associated with the feedstock, production, transportation, storage, and combustion of low-carbon alternative fuels should be considered. To maximize global GHG emissions reductions, New York State prefers waste-based feedstocks for alternative fuel production. To further maximize in-state benefits and achievement of the State's climate goals, the State prefers fuels and feedstocks sourced within the state. Recognizing the supply limitations, the State remains open to regionally sourced and other low-impact feedstocks to advance global GHG reduction.

- **Both life cycle analysis and Climate Act accounting of GHG emissions from low-carbon alternative fuels should play a role in the design and development of programs and policies.** Life cycle analysis should be used in policy development to evaluate and compare GHG emissions reductions associated with different feedstocks, fuels, and end uses and to calculate emissions reductions relative to a business-as-usual scenario. The Climate Act accounting framework should be used when calculating emissions impacts that relate to measuring progress toward Climate Act goals.

- **Alternative fuels deployment should be strategic to realize co-pollutant emissions reductions, especially in and near disadvantaged communities.** While reducing global GHG emissions is important, any potential net increase in local co-pollutant emissions from the use of alternative fuels should be considered and avoided wherever possible. To maximize co-pollutant emission reductions, electrification and other zero-emission solutions should be prioritized unless there are specific technological, safety, or reliability challenges.

- **Policies and tracking systems should balance rigor with feasibility to accelerate alternative fuels deployment while ensuring credible emissions reductions.** The integrity of GHG emission reduction claims depends on transparent, robust, and credible tracking of alternative fuel attributes; however, systems should be designed to avoid excessive administrative burdens that could stifle deployment and prevent emissions reductions. The delivery of fuels to New York State for use within the state is of critical importance. New York State should carefully consider methods to appropriately and accurately measure emissions reductions and should consider designing an attribute tracking process that includes additional considerations, such as valuing unique aspects of certain fuels or technologies, avoiding land use change, or avoiding undesired feedstocks or origin locations.

- **To catalyze low-carbon alternative fuels markets to meet future demand, policy, regulatory, and market interventions—such as mandates, market-based mechanisms, and incentives—will likely be needed.** Demand is likely to outpace the current limited supply of these fuels, underscoring the need for supportive policies and regional market development to expand cost-effective production to increase availability. Additional market structures or mechanisms may also be needed to align price structures to realize the needed supply of low-carbon alternative fuels and should be evaluated against any potential consumer cost increases resulting from these policies.

- **To meet State policy goals, a limited amount of alternative fuels will need to be produced, transported, and used in the broader energy system.** To minimize costs and other impacts, existing infrastructure should be leveraged for the transport and storage of pure or blended alternative fuels wherever it is safe and technologically and economically feasible. In cases where existing systems are incompatible or insufficient, limited new, fuel-specific infrastructure may be needed to connect supply with areas of demand. New York State does not currently support the blending of hydrogen into the existing natural gas pipeline system due to safety, system integrity, and indoor air quality concerns, as additional research is needed to understand such use.

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1. Overview

Zero- and low-carbon alternative fuels, such as hydrogen, renewable natural gas (RNG), renewable diesel, synthetic fuels, and sustainable aviation fuel (SAF), have the potential to replace some fossil fuel use and reduce greenhouse gas (GHG) emissions in New York State. These fuels are especially useful in helping to decarbonize difficult-to-electrify end-uses where liquid or gaseous fuels remain necessary due to energy intensity, infrastructure constraints, or cost barriers. Sectors such as agriculture, marine, aviation, long-distance trucking, and some rail transportation face technological and economic challenges to electrification and are prime candidates for alternative fuel use. Low-carbon alternative fuels could also support electric system reliability by supplementing electricity supply during peak periods, such as winter heating demand, when clean electricity alone is insufficient to meet heating and electrical needs and maintain necessary reliability standards.

Two supporting reports, *Considerations for Low-Carbon Alternative Fuel Use in New York State* and *Co-Pollutant Impacts of Low-Carbon Fuels and Technologies—2025 Update*,[1] explore the potential role of alternative fuels in achieving New York State's energy and climate goals. The first report examines feedstocks, production pathways, end-uses, infrastructure, market development, and research needs related to alternative fuels. The second report focuses on the impacts of alternative fuel use on health and air quality. These reports, along with ongoing alternative fuels research at NYSERDA, helped inform the development of this chapter.[2,3] The primary focus of this chapter and the Plan's Pathways Analysis is RNG, biodiesel, renewable diesel, SAF, and hydrogen.

2. State of the Sector and Progress Report

2.1. Alternative Fuel Production and Use in New York State

Alternative fuels currently used in New York include biodiesel, ethanol, RNG, renewable diesel, and SAF. Current alternative fuel use is currently limited compared to conventional fossil fuels. In 2022, New York State consumed approximately 44.2 trillion British thermal units (TBtu) of ethanol, 10.5 TBtu of biodiesel, and 4.6 TBtu of landfill gas, each a small fraction compared to 373 TBtu of diesel and 1,402 TBtu of natural gas consumed that same year. [4] Current production capacity within the state is also limited: New York State does not presently produce biodiesel, renewable diesel, or SAF.

2.1.1. Biogas and RNG

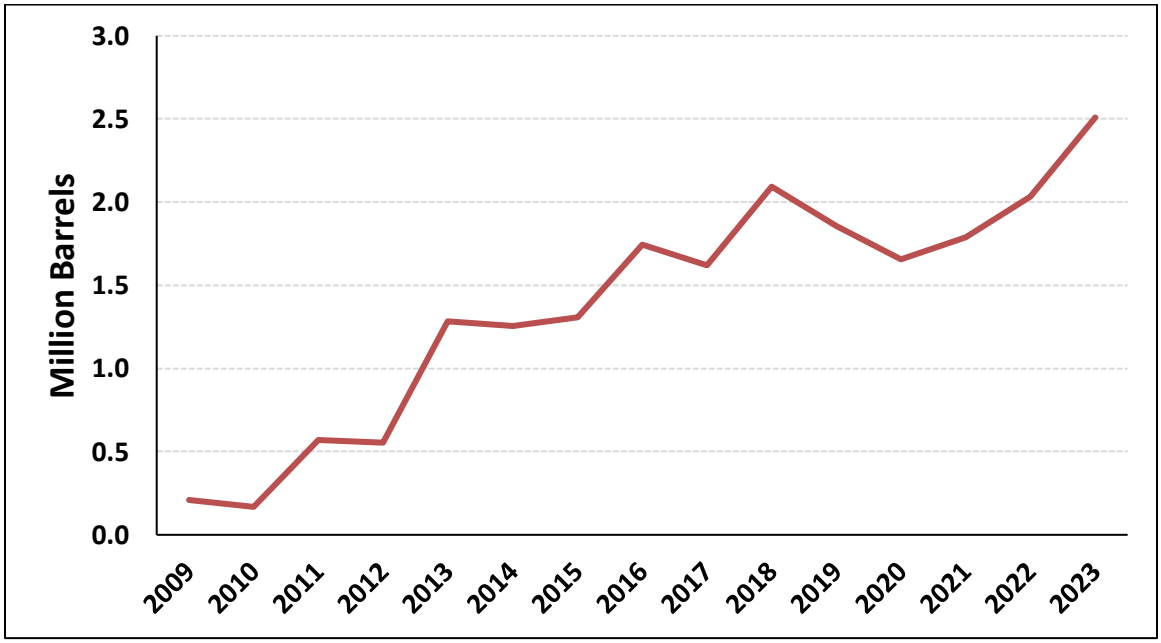
Biogas and RNG are produced through the anaerobic digestion of organic materials, such as agricultural waste, food scraps, and wastewater sludge. These fuels are typically used to generate heat and electricity on-site or upgraded into pipeline-quality RNG for broader distribution and use. There are at least 39 on-farm anaerobic digesters in New York State, primarily located in agricultural regions of Western New York, the Finger Lakes, and the Southern Tier. Anaerobic digesters producing biogas are also present statewide. The Newtown Creek Wastewater Resource Recovery Facility is an RNG demonstration project, the first of its kind in the state, and processes 250 million gallons of wastewater and 220 tons of organic waste each day. Approximately 40 percent of the biogas generated is used to power the facility, while the remainder is upgraded by National Grid into RNG. When the biogas-to-grid system is offline, the excess gas is flared.

2.1.2. Biodiesel

Biodiesel is produced by chemically converting vegetable oils, animal fats, or recycled cooking oils through a process known as transesterification. In New York State, biodiesel is primarily used for blending with petroleum diesel for on- and off-road transportation and in heating oil. In response to recent changes in state law, data on biodiesel in home heating oil will become increasingly available, as a rising percentage of such oil is required to be from biodiesel.[5] Figure 1 reflects only biodiesel consumption in the transportation sector for 2022. Biodiesel use in transportation has increased steadily since 2010 (with the exception of 2020, when the COVID-19 pandemic led to a temporary decrease in transportation fuel demand).[4] New York State does not have any biodiesel production facilities, but it is the sixth-largest consumer of biodiesel in the country.[6] New York State does have companies that collect used cooking oil and refine it for biofuel production.

Figure 1: New York State's Historical Consumption of Biodiesel (Million Barrels)

Source: Patterns & Trends[4]



2.1.3. Renewable Diesel

Renewable diesel is produced through the refining of organic feedstocks, such as waste oils, animal fats, and vegetable oils, through the process of hydrotreating. Unlike biodiesel, renewable diesel is chemically similar to conventional diesel and can be used as a replacement in existing diesel engines. Currently, there is no commercial-scale renewable diesel production in New York State. Most of the renewable diesel used on the East Coast is imported from other U.S. regions or abroad.[7]

Renewable diesel use in New York State is currently applied in limited targeted end-uses. Specifically, New York City emerged as a leader in 2023, becoming the first city on the East Coast to transition municipal fleet vehicles, including garbage trucks, ambulances, work trucks, and emergency generators, to renewable diesel. This shift displaced an estimated 12 million gallons of conventional diesel fuel from

September 2023 to October 2024.[8] In October 2024, New York City announced plans to begin testing renewable diesel in the Staten Island Ferry and NYC Ferry systems.[9] In April 2025, New York City completed its first purchase of renewable diesel for use in its ferries.[10]

2.1.4. Sustainable Aviation Fuel

SAF is a recent and promising addition to New York State's alternative fuels landscape. SAF is produced from renewable or waste-derived feedstocks and can significantly reduce GHG emissions compared to conventional jet fuel. The Port Authority of New York and New Jersey conducted a logistics and production study that determined SAF would support its commitment to meet the goals of the Paris Agreement by reducing aviation-related GHG emissions. In June 2022, a demonstration project successfully delivered a blend of SAF and conventional jet fuel from a refinery in Houston, Texas to LaGuardia International Airport for use by Delta Airlines via pipeline.[11] Building on this progress, in March 2025, JetBlue and its corporate partners announced a 12-month agreement to procure 1 million gallons of SAF for New York's John F. Kennedy International Airport, with the option to scale up to 5 million gallons with additional corporate partner support. The blended SAF will be used on JetBlue flights departing from John F. Kennedy International Airport.[12] In addition to SAF use, the carbon conversion technology company, Airco, has a pilot SAF production facility in Brooklyn, New York. The company's technology captures carbon dioxide (CO_2) and hydrogen and converts them into a synthetic SAF fuel.[13]

2.2. Current New York State Policies

Zero- and low-carbon alternative fuels, such as hydrogen, RNG, renewable diesel, and other bio-based fuel products, have the potential to displace some fossil fuel use, particularly in sectors that are difficult to electrify; however, additional research, analysis, and technological development are needed to determine the feasibility, climate benefits, and environmental and health impacts of these fuels. The New York State Climate Action Council Scoping Plan highlighted the need for further analysis to prioritize and optimize the use of low-carbon alternative fuels in New York State while minimizing associated emissions and public health risks.[14]

New York has already taken steps to increase alternative fuel use. In 2023, New York became the largest state in the nation to require that all heating oil sold for use in buildings contain at least five percent biodiesel.[15] This requirement, previously limited to New York City, will increase to 10 percent in 2025 and to 20 percent by 2030.[16] Separately, the Clean Heating Fuel Credit, which began in 2006, provides a one cent per gallon tax credit for every percent of biodiesel blended into heating oil, up to 20 cents per gallon, purchased before January 1, 2026 to help offset the added cost of using biodiesel and support GHG reduction efforts.[17]

2.3. New York State Programs and Initiatives

2.3.1. Clean Transportation Standard Study

As announced in the Governor's 2024 State of the State address, NYSERDA and the New York State Department of Environmental Conservation (DEC) have initiated a study to evaluate how a Clean Transportation Standard may contribute to clean energy deployment, emissions reductions, health, and equity in New York State. A Clean Transportation Standard would seek to lower the GHG intensity of

transportation fuels sold statewide and would include both electrification and low-carbon alternative fuels.

2.3.2. Low-Carbon Alternative Fuel Research & Development

NYSERDA's Innovation and Research Program focuses on innovative solutions to build ecosystems for clean hydrogen and other low-carbon alternative fuels, including production, transmission, distribution, storage, and adoption of these fuels. NYSERDA recently announced the availability of $7.8 million to support pilot and demonstration-scale projects that convert in-state waste streams to low-carbon fuels. Eligible feedstocks include landfill gas, municipal solid waste organics, wastewater sludge, agricultural residues, and point-source or waste CO_2, while eligible fuels include SAF, renewable diesel, RNG, clean methanol, and sustainable marine fuels.[18] This funding is part of NYSERDA's 2025 Regional Greenhouse Gas Initiative Draft Operating Plan, which allocated $24.5 million over three years to accelerate the development of alternative fuels. This funding will support identification, scoping, engineering, measurement, verification, and execution of pilot demonstrations statewide that showcase alternative fuels processes. It will also establish a program that accelerates the development of advanced feedstock conversion technologies for alternative fuels produced with waste-based feedstocks.[19]

2.3.3. Clean Hydrogen Research & Development

New York State is actively supporting clean hydrogen innovation projects. In 2024, the State awarded nearly $8.1 million to projects to decarbonize industrial process heat, facilitate the integration of clean hydrogen production with renewable energy, and demonstrate hydrogen-based generation systems for grid support services. An additional $1.2 million was awarded for clean hydrogen research and development projects to demonstrate new designs for clean hydrogen electrolyzers that have the potential to lower costs, mitigate supply chain risks, and reduce reliance on fossil fuels in difficult-to-electrify sectors, such as some industrial operations or long-range heavy-duty transportation. NYSERDA recently published the *New York State Hydrogen Assessment*, a comprehensive analysis of hydrogen's potential to decarbonize hard-to-electrify sectors such as high-temperature industrial processes, heavy-duty transportation, and district heating.[20]

2.3.4. Zero by 40 Target and Technoeconomic Assessment

In May 2023, the New York State Public Service Commission issued an order initiating a process "to identify technologies that can close the gap between the capabilities of existing renewable energy technologies and future system reliability needs, and more broadly identify the actions needed to pursue attainment of [New York State's] Zero Emission by 2040 Target."[21] New York State subsequently conducted a study to evaluate the candidate technologies to close that gap, including hydrogen, RNG, and renewable diesel. The *Zero by 40 Technoeconomic Assessment* (the Assessment) evaluated performance attributes, technology and infrastructure readiness, emissions and other environmental considerations, costs, and scalability. The Assessment found that all three fuels could contribute to reaching 2040 goals but will have limited supply and high costs that require limiting use in the electricity sector to times of most extreme need. Hydrogen is an alternative fuel that has long-term potential as a zero- to low-carbon energy resource but faces significant infrastructure challenges. Its viability in the power sector by 2040 is dependent on renewables deployment and building out transportation and

storage infrastructure, which makes statewide deployment challenging. RNG and renewable diesel face fewer infrastructure challenges than hydrogen because they are drop-in replacements for natural gas and fossil distillate and can leverage existing infrastructure. However, their availability for the power sector would require a mix of feedstocks and production pathways and is limited due to feedstock quantities and competition from other uses.[22] RNG and renewable diesel are expected to be lower cost than green hydrogen, but they also have gross emissions implications that must be considered. For an expanded discussion of the Assessment, refer to Section 2.7.2 of the Electricity Chapter.

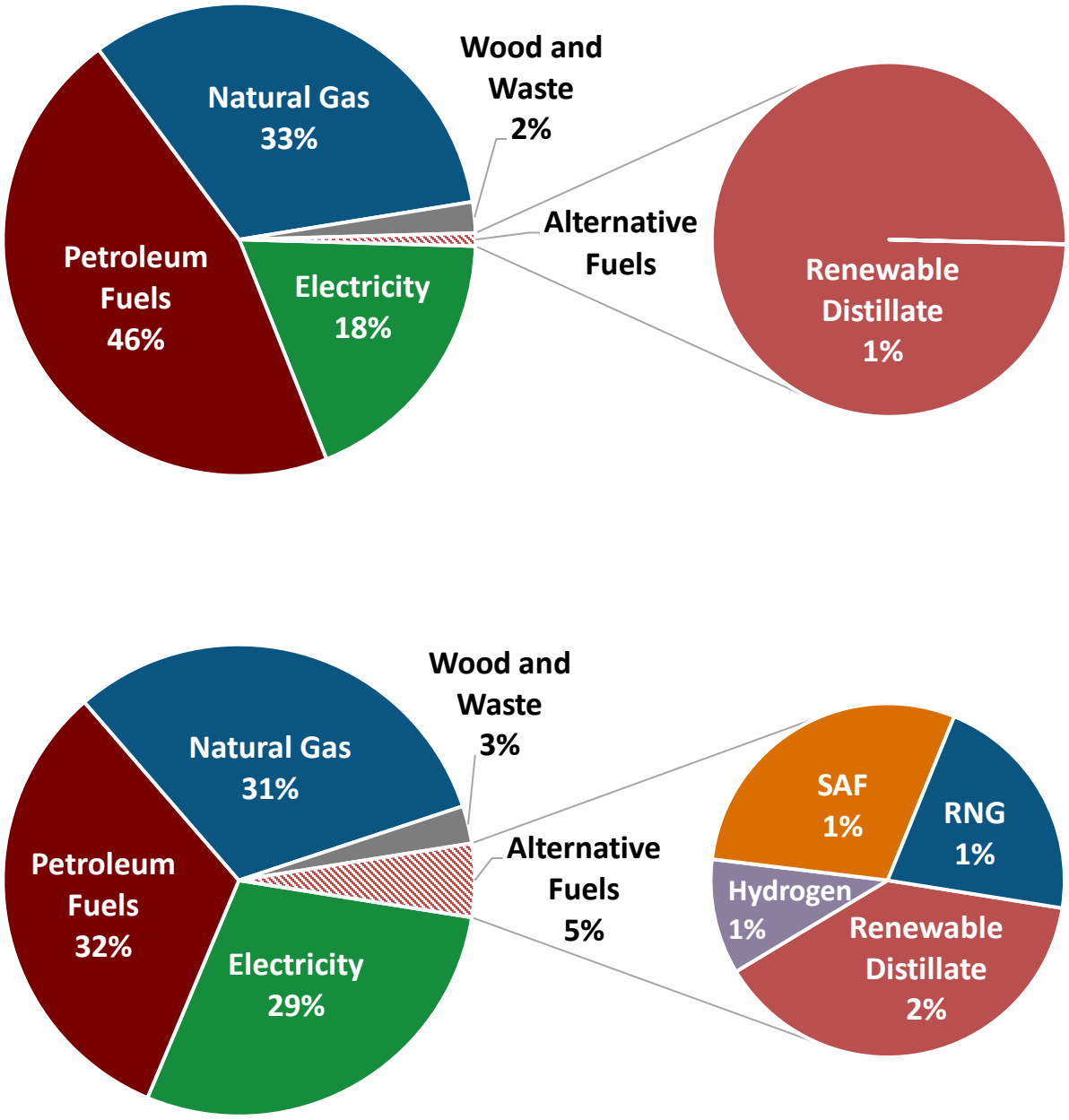
3. Outlook

3.1. Alternative Fuels End-Uses

As New York State decarbonizes and electrifies its energy system, clean electricity will become the primary energy source and the first solution for emissions reductions. Zero- and low-carbon alternative fuels will play a limited, though critical and strategic, role in decarbonizing end uses that are difficult –to–electrify due to process-specific requirements, technological constraints, safety, or reliability needs. While petroleum and natural gas use is projected to decline significantly between 2025 and 2040 due to increased electrification, fossil fuels are expected to remain primary components of the energy system in 2040. According to the Pathways Analysis, low-carbon alternative fuels are anticipated to grow from meeting just 1 percent of total final energy demand in 2025 to approximately five percent by 2040 (Figure 2).[23] Key contributors to this share include renewable diesel, SAF, RNG, and clean hydrogen.

Figure 2: 2025 (top) and 2040 (bottom) Final Energy Demand by Fuel

Source: State Energy Plan Pathways Analysis, Additional Action Scenario

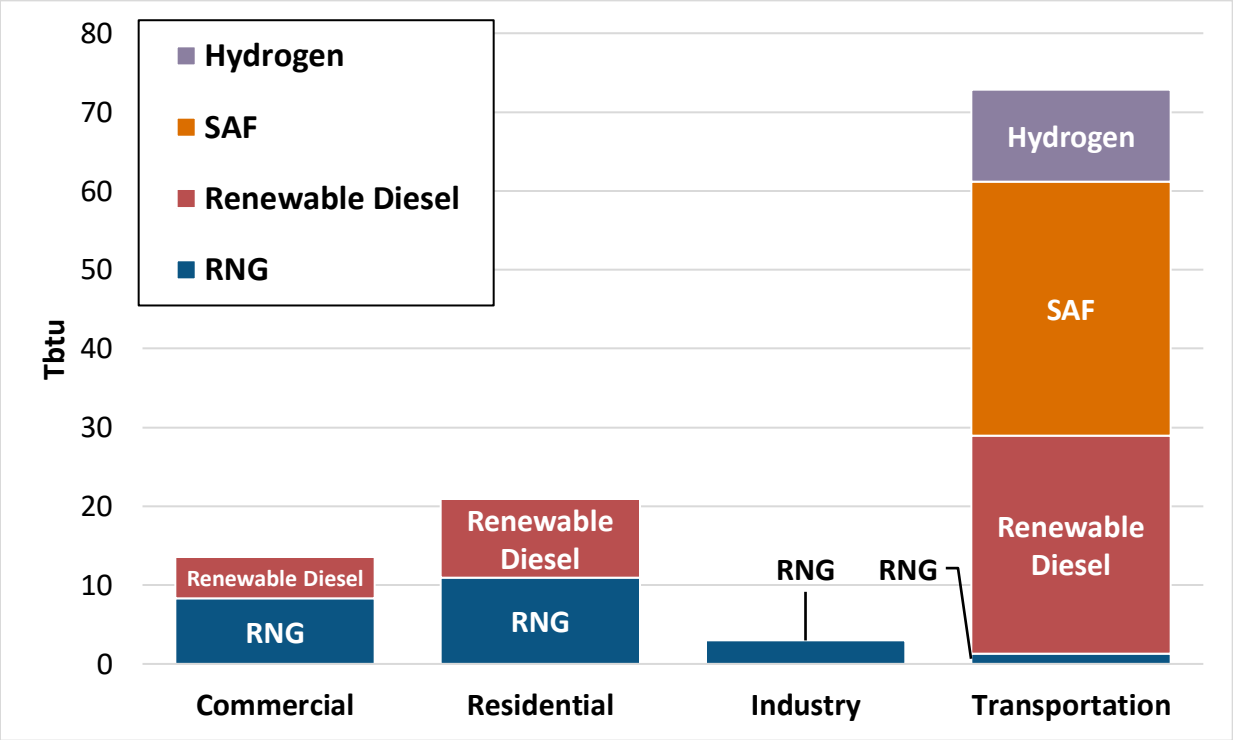


By 2040, the transportation sector is expected to be the largest consumer of alternative fuels, primarily relying on renewable diesel and SAF to decarbonize heavy-duty transportation and aviation (Figure 3).

The commercial, residential, and industrial sectors will rely on RNG and renewable diesel for heating and high-heat industrial processes. While fossil fuels and electricity will remain the dominant energy sources across all sectors in 2040, alternative fuels will comprise only a small percentage of overall fuel consumptionFigure 3. Hydrogen, RNG, and renewable diesel could also play a role in the power sector. The Pathways core cases assume green hydrogen provides low-capacity-factor clean firm capacity for the power sector, while a sensitivity analysis explores the effects of replacing hydrogen with RNG. Renewable diesel, as a drop-in replacement for fossil distillate, is a promising potential backup fuel for reliability needs, similar to the use of distillate in dual-fuel-generating units today.[22] The scale of alternative fuel use will be shaped by sector-specific energy demands, the technological readiness of fuel options, and the production and delivery capacity for each fuel.

Figure 3: 2040 Alternative Fuel Use by Sector

Source: State Energy Plan Pathways Analysis, Additional Action Scenario.



In 2040, hydrogen is projected to be used primarily in the transportation sector to decarbonize heavy-duty, long-distance trucking. Beyond 2040, current analysis suggests hydrogen could also play a role in district heating, industrial processes, and select non-road applications, with limited deployment in power generation, aviation, and maritime sectors as production increases. Hydrogen demand is likely to peak during the winter months, driven by the heating needs of district steam heating, particularly in New York City, where dense industrial, heating, and transportation needs converge.[20]

3.2. Market Development

Current markets for low-carbon alternative fuels remain limited, as fossil fuels continue to dominate primary energy demand. As such, only small volumes of low-carbon alternative fuels are currently produced in New York State and nationwide.

Low-carbon alternative fuels, except for hydrogen produced using clean electricity, generally depend on a limited supply of organic feedstocks. These feedstocks can be used to produce multiple fuel types, leading to significant competition for their use. In addition to feedstock competition across alternative fuels, neighboring states and Canadian provinces with similar decarbonization targets are also seeking to secure these fuels, creating additional competition for available feedstocks and fuels. As a result, New York State should take a targeted approach to alternative fuel use—prioritizing in-state, waste-based feedstocks when possible—to maximize GHG emissions reductions and other benefits of reducing waste disposal in landfills, affordability, and economic development opportunities (further discussed in Section 4.3). To meet the demand projected in the Pathways Analysis, regional and non-waste feedstocks and fuel production will also be necessary. To catalyze the collection of feedstocks and production of new fuels, new policies—including mandates, market-based mechanisms, and incentives—will be needed. As these policies foster increased demand across the region, supply chains and regional markets for the production and delivery of these fuels will emerge.

3.3. Infrastructure Development

New York State has an extensive existing infrastructure for both gaseous and liquid fuels, including pipelines, ports, railways, fueling depots, and storage facilities. Where feasible, leveraging existing fossil infrastructure for alternative fuel production, transport, storage, and use could help reduce costs, avoid stranded assets, and minimize additional environmental and land use impacts. However, the compatibility of existing infrastructure varies by fuel type. For example, RNG and renewable diesel are interchangeable with their fossil-fuel-based counterpart and can be used in existing infrastructure without equipment modifications, limiting deployment barriers. Hydrogen, on the other hand, has different, sometimes adverse, infrastructure requirements than conventional natural gas and faces significant infrastructure challenges to deployment.[25]

New infrastructure development or retrofitting of existing infrastructure should align with the long-term needs of a decarbonized energy system to maximize the potential of low-carbon alternative fuels, minimize costs, and reduce the risk of stranded assets. Infrastructure investments in long-term low-carbon alternative fuel options (e.g., SAF or renewable diesel) should be prioritized, with a focus on waste-based fuels with fewer technical and environmental challenges and greater GHG emissions reduction potential. Strategic choices will also be required to guide infrastructure development to scale alternative fuel production and ensure efficient delivery to areas of demand. For example, downstate New York is expected to have higher energy demand than Upstate areas, where alternative fuel production may be higher.

It is important to recognize that many alternative fuels, such as hydrogen, SAF, renewable diesel, and RNG, can be produced from the same limited pool of feedstocks. As such, infrastructure and policy decisions should prioritize fuels with the greatest long-term strategic value, which are expected to play a

role in decarbonizing hard-to-electrify sectors. For example, one possibility is that wastewater treatment facilities could be designed to lower methane generation and instead optimize conditions for producing liquid fuel or hydrogen rather than RNG. Ultimately, infrastructure should reflect a long-term holistic, system-wide vision rather than focus on single fuels.

3.3.1. RNG Infrastructure Needs and Development

Currently, anaerobic digesters in New York State are typically designed to serve individual facilities, processing primarily on-site waste, though sometimes inputs from other facilities, such as food waste, may also be collected. The biogas produced is most often used on-site to generate electricity, with any excess sold to the grid. Though some on-site biogas use may be needed, to meaningfully contribute to the decarbonized energy system, the biogas will need to be refined to RNG and produced, transported, and used at a scale. To maximize production and leverage economies of scale, future RNG production facilities may be sited where they can collect feedstock from multiple sources, such as clusters of farms or food waste producers, in an efficient and cost-effective manner and be located near existing pipeline infrastructure to minimize the need for new construction. Whether RNG is injected into the local distribution network or the larger intrastate pipeline transmission system will depend on the location and type of end-uses it is intended to serve, such as residential heating or utility-scale power production.

3.3.2. Biodiesel and Renewable Diesel Infrastructure Needs and Development

Renewable diesel is interchangeable with conventional diesel, allowing it to be used with little or no modification in existing production and transportation infrastructure as well as end uses. existing uses and transportation infrastructure. This compatibility enables renewable diesel to leverage the State's existing diesel production, storage, and transportation system, reducing the need for new infrastructure. However, New York currently has very limited in-state production capacity for both biodiesel and renewable diesel.

While biodiesel can also be blended with conventional diesel, it has greater handling and infrastructure constraints. Blends of up to 20 percent are generally compatible with most engines and infrastructure. As the blends increase, biodiesel becomes more susceptible to gelling in cold temperatures, microbial contamination, and corrosion of metallic infrastructure components. Therefore, biodiesel must be transported by rail, barge, or truck rather than through conventional diesel pipelines.

Despite these limitations, biodiesel remains a valuable asset for decarbonization due to its relatively lower cost and production emissions compared to renewable diesel. It can be blended with conventional diesel in the near term or blended with renewable diesel as those supplies increase.

3.3.3. SAF Infrastructure Needs and Development

SAF can be produced at either retrofitted petroleum refineries or in dedicated alternative fuel refineries. Nationwide, there are only three known commercial producers of SAF, though this number is expected to grow as airlines continue to sign contracts with existing and future SAF producers.[24] SAF is limited to blends of up to 50 percent with conventional jet fuel, except in research uses.

Transport and handling of SAF involves a multi-step process. SAF is typically transported from production facilities by dedicated railcar or barge or blended with conventional jet fuel for pipeline transport.

Pipeline transport of unblended SAF is not currently permitted. At airport terminals, unblended SAF is generally delivered by truck and stored separately from conventional jet fuel. It must undergo compliance testing to meet fuel quality standards before being blended with conventional jet fuel in a third tank. Fuel terminals located near major New York airports, such as LaGuardia and John F. Kennedy, already import and transport jet fuel and are well-positioned to handle SAF.

Additional consideration must be given to jurisdiction over air travel. The federal government has jurisdiction over interstate and international air travel, while New York State has jurisdiction over intrastate flights. The State will need to collaborate with federal agencies to develop SAF infrastructure, expand transport capacity, and support adoption at in-state airports.

3.3.4. Hydrogen Infrastructure Needs and Development

To maximize GHG emissions reduction potential, hydrogen should be produced using zero-emissions electricity and carefully coordinated with other competing demands for electricity. In New York, most projected hydrogen demand is concentrated downstate, which presents transportation and storage challenges. Supply-demand proximity helps to reduce transportation costs and storage requirements.

Hydrogen can be consumed immediately or stored in underground caverns or in above ground steel tanks for future use. Hydrogen can either be used on-site (as energy storage or with co-located industrial use) or transported by truck or pipeline to areas of demand. However, New York's existing natural gas pipeline system is incompatible with hydrogen due to its lower volumetric density, risk of embrittlement and leakage, and end-use compatibility. Retrofitting the existing natural gas infrastructure to blend or carry hydrogen is likely infeasible and not cost-effective, unless future research and development shows otherwise. Given these constraints, hydrogen use is expected to remain targeted in the near-term, with on-road truck transportation being the most viable option. If hydrogen demand increases to an estimated 100 tons per day, investment in dedicated hydrogen pipeline infrastructure may become economically viable.[20] Hydrogen viability is dependent on building out transportation and storage infrastructure, which is most practical and economical with multisector hydrogen demand.[22]

3.4. Technology Development

Alternative fuels are at varying stages of technological maturity. For example, anaerobic digestion is a well-established process compared to hydrogen production, which requires additional research and development. Over the next fifteen years, continued research, development, and deployment can be done to refine production processes and increase efficiencies, reduce costs, increase fuel flexibility and application designs, and improve infrastructure across the prioritized alternative fuels. Recent studies by NYSERDA, including the *Hydrogen Assessment*, the *Zero by 40 Technoeconomic Assessment*, and the *Feasibility Study for Renewable Fuel Production from Waste Resources in New York State*, indicate technology areas in need of further development in order to effectively deploy alternative fuel resources at scale.[20,22,25]

4. Themes and Recommended Actions

4.1. End-Uses of Alternative Fuels

Low-carbon alternative fuels will be an important and complementary decarbonization strategy alongside electrification in a variety of settings, such as supplemental heating and difficult-to-electrify end-uses. It is important to consider that the supply of alternative fuels will be limited due to regional competition and supply constraints on organic feedstocks used to produce most alternative fuels as well as the supply of clean electricity for hydrogen production. Electrification typically delivers greater health and GHG emission reduction benefits at lower cost compared to alternative fuels. Therefore, electrification should remain the State's primary decarbonization solution. The use of low-carbon alternative fuels should be prioritized for end uses to maximize GHG emissions reductions, minimize costs, ensure net co-pollutant emission reductions, and avoid localized co-pollutant emission impacts. The development and use of alternative fuels should support the State's long-term GHG reduction targets and long-term energy vision. Some fuels, such as biodiesel, may incrementally decrease emissions relative to fossil fuels, but would not enable the deep emission reductions required to meet the State's goals. Renewable diesel, for example, provides near-term decarbonization in the transportation sector without extensive buildout of infrastructure while allowing the production infrastructure and feedstock supplies to be redirected toward SAF in future years as heavy-duty transportation electrification develops. Similarly, investing in hydrogen production using today's electric grid can deliver incremental GHG emissions reductions, recognizing that electricity emissions will continue to decline as more renewable generation is added to the mix.

Recommendations

- Electrification should remain the first decarbonization solution and the use of low-carbon alternative fuels should be directed toward end-uses to maximize GHG emissions reductions while minimizing the cost of the energy transition, ensuring net co-pollutant emission reductions, and avoiding impacts associated with co-pollutant emissions.
- The use of alternative fuels should be oriented such that technologies for near-term decarbonization can effectively transition to longer-term solutions as technologies and markets develop, consistent with long-term GHG reduction targets.

4.2. Prioritization of Alternative Fuels

Given the limited supply of common feedstocks, the long-term considerations for fuel use described above, and the GHG and co-pollutant concerns described below, the development of long-term fuel infrastructure should prioritize certain fuel types. There are several factors that drive this prioritization:

- **Maximizing the use of New York's waste resources**. Utilizing New York State waste resources and waste feedstocks avoids unnecessary emissions in the waste sector, further reducing GHG emissions and reducing the need for purpose-grown feedstocks that have increased production emissions and uncertain land use impacts. NYSERDA's recent *Feasibility Study for Renewable Fuel Production from Waste Resources in New York State* evaluated the potential fuel production from in-state waste feedstocks, focusing on SAF production and fuels typically coproduced with

SAF (renewable diesel and renewable gasoline).[25] The study found a maximum theoretical potential of 77.4 – 90.9 TBtu/year of alternative fuel energy content. This study focused on the production of SAF and associated coproducts and did not consider the need for other fuels, such as RNG. In addition, it is important to note that this finding is only a fraction of the State's current energy consumption, which was estimated at 3,646 TBtu in 2022[4], and the Pathways Analysis indicates a need to expand to regional feedstocks and fuels (see Pathways Analysis chapter).

- **The long-term needs of the energy system and interchangeability of fuel types.** For example, designing wastewater treatment plants to optimize methane production for RNG would require a different configuration than designing for liquid fuel production for renewable diesel or SAF. Given that liquid fuels share a common production pathway, designing infrastructure to produce renewable diesel could be compatible with a later shift toward SAF.
- **Minimizing risks associated with land-use changes driven by purpose-grown energy crops.** While changes in global GHG emissions can and should be evaluated using Life Cycle Analysis (LCA) methods for specific fuel pathways, significant uncertainty remains around the GHG impacts of purpose-grown energy crops and the associated land-use change. Applying the precautionary principle, suggests a preference for waste-based feedstocks over purpose-grown crops, and where purpose- grown resources are necessary, prioritize those with minimal land-use impact, such as cover crops or algae.

Recommendations

- New York State should prioritize alternative fuels by maximizing in-state waste resources, aligning the long-term needs of the energy system, and accounting for the uncertainty of land-use impacts and emissions from purpose-grown crops.

4.3. GHG Impacts of Alternative Fuels

Alternative fuels should be carefully managed to realize global GHG emissions reductions, including those associated with the production, transportation, storage, and combustion of low-carbon alternative fuels. These emissions vary based on the feedstock, equipment used, and end-use. Policies, programs, and regulations should appropriately consider the GHG emissions associated with alternative fuel use. This section recommends that GHG emissions accounting for alternative fuels in New York State can be done in two frameworks: New York State Climate Act accounting, as directed by the Climate Act, and LCA. LCA should be used in policy development to evaluate and compare GHG emissions reductions associated with different feedstocks, fuels, and end-uses and to calculate emissions reductions relative to a business-as-usual scenario. However, entities in New York State, such as individual facilities or utilities, should use the Climate Act accounting framework when making emissions claims related to measuring progress toward the Climate Act's targets.

Climate Act and LCA accounting are described in further detail below, along with an analysis of how fuels and feedstocks are treated under each framework. While numerical examples are illustrative, they

demonstrate how these accounting methods can be used in the State's policies, programs, and regulations to maximize GHG emissions reductions while supporting in-state economic development.

4.3.1. Climate Act Accounting of Alternative Fuels

The methodology used in the Statewide GHG Emissions Report[26] is based upon the requirements defined in the Climate Act, which differ from typical jurisdictional GHG accounting done in other states or at the federal level. The main components of the methodology relevant to alternative fuels GHG emissions accounting are:

- Emissions are calculated using a 20-year Global Warming Potential (GWP20).
- Emissions from the production and transport of fossil fuels outside of New York for combustion and use in the state are included in the *Statewide GHG Emissions Report*. However, this provision does not apply to alternative fuels. Therefore, any emissions, or avoided emissions, associated with the production and transport of alternative fuels outside of New York for use in-state are not included in the *Statewide GHG Emissions Report*.
- For alternative fuels produced, transported, and combusted or used within New York, associated emissions (e.g., sequestration, production, or delivery) or emissions reductions (e.g., capturing manure waste for RNG production) are included in the *Statewide GHG Emissions Report*, though these emissions are attributed to the relevant sector, such as transportation, agriculture, or waste, rather than being reported as energy emissions.
- Gross emissions accounting is used to measure progress toward the Climate Act's GHG emissions targets: 40 percent reduction by 2030 and 85 percent by 2050, relative to 1990 levels. This includes biogenic CO_2 from the combustion of alternative fuels, which is counted toward gross emissions totals. Emission removals occurring in New York, such as through carbon sequestration and storage in plants, are reported in the *Statewide GHG Emissions Report* for tracking progress toward the Climate Act's net-zero target.

Another difference from the Climate Act accounting as relates to alternative fuels is that benefit-cost analyses typically treat biogenic emissions as carbon neutral.[27]

While reporting using other accounting methods, such as LCA, may be appropriate and informative in certain contexts, the inclusion of these is not a replacement for Climate Act accounting and should be treated as supplementary.

4.3.2. Lifecycle Analysis of Alternative Fuels

Under an LCA approach, all GHG emissions from the feedstock, production, transport, and use of the fuel are accounted for, regardless of the location of emission (Table 1). Biogenic combustion is considered carbon neutral, or zero. On an LCA basis, alternative fuels can contribute meaningfully to global GHG emissions reductions. Though Climate Act accounting methodology governs the emissions inventory and progress toward Climate Act emission targets, LCA can provide valuable information to differentiate and select between alternative fuels based on their feedstock, production method, and end-use. For example, avoided emissions from RNG production are much greater when comparing anaerobic

digestion of animal manure, where the business-as-usual treatment of the feedstock is from a manure storage producing and releasing significant amounts of methane, versus landfill gas, which is often already captured and flared, resulting in CO_2 emissions under business-as-usual conditions. Climate Act accounting would only capture this difference if the RNG feedstock and production occurred in-state.

Avoided emissions may also vary within a feedstock. For example, if a farm is already implementing sustainable manure management practices, avoided emissions would be significantly lower when using the manure to produce RNG compared to a farm utilizing an uncovered anaerobic manure pit allowing unmitigated methane release. Therefore, LCA is beneficial for assessing the global contribution to GHG emission mitigation for specific alternative fuel projects. All else being equal, entities using alternative fuels should prioritize those with lower LCA-calculated GHG emissions. In this way, LCA provides a guide for maximizing the global emissions benefits of using alternative fuels. While LCA can estimate the relative emissions performance of various fuels, additional considerations are warranted—particularly for crop-based fuels, in line with the precautionary principle described above.

LCA may be applied within specific programs to support environmental outcomes aligned with New York State's policy goals. LCAs should use GWP20 except where, in the judgment of the State, doing so would yield outcomes contrary to the State's policy goals, in which case it may be appropriate to instead use a 100-year GWP.

The key categories of emissions considered in the LCA and Climate Act accounting for both out-of-state fuel production and in-state fuel production, are depicted in Table 1.

Table 1: Treatment of GHG Emissions for LCA and Climate Act Accounting for Various Emissions Categories.

Emissions	LCA	Gross Climate Act Accounting: Out-of-State Alternative Fuel Production, In-State Use	Gross Climate Act Accounting: In-State Alternative Fuel Production, In-State Use
Land Use	✓	X	X
Feedstock Production/Processing	✓	X	✓
Fuel Production	✓	X	✓
Biogenic Combustion	0	✓	✓

GHG emissions from out-of-state fuel production, for both fossil and alternative fuels, are typically not included in state GHG inventories. The Climate Act requires accounting for emissions from the production and transportation of imported fuels, but this requirement applies only to fossil fuels. Under Climate Act accounting, emissions and emissions removals associated with out-of-state production of alternative fuels are not included in statewide gross emissions reported in the *Statewide GHG Emissions Report*. This creates an incomplete picture of the emissions from alternative fuel use, either under- or over-reporting the benefits compared to fossil fuel use. For example, under Climate Act accounting, in-state tallow-based or used-cooking oil-based renewable diesel have similar emissions to conventional

diesel, while imports of the same fuel would represent reductions in apparent emissions (see Figure 5). From the perspective of global climate change, the imported fuel would have equal emissions to a fuel produced in-state, if not higher due to additional emissions from transportation. Moreover, under gross emissions accounting, biogenic fuel combustion is treated the same as fossil fuel combustion. LCA would demonstrate the global GHG emissions impact of both imported and in-state renewable diesel accurately and considering biogenic emissions as carbon neutral would demonstrate further GHG emissions reductions compared to conventional diesel. Both renewable diesel and biodiesel, in reality, represent GHG emissions improvement over conventional diesel.

In addition, if there is a demand for alternative fuels driven by State policy, whether produced in-state or out-of-state, the impact on global emissions is the same. The Climate Act calls for consideration of impacts on both New York economic and business competitiveness and emissions leakage. In-state fuel production offers greater oversight and control over alternative fuel feedstocks and production methods, helping to maximize GHG emissions reductions. In-state production also has the potential to support economic development, job creation, and energy supply security while fostering innovation in supply chains. In addition, the use of in-state waste feedstocks directly contributes to achieving the Climate Act's target to reduce in-state emissions by 85 percent by 2050.

4.3.3. Comparison of GHG Emissions for Alternative Fuels

In Figures 4 through 7 below, Climate Act accounting is used to measure gross emissions from both in-state emissions and out-of-state sources. The orange squares represent gross emissions that occur in New York State from alternative fuels that are sourced, produced, and then consumed in New York. The pink squares represent gross emissions that occur in New York from alternative fuels that are used within the state but are sourced and produced outside of New York and then transported to the state for use. The yellow diamond on each bar in the figures indicates estimated LCA-calculated emissions for different feedstocks and fuels. The emissions values in the figures are indicative examples, which do not include all potentially prioritized fuel types or feedstocks and do not represent project-specific emissions nor the emissions factors used in the *Statewide GHG Emissions Report*. These figures are intended to illustrate general preferences among fuels expressed in the State Energy Plan. Individual projects and programs should engage in LCAs that are specific to the feedstock and fuel used where possible, and additional considerations may apply.[28]

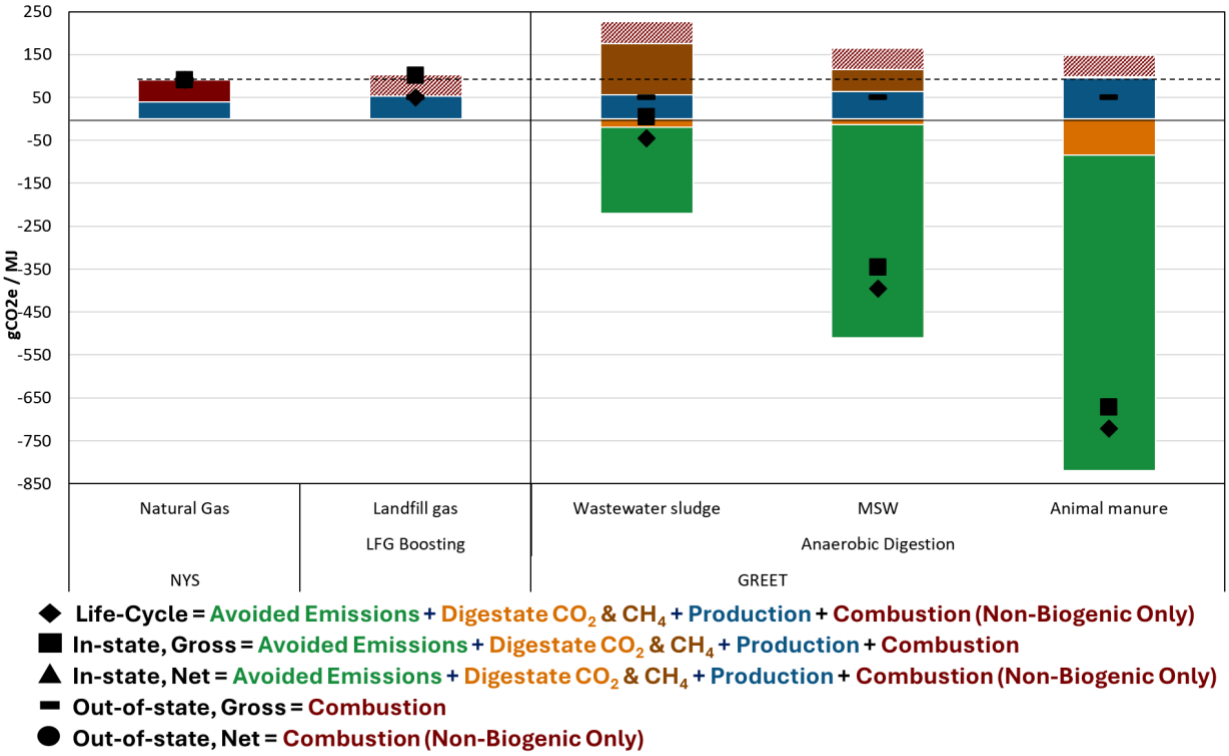
RNG

On an LCA basis, RNG reduces emissions compared to natural gas across all feedstocks (Figure 4). However, under Climate Act accounting, RNG derived from in-state, waste-based feedstocks, such as anaerobic digestion of manure waste, wastewater recovery facilities, and food or organic municipal solid waste, is preferred. These sources not only support reductions in the State's GHG inventory and global emissions but also offer potential co-benefits, including economic development, improved waste management, and enhanced supply reliability. Landfill gas shows more limited emissions benefit in this framework, as methane is typically captured and flared at these facilities, reducing the relative avoided emissions by diverting it to energy use, though the energy benefit of diverting the methane still exists. There is potential for greater emissions reductions if the digester is run using clean electricity, methane

leak detection and repair is performed on the digester and associated equipment, energy efficiency measures are taken, and the digester and gas production equipment is right sized for its operations.

Figure 4: Comparison of Emissions Accounting Frameworks for RNG.

Source: Considerations for Low-Carbon Alternative Fuel Use in New York State.[2]



Biodiesel and Renewable Diesel

As shown in Figure 5 and

Figure 6, on an LCA basis, both biodiesel and renewable diesel reduce emissions compared to conventional diesel, especially for waste-based feedstocks. Emissions for renewable diesel are slightly higher than biodiesel due to its more energy-intensive production process.

Both renewable diesel and biodiesel reduce fossil fuel emissions, but biodiesel alone cannot phase out fossil fuels from hard-to-electrify uses because it typically has a 20 percent blend limit. Yet, biodiesel is easier and less costly to produce with less energy input and can make use of smaller, dispersed feedstock sources, including in-state waste feedstocks. Blends of 20 percent biodiesel and 80 percent renewable diesel can directly replace fossil fuel. Renewable diesel supplies are currently limited, and therefore, biodiesel may be an interim solution for near-term GHG emissions reductions.

Figure 5: Comparison of Emissions Accounting Frameworks for Renewable Diesel.

Source: Considerations for Low-Carbon Alternative Fuel Use in New York State.[2]

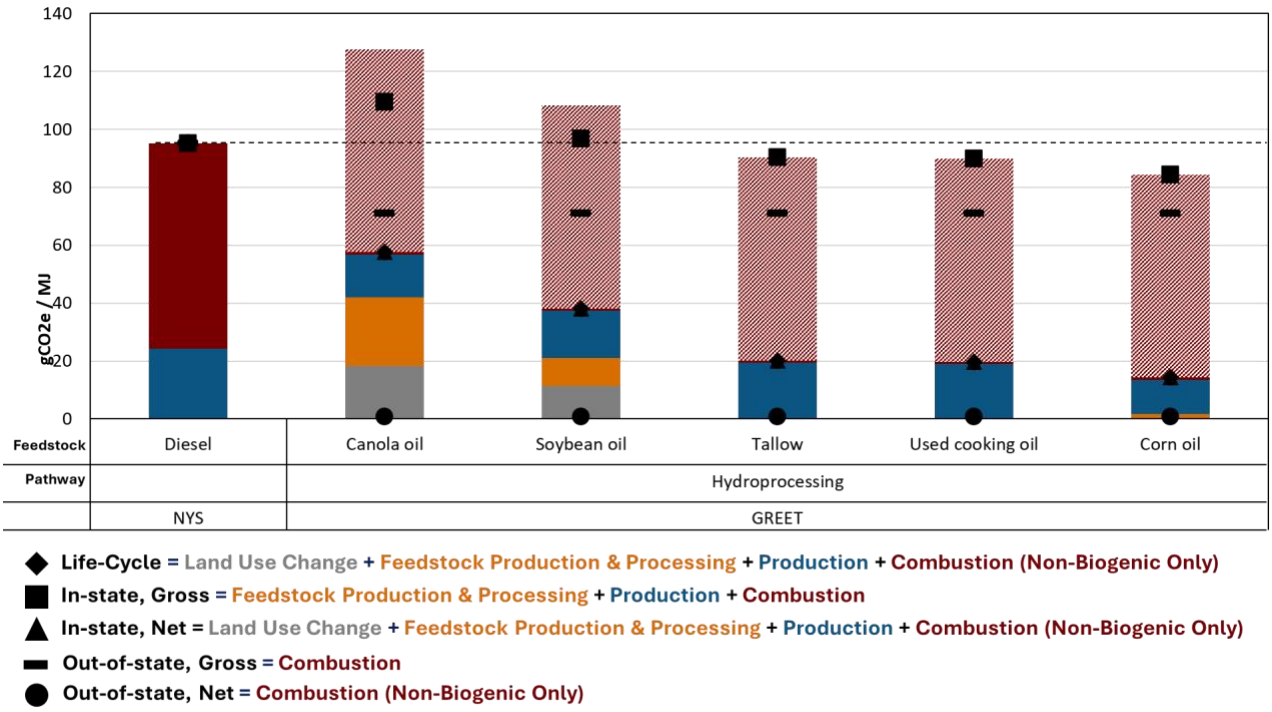
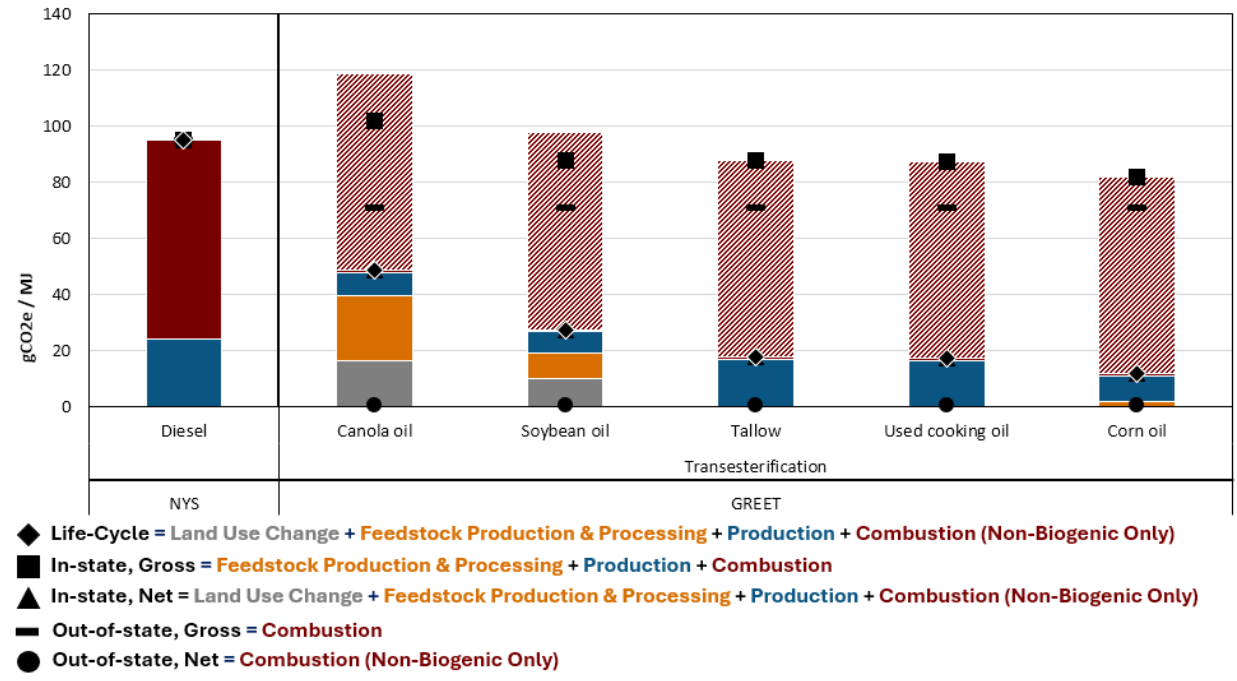


Figure 6: Comparison of Emissions Accounting Frameworks for Biodiesel.

Source: Considerations for Low-Carbon Alternative Fuel Use in New York State.[2]



For the reasons described above, the State prefers in-state fuel feedstock sourcing and waste-based feedstocks, including tallow, used cooking oil, wastewater, and organic municipal solid waste, for biodiesel and renewable diesel production. Feedstocks with low LCA scores, especially those with low land use impacts, are next in preference order. However, the State will continue to consider other sources in light of their contribution to global and local emissions reductions. Biodiesel and renewable diesel produced from purpose-grown energy crops should be minimized, with a strong preference for waste-based fuels.

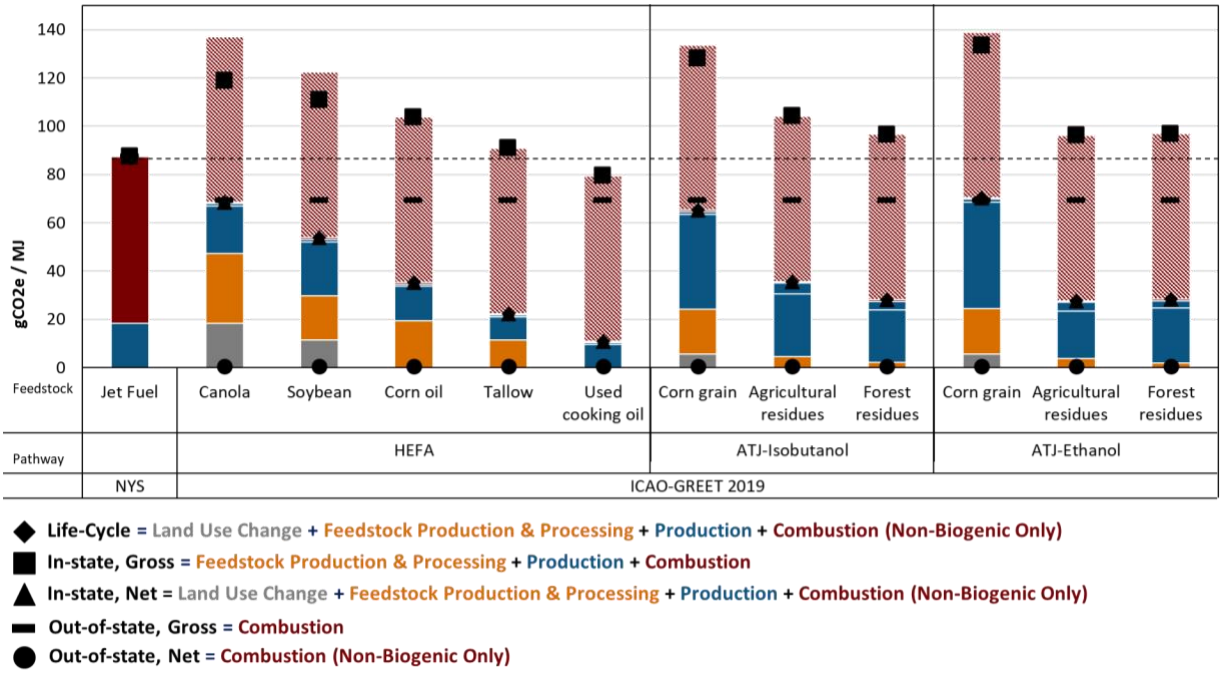
Energy crop use as an interim fuel until more waste-based fuels are available may be appropriate if needed, though policies and programs should create preferences for transition over time and for prioritization of waste feedstocks and other fuels with low LCA scores. Energy crop use and associated GHG emissions should be carefully monitored and reported within any such policy or program. However, in instances where there are meaningful global climate benefits, their use should not be disqualified entirely, especially because the supply of waste-based fuels may be limited as demand increases regionally to achieve Climate Act targets.

SAF

Production of SAF utilizes the same feedstocks and a very similar process to renewable diesel. The main difference is the additional refinement needed to upgrade the fuel to aviation standards, which requires additional energy input and expenses. Consistent with renewable diesel, the State prefers in-state, waste-based feedstocks, including tallow, used cooking oil, and agricultural and forest residues, for SAF production but will continue to remain open to other sources while considering their contribution to global and local emissions reduction (Figure 7). SAF is an essential component of achieving long-term policy goals, as technology options for aviation decarbonization are currently extremely limited. SAF produced with purpose-grown energy crops, such as canola or soybean oil, should be minimized in New York, with a strong preference for waste-based fuels, followed by fuels with low LCA scores, especially those with low or no land use impacts. The use of crop-based SAF may be appropriate in the near term, particularly while waste-based fuels remain limited, provided these fuels deliver meaningful emissions reduction benefits. Given the increasing regional demand for low-emissions and waste-based feedstocks, crop-based SAF should not be categorically excluded, especially if it enables early market development and emissions reductions.

Figure 7: Comparison of Emissions Accounting Frameworks for SAF.

Source: Considerations for Low-Carbon Alternative Fuel Use in New York State.[2]



In contrast to renewable diesel and recognizing the high priority for SAF deployment in New York State to achieve long-term policy goals, the extra hurdles producers and users face for SAF, and the local air quality and health benefits associated with SAF substitution discussed below, State policy should adopt a more expansive approach to SAF sourcing to avoid creating insurmountable barriers to entry or economic preference for easier-to-produce fuels.

SAF is currently the only viable method to significantly reduce GHG emissions from the aviation sector. Though regional feedstock and/or production will be needed, in-state production is also preferred to help maintain the integrity of GHG emissions reductions and benefit economic development within the state, and the use of in-state waste feedstocks remains a priority to ensure the beneficial use of waste while eliminating emissions from waste sources in-state.

Hydrogen

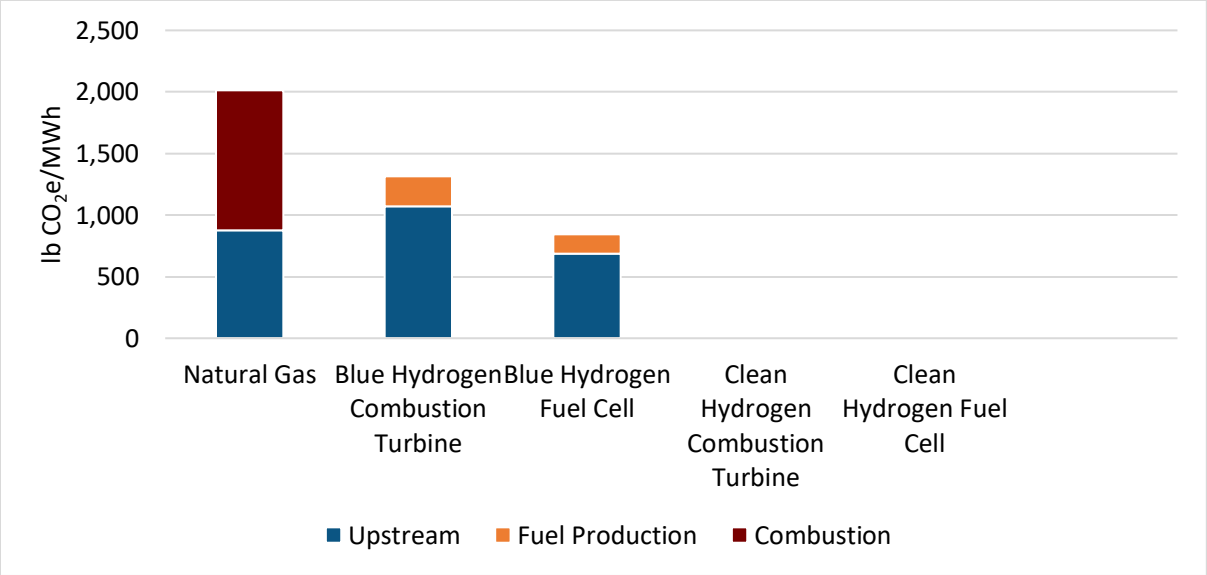
Hydrogen can be produced through a variety of methods with varying emissions implications. At this time, the State prefers hydrogen produced with clean energy. The State will continue to assess hydrogen production technologies as they become available. Under current Climate Act accounting methodology, as with biofuels, when imported hydrogen is used in New York, emissions from out-of-state hydrogen production are not included, though there are methods of hydrogen production that use significant inputs of fossil fuels. When making policy decisions, the upstream and combustion emissions associated with the fossil fuels used in the production of hydrogen should be considered. For example, some hydrogen production processes use steam reformation of natural gas. The process can be paired with carbon capture and sequestration, known as blue hydrogen, at the hydrogen production location, to

reduce CO_2 emissions produced from natural gas combustion. Yet, the carbon captured does not mitigate the upstream production and transport emissions of the natural gas feedstock. Including these emissions significantly reduces the global GHG emissions benefits, shown in Figure 8. In its recent white paper, the New York State Department of Public Service proposed including out-of-state emissions from the production of "energy carrier" fuels (e.g., hydrogen) in the power sector and to require a facility that consumes "energy carrier" fuels to verify and attest that those fuels' production process does not yield GHG emissions to address this issue.[29]

New York State supports the development of in-state hydrogen production infrastructure using current grid electricity because, although the current grid emissions profile would result in emissions from hydrogen production, the GHG emissions are expected to trend toward zero as we progress toward the Climate Act 2040 zero emissions electricity target and align with the long-term development prospects for hydrogen systems. For hydrogen produced out-of-state, New York State should require substantiation that the hydrogen was produced using clean energy.

Figure 8: Emissions from Different Hydrogen Production and Combustion Technologies Compared to Natural Gas (lbs CO_2e/MWh)

Source: Zero by 40 Technoeconomic Assessment[22]



Recommendations

- LCA should be used in policy development to compare GHG emissions reductions across feedstocks, fuels, and end-uses and to calculate emissions reductions relative to business-as-usual and alternative fuel production pathways.
- Entities in New York State, such as individual facilities or utilities, should use the Climate Act accounting framework when making emissions claims related to measuring progress toward the Climate Act's targets.

- Both LCA and Climate Act accounting will have roles in the design of programs, policies, and regulations to provide a more holistic picture of the GHG emissions associated with alternative fuels, to inform policy decisions, and to understand how those policy decisions intersect with measuring emissions reduction progress.
- New York should prioritize the use of in-state waste-based feedstocks and fuels whenever possible due to their potential to reduce emissions from the waste sector, support economic development, and improve supply chain security and integrity. The scale of projected demand for alternative fuels will require regional sourcing across a range of feedstocks and technologies. Fuels produced with purpose-grown energy crops should be minimized.
- Anaerobic digestion and RNG production should focus on energy efficiency, leak detection and repair, right-sizing digester and gas production operations, and using clean energy in production processes to further reduce GHG emissions.
- Both renewable diesel and biodiesel contribute to fossil fuel displacement. Biodiesel offers a near-term decarbonization strategy, including the potential for blending with renewable diesel as supplies of renewable diesel expand to offer long-term decarbonization.
- SAF is essential to achieving long-term decarbonization goals, particularly as aviation is a sector with limited near-term alternatives. Given the barriers SAF producers and users face and the GHG reduction and local air pollution benefits (discussed below), State policy should take a more flexible and expansive approach to SAF sourcing compared to other fuels. While fuel derived from waste and with low-LCA-score feedstocks is preferred, the use of crop-based SAF may be appropriate in the near term, until other feedstocks scale.
- Based on currently available technologies, New York State is focused on using hydrogen produced with clean energy, both in- and out-of-state, to avoid using hydrogen that may have been produced with fossil fuels and therefore have unintended emission consequences.

4.4. Co-Pollutant Emissions and Air Quality Impacts of Alternative Fuels

Many air pollutants are byproducts of the combustion of carbonaceous fuels, including fossil fuels and most alternative fuels. These include fine particulate matter ($PM_{2.5}$), nitrogen oxides (NO_x), volatile organic compounds (VOCs), sulfur dioxide (SO_2), and various toxic compounds. $PM_{2.5}$ is a primary pollutant of public health concern, as is NO_2 (nitrogen dioxide, one component of NO_x), and ozone (produced in the atmosphere from VOCs and NO_x in the presence of sunlight). These pollutants contribute to a range of health issues—including respiratory conditions, asthma, heart attacks, and other serious illness—leading to premature mortality, increased hospitalizations, emergency room visits, and widespread health burdens.

While fossil fuels and most alternative fuels emit similar air pollutants when combusted, there are important differences to consider when evaluating alternative fuels as replacements. The use of low-carbon alternative fuels and technologies can either improve or worsen air quality relative to their fossil counterparts, depending on the specific fuel type, application, and emissions controls in place. In

general, replacing fossil fuels with zero-emission solutions, such as electrification or hydrogen fuel cells, will always result in the greatest health benefits, but those solutions may not always be feasible, especially in the near-term. In such cases, switching to alternative fuels may still offer public health benefits associated with fuel swapping, depending on the fuel, end use, emissions controls, and other considerations discussed here. The discussion below focuses on the direct emissions of air pollutants associated with the combustion of alternative fuels, which would most directly affect public health, and does not include the additional emissions associated with producing and delivering both fossil and alternative fuels. Additional details are available in the memorandum Co-Pollutant Impacts of Low-Carbon Fuels and Technologies—2025 Update (2025).[3]

RNG

RNG is chemically similar to natural gas. As such, its combustion emissions are generally expected to be comparable to those from natural gas combustion.

Biogas

Biogas combustion emissions may differ from those of natural gas depending on the feedstock and end use. Biogas feedstocks may include trace gases and impurities such as VOCs, siloxanes, and hydrogen sulfide (H_2S); if H_2S is not removed before combustion, SO_2 emissions will be produced. Combusting biogas for on-site electricity rather than natural gas will produce similar NO_x emissions and may increase SO_2 emissions if trace sulfur gases are not removed.

Note that biogas is often combusted on-site as an alternative to flaring, which is done to avoid worse emissions and is not necessarily replacing natural gas combustion on-site. Compared to flaring, biogas combustion in boilers or steam turbines for electricity generation would decrease $PM_{2.5}$ and NO_x emissions, while combustion in gas turbines or internal combustion engines would increase $PM_{2.5}$ and NO_x emissions relative to flaring biogas. However, beyond the local impact, there would be an additional benefit of reducing emissions from electricity generation elsewhere that is replaced by the biogas electricity production on-site.

Biodiesel

Biodiesel combustion in on-road engines, which are equipped with diesel particle filters and NO_x controls, is expected to have similar $PM_{2.5}$ and SO_2 emissions as those from conventional diesel, which is currently all ultra-low sulfur diesel (ULSD) in New York. NO_x emissions from biodiesel combustion in engines equipped with NO_x controls (virtually all on-road engines and newer non-road engines) will be low to begin with, and variations will be affected by the feedstock, engine load, and vehicle speed; thus, NO_x emissions are expected to be similar to ULSD.

Older engines, often still used in various non-road applications, would not be equipped with diesel particle filters unless they are retrofitted. In these older engines, using biodiesel can reduce $PM_{2.5}$ emissions by up to 25 percent with 20 percent biodiesel blends and reduce $PM_{2.5}$ emissions up to 58 percent with 100 percent biodiesel. Note that the biodiesel blend is usually limited to 20 percent unless both engine and fuel storage systems are specially designed and managed.

There is limited literature comparing emissions from biodiesel used in boilers to those from ULSD, which currently serves as the standard heating oil in New York State and contains at least 5 percent biodiesel content, with mandated increases over time.

Renewable Diesel

While renewable diesel has very low sulfur content and emits less $PM_{2.5}$ than conventional diesel when combusted, all on-road diesel engines today use ULSD and are equipped with substantial $PM_{2.5}$ and NO_x controls. Therefore, emissions of SO_2, NO_x, and $PM_{2.5}$ from renewable diesel in on-road engines are similar to conventional diesel.

However, $PM_{2.5}$ emissions from renewable diesel could be up to 38 percent lower than ULSD in older engines not equipped with diesel particle filters, which are still common in many non-road applications. As such, there are likely near-term benefits from substituting renewable diesel for fossil fuels in limited subsectors such as rail, agricultural engines, and some construction engines,[30] though these benefits may decline as equipment in these sectors is replaced. For example, pure renewable diesel has been shown to reduce $PM_{2.5}$ emissions by 22 percent and NO_x emissions by 13 percent compared to ULSD in agricultural tractors and reduce $PM_{2.5}$ emissions by up to 36 percent and NO_x emissions by up to 17 percent in locomotives. While there may be some reductions in toxic emissions (e.g., benzene) from renewable diesel, it is not expected to result in substantial health benefits, as diesel is not a large source of air toxics in New York.

SAF

Emissions from the combustion of aviation fuel during idling and landing and takeoff cycle (LTO) are the most relevant for air quality and public health impacts, as they commonly occur at locations and elevations that impact local air quality. Differences between pollutant emissions from SAF and conventional jet fuel depend on the specific SAF type, engine technology, and engine operation mode. A 50 percent SAF blend (the maximum blend currently allowed) can reduce $PM_{2.5}$ by 63 to 73 percent during idling and 39 to 80 percent during LTO compared to conventional jet fuel. These $PM_{2.5}$ emission reduction levels are expected to scale roughly linearly by blending percentage for blends below 50 percent SAF. Unlike conventional jet fuel, SAF generally has ultra-low sulfur content and SO_2 emission reductions from SAF will directly correlate with the reduction in sulfur content. A 50 percent SAF blend is expected to reduce SO_2 emission by 36 to 50 percent compared to conventional jet fuel. NO_x emissions primarily depend on turbine inlet temperature rather than fuel composition, so no changes in NO_x emissions are expected from SAF use. On balance, increased deployment of SAF is likely to produce beneficial outcomes for communities located near airports.

Hydrogen

Combustion of pure hydrogen fuel does not produce most co-pollutants. NO_x production varies with combustion temperature, and as hydrogen combustion generally occurs at a higher temperature than natural gas, its use in systems designed for natural gas without modification has the potential to emit higher levels of NO_x per unit of energy. Overall, the reduction in co-pollutant emissions when replacing natural gas with hydrogen—including the elimination of $PM_{2.5}$ emissions—can be beneficial if NO_x emissions are controlled. NO_x control technologies, such as selective catalytic reduction, are available,

and operational controls can be varied to adjust the air-to-fuel ratio and reduce NO_x emissions. Importantly, systems designed explicitly for hydrogen combustion can benefit from efficiencies that avoid producing high NO_x levels.

Electricity generation systems designed for hydrogen combustion can substantially reduce the potential for NO_x emissions, and traditional control technologies, such as selective catalytic reduction, can be applied to further reduce NO_x emissions if needed. This indicates the need to carefully design new or repurposed systems to ensure hydrogen use doesn't result in notable increases in NO_x, but these emissions should be considered manageable. In addition, DEC Regulation 6 NYCRR Subparts 227-2 and 227-3 place limits on NO_x emissions, and the robust permitting process provides increased assurance that hydrogen combustion for electricity generation would not be inconsistent with protecting public health in adjacent communities.

Pure hydrogen combustion in industrial boilers and turbines can emit high levels of uncontrolled NO_x compared to natural gas. As with electricity generation, the use of hydrogen in industrial systems should be reviewed to ensure NO_x emissions don't increase appreciably, if at all. Systems should be purpose-designed for hydrogen combustion where practicable to avoid excess NO_x emissions, and available NO_x control technologies and operational controls should be utilized as needed. Such sources would also be subject to permitting requirements. As is the case for any source combusting hydrogen, the elimination of $PM_{2.5}$ emissions would always represent a public health benefit.

Low levels of hydrogen blended into existing natural gas infrastructure and combusted in industrial, commercial, or residential systems not designed or retrofitted for the blended fuel would have uncertain impacts on NO_x emissions depending on the appliance, configuration, and blend level. While the hydrogen portion of the blend is not expected to emit $PM_{2.5}$ or other co-pollutants and may offer overall health benefits, any potential increase in NO_x emissions, particularly in indoor environments, such as in residential kitchen stoves and ovens, would raise health concerns that may be more difficult to mitigate in residential settings. Careful consideration of any potential net increase in local co-pollutant emissions from blended hydrogen is needed, and such increases should be avoided wherever possible.

Production Co-Pollutants

In addition to the direct co-pollutant emissions from combustion considered above, NYSERDA's *Feasibility Study for Renewable Fuel Production from Waste Resources in New York State* estimated co-pollutant emissions from renewable fuel production, specifically focusing on emissions within the boundary of the renewable fuel plant that are relevant for air permitting and regulatory compliance. The study evaluated various feedstock conversion pathways for hydrocarbon fuels (such as SAF and renewable diesel), RNG, and bio-oil. The production of these fuels emits co-pollutants including PM, SO_2, NO_x, VOCs, CO, and other hazardous air pollutants. The study considered additional emission control technologies beyond those included in the base design of the renewable fuel plant that could significantly reduce these emissions. The study recognized the need for further work to understand the public health implications of renewable fuel production.[25]

Recommendations

- Replacing fuel combustion with zero-emission alternatives, such as electrification or hydrogen fuel cells, will always yield the highest co-pollutant reductions. Therefore, these should always be prioritized where practicable.
- In on-road applications, biodiesel and renewable diesel are expected to produce co-pollutant emissions similar to their fossil counterparts. However, some emissions benefits would be expected in non-road applications where older engines without emission controls are used. Implementation of biodiesel and renewable diesel should focus, where practicable, on non-road subsectors that often use old engines such as rail yards, intermodal facilities, ports, and construction—especially near residential and other sensitive uses.
- SAF is expected to provide co-pollutant reduction. Applying SAF, especially for use in urban airports, is recommended to benefit local air quality.
- Hydrogen combustion may increase NO_x but eliminates $PM_{2.5}$ and other pollutant emissions relative to natural gas combustion. For power and industrial applications of hydrogen combustion, system design and operating procedures should be required to ensure low NO_x emissions.
- General use of blended hydrogen through pipeline injection would result in uncertain co-pollutant emissions consequences.
- Collection and use of biogas either as a fuel consumed locally as a beneficial energy source or as a feedstock for production of other alternative fuels can reduce local emissions associated with flaring. Therefore, efforts should be made to ensure collection or beneficial use of biogas produced at all New York landfill sites and to ensure collection or beneficial use of biogas associated with New York's exported waste through contract requirements.

4.5. Other Environmental Impacts

4.5.1. RNG

Anaerobic digestion, which is the process that creates the biogas, which is then refined to RNG, can be a valuable tool for waste management. A byproduct of anaerobic digestion is digestate, a stable nutrient source that can be used as a fertilizer for growing crops in place of synthetic fertilizers. Its use can improve water quality, reduce odors, reduce the spread of invasive plants, and increase carbon uptake in soils.[2] Digestate has lower—and in most cases no—animal and plant pathogens compared to raw manure, reducing the risk of water contamination after application.[31]

4.5.2. Biodiesel, Renewable Diesel, and SAF

As previously discussed, use of energy-crop-based fuels requires careful oversight. Concerns include uncertainties associated with the emissions impacts from land use change, loss of biodiversity, and water quality impacts.

Biodiesel production generates alkaline wastewater containing methanol residues, glycerin, and soap byproducts, requiring treatment before discharge. Wastewater from renewable diesel or SAF production using hydroprocessing includes traces of sulfides, ammonia, and other byproducts that must also be treated and properly managed. However, the amount of water used in production is small.

Alcohol-to-jet pathways for SAF production are water-intensive and can require more water than conventional diesel production. The Argonne National Laboratory estimates one gallon of corn ethanol, the base product, requires an average of 76 gallons of water (including water for irrigation) compared to 5.7 gallons for a gallon of conventional diesel.[32]

4.5.3. Hydrogen

Hydrogen production requires significant water consumption, though less than typical a gas power plant requires. A 1-gigawatt (GW) coal-fired or combined-cycle gas power plant typically uses between 18.2 and 14.8 million cubic meters of water per year, while a clean hydrogen facility producing the same amount of energy would use 7.6 million cubic meters.[2]

Recommendations

- In addition to GHG and co-pollutant emissions, the broader environmental impacts of alternative fuels, including effects on water use, water quality, land use, biodiversity, and waste management, should be considered in New York State's energy planning, policy development, and project evaluation. These impacts vary significantly by fuel type and production pathway and should be evaluated alongside climate and health outcomes to support sustainable decision-making.

4.6. Market and Policy Mechanisms

New York State will need to advance market and policy mechanisms to encourage development of feedstock and alternative fuel supply and demand and direct available fuels to high-priority end-uses, consistent with the discussion in Section 4.1.

Currently, alternative fuels remain more expensive and less widely available than fossil fuels, and their treatment under the Climate Act, as discussed above, decreases the relative value of any dollar invested in alternative fuels to reduce emissions as compared to in other sectors. To accelerate deployment, targeted market-based mechanisms can help expand production and direct supply to the sectors and locations where these fuels will have the greatest long-term climate and system benefits. Federal production and investment incentives could reduce costs, thereby increasing production and use, though alternative fuel policy at the federal level is currently uncertain. Coordinating with neighboring states and provinces to develop broader regional markets can facilitate efficiency of scale and flexibility, price formation, and transparency while increasing fuels and feedstocks import and export efficiency. Where possible, collaborating with regional, federal, and industry partners to develop consistent technical and emission accounting systems and standards for alternative fuels, infrastructure, and end-use equipment can foster market uptake. See the Local, Regional, and Federal Government Collaboration Chapter of this Plan for more information.

4.6.1. Attribute Tracking to Ensure Emissions Reductions

To ensure GHG emissions reductions from the use of alternative fuels, their associated emissions must be accurately tracked from production, both in- and out-of-state, through to end use within New York. Environmental attributes are tracked under four frameworks: (1) identity preservation models, (2) segregation chain of custody models, (3) mass balance, and (4) book and claim.[2] These tracking frameworks offer varying levels of credibility in asserting the use of alternative fuels and associated GHG emissions reductions, as well as differing levels of operational complexity. For example, *identity preservation* tracks the fuel product in detail from production to end use and does now allow mixing of the product with any other fuels. While the method has high credibility for making fuel use claims, it is administratively burdensome and would require substantial infrastructure buildout, making it infeasible for some fuels. *Book and claim*, on the other hand, separates the environmental attribute from the fuel product and allows trade of attributes on a secondary market, independent of the underlying fuel sale. This method is easier to facilitate and manage but has the potential for double-counting GHG emissions reductions and lower integrity for use claims.

As the alternative fuel market grows, the State should consider implementing an environmental attribute tracking framework, balancing the verifiability and administrative burden. Without such a framework, the following outcomes could result: reduced deployment, leading to increased emissions and missed economic and environmental benefit; or enabling unverified claims of fuel use without actual deployment, resulting in similar consequences of higher emissions and lost opportunities. An adopted framework could establish clear guidelines for participants to ensure market clarity, while documentation and certification processes should be robust to ensure emissions reduction claims are valid. A designated State authority or an independent third party should have the ability to systematically audit emission reduction claims and address noncompliance.

To facilitate deployment of alternative fuels at the scale described in the Pathways Analysis at the capacity necessary to achieve State policy targets, existing transmission and distribution infrastructure currently used for fossil fuels will need to be leveraged during the transition. Purpose-built infrastructure such as pipelines and storage may be used in isolated situations but is not adequate or practical to meet all needs and would entail substantial cost and environmental impact. As such, New York should not adopt a chain-of-custody framework that requires physical segregation of fuels to substantiate a use claim; New York should continue to pursue high integrity standards for use claims.

A critical consideration for New York State is the deliverability of alternative fuels for use in-state and to ensure that emissions reductions are both real and claimable in support of the Climate Act targets. This challenge is not new: New York has previously addressed similar issues in the Clean Energy Standard by implementing rigorous verification requirements, which established the New York Generation Attribute Tracking System, where a renewable energy credit (REC) generated by a clean electricity project is closely tracked and bundled with the megawatt-hour of renewable generation. To support a claim under the Clean Energy Standard, a REC is accepted only if the associated generation is delivered within the New York Control Area boundaries. This approach is similar to the mass balance framework, where energy is tracked “from source to sink,” with clear delivery requirements.

If New York develops a supportive legal and/or regulatory framework for alternative fuels, it is critical to consider adopting similar requirements where both the fuel attribute and the fuel itself travel together from source to a sink in New York, with a clear physical and contractual path linking the two. The specific infrastructure used, however, does not need to be dedicated exclusively to alternative fuels. Provided that deliverability can be clearly established via this kind of clear physical and contractual path, the use of common carrier pipelines, storage facilities, and other infrastructure is acceptable. Like the New York Generation Attribute Tracking, the deliverability for alternative fuels ensures that New York is supporting genuine GHG emissions reductions and therefore aiding global climate change mitigation.

The Climate Act accounting and the *Statewide GHG Emissions Report* are not market-based programs and do not solely direct policy choices. The *Statewide GHG Emissions Report* was developed to inventory GHG emissions, as required by the Climate Act, which is distinct from any market or financial claims, such as attributes. While New York cannot control the actions of other jurisdictions, the State should engage in best efforts to ensure the validity of claims made by New York State market-based programs. While fuels may be claimed across multiple programs (and often intentionally are in order to create stacked values; for example, state-based Clean Fuels Standards and the federal Renewable Fuel Standard), care should be taken to prevent unintended dual claims. For example, a fuel used to substantiate an emission reduction claim in another jurisdiction's program, should not also be claimed in New York's program; likewise, two entities should not be able to claim emission reduction from the same fuel. Further refinement to provisions around double counting will continue to be determined through relevant regulatory proceedings and program development efforts.

New York State can consider integrating the preferences described in this chapter into its tracking and accounting framework.[33] In alignment with the State's climate policy goals, GHG emissions should serve as the primary metric for fuel selection. While policy decisions can shape preference for specific feedstock and fuels, the use of LCA pathways allows for a more comprehensive evaluation, capturing not only emissions but also land use change risks, avoided emissions, and the distinct characteristics of fuels based on technology, geographic origin, and feedstock type. To safeguard against adverse impacts, the State should establish clear guardrails to avoid land use changes, such as tracking crop- and forestry-based feedstocks to their point of origin or prohibiting certain feedstocks such as palm oil are important to avoid loss of food production or deforestation. The State can also adopt a framework to prioritize development and use of specific fuels or pathways that yield the greatest GHG emissions reductions, such as a cap on the amount of a certain feedstock or fuel a producer can claim or requirements for feedstocks and fuels or other preferences. While it is not likely the State can mandate in-state sourcing, complementary policies can foster local sourcing.

Recommendations

- To catalyze the collection of feedstocks and production of new fuels, new policies—such as mandates, market-based mechanisms, and incentives—will likely be needed and should be weighed with respect to their customer costs and relative benefit under Climate Act accounting. As these policies generate demand across the region, supply chains and regional markets for the production and delivery of these fuels will emerge. While it is not likely New York can reasonably

rely upon in-state sourcing, the State should consider developing complementary policies, such as production incentives and emissions-based preferences, to prioritize local sourcing.

- To ensure that alternative fuel use results in real, verifiable GHG reductions, it is important to accurately and robustly track and account for fuels and their associated emissions from production through combustion. New York State should look to strike a balance between integrity and credibility of emissions reduction claims and the administrative burden to ensure emissions reductions and alternative fuel deployment. When considering an attribute tracking system New York State should be guided by the following principles:
    - The State prefers a mass balance approach to attribute tracking, which supports regional sourcing and local benefits, while allowing alternative fuels to leverage existing infrastructure. There should be a clear, verifiable physical and contractual connection between the production source and location of use within New York State.
    - The State should prevent double counting of emissions reductions. If a fuel is used to substantiate an emission reduction claim in another jurisdiction's program, it should not also be claimed in New York's program. Double counting should be addressed in relevant proceedings and program rules.
    - If developed, New York's attribute tracking process should allow for integration of additional safeguards and priorities. These could include rewarding low-impact or waste-based feedstocks or recognizing innovative production technologies. These provisions can help align fuel sourcing with broader environmental and economic development goals.

4.7. Production and Delivery Infrastructure

While electrification remains the State's primary decarbonization solution, alternative fuels will play a necessary and complementary role within the broader energy system to meaningfully contribute to the energy transition and help achieve Climate Act targets, as identified in the Pathways Analysis. Sufficient production, delivery, and storage infrastructure will be needed to produce and move alternative fuels to areas of demand. Where feasible, existing production and delivery infrastructure should be leveraged to minimize costs and other impacts associated with new infrastructure development, provided that technological, economic, and safety considerations are met. Limited alternative fuel-specific transportation infrastructure may be needed to connect supply and demand for alternative fuels, where the use of existing infrastructure is not feasible. New York State should continue to review alternative fuels production and delivery technologies and best practices for necessary infrastructure development, and any infrastructure development should be done with the future energy system in mind. As discussed in Section 4.6, the alternative fuels market will expand regionally and therefore infrastructure needs should be coordinated across neighboring states and provinces to increase efficiency and reduce costs.

Recommendations

- To meet New York State's climate and energy goals, alternative fuels must be produced, transported, stored, and utilized within the broader energy system.

- Infrastructure development and retrofits should be aligned with the needs of the future energy system to maximize the potential of low-carbon alternative fuels, minimize costs, and reduce the risk of stranded assets.
- Where feasible, preference should be given to alternative fuels that can leverage existing fossil fuel infrastructure with little or no modifications, thereby accelerating deployment and reducing costs and environmental disruption.
- The blending of hydrogen into existing natural gas pipeline infrastructure remains untenable due to safety, integrity, and indoor air quality concerns.

4.8. Technology Research, Development, and Deployment

Over the next fifteen years, continued research, development, and deployment efforts will enhance production processes, increase efficiencies, reduce costs, expand fuel and application flexibility, and improve infrastructure. NYSERDA's Innovation and Research program plays a central role in accelerating the development and demonstration of high-impact energy technologies, including alternative fuels. NYSERDA also implements rigorous research and assessment of current and future technologies. See the Energy Innovation Chapter of this Plan for more information.

Recommendations

- NYSERDA should continue supporting alternative fuel research, development, and deployment in New York.

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New York State Energy Plan

VOLUME II | Our Energy Systems

Climate Change, Adaptation, and Resiliency

06

Key Terms Used in This Chapter

FOR THE COMPLETE GLOSSARY ➜

Adaptation: In human systems, the process of adjustment to actual or expected climate and its effects in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; the process by which a system moves toward resilience.[1]

Climate Mitigation/Greenhouse Gas Mitigation: A human intervention to reduce emissions or enhance the sinks of greenhouse gases.[2]

Climate Resilience: A system's ability to anticipate, prepare for, respond to, recover from, and adapt to a disruption, such as an extreme climate hazard, with minimum damage to social well-being, public health, the economy, and the environment.[1]

Greenhouse Gas: Gases that trap some of the Earth's outgoing energy, thus retaining heat in the atmosphere. This heat trapping, known as the greenhouse gas effect, alters climate and weather patterns at global and regional scales. Greenhouse gases include carbon dioxide, methane, nitrous oxide, and certain synthetic chemicals such as fluorocarbons and sulfur hexafluoride.[3]

Hazard Mitigation: Any sustained action taken to reduce or eliminate long-term risk to life and property from hazard events. It is an ongoing process that occurs before, during, and after disasters and serves to break the cycle of damage and repair in hazardous areas.[4]

Reliability: The energy system's ability to function consistently during normal conditions. In many cases, adaptation strategies that improve resilience also have the benefit of improving reliability.[5]

Resilience: The capacity to withstand or to recover quickly from negative events such as natural disasters, climate change, and other threats/hazards.

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Key Findings → Climate Change, Adaptation, and Resiliency

Climate change is no longer a future threat: it is already driving measurable impacts. New Yorkers have experienced the impacts of climate change in numerous ways in recent years, including extreme storms, heat waves, seasonal drought, and smoke from wildfires in the Western U.S. and Canada. Actions to adapt to an already changing climate are essential to building a more resilient energy system now and in the future. This chapter describes greenhouse gas (GHG) emissions and climate impacts in New York State. It outlines major policies and initiatives underway and recommends continued and additional actions to further the State's climate goals as well as adaptation and resilience efforts.

- **Without resilience and adaptation efforts, projected changes in climate hazards will pose a significant risk to New York's energy system.** Increasing temperatures, changes in precipitation, and sea level rise can affect nearly all aspects of the system, including electricity generation and transmission, natural gas supply and infrastructure, and demand across all fuel sources. These hazards are already affecting the energy system, and the risks will only increase as the climate continues to change.
- **As a threat multiplier, the effects of climate change can exacerbate non-climate-related impacts on the energy system.** Evolving energy demands and aging or inadequate infrastructure already place stress on New York's electricity system. When compounded by the impacts of a changing climate, these non-climate-related challenges further increase risks to the system, underscoring the critical need to enhance resilience and maintain reliability across the State's energy infrastructure.

- **While climate hazards are projected to escalate significantly in the next few decades, their worst impacts can still be prevented if swift action is taken to reduce emissions.** The scientific community has stated that substantial reductions in GHGs by the middle of the century will be required to minimize the risk of severe climate impacts. An assessment of climate projections shows significantly higher impacts to New York State from a high-emissions scenario when compared to a lower-emissions scenario.

- **The energy sector contributes 73 percent of total GHG emissions in New York State, though energy sector emissions have declined 24 percent since 1990.**[1] Energy-related emissions can span across almost all economic sectors, but are primarily included in the electricity, buildings, and transportation sectors. The State's clean energy policies have already reduced emissions, and both existing and emerging policies are laying the foundation for deeper, economy-wide emissions reductions statewide.

- **Actions to adapt to an already changing climate are essential to building a more resilient energy system now and in the future.** As New York State advances electrification and expands its zero-emission electricity supply, it has a unique opportunity to implement innovative strategies to enhance climate resilience. New approaches will be essential not only to address the long-term impacts of climate change but also to respond to today's severe weather events and ensure the energy system remains flexible, safe, resilient, and cost-effective.

1 2025 Statewide GHG Emissions Report (New York State Department of Environmental Conservation [DEC], 2025), https://dec.ny.gov/environmental-protection/climate-change/greenhouse-gas-emissions-report.

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1. Overview

Climate change is no longer a future threat: it is already driving measurable impacts at all levels. According to the World Meteorological Organization, the number of climate-based disasters worldwide increased fivefold between 1970 and 2019, while economic losses from climate- and weather-related events have risen sevenfold.[1]

New Yorkers have experienced the impacts of climate change in numerous ways in recent years, including extreme storms, heat waves, seasonal drought, and smoke from wildfires in the Western U.S. and Canada.

- In 2011, Tropical Storm Irene caused widespread destruction, particularly in the Catskills, Adirondacks, and Schoharie Valley, largely due to catastrophic flooding that washed out roads and overwhelmed wastewater treatment plants. While New York communities worked to rebuild they were faced with another major storm, Tropical Storm Lee, less than two weeks later.
- Superstorm Sandy devastated much of New York City in 2012, with 13-foot-high storm surges battering the region along with heavy rains and strong winds. The storm left hundreds of thousands of New Yorkers without power and resulted in dozens of fatalities.[2] Over the next five years, the Federal Emergency Management Agency contributed over $25 billion to recovery efforts in New York and New Jersey.[3]
- In 2020, high winds from Tropical Storm Isaias damaged critical infrastructure and caused power outages for more than 800,000 New Yorkers.[4]
- Historic flooding from Hurricane Ida in 2021 caused lasting damage to the Gulf Coast and devastated the Northeast. The National Weather Service issued its first flash flood emergency warning for parts of northeastern New Jersey and its second ever flash flood emergency for New York City.[5]
- In July 2023, the Hudson Valley saw excessive amounts of rain, with some areas reporting a 1-in-200-year (0.5% annual chance) rainfall event.
- In recent years, most notably in summer 2023, smoke from wildfires outside New York has severely affected air quality across the state, putting New Yorkers' health at risk.
- In late September 2023, the Governor issued a State of Emergency for an extreme precipitation event downstate, during which over nine inches of rain fell in Nassau County.

New York is expected to face a wide range of climate-driven impacts, reflecting the state's diverse geography and socioeconomic conditions. Intensifying heat waves and long-term warming trends are expected to increase localized heat stress, requiring New York's electricity grid to adapt to rapidly shifting demand patterns. Heavy rainfall events will lead to more frequent localized flooding, disrupting food production, water resources, and both natural and built environments statewide. Rising sea levels will pose growing risks to coastal communities and sensitive ecosystems. Disadvantaged communities (DACs) are especially vulnerable, as they face disproportionate impacts from climate change.

New York's nation-leading policies position the State to take meaningful action to confront local climate challenges. The urgency of response is underscored in recent reports from the Intergovernmental Panel on Climate Change (IPCC). The IPCC's latest assessment (Sixth Assessment Report [AR6]) emphasizes that sustained and significant reductions in greenhouse gas (GHG) emissions are essential to curbing the worst impacts of climate change and slowing the pace of unprecedented changes felt by all facets of society.

Meeting the challenge of climate change begins with a clear understanding of statewide emissions and shifting climate patterns. Through robust research and strategic planning, New York can adapt, leveraging the strength of its people, systems, and technologies. Efforts such as the New York State Department of Environmental Conservation (DEC) Statewide GHG Emissions Report and the New York State Climate Impacts Assessment (NYSCIA) play a critical role in guiding State actions, informing investments, and shaping adaptation strategies to ensure that communities across New York continue to receive clean, reliable energy for decades to come.

2. Summary of New York State Emissions

As required by New York's 2019 Climate Leadership and Community Protection Act (the "Climate Act"), DEC publishes a Statewide GHG Emissions Report to track progress towards meeting the State's 2030 and 2050 reduction targets. The first Statewide GHG Emissions Report, released in 2021, covered emissions from 1990 through 2019. The 2025 report includes data through 2023 and examines emissions of the seven primary GHGs: carbon dioxide (CO_2), methane, nitrous oxide, hydrofluorocarbons (HFCs), perfluorocarbons, sulfur hexafluoride, and nitrogen trifluoride. These gases are measured in terms of carbon dioxide equivalent (CO_2e) using a twenty-year time horizon, as required by the Climate Act.

To measure progress toward the Climate Act targets, New York accounts for GHG emissions differently than other jurisdictions in two primary ways: the twenty-year timeframe required by the Climate Act diverges from the more widely used interval of one hundred years; and the report incorporates emissions from electricity generation and fossil fuel extraction and transmission that occur outside of New York State but are imported for use within the state. A third difference is that for the gross emissions inventory, which is the basis of the emission reduction targets adopted in State law, combustion emissions associated with alternative fuels are not considered carbon neutral and the emissions benefits associated with land use are excluded. Therefore, New York's inventory is not always directly comparable to other governments', nor to pre-2019 New York inventories. New York's inventory is continually updated and improved as new methodologies and data become available, which can result in differences in emission values from previous reporting years. Detailed information on the methodologies used and recent updates is outlined in each report.

The 2025 Statewide GHG Report found that the energy sector accounted for approximately 73 percent of statewide emissions in 2023 using the Climate Act accounting methodology.[6]

Figure 1: NYS Statewide GHG Emissions by IPCC Sector, 1990 – 2023, Climate Act Accounting (MMT CO_2e GWP20)

Source: 2025 Statewide GHG Emissions Report[7]

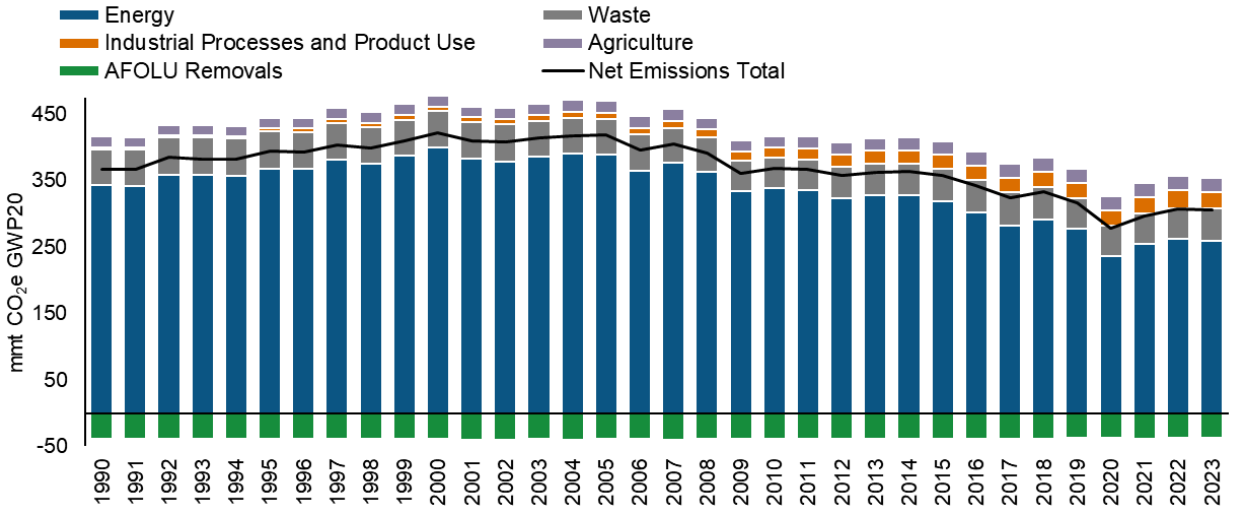
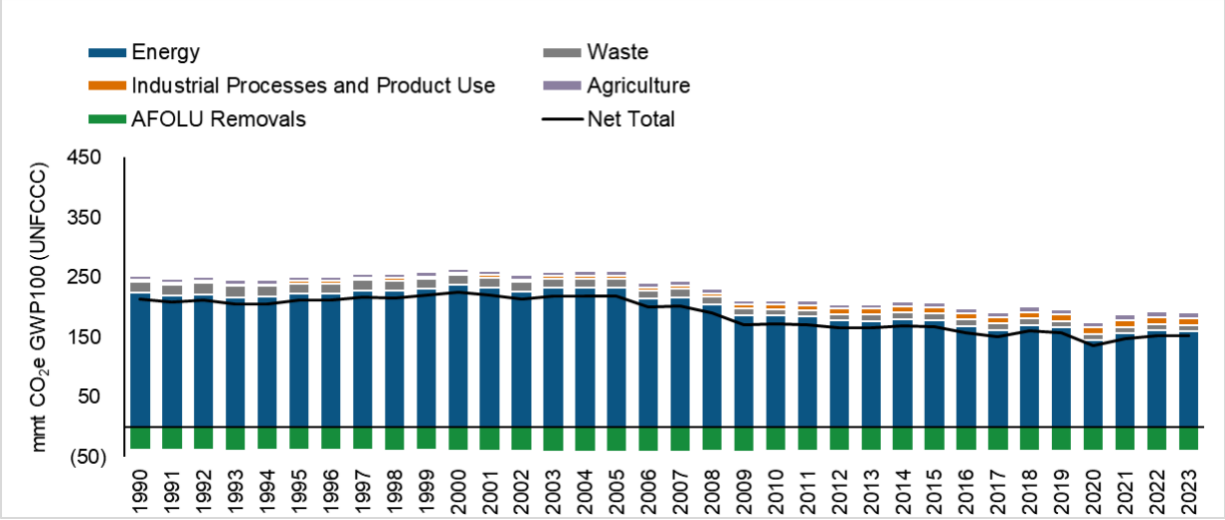


Figure 2: NYS Statewide GHG Emissions by IPCC Sector, 1990 – 2023, UNFCCC Accounting (MMT CO_2e GWP100)

Source: 2025 Statewide GHG Emissions Report[8]



Energy-related emissions can span across almost all economic sectors, but are primarily included in the electricity, buildings, and transportation sectors.

- In 2023, buildings and transportation were the highest-emitting sectors, each at approximately 28 percent of total emissions, followed by emissions from the electricity sector, at 15 percent of statewide emissions. These sectors include GHG emissions from fuel use as well as emissions associated with the production and transport of imported fuels.

- The transportation sector includes GHG emissions associated with on-road transportation; non-road transportation modes (such as aviation, rail, and marine); and other mobile equipment, as well as HFCs used for mobile heating, ventilation, and air conditioning (HVAC).
- The buildings sector includes fuels used in residential and commercial buildings and HFCs used in HVAC.
- The electricity sector includes fuels used for generating electricity within the state, imported electricity, and the transmission and distribution of electricity. The industrial sector, although a smaller fraction of total state emissions, is made up largely of energy-related emission sources, including fuels used in industrial buildings and for industrial processes as well as emissions from the oil and gas industry in the state. The remaining sectors, including waste, agriculture, and forestry, account for approximately 20 percent of state emissions combined, with minimal energy-related emission sources.

With 2023 gross emissions totaling the equivalent of 354 million metric tons of carbon dioxide (354 MMT CO_2e), New York State will need to reduce emissions by 30.6 percent to meet the 2030 GHG reduction target. Net emissions in 2023 were 317 MMT CO_2e.

According to the 2025 Statewide GHG Emissions Report, by 2023, gross emissions had dropped markedly compared to a broad historic context but have more recently remained largely unchanged:

- 14.8 percent below 1990 emissions
- 24.5 percent below 2005 emissions
- 4.0 percent below 2019 emissions
- 0.7 percent below 2022 emissions

Gross emissions reflect a decrease across key economic sectors between 1990 and 2023, including:

- a 43 percent decrease in electricity emissions;
- a 39 percent decrease in industrial energy emissions;
- a 1.6 percent decrease in transportation energy emissions; and
- a 21.2 percent decrease in building energy emissions.

The report found that 2023 energy emissions were 24 percent lower than in 1990 and 33 percent lower than in 2005. As noted above, the electricity sector alone has experienced some of the largest reductions, a 43 percent decrease between 1990 and 2023. However, it is important to note that recent trends reflect the collective impacts of the COVID-19 pandemic on the energy sector.

Despite significant reductions, the report documents a 10 percent increase in energy emissions since 2020 (continuing to return to pre-pandemic levels). The 2023 report found energy emissions fell 1 percent since 2022. Electricity emissions increased by 14.1 percent between 2019 and 2023, even as

electricity sales were 4.2 percent lower. This increase is likely due to a decrease in nuclear generation, as New York saw the closure of Indian Point and a subsequent increase in gas and petroleum fuel use for electricity production.

Of energy sector emissions, approximately 76 percent are CO_2, including CO_2emissions from plant-based fuels. Methane makes up about 24 percent of energy sector emissions, the majority of which is associated with out-of-state sources. Nitrous oxide and sulfur hexafluoride account for only fractions of a percent.

When developing plans to mitigate GHG emissions, it is important to consider the impact of carbon sequestration on the statewide emissions inventory and incorporate efforts to minimize disturbance to New York's natural lands. Several land use types, including forests, croplands, and wetlands, are capable of "carbon sequestration," a process where carbon is captured and stored, thereby removing it from the atmosphere. These "net removals"[9] amounted to 37.48 MMT CO_2e in the 2025 report, reducing New York's total emissions on a net basis to 316.58 MMT CO_2e.

A Pathways Analysis was completed in 2025 to inform this energy plan and other state climate planning efforts and is included in this Plan. The analysis explores current trends in the energy sector, models several mitigation scenarios, and provides a forecast of future statewide emissions.

3. Climate Change in New York State

3.1. Scientific Evidence of a Changing Climate

The 2024 NYSCIA[10] offers a thorough evaluation of historical climate data and concludes that New York State's climate has already changed, with impacts evident across economic sectors, industries, natural systems, communities, and regions.[2] The assessment explores and evaluates specific climate observations and projections and their unique physical, ecological, and societal impacts on the state. It takes a deeper look into how these hazards are magnified in different geographic areas of the state, as well as how these hazards may affect state economies and crucial natural resources. In addition to detailing the impacts the state is experiencing and projected to experience, the assessment presents information on vulnerabilities and offers recommendations on adaptation and resiliency strategies, with an eye toward recognizing inequities and advancing solutions that respond to climate hazards justly, comprehensively, and equitably.

Research from both the U.S. Global Change Research Program and the IPCC has concluded that, in order to limit the global average increase in temperature to 2°C (if possible, 1.5°C) and minimize the risk of the most severe climate impacts, substantial reductions in GHG emissions by mid-century are required. Despite commitments by national governments to limit warming to under 1.5°C, global average temperatures temporarily exceeded 1.5°C for more than half of 2024, with an annual average that may have exceeded 1.5°C for the first time. The last ten years have been the hottest on record globally. NASA recently confirmed that 2024 surpassed 2023 as the hottest year on record since record-keeping began in 1880.[11] GHGs already emitted into the atmosphere will continue to contribute to warming for years, and often decades. It is clear that New York State's climate has already changed, and some amount of further climate change has already been set in motion. Therefore, preparing communities and

infrastructure for projected climate impacts and incorporating adaptation and resiliency measures to address these impacts is crucial to preserving the safety and well-being of all New Yorkers.

3.2. Climate Projections for New York State

The 2024 NYSCIA provides a science-based analysis of projected climate change for multiple hazards in New York. Physical variables like temperature, rainfall, heat waves, extreme precipitation, and sea level are likely to change between now and 2100. The NYSCIA projections were modeled for both a moderate- and a high-emissions scenario, and it is important to note that modeling shows the moderate scenario leads to significantly lower changes in the climate and the resulting impacts of those changes.

3.2.1. Temperature

Average and maximum temperatures are projected to continue to rise throughout the 21st century. The number of days above approximately 32°C (90°F) and 35°C (95°F), with a high heat index, and with the maximum heat index are all projected to increase. Heat waves are expected to occur more often and become more intense, posing greater risks for human health, built infrastructure, ecosystems, and other sectors. All regions of the state, including the North Country and Western New York, will experience large increases in temperature and extreme heat.

The annual number of days below 0°C (32°F) and below approximately -18°C (0°F) are projected to decrease across the state. The reduction in days below freezing will affect animal migration, pests (e.g., ticks), hydrological cycles, and, more generally, whether precipitation falls as rain or snow.

3.2.2. Precipitation

New York State has experienced increases in total and heavy precipitation, trends that are expected to continue through the century. Heavy rainstorms that lead to flooding will likely become more frequent. In the Great Lakes region, warmer water and reduced ice cover may initially increase lake-effect snow, but as temperatures rise further, more of this precipitation will fall as rain. Overall, snowfall and snowpack are projected to decline across the state due to warmer winters, with a shorter snow season and a shift from snow to rain.

3.2.3. Extreme Events

Climate change is creating conditions that will increase the frequency and severity of many types of extreme events. As noted in Section 3.2.2, heavy precipitation events will become more frequent, and hurricanes and tropical storms may become more intense. Short-term, seasonal droughts may happen more often, especially in the summer. Wildfire season in the Northeast may begin earlier and last longer. However, increased wildfires in other parts of the region and country may impact air quality in New York more frequently.

3.2.4. Ocean Conditions

Sea level is projected to rise along the New York State coastline and in the tidal Hudson by approximately two to three feet by the end of the century, although some models project an even higher rise. There is also a chance of an even more dramatic rise due to “low-probability, high-impact” events, such as the

collapse of the Antarctic ice sheet. Rising sea levels will continue to increase the severity and frequency of coastal flooding, including both high-tide floods and storm surge floods.

Rising temperatures will increase sea surface temperature, affecting ocean currents, weather, and ecosystems. Continued high CO_2 in the atmosphere will lead to increased acidification of the ocean.

3.2.5. Lakes and Rivers

New York State's lakes and rivers will continue to experience increased water temperature, fluctuating water levels, and decreased ice cover. Lakes are projected to experience more severe summer heat waves and decreased winter ice cover as temperatures rise in the coming decades. While future water levels in the Great Lakes are difficult to project, the lakes will likely experience greater variability in those water levels, driven by periods of drought and extreme precipitation. Flood intensity and associated damages are expected to rise due to extreme rainfall and broader changes in river and streamflow patterns.

3.2.6. Compound Events

The changes described above become more severe and damaging when multiple stressors combine or co-occur. These combinations are referred to as compound events. As many of the individual risks increase with climate change, it follows that the risk of increasingly severe combinations will also grow.

As defined and described in the NYSCIA, compound events fall into four main categories, all relevant to New York State:

- *Preconditioned events* occur when one or more hazards cause an impact, or lead to an amplified impact, only because of a pre-existing, climate-driven condition. Examples include heavy rainfall on top of snow and a false spring (when cold conditions return after unseasonable warmth).
- *Multivariable events* refer to the co-occurrence of multiple climate hazards in the same geographic area. An example is the vulnerability of communities along the tidal Hudson River to flooding from a combination of high streamflows and tidal flooding exacerbated by sea level rise.
- *Temporally compounding events* refer to a succession of hazards that affect a given geographic area, creating or amplifying an impact when compared with a single hazard. Examples include a heat wave after a coastal storm has knocked out power, a cold snap after a destructive storm (as occurred with Superstorm Sandy in 2012), and back-to-back nor'easters associated with persistent troughs in the jet stream.
- *Spatially compounding events* occur when multiple connected locations are affected by the same or different hazards within a limited time window, causing an impact. For example, the entire Northeast could experience heavy precipitation over the same period, leading to large increases in riverine flood risk in New York State and beyond. Some authors have considered cases in which compounding goes beyond climate hazards to include other aspects of human and natural systems, such as the risk of power failures and poor air quality, both of which are correlated with extreme heat.

These compound events are particularly important to consider in any planning process. They are not well-studied from a modeling perspective but can have severe consequences when they occur.

3.3. Key Hazards for New York's Energy System

Extreme heat, changes in precipitation, and other climate hazards are already stressing the State's energy infrastructure and affecting supply and demand. These risks will only increase with the changing climate. Examples of climate impacts already experienced and expected in the future are highlighted in this section. More information and details are presented in subsequent chapters of this Plan and in the NYSCIA.[10]

- **Increasing temperatures.** Increasing temperatures can lead to performance reduction for critical energy assets, including a loss of electric generating efficiency in combustion-based, wind, and solar resources and a potential reduction in the capacity, efficiency, and life span of battery storage components. High temperatures can disrupt electricity delivery by reducing the efficiency and capacity of transmission and distribution systems, causing equipment derating and increasing the sagging of transmission lines. Increased extreme heat events, in particular, could also significantly increase cooling demand. Natural gas and fuel oil infrastructure can be damaged through movement caused by increased frequency of frost heaves and changes in freeze-thaw cycles. Demand for natural gas and other heating fuels may decrease as winter temperatures rise, although New York State will still likely experience cold snaps in the near term. Heating degree days will decrease in New York over the course of the 21st century and cooling degree days will increase, as winters warm and summers become hotter. This will be a complicating factor for electricity demand and grid resilience, as heating systems become more electrified and cooling systems are used more often statewide.

- **Precipitation changes.** Changing precipitation patterns and intensity can damage energy assets as well as impact performance and generation capacity. Flooding from extreme precipitation events can result in equipment and asset damage and lead to inaccessible or washed-out access roads. Rain and floodwaters can infiltrate into underground natural gas pipelines and low-pressure natural gas delivery systems, corrode and undermine fuel tanks, and damage underground electrical equipment. Short-term, seasonal drought can result in impacts to the operations of small hydropower facilities.

- **Sea level rise.** Rising sea levels will lead to higher storm surge and more coastal flooding of critical energy facilities and fuel storage tanks, as well as increased damage to and corrosion of underground natural gas and electric transmission and distribution infrastructure. Nuisance flooding, inundation, or storm surge can disrupt access to facilities and fuel delivery distribution systems that require the use of roads. Drainage and stormwater flooding can impede automatic pumps from removing floodwater from facilities.

- **Changes in wind speed and direction**. Extreme events, such as hurricanes and other storms, affect the energy system in multiple ways, including causing damage to overhead lines, poles, and transmission towers from wind and debris. High winds can also affect solar electricity

generation and damage photovoltaic panels. Changes in wind patterns not linked to extreme events remain uncertain. However, recent research indicates that any such changes, if they occur, are likely to fall within the range of natural variability and are not expected to impact the generation potential of wind turbines.

- **Cascading impacts across sectors.** It is important to recognize that every sector of New York State's economy depends on the energy sector.[12] Climate-driven disruptions to the energy system can have ripple effects that impact other interconnected sectors and potentially cause failures. Similarly, disruptions in sectors like transportation and water can also affect energy systems, such as hindering fuel delivery.[13] Digitalization and the increasing reliance on the internet for a wide range of functions within and beyond the energy sector have already changed the way disruptions, including climate-driven ones, can impact other industries.

3.4. Non-Climate Factors

Other factors unrelated to climate change can still interact with climate hazards, influencing and potentially exacerbating their impacts. For instance, the electrification of buildings and transportation will increase the need to ensure the resilience and reliability of the electric system.

Electrification will shift demand patterns by increasing overall annual electricity consumption and altering peak usage times. As it expands, electricity demand will become more sensitive to climate, with a greater need for both heating and cooling. Climate change adds further complexity: under a high GHG emissions scenario, winter warming reduces the need for heating more than in a moderate scenario. However, the resulting hotter summers drive up cooling demand even more sharply, leading to a greater overall increase in electricity use for cooling than under moderate emissions. Additionally, aging transmission and distribution infrastructure will need to be upgraded to accommodate future conditions and enhance the system’s resiliency to the changing climate.

Uncertainty in federal positioning on climate adaptation and resiliency, including policy, resources, tools, data, and more, may impact infrastructure sectors in meeting resilience needs, including the energy sector.

4. The Case for Climate Action in New York

While climate hazards are projected to escalate significantly in the next few decades, the worst impacts can still be prevented if swift action is taken to reduce emissions. Here in New York, actions to adapt to an already changing climate are essential to build a more resilient energy system.

4.1. Mitigation, Adaptation, and Resilience

To effectively address the climate-related vulnerabilities of New York State’s energy systems and reduce both current and future impacts, the State must adopt an integrated energy planning approach that incorporates mitigation, adaptation, and resiliency, while recognizing the interdependence of these three pillars of climate strategy.

Reducing GHG emissions produced by human activity is essential to mitigating the impacts of climate change. Climate change mitigation can also include the removal of GHGs that have already been emitted

in the atmosphere through carbon sequestration and storage by natural ecosystems such as forests, wetlands, soils, and grasslands. When these natural ecosystems are disrupted or converted for development, sequestered GHGs are often re-released into the atmosphere. Therefore, climate mitigation measures are broad and far-reaching. They encompass strategies that include the transition to renewable energy sources; changes in consumer behaviors; the development of energy efficient technologies; land conservation, reforestation, and afforestation initiatives; and any action that reduces emissions or sequesters GHGs.

Adaptation is the process of identifying risks and vulnerabilities to future climate hazards, adjusting plans and behaviors, and incorporating measures in the design and construction of infrastructure that will prepare systems to withstand or adjust to changing climate conditions. Successful adaptation can sometimes be accomplished with simple adjustments, but it can also require complete transformations of existing processes. For example, adaptation can include elevating important infrastructure above future projected flood levels or changing zoning to limit new development in projected future floodplains. Importantly, adaptation processes and investments need to be re-assessed over time to ensure systems are adequately able to adapt. Timely investment in effective and adequate adaptation strategies is critical in order to avoid the larger costs of recovery from damaging climate events.

Climate resilience is closely related to adaptation. It refers to a system's ability to prepare for climate hazard risks in a proactive manner, respond effectively to reduce damages from climate hazards, and recover from extreme climate hazard events quickly. A climate-resilient system, be it natural or human-made, is prepared for climate impacts and experiences minimal damage from events. Natural systems offer many benefits to engineered systems, particularly in terms of risk reduction. Conserving and enhancing ecosystems, such as forests, flood plains, and wetlands, can greatly improve the climate resilience of the built environment and energy infrastructure by offering protection from flooding and storm surges. Resilience is a process, not an endpoint, and as such requires continued re-evaluation of current and future conditions. It is important to note that resilience is not exclusively used in reference to climate hazards. Resilience, in a general sense, refers to a system's ability to prepare for any threat or hazard, adapt to changing conditions, and withstand and recover rapidly from adverse conditions and disruptions, regardless of the cause.

The concepts of climate change mitigation, adaptation, and resilience are closely interconnected and mutually reinforcing. Mitigation efforts often include adaptation strategies that enhance overall climate resilience, while true resilience can only be achieved through effective adaptation. At the same time, mitigation must account for adaptation needs to ensure preparedness for evolving climate conditions. According to the IPCC's AR6, adaptation is critical to minimizing harm, but its effectiveness diminishes as global warming intensifies, highlighting the urgent need for ambitious GHG emission reductions. In this context, integrating mitigation, adaptation, and resilience is essential to ensuring the long-term reliability of New York's energy systems.

4.2. Benefits of Climate Action and Costs of Inaction

The direct and indirect social costs of climate change are already significant and expected to rise as impacts intensify. These include damage to infrastructure, increased strain on public health systems, and

disruptions to critical services—including energy. For example, in New York, climate hazards like rising temperatures and more frequent extreme weather events are projected to increase total energy expenditures in some counties by up to 10 percent by the end of the century.[14]

Climate change vulnerabilities intersect with, and are exacerbated by, underlying and systemic social/economic stressors and fragilities.[15] However, proactive investments in climate mitigation, adaptation, and resilience can yield substantial and wide-ranging benefits. These include improvements in public health, system reliability, energy and resource security, and long-term economic stability. Integrating the latest understanding of projected climate hazards into planning and development processes helps reduce the need for costly future repairs and retrofits, particularly for infrastructure not designed for evolving conditions.

Ultimately, while the specific economic outcomes of climate change depend on the severity of physical impacts, the evidence is clear: failing to act will lead to far greater social and economic costs. A forward-looking approach that centers resilience and equity can deliver lasting advantages across both natural and built environments. New York can also continue to set an example as a climate leader, demonstrating successful implementation of climate mitigation and adaptation strategies for other local and national jurisdictions to replicate.

Climate action can benefit all sectors of society. As the latest energy-efficient technology makes its way into homes and businesses, New Yorkers can benefit from cost-savings as well as cleaner, more reliable heating and cooling systems. Distributed energy resources, primarily seen as a GHG reduction strategy, can also offer the additional benefits of affordability and reliability. An increase in uptake of zero-emission transportation will offer economic benefits and jobs, while also driving a reduction in harmful co-pollutants that disproportionally impact DACs. See the Environmental and Climate Justice, Clean Energy Jobs and a Just Transition, Buildings, Transportation, Public Health Impacts Analysis, and other chapters of this Plan for more detailed information on these initiatives.

4.2.1. Benefits of GHG Emission Mitigation

Reducing emissions can deliver immediate and substantial benefits by helping to prevent the most severe impacts of climate change. Swift emissions reductions may avert illnesses and fatalities linked to extreme heat; flooding; and the spread of food-, water-, and vector-borne diseases. Transitioning to cleaner energy sources also brings indirect health benefits by reducing harmful co-pollutants both indoors and outdoors. Smart growth strategies that promote active transportation, like walking and biking, can improve public health at the community level. Energy efficiency retrofits further reduce health risks in the home by replacing combustion-based fuels with cleaner, safer alternatives. Moreover, investments in climate mitigation stimulate economic growth, create clean energy jobs, and enhance housing security, social equity, accessibility, resource efficiency, and the quality of mobility services. See the Electricity, Transportation, Buildings, Environmental and Climate Justice, and other chapters of this Plan for more detail.

4.2.2. Benefits of Adaptation and Resilience

Adaptation and resilience planning helps prepare communities, ecosystems, and the built environment for the impacts of climate change, enabling them to thrive into the future. This planning process identifies actions and strategies that can be implemented now or over time to address risks to quality of life, public safety, infrastructure, and natural systems. These risks are especially high for DACs, which face increased vulnerabilities due to longstanding and systemic inequities. Like GHG mitigation, investments in adaptation and resilience can enhance quality of life, support local economic development, reduce future recovery costs, advance equity in both rural and urban areas, and protect the environment.

While adaptation and resilience planning is often associated with reducing vulnerabilities from climate change hazards (e.g., sea level rise, extreme heat, heavy precipitation events), planning for the energy system must also consider non-climate-hazard-related vulnerabilities that may be worsened by climate change. Shifts in population densities can occur as people affected by climate change relocate to avoid climate impacts.[16] Regions of the state that receive those who are relocating may see a change in energy demand with potential subsequent implications for existing infrastructure or energy generation planning. Incorporating consideration for non-climate-related vulnerabilities into adaptation and resilience planning can aid in the development of strategies that provide co-benefits and support additional community energy needs beyond those related to climate impacts.

Land use planning and decision-making regarding development siting is a primary mechanism for risk avoidance. As noted in the sections above, climate change impacts will be felt broadly across New York State. Flooding is one of the costliest and most widespread hazards in the state, but there are locations that are less risky to develop than others. While there is no guarantee that flooding will not occur outside the floodplain, these areas are typically safer for development. Local knowledge and history of flooding should be considered when determining locations for development, such as energy infrastructure. Avoidance of hazard risk through appropriate site location will decrease the likelihood of needing to mitigate impacts into the future. In addition to proper siting, there are other safeguards that can be implemented to decrease potential impacts from flooding, such as floodproofing or elevating structures above expected flood levels where possible.

4.3. Environmental/Climate/Energy Justice

DACs are projected to experience greater impacts from climate change, and energy-related climate impacts are no exception. Existing inequalities and burdens in New York State's energy system heighten the risk of disproportionate impacts, especially as the energy system evolves. For instance, low-income households, DACs, and other vulnerable populations, such as people with existing health conditions, are already more likely to face challenges cooling their home in hot weather and are more vulnerable to power outages during extreme weather events.[5] However, reliance on fossil fuels has long been a source of social injustice, with the siting and operation of fossil-fuel-based energy infrastructure resulting in greater environmental health and safety burdens on some communities than others. An energy sector transition provides an opportunity to work toward a more just and resilient energy system where all New Yorkers receive equitable benefits of clean and resilient energy infrastructure, affordable energy, and associated jobs.

4.4. National and Global Context for Climate Action

For decades, national and global policymakers have collaborated to mitigate climate change, beginning with the establishment in 1992 of the United Nations Framework Convention on Climate Change (UNFCCC) as the primary international platform for climate action. This effort was strengthened by the 1997 Kyoto Protocol and the 2015 Paris Agreement, both of which included commitments to reduce GHG emissions and limit global temperature rise to below 2°C above pre-industrial levels, particularly from developed nations. The UNFCCC acknowledged that climate change is primarily driven by human-generated GHG emissions and set the goal of preventing "dangerous anthropogenic (human-caused) interference with the climate system" by stabilizing these emissions. The latest report from the IPCC, AR6, underscores an even more urgent need for bold, immediate action.

In the wake of uncertain federal involvement, continued action at the State level is needed to prepare the country's energy sector for the challenges and opportunities that lie ahead.

5. Past and Current Climate Action in New York's Energy Sector

Through the Climate Act and other landmark legislative and executive actions, New York has established itself as a national leader in climate action. The State has a long history of advancing the clean energy transition. Early initiatives, including the 2004 Renewable Portfolio Standard, demonstrated New York's commitment to clean energy and laid the groundwork for later action, such as the Clean Energy Standard (CES) and the clean energy targets in the Climate Act. The CES was established in 2016 alongside a suite of clean energy and climate initiatives, together called "Reforming the Energy Vision," to support local adoption of renewable energy and clean transportation. The State's Clean Energy Communities program provides grants to help local governments lower their energy use, reduce GHG emissions, and advance clean energy projects in their communities. The interagency Climate Smart Communities (CSC) program, created in 2009, is another example of New York's pioneer climate initiatives to encourage climate action at a local level. CSC significantly expanded due to its success and popularity, with over 90 percent of New York State's population currently residing in a registered CSC.[17] Through early actions like these, and a continued focus on climate initiatives in the years since, New York is well-positioned to meet future challenges.

5.1. The Climate Act

The 2019 Climate Act established statewide GHG emission targets, including a 40 percent reduction in statewide GHG emissions from 1990 levels by 2030 and an 85 percent reduction by 2050.[18] The Climate Act also established a target of net zero emissions across all sectors of the economy by 2050.[19] In addition, the Climate Act directed the New York State Public Service Commission (PSC) to establish a program that aims to decarbonize the electric sector and achieve 70 percent of the State's electricity generated by renewable[20] energy systems by 2030 (70x30) and 100 percent zero-emission electrical demand system by 2040 (100x40).[21] The Climate Act includes provisions that codified existing clean energy goals, including a target for the procurement of at least 9,000 megawatts (MW) of offshore wind by 2035, 6,000 MW of distributed solar generation by 2025, and 3,000 MW of energy storage by 2030.[22] The State has since set increased targets to deploy 10,000 MW of distributed solar and 6,000 MW of energy storage by 2030.[23]

The Climate Act's provisions are comprehensive and expansive. Other notable directives include:

- **Climate Action Council.** The 22-member Climate Action Council[24] is comprised of representatives from 12 State agencies and authorities and several members appointed by the Governor and Legislature. The Climate Act established the Council and charged it with developing an economy-wide Scoping Plan to provide recommendations to achieve the Climate Act emission targets. To inform the plan, the Council was directed to convene several advisory panels to provide expertise on topics such as transportation, power generation, and energy-intensive and trade-exposed (EITE) industries. The Climate Act also directed the Council to convene a Just Transition Working Group to identify sites of electric generating facilities that could face closure due to the transition to a clean energy sector and to advise the Council on issues and opportunities related to workforce development with additional considerations for DACs, EITE entities, and impacts to State and local economies.

- **Climate Justice Working Group (CJWG).** The Climate Act established the CJWG within DEC, comprised of representatives from environmental justice communities and State agencies.[25] Under the Climate Act, the CJWG was tasked with defining what constitutes a DAC in New York State. Based on criteria that were adopted by the CJWG on March 27, 2023, 35 percent of census tracts in the State are defined as DACs.[26]

- **Community Air Monitoring Program.** In accordance with the Climate Act, DEC undertook a significant community air monitoring initiative. While the Climate Act required monitoring in no less than four DACs, the State expanded this effort to ten DACs to identify sources contributing to disproportionate air pollution burdens. DEC and community stakeholders will develop strategies to reduce air pollution in these communities, including GHG emissions that contribute to climate change, with the goal of implementing these strategies statewide. [27]

- **Investments in DACs.** The Climate Act acknowledges that DACs bear disproportionate and inequitable impacts from climate change. In response, it establishes mechanisms to ensure these communities benefit from the clean energy transition envisioned by the Climate Act. This includes provisions that at least 35 percent of the overall benefits from spending on clean energy and energy efficiency programs are directed to these communities, with a goal of reaching 40 percent.[28]

5.2. Scoping Plan and State Energy Plan

The Climate Action Council finalized the Scoping Plan in 2022, outlining recommendations to meet the statewide GHG emission targets and achieve economy-wide net-zero targets.[29] While the Scoping Plan mainly focused on strategies to reduce GHG emissions across all sectors of the economy, it also introduced innovative approaches to address the systemic risks posed by climate change. Additionally, the Plan emphasized the need to address the disproportionate impacts on DACs. The final Scoping Plan was shaped by ongoing Council deliberations and extensive public input. In accordance with the Climate Act, the Plan will be updated at least every five years.[30]

The current State Energy Plan was amended in 2020 to align with the new energy and emissions targets outlined in the Climate Act. The Climate Act requires that the Scoping Plan and its recommendations inform the subsequent State Energy Plan.

5.3. Other Mitigation Policies and Goals

Aside from the Climate Act, State leaders have advanced a variety of policies to target energy-related emissions via legislation, executive action, and regulatory measures.

5.3.1. Electricity Sector

The Regional Greenhouse Gas Initiative (RGGI) was established in 2005, becoming the first mandatory market-based emissions trading program in the United States to reduce CO_2 emissions, and the first anywhere to use the cap-and-invest model for reducing pollution.[31] New York and other RGGI-participating states set a regional cap on total CO_2 emissions from electric generation facilities and implement the program through their own regulations. The regionwide RGGI cap declines over time, gradually lowering CO_2 emission limits. Revisions made in 2020 further reduce the CO_2 emissions cap by 30 percent through 2030 and expand applicability to peaking units. On July 3, 2025, RGGI-participating states agreed to strengthen their regional CO_2 emissions cap through 2037, starting in 2027, and to establish new mechanisms to protect energy affordability.

DEC has been permitting and regulating emissions of co-pollutants from power plants for over 50 years. DEC regulates new, modified, and non-modified existing major electric generating facilities under Part 251, which created CO_2 emission rate limits. The 2019 revisions to this regulation were critical to ensuring the State fulfilled its commitment to eliminating coal from the electric generation sector by 2020 and that any new or modified sources comply with stringent CO_2 emissions standards.[32] DEC's subpart 227-3, often called the "Peaker Rule," established ozone season nitrogen oxide (NO_x) emission limits for simple cycle and regenerative combustion turbines.[33]

Enacted in 2020, the Accelerated Renewable Energy Growth and Community Benefit Act established a first-in-the-nation Office of Renewable Energy Siting and Electric Transmission (ORES) to dramatically speed up the siting and construction of clean energy projects by improving and streamlining the process for the environmentally responsible and cost-effective siting of large-scale renewable energy projects across New York.[34] The 2024 Renewable Action through Project Interconnection and Deployment Act (the "RAPID Act") consolidated the environmental review, permitting, and siting of major renewable energy facilities and major electric transmission facilities[35] under the purview of ORES.[36]

In 2020, the PSC implemented key provisions to align the CES and Offshore Wind Standard with the Climate Act and provide NYSERDA with the authorization to procure the renewable energy needed to meet emission reduction targets. These provisions included increased renewable procurement targets, the adoption of the 9,000 MW offshore wind procurement directive, and new initiatives that aid in the delivery of renewable energy to New York City.[37] The CES also includes the Tier 2 Maintenance Resource program, which is an important mechanism to keep existing renewable facilities operational.

The 2023-24 Enacted State Budget authorized the New York Power Authority (NYPA) to plan, design, develop, finance, construct, own, operate, maintain, and enhance renewable energy generation projects

in order to ensure a reliable and sufficient supply of electricity and to advance New York State's renewable energy targets as outlined in the Climate Act.

New York State has already made significant progress in reducing emissions from the electricity sector including investing in energy efficient technologies that are saving New Yorkers money, installing six gigawatts of distributed solar, completing South Fork Wind, and breaking ground on the Champlain Hudson Power Express, Empire Wind 1, and Sunrise Wind. Governor Hochul has taken additional action by directing the New York Power Authority to develop and construct at least one advanced nuclear energy power plant – the first new nuclear power construction in New York State in a generation.

5.3.2. End-Use Sectors

Energy emissions expand well beyond those associated with the electricity sector. Policymakers have advanced a wide breadth of cross-cutting measures that target building, transportation, and industrial sector emissions.

To address building sector emissions, recent policy measures aim to update building codes and support adoption of alternatives to fossil fuels. These include policies to support energy efficiency and GHG reduction strategies, weatherization, and utility thermal energy networks, including district geothermal and other community-scale thermal infrastructure projects, for heating and cooling homes.[38] Recent policy updates support expanded appliance standards and changed building code law to permit climate-friendly refrigerant alternatives.[39]

DEC recently adopted regulations to limit the venting of fossil natural gas and establish rigorous leak detection and repair requirements. The regulations reduce methane and volatile organic compound emissions from sources in New York's oil and natural gas sector and is expected to cut methane emissions by 1.2 MMT CO_2e.[40]

In the transportation sector, policies largely encourage adoption of zero-emission vehicles (ZEVs) through tax credits and rebates, as well as funding mechanisms to cover installation costs of new charging infrastructure and support municipal fleet transitions. New York State also has adopted regulations that require automakers of passenger vehicles and medium- and heavy-duty vehicles to sell an increasing percentage of ZEVs in the state over time.[41] New York's ability to implement and enforce these Advanced Clean Cars 2 and Advanced Clean Trucks rules, however, is currently subject to litigation challenging the federal government's attempt to revoke the federal preemption waivers for these rules using the Congressional Review Act.[42,43] New York State has established an interagency working group focused on the successful implementation of the clean vehicle transition and enhancing existing efforts to build out electric vehicle charging infrastructure. New York State is also a member of the U.S. Climate Alliance Affordable Clean Cars Coalition. For more information, see the Transportation chapter of this Plan.

Many policy measures mitigate emissions from multiple economic sectors. In 2024, DEC adopted two new regulations to address emissions of fluorinated gases, a particularly potent type of GHGs, which will primarily reduce emissions from refrigeration and air-conditioning equipment and electricity transmission and will support a transition to climate-friendly alternatives.[44,45] The 2010 State Smart Growth Public Infrastructure Policy Act requires that public infrastructure projects align with certain

smart growth criteria.[46] New York voters also prioritize climate change mitigation, having approved the $4.2 billion Clean Water, Clean Air, and Green Jobs Environmental Bond Act (the "Bond Act") to support the implementation of the Climate Act, funding GHG mitigation projects, and other initiatives including flood risk reduction and resilient infrastructure projects. Like the Climate Act, the Bond Act requires that DACs receive at least 35 percent of the fund benefits, with a goal of 40 percent.[47] The fiscal year 2026 State budget includes the $1 billion Sustainable Future Program, the largest single State budget commitment to climate and clean energy in New York's history. The program provides targeted funding to lower emissions, reduce household energy costs, and spur green job growth.[48]

5.4. Adaptation and Resilience Actions

In an effort to build systems capable of withstanding and recovering quickly from climate hazards while maintaining reliability, in 2022 Governor Hochul signed legislation that required the major utility corporations in the State to conduct a Climate Change Vulnerability Study (CCVS) and a Climate Change Resilience Plan (CCRP).[49] This requires these utilities to evaluate infrastructure, design specifications, and operational processes that are at risk from climate change[50,51,52] and must include measures to improve system hardness, as well as reduce outage time and restoration costs over 5-, 10-, and 20-year time horizons. Utilities must also propose adaptation measures that would improve equity and reliability. In December 2024, the PSC acted on the first iteration of the CCVSs and CCRPs and recognized the utilities' climate resilience plans will need to be updated every five years, with ongoing engagement with stakeholders, and will be subject to approval by the PSC.[53]

Incorporating input from over 29 agencies and authorities, DEC and NYSERDA recently published an Extreme Heat Action Plan (EHAP) to help New Yorkers respond to more frequent and intense extreme heat events driven by climate change.[54] EHAP includes 49 discrete actions that the State plans to take to support statewide adaptation and resilience to extreme heat and centers New York's most vulnerable communities. Many EHAP recommendations focus on planning and implementing adaptation and resilience measures within infrastructure and built environments statewide. Key priorities include expanding access to cooling centers, supporting weatherization and thermal resilience, developing model laws and planning standards, and enhancing protections for worker health and safety. EHAP recognizes the critical and increasingly important role that grid reliability and grid resilience have in ensuring the health and well-being of New Yorkers in extreme heat emergencies.

The New York Community Risk and Resiliency Act (NYCRRA) was signed into law in 2014[55] to improve New York's resilience to rising sea levels and extreme flooding. NYCRRA directs the Department of Environmental Conservation to adopt sea level rise projection regulations and to update these projections at least every five years. 6 NYCRR Part 490, Projected Sea Level Rise, was adopted using data from the 2014 ClimAID report and was updated in 2024 using projections from the latest NYSCIA. It establishes statewide sea-level rise projections for use in the consideration of permits and other decision-making processes specified under NYCRRA. Additionally, several guidance documents were developed to support the implementation of NYCRRA,[56] including State Flood Risk Management Standards, Model Local Laws for Resilience, and the use of Natural Resilience Measures to Reduce Risk of Flooding. The Climate Act expanded the scope of NYCRRA to incorporate additional climate hazards,

cover additional projects and permitting programs, and allow State agencies and other entities to require mitigation of climate risks, including adverse impacts on DACs.[57]

To help put many of these strategies into action New York also launched the "Green Resiliency Grant" program, which supports transformative infrastructure projects in various flood prone communities across the state.

6. Looking Ahead

While climate change reveals the vulnerabilities of New York's existing energy infrastructure, it also presents an opportunity to identify new strategies that can support the development of a climate-resilient energy system. Uncertainties remain on both the demand and supply sides of the electricity system, including renewables' sensitivity to climate change, and the need for new technologies, infrastructure, and operations. Ensuring a reliable energy supply and delivery will require diverse solutions such as investments in new energy infrastructure, hardening of current energy infrastructure, new business models, and demand-side management programs.

Coordinating efforts to mitigate GHG emissions while adapting to our changing climate can also offer additional opportunities and benefits. Direct resilience benefits of the State's GHG reduction commitments include enhanced building resilience, availability of backup power in storm events, job opportunities, air quality improvements, and reduced energy costs. It also provides an opportunity to address social injustices in the energy system as the State invests in cleaner energy sources.

6.1. GHG Mitigation Strategies

Patterns of energy demand are shifting due to climate change and will continue to evolve as the State decarbonizes and electrifies sectors that historically rely on fossil fuels. GHG mitigation policies discussed earlier in this chapter, such as clean transportation requirements and zero-emission building codes, will increase electricity demand and thereby increase the amount of renewable electric generating capacity needed to meet the Climate Act targets. Altered demand patterns driven by climate change, such as a shift in peak demand from summer to winter, can strain energy supply and delivery and could result in higher energy prices and greater risk of damage to infrastructure.

There are many options that can be implemented in the energy sector to mitigate GHG emissions and support a gas system transition, many of which have been incorporated into this Plan. Load flexibility and controllability will play a vital role in the development of a more manageable electric grid that will accommodate the large volume of renewable energy being procured and developed in pursuit of the Climate Act targets. Statewide upgrades to transmission and distribution systems will be needed, including specific investments to deliver energy from where the generation is located to where demand exists. The PSC will conduct biennial reviews to update and refine CES policies, ensuring that program requirements and procurement targets are aligned with the 2030 and 2040 emission reduction targets while safeguarding the future of the existing renewable energy infrastructure.

Fortunately, actions that mitigate GHG emissions in the energy system often have the added benefit of improving resiliency, reliability, and affordability. For example, energy efficiency measures in buildings typically reduce GHG emissions by lowering energy consumption. This, in turn, decreases the overall

demand on backup energy services, thereby enhancing energy resilience. On a large scale, homes with efficient building envelopes can significantly reduce electricity demand, which helps prevent generator failure during emergency events. Targeted, reliability-focused energy efficiency programs can reduce emissions while enhancing electric grid reliability. One study found that such programs, implemented over a single summer in California, saved approximately 700 MW of capacity and 1,700 GW-hours of energy over the following year.[58] Building envelope improvements also enhance the ability of the structure to maintain comfortable and safe conditions during extreme weather conditions and power outages.

6.2. Adaptation and Resilience Strategies for New York's Energy Systems

As described above in Section 4.1, adaptation and resilience strategies will play an important and distinct role in developing a safe, reliable, and flexible energy system that can withstand the challenges and uncertainties of increased climate impacts, changing energy demands, and a growing reliance on emissions-free electricity supply sources.

Solutions such as demand-side behavior changes, operational adjustments, investments in system capabilities and capacities, modified business models, and new technologies that are attuned to the changing energy system can moderate the effects of uncertainty due to climate change.

The Climate Change Adaptation Cost Recovery Program was signed into law in 2024 to support projects that bolster New York's resiliency to climate impacts. The legislation aims to shift the cost of climate adaptation to the fossil fuel companies most responsible for the pollution by creating a "Climate Superfund." The law, which is currently the focus of litigation, directs investments to fund climate change adaptive infrastructure projects, which may include energy efficiency upgrades and electric grid upgrades that help increase stability and resilience, including the creation of self-sufficient clean energy microgrids.[59]

The State is also currently developing a statewide adaptation and resilience plan (NYSARP). This effort will establish the vision, principles, and actions to adapt and prepare for extreme weather events and other climate impacts to New York's communities. The results of the NYSARP initiative will equip the State and its local partners to equitably adapt to and prepare for climate change, create consistency and shared direction, and foster collaboration across regions and sectors, including the energy sector.

Examples of adaptation strategies that may increase resilience of the energy system are below.

6.2.1. Supply

Plans and policies have already started to incorporate future climate change in ways that will increase the resilience of the energy supply and generation system. For example, at the direction of the Department of Public Service, the State's electric generation utilities have undertaken climate change vulnerability studies and adaptation plans specific to their operations and assets. The New York Independent System Operator has incorporated climate projections into its planning and electric demand activities and is exploring new and updated approaches for valuing flexibility and responsiveness of the grid, which would improve resilience to climate hazards.

6.2.2. Delivery

Key stakeholders in the electricity sector acknowledge and agree that the electricity grid and its components require improvements in system adaptability and resilience in the face of projected climate hazards. This can be accomplished through the incorporation of new and innovative techniques that enable more reliable and flexible energy delivery processes. Examples include creating vulnerability curves and risk heat maps, identifying and prioritizing adaptation measures for investments, evaluating grid-impact models, conducting asset mapping and processing physical event data, and implementing intervention actions that reduce GHG emissions.[60] The New York State Reliability Council has also begun to study extreme weather transmission planning criteria in response to a noticeable increase in the frequency and severity of extreme weather events and their impact on the power grid.[61] After Superstorm Sandy, a workshop was held that explored electric system-related challenges that occurred during extreme events and potential opportunities to address them. The workshop identified several technologies that could improve resilience and reliability of the grid, including advanced meter infrastructure; control and data acquisition systems for power lines; line sensors and smart relays; and management systems for energy, distribution, outages, and enhanced automated mobile work. [62] Redundant communication systems and smart meters can offer improvements in grid recovery speed, and microgrids can build resilience by acting as an emergency power option in the event of an outage from the primary energy source. [63]

6.2.3. Demand

To manage electricity demand during periods of high-grid-stress events, traditional hardening and adaptation techniques can prepare the grid in advance and can also provide backup power in the event of an outage. An example of traditional hardening techniques includes strategic flood protection measures for critical energy infrastructure, like substations. Distributed energy solutions, such as distributed solar, can also help manage demand in these periods and support reliability by reducing the overall need for electricity from the grid. Combining these distributed energy systems with storage can improve energy system resiliency by providing backup power that supports grid operations. These systems can support individual buildings or customers during outages and can also offer cost savings during high-demand hours if customers store energy for later use.[64] Climate modeling can also play a key role in energy demand resiliency. By incorporating climate models into load forecasting models, utilities can be better equipped to build additional system capacity, develop redundant systems, or incorporate energy storage solutions in preparation for peak demands that could occur during low-likelihood climate events.

6.2.4. Overarching Adaptation Considerations

Strategies aimed at other sectors can positively impact the energy sector, and vice versa. For instance, reducing the heat island effect to lessen the health impacts of extreme heat can also lower energy demand for cooling. Resilience and adaptation strategies for buildings, such as passive cooling, will reduce demand and strain on the energy system. These types of cross-sector strategies are important, as they can result in significant co-benefits. Similarly, coordination and collaboration across sectors, organizations, and jurisdictional levels is critical for effective adaptation and resilience to ensure a holistic approach.

It is imperative that energy inequities be addressed as part of a holistic adaptation and resilience strategy. Existing energy disparities will only be exacerbated by climate change, and vice versa. Strategies such as workforce development in the renewable energy space, increasing energy affordability, and expanding new energy technologies with a focus in vulnerable and DACs can help reduce energy-related inequities and thereby reduce the potential for climate change to worsen these conditions.

6.2.5. Local and Regional Planning and Implementation

Local governments (counties, cities, towns, villages) in New York have broad authority to enact local laws and regulate land. Cities, towns and villages can pass laws on zoning and land use, and all local governments can enact regulations governing local services (like fire and police), environmental regulations, public health and safety, and administration and structure of local government. Generally speaking, local governments can undertake planning processes to determine their vision for the future, typically in the form of a comprehensive plan, though permitting for major renewable energy facilities is handled at the State level and may supersede local zoning and land use regulations. Comprehensive plans may include specific recommendations to address climate vulnerabilities, but other planning processes can also reflect local considerations of climate risk. For example, a local hazard mitigation plan or a standalone climate adaptation and resilience plan can also serve this purpose. These planning processes benefit immensely from an actively engaged public. Local knowledge and experiences with climate and extreme weather impacts can lead to identification of equitable and effective adaptation and resilience solutions. State programs, such as the CSC Program, the Department of State's Smart Growth program, and NYSERDA's Clean Energy Communities program, can support municipalities as they navigate both planning and implementation. Regional planning occurs in New York State through collaborative governance, which involves coordination among local governments, regional planning councils, and State agencies (see the Smart Growth and the Local, Regional, and Federal Government Collaboration chapters of this Plan for more information). There are many common intermunicipal issues that can be solved with regional planning, such as regional cooperation for economic development and solid waste facilities. Regional planning is important to ensure that resilience measures implemented by one municipality are not detrimental to another (e.g., ensure that flood mitigation measures do not negatively affect downstream localities).

7. Themes and Recommendations

7.1. Research Needs

The NYSCIA revealed gaps in knowledge that could be valuable to fill in the years ahead. Research will be needed to better understand how climate change will impact the State and its energy system, as well as identify and progress development and implementation of new solutions for adapting to future climate conditions.

Recommendations

- **NYSERDA should undertake additional research on climate hazards with higher uncertainty,** such as changes in wind conditions, storm intensity, winter weather, and changes in extreme precipitation, along with the resultant impacts on the energy system. For example, the impact of climate change on winter weather conditions as they pertain to New York's energy systems will

require additional research, modeling, and monitoring, such as research on the effects of less snowfall and earlier snowmelt on hydropower generation and the impact of warmer weather on residential energy use. The impact of climate change on natural gas demand will also require additional research and monitoring.

- **NYSERDA should conduct research on the performance and effectiveness of emerging resilience and adaptation technologies for the energy system,** particularly under changing climate conditions. For example, more research should be conducted on battery storage, including performance under various conditions, both current and future, and how battery storage may affect overall electric system reliability and resilience under these different conditions. Additional research is also needed to explore the effectiveness of hydrogen production, storage (including long-duration energy storage technologies), transportation, and end uses; this includes market research to examine the potential hydrogen economic development opportunities and research into reduction of NO_x emissions from hydrogen combustion.

7.2. Overarching Considerations

Several themes emerged that are not specific to a particular sector of the energy system. These overarching actions will be important for ensuring an efficient and just transition to a more resilient energy system.

Recommendations

- **The State should continue to coordinate efforts to mitigate GHG emissions with efforts to adapt to the changing climate.** The State should use all options available to find alignment between GHG mitigation and climate resiliency. DEC and NYSERDA, along with other State agency partners, should continue to elicit feedback from key stakeholders and from the public to inform climate plan development and future updates, and should ensure plans incorporate the latest climate science and GHG emissions data.[65]

- **The State should identify and implement actions and policies that reduce the disproportionate impacts of climate change resulting from unequal distribution of energy system burdens and benefits.** Actions and policies should be identified that reduce the disproportionate distribution of energy system burdens, such as through clean energy workforce training, job development, and regional economic transition for communities that have historically relied on the fossil fuel industry as a main source of employment, as well as energy assistance and weatherization programs focused on DACs. Likewise, the State should ensure that the benefits of transitioning to a clean and resilient energy system are distributed to these communities, such as clean technology deployment and resilience measures such as green infrastructure. The State should facilitate meaningful participation in energy system decisions, particularly in these DACs.

- **The State should continue to incorporate climate change as a part of energy system planning and program design.** For example, existing energy infrastructure should be hardened against both current extreme weather and future climate change impacts, particularly where

infrastructure cannot be relocated, and system redundancies should be expanded where necessary to ensure resilience to climate change. Climate resilience considerations should be incorporated where feasible into clean energy programs—for example, energy storage deployment efforts and incentives, including considerations for system sizing and siting (such as siting storage out of floodplains where feasible and sizing storage capacity to support critical functions for a set period in times of outage or emergency). When siting renewables, climate risks should be considered over the anticipated useful life of the assets.

- **The State should consider investing in energy-efficient, clean-energy resilience hubs, especially in DACs that are particularly vulnerable to climate change.** These community-serving facilities would serve as resource centers during climate and other emergencies and support year-round resilience services and ongoing programming to build community resilience and adaptive capacity. The State should ensure that such facilities are equipped with cost-effective onsite power systems, using renewable sources of energy to provide locally generated power and behind-the-meter storage, capable of reliably sustaining operations during an extended power outage.

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New York State Energy Plan

VOLUME II | Our Energy Systems

Energy Security Planning and Emergency Preparedness

07

2025 NEW YORK STATE ENERGY PLAN

Key Terms Used in This Chapter

FOR THE COMPLETE GLOSSARY ➜

Emergency: A serious, unexpected, and often dangerous situation requiring immediate action.

Energy Security Planning and Emergency Preparedness: Plans and actions that ensure a reliable and resilient supply of energy that protects public health, safety, and welfare while minimizing economic disruption. Energy security planning identifies, assesses, and mitigates risks to energy infrastructure and plans for, responds to, and recovers from events that disrupt energy supply. New York State energy emergency preparedness includes energy emergency planning and response as well as energy security risk and mitigation planning through the New York State Energy Emergency Plan and the New York State Energy Security Plan.

Risk: The potential for the loss or degradation of energy supply or services, and the associated indirect impacts of those losses on society, resulting from the exposure of energy infrastructure to a threat.

Threat: Anything that can damage, destroy, or disrupt energy systems, including natural, technological, human/physical, and cybersecurity events.

Vulnerability: The susceptibility of an energy infrastructure system to damage, loss, or degradation caused by a threat due to weaknesses within the system or due to the system's dependence on critical supporting systems or material, technical, or workforce resources affected by the threat.

Consequence: The effect of the loss or degradation of an energy infrastructure asset on energy supply or service, and the associated indirect impacts of those losses on society.

Resilience: The capacity to withstand or to recover quickly from negative events such as natural disasters, climate change, and other threats/hazards.

Community Lifelines: The most fundamental services in the community that, when stabilized, enable all other aspects of society to function. They include safety and security; health and medical; energy; communications; transportation; food, hydration, shelter; hazardous materials and water systems.

Cross-Sector Interdependency: One energy sector (electricity, gas or liquid fuel) relying on another energy sector; for example, the electric sector has a cross-sector interdependency with the natural gas sector.

Intra-Sector Interdependency: One part of an energy sector (electricity, gas or liquid fuel) relying on or controlled by another part of the energy system within the same sector; for example, the liquid fuel inventory in New York has an intra-dependency with refinery production and pipeline operations in the Gulf states.

Mitigation: The action of reducing the severity, seriousness, or painfulness of a risk.

Risk Mitigation Strategy: A proactive approach to enhance the State's energy reliability and end-use resilience through which risk mitigation measures are identified, evaluated, and potentially prioritized for implementation.

New York State Energy Emergency Plan: An emergency response plan outlining State activities and responsibilities in response to an energy emergency. The scope includes emergency response planning and coordination with federal and industry partners; it does not identify the major risks to the current energy system or include longer term resilience or mitigation activities. It is an annex to the State's Comprehensive Emergency Management Plan.

New York State Energy Security Plan: A plan focused on identifying and protecting the state energy systems by providing a detailed, comprehensive risk assessment of critical energy infrastructure and cross-sector interdependencies and providing a framework for evaluating risk mitigation approaches to enhance reliability and end-use resilience.

Key Findings → Energy Security Planning and Emergency Preparedness

New York's critical infrastructure and communities depend on energy. Energy security planning and emergency preparedness are essential to protect public health, safety, and welfare; minimize economic disruption; and equitably direct energy supplies in the event of an emergency, such as a major winter storm or extreme flooding. As climate change, aging systems, new energy demands, geopolitical tensions, and the energy transition introduce new and evolving risks to energy systems, New York's energy security planning and emergency response practices need to keep pace to protect the welfare of all New Yorkers and enhance the resiliency of the energy system. This chapter provides an overview of the State's approach to energy security planning and emergency preparedness, outlines ongoing initiatives, and recommends continued and additional actions.

- **New York is well positioned and prepared to respond to energy emergencies.** Energy emergency preparations and responses are outlined in the State Energy Emergency Plan. This plan is integrated into and coordinated with the State's larger Comprehensive Emergency Management Plan. The State Energy Emergency Plan identifies the State and federal energy management emergency structures, energy market intelligence, detailed response actions, information sources, and recovery plans for energy emergencies.

- **Risk-based energy system analysis is broadly utilized to prepare and secure energy systems in New York.** The state's energy profile; risk threats, and vulnerabilities assessments; energy security and emergency response authorities; energy security plans and preparedness; energy emergency responses and resilience resources; and hazard mitigation efforts are all evaluated and used to inform and direct preparations for and prioritize responses to energy emergencies. The State's major critical energy infrastructure components are evaluated for threat probability, vulnerability, and consequences for all hazards. The resulting risk scores are used to prioritize energy emergency responses, planning, and mitigation efforts in the state.

- **New York State is involved in multi-level and multi-agency energy preparedness, response, and mitigation efforts in coordination with industry.** State and federal partners, as well as private sector gas and electric utilities, pipeline owners, fuel terminal owners, energy stakeholders and trade associations, all collaborate to prepare for and respond to energy emergencies in the state, region, and country. From major winter storms to extreme heat, flooding, other severe weather, and additional man-made events, New York's energy systems have been resilient to major disruptions or impacts. With potential support from the federal government and coordination with the industry, New York agencies should continue to act to support the preparedness, response, and mitigation of the hazards and risks faced by New York's energy system.

- **New York continues to monitor and evaluate the changing risks as they appear in the evolving energy systems across the state.** Risks/hazards to the energy system are consistently monitored and analyzed. Historical and emerging risk as a consequence of both natural hazards from the weather and climate change, such as flooding, severe storms, hurricanes, and extreme heat and cold, and human-caused hazards from policy and threat environment changes are consistently evaluated. Increased electrification, the intermittency of renewable energy sources, and the need for clean firm and backup power are all energy transition issues that are being monitored, evaluated, and addressed.

- **Energy infrastructure owners continue to invest in the energy infrastructure in the state in response to the changing risks to energy systems.** Hardening energy assets from physical, natural, and cyber hazards is widespread in all energy systems in the state. Investment in the state's energy generation, transmission, distribution, and supply chain assets in the electric, natural gas, liquid fuels and renewables sectors must continue.

- **New York State must continue to prioritize energy emergency preparedness.** This includes continued risk evaluation and response planning and continued support for collaboration among the various stakeholders in the current and evolving future energy systems in the state.

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1. Overview

New York State is well-positioned and well-prepared to respond to energy emergencies, with extensive interconnected energy and emergency plans to insure a reliable and resilient energy supply for all New Yorkers. New Yorkers power their homes and businesses through robust, interconnected networks that draw from a wide range of energy sources. As fuel supplies continue to transition away from fossil-based to clean energy sources, this shift will introduce new challenges, with impacts to emergency preparedness plans, responses, and mitigation strategies that must adapt to ensure a reliable energy supply to all New Yorkers.

The New York State Energy Emergency Plan[1] outlines energy emergency preparations and responses (see Figure 1 and

Table 1). The objectives of the Energy Emergency Plan are to protect public health, safety, and welfare; enhance the resiliency of services while minimizing economic disruption; and direct scarce energy supplies in an equitable manner among competing essential purposes. The Energy Emergency Plan is an integrated resource plan specifying actions in the event of an energy or fuel supply emergency and is part of and coordinated with the State's larger Comprehensive Emergency Management Plan (CEMP)[2] and other emergency response documents, such as the Emergency Support Function #12 Energy Annex guiding coordinated response actions for this sector.

The Energy Emergency Plan provides flexibility to meet a broad range of supply disruptions, incorporates private sector emergency planning efforts, relies on voluntary rather than mandatory strategies, includes detailed options to respond to a broad range of information needs, and helps develop New York State's emergency response options considering federal strategies and energy industry practices. The Energy Emergency Plan provides advance notice of available emergency response strategies and options to energy suppliers, energy users, and all levels of government to allow necessary preparations before an actual emergency occurs. It minimizes delays in establishing response mechanisms during energy emergencies, promotes consumer and supplier cooperation during periods of emergency, and coordinates State, federal, and private sector actions for maximum effectiveness during an energy emergency.

The New York State Energy Security Plan provides State and federal governments, as well as other stakeholders, with an up-to-date, comprehensive assessment of the State's energy supply chain, energy risk profile, and energy emergency mitigation and response measures. Since all critical infrastructure sectors depend on energy, a change in energy infrastructure can ripple across the security and resilience of the sectors, creating threats to public safety, the economy, and national security. Energy security planning ensures a reliable and resilient supply of energy by identifying, assessing, and mitigating risks to energy infrastructure, and plans for their response and recovery from energy supply disruptions. The Energy Security Plan details how the State, working with energy stakeholders, can secure its energy infrastructure against all physical and cybersecurity threats, mitigate the risk of energy supply disruptions, enhance the response to, and recovery from, those disruptions, and ensure that the State has a secure, reliable, and resilient energy infrastructure. All states are required to submit an Energy Security Plan to the United States Department of Energy, and these plans are not in the public domain due to the sensitive nature of the content.

Figure** 1**: Network of Organizations Involved in State Energy Emergency Planning and Response Activities

Source: New York State Energy Emergency Plan[1]

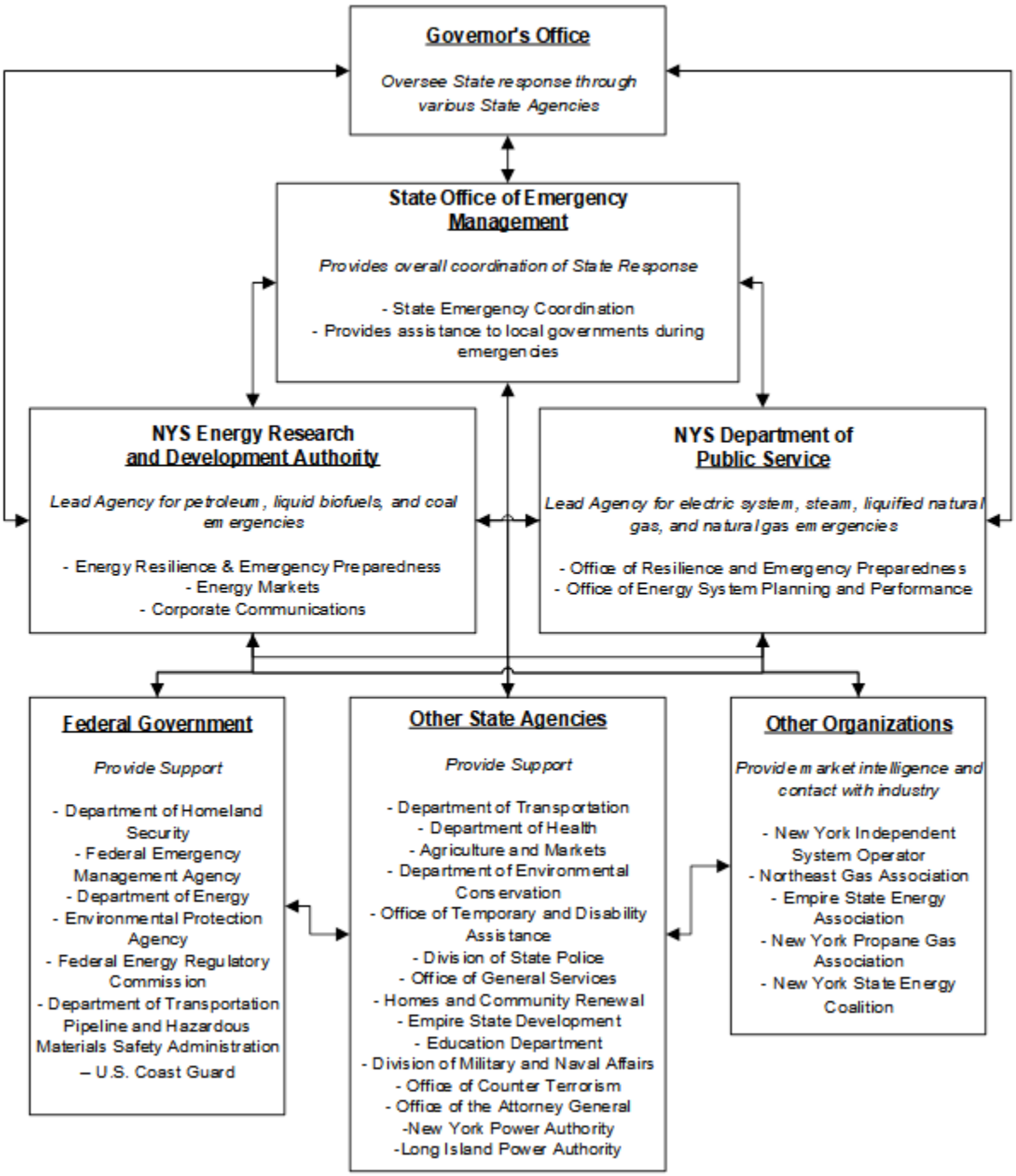


Table 1: New York State Energy Emergency Response Agency Responsibilities

Source: New York State Energy Emergency Plan[1]

Agency	Responsibility
New York State Energy Research and Development Authority (NYSERDA)	• Serves as lead agency for petroleum, liquid alternative fuels, and coal emergency response and the Fuel NY Strategic Fuel Reserve Initiative. Assists in implementing petroleum and coal emergency procedures. • Monitors international and national energy markets and the effect on the overall fuel price, supply, and demand in New York State. Discusses potential corrective actions with major energy suppliers. • Issues emergency orders and directives as necessary and appropriate. • Operates a public relations center and maintains liaison with the media and local governments for liquid fuels.
NYS Department of Public Service (DPS)	• Serves as lead agency for electric system, natural gas, steam, and Liquified Natural Gas emergency response. Assists in implementing electric and natural gas emergency procedures. • Serves as the coordinating agency for ESF#12 (Energy). • Monitors status of interruptible industrial and commercial natural gas users and users with dual fuel capability. • Maintains liaison with the electric, natural gas, and steam dispatch centers of New York State's investor-owned local distribution companies, electric generators, energy service companies and marketers, wholesale suppliers, and key New York State agencies. • Maintains liaison with the New York State Independent System Operator (NYISO) and Northeast Gas Association. • Maintains communication with New York State Office of Emergency Management (OEM). • Maintains liaison and communication with the large electric and natural gas utilities, New York Power Authority (NYPA), OEM, New York State Intelligence Center (NYSIC), Office of Information Technology Services (ITS), and NYISO for cyber and/or physical security incidents that result in a severe or extended energy emergency. • Investigates and enforces regulated entities' compliance with emergency response action plans obligations under Public Service Law and regulations, as necessary.
NYS Office of Emergency Management (OEM)	• Provides overall coordination of New York State emergency response. • Manages or co-manages major staging areas during emergencies that could require on-site fueling depots.

Agency	Responsibility
	• Runs the Joint Information Center; manages Emergency Support Functions and ad hoc taskforces under the State's Comprehensive Emergency Management Plan (CEMP).
New York Power Authority (NYPA)	• Owns and operates seventeen (17) generating facilities with more than 1,550 miles of high-voltage transmission lines across the state. • A Non-Disaster Preparedness Committee Support Member for ESF #12.
Long Island Power Authority (LIPA)	• A Non-Disaster Preparedness Committee Support Member for ESF #12.
NYS Agriculture and Markets (AGM)	• Maintains liaison with farm and agriculture-related associations. • Obtains status of fuel requirements for seasonal agricultural production. • Enforces compliance with the Fuel NY Initiative as it relates to Article 16 § 192-h of the NYS Agriculture and Markets Law for alternative power sources at retail gasoline outlets.
NYS Empire State Development (ESD)	• Maintains information on status of industry and commercial closings due to energy shortages. • Provides information on energy supply circumstances affecting specific industries. • Maintains liaison with regional tourism centers, businesses, trade groups, and utility companies.
NYS Education Department (State Ed)	• Maintains liaison with all school districts. • Coordinates with school administrators to identify needed energy supplies.
NYS Division of Military and Naval Affairs (DMNA)	• Identifies fuel shortages affecting military operations. • Prepares inventory of available heavy equipment and supplies. • Assists with fueling missions supporting convoy escorts, security, traffic control, and staging area operations.
NYS Department of Transportation (DOT)	• Assists in preparations to expedite energy resource deliveries when necessary. • Coordinates with federal agencies for any necessary waivers (e.g., weight restrictions, driver's hours of operation, geographical area limitations) to expedite fuel distribution. Conducts maintenance operations such as snowplowing, sanding, and traffic signals. • Coordinates with the Port of Albany and the U.S. Coast Guard for ice-breaking operations on the Hudson River to facilitate winter fuel deliveries. • Maintains liaison with appropriate federal agencies, such as U.S. Department of Transportation and local transit authorities.
NYS Office of General Services (OGS)	• Manages the operation of approximately 55 NYS-owned facilities statewide. Solely responsible for supporting and managing the energy needs of numerous NYS agencies that occupy these facilities.

Agency	Responsibility
	• Collaborates in the design, oversight, policy development, and administration of the centralized electricity procurement for all large NYSOGS facilities and large facilities of other NYS agencies. • Receives emergency resources or assistance requests from State OEM or the SEOC when activated as a support member of ESF #7 (Logistics). • Maintains contact with all institutions supplied under NYS fuel contracts, including gasoline and E85 (flex fuel), diesel engine fuel, heating fuel oil, LP gas (propane), and natural gas.
NYS Office of Temporary and Disability Assistance (OTDA)	• Oversees and supervises local districts in administering the Home Energy Assistance Program (HEAP) to assist eligible households in meeting home energy costs. Program components include regular, emergency, heating equipment repair/replacement, cleaning and tuning, and cooling. • Provides funding to New York State Homes and Community Renewal (HCR) for the Weatherization Assistance Program (WAP) and to NYSERDA for energy efficiency services. • Coordinates with DPS, HCR, NYSERDA, and the State Office for the Aging on HEAP energy-related matters for low-income families. • Manages relationships with over 3,000 energy vendors, including large electric and natural gas utilities, municipal utilities, vendors of deliverable fuels such as oil, kerosene, propane, wood, and wood products, as well as vendors that perform heating and air conditioning services. Activities include negotiating vendor agreements, certifying participating vendors, and maintaining a central vendor database.
NYS Homes and Community Renewal (HCR)	• Determines status of State-assisted housing fuel and energy requirements and maintains liaison with housing owners and statewide associations. • Coordinates WAP network response to decrease energy use in low-income housing units. • Issues energy conservation recommendations to all HCR-regulated property owners.
NYS Division of State Police (State Police)	• Assists in emergency energy resource deliveries to critical or sensitive locations through vehicle escorts and traffic control and enforces other emergency response measures as required by statute.
NYS Office of Counter Terrorism (OCT)	• Oversees and coordinates NYS agencies' homeland security resources. • Recommends and communicates changes to National Terrorism Advisory System threat alert level. • Reviews and assesses measures taken to protect energy-related critical infrastructure by State agencies and others. • Prescribes protective measures commensurate with current terrorist threat.

Agency	Responsibility
	• Chairs the Critical Facilities and Infrastructure Branch as well as the Fuel Taskforce and Pump and Generator Taskforce. • Takes the lead for cybersecurity issues.
NYS Department of Environmental Conservation (DEC)	• Issues waivers of environmental restrictions (e.g., sulfur in fuel content standards). • Maintains liaison with the U.S. Environmental Protection Agency.
NYS Department of Health (DOH)	• Maintains liaison with the New York City Department of Health and Mental Hygiene, hospitals, and other health-related agencies and facilities. • Acts as the State's lead agency for nuclear and radiological emergencies.
NYS Office of the Attorney General (AG)	• Support enforcement actions as necessary.
New York State Intelligence Center (NYSIC)	• Collects, evaluates, analyzes, and disseminates information and intelligence data regarding criminal and terrorist activity relevant to New York State, including energy infrastructure.
Joint Security Operations Center (JSOC)	• Operates as a statewide cyber command center, providing insight into the cyber threat landscape across the State and enhancing collaboration as a hub for information sharing, response efforts, and cyber coordination across New York State, New York City, Albany, Syracuse, Buffalo, Rochester, Yonkers, and local and regional governments, critical infrastructure, and federal partners.

New York State must continue to prioritize energy emergency preparedness. This includes ongoing risk evaluation and response planning in addition to support for collaboration among both current and future energy system stakeholders. These emergency preparedness efforts strengthen not only the energy sector but increase the resiliency of New York State and its population.

2. Energy Emergency Planning and Response-Related Roles and Responsibilities for State Agencies

2.1. Energy Emergency Management Structure for Energy Emergency Planning and Response

Lead energy agency responsibility in the event of a severe or extended energy emergency is assumed by either NYSERDA or the New York State Department of Public Service (DPS), depending on the type of energy involved. NYSERDA assumes lead agency status for petroleum, liquid alternative fuels, or coal

supply emergencies. DPS assumes lead agency status for electric systems, natural gas, steam, and liquefied natural gas (LNG) emergencies. The State Office of Emergency Management (OEM) assumes responsibility for coordinating the overall State response, including the activation and operation of the State Emergency Operations Center, as necessary. DPS serves as the coordinating agency, and NYSERDA serves as a supporting agency for Emergency Support Function #12 (Energy). NYSERDA and DPS also receive support from other State agencies, federal government partners, and other key stakeholders including local distribution companies. Figure 1, above, provides a high-level overview of the network and interactions between NYSERDA, DPS, OEM, Governor's Office, and other State, federal, and private partners involved in the State's energy emergency planning and response activities.

2.2. Multistate and Regional Collaboration

2.2.1. Federal Government State Energy Emergency Assurance Coordinators Program, Emergency Management Assistance Compact

NYSERDA and other New York State agencies routinely engage in multistate and regional collaboration energy assurance planning and response. This collaboration occurs regularly throughout the year and increases during potential disruptions to energy delivery, including ahead of major storms or other conditions that could affect energy markets in New York State and neighboring states.

The Energy Emergency Assurance Coordinators (EEAC) Program is a cooperative effort between the U.S. Department of Energy Office of Cybersecurity, Energy Security and Emergency Response (CESER), the National Association of State Energy Officials (NASEO), the National Association of Regulatory Utility Commissioners (NARUC), the National Governors Association (NGA), and the National Emergency Management Association (NEMA). The EEAC Program provides a network for states to share and receive information with other states and CESER prior to and during energy emergencies. EEACs include representatives from State Energy Offices, Public Service Commissions, and other State agencies.

The Emergency Management Assistance Compact (EMAC) Program is a national disaster-relief compact that New York State can leverage when it needs assistance from another state during governor-declared states of emergency or disaster. EMAC is implemented through the State OEM on behalf of the Governor. Every state in the United States has signed onto this compact.

3. Role of Local Government in Energy Security Planning and Emergency Preparedness

OEM and other stakeholders consult with local governments to determine the existence of unusual energy conditions or events that should be addressed. The following circumstances could require special attention:

- Local laws, regulations, and ordinances that might impede the success of emergency response programs.
- Local policies regarding traffic flow, routes, and transit service that have the potential for improving the effectiveness of energy emergency response measures initiated at the State level.
- Energy usage patterns that deviate from historic trends.

- Fuel requirements for essential municipal services and supporting alternative operational patterns during an emergency.

In the event of these circumstances, local governments have numerous resources and procedures with which to respond.

3.1. County Emergency Managers

County Emergency Managers coordinate emergency response activities for the county executive or chief elected official and advise on the need for declaring a local state of emergency based on the severity of the situation and the necessity to use additional executive power to formulate an effective response. County Emergency Managers perform County Emergency Preparedness Assessments (CEPAs) with local governments and with input from the Division of Homeland Security and Emergency Services (DHSES).

Each county in the State has developed and maintains a CEMP. Similar to the State's operational planning construct, county CEMPs are scoped in an all-hazards focus, and identify how the jurisdiction prepares for, responds to, and recovers from an emergency. County CEMPs include several mechanisms to manage county resources in response to an emergency, including an electrical outage.

County emergency management offices may participate in the State's voluntary Local Emergency Management Accreditation Program facilitated by DHSES, in partnership with the New York State Emergency Managers Association. This accreditation signifies a county's commitment to developing a sound and robust emergency management program in meeting 21 standards. To achieve this accreditation, counties must demonstrate the existence of refined contingency and emergency response plans (ERPs), including possessing a Continuity of Operations Plan (COOP) to ensure the continuance of mission essential functions during an emergency, including electrical outages. The COOPs are developed in accordance with guidelines facilitated by DHSES, which promotes a statewide continuity planning program.

3.2. Mutual Aid, Local Hazard Mitigation Planning

DPS works closely with electric utilities to ensure they have sufficient staff and are prepared for emergencies. Utilities draw on intrastate mutual aid, when available, and also secure interstate support through external contracts and agreements. In addition, utilities work with DHSES to coordinate with crews entering the United States from Canada, who can assist with restoration efforts.

3.3. City and County Energy Coordinators

Local municipal officials may appoint staff to serve as energy coordinators to support emergency fuel inquiries,[3] conduct fuel-related surveys, submit reports, and identify energy issues in communities across the state. The network of city and county energy coordinators is a vital link between consumers and the State government. OEM maintains a list of local energy coordinators and facilitates periodic training.

4. Industry's Role in Energy Security Planning and Emergency Preparedness

The energy industry in New York collaborates closely with the State to prepare for, respond to, and mitigate energy emergencies, and interacts with all relevant agencies tasked with coordinating a

response. The natural gas and electric industries collaborate primarily with DPS and DHSES on energy emergency issues, while the liquid petroleum industry interacts closely with NYSERDA and DHSES. Stakeholders managing critical energy infrastructure are equipped to address a wide range of risks. In anticipation of and during emergencies, various industry associations provide State agencies regular updates on critical infrastructure, emergency responses, and planning efforts.

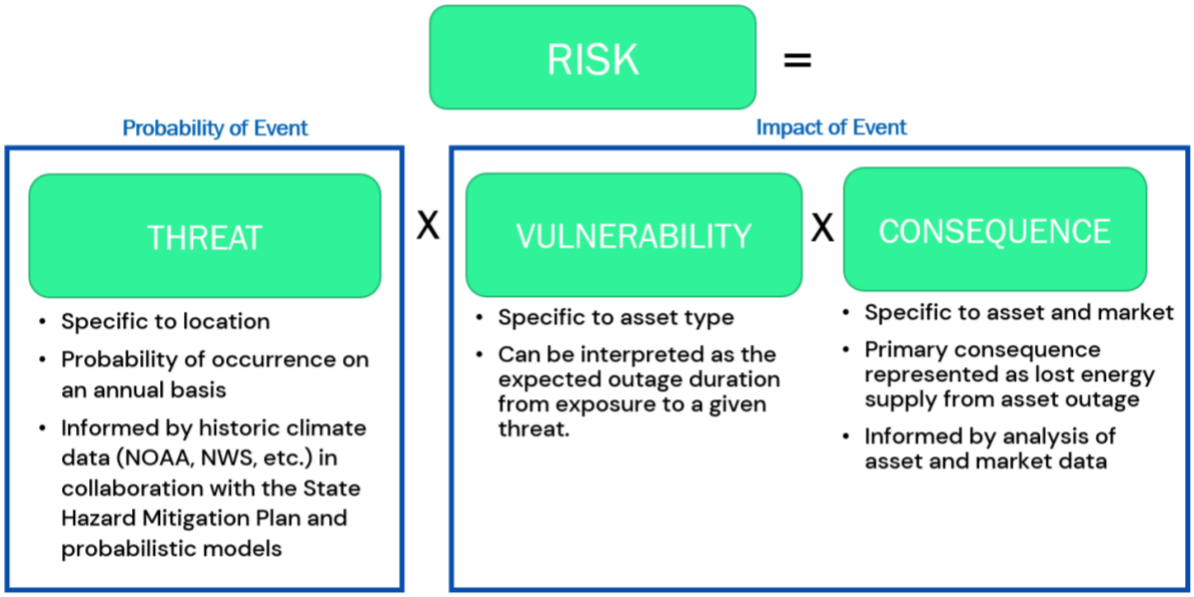
5. New York State Energy Sector Threats and Vulnerabilities

5.1. Risk-Based Energy System Analysis

New York State employs an all-hazards approach to emergency planning, using risk-based analysis to strengthen and safeguard its energy systems. The State regularly assesses its energy profile, potential threats and vulnerabilities, and its energy security and emergency response capabilities to guide pre-paredness efforts and prioritize response strategies during energy emergencies. This includes the current portfolio of energy emergency preparedness plans: the Energy Emergency Plan, the CEMP, the Energy Security Plan, and the Emergency Support Function #12 Energy Annex. Resilience and hazard mitigation efforts also use this risk-based data analysis to prioritize and address hazards most likely to occur and create consequences that impact the State and at-risk populations in the energy sector (i.e., groups such as disadvantaged communities [DACs] as well as particularly vulnerable groups, including senior citizens).

In New York State, energy risks are evaluated by both the probability of the event happening and its potential impact, as illustrated in Figure 2. The probability of a specific threat is calculated based on a given energy system's location combined with the likelihood of that event occurring on an annual basis. Natural hazards are informed by historic climate data in collaboration with the State Hazard Mitigation Plan (SHMP) and probabilistic models. The impact of the event is a combination of the vulnerability of an asset to the threat as well as the consequence of the energy asset being unavailable. The vulnerability is specific to each asset type by energy sector and based on the expected duration of an outage from exposure to a specific threat. The consequence of an asset being unavailable is specific to each asset and market but is primarily defined from the lost energy supply occurring during an asset outage. The resulting risk scores are used to prioritize energy emergency responses, planning, and mitigation efforts across New York State.

Figure 2: Risk Assessment Methodology



5.2. Historic Emergency Events and Energy Disruptions

The events listed below exposed vulnerabilities in New York State's energy supply network to produce significant disruptions.

5.2.1. Hurricanes and Tropical Storms

- Power Supply
    - In October 2012, Superstorm Sandy made landfall, causing power outages that left several hundred thousand customers in downstate New York without electricity for more than two weeks.
    - In August 2011, Hurricane Irene caused significant power system damage due to widespread flooding, leading to one of the longest electrical restoration delays in State history, lasting over four months in Cornwall, New York.
- Liquid Fuel and Natural Gas System
    - Two weeks after Superstorm Sandy in 2012, only about 20 percent of retail gasoline stations in the downstate region were operational, primarily due to electrical supply disruptions.
    - Liquid fuel terminals and pipeline assets experienced wind- and storm-surge-related impacts resulting from Superstorm Sandy. Downstate liquid fuel assets experienced damage to equipment at terminals, marine facilities, and pipeline pump stations from the extreme winds and storm surge.

- In 2011 and 2012, widespread loss of power from Hurricanes Irene and Sandy led to a number of pipelines losing power, forcing shutoffs in liquid fuel supply systems.
- In 2011 and 2012, flooding from those storms washed out several large natural gas pipelines upstate and in the Hudson Valley.

5.2.2. Winter Weather – Polar Vortices

- **Lake Effect Snow.** Large amounts of snow regularly disrupt liquid fuel distribution, including gasoline and heating fuel, in the lake effect areas of New York State.
- **Winter Storm Elliot.** In December 2022, a period of cold temperatures led to a surge in natural gas demand. When combined with production curtailments, this resulted in critically low pressure within natural gas distribution systems in the downstate region.
- **1998 Ice Storm.** Freezing rain and heavy ice accumulation in January 1998 caused widespread power outages, leaving millions without electricity for days, and in some areas, weeks. The storm also disrupted cross-border electric energy delivery into New York State.

5.2.3. Cyberattacks and Technological Failures

- **CrowdStrike.** On July 19, 2024, a CrowdStrike software update triggered a widespread IT outage, crashing millions of Windows systems. The disruption severely impacted critical services and business operations across the energy sector (see also Section 5.5.2).
- **Volt Typhoon.** On February 7, 2024, the U.S. Department of Homeland Security Cybersecurity and Infrastructure Security Agency (CISA), National Security Agency, and Federal Bureau of Investigation jointly assessed with high confidence that state-sponsored cyber actors from the People's Republic of China—known as Volt Typhoon—had compromised the information and operational technology environments of multiple critical infrastructure organizations, including those in the U.S. energy sector.
- **Colonial Pipeline Shutdown.** The May 2021 shutdown of Colonial Pipeline remains one of the most high-profile examples of a cyberattack targeting an energy company. It caused significant disruption to U.S. energy delivery systems, affecting fuel supply across the East Coast, including New York State (further details are provided in Section 5.5.1).
- **Northeast Blackout of 2003.** A software error in an alarm system in an Ohio utility triggered a cascading failure across the electrical grid in August 2003, disrupting transmission and generation capacity throughout the Northeastern and Midwestern United States as well as Ontario, Canada. The blackout left approximately 55 million people without power. In New York City, the outage lasted for 29 hours (see also Section 5.5.2).

5.3. New York State Energy Sector Natural Hazards

Naturally occurring hazards that pose a threat to energy delivery in New York State include the following:

- Flooding,

- Strong Winds,
- Severe Winter Snowstorms,
- Ice Storms,
- Tornadoes,
- Coastal Hazards,
- Drought,
- Extreme Cold,
- Hurricanes,
- Severe Thunderstorms,
- Heat Waves, and
- Wildfires.

As noted in Section 5.1, New York State follows an all-hazards approach to emergency planning. This includes the development of multiple hazard-specific annexes to the State CEMP, each informed by risk-based data to address the most likely and consequential threats to the state and at-risk populations. Each annex outlines tailored response actions for both natural and human-caused hazards. The SHMP identifies and assesses risks associated with natural hazards and disasters, providing a foundation for long-term risk reduction strategies. The Energy Emergency Plan incorporates SHMP data to support planning, response, and mitigation efforts specific to energy-related risks.

5.4. Climate Change and Increasing Severity and Frequency of Extreme Weather

Climate change is increasing the severity and frequency of hazardous events, posing growing risks to New York State's energy security. In the Northeastern United States, every component of the electricity supply chain, as well as fuel and gas distribution systems, is vulnerable to climate-related threats, including rising temperatures, increased precipitation, reduced water availability, sea level rise, and more frequent, intense hurricanes.

In particular, the State must be prepared for more frequent and severe tropical storms and hurricanes in the coming decades. Between 1980 and 2020, the proportion of major storms, including category 3, 4, and 5, in the North Atlantic rose from 10 percent to 40 percent of all hurricanes. According to the First Street Foundation's Wind Model, annual damages in the North Atlantic are projected to increase by 87 percent by 2053, driven by a northward shift in hurricane activity. New York State has begun mobilizing resources through local and State hazard mitigation efforts to address these evolving threats. Mitigation measures will be discussed further in Section 8.

5.5. New York State Cybersecurity and Human-Caused Threats and Vulnerabilities

Human-caused hazards posing a threat to energy delivery in New York State include the following, and are subsequently discussed in more detail in Sections 5.5.1 through 5.5.10:

- Cyberattacks,
- Technological Hazards,
- Physical Attacks,
- Criminal Activity,
- Drones,
- Terrorism,
- Pandemics,
- Transportation Failure,
- Electromagnetic Pulses and Space Weather, and
- Energy Transition Policies.

5.5.1. Cyberattacks

Cyberattacks are increasingly prevalent both in the global energy sector and across many sectors in New York State. The examples cited below are representative of such events.

In December 2020, it was announced that updates to SolarWinds' Orion software, a network monitoring tool used by Con Edison, Orange and Rockland Utilities, and businesses in the clean energy sector, had been compromised, enabling a widespread cyberattack targeting numerous public and private sector entities. While these companies have experienced various cyber incidents, including the SolarWinds breach, none of the events to date have resulted in material impacts. The U.S. government later attributed the SolarWinds compromise to the Russian government.

The May 2021 Colonial Pipeline shutdown remains one of the most prominent examples of a ransomware attack on an energy company, causing widespread disruption to U.S. energy delivery systems. The pipeline, which transports millions of barrels of refined gasoline, diesel, and jet fuel daily from Texas to New York State, was taken offline for six days. Although Colonial paid the ransom and regained access to its systems quickly, the company kept operations suspended to assess the extent of the breach and to install security measures to detect and prevent subsequent attacks.

5.5.2. Technological Hazards

Technological hazards are human-caused events that stem from accidents, operational errors, or deficient infrastructure. Power outages are the most common consequence of such hazards. The condition of infrastructure within the electricity and transportation subsectors is of particular concern due to the advanced age of many systems across New York State's energy network. Aging infrastructure

not only undermines system resilience but also amplifies risks from other threats, including cyberattacks and other human-caused disruptions.

On July 19, 2024, a faulty CrowdStrike update triggered a widespread IT outage, crashing millions of Windows systems. Critical services and business operations were disrupted, revealing the risks of technological reliance across many sectors of the energy delivery system. Fortunately, most systems were restored within a few hours with minimal lasting effects.

Technological incidents, defined by the U.S. Pipeline and Hazardous Materials Safety Administration as events involving the unintended release of product, are the most common cause of pipeline disruptions. Between January 2016 and December 2020, New York State experienced 43 such incidents, resulting in two fatalities, six injuries, and $8.5 million in damages.

5.5.3. Physical Attacks

Intentional attacks on energy infrastructure are an increasing concern, particularly following incidents in December 2022 that targeted electricity substations in Washington State and North Carolina. Energy infrastructure is a target for a range of bad actors, including domestic and foreign terrorists, ideological activists, and disgruntled employees. In some cases, energy operators and law enforcement are unable to determine the motive behind infrastructure damage, such as distinguishing whether gunfire damage to energy equipment is intentional or incidental.

Many federal and State agencies are involved in planning for and responding to physical threats against energy infrastructure. These include the DHSES Office of Counter Terrorism (OCT) Critical Infrastructure Protection Unit; the New York State Intelligence Center; the DPS Office of Resilience and Emergency Preparedness; the U.S. Department of Energy Office of Cybersecurity, Energy Security, and Emergency Response; the U.S. Department of Transportation Security Administration; and CISA.

5.5.4. Criminal Activity

Criminal activity related to utility assets and sites takes many forms, including theft, trespass, burglary, and vandalism. While individual incidents often result in minor disruptions and limited financial loss, the cumulative impact, from equipment replacement and supply loss to repair efforts and security upgrades, can be substantial. Combined with the safety and reliability risks inherent to utility infrastructure, these factors underscore the need for robust and proactive security measures.

5.5.5. Unmanned Aircraft Systems (Drones)

Unmanned aircraft systems (UAS), commonly known as drones, are becoming more widely used by the general public. As technology advances, they are becoming easier to operate and more affordable. The majority of UAS activity is conducted by recreational users who comply with Federal Aviation Administration regulations. However, there have been instances where drones have been modified for malicious purposes, including attempts to cause harm or for espionage. In response, utility companies and other critical infrastructure operators are investing in UAS detection and forensic analysis capabilities. They also coordinate with DPS' Utility Security Section as well as local, State, and federal authorities to report and investigate drone activity.

5.5.6. Terrorism

Targeted attacks on the electricity subsector and pipelines worldwide have demonstrated the serious disruptions they can cause to supporting infrastructure, system reliability, and dependent systems.

Domestic Violent Extremists and Foreign Terrorist Extremists

The U.S. Department of Homeland Security recently reported that racially motivated violent extremists who support accelerationist ideologies maintain interest in attacking the power grid and other energy infrastructure. These known and evolving threats are monitored across the energy landscape and emphasize the importance of physical security to energy-critical infrastructure assets. Concerns persist over the continued interest of foreign terrorist organizations and homegrown violent extremists to carry out attacks in the United States.

5.5.7. Pandemics

Pandemics can significantly disrupt energy sector operations by reducing workforce availability, both due to employee illness and public health measures such as social distancing or stay-at-home orders. These impacts are especially pronounced in roles that require highly skilled and qualified workers, such as control room operators, electric line workers, and hazmat-certified petroleum truck drivers. These skilled workforces are limited in number and cannot be easily or quickly replaced, given the extensive training, credentialing, and other qualifications required.

5.5.8. Transportation Failure

New York State's petroleum sector is vulnerable to disruptions in transportation systems, because these potential disruptions affect terminals, retail locations (i.e., gasoline stations), and end-use customers (i.e., for heating oil), all of which rely almost entirely on trucking. In addition, the sector depends heavily on rail for the transport of ethanol and gasoline additives to petroleum terminals. Beyond pipelines, marine deliveries through the States' navigable ports and waterways play a critical role. The Port of New York serves 80 million people (35 percent of the entire U.S. population) and ranks first in the nation for movement of petroleum, including aviation fuel, gasoline, and home heating oil. However, the sector's dependence on aging transportation infrastructure poses a growing risk to the reliability of the State's energy systems.

5.5.9. EMP and Solar Storms

An EMP is a burst of electromagnetic radiation caused by either natural phenomena, such as solar storms (i.e., space weather), or man-made sources, such as explosions. EMPs can induce electrical surges capable of damaging or disabling electronic equipment. The electrical grid's control systems and communication networks can be disrupted, leading to blackouts or outages if an EMP occurs. Solar storms, in particular, can cause geomagnetic disturbances especially in regions with electrically resistive geologic formations and may interfere with the operation of high-voltage lines.

5.5.10. Energy Transition

New York State is making significant progress in its transition away from fossil-based energy sources. This transformation is already reshaping the traditional risk profile of the State's energy systems. Understanding key policy drivers, such as the Climate Act, and their effects on energy generation,

transmission, and supply is critical to understanding the risks to maintaining system reliability, providing adequate energy supply, and securing affordable energy.

The primary challenges of the energy transition include shifts in fuel sources, resource adequacy, transmission capacity, generation retirements, new intermittent generation sources, and increasingly variable energy demand. These challenges are actively being analyzed and mitigated through New York's energy planning processes. Current energy policy designs include temporary off-ramp provisions intended to preserve system reliability and resilience while pursuing aggressive decarbonization targets in the Climate Act. New York continues to monitor and evaluate emerging risks and incorporates findings into ongoing response and mitigation planning processes.

In the electrical sector, the energy transition is expected to introduce significant risks. These risks include electrical generators being retired at a faster pace than the construction of new resources to replace them, and associated siting and supply chain concerns. Additionally, output from new renewable resources is intermittent and of limited duration. While battery storage is the primary solution to fill the voids, there are associated challenges, as extended high-demand periods rapidly deplete current storage capabilities. Concern about fire risks associated with the current energy storage technology has received attention. The growth of electric demand is likely to continue due to electrification, requiring more generation and/or transmission infrastructure to reliably meet this rising customer demand.

The transition also affects New York's liquid petroleum and natural gas systems, which are currently well-established and generally resilient. These sectors are expected to undergo significant changes. The liquid fuels and natural gas sectors face the challenge of continuing to provide safe, reliable, and affordable energy supply amid potentially declining long-term demand. As this sector responds to the energy transition, industry focus is shifting toward innovation and the integration of cleaner products, such as liquid alternative fuels, renewable natural gas (RNG), and hydrogen. However, these newer products often rely on less-established supply chains and emerging technologies, which may introduce additional vulnerabilities. Regulatory uncertainty further complicates the landscape, contributing to reduced capital investment in infrastructure. The energy transition is discussed in more detail in Section 8.

Table 2 summarizes major risks to New York State's three energy sectors: Electric Power, Natural Gas, and Liquid Fuels.

Table 2: Major Risks of Energy System Sectors

Hazard	Electric Power	Natural Gas	Liquid Fuels
Flood (Riverine, Coastal, Lakeshore, Sea-Level Rise, Flash Flood)	Flooding may damage equipment exposed to water and flood-related debris.		
	Examples: power generation and storage equipment, substations, control center buildings, underground transmission lines.	Examples: underground pipelines and storage facilities.	Examples: alternative fuel process units, tanks, underground pipelines, on-site electrical equipment at terminals.
	Flooding on roads can create access issues for damage assessment and restoration activities.		
Wind	High winds can damage transmission and distribution infrastructure directly, including transmission towers, power lines, and transformers, or indirectly, if debris and fallen tree limbs impact power lines. Damage to power generators from high winds can reduce the total amount of electricity available and, in extreme cases, create grid instability.	Power outages may impact select electric compressor operations.	Debris from high winds can cause road closures and create access issues for fuel distributors attempting to resupply retail stations and end-users. Extended regional power outages may increase demand for fuel for backup generators. Power outages may also shut down operations at terminals, pump stations, retail stations, and out-of-state refineries. Terminal equipment could be damaged by high winds, inhibiting the ability to receive fuel at the port or distribute fuel over the truck rack.
Tornado	High winds can cause damage to power lines and power generation facilities.	High winds can damage compressor stations, metering and regulating stations, and other above-ground facilities.	High winds can cause damage to equipment at alternative fuel production facilities, terminals, and other above-ground facilities.
	Damage and debris on roads may create access issues for crews attempting restoration.		
	Damage to communication systems may complicate restoration activities.		

Hazard	Electric Power	Natural Gas	Liquid Fuels
Winter Storms and Extreme Cold	Ice accumulation on power lines may cause power outages. Cold temperatures may cause freezing in generation facilities' cooling towers, preventing electricity generation. Other equipment within generation facilities may be inoperable or damaged in cold temperatures, reducing electricity availability. Freezing temperatures impacting rail systems may limit feedstock to power generation (e.g., coal). Coal piles stored at power plants may freeze solid and be unavailable for generation. Increased demand for heating during cold weather may strain available capacity, causing RTOs/ISOs to request voluntary electricity conservation or to implement rolling blackouts to maintain grid stability.	Freezing may impact non-weatherized equipment, which can cause production shut-ins. Increased demand for heating can strain natural gas supply and may cause dual-fuel power plants to switch to fuel oil to conserve natural gas. In extreme cases, natural gas prioritization for heating can cause power outages due to limited gas available for generation. Severe natural gas supply shortages or damage to infrastructure may force transmission pipelines and LDCs to interrupt supply to firm customers.	Non-weatherized equipment may freeze or be damaged by cold temperatures, including frozen product within piping systems, malfunctioning flow control equipment, flaring, and production shut ins. A region experiencing prolonged power outages may also see increased demand for backup generator fuels.
	Icy roads and storm-related debris may create access issues for crews attempting restoration.		
	Ice and snow accumulation and other storm-related impacts may impact communication systems, complicating restoration activities.		

Hazard	Electric Power	Natural Gas	Liquid Fuels
Coastal Hazards (including Hurricanes)	High winds associated with coastal storms can damage transmission and distribution infrastructure directly, including transmission towers, power lines, and transformers, or indirectly, if debris and fallen tree limbs impact power lines. Storm surge and flooding related to these storms may flood and disable low-lying substations. Damage to power generators from high winds or flooding can reduce the total amount of electricity available and, in extreme cases, create grid instability.	Power outages may impact select electric compressor operations.	Both debris from high winds and flooding can cause road closures and create access issues for fuel distributors attempting to resupply retail stations and end-users. This could cause localized fuel shortages. Extended regional power outages may increase the demand for fuel for backup power generation. Power outages can shut down operations at terminals, pump stations, retail stations, alternative fuel production facilities and out-of-state refineries. Terminal infrastructure, especially located at ports, can be impacted by flooding, with tank damage or even tanks washed away. Other terminal equipment could be damaged by high winds, inhibiting the ability to receive fuel or distribute fuel over the truck rack. Facilities may shut down ahead of storms for personnel safety. Shoaling in ports can prevent ship and barge traffic to terminals.
	Outages of communications systems caused by high winds can complicate restoration efforts.		
	Debris and flooding on roads may create access issues for crews attempting restoration.		

Hazard	Electric Power	Natural Gas	Liquid Fuels
Thunderstorm (Hail and Lightning)	Blown transformers and downed trees may impact power lines. High winds can cause damage to power lines and power generation facilities. Lightning strikes can damage transmission and distribution infrastructure, transformers, substations, and power generation facilities, and potentially start fires.	Power outages may impact select electric compressor operations. High winds can cause damage to processing plants, compressor stations, metering and regulating stations, and other above-ground facilities; also, lightning strikes can potentially start fires. Natural gas is extremely combustible, and lightning-induced fires could become catastrophic if gas is ignited. .	High winds can cause damage to alternative fuel production facilities, terminals, and other above-ground facilities or operations may be impacted by power outages. Lightning strikes can damage alternative fuel production facilities, terminals, and pumping stations, and potentially start fires. Liquid fuels are extremely combustible, and lightning-induced fires could become catastrophic if fuel is ignited
	Flooding and debris on roads may create access issues for crews attempting restoration.		
Drought	Reduced hydroelectric generation due to low-water levels. Reduced efficiency at thermoelectric generation facilities if there are constraints on steam or cooling.		Impacts to alternative fuel feedstocks from low moisture in soil. Low-water levels can prevent barge traffic on inland waterways. Low-water supply may limit alternative fuel production operations if alternative water supply is not available.
Extreme Heat	Increased demand for air conditioning may strain available generation capacity, causing RTOs/ISOs to operate below reserve margins. Increased risks of wildfires from power lines.	High temperatures can prompt RTOs/ISOs to call peaker plants online to meet electricity demand for cooling, potentially straining supply of natural gas.	Can reduce efficiency at alternative fuel production facilities.

Hazard	Electric Power	Natural Gas	Liquid Fuels
Wildfire	Damage to power lines and power generation facilities. May trip offline due to smoke. Utilities may shut off power to prevent wildfires (e.g., high temperatures and high winds).	Natural gas is extremely combustible, especially if above-ground infrastructure is exposed to fire.	Liquid fuels are extremely combustible, especially if above-ground infrastructure is exposed to fire.
	Active fire perimeters encompassing roads may limit crews' ability to conduct damage assessment and restoration.		
Dam Failure	Damage to downstream infrastructure due to flooding and debris.		
	Hydroelectric power generation may be disrupted, which may also reduce black start capabilities.	Unearthing and rupturing of pipelines.	Unearthing and rupturing of pipelines.
Human Error	Accidental car crashes into power poles may cause power outages. Human error at power generating stations and other grid infrastructure locations requiring active human involvement could damage generating equipment, transmission and distribution infrastructure, and other electrical grid equipment.	Accidental strikes to underground pipelines can cause leaks. Valves can be left open accidentally, or improper adherence with safety regulations can cause leaks or explosions at facilities.	
Sabotage/ Physical Attacks	Substations are a primary target for attack. Generation facilities and transmission infrastructure are also targets for physical attack.	Pipelines and compressor stations could be attacked, disrupting flow.	Pipelines and pump stations could be attacked, disrupting flow. Terminals and port infrastructure could be attacked.
Maintenance Issues/Faulty Equipment	Poorly maintained or older infrastructure is more prone to failure. Line arcing, power surges, corrosion, or moisture on equipment can cause equipment to malfunction or go offline.	Corrosion, material failure, excess pressure buildup, or controls malfunction can cause supply disruptions.	
Pandemic	Employee illness, social distancing requirements, and stay-at-home orders may impact energy sector staff availability and response activities and shift energy demand profiles. Global supply chains for energy equipment, such as transformers, may be disrupted, causing equipment shortages or delays.		
Cyberattack	Informational technology and operational technology systems can be impacted; this can include company and customer data, payment and scheduling systems, sensors, control systems, and distributed energy resources.		

6. Interdependencies in the Energy Sector

New York State's energy systems are interconnected, both directly and indirectly by design. These interdependencies typically enhance the overall robustness and resilience of the energy system. However, they can result in cascading impacts that extend beyond the initially affected sector. NYSERDA has collaborated with partners, including the New York State Independent System Operator (NYISO), DPS, DHSES, CISA, the U.S. Department of Energy, and others, to identify and document these critical energy system interdependencies.

6.1. Intra-Sector Interdependencies

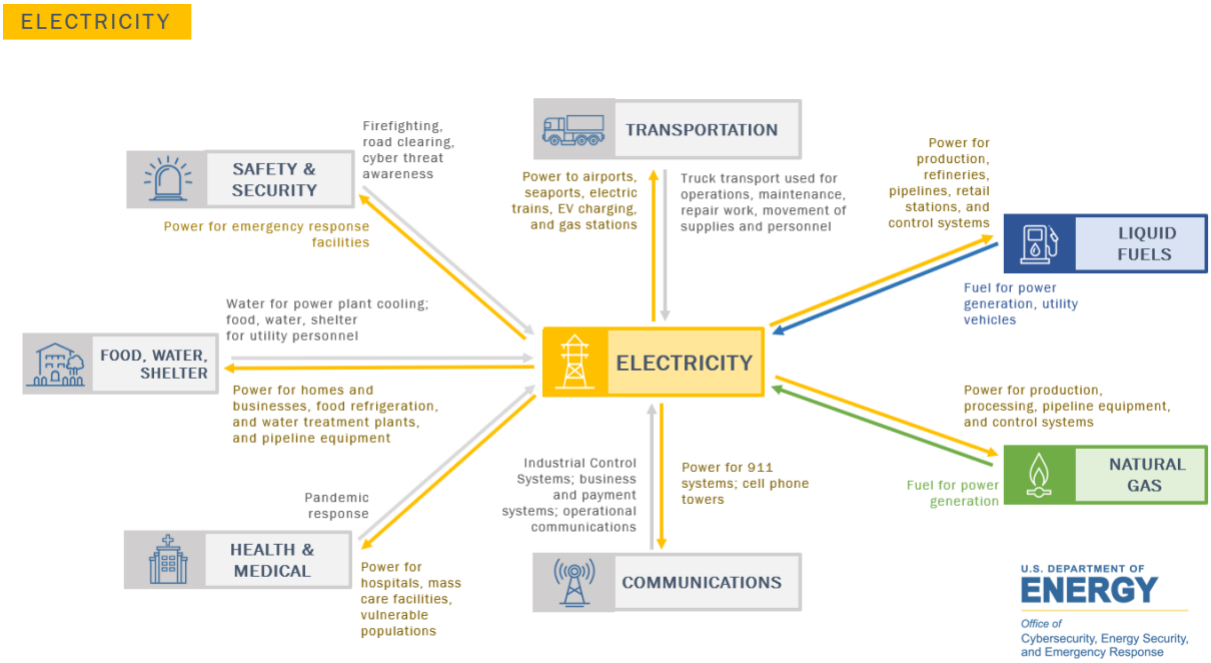
New York's energy sectors are dependent on regional, national, and international systems. The electrical, natural gas, and liquid petroleum sector systems all rely on interconnected supply chains to ensure reliable and cost-effective energy for New Yorkers. The State's electric system is integrated with neighboring regional grids and Canadian Independent System Operators, enabling the import of power from outside New York. The natural gas system depends on production facilities, pipelines, and marine import terminals located across the United States and Canada. Similarly, New York's liquid petroleum system relies on national and regional production facilities, refineries, and pipelines, marine import terminals, and both rail and road transportation networks.

6.2. Electricity Cross-Sector Interdependencies

Virtually all industries depend on electric power. As shown in Figure 3, the electricity sector has significant interdependencies with other critical infrastructure sectors. The safety and security sector relies on electricity to provide power for emergency response facilities such as police stations, fire stations, and emergency operations centers. The safety and security sector is also essential for the protection of electricity infrastructure and responding to emergencies that disrupt electricity. This includes law enforcement's support of electricity infrastructure security, firefighting during electricity infrastructure fires, wildfire fighting to prevent infrastructure damage, and clearing debris from roads to aid in power restoration after storms. Additionally, federal agencies, such as CISA and the Federal Bureau of Investigation, support the electricity sector by sharing information on physical attacks and cyber threats and assisting with response efforts during physical and cyberattacks.

Figure 3: Electricity Cross-Sector Interdependencies

Source: U.S. Department of Energy Office of Cybersecurity, Energy Security, and Emergency Response[4]



Electricity underpins nearly every critical function across New York's essential infrastructure. It powers homes and businesses, enables food production, supports water and wastewater treatment, and fuels heating, cooking, internet access, and medical equipment. Most space heating and cooling systems, regardless of their primary fuel source, require electricity for operation, making outages during extreme temperatures potentially life-threatening.

These dependencies also extend in the other direction. The electricity sector relies on access to food, water, and shelter, especially for mutual aid crews during restoration efforts. Water is also essential for power plant cooling, particularly for natural gas-fired generators, which produced 45 percent of the State's utility-scale electricity in 2021. Even solar power, a growing share of the state's electricity generation, depends on water to clean photovoltaic panels and other reflective surfaces.

Hospitals, care facilities, and public health systems depend on electricity to power lifesaving medical equipment and refrigerate vaccines and medications. While many facilities have backup power generators, these are typically powered by onsite liquid fuels with only a few days of supply. The COVID-19 pandemic demonstrated the vulnerability of the energy sector to public health emergencies, such as illness and distancing requirements among utility personnel, which disrupted operations, reinforcing the sector's reliance on a functioning health system.

The communications sector depends heavily on electricity to power 911 systems and other emergency response communications networks, internet services, and cellular infrastructure. At the same time, energy providers rely on communications services to run industrial control systems, provide platforms for business and payment systems, and for operational communications. Communications and data

collection networks are essential to monitoring grid conditions and ensuring efficient and reliable operation. Supervisory Control and Data Acquisition (SCADA) systems, which use sensors and smart devices, are vital for utilities and NYISO to maintain supply and demand balance and reliability. Many of these systems use global positioning system (GPS) software for positioning, navigation, and timing. Disruptions to GPS could impair data accuracy and hinder grid operations. Slower SCADA data or timing errors on localized measurements could cause false conclusions about grid conditions. Russian forces have regularly been interfering with the U.S. GPS as part of Russia's war on Ukraine and could be used by an adversary as a strategy to target critical infrastructure.

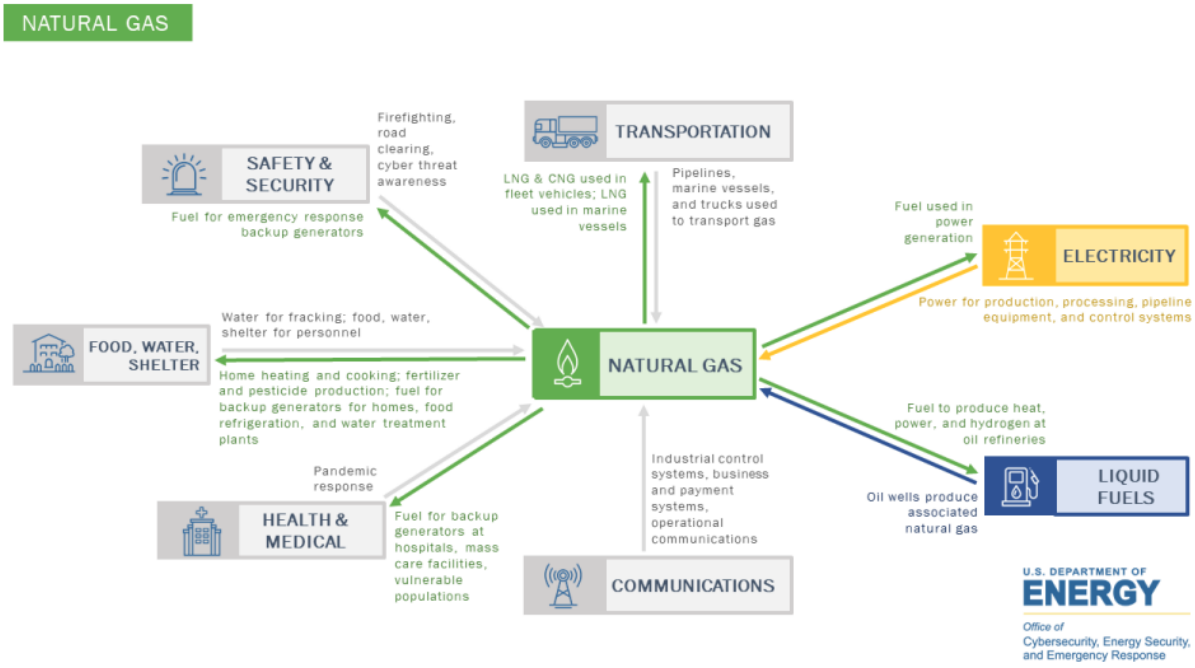
Transportation infrastructure also depends on electricity. Airports rely on it for cooling, lighting, ventilation, communications, and scheduling systems. Seaports use electricity to support business operations and power cranes, forklifts, and other equipment used to lift cargo onto and off marine vessels. Seaports are critical for the delivery of replacement parts for energy infrastructure. Rail lines and trucks are essential for transporting equipment and personnel, including for storm recovery or system maintenance. Electrified transit systems, including the New York City subway and electric vehicle charging networks, further deepen this dependence.

6.3. Natural Gas Cross-Sector Interdependencies

The natural gas system has important interdependencies with other critical infrastructure sectors, as shown in Figure 4. The safety and security sector relies on the natural gas sector to heat many emergency response facilities, including police and fire stations, and emergency response operations centers. Additionally, natural gas may be used to fuel some emergency response backup generators in the event of electrical outages. In turn, the natural gas sector depends on the safety and security services to prevent and respond to a range of potential hazards. This includes law enforcement's protection and investigation of natural gas infrastructure security, firefighting response during natural gas infrastructure fires, wildfire fighting to prevent natural gas infrastructure damage, and clearing debris from roads to aid utility personnel in equipment restoration after storms or other events that hinder accessibility to natural gas infrastructure. Additionally, government agencies support the natural gas sector by sharing information on cyber threats and assisting in response efforts during cyberattacks.

Figure 4: Natural Gas Cross-Sector Interdependencies

Source: U.S. Department of Energy Office of Cybersecurity, Energy Security, and Emergency Response[4]



The food, water, and shelter sectors may rely on natural gas for home heating and cooking, fertilizer and pesticide production, and fuel for backup generators powering homes, community emergency shelters, food refrigeration, and water treatment plants. The natural gas sector requires food, water, and shelter for utility personnel.

The health and medical sectors may depend on natural gas to fuel backup generators, hot water systems, and laundry equipment for hospitals and mass care facilities. Widespread illness affecting the natural gas utility workforce can hinder operations, so the natural gas sector is also reliant on the health and medical sectors to support a healthy workforce.

The natural gas sector uses communications services to run industrial control systems, provide platforms for business and payment systems, and facilitate operational communications. The natural gas industry often uses its own, privately owned telecommunications networks to manage day-to-day operations and coordinate emergency responses during crises. It is critical for these systems to be reliable and have minimal processing delays (also known as “low latency”) to maintain smooth operations of natural gas assets. These control systems are also typically reliant on GPS systems for accurate timing information. Devices used to measure and report the status of pipeline natural gas flows are important for quickly identifying and responding to any natural gas supply disruptions.

The transportation sector is supported by the natural gas sector, mainly through LNG and compressed natural gas (CNG). LNG and CNG are used in fleet vehicles, such as delivery trucks and buses. LNG is also used by marine vessels. Natural gas in New York is delivered via multiple pipelines and can be stored in

New York State's three LNG storage facilities in Greenpoint, Holtsville, and Astoria. LNG from these storage facilities supply critical customers in the event of disruptions and during peak demand seasons when pipelines are not able to fully meet customer needs.

In addition to supporting the transportation sector, LNG serves as an efficient form of natural gas on-system, localized storage. Typically filled from pipelines during off-peak seasons, LNG storage helps ensure a reliable supply during periods of peak demand or supply constraints, mitigating risks associated with upstream supply disruptions. These critical assets offer flexible and scalable solutions for meeting spikes in demand to maintain adequate system pressures providing operational security. LNG assets support peaking supply needs on the coldest days of the year to help keep customers warm including in disadvantaged communities. They provide a reliable backup supply, reduce dependency on constrained pipelines, and enhance overall supply reliability and diversity.

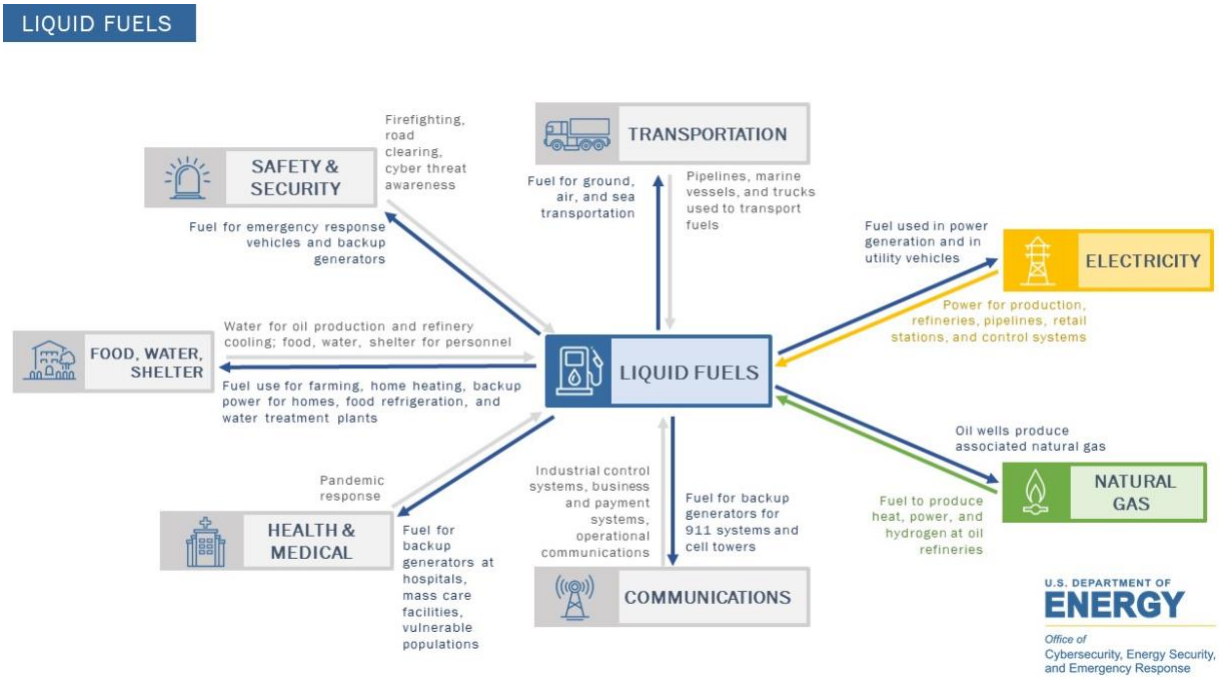
6.4. Liquid Fuel Cross-Sector Interdependencies

Community lifelines depend on the liquid fuel system, primarily for transportation and backup power, and rely on the various critical infrastructure sectors, as summarized in Figure 5. The safety and security sectors rely on the liquid fuels sector to fuel emergency response vehicles, such as police cars, fire trucks, and ambulances, and backup generators for emergency response facilities. Meanwhile, the liquid fuels sector depends on the safety and security sectors to protect against and respond to a variety of potential hazards. This includes law enforcement's protection and investigation of liquid fuels infrastructure security, firefighting during liquid fuels infrastructure fires, wildfire fighting to prevent liquid fuels infrastructure damage, and clearing debris from roads to aid crews in equipment restoration after storms or other events that hinder accessibility to liquid fuels infrastructure. Additionally, government agencies support the liquid fuels sector by sharing information on cyber threats and assisting in response efforts during cyberattacks.

The food, water, and shelter sectors may rely on liquid fuels (e.g., diesel, propane, etc.) for home heating and cooking, fertilizer and pesticide production, and fuel for backup generators powering homes, community emergency shelters, food refrigeration, and water treatment plants. The liquid fuels sector requires food, water, and shelter for employees.

Figure 5: Liquid Fuel Cross-Sector Interdependencies

Source: U.S. Department of Energy Office of Cybersecurity, Energy Security, and Emergency Response[4]



The health and medical sectors depend on liquid fuels to fuel backup generators for hospitals and mass care facilities and to provide services to vulnerable populations. Across the energy sectors, there is a reliance on the health and medical sectors to support a healthy workforce for continued operations.

The communications sector relies on liquid fuels to fuel backup generators for 911 systems, other emergency-response communications networks, and cell phone towers. Meanwhile, the liquid fuels sector utilizes communications services to run industrial control systems, provide platforms for business and payment systems, and for operational communications. The liquid fuels industry often uses its own, privately owned telecommunications networks to manage day-to-day operations and coordinate emergency responses during crises. It is critical for these systems to be reliable and have minimal processing delays to maintain smooth operations. The systems typically rely on GPS for accurate timing information that could make systems vulnerable to adversaries seeking to cause harm by disrupting GPS signals.

The transportation sector is heavily reliant on liquid fuels as fuel for ground, air, and sea transportation. The liquid fuels sector, meanwhile, is reliant on the transportation sector for the operations of its supply chain. The State receives petroleum products mainly via marine vessels and pipelines into storage terminals. Supply from the terminals is delivered to New York end users by truck. Some heating oil distributors store fuel at local depots that receive railcars or trucks. Heating oil is then transported on smaller trucks to end users such as residential and commercial customers. Jet fuel is typically stored on site in storage tanks at airports (typically called airport fuel farms), although additional jet fuel can also be stored at nearby bulk terminals. Typically, propane is moved from fractionation facilities by pipeline,

truck, rail, or barge to bulk propane terminals or directly to distributor storage depots. From distributor sites, the propane is transported by smaller trucks, known as bobtail trucks, to end users such as residential and commercial customers. Ethanol is typically transported by rail, barge, or truck to either bulk petroleum terminals or terminals that are ethanol rail hubs.

6.5. Energy Systems Interdependencies and Critical Lifelines

New York's energy system is highly complex and characterized by many cross-sector interdependencies. The electricity, natural gas, and liquid fuels sectors are themselves deeply interconnected. The electricity sector relies on both natural gas and liquid fuels as fuel for power generation, as well as on liquid fuels to operate utility vehicles needed to repair and maintain the system.

Conversely, the natural gas sector relies heavily on electricity to power natural gas production and processing, as well as for the operations of natural gas pipelines, compressor stations and control systems. DPS, through its New York State Pipeline Safety Program, identifies and addresses these vulnerabilities within the natural gas system.[5]

The liquid fuels sector is also directly dependent on electricity. Electrical power is essential to run petroleum terminals, retail gas stations, and associated control systems. Pipelines rely on electricity to power pump stations and industrial control systems. Terminals use electricity-powered technology to receive, pump, and store fuel and to load fuel onto transportation for distribution. Petroleum terminals and other liquid fuels critical infrastructure sites in the state have completed Regional Resiliency Assessment Program (RRAP) assessments that identify this electricity dependency for site-specific locations. NYSERDA works with industry terminal contacts and DPS to ensure power reliability and timely power restoration to these critical energy facilities by the State's electric utilities. Retail gas stations rely on electricity to run gas pumps and payment systems. Retail gas stations that are designated under the Fuel NY law have installed either a permanent generator or a transfer switch on site to help mitigate the risk of electricity disruption.

Petroleum plays an important role in both summer electricity peak periods and winter high-gas-demand periods. During periods of high demand for natural gas, natural-gas-interruptible customers, a group including electric generators, may be forced to switch to petroleum fuel sources. If this happens during an extended period of high petroleum demand, when cold weather drives demand for home heating fuel, it can have a significant compounding effect on petroleum supply and availability. The stability of the petroleum system, the natural gas system, and the electrical system can all be affected. Evolving oil industry supply and distribution practices and de-emphasizing inventory buildup increases the risk that short-term cold or severe weather will sharply increase demand and disrupt deliveries. The response of the related energy markets to this instability can be significant and can directly and indirectly impact the cost and availability of energy in the state.

The petroleum and alternative fuel supply chains in New York are interdependent. For finished gasoline, the petroleum-based gasoline blend stock is blended with ethanol, which is primarily delivered by rail from the Midwest to liquid fuel terminals throughout the state. If ethanol supply is disrupted and terminal storage is depleted, the resulting finished blend would not meet New York State fuel

specifications. Without ethanol, the finished blended gasoline would lack sufficient octane, potentially causing drivability issues and triggering a gasoline supply shortfall. Similarly, New York requires heating oil to be blended with a specified percentage of biodiesel. In the event of a biodiesel supply disruption, the State would need to issue a temporary waiver to avoid heating oil shortages and ensure continued availability for consumers.

7. Current Energy Security Planning and Emergency Preparedness Programs

A sample of New York State Energy Security Planning and Emergency Preparedness programs follows.

7.1. NYSERDA

As the lead agency for petroleum energy emergencies in New York State, NYSERDA regularly engages in market analysis and monitoring and conducts energy supply system monitoring efforts, in coordination with fuel industry and other state agency, regional, and federal partners. These efforts include seasonal preparations, such as Winter Fuels Outlook meetings and readiness meetings, to ensure adequate planning and response capabilities.

7.1.1. Regional Resiliency Assessment Program (RRAP)[6]

The RRAP uses site visitations to update and enhance the State's understanding of New York's critical liquid fuels infrastructure. These efforts identify the evolving risks to this nonregulated sector of the energy system, improve the relationship between the public and private stakeholders in this sector, and is informing and improving New York's emergency response and energy resilience capabilities.

7.1.2. New York State Strategic Fuel Reserve[7]

The New York State Strategic Fuel Reserve includes an upstate and downstate fuel reserve and is designed to mitigate fuel distribution disruptions during declared emergencies by bridging gaps created by a disruption in supply until an adequate level of market deliveries can be restored. Upon declaration by New York State of an energy supply emergency and upon the written direction of NYSERDA, fuel from the Reserve may be sold to suppliers and distributors to provide fuel for emergency responders, municipal and governmental customers, and retail outlets as determined for the emergency event.

7.2. DPS

The Public Service Law (PSL) vests the New York State Public Service Commission (PSC) and DPS with regulatory authority concerning electric corporations' preparation for, and response to, various emergency events; see PSL §66(21) and PSL §3-b(3)(c). Electric corporations must submit utility Emergency Response Plans (ERPs) to DPS in accordance with PSL §66(21)(a), PSL §3-b(3)(c)(i), and 16 NYCRR §105.1, to ensure they are prepared for and can efficiently respond to emergencies. Utilities are further required to update and file their ERP annually, which are submitted to the Commission for approval after review by department staff. DPS, as the operational arm of the PSC, is responsible for emergency response oversight of the IOUs, which occurs in three phases: storm preparedness, active tracking of utility impacts, and system repair and restoration and post event analysis, as necessary. The obligation to submit annual ERP updates was established after Superstorm Sandy, which caused widespread damage and prolonged service outages, prompting a review of utility preparedness and

response protocols. Annual submission ensures that regulated entities' plans are current and reflective of any new risks, regulatory requirements, and technological advancements. PSL §66(21)(d) provides for the Commission to certify to DHSES that each electric corporation's ERP is sufficient, to the greatest extent feasible, to provide for the timely and safe restoration of energy services after a major event.

Like electric corporations, gas distribution utilities must also develop plans to respond to an emergency. The Department's Part 255 regulations require gas utilities to establish and implement emergency plans for the gas distribution system in their respective service territories; see generally 16 NYCRR §255.615.

In addition to utility ERPs, major utility corporations are required to submit a Climate Change Vulnerability Study and Climate Change Resilience Plan to the PSC. In December 2024, the PSC approved, with modifications, the Climate Change Resiliency Plans filed by New York's major utility corporations. In its decision, the Commission directed the utilities to include proposed resilience investments as part of ongoing and future rate case proceedings, provide more explicit process and design changes with respect to climate change projections, define engagement strategies for proposed resilience measures that could impact telecommunication service providers, and include implementation- and outcome-based performance benchmarks for all proposed resilience measures in future updates to the plans and upcoming progress reports.[8] Please see the Electricity and Climate Change, Adaptation, and Resiliency chapters of this Plan for more information.

The Commission approves budgets for storm hardening, resilience, climate change resilience plans, reliability, asset condition driven capital programs, and vegetation management programs in rate proceedings. These programs in conjunction with many other capital and operations and maintenance projects and programs reviewed by Department Staff in rate case and other proceedings contribute to electric utility performance during emergency events.

The DPS Office of Resilience, Utility Security, Nuclear Affairs, and Emergency Preparedness (OREP) Utility Security Section (USS) has utility cybersecurity oversight responsibilities. Under the authority granted by the PSL and PSC orders, OREP USS staff regularly conducts thorough inspections and audits of the physical and operational technology cybersecurity postures of regulated utility facilities, sites, and assets. OREP USS also audits annually the protection of Personally Identifiable Information at electric, gas, and water utilities. Through these inspections, examinations, and audits, OREP USS assesses the capabilities of utility companies to respond to threats. In conducting these audits, OREP USS utilizes the North American Electric Reliability Corporation Critical Infrastructure Protection standards for gas and electric companies.

7.3. NYISO

NYISO is responsible for managing and operating New York's electrical grid and its competitive wholesale electricity marketplace. NYISO ensures that the electrical grid in New York is reliable and plans for the future, working with power producers, utility companies, and stakeholders to provide power to meet New Yorkers' electricity needs on a daily, hourly, and minute-to-minute basis balancing the supply of power from energy producers with the demand for electricity from consumers across the state. NYISO plans the power system for the future, over one, five, and ten-year studies to maintain long term

reliability, reduce congestion on the transmission system, and meet public policy needs calling for new transmission, such as lines to bring renewable resources to customers. NYISO plays a critical role in planning and encouraging investment in New York's electricity infrastructure by identifying the reliability needs of the power system, determining congested areas, encouraging market-based solutions, and evaluating proposed projects through numerous assessments.

In October 2025, NYISO issued a press release directly addressing the resource adequacy of the electrical system through their quarterly Short-Term Assessment of Reliability and the longer-term draft 2025–2034 Comprehensive Reliability Plan. Both reports are issued publicly under the NYISO's planning processes, which is approved by the Federal Energy Regulatory Commission. The finding of a reliability need initiates a process administered by NYISO to bring reliability margins back to acceptable operating levels. NYISO will begin the process immediately by working with local utilities and the marketplace to identify and evaluate possible solutions. Transmission, generation, energy efficiency or a combination of each can qualify as solutions through the process.

Additionally, NYISO, DPS, the New York State Department of Environmental Conservation (DEC), NYSERDA, and the New York State Department of Transportation (DOT) support energy emergency preparedness through the State agency and NYISO Winter Coordination Protocol, which is used when electricity generation unit fuel supply may be at risk, posing a threat to electrical system reliability. During the winter season, NYISO maintains contact with electric generators through its Cold Weather Fuel Survey, which assesses availability of both primary and alternate fuel supplies. As a result, NYISO can coordinate with State agencies to assess the current information on predicted electricity demand, weather forecasts, and generator fuel supplies, as well as a general assessment of any issues generators may be experiencing in securing resupply volumes or any additional fuel distribution difficulties. State agencies can take appropriate actions, including waiver requests for sulfur fuel requirements or hours-of-service for the transportation of fuels needed to operate electricity generation, if needed.

7.4. NYPA

The NYPA emergency preparedness plan is designed to ensure a swift and effective response to power grid disruptions caused by natural disasters or other emergencies. The plan includes maintaining a robust system to restore power, maintaining strategic fuel reserves for critical equipment, and collaborating with other utilities and emergency responders across the state. It also includes measures to enhance infrastructure resilience and ensure operational continuity during crisis situations.

Key elements of the NYPA emergency preparedness plan include:

- **Risk assessment**
    - Identifying potential hazards, such as severe weather events, cyberattacks, and equipment failures to develop targeted response strategies.
- **Communication protocols**
    - Establishing clear communication channels with stakeholders including State agencies, local authorities, and customers to provide timely updates during emergencies.

- **Emergency response teams**
    - Training dedicated teams to rapidly assess damage, mobilize repair crews, and manage power restoration efforts.
- **Strategic fuel reserves**
    - Maintaining a stockpile of fuel to ensure uninterrupted operation of power restoration equipment.
- **Infrastructure resilience**
    - Implementing measures to enhance the durability of power lines, substations, and other critical infrastructure against extreme weather events.
- **Collaboration with other utilities**
    - Coordinating with other power companies in New York State to share resources and expertise during emergencies.
- **Community engagement**
    - Educating the public on emergency preparedness measures and providing updates on power restoration efforts.
- **Integration of renewable energy sources**
    - NYPA is actively incorporating renewable energy sources such as battery storage to enhance grid resilience during emergencies.
- **Continuous improvement**
    - Regularly reviewing and updating the emergency preparedness plan based on lessons learned from past events.

7.5. DHSES

The New York State Mesonet[9] helps mitigate harmful effects from high-impact weather events and helps prepare New Yorkers with greater lead times and more accurate predictions. It provides real-time data to operational forecasters from across the state with updates every five minutes and an average station spacing of about 17 miles. This data is combined with data from other surface networks, weather radar, and satellite to improve numerical weather prediction models for even greater accuracy and precision than ever before, giving forecasters much greater confidence in their warning products.

The New York State Weather Risk Communication Center provides real-time weather information to State agencies, emergency managers, and other critical stakeholders through briefs, updates, special reports, and forecasts.

The State conducts **CEPAs**[10] in each of the 57 counties of New York as well as in New York City. These provide great insight as to the State's risk profile from a local-level perspective. Counties also participate in their own CEPA to help understand their local risks. Progress of the mitigation activities are captured in the Threat and Hazard Identification and Risk Assessment, State Preparedness Report, and the State Emergency Preparedness Assessment, which are updated every three years.

The New York State Watch Center[11] is New York State's 24/7 alert and warning point. It supports the mission of DHSES by maintaining situational awareness of state, national, and international incidents, sharing information with Division staff, State agencies, and other emergency officials, and notifying State agencies and counties of developing incidents. The State Watch Center is responsible for activating the State Emergency Operations Center in Albany during emergencies and maintaining dedicated communications with federal emergency response agencies and commercial nuclear power generation facilities. It also assumes daytime and off-hours responsibility for several State agency emergency hotlines and maintains the authority to mass notify the public statewide to an emergency or imminent threat.

The DHSES-OCT risk assessment program. Offers risk and vulnerability assessment services for critical infrastructure, including critical energy infrastructure, provided by the OCT's Critical Infrastructure Unit. These services are a vital component of the Division's ability to uphold the statutory obligation set forth in New York State Executive Law, Article 26 §709 (j), to work with local, State, and federal agencies and private entities to conduct assessments of the vulnerability of critical infrastructure to terrorist attacks, cyberattacks, and other natural and man-made disasters.

New York State COOP Program. DHSES offers guidance and assistance in supporting the development of COOPs for State agencies and county emergency management offices. The program includes a variety of tools, guides, and technical assistance to support agency-specific contingency planning to ensure the continuance of mission essential functions in response to all hazards, including electrical outages.

New York State Citizens Preparedness Corps (CPC) Program. DHSES, in partnership with the New York State Division of Military and Naval Affairs/National Guard, began delivering CPC training in 2014. The goal of the training is to teach people how to prepare for disaster or emergency situations and provide information about the types of risks and hazards people face. Additionally, the training teaches individuals how to identify and save needed supplies, and to develop individual and household plans for all emergencies, including energy outages. The CPC training events are widely held and are continually in great demand. In 2024, 896 CPC events were held across the state, with 31,761 members of the public attending. The state is on track this year to meet demand. Since January 1, 2025, to the present, 815 CPC events have been held across the state with 29,015 in attendance.

7.6. Department of State

The Department of State's Division of Building Standards and Codes provides various services related to the development, administration, and enforcement of the Uniform Fire Prevention and Building Code (Uniform Code) and State Energy Conservation Construction Code (Energy Code). The statutory

responsibility for developing and maintaining the Uniform Code and the Energy Code is vested in the State Fire Prevention and Building Code Council (Code Council).

The Uniform Code and the Energy Code serve as key mitigation strategies by setting minimum standards for construction, ensuring structures are designed and built to withstand natural hazards, including earthquakes, hurricanes, floods, and wildfires. By promoting resilient design and construction, these codes help minimize damage and loss of life during disasters, reducing the impact of disasters on communities. They are a proactive approach to disaster preparedness by fostering development of more resilient buildings. Both codes are reviewed on a three-year cycle, along with the national model codes on which they are based, to ensure alignment with evolving construction technologies and best practices in resilient building design.

7.7. Agriculture and Markets Weights and Measures

The "Fuel NY" law (16.192-H)[12] was established to maintain the availability of motor fuel during energy or fuel supply emergencies and expedite a return to normal operations. The program requires strategically located gas stations in the downstate region to be equipped with transfer switches, making them generator-ready, and to have a plan for generator deployment in the event of a declared energy emergency. The State enforces the Fuel NY law among gas stations within designated geographic areas and publishes a list of gas stations in compliance with the Fuel NY law.

7.8. New York State Department of Health

The Building Resilience Against Climate Effects program[13] provides near-real-time surveillance for some extreme weather impacts, the Cooling Center Finder Tool, and works to put risk awareness messaging out for different types of hazards.

8. Energy Transition and Resilience

8.1. Overview

As described in the Climate Change, Adaptation, and Resiliency chapter of this Plan, decarbonizing the energy system is imperative for combating climate change. New York State has taken a leading role in this through the Climate Act, which codifies renewable energy targets. New York is making advances toward these ambitious targets, but it will require substantial changes to energy systems across the state, primarily by phasing out fossil fuel generation infrastructure, building out renewable energy, and constructing transmission systems to deliver it. The planned energy transition from fossil fuels to renewables will bring about significant benefits for New York State, including job creation, energy security, and health benefits. Going forward, the design and location of renewables may introduce new risks to the State's current energy mix. Understanding and mitigating these risks, especially in the face of climate change, is essential for emergency preparedness as New York transitions to a clean energy future. The energy transition will substantially change the production, distribution, and consumption of energy across the state, and particularly in the downstate region. Changes to the types and locations of energy infrastructure in New York will have both short- and long-term hazard, risk, and mitigation implications for the State's energy emergency preparedness.

8.2. Energy Transition, Resilience, and Policy

New York State is advancing its ambitious decarbonization targets under the Climate Act while adhering to a core energy policy principle: balancing emissions reductions with reliability, resilience, and risk mitigation in the energy system. This approach includes temporary, tailored "off-ramp" provisions that ensure critical energy services remain uninterrupted during the transition. An example of this principle in action is the DEC Peaker Rule regulation to limit nitrogen oxide (NO_x) emissions from combustion turbines during the ozone season, which included built-in system reliability provisions. The rule led to the retirement of 1,027 megawatts (MW) of generators by May 2023 with an additional retirement slated for 2025. NYISO projections of peak day demand under expected weather conditions found that New York City may have a reliability margin deficit of as much as 446 MW for 9 hours on a peak day in 2026, with extreme heat exacerbating this issue. These negative resource adequacy projections led to the activation of the Peaker Rule's built-in reliability provisions to avoid this system deficit.

8.3. State Energy Transition and Resilience Priorities

The State's Energy Transition and Resilience priorities, developed through the Energy Security Plan, are closely aligned with the State's Hazard Mitigation Goals and the Climate Action Council Scoping Plan Goals. These priorities will help to ensure that the energy sector in New York is strengthened, secured, and made more resilient and transitions to a clean energy future.

- Priority 1—Strengthen energy sector reliability to ensure all communities, especially DACs, will benefit from continuous access to secure energy.
- Priority 2—Secure all critical energy infrastructure against human-made (i.e., physical and cybersecurity threats) and natural hazards.
- Priority 3—Enhance the response to, and recovery from, energy disruptions to improve energy supply resilience for end users.
- Priority 4—Reduce greenhouse gas emissions and achieve net-zero emissions, increase renewable energy use, and ensure all communities equitably benefit in the clean energy transition.

8.4. Resilience and Mitigation Strategies to Support Existing Energy Infrastructure

As New York transitions to a clean energy economy, all resources that may be available as part of the State's comprehensive decarbonization strategy will be explored. Supporting innovation and studying all technologies will enable the State to remain on the cutting edge of evolving solutions that will complement existing decarbonization efforts in achieving the State's ambitious Climate Act targets while contributing to energy resilience and mitigation strategies. Despite the current readiness of the energy system, investing in additional resilience and mitigation strategies to support the current energy infrastructure in transition is needed. This effort includes the role of private stakeholders as owners and/or operators of critical energy infrastructure and related systems. Examples of current private investment include the Champlain Hudson Power Express (CHPE), a major new transmission project, which will bring a dependable supply of clean electricity from existing hydroelectric facilities and other

renewable facilities in Quebec, Canada, directly to New York City. The route has been carefully designed to minimize its impact on the environment, and burying and/or submerging the line protects it from extreme weather risks impacting other forms of electric transmission. By delivering directly into New York City's grid, CHPE bypasses mid-state electric transmission congestion.

Distributed energy resources (DERs) are playing an increasingly important role in New York's energy landscape. These resources, including solar, energy storage, combined heat and power, anaerobic digesters, and fuel cells, generate or store electricity for use on-site (e.g., for homes and buildings) or to supply power directly to the electrical grid. DERs contribute to a cleaner and more efficient grid and result in lower energy bills. DERs can improve system resilience by providing backup power during outages. Microgrids, small, localized energy systems powered by DERs, can supply electricity locally. Their ability to connect to or disconnect from the larger grid makes them a resilient solution, capable of continuing operations during hazard-induced outages affecting the larger grid system. Biogas and RNG are being used in DER systems and hydrogen blends are being evaluated, but additional research and review are needed. Generation equipment currently running on traditional fuels may be able to transition to lower-carbon fuels, including biogas and RNG. Numerous energy storage project investments also help to ensure that intermittent renewable power is supported with sufficient energy storage to provide clean, reliable, and resilient power. DERs are critical to advance New York State's climate and clean energy goals and support a resilient energy system. Adversaries such as Russia, China, Iran, and others can target DERs with cyberattacks, including supply chain attacks and targeted cyberattacks on specific facilities via their DERs. The cybersecurity of DERs, including secure communications and operations and protection against physical damage should be emphasized.

Private investment is also advancing energy resilience and decarbonization in New York's liquid petroleum sector. Petroleum terminals across the state are upgrading infrastructure, such as dedicated tanks, new pumps, piping, controls, insulation, and heat tracing, to support the State's biodiesel mandate. This mandate reduces the level of petroleum fuel used in New York, helping to further New York's clean energy goals, and the upgraded and dedicated infrastructure will help ensure those fuels are readily available in all seasons to New Yorkers. Additional investments by the liquid fuels sector include the installation of new vaper recovery units at terminals that have direct environmental/air quality benefits for vulnerable populations and communities.

Another example of New York's energy resilience and mitigation strategies can be found in the Office of Renewable Energy Siting and Electric Transmission (ORES), recently integrated into DPS. ORES was established to consolidate the environmental review and permitting of major renewable energy facilities in New York State into a single forum that provides a coordinated and timely review of siting permit applications. All large-scale, renewable energy projects of 25 MW or larger are required to obtain a siting permit from ORES for new construction or expansion. This process is designed to help progress toward State's renewable energy objectives by streamlining the permitting process while ensuring the protection of the environment with consideration of all pertinent social, economic, and environmental factors (including environmental justice) and providing opportunities for local government and community participation in the permitting process.

8.5. Resilience and Mitigation Strategies to Support Clean Energy Transition and Enhance Emergency Preparedness

New York State's energy system will evolve over the coming decades and investing in solutions that increase resilience and improve mitigation is critical to support the clean energy transition. The nexus of energy-transition-driven policy, technological advancements, and evolving energy systems' risk and reliability issues make for a dynamic environment for current and future mitigation efforts.

Energy storage is one example of an evolving mitigation strategy and plays a pivotal role in delivering reliable and affordable power to New Yorkers as the State increasingly switches to renewable energy sources. Integrating residential, commercial, and bulk storage in the electrical grid, especially in areas with high energy demand, will allow clean energy to be available when and where it is most needed. Energy storage can also provide backup power during power disruptions. However, increasing numbers of risks associated with energy storage and fire has been reported. On July 28, 2023, Governor Kathy Hochul announced the creation of a new Inter-Agency Fire Safety Working Group to ensure the safety and security of energy storage systems across the state and to help address and mitigate the emerging fire risks associated with this developing technology. The Working Group provided the final report to the New York State Fire Prevention and Building Code Council[14] and Department of State staff. The Department of State released a Notice of Proposed Rule Making[15] in March 2025 containing proposed code language intended to reflect the recommendations of the Working Group to enhance safety standards for battery energy storage systems. This will advance the safe and reliable growth of battery storage capacity, a critical component of the clean energy transition.

These examples of private investments and public efforts all support New York's clean energy goals while providing reliable and resilient energy to all New Yorkers.

- **Existing SHMP Strategies.** The goal of the SHMP is that all jurisdictions develop robust mitigation plans and tangible mitigation actions that will contribute to long-term risk reduction, including developing the critical energy infrastructure necessary for the clean energy transition. Hazard mitigation is any sustained action taken to reduce or eliminate long-term risk to life and property from hazard events. It is an on-going process that occurs before, during, and after disasters and serves to break the cycle of damage and repair in hazardous areas. At a minimum, mitigation measures must be technically feasible, cost-effective, and environmentally sound. The goal is that all jurisdictions (state, county, and local) develop robust mitigation plans and tangible mitigation actions that will contribute to long-term risk reduction, including existing critical energy infrastructure.

  Mitigation strategies for the State's energy system are included in the SHMP. These strategies address specific risks caused by natural, physical, or man-made hazards and vulnerabilities and are focused on specific energy asset types. These strategies are informed by and aligned with the detailed energy risk assessments found in the State's Energy Emergency and Energy Security planning documents.

Mitigation strategies are outlined in the New York SHMP through Mitigate NY.[16] Identified mitigation measures included in the plan are found in the State Hazard Mitigation Action Database, the State Capabilities Catalog, and the Local Hazard Mitigation Action Database.

Hazard-specific annexes are part of the State's CEMP. They outline an active approach to providing various services throughout New York State during the response and short-term recovery phases of specific hazard induced events. These annexes are developed in response to the evolving risks to the state and include responses consistent with the changing energy systems in the state. Examples of hazard-specific annexes that incorporate significant energy system components include:

- **New York State Extreme Heat Annex.**[17] This annex acknowledges that the critical infrastructure that society relies on can be severely impacted by extreme heat. Critical lifelines including energy systems are impacted by extreme heat and the impacts from extreme heat can disproportionally affect vulnerable populations and disadvantaged communities. To escape the negative effects of extreme heat, a large majority of private residences and other buildings use some sort of cooling system, whether it be central air conditioning or a simple window unit. The increased demand caused by using these systems can lead to a strain on the power grid that may lead to damage to electrical components and blackouts. The annex includes response, and mitigation action plans to manage the risk and ensure public safety for all communities during these extreme heat events. This Annex identifies the risks for energy systems, including the electrical grid, nuclear power plants, and impacts to transportation. In the energy sectors, extreme heat can cause reduced efficiency for systems such as generator units and hydroelectric systems. Nuclear power plants, particularly ones built along lakes or rivers, may also be at risk of temporarily shutting down if water levels drop too low or if the water becomes too warm, not allowing it to cool the plant properly. New York State's transportation infrastructure may be impacted in various ways. Expansion joints on bridges and highways may weaken and show signs of stress, creating rutting and potholes, while the warping of railroad tracks increases the likelihood of a train derailment, and the buckling and melting of asphalt and tarmac on public roads and airports may affect traffic. Powerlines may begin to overheat and sag over roadways, causing hazardous conditions and outages. The Extreme Heat Annex is aligned with the overall New York State Extreme Heat Action Plan,[18] which is represented in more detail in the Climate Change, Adaptation, and Resiliency chapter of this Plan.
- **New York State Blizzard and Severe Winter Weather Annex.**[19] This annex outlines New York State's strategy in preparing for, responding to, and recovering from a blizzard as well as other impactful severe winter weather events using a collaborative, multi-agency State approach. The Annex identifies that critical infrastructure, such as the electrical grid, major electricity generators, communications infrastructure, and transportation infrastructure, is at a major risk of being impacted during a severe winter weather event. During extreme cold particularly, the increased demand on the electrical grid can overload it and cause outages. The electrical grid is also at risk of physical damage as heavy snow, high winds, and ice can potentially damage electrical infrastructure. Severe winter weather can curtail natural gas production facilities and

affect the operation of natural gas pipeline compressors. Colder temperatures will increase demand for natural gas for space heating potentially causing large industrial and electricity generator or other natural gas interruptible customers to switch to alternate fuel supplies, including liquid heating fuels. Severe winter weather can also impact the liquid fuels industry, disrupting or delaying the transport and delivery of critical home heating and transportation fuels. Emergency services, shelters, and other community lifelines rely on liquid fuels to run their vehicles, provide heat for buildings, and provide fuel for generators during electrical outages. Critical infrastructure for the liquid fuels sector, including petroleum terminals and pipelines is also dependent on electricity to maintain operations and can be severely curtailed by electrical outages. Severe cold winter weather increases demand for liquid heating fuels across the residential and commercial sectors. Electricity generators and other natural gas users may have to rely on alternative liquid fuels if they do not have firm natural gas service. The potential for disruption of deliveries of essential home heating fuels would especially impact vulnerable consumers and disadvantaged communities.

- **New York State Coastal Storm Annex.**[20] This annex applies to any warm weather or cold weather coastal storm that warrants a collective, multi-agency State disaster response. This Annex identifies the key mechanisms in coordinating with local and federal stakeholders in response to an impending coastal storm. It includes an operational timeline and operating protocols that ensure the State's response is mobilized in advance of all local or federal plans. The plan includes detailed energy system monitoring for this risk and restoration following an incident through the Emergency Support Function #12 Energy Annex.

9. Themes and Recommended Actions

New York State has a robust interagency emergency preparedness and response system and is well-positioned and prepared to respond to energy emergencies. It is important to continue to build out additional energy security resilience and preparedness capabilities and actions through existing agencies and programs.

The current energy systems in New York are rapidly evolving in response to the transition to clean energy as well as local, regional, and global market, technology, climate, and policy changes. This evolution will continue to introduce new hazards and vulnerabilities, changing the risk profile of the energy systems in the state, and will have a direct effect on the emergency preparedness plans, responses, and mitigation strategies needed in New York.

Recommendations

- New York State should continue to prioritize multi-agency energy emergency management and test capabilities through exercises, training, and collaborations.
- New York State should continue to apply risk- and threat-based assessment to monitor, evaluate, and respond to the changing risks and threats in the evolving energy systems within the state. The changing risk and threat landscape will introduce opportunities to test emergency preparedness strategies and improve them.

- New York State should study and analyze the effects of mitigation and sustainability efforts to inform future strategies and investments.
- New York State should continue to encourage energy infrastructure investment consistent with both State clean energy and energy security goals.
- New York State should continue to emphasize and communicate the critical role that the public will play in energy emergency preparedness throughout the clean energy transition. Response plans (including the Extreme Heat and Extreme Winter Weather annexes) should continue to include public planning and participation to help mitigate the risks posed by these evolving threats, including misinformation.
- Individuals should understand their evolving role in energy emergency preparedness as well: for example, securing guaranteed winter heating fuel supply contracts (heating oil, propane or kerosene) for private residences is becoming more critical as the current energy systems continue to transition.

These efforts will continue to strengthen the State's energy infrastructure, delivering a more resilient and clean energy system into the future.

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[18] "Extreme Heat Action Plan," New York State Department of Environmental Conservation, https://dec.ny.gov/environmental-protection/climate-change/effects-impacts/extreme-heat.

[19] *New York State Comprehensive Emergency Management Plan: Blizzard/Severe Winter Weather Annex* (DHSES, March 2025), https://www.dhses.ny.gov/blizzardsevere-winter-weather-annex.

[20] *New York State Comprehensive Emergency Management Plan: Coastal Storm Annex* (DHSES, March 2025), https://www.dhses.ny.gov/coastal-storm-annex.

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2025 NEW YORK STATE ENERGY PLAN

Key Terms Used in This Chapter

FOR THE COMPLETE GLOSSARY ➔

Efficient Electrification: Electrification of a building with an adequately efficient thermal envelope to conserve energy use, keep occupants comfortable, and enable an efficient electric heat pump system to operate effectively.

Efficient Electric Heat Pumps: Includes ground source heat pumps and heat pump water heater systems that meet or exceed the U.S. Environmental Protection Agency's ENERGY STAR specification, as well as cold climate air-source heat pumps, packaged terminal heat pumps, and variable refrigerant flow products that meet or exceed standard specifications for heat pumps that are best suited to heat efficiently in cold climates.

1–4-Unit Home: Housing with 1 to 4 residential units, including single-family, owner-occupied, and rental housing. Small residential energy efficiency programs often serve 1–4 unit homes.

Multifamily Housing: A building that has five or more residential housing units where the predominant building use is for residential purposes. Multifamily energy efficiency programs often serve buildings with 5+ units.

Low- to Moderate-Income (LMI) Household: A low-income household is defined as a household with an annual income of less than 60 percent of either the state or area median income, whichever is higher and adjusted for household size. A moderate-income household has an annual income of less than 80 percent of either state or area median income, whichever is higher and adjusted for household size.

Phased Electrification: This term refers to projects wherein the building electrification process is carried out over time. This staged approach aims to electrify most or all of a building's energy systems while minimizing disruptions to building operations and occupant experience. This may be a multifamily or commercial building where certain units of the building are converted to electric heat pumps for space heating (e.g., at the time of tenant turnover), or as part of a phased more comprehensive renovation project. This may also result in instances where full electrification of the building may not be possible due to available electric capacity or limitations related to customers' capital cycles.

Resource Efficient Decarbonization: A phased approach to eliminating greenhouse gas emissions from large buildings in cold climates that creates a path toward cost-effective decarbonization.

Subsidized Affordable Housing: Housing that is affordable because of government subsidy. This can include, but is not limited to, housing units receiving support under the U.S. Department of Housing and Urban Development programs (e.g., Section 8 Housing Choice Voucher, tenant-based vouchers, project-based vouchers, and HOME), including units owned or overseen by Public Housing Authorities.

Supplemental Heat: A heating system that is installed or left in place to complement a heat pump heating system that is not sized to meet the full heating load of the building, providing heat to supplement the main heating system during the coldest hours of the year.

Thermal Energy Network: A network of equipment and pipes that connects multiple buildings together to thermal energy sources such as geothermal, surface water, waste heat, and the air, to provide space heating, cooling, and domestic hot water. This technology can be an effective way to reduce energy costs and greenhouse gas emissions from a set or groups of buildings at scale.

Weatherization: Protecting a building's interior from outside temperatures and moisture to cut energy use and enhance indoor comfort through measures such as air sealing, insulation, and window upgrades.

Key Findings → Buildings

New York State's buildings are as varied as their surrounding communities. Modernizing and decarbonizing the buildings where New Yorkers live, work, and learn will deliver multiple benefits, including better comfort, health and resiliency benefits, and energy bill savings from energy efficiency upgrades. In particular, the energy transition provides an opportunity to invest in and expand access to affordable and quality housing.

New York has a strong foundation of policy and programs to make energy efficiency and building energy upgrades more affordable. This chapter provides an overview of the State's approach, outlines major initiatives underway, and recommends continued and additional actions to enable more New Yorkers to choose and benefit from these energy upgrades.

- **Energy efficiency, efficient electrification, and demand management are core strategies to drive energy savings in New York's residential, commercial, and institutional buildings; keep buildings comfortable; and support reliability of the grid and gas system.** As the buildings sector transforms, the use of efficient heat pumps will increase, such that heat pumps could outpace residential gas equipment installations and make up a meaningful share of space conditioning by 2040. Increased levels of energy efficiency and weatherization measures will result in lower per-capita energy usage across the sector, helping to provide energy savings for many residents and businesses. In addition, distributed solar generation and energy storage can provide a dependable source of electricity for buildings, help reduce costs, and improve resiliency. Collectively, these strategies will bring about a modern, low-carbon building stock that delivers a multitude of public health, safety, affordability, and resiliency benefits to New Yorkers.

- **The clean energy transition offers an opportunity to invest in and expand access to affordable and quality housing that is comfortable, energy efficient, and resilient.** State support for low- to moderate-income (LMI) households and buildings in disadvantaged communities (DACs) to make energy-related upgrades will help make homes and communities healthier places to live. New York must accelerate new housing development and construction under advanced energy codes to enable lower energy costs and more resilient buildings.

- **Financial incentives and affordable financing will continue to be necessary to reduce upfront costs and motivate New Yorkers to make energy upgrades in buildings.** New York State currently invests over $1 billion annually in public funds for State- and utility-administered customer incentives, market development programs, and financing offerings that help make energy efficiency and efficient electrification solutions more affordable. A strategic priority for State- and ratepayer-funded incentives is supporting energy upgrades that help building owners reduce energy load, displace fossil fuel-based consumption, and lower energy bills through energy efficiency and efficient electrification. In the near-term, funding should continue to focus on energy efficiency and weatherization projects as well as replacing oil, propane, or electric resistance heating with efficient heat pumps while helping to make the switch from gas equipment, where it is financially viable, as aging equipment becomes ready for replacement (though before an emergency replacement is needed).

- **In existing buildings, sequencing capital investments is often an effective way to manage the associated cost and disruption of energy and building upgrades that support climate and affordability goals.** For example, energy upgrades in a building may happen at different times to align with equipment and capital planning life cycles and tenant turnover. State policies and programs should continue to support such sequencing of upgrades and offer flexibility in the way that buildings reduce energy use, displace fossil fuel consumption, and electrify efficiently.

- **Innovation and market transformation will expand decarbonization solutions across various building types and can help reduce equipment and installation costs over time.** Public investments, coordinated with strategic public-private partnerships, can help spur further technology innovation, demonstration, and commercialization and can bring emerging solutions to the market and lower costs, especially for hard-to-decarbonize building types or energy uses. These actions can also help advance methods to decarbonize district steam systems that may continue to serve certain geographies or building segments. Market development support can help expand the clean energy workforce and support existing supply chain actors and businesses in adapting business models to effectively deliver clean energy technologies, all while building awareness and confidence in clean heating solutions among consumers and contractors.

- **Expanding mechanisms to integrate flexible equipment loads while aligning price signals to manage and shift demand will be important for managing operating costs, optimizing grid investments, and maintaining grid reliability.** As energy uses such as heating, hot water, clothes drying, and vehicle charging increasingly become electrified, demand on the electric grid will grow. Distributed renewable generation, including solar and storage (electric and/or thermal) at the building, can help offset some of this demand and shift energy use to when it is more affordable. Technology advancements such as smart panels, smart plugs, and demand response software can further facilitate the ability to aggregate and shift demand, which can help consumers reduce operating costs while optimizing grid investment needs.

- **Coordinated grid planning is needed to shift beyond building-by-building conversions to network solutions, including thermal energy networks.** Enabling efficient community-scale decarbonization will be important in unlocking strategies such as thermal energy networks, area-based thermal energy planning, and other integrated planning approaches. Integration of energy efficiency and electrification projects with neighborhood redevelopment and master planning can help ensure that decarbonization is a central component when redevelopment, replacement, and total rehabilitation occur.

- **Regulatory frameworks are important to drive broad and sustained improvements in building energy performance and to reduce emissions from building operations, equipment, and construction materials.** New zero-emission building and energy codes help improve comfort, indoor air quality, and resilience while shifting new buildings away from fossil fuels. Appliance and product standards are lowering energy usage as existing residential and commercial buildings upgrade their equipment, and State standards can further help promote demand flexibility for certain appliances, even with uncertainty around federal standards. Improved access to building energy consumption data provides actionable insights to identify the best opportunities for achieving energy cost savings and emissions reductions. Lessening the environmental impact of the buildings sector also requires managing refrigerants and embodied greenhouse gas (GHG) emissions.

- **As buildings of all ages, functions, and locations across New York State are vulnerable to the impacts of climate change, design and investment decisions should account for long-term climate risk.** All regions of the state will experience a range of climate impacts, which can affect building structures, systems, and operations, as well as the occupants. Making design decisions in both new and existing buildings that align buildings' and building components' life cycles with future climate projections and expected hazards will lead to more cost-effective, sustainable, and future-ready buildings that can support many generations of use.

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1. Overview

New York State's buildings are as varied as their surrounding communities. Upgrading the structures where New Yorkers live, work, and learn offers unique challenges, as well as significant opportunities. New York State's buildings sector accounts for approximately half of the net energy consumption statewide.[1] According to Climate Act emissions accounting, in 2023, the buildings sector was the largest source of emissions, responsible for 28 percent of emissions statewide, which includes the combustion of fossil fuels in residential (35 percent) and commercial (21 percent) buildings, emissions from imported fuels (25 percent), and hydrofluorocarbons (HFCs) released from building equipment and foam insulation (18 percent).[2] Investments that modernize and improve the quality of New York's buildings will therefore contribute significant impacts toward a key source of energy use.

This Plan recommends five main strategies as central to improve and decarbonize New York's buildings sector, keep occupants comfortable, prioritize affordability, and support reliability of the grid and gas system:

1. Prioritizing energy efficiency and weatherization
2. Advancing efficient electrification to reduce on-site fossil fuel use
3. Continuing innovation and market development for new and emerging clean building technologies
4. Enabling demand management and load flexibility at scale
5. Reducing embodied greenhouse gas (GHG) and refrigerant emissions

Strategies that increase clean energy generation and storage, modernize the electric grid, and expand access to electric vehicle (EV) charging infrastructure (as discussed in the Electricity and Transportation chapters of this Plan) will also be important in enabling a clean and resilient building stock.

1.1. New York's Large Geography, Varied Climate, and Vibrant Economy Drives a Diverse Buildings Mix

The buildings sector encompasses over 6 million buildings across New York State, providing homes to more than 7.5 million households;[3] it contains over 5 billion square feet of commercial and institutional space where New Yorkers work, learn, gather, and access essential services. New York's buildings are older than the national average, pointing to opportunities for upgrading buildings in ways that improve both quality of life and energy performance. New York's homeownership rate of 54 percent is lower than the national average and nearly half (48 percent) of households statewide are low- to moderate-income (LMI) households, underscoring the importance of careful attention to equity and to housing and energy affordability.[4;5]

Buildings in New York State vary widely by region when it comes to their size, type, local climate conditions, development patterns, and socioeconomic conditions. Therefore, multiple approaches will be required to enable a sector-wide transition to a low-carbon building stock. New York's downstate region (Long Island, New York City, and Westchester County) includes dense urban areas and is characterized by a mixed-humid climate zone (International Energy Conservation Code Climate Zone 4A). The localities in this region often have higher costs for construction and real estate, with certain areas

also having more multifamily rental housing and leased space, and taller buildings with denser occupancy than other parts of the region or state. Median household incomes are typically higher in downstate counties than those upstate; however, Bronx County has the lowest median household income and the highest poverty rate of any county in the state.[6] Income inequality is high in New York City, where nearly one in four residents lives in poverty.[7]

The upstate region is characterized by suburban and rural communities, as well as small and moderate-sized cities, with cooler climates (Climate Zone 5, cool-humid and Zone 6, cold-humid). These smaller cities, towns, and villages often have lower-cost real estate and more single-family homes and low-rise buildings. Median incomes are typically lower than in downstate New York, with those in the Southern Tier being among the lowest in the state. In the Southern Tier and in the mostly rural and suburban counties in the Mohawk Valley and the North Country regions, low-income households are more likely to live outside the census tracts geographically designated as DACs.

1.2. Most of New York's Buildings Rely on Fossil Fuels

Typical buildings use energy for space heating, ventilation, and air conditioning (HVAC), water heating, lighting, refrigeration, cooking, computer and office equipment, and other appliances. The building thermal envelope (roof, walls, windows, doors, and floor) acts as a barrier, regulating the exchange of air, heat, water, vapor, fire, smoke, dust, sound, and light between the inside and outside of the building. For residential buildings, the typical thermal envelope has roughly a 30 percent to 40 percent impact on the building's energy consumption for heating and cooling.[8] Space heating, air conditioning, and water heating collectively comprise roughly 77 percent of a home's total average energy use.[9]

More than eight out of ten of New York State's occupied housing units rely on gas, distillate/fuel oil, or other fossil fuels for their main source of heating. Among those homes heating with electricity, the majority use inefficient electric resistance heating. Hot water heating in New York's residential buildings is likewise dominated by gas and fuel oil. A majority (62 percent) of homes in New York also have gas cooking appliances.[10] An estimated 160,000 homes, or a little over 2 percent of all households, use wood for primary or supplemental heating. Across New York, just over 250,000 homes, or around 3.5 percent of all households, use an electric heat pump as their main source for space heating.[11]

The commercial and institutional sectors are notably diverse and span many different building types, customer types, and energy needs, including office, government, education, retail, warehouse, health services and hospitals, lodging and hospitality, food service, grocery, and mixed-use buildings. Most of New York's commercial and institutional buildings rely on fossil fuels for space conditioning, with over 85 percent of commercial building square footage using fossil fuels for heating. Electricity is used for heating in 10 percent of all commercial floor area, but as of 2020, mostly inefficient electric resistance heating and supplementary heating using dual fuels are prevalent in commercial buildings. Additionally, roughly 7 percent of commercial square footage in New York is heated by district steam systems, including many large buildings in New York City.[11]

1.3. Modernizing and Decarbonizing Buildings Will Deliver Multiple Benefits to New Yorkers

Energy efficiency and decarbonization investments in buildings provide a transformative opportunity to improve the many spaces of New Yorkers' everyday lives. Weatherization, efficient electrification, and other energy-related upgrades directly improve occupant comfort in homes, schools, and workplaces; provide better indoor and outdoor air quality; contribute to lowering energy usage and associated energy bills; and offer better access to heating and cooling amidst increasingly variable weather conditions. Modernized and decarbonized building infrastructure brings value to New Yorkers across multiple areas, including:

- **Public health benefits**, because reducing on-site fossil fuel combustion decreases outdoor air pollution and improves neighborhood outdoor air quality. Indoor air quality and safety improvements also result from electrification of space conditioning, cooking, proper ventilation, and air-sealing, with reduced risk of carbon monoxide exposure and gas leaks.
- **Better comfort** from energy efficiency and weatherization upgrades that make buildings' indoor environments and temperature more stable and comfortable, as well as from versatile heat pump systems that offer dehumidification in the summer, along with filtered indoor air.
- **Improved access to cooling** by transitioning from heating-only systems to heat pumps that provide cooling and heating, which is especially critical to health, safety, and equity as temperatures rise.
- **Energy bill savings** from energy efficiency and other load reduction measures, as well as highly efficient heat pump systems (when compared to heating with fuel oil, propane, or electric resistance heating equipment) as well as less-variable energy costs.
- **Resiliency**, because well-designed efficiency measures such as improved insulation, air sealing, orientation, and load reduction improve passive survivability and maintenance of safe indoor temperatures; load flexibility measures can improve reliability in grid-constrained areas. Buildings built to withstand and recover from climate impacts are more likely to perform as intended throughout their useful lives in a changing climate.

Energy efficiency and weatherization, along with efficient electrification, will immediately reduce energy use overall and emissions from buildings, providing benefits to the energy system and to the broader economy. Efficient electrification will enable buildings to be able to operate with increasingly lower emissions as the State advances toward a zero-emissions electric grid. Growth in demand for energy efficiency, weatherization services, and heat pump systems will provide new and incumbent workers with opportunities in the clean energy economy and encourage economic development as design professionals, installers, and manufacturers expand their capacity to serve the growing regional market.

1.4. The Energy Transition Highlights the Opportunity to Improve Buildings in Disadvantaged Communities and Low- to Moderate-Income Housing

Though LMI households and residents in DACs are among those who stand to benefit the most from modernizing New York's building stock, ensuring energy investments and their associated benefits

equitably reach these populations will require intentional effort. These households and residents face barriers including limited access to affordable capital, lower home ownership rates, and disproportionate energy burdens. Similarly, affordable housing property owners often operate on tight margins and may have limited access to capital to make energy-related improvements. Among low-income housing and in DACs in particular, there is a higher proportion of homes and buildings with structural deficiencies and other health and safety issues, which can inhibit energy efficiency and weatherization, as well as electrification measures. Investments in these communities will be critical to the successful and equitable transformation of the buildings sector.

2. State of the Sector

2.1. New York Is Advancing Statewide Goals

New York has a statewide energy efficiency target of 185 trillion British thermal units (TBtu) of end-use energy savings by 2025—relative to forecasted energy consumption. This is the equivalent to fueling and powering over 1.8 million New York homes annually. The 185 TBtu target is set on an all-fuels basis, covering buildings and industrial facilities (while excluding the transportation sector) and aggregating energy efficiency achievement from across electricity, natural gas, and delivered fuels.

State agencies and authorities, electric and gas utilities, and private sector businesses have made significant progress toward this target. Across the supply chain, market actors have collaborated to scale and innovate energy efficiency and electrification activities, improve cost effectiveness of energy efficiency and electrification solutions, foster public-private partnerships, and encourage greater leverage of public funds with private capital. By June of 2025, over 80 percent of the targeted efficiency savings had been achieved through State- and utility-led actions, meeting nearly 150 TBtu of New York's target. Energy efficiency programs administered by the investor-owned utilities and Long Island Power Authority (LIPA) have installed over 88 TBtu of savings while New York State Energy Research and Development Authority (NYSERDA) programs delivered statewide have driven more than 40 TBtu of direct savings, plus more than 6 TBtu of evaluated indirect savings. State energy codes have contributed over 3 TBtu of savings. State-owned and operated facilities are leading by example in their operations and construction activities to deliver 11 TBtu of the statewide target and have achieved over 9 TBtu of installed energy efficiency. In addition, federal appliance standards have been critical in driving efficiency savings, resulting in more than 24 TBtu of energy efficiency.

Even with the progress that has been accomplished, significant opportunities for cost-effective energy savings and GHG emissions reductions remain in the buildings sector. The *Assessment of Energy Efficiency and Electrification Potential in New York State Residential and Commercial Buildings* underscored that energy efficiency incentive programs must transition away from lighting and toward deeper savings measures (namely building envelope and space heating improvements) to drive savings above existing federal standards.[12] The study found that heat pump installation and building envelope improvement packages are highly responsive to incentives, in particular for single-family homes. Concurrently, the study also found that, for a set of low-cost energy efficiency measures that offer reasonable returns on investment (including higher-efficiency boilers and furnaces, HVAC tune-ups, commissioning and distribution improvements, and thermostats and boiler controls), providing

incentives does not significantly increase market adoption. This statewide study suggests that strategic opportunities to drive energy savings with public incentives include residential building envelope improvements, efficient electrification of space and hot water heating in residential and commercial buildings, and certain non-thermostat HVAC controls in the commercial sector.

2.2. New York Has a Strong Foundation of Policy and Programs to Build Upon

2.2.1. Major Programs/Initiatives in Place or Underway

New York State currently invests over $1 billion annually in public and ratepayer funds for State- and utility-administered customer incentives and financing offerings that help make energy efficiency and electrification solutions more available and affordable. Well-established policies and programs (further described below) are in place to help New Yorkers lower energy use and save on energy bills, assist residents and business owners understand, plan, and pay for energy upgrades, and stimulate innovation, market transformation, and private investments to advance efficient and low carbon buildings.

Continuing on the successes of the Clean Energy Fund and New Efficiency: New York, the Public Service Commission (PSC) issued orders in May 2025 approving non-LMI and LMI portfolios for energy efficiency and building electrification programs administered through NYSERDA and the State's large investor-owned utilities, reflecting a total annual budget of $1 billion from 2026 through 2030.[13] The PSC adopted a strategic framework for the ratepayer-funded energy efficiency and building electrification program portfolios, establishing that a minimum of 85 percent of the funding must be dedicated toward strategic measures, such as heat pumps and building envelope improvements, that reduce energy load and advance electrification and electrification-readiness, signaling a clear commitment to align investments with the State's clean energy goals. These portfolios will work in concert with other State and federal resources—including from the Regional Greenhouse Gas Initiative (RGGI) and the Environmental Bond Act—to advance a transformation of the buildings sector.

Central to New York's energy transition is the State's policy commitment to prioritizing LMI residents and those residing in DACs. The PSC's Energy Affordability Policy sets a goal of ensuring that low-income households will pay no more than six percent of annual household income toward energy bills, with major electric and gas utilities providing low-income customers with energy bill payment assistance through monthly tiered discounts. Additionally, ratepayer-funded LMI programs dedicated to improving energy affordability and access to clean energy solutions have been in place since the inception of the System Benefits Charge and continue to be a cornerstone of New York's residential energy efficiency and building electrification portfolios. NYSERDA, Homes and Community Renewal (HCR), and LIPA—in coordination with the utilities and the Office of Temporary and Disability Assistance (OTDA)—provide State leadership in administering ratepayer, RGGI, federal, and State funding across a multitude of programs serving LMI households, as described below and in Section 4.1.2.

Key initiatives include:

- **The NYS Clean Heat program** broadly advances clean heating and cooling solutions statewide. From 2020 through 2025 the collaborative has been led by New York's electric utilities and NYSERDA, providing upfront customer incentives for heat pumps while supporting broader

market development aimed at strengthening the heat pump supply chain and helping contractors and consumers better understand clean heating options. Comparable programs on Long Island are run by LIPA. Beginning in 2026, Clean Heat will exclusively serve the 1-4 family market-rate residential sector through incentives for heat pump installations.

- **NYSERDA's Comfort Home Program** currently offers seal and insulate weatherization packages throughout New York State to improve building envelopes and support peak load reduction in 1–4-unit homes. Comfort Home will continue to operate through 2026 with an expected hand-off to the new regional weatherization programs currently under development by the electric and gas utilities to serve 1–4 family homes in the upstate and downstate regions.
- **NYSERDA's Empower+, LIPA's Home Comfort Plus, the Weatherization Assistance Program, and the utility administered Affordable Multifamily Energy Efficiency Program (AMEEP), along with other programs** support energy efficiency and electrification solutions that will help LMI New Yorkers save energy and money, increase comfort, and improve the quality of their homes.[14]
- **HCR** is working to produce high-quality affordable housing with improved building envelope performance and significantly lower (or zero) GHG emissions from fossil-fuel-burning appliances. HCR is carrying out the State's $25 billion, five-year housing plan to create or preserve 100,000 affordable homes across New York. The housing plan also provides for electrification and energy efficiency work to be ready for electrification in an additional 50,000 homes.
- **Green Jobs – Green New York (GJGNY)** offers energy assessments and low-interest financing to help residential customers, small businesses, and not-for-profit organizations make energy efficiency upgrades. Created in the 2009 Green Jobs – Green New York Act, the program also supports workforce training for clean energy careers, with funding support provided through proceeds from the sale of carbon emission credits under RGGI.
- **Demonstration programs**, including NYSERDA's Empire Building Challenge (EBC), advance the market for building decarbonization for larger and more complex building sub-sectors. In partnership with the real estate industry and technology solution providers, these programs test and demonstrate new decarbonization solutions and identify areas for further technological innovation. These demonstrations have focused on commercial and affordable multifamily buildings and have more recently expanded to include hospitals.
- **Design standards** set by HCR are leading the industry in sustainable construction and require affordable multifamily housing to be constructed to zero-emission standards. Additionally, a new first-of-its-kind interim "Decarbonization and Climate Resiliency Design Guide" for State buildings standardizes recommendations for increasing energy efficiency, designing for zero emissions, and designing for climate resiliency in State buildings. These guidelines will begin integrating into State projects in 2025 and will ensure State investments are reducing emissions and serving New Yorkers well into the future.

2.2.2. Recent Policy Accomplishments

New York State has enacted several key policies to significantly advance pathways to an efficient and decarbonized building stock.

- **Zero-emission codes for new buildings.** In July 2025, the New York State Fire Prevention and Building Code Council (Code Council) adopted new State codes that prohibit the use of fossil fuel equipment and building systems in new buildings (with some exceptions) and meet the requirements of the Advanced Building Codes, Appliance and Equipment Efficiency Standards Act of 2022.[15] Implementation of the all-electric new construction requirements included in these new codes is currently subject to ongoing litigation.[16]
- **The Advanced Building Codes, Appliance and Equipment Efficiency Standards Act of 2022** directed the adoption of an Energy Code with greater energy savings than the national model codes (see action by the Code Council in previous bullet point) and appliance and equipment standards to improve energy efficiency. NYSERDA has accordingly promulgated minimum efficiency standards for 21 product categories, which help maintain performance and quality while reducing energy and/or water consumption, reduce utility bill costs, and lower GHG emissions.[17]
- **New York's Utility Thermal Energy Networks and Jobs Act of 2022 (UTENJA)** allows gas and combined gas and electric utilities to become holistic thermal energy providers. It requires New York's seven largest investor-owned gas and electric utilities to propose thermal energy network (TEN) pilot projects for PSC review and approval, with an emphasis on serving disadvantaged communities. It also directs the PSC, which initiated a proceeding in September 2022, to establish a regulatory framework for these networks that protects customers, supports fair market access and third-party competition/participation and exempts non-utility-owned small-scale networks while promoting the training and transition of utility workers impacted by the Climate Act.
- **A $1 billion climate investment in the FY 2026 Enacted Budget** dedicates $450 million to reducing building emissions—investing in energy efficiency and clean heating technologies such as heat pumps. It also advances next-generation infrastructure, with $200 million for TENs, including projects at the State University of New York (SUNY) and City University of New York (CUNY) campuses and State and municipal facilities.[18]

3. Outlook (2025 – 2040)

The next fifteen years will be a period of significant transition for the buildings sector as end-users increasingly move away from a reliance on fossil fuels. Advanced codes and zero-emission codes help drive new construction of highly efficient and comfortable buildings, which use heat pumps for heating, cooling, and hot water. In existing buildings, replacing aging appliances presents meaningful opportunities to drive improved energy performance through more efficient building envelopes and efficient, electrified technologies. State, local, and federal actions are already helping to support this early market evolution as described in Section 2, and these existing policies will continue building the

momentum that is needed to drive a transformation of New York's buildings, becoming more evident over time.

The State Energy Plan Pathways Analysis shows that additional governmental and private action can and will lower energy usage and support gradual market penetration of clean energy technologies. Under the Additional Action scenario, the residential sector is expected to see a total of 680,000 housing units with heat pumps as the primary heating system and 1.2 million housing units with efficient building envelopes in place by 2030.

Beyond 2030, continued investment, innovation, and policy action will further accelerate energy efficiency and heat pump installation such that by 2040, heat pumps are projected to make up 47 percent of HVAC sales share, outpacing new gas equipment installations and resulting in 1.8 million housing units with heat pumps as the primary heating system and 3.3 million units with efficient building envelopes in place across single-family and multifamily homes.[19] Similarly, in the commercial sector, heat pumps are expected to reach 26 percent sales share by 2030 and 36 percent sales share by 2040. Overall, total energy demand in the commercial buildings sector will see reductions of more than 10 percent by 2040 as buildings prioritize load reduction, more efficient equipment, and a transition away from less-efficient heating with fossil fuels.

Notably, the Pathways Analysis highlights that across all sectors and throughout the Energy Plan timeframe, energy efficiency, weatherization, and other load reduction measures consistently outpace heat pump adoption. Thus, while meaningful adoption of heat pumps and other efficient electric appliances will transform the energy profile of the buildings sector, energy efficiency and load reduction remain a bedrock strategy to enabling a reliable and affordable transition for energy consumers and suppliers alike. Similarly, phased electrification and supplemental heating strategies will remain important approaches to decarbonizing existing buildings through 2040. Approaching mid-century, as more buildings begin to fully electrify and as research, development, and demonstration (RD&D) advances, some hard-to-decarbonize building typologies may continue to be served by low-carbon district steam or by low-carbon alternative fuels (as discussed in the Low-Carbon Alternative Fuels chapter of this Plan). Throughout this transformation, LMI households and disadvantaged communities will need to be protected from potential displacement and affordability risks.

Achieving the level of transformation described under this Additional Action scenario requires a stable market and clear policy signals. This scenario assumes existing policies, incentives, and financial assistance in place as of October 2025 will remain intact, though the current federal and global economic context is one of great uncertainty which impacts long-term planning, investment decisions, and the pace of transition. Federal policy sensitivity cases analyzed as part of the Pathways Analysis indicate that the recent loss of federal incentives for energy efficiency measures and efficient electric equipment is expected to have a dampening effect on the market and slow action by building owners. Additional repeal of policies such as federal appliance standards would further jeopardize progress to lower building energy usage, resulting in roughly 50 TBtu more energy usage from buildings projected in 2040 than would have been expected prior to the Inflation Reduction Act rollback.

Though the impacts of federal changes are meaningful, these sensitivity cases also indicate that existing State policies and programs at the time of modeling (including State and utility incentive programs and advanced, energy-efficient codes and appliance standards) significantly mitigate the consequences of the rollback of federal tax credits and other incentives, acting as the primary policy drivers of energy efficiency and heat pump adoption in New York State and establishing a pathway for continued progress. Regardless of future federal actions or other policy updates, the scale of investment needed to modernize and decarbonize the buildings sector requires that New York State continue and expand upon current publicly supported initiatives that help animate the broader market.

With these needs and uncertainties in mind, the themes and recommendations discussed in the remainder of this chapter reflect ambitious, yet achievable, approaches that are expected to promote a consistent, gradual transition and put New York on a path of achievement that resembles the Additional Action scenario and lays a market foundation for even more ambition. However, full realization of Climate Act targets by 2050, as portrayed in the Net Zero scenarios, would require significant additional investment and market adoption for efficient electrification, backed by strong policy commitments such as new regulatory mandates, incentives for early retirement of existing fossil fuel equipment, as well as substantial technological progress that helps to bring more affordable, advanced technical solutions to market for even the hardest-to-electrify building types.

4. Themes and Recommended Actions

4.1. Making Energy Efficiency and Electrification Upgrades More Affordable

4.1.1. Mitigating and Reducing Cost Barriers to Efficiency and Electrification

Energy efficiency and decarbonization deliver significant value to building owners and occupants, but the cost of energy upgrades often outweighs the benefits that can be monetized in the marketplace. At the same time, political and market instability in the wider economy creates an uncertain investment environment. A volatile near-term economic context has shortened the investment horizon, putting pressure on companies to reduce capital spending and impacting wages as well as equipment and installation costs, while diminishing the purchasing power of consumers. Additional shocks to the global economy from international conflicts, fiscal and trade policies, and energy delivery disruptions have increased uncertainty and strained budgets.

Successfully enabling the energy transition of the buildings sector will require addressing upfront and operating cost barriers. Continued incentive programs, such as upfront rebates and tax credits, play an important role in reducing costs as the clean energy market develops, and must be combined with access to affordable financing. Additionally, public support will be needed to drive medium- and long-term cost reductions through scale and innovation, as further described in Section 4.2.

An important strategy for managing the cost and disruption of energy upgrades within existing buildings is by sequencing improvements, where different upgrades in a building may happen at different times to align with equipment and capital planning lifecycles and tenant turnover. For large buildings, Resource Efficient Decarbonization (RED), as described below, is a proven strategy to leverage load reduction and phased electrification.[20] Similarly, a homeowner may sequence upgrades by replacing a gas-fired hot

water heater with an efficient heat pump appliance before it is time to replace the space heating and cooling equipment, or vice versa.

Resource Efficient Decarbonization

Resource Efficient Decarbonization (RED) is an incremental methodology, coupled with integrated design and strategic capital planning, that creates a path towards efficiently decarbonizing buildings. It offers a strategic, phased approach to eliminate greenhouse gas emissions from tall buildings, making decarbonization technically and economically feasible. Applying this model provides a repeatable process to help alleviate space constraints, optimize peak thermal capacity, increase operational efficiencies, utilize waste heat, and reduce the need for oversized electric thermal energy systems, creating retrofit cost compression. The model contains four steps:

1. **Reduce** energy loads as much as possible
2. **Reconfigure** systems to create thermal networks and enable low temperature distribution
3. **Recover** as much heat as possible from air, water, and wastewater sources
4. **Replace** equipment incrementally over time until full decarbonization is reached

Addressing Upfront Cost Barriers

In existing buildings, the upfront project costs for efficiency and electrification can be significant. The cost of efficient electric equipment, such as heat pumps, is currently higher than a like-for-like equipment replacement of fossil-fuel-fired systems, while the project's economic return varies depending on a building's existing heating fuel, as discussed below. As the technology driving low-carbon energy solutions is relatively new (particularly in larger buildings and those with hard-to-electrify energy loads), costs may remain higher than traditional fossil fuel solutions.

Beyond the cost of equipment, the ancillary work needed to retrofit a building to enable a heat pump installation or other low-carbon energy solution adds to project costs. For example, new duct work and upgrades to a building's electrical service also may be needed to support heat pumps and all-electric appliances. In some cases, a building may also require remediation work related to health and safety issues before any energy efficiency and/or electrification work can commence.

Additionally, despite recent growth trends in heat pump sales and installations, the New York market has not yet started seeing a decline in the installation costs for efficient electrification retrofits in existing buildings. A 2024 study found that total HVAC replacement project costs in the residential sector increased by an average of 20 percent from 2021 to 2024. Roughly half of these project costs are driven by "soft costs," which increased by 24 percent in the same time period. Soft costs include installation labor costs, project design, marketing and customer acquisition, and transaction costs (e.g., permitting, certifications).[21] Although a number of factors, including COVID-19-related supply chain disruptions, resulted in high inflation across the economy during and after this time (the national Producer Price Index increased by 15 percent from July 2021 to July 2024 for residential construction and 14.7 percent for non-residential construction), the relative novelty of heat pumps both within New York and nationwide make these technologies more susceptible to cost changes. Reducing both the hard and soft costs of energy projects will be key to expanding the market.

Affordable Operating Costs

Another challenge that can impede building upgrade projects is the potential impact on operational energy costs. Energy efficiency is an established means of reducing household and business energy spending by lowering usage. Continuing to prioritize efficiency and load reduction measures will be an important strategy to support energy affordability and manage the costs of decarbonization retrofits. Still, electrification projects can be challenging with respect to their impact on ongoing costs given the current relative costs of energy. In particular, the cost of gas, as compared to electricity, is a barrier to electrification as switching from gas to heat pumps can result in higher operating costs. Switching to heat pumps can reduce energy bills when they are replacing systems that use oil, propane, and/or electric baseboard heating, particularly when paired with thermal efficiency measures. But electricity prices in New York State are currently well above gas prices on a per unit of energy basis, creating uncertainty as to whether heat pump investments will offer an economic return on investment when they replace gas boilers and furnaces, despite heat pumps operating at two to three times the efficiency of combustion-based gas heating systems. Converting a building from gas heating to a highly efficient, cold climate heat pump may increase bills for some customers, but in other cases, can result in lower or comparable energy costs. Large buildings that pay commercial electricity rates for central systems also need to factor in whether adopting heat pumps will result in higher electricity demand charges.

Initiatives Underway (e.g., Policy Processes, Programs)

- The PSC's portfolio for energy efficiency and building electrification includes several of New York State's core incentive programs, such as the residential Comfort Home program and future utility-administered regional weatherization programs offering rebates for air sealing and insulation packages, as well as the residential heat pump program, NYS Clean Heat.[22] The State likewise has established programs that focus on improving efficiency and decarbonization of the commercial and institutional sectors, including the Empire Building Challenge, P-12 Schools Initiative, and Buildings of Excellence, which are described further in Section 4.2.1.

- NYS Clean Heat is intended to drive the adoption of heat pump technologies in new and existing buildings. The program provides upfront customer incentives while supporting broader market development. From its inception in April 2020 to April 2024, Clean Heat has supported over 57,000 full-load home heating projects, with most of the projects being served by cold climate air-source heat pumps. The program has primarily supported the 1-4 family sector and will do so exclusively from 2026 onward, in tandem with minimum weatherization requirements that will be in effect in 2028. In addition to customer incentives, Clean Heat has supported market development for heat pumps through 2025 as described in Section 4.2.1.

- New York State also administers several programs specifically dedicated to helping income-eligible homeowners and renters adopt climate-friendly housing improvements, as described further in Section 4.1.2.

- GJGNY offers New Yorkers—with special focus on LMI residents—access to no-cost energy assessments, below-market-interest financing, and work readiness pathways to participate in the energy transition.

- New York enacted a State Geothermal Income Tax Credit equal to 25 percent of geothermal system equipment expenditures. The FY 2026 Enacted Budget increased the tax credit to $10,000 for eligible geothermal systems installed beginning in July 2025 and also makes this tax credit refundable.

Recommendations

- **The State and utilities should continue to offer financial incentives to reduce upfront costs and motivate New Yorkers to make energy upgrades in buildings,** supporting strategic measures that result in energy load reduction and reduction or elimination of fossil fuel consumption through energy efficiency and weatherization, heat recovery, and electrification. NYSERDA, LIPA, HCR, the New York Power Authority (NYPA), and the PSC/Department of Public Service (DPS) should collectively ensure that these incentives offered by State- and utility-administered programs are tailored by market segment and designed to support flexibility in the way that buildings reduce energy use and efficiently electrify.

- **State- and ratepayer-supported incentives should prioritize support for energy upgrades in existing buildings that are likely to deliver both energy and cost savings.** For example, residential heat pump programs could focus outreach to homes that are heating with oil, propane, or electric resistance equipment to encourage near-term heat pump adoption, as well as continue to have incentives available that help make switching from gas equipment financially viable as aging equipment becomes ready for replacement (though before an emergency replacement is needed).

- **NYSERDA should continue to offer and explore expanding access to affordable financing programs** such as GJGNY. It should also continue offering, in collaboration with the NY Green Bank, financing products to community development financial institutions, credit unions, and specialized community-focused financial intermediaries, with the objective of unlocking local private capital and enabling below-market-rate consumer lending programs.

- **DPS should ensure the efficient and effective rollout of the three-part rate design** (customer charge, contract demand charge, daily as-used demand charge) adopted by the Commission under the standby rate proceeding. This includes the development and availability of tools necessary to evaluate the impact of such rates on various use cases. This roll-out should include implementation approaches that align with the PSC's rate design principles of being practical, understandable, and promoting customer choice while advancing the goals of electrification and affordability.

4.1.2. Prioritizing an Affordable and Equitable Transition for Low- to Moderate-Income Housing and Buildings in Disadvantaged Communities

The cost of energy upgrades as well as energy and housing costs in general are acute challenges for LMI households, affordable housing property owners, and building owners in disadvantaged communities who lack financial and capital resources to make these investments. Many LMI homes and buildings in DACs will need to address costly health and safety hazards such as mold or asbestos remediation or

other structural repairs before they are ready to undertake weatherization, efficient electrification, or other energy upgrades. Electrifying these buildings also often requires expensive upgrades to electric infrastructure that are challenging to fund through existing programs, such as upgrading electric panels, and in some old homes, replacing knob-and-tube wiring. The accumulation of these costs, along with the relatively limited funding sources that are available to help residents and building owners offset them, often makes building energy upgrades prohibitive to LMI households and other disadvantaged community populations unless they can access incentives and/or subsidized financing. The financial assistance opportunities that do exist are not without their own challenges, as home and property owners must frequently go through multiple State- or utility-administered programs to access incentives for various aspects of a building upgrade project.

Prioritizing energy efficiency and weatherization as a primary strategy for permanent load reduction and to support energy affordability while investing in LMI homes and buildings in DACs will be critical. Attention to how building electrification may impact ongoing energy costs is also a particularly important policy concern for low-income households, who often experience disproportionately high energy burdens. State- and utility-administered programs can help manage these considerations by ensuring weatherization and other load-reducing measures are implemented prior to or in conjunction with electrification of LMI homes and other energy-burdened buildings.

For homes that are owner-occupied or where heating costs already are paid by residents, a key consideration is how to structure and expand bill assistance and participation in community solar programs in a manner that helps manage energy costs for low-income households, especially as they electrify their homes with heat pumps. Existing low-income energy bill discount programs are not currently able to serve all households with needs. Additionally, affordable housing providers—who frequently pay a portion of LMI households' energy costs—are not eligible for these bill discount programs. Though electrification may make managing energy affordability challenging at present given current gas and electricity prices, these dynamics must be carefully monitored and re-assessed as what drives energy cost burden over time for an LMI household may change due to a variety of reasons, including potential increases in gas costs as more and more customers electrify and transition away from gas over the long-term (as discussed in the Natural Gas chapter of this Plan).

In rental housing, there is an additional need to consider potential cost-shifting risks that may lead residents to bear new costs. Electrification of residential buildings can lead to changes in metering and the potential for a transfer in operating costs between building owners and residents. For example, many multifamily buildings in New York City have centralized gas heating systems and individual electric meters for each apartment. Costs associated with heating are included in the rent while residents pay individual electricity bills. If the building is electrified using a heat pump system connected to the apartments' electric meters, heating costs would be transferred from the owner to the residents, leading to higher overall housing and energy costs if rent is not adjusted to account for this transfer. While housing policies may manage these impacts in certain circumstances, such as in regulated or subsidized affordable housing, other LMI renters currently do not have any legal protections against housing cost increases or cost shifting that may occur because of building electrification. Advancing electrification of LMI housing therefore warrants careful consideration of the potential impacts across different types of

population segments and continued examination of policies that can help to enable equitable electrification for regulated affordable housing.

As nearly 46 percent of households in New York reside in rental properties, it will be necessary to ensure that decarbonization strategies more broadly can contribute to and preserve housing affordability for tenants. This includes assessing market, regulatory, and policy levers across the State's housing and energy portfolios to address barriers that tenants face accessing decarbonization incentive programs, improving technical assistance and access to capital for building owners; mitigating the potential for cost-shifting to occur between landlord and tenant when electrifying buildings; and exploring opportunities to strengthen consumer protections related to the submetering of affordable multifamily buildings. Within New York State, HCR maintains regulatory oversight over a variety of affordable multifamily property portfolios across the state and these properties are governed by a series of laws, regulations, and/or regulatory agreements that provide tenants with a variety of protections including predictable forms of rent increases, which may include utility and meter changes with appropriate approvals and oversight. However, additional consideration is necessary to advance similar protections for tenants residing in naturally occurring affordable housing.

Finally, while access to the cooling benefits of heat pumps is an important part of the opportunity to improve the quality of LMI homes in a warming climate, this may introduce added costs. Incentive offerings and energy bill assistance structures should be designed to accommodate costs associated with new or additional cooling loads.

Initiatives Underway (e.g., Policy Processes, Programs)

- NYSERDA's **EmPower+** program provides no-cost and discounted energy efficiency and electrification solutions that will help income-eligible New Yorkers save energy and money, increase comfort, and upgrade their homes through a phased, efficiency-first approach. Comparable assistance is offered through LIPA's Home Comfort Plus program.
    - EmPower+ is funded through a variety of sources including the RGGI, utility ratepayer collections, and the State budget. In addition to funding from the Inflation Reduction Act, the program received a one-time infusion of funds through the State budget in 2023 intended to be spent over two years, making it the largest program of its kind in the country without putting additional strain on ratepayer collections. Upon the expenditure of this allocation, Governor Hochul secured another $50 million in the FY 2026 budget through the $1 billion Sustainable Future Program, which will be allocated for heat pumps and other electrification measures.
    - With the deployment of the Inflation Reduction Act-funded Home Electrification and Appliance Rebates offered through the EmPower+ program, NYSERDA has provided incentives to LMI 1-4 unit residential buildings to make the transition from fossil fuel heating and hot water to heat pumps. In taking on this role, NYSERDA has rolled out a series of targeted technical assistance initiatives to promote a better range of affordable, high-performing whole house heat pump system designs, proper equipment selection,

and quality installations. These efforts are designed to aid in reducing the up-front cost of installation as well as the future operating costs of this equipment for the occupants.

- **The Weatherization Assistance Program**, administered by HCR, helps income-eligible homeowners and renters reduce energy costs and improve comfort through energy efficiency and weatherization, direct installation of electricity savings measures, and mechanical system improvements.
- **AMEEP** is administered through the investor-owned utilities to support energy efficiency upgrades in existing affordable multifamily homes downstate, and NYSERDA will launch a new program to support affordable multifamily homes upstate.[23]
- **The PSC's Energy Affordability Policy,** established in 2016, sets a goal to ensure that low-income households will pay no more than six percent of annual household income toward energy bills. The Energy Affordability Program supports this goal and is administered through major electric and gas utilities to provide low-income customers with energy bill payment assistance through monthly tiered discounts. In July 2025, the PSC adopted an Enhanced Energy Affordability Policy to extend energy bill discounts to additional households below median income.
- **Through the PSC's Energy Affordability Guarantee Pilot**, a first-in-the-nation pilot program, low-income homes that fully electrify through NYSERDA's EmPower+ program will pay no more than six percent of their annual income on electricity.
- **The Climate Friendly Homes Fund, administered by HCR,** provides 0 percent interest and grant financing for smaller multifamily properties between 5 and 150 units in DACs to support electrification measures.
- **In subsidized affordable housing, funding embedded within current Housing Plans** (e.g., HCR Housing Plan, HCR Climate Friendly Homes Fund) and design guidelines are enabling the development of efficient and electrified units as housing agencies help support creating and preserving affordable homes.
- **The Green Affordable Pre-Electrification Program**, newly established in the FY 2026 Enacted Budget, provides $2 million administered through HCR to support health and safety remediation upgrades needed prior to homes and apartments being eligible for energy efficiency and weatherization, electrification, and insulation incentive programs.
- **The Clean Green Schools program** serves public schools that traditionally lack resources to invest in infrastructure improvements. This program aims to improve the environmental sustainability of those schools by reducing school energy loads, decarbonizing their building portfolio, and creating healthier and more productive learning environments.
- **NYSERDA's Regional Clean Energy Hubs** are a multidisciplinary network of community- based organizations that are charged with establishing partnerships with local government and human service, housing, and workforce training organizations to connect residents and disadvantaged

communities with programs and resources to undertake clean energy upgrades or to otherwise participate in and benefit from the clean energy economy.

Recommendations

- **New York State, in partnership with local agencies and utilities, should continue to prioritize and coordinate public support across energy and housing programs to address energy performance and housing quality for LMI housing and buildings in DACs,** with State leadership from HCR, NYSERDA, LIPA, PSC and DPS, and OTDA.

- **NYSERDA, HCR, LIPA, and the PSC/DPS should ensure State and investor-owned utility programs that support energy upgrades in LMI housing focus on weatherization in the near-term.** LMI programs should take an "efficiency-first" approach when supporting electrification, where energy efficiency and load reduction measures are required to be completed prior to or in conjunction with a heat pump installation.

- **New York State should explore all funding sources that could support energy upgrades and non-energy improvements that are necessary before the installation of energy measures in LMI housing, including health and safety upgrades.** The State should consider how existing funding for emergency replacement and deferred maintenance can be leveraged to help enable decarbonization.

- **NYSERDA, HCR, LIPA, OTDA, and the PSC/DPS should continue to simplify and streamline access to energy efficiency, building electrification, and related programs with particular attention to LMI programs, including those administered by the investor-owned utilities**. This should include streamlining program application processes to help support New Yorkers' ability to smoothly access eligible services across agencies. The Low-Income Energy Task Force should be leveraged to coordinate and advance these cross-agency efforts.

- **The State should consider opportunities to expand or modify energy bill assistance while prioritizing strategies for lasting energy bill reductions.** This should include optimizing available resources to reduce household energy burden, including bill payment assistance programs and the prioritization of weatherization and energy efficiency programs to provide long-term energy bill reductions. In addition, the State should explore opportunities to expand participation in community solar or other clean energy projects that provide electric bill savings to income-eligible households and/or that benefit affordable housing or buildings in DACs.

- **NYSERDA, HCR, the PSC/DPS, LIPA, and NYPA should continue to support opportunities for LMI residents and buildings in DACs to pair electrification with solar energy** to benefit both the building owner and residents. Though there is particular benefit for LMI and DAC residents, such opportunities may have broader applicability, including for market rate residential and other buildings.

- **State agencies including DPS, HCR, NYSERDA, and OTDA should coordinate on policies, programs, and strategies to advance and preserve housing affordability as part of the State's**

effort to decarbonize buildings. The State, including HCR should consider updates to policies that enable equitable electrification for regulated affordable housing.

4.2. Transforming the Market for Efficient and Low-Carbon Building Technologies

4.2.1. Supporting Marketing Development

State support for market development is important to deliver affordable, effective, and value-enhancing building upgrades that reduce and/or eliminate fossil fuel consumption. These initiatives are necessary to address market barriers and gaps, working alongside financial incentive programs to drive long-lasting, sustainable change. Market development strategies aim to address key barriers, including a limited clean building technology supply chain, lack of industry and consumer awareness about available technology or its benefits; limited availability or variety of affordable products; perceived risks of new technology; skilled workforce shortages; and limited access to capital by consumers and/or product manufacturers.

Market development support also includes key technical assistance and other activities that deliver robust information and insights to building owners to directly support decision-making, including showing how measures that reduce and eliminate fossil fuel consumption can become standard "business-as-usual" considerations when undertaking energy and capital planning. Delivering market insights about project cost, performance and other key factors in a transparent manner helps build confidence in decarbonization solutions and shows building decisionmakers and the industry-at-large that such solutions are replicable and reliable. Such information also encourages supply chain actors to adapt to deliver clean energy technologies. Ultimately, to drive widespread adoption of clean energy solutions will require building awareness and confidence among contractors and consumers and providing streamlined technology and equipment solutions, while equipping the clean energy workforce with the skills to confidently install and service low-carbon solutions in New York.

Initiatives Underway (e.g., Policy Processes, Programs)

- Through the Clean Energy Fund, NYSERDA has advanced $2.7 billion in investments within its market development portfolio from 2014 to 2025, enabling the delivery of energy efficiency and clean energy solutions by providing financial support, technical knowledge, data, and education/workforce training to service providers and customers. This portfolio also specifically supports initiatives that benefit low-and-moderate income households.

- Market development initiatives are in place aimed at driving heat pump adoption by reducing market barriers for contractors and solution providers and dispelling misinformation. Through broader access to sales tools, design and installer training, quality installation practices, marketing, and education, these initiatives help contractors and customers understand heat pump products and make informed choices.

- Through Clean Heat Connect, NYSERDA has developed a voluntary network of 28 heat pump manufacturers and distributors representing the majority of the New York State heat pump market. Through this network, NYSERDA leverages its trusted relationship as an honest broker with these market actors by providing easy-to-use technical support, business support, and

educational resources they can disseminate to their contractor networks to promote growing overall market capacity, market confidence, and consumer interest in heat pumps by reaching contractors at scale.

- The Experience Clean Heat initiative is a communication and engagement campaign focused on promoting direct access to and experience with heat pumps to build consumer and contractor confidence and boost demand through publicly accessible pilot sites where heat pumps are currently operating. This pilot initiative has enrolled 46 participant sites statewide and will continue to be tested in market through 2026 with a planned evaluation to assess its impact for future consideration.
- The Flexible Technical Assistance (FlexTech) Program shares the cost to produce objective, site-specific, and targeted studies on how best to implement clean energy and/or energy efficiency technologies. This program supports commercial, institutional, industrial, agriculture, and multifamily customers to chart their course for reducing and eliminating fossil fuel consumption and upgrading buildings. As of 2025, FlexTech also serves the P-12 Schools Initiative, with additional funding for schools located in Disadvantaged Communities.
- The EBC illustrates resource-efficient pathways for retrofitting buildings in hard-to-decarbonize segments, such as large residential and commercial buildings and hospitals, while NYSERDA's Buildings of Excellence program provides ongoing support for the design, construction, and operation of the next generation of carbon-neutral new construction, including affordable housing.
- Workforce development programs offered by NYSERDA, the New York State Department of Labor (DOL), and other state agencies and industry partners are supporting workers and businesses to help build a trained workforce that is available and skilled in implementing high quality, efficient clean energy solutions, as described in the Clean Energy Jobs and a Just Transition chapter of this Plan.

Recommendations

- **NYSERDA, through existing GJGNY requirements, should continue to provide free audits for single family residential and small business applications, and consider opportunities to scale virtual remote audits.** These audits are valuable engagement opportunities to assist building owners to identify and prioritize projects that reduce energy consumption and learn how they can start planning for and implementing decarbonization retrofits. They provide homeowners and business-owners with a roadmap to guide their building investment planning as well as initial connections to energy service programs. Virtual energy assessments provide a path to offer decision-quality information to homeowners at greater scale and for lower cost than in-person on-site assessments.
- **NYSERDA should continue to cost-share technical assistance and energy planning that provides actionable information for how larger, more complex buildings can cost-effectively decarbonize over time following the Resource Efficient Decarbonization model.** NYSERDA

demonstration programs, as well as projects at SUNY campuses and other State facilities, can help to demonstrate how RED can be executed across large, hard-to-decarbonize typologies in the commercial, institutional, and multifamily sectors, yielding valuable market insights on how to scale and replicate approaches across various subsectors.

- **NYSERDA, DOL, industry, and institutional and community partners should continue to support workforce development and training for critical growing building occupations,** including energy auditors, weatherization technicians, and HVAC installers, as described in the Clean Energy Jobs and a Just Transition chapter of this Plan.

- **NYSERDA and utility program administrators should continue working with the industry to streamline and standardize the delivery of weatherization measures and heat pumps,** including focusing on the sale, system design, equipment selection, installation, and customer engagement process. This could include partnerships across the state that leverage co-funded investments in research and technical assistance to develop more affordable, high-performing system designs, system design templates, and tools and standards supporting greater transparency in equipment performance data to enable better informed equipment selection practices. Other strategies include piloting different weatherization and heat pump delivery models that could reduce custom installation and design costs, piloting an owner's representative service for under-resourced sub-sectors to help with project development and implementation, providing targeted educational resources and technical tools, and identifying opportunities for customer aggregation to help reduce costs and support community-scale transformation.

- **NYSERDA, NYPA, and utility program administrators should continue to engage key heat pump supply chain actors**—including manufacturers, distributors, and contractors—to help build confidence in heat pump products while improving access and availability for both residential and larger-scale heat pumps in New York State.

- **The State should explore providing mid-stream and upstream incentives to motivate local distributors of heating and air conditioning equipment to stock a range of efficient products** at affordable prices, increasing availability and consumer choice to support sales of efficient heat pumps for homes, small- and mid-sized businesses, and public buildings.

4.2.2. Accelerating Technology Innovation and Business Model Development

Continued innovation and new business models will be needed to help bring new and emerging electrification solutions to the market. Though heat pumps are available and can be configured for nearly every type of residential building, there are limited pathways for harder-to-decarbonize buildings. In typologies such as in existing multifamily buildings, large commercial buildings, and subsectors such as hospitals, laundromats, and restaurants that are reliant on gas for substantial process loads (e.g., functions that are not space heating and/or domestic hot water), there is a pressing need for equipment that is more affordable, easier to operate and install, and more effective.

State support for technology and business innovation should help to identify, consider, and design solutions by sub-sector that address the unique challenges in hard-to-decarbonize typologies. State innovation funding should be coordinated with strategic public-private partnerships in a manner that helps catalyze and leverage further investment from private or other governmental sources. Strategic partnerships that can effectively support replication of clean building technologies at scale are critical to drive deployment and cost compression of emerging solutions over time, while helping demonstrate the potential of these solutions in New York State. For example, technology-based partnerships with portfolio owners and affordable housing agencies that can aggregate demand and have significant purchasing power has been a promising approach to-date.

One direction that appears promising is innovation focused on drop-in/commoditized heat pump-based options that can be installed with minimal additional work (e.g., do not require custom engineering and design, electric upgrades, new piping/ducting, additional ventilation, etc.) and displace fossil fuel use. These are generally cheaper than existing solutions and significantly streamline the design/installation phase of a HVAC project. Various initiatives are underway to support innovation in this direction for heat pumps.

Initiatives Underway (e.g., Policy Processes, Programs)

- **The EBC and Empire Tech Prize (ETP)** advance the market for large building decarbonization through purposeful demonstrations in partnership with the real estate industry and solution providers. The EBC brings in a cohort of key portfolio building owners who have committed to decarbonizing their buildings. As part of this process, they identify key areas where technological innovation is needed. Solutions are then developed through the ETP process. The EBC has served commercial and affordable multifamily buildings since 2020 and expanded to include hospitals in 2025. The current ETP is focused on developing a drop-in high-temperature heat pump that can provide heat to buildings currently heated with steam, primarily addressing the New York City market.

- **The Clean Heat for All Challenge** seeks to develop innovative products designed for retrofitting solutions to hasten the transition to heat pump electrification and fossil-free heating sources. The initial challenge advanced a unitary, packaged window heat pump, which could be deployed with low cost and ease of installation. Following a successful demonstration in Fall 2024, the New York City Housing Authority (NYCHA) has plans to purchase and install 30,000 production models once they become available during 2025. Building on this approach, a packaged terminal heat pump challenge was launched in early 2025, awarding grants to support the development of electrified replacement equipment that is commonly used in multiple family buildings. Selection of manufacturers and recruitment of multifamily building owners as demonstration partners will occur throughout 2025 and 2026.

- **The Induction Stove Challenge** seeks innovative solutions for new induction stoves that can be installed in older buildings using standard 120-volt, 20-amp outlets. One or two selected manufacturers will have up to 24 months to design, prototype, and produce 100 units of the new product for testing during the challenge's pilot phase. The units will be installed in up to 100

NYCHA apartments, with new cookware provided to each participating household, with the intent of providing best-in-class comfortable cooking, as well as health and quality of life benefits to NYCHA residents.

Recommendations

- **NYSERDA should continue to fund innovation and in-state demonstration for drop-in decarbonization solutions that can be installed with minimal additional work (e.g. electrical upgrades, new piping/ducting, additional ventilation, etc.) and displace fossil fuel use.** These solutions should continue to be developed in partnership with portfolio owners that can deploy such equipment at scale. Ongoing innovation and deployment should focus on drop-in solutions for efficient cold-climate window heat pumps, packaged terminal heat pumps, and other opportunities.

- **The State, including NYSERDA, NYPA, and SUNY, should accelerate technology transfer, product testing, and commercialization** to make it easier to bring emerging solutions for efficient electrification to market in New York State. Key strategies could include recruiting companies with advanced technology that is being used in cold climate regions such as Northern Europe, aiding with product testing/certification and navigating the New York or U.S. market, and cost-sharing demonstration projects in New York to demonstrate the viability of these technologies in decarbonizing New York State buildings.

- **The State, including NYSERDA, Empire State Development, and SUNY, should support development of growth-stage companies and capital partners to scale clean energy solutions and new business models.** This could include continuing to provide support for local and statewide incubators, innovation challenges, and peer-based knowledge sharing among industry leaders, with dedicated support for minority- and women-owned business enterprises, socially responsible businesses, and solutions that benefit disadvantaged communities. Support could also focus on expanding successful demonstrations of key building energy technologies to promote economies of scale as well as investment in manufacturing facilities to meet state and regional demand**.**

- **The State, including NYSERDA, HCR, and SUNY/CUNY should continue to coordinate with the federal government, incubators, and industry leaders on RD&D investment areas to support development, demonstration, and technological improvement for the next generation of building decarbonization solutions.** Priority areas for public RD&D support include next-generation HVAC, building shell improvements, panelized offsite improvements, and demand flexibility.

4.3. Integrating Buildings Transformation with Gas, Electric, and Steam System Planning

4.3.1. Deploying Thermal Energy Networks

The term “thermal energy network” describes a network of equipment and pipes that are connected to thermal energy resources and deliver thermal energy to multiple buildings, providing space heating, and potentially cooling and domestic hot water. TENs that rely on combustion-based resources (e.g.,

cogeneration plants or boilers fueled by natural gas that generate steam or hot water) have existed in New York for over a century under several ownership types.[24] TENs that rely on low and carbon-free thermal resources (e.g., geothermal, surface water, waste heat, and air) are still in early development in New York State, but play (or are planned to play) a substantive role in the decarbonization strategies of many European countries—including (but not limited to) Denmark, Sweden, Germany, Scotland, Ireland, and Canada.

TENs can provide certain advantages over single-building solutions because they have the potential to more efficiently meet the aggregated thermal demand of multiple consumers (e.g., at a campus and/or community-scale location), especially when it includes a diverse set of buildings with different uses. By aggregating multiple building loads, a TEN can substantively reduce peak heating needs compared to stand-alone building solutions. Networks can also integrate a variety of thermal resources, including waste heat from wastewater sewage flows and treatment facilities, data centers and other centralized cooling equipment, transportation infrastructure, and other buildings and industrial processes. Certain TENs can further minimize the need for additional heating equipment located within the building, saving on space and maintenance costs. TENs by default aggregate thermal load, and when combined with thermal storage, can enable significant load shifting of heating demand at scale, thereby helping reduce operating costs (energy bills) and manage grid constraints.[25] TENs also present a unique opportunity to leverage the skills and expertise of gas workers for low-carbon projects, as the pipe networks used for thermal energy delivery are similar to those used in the oil and gas sector; this overlap enables existing union labor to transition into clean energy jobs.

State-level actions will be essential to the successful development of TENs in New York State and realizing their associated energy and emissions savings, including an emphasis on prudent resource planning to diversify energy sources and delivery strategies. [26] Despite their potential benefits, TENs face a series of challenges (both in New York State and the U.S.) due to long planning and construction timelines, high upfront capital expenditures, and regulatory complexity from serving multiple customer types and leveraging non-traditional energy resources (such as waste heat). In the near-term, single-owner networks such as campuses remain the easiest to develop and provide an opportunity to showcase the viability of TENs while attracting expertise, vendors, and services to New York.

Further analysis is needed to help identify the best path forward for New York State, including what policies are necessary to create a supportive market and policy environment for TENs. Key steps include but are not limited to: identifying where in the state, due to density of thermal demand and availability of potential thermal resources, may be most viable for TENs projects; improving access to this data to help de-risk site identification and drilling and to catalyze private interest and investment; assessment of potential business models and policy approaches that support customer acquisition, including area-based heat planning and supportive local zoning and permitting policies, public-private partnerships with municipalities, priority connection policies, and heating-as-a-service contracts (which allow developers to lock in customers as a network is being planned and installed, and obligate provision of reliable heating prior to and during network connection); and further work on understanding tradeoffs of TENs compared to standalone building solutions.

TENs can operate by delivering hot and chilled water from a central production plant, or by delivering ambient water to customers and using on-site heat pumps to meet heating and cooling needs. Both systems will be needed to fully take advantage of the opportunity, and present different advantages (see Table 1).

Table 1: Comparison of Types of TENs: Hot/Chilled Systems vs. Ambient Systems

Type	Infrastructure Types	Heat Sources and Heat Sharing	Electric System Impacts
Hot/Chilled	• Centralized plant holds most system infrastructure and distributes hot and chilled water, less equipment at the consumer site. • Require separate piping for hot and chilled water. • Much greater density of delivered thermal energy.	• Centralized production captures economies of scale when producing heated or chilled water. • Less risk for downstream customers, due to increased thermal energy density of delivered water. • System balancing is not vital to operations, and easy integration for network expansion or energy storage. • Storage in boilers and chillers can be long duration, providing backup and resiliency.	• Can alleviate demand on the electric grid, by serving heating and cooling demand separately. • Centralized infrastructure can be metered on industrial rates rather than residential. • Easy integration of cheap thermal storage through boilers and chillers. Customers only need a heat exchanger.
Ambient	• Fewer pipes and centralized equipment are needed, but additional in-building equipment is used to condition water to desired temperatures. • Pipes may need to be very large to deliver enough thermal energy to customers.	• Enables additional heat sources and heat sharing, as high temperatures are not required. • Less heat loss over long distances. • System balancing is vital to operations to ensure all customers have enough heat from ambient temperature water. • Difficult to expand networks for new customers.	• Additional on-site equipment increases electric demand, likely billed at highest electric rates (residential). • Fewer opportunities for storage.

Initiatives Underway (e.g., Policy Processes, Programs)

- **UTENJA**, as described in Section 2.2.2, allows the State's investor-owned utilities to own and operate TENs and directs the seven largest utilities to propose TENs pilot projects that include labor protections and support workforce development. It also directs the PSC to develop a regulatory framework to guide the ownership rules, market development, and rates structure for TENs.

- **The PSC's UTENJA proceeding** was initiated in September 2022 to implement the requirements of the statute.[27] Through this process, the PSC has adopted initial fair market access rules, which

will allow for utility-owned TENs to accept thermal energy; identifies small-scale TENs that will be exempt from Commission regulation at this time; promotes the training and transition of utility workers impacted by this act; and encourages third-party participation and competition where it will maximize benefits to customers.[28] Through this process, the PSC established a stage-gating process for the development and consideration of UTEN pilot projects proposals called for in the act. At the time of this writing, ten utility pilot projects are under consideration by the Commission.[29]

- **NYSERDA** has been supporting the market development of TENs from technical assistance to design and construction of networks through its Community Heat Pump Systems and Large Scale Thermal programs.
- **The Decarbonization Leadership Program** directs NYPA to develop decarbonization plans for fifteen of the highest emitting State facilities—including ten SUNY and CUNY campuses—that include consideration for TENs.[30]
- **The FY 2026 Enacted Budget includes funding for TENs construction as part of a $1 billion climate investment,** including $200 million for TENs projects at public and State-owned buildings such as SUNY and CUNY campuses, and $40 million for municipal TENs projects. This funding supports additional avenues to deploy and demonstrate the effectiveness of these networks.

Recommendations

- **NYSERDA, DPS, and other relevant State actors should develop a Thermal Energy Network Roadmap for New York State** that explores the overall role TENs could play in support of the state's building decarbonization goals and identifies market and other barriers currently facing viable TENs development in New York State, while identifying a set of holistic solutions in the near and mid-term the State could consider to address these barriers. This Roadmap should be informed by experiences in Europe, Canada, and jurisdictions in the United States, including assessing market and policy opportunities to promote the re-capture and re-utilization of existing waste heat from municipal, industrial, and transportation infrastructure. Development of this Roadmap should include and be informed by stakeholder and industry input, including but not limited to utilities, organized labor, local governments, environmental groups, community-based groups, real estate and economic development experts, and energy management experts. The Roadmap should be informed by related analysis including that described in the below recommendations.
- **NYSERDA, in coordination with DPS, should advance analysis of TENs.** Topics for study should include geospatial analysis to identify areas of the state that may be most viable for TENs (e.g., support mapping of thermal demand and thermal resources, including waste heat) and improve public access to thermal resource data. Other analysis should include assessment of potential business models and policy approaches that support customer acquisition, including public-private partnerships with municipalities, priority connection policies, and the potential role of heating-as-a-service contracts. Analysis should further explore the impacts, benefits, and

tradeoffs for the energy system of investing in TENs versus standalone building decarbonization strategies and approaches to valuing these benefits, including thermal storage benefits.

- **The PSC should continue to develop the regulatory framework** for TENs in a manner that provides increased market understanding and certainty as to what regulations will be required and for which types of systems. This is especially integral for multi-user (non-campus) TENs. Potential topics to address include customer protections, standards/guidance with respect to the sale/purchase of thermal resources, and supplier-of-last resort rules.

- **NYSERDA, DPS, utilities and other actors should explore TENs and area-based thermal planning to support municipalities and communities in identifying locations with high potential and local support for TENs.** This could include working with municipalities to identify a package of rules/standards/benefits (e.g., planning, zoning, permitting) that apply to support prioritized TENs development. It could also include State-supported technical assistance, training, and capacity building for how to consider TENs in local planning and redevelopment. The opportunity to incorporate TENs into integrated energy system planning is discussed in the Natural Gas chapter of this Plan.

4.3.2. Enabling a Flexible Electric Grid

Electrification of building systems and appliances (space heating, domestic hot water, drying, cooking, and EV charging) will add significant new electric demand onto the grid, changing peak load patterns and driving the need for new ways of planning. However, advancements to grid and appliance hardware/software technologies can enable better management and control of building energy loads to support more optimal grid investment and management, potentially reducing consumer operating costs. These new sources of demand can be leveraged as electric grid "flexible loads," meaning one can shift when these types of equipment use electricity to align with when there is the most grid capacity and lowest electricity costs. Aggregating these loads and managing at scale, whether through third-party agreements or via direct utility control, can substantively change how much grid infrastructure buildout is required and can save ratepayers money.

Behind-the-meter battery storage at residential or commercial buildings can be charged during times when electric demand and cost is lower, then subsequently store energy for use during peak periods. Technologies such as thermal energy storage and TENs can further support aggregated load shifting so that electricity can be stored and discharged at optimal times at a community scale. This integration of flexible loads with storage technologies can offer additional benefits for grid-constrained areas, reduce costs for electrified buildings, and improve overall grid reliability.

Initiatives Underway (e.g., Policy Processes, Programs)

- Several proceedings are underway at the PSC to plan for new electric demand needs, including the Coordinated Grid Planning Proceeding and the Proactive Planning Proceeding. These processes are discussed in the Electricity chapter of this Plan.

- As described in the Electricity chapter of this plan, the PSC has instituted a Grid of the Future proceeding to unlock innovation and investment to deploy flexible resources, such as distributed

energy resources and virtual power plants, to achieve New York's clean energy goals at a manageable cost and at the highest levels of reliability.[31] This proceeding takes a three-phase approach:

  - Phase 1 includes the Grid Flexibility Study, which conducted a quantitative assessment of cost-effective, achievable potential for grid flexibility and identified barriers and preliminary options for addressing barriers.
  - Phase 2 uses insights from the study to guide the development of a more expansive Distributed System Implementation Plan aligned with the goals of the Grid of the Future proceeding.[32]
  - Phase 3 will develop a comprehensive plan for achieving a long-term grid flexibility vision for New York.

- Utility demand response programs exist for both residential and commercial customers. For residential and small commercial customers with central air conditioning, load control through smart thermostats is widely available ,and time-varying rate options also exist.[33] Large customers have a suite of demand response programs available, including a commercial system peak shaving program (the state's largest source of utility demand response) that can reduce a customer's/aggregator's demand when the current minimum threshold of 50 kW is met. Other dynamic load management programs offer load relief at a fixed rate and enrollment incentives for aggregators across the state.[34] The Electricity chapter of this Plan provides additional discussion on wholesale and utility demand response programs.
- NYSERDA's Residential Energy Storage Incentives are available to contractors installing energy storage systems for new and existing homes,[35] while the Retail Energy Storage Incentives are available for new commercial scale distributed (retail) energy storage projects up to 5 MW that are either located behind a customer's electric meter or interconnected directly to the distribution network. Starting in the first quarter of 2026, both programs will also include Inclusive Storage Incentives to support deployment of energy storage projects that benefit disadvantaged communities.
- The adopted 2025 State Energy Code update includes demand response requirements for buildings that enable flexible electric load management for certain newly installed electric equipment and appliances, where such programs exist and are voluntarily chosen by the utility customer.

Recommendations

- **The State should continue to offer incentives for the installation of residential and commercial energy storage systems**, supporting market development and adoption of behind-the-meter storage to advance both customer decarbonization and electric system flexibility.

- **The State should explore opportunities to support the adoption of smart thermostats and other grid responsive appliances** as well as ways to encourage enrollment and participation in relevant demand response programs.
- **The PSC/DPS and New York Independent System Operator should consider opportunities to expand utility demand response programs,** adapting them to enable mass-market participation and support load flexibility at scale.
- **The Department of State, NYSERDA, and other State actors should continue to assess and develop standards for flexible load capabilities** for other equipment and building types beyond those covered in the 2025 State Energy Code.

4.3.3. Decarbonizing District Steam

District steam systems serve several cities in New York State including New York City, Rochester, and Jamestown.[36] District steam systems also serve many large college campuses across the state, including several that are in the process of transitioning from steam-based networks for heating to lower temperature hot water. Most notably, Con Edison's district steam system serves about 1,500 customers in New York City, spanning a diverse mix of commercial and residential buildings including over a dozen affordable housing campuses, and is the largest district energy system in the United States. This district steam system serves many end uses, including space heating and cooling, hot water, sterilization, and humidification for many of New York's landmark buildings and transportation hubs, and it powers process loads in restaurants, dry cleaners, and other businesses across Manhattan.

The Con Edison steam system today generates and distributes steam to individual buildings via steam pipes under City streets; 60 percent of the steam is produced from steam-electric cogeneration, and the remainder is produced by natural gas-fired steam boilers. For many buildings currently served by steam, electrification may be more challenging than traditional retrofits due to physical constraints with installing in-building equipment and/or extensive interior retrofit work that would be needed to accommodate building-based solutions. In some cases, space limitations for installing new equipment may pose a barrier to full electrification.

A safe and reliable steam system provides a valuable energy service in its current form, although it relies on natural gas to generate nearly all (99 percent) of the steam currently being used. Given longer-term goals, it will be necessary to advance cost-effective solutions that can reduce the GHG emissions intensity of the steam system and decarbonize over time. Decarbonization of district steam systems must account for the unique thermal properties of steam, the design of the district systems, the energy needs of the buildings and industries served by the system, and opportunities for waste-heat recovery to increase system efficiency.

Energy efficiency improvements in buildings—such as building shell improvements and load reduction measures—can help lead to more efficient use of the steam system but significant decarbonization will require additional action. One approach is to convert steam production to low-carbon fuel sources and undertake innovative waste heat recovery. Many of these potential solutions—which may include hydrogen, renewable natural gas or other low-carbon alternative fuels, industrial heat pumps, heat

recovery, and storage—are novel. While some uncertainty exists, these measures offer promising emerging solutions to steam system decarbonization. Innovation, demonstration, and regulatory assessment will be important components to accelerating progress over the near and mid-term.

Initiatives Underway (e.g., Policy Processes, Programs)

- As part of the Joint Proposal from the 2022 Steam Rate Case, the PSC authorized Con Edison to conduct a Steam Operations Decarbonization Study and to create an Implementation Plan based on the study's findings. In the Implementation Plan, Con Edison identified three separate projects that would pilot approaches to lower carbon steam production, including through the use of industrial heat pumps and electric boilers as alternative ways of generating steam, and a thermal energy storage unit that will use off-peak electricity from the grid to create stored heat energy that can be used during times when the electric system is most constrained.[37]
- The New York State Hydrogen Assessment examines the potential role of hydrogen as an avenue to decarbonizing district steam.[38]

Recommendations

- **The State should continue to support innovation for technologies that can help decarbonize steam production**, including industrial heat pumps, low-carbon alternative fuels, electric boiler systems, and thermal and electric storage solutions. As part of this effort, NYSERDA, the PSC and DPS, and other relevant governmental entities should continue to evaluate potential demonstrations as well as permitting updates that could enable the implementation of emerging low-carbon steam production technologies.
- **The State should continue to learn and apply replicable lessons from the experiences of other jurisdictions with large steam-based networks**, including funding relevant local studies and assessments.

4.4. Supporting Regulatory Frameworks

4.4.1. Improving Building Energy Data Collection and Access

A clear understanding of each building's energy usage is essential to improving the energy efficiency of those buildings. Ensuring that data on buildings' energy usage is readily available is a fundamental step in driving market-based behaviors and decisions regarding how to reduce energy consumption. This requires metered consumption data that is robust, reliable, and aggregated at the whole-building level—as well as easily shared by customers with other entities of their choice, such as energy efficiency service providers. To achieve this, a wide range of tools and techniques are required, from advanced metering infrastructure (AMI), which can provide more granular or even instantaneous consumption data, to data infrastructure capable of automatically aggregating meter data to a particular building. Improved access to building consumption data can also facilitate benchmarking to other similar building types, which helps bring attention to potential behavioral and operational changes that can result in immediate and/or low-cost measures to achieve energy reductions, provide insight into what policy and programmatic approaches are most relevant to building sub-sectors/regions, and provide helpful information about existing heating equipment and distribution systems, age, and size of buildings, and where they are located, and type of construction.

Initiatives Underway (e.g., Policy Processes, Programs)

- **Integrated Energy Data Resource (IEDR)** – In 2021, the PSC commenced Case 20-M-0082, ordering the development of a single platform to bring together data from the State's regulated utilities, including consumption data from AMI. After an initial platform launch in 2024, development work will continue in the near future to provide tools and energy-related data to renewable energy developers, governments, researchers, and the public to guide policy, investments, operational decisions, and innovative business models.

- **Building Information and Land Use Database (BILD)** – Produced by the New York State Department of Homeland Security and Emergency Services (DHSES) to support the State Hazard Mitigation Plan. This dataset, which will have a public release in 2025, leverages multiple public data sources to provide the first comprehensive picture of the building stock statewide, including attributes such as building size, age, and heating and cooling system types.

Recommendations

- **Utilities across New York State should continue efforts to provide customers with readily available access to their consumption data,** with tools to aggregate and automate the process of sharing this data.

4.4.2. Driving Transformation At-Scale with Codes and Low-Carbon Product Standards

Building and Energy Codes

As noted in Section 2.2.2, new Uniform and Energy codes have been adopted statewide. The adopted codes include requirements prohibiting, with some exceptions, fossil fuel combustion in newly constructed buildings, though implementation is currently subject to ongoing litigation.

As part of the continuous process of code improvement, the State will continue to participate in the development and review of model codes to inform the next iteration of the energy code to continue reducing energy use in new and substantially renovated buildings.

Appliance and Product Standards

Updated State and federal appliance and product standards over the medium- to long-term should help drive residential and business energy savings by supporting the installation of highly energy-efficient space heating and cooling, hot water, and other appliances as existing residential and commercial buildings upgrade their equipment. New State standards should also incorporate the ability for appliances to be managed as flexible loads, including directly by the consumer.

Initiatives Underway (e.g., Policy Processes, Programs)

- In July 2025, the Code Council adopted new State Uniform and Energy codes as described above in the State of the Sector section. To prepare the industry and local code officials for these new requirements, DOS and NYSERDA, in partnership with regional organizations, are developing new training resources and code enforcement tools tailored to support local code enforcement and other code users. DOS and NYSERDA are also developing tools to help local building departments modernize their permitting processes, to further support code compliance.

- Enhanced product and appliance standards are in place for 21 product categories through the requirements of the Advanced Building Codes, Appliance and Equipment Efficiency Standards Act of 2022, as described above in Section 2.

Recommendations

- **DOS, NYSERDA, and other State agencies should continue to support education and development of new tools, training, and resources for local governments** to help support successful implementation of new code requirements.
- **DOS and NYSERDA should continue to recommend reduced energy use intensity** as part of each iteration of the energy code to continue reducing energy use in new and substantially renovated buildings.
- **NYSERDA should continue evolving appliance standards** to incorporate improvements to energy performance and demand response capability requirements, as appropriate.

4.4.3. Managing Refrigerant Emissions

HFC refrigerants are widely used for HVAC and refrigeration applications, including heat pumps. However, as discussed in the Climate Change, Adaptation, and Resiliency chapter of this Plan, their high global warming potential (GWP) causes significant GHG emissions when released into the atmosphere. This typically happens from refrigerant leakage, which can occur throughout an HVAC system's lifetime during installation, operation, servicing, and end-of-life decommissioning, as well as events that physically damage the system. Reducing refrigerant leakage through proper end-of-life decommissioning and refrigerant management not only reduces GHG emissions but also improves system performance and reduces electricity use. In addition, transitioning to the use of lower GWP refrigerants will significantly reduce the GHG emissions impacts of any leakage that does occur.

As New York ramps up heat pump installations, detecting and preventing leakage and transitioning to the use of low and ultra-low GWP refrigerants will be of increasing importance. While a handful of products using low-GWP refrigerants are available now, significant research, product and code development over the next 5 to 10 years will be necessary to safely bring to market ultra-low GWP technologies for building HVAC systems. The State will need to continue working with local governments, industry partners, large HVAC and refrigeration end-users, and other organizations to prepare for the coming refrigerant transition and incorporate leakage management best practices through education, technology, and regulatory initiatives such as those identified in the 2021 NYSERDA HFC Inventory and Mitigation Report, New York's Scoping Plan, and the DEC Part 494 Stakeholder Engagement materials.[39,40,41]

Initiatives Underway (e.g., Policy Processes, Programs)

- The Clean Air Act has outlined best practices to prevent refrigerant leakage. For technicians working on the refrigeration system of any HVAC and refrigeration product, U.S. Environmental Protection Agency (EPA) Section 608 and 609 requires technicians to pass a one-time EPA-approved certification exam related to proper handling and disposal of refrigerants.

- EPA established HFC supply-side production and import allowances under the American Innovation and Manufacturing Act.[42] In late 2022, the EPA set a GWP limit of 700 for refrigerants used in residential and light commercial air conditioners and heat pumps, variable refrigerant flow systems, and chillers. The effective date for product manufacturing is January 2025 for most HVAC equipment categories, with a sell-through period until January 2026. An EPA proposal to delay these requirements is under review in late 2025.
- In December 2024, DEC adopted an updated 6 NYCRR Part 494, "Hydrofluorocarbon Standards and Reporting," to establish similar GWP limits on a 20-year GWP basis in the near-term, with anticipated lower GWP limits from 2026 to 2034. This provides an important State-level policy backstop to continue progress in reducing refrigerant emissions, even in the midst of federal uncertainty and potential rollback.
- In July 2025, the Code Council adopted updated State codes. The updates include specific regulations in the Mechanical, Residential, and Fire codes to address low-GWP refrigerants such as ammonia, A2L, and B2L refrigerants.

Recommendations

- **The State should support training and/or certifications for industry technicians, system designers, and other stakeholders on proper use of alternative refrigerants and best practices for leak detection, reclamation, and market development for reclaimed refrigerants.** Although some leakage is expected over time for most systems, developing an education and outreach strategy for local industry stakeholders to support proper disposal and greater refrigerant recovery and reclamation in alignment with industry best practices can minimize annual and end-of-life leakage. The State should provide technical assistance that supports the effective roll-out of 6 NYCRR Part 494 and leverage market input to inform further interventions or market support that can help enable this transition.
- **NYSERDA and SUNY should advance research and demonstration to enable adoption of the next generation of low and ultra-low GWP refrigerants.** Areas for research and development should include low-GWP and no GWP technologies such as low charge propane and CO_2 heat pump systems as well as development of hardware to detect refrigerant losses. Demonstration pilots should focus on encouraging adoption of ultra-low GWP refrigerants and automatic leak detection for large commercial and institutional refrigeration systems, especially in DACs.
- **DOS and NYSERDA should track and evaluate the need for further code improvements to support roll-out of ultra-low GWP refrigerants.** Continued consideration of code improvements—including comparison against European precedents—is necessary to ensure that code requirements include consideration for the safe use or storage of these new low-GWP refrigerants to support the cost-effective installation of heat pump and refrigeration systems.

4.4.4. Reducing Embodied Greenhouse Gas Emissions from Building Materials

Embodied GHG emissions are emissions that result from the extraction, production, and delivery of materials, and they are associated especially with energy-intensive construction materials such as steel

and concrete. Steel and concrete production alone account for roughly 16 percent of global GHG emissions annually.[43] While the ratio varies by building, over a building's useful life, generally around 33 percent of a building's emissions are embodied in the materials, and the rest are generated from building operations.[44] Beyond the benefits of reducing GHG emissions, reducing embodied emissions can also promote growth for in-state industries that produce materials with lower embodied emissions than importing competitors.

There are challenges to precisely measure the quantities and emissions levels associated with construction and emissions-intensive materials used in New York State. Currently, environmental product declarations (EPDs) are the primary tool broadly available for reporting on the environmental impact of products. However, they are an optional private-sector tool—meaning EPDs are not always available and most high-polluting products have no incentive to produce an EPD, making it difficult to fully understand the state of the sector. As New York continues to gather data to better understand the embodied emissions of materials used in construction, coordinating with other states and jurisdictions on standardized reporting requirements and methods in EPDs could be an important initial step, which could then extend to potential collaboration on policy development and implementation.

Initiatives Underway (e.g., Policy Processes, Programs)

In December 2021, Buy Clean Concrete mandates were signed into law requiring the Office of General Services (OGS) to establish guidelines. These were released in January 2025, requiring state agencies to meet embodied emissions limits for any projects over $1 million with over 50 cubic yards of concrete ($3 million and 200 cubic yards for Department of Transportation projects). Starting in 2027, this maximum allowable emissions intensity will be reduced and gradually lowering embodied emissions over time. Agencies must obtain and report EPDs for a larger list of "covered materials": asphalt, concrete, steel products, and glass.[45] Section 7 of the Transportation chapter discusses this topic further.

Recommendations

- **New York should seek to advance partnerships** with other states to increase market purchasing power and demand for low-emissions construction materials, which can support diversification of product options.
- **The State should support market development** of technologies and industries in New York that produce affordable, low-emission materials.
- **DOS and NYSERDA should monitor and when appropriate participate in the development of embodied emissions requirements** and make recommendations to the Code Council for possible incorporation into future code updates.
- **NYSERDA should integrate embodied GHG considerations into programs** that are designed to bring awareness to sustainable building practices.

4.5. Ensuring a Modern and Resilient Building Stock

As New York modernizes buildings it will be important to plan and make upgrades in a manner that future-proofs these investments to withstand the effects of a changing climate and ensures that the

building stock can be resilient to extreme weather. Buildings across New York State will continue to be exposed to more extreme flooding, precipitation, and heat events due to a changing climate. These challenges not only highlight the imperative of reducing carbon and other GHG emissions to help slow the pace of climate change, but also the need to embed resiliency measures in the State's residential, commercial, and institutional buildings. Climate resilience and decarbonization strategies can be mutually supportive; decarbonization strategies such as high-performance building envelopes, demand flexibility, and on-site energy generation and storage can support active resiliency and passive survivability. These measures will help protect lives and infrastructure from the impacts of future climate hazards.

Initiatives Underway (e.g., Policy Processes, Programs)

- The New York State Climate Impacts Assessment identified a range of impacts that will be experienced throughout the state, including more severe storms, coastal and inland flooding, and increasing temperatures, all of which pose risk to building structures and systems, operations, and occupants.[46]

- The New York State Adaptation and Resilience Plan will help communities prepare for and adapt to current and future climate impacts. Led by DEC, DOS, DHSES, and NYSERDA, the plan will establish a statewide framework to guide adaptation planning and implementation, including a collective vision, principles, planning resources, and State actions to advance climate adaptation and resilience across New York State. The plan will establish a coordinated strategy to increase resilience, build adaptive capacity across New York communities, and develop tools and resources to help communities thrive in a changing climate.[47]

- Commitments contained in the Community Risk and Resiliency Act encourage resilient design with a focus on disadvantaged communities.

- DOS, in partnership with DEC and others, offers model local laws to help local governments be more resilient to sea-level rise, storm surge, and flooding.[48]

- The Environmental Bond Act provides $250 million to HCR to purchase private real property identified as at-risk to flooding from willing sellers, demolish and remove structures and/or infrastructure on the property, and transfer properties to land stewards to facilitate the conversion to provide beneficial open space, flood mitigation, and/or shoreline stabilization, which shall be subject to recorded land use restrictions.

- A variety of programs are available to support homeowners in proactively preparing for future climate conditions. HCR has expanded the Resilient Retrofits Program, a combination of low-interest loans and grants to LMI single-family homeowners whose homes are in flood-prone areas or have been damaged due to heavy rainfall. This program enables them to render their homes more resilient to flood damage and if, desired, to reduce energy use by improving the energy efficiency of the home and/or electrification of the home's heating and cooling systems.[49] HCR is also administering Community Development Block Grant – Disaster Recovery funding that goes beyond damage repair to support resilient investments for future storms including housing

and infrastructure programs assisting residents and communities impacted by Superstorm Sandy, Hurricane Irene, Tropical Storm Lee, and Hurricane Ida.[50] Additionally, HCR's updated Multifamily Sustainability Guidelines include a new resiliency checklist for New York-specific climate hazards, which will require all new construction projects to identify potential risks.

- NYSERDA also has begun to incorporate forward-looking climate projections into competitively awarded programs to encourage efficient and resilient buildings in multifamily, single family, commercial, and industrial sectors. Program examples include the Building of Excellence competition, EBC, and Clean Green Hospitals.

Recommendations

- **NYSERDA, HCR, LIPA, and the PSC/DPS** should explore pairing weatherization/energy efficiency measures with climate resilience measures in State and investor-owned utility building programs. Such measures should include back-up battery energy storage solutions and should inform broader community and building-level resilience strategies that can meet community safety and passive survivability needs in acute situations.

- **NYSERDA and OGS** could consider piloting a "resiliency first" energy storage incentive—prioritizing the ability of an energy system to withstand and recover from disruptions, such as power outages, natural disasters, or other emergencies—starting with critical community serving public sector facilities.

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4 *Homeownership Rates in New York*, (Office of the New York State Comptroller, prepared by the Office of Budget Policy and Analysis, October 2022), https://www.osc.ny.gov/reports/homeownership-rates-new-york#:~:text=In%20the%20second%20quarter%20of%202022%2C%20homeownership%20rates%20were%2053.6,and%20Nevada%20(59.1%20percent).

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7 "Robin Hood Annual P Tracker Report Shows 25% Overall Poverty Rate in New York City, Climbing Beyond Record Highs Observed in 2022" (Press Release, Robin Hood, February 26, 2025), https://robinhood.org/news/robin-hood-annual-poverty-tracker-report-shows-25-overall-poverty-rate-in-new-york-city-climbing-beyond-record-highs-observed-in-2022.

8 *New York's Carbon Neutral Buildings Roadmap* (NYSERDA, December 2022), https://www.nyserda.ny.gov/All-Programs/Carbon-Neutral-Buildings, and Energetics Incorporated for U.S. DOE, "Windows and Building

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10 *Highlights for Appliances in U.S. Homes by State*, EIA RECS, 2020), https://www.eia.gov/consumption/residential/data/2020/state/pdf/State%20Appliances.pdf.

11 See the Pathways Analysis chapter of this Plan.

12 *Assessment of Energy Efficiency and Electrification Potential in New York State Residential and Commercial Buildings*, (NYSERDA, February 2023), https://www.nyserda.ny.gov/About/Publications/Evaluation-Reports/Building-Stock-and-Potential-Studies/Assessment-of-Energy-Efficiency-and-Electrification-Potential.

13 Case 14-M-0094 et al., Proceeding on Motion of the Commission to Consider a Clean Energy Fund, Order Authorizing Non-Low- to Moderate-Income Energy Efficiency and Building Electrification Portfolios for 2026-2030 (issued May 15, 2025); and Order Authorizing Low- to Moderate-Income Energy Efficiency and Building Electrification Portfolio for 2026-2030 (issued May 15, 2025).

14 Beginning in 2026, NYSERDA will administer a new upstate multifamily low- and moderate-income program, while the Affordable Multifamily Energy Efficiency Program will continue to serve the downstate market.

15 Part RR of Chapter 56 of the Laws of 2023 requires the New York State Fire Prevention and Building Code Council to adopt Uniform and Energy codes that prohibit the use of fossil fuel equipment and building systems in new buildings, with some exceptions. This is commonly referred to as the "All-Electric Buildings Act" in reference to a preceding bill that did not pass the legislature.

16 Notices of Adoption Rules Amending and Updating the Uniform Code (19 NYCRR Parts 1219 to 1229) and Energy Code (19 NYCRR Part 1240)," Department of State (DOS) October 1, 2025, https://dos.ny.gov/notice-adoption.

17 NYSERDA, "Current Standards," New York State Appliance and Equipment Efficiency Standards, December 28, 2022, https://www.nyserda.ny.gov/All-Programs/New-York-State-Appliance-and-Equipment-Efficiency-Standards/Current-Standards.

18 "Governor Hochul Announces Plan for the $1 Billion Sustainable Future Program Supporting Climate Action and Jobs," Office of Governor Kathy Hochul, September 24, 2025, https://www.governor.ny.gov/news/governor-hochul-announces-plan-1-billion-sustainable-future-program-supporting-climate-action.

19 Sales share is defined as the percent of building stock units (commercial square feet or residential housing units) purchasing equipment in a given year that adopt the target technology (e.g., high-efficiency heat pumps as the primary heating system, efficient shell packages).

20 "Building Decarbonization Insights," NYSERDA, https://www.nyserda.ny.gov/All-Programs/Empire-Building-Challenge/Building-Decarbonization-Insights.

21 *2024 Update: Energy Efficiency & Electrification Soft Costs in New York,* (NYSERDA, March 31, 2025), https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Publications/PPSER/Program-Evaluation/2024-Soft-Costs-in-NY-market-Evaluation-Executive-Summary-and-Final-Report.pdf

22 NYSERDA's Comfort Home pilot program will continue through 2026. By 2027, electric and gas utilities will develop regional weatherization programs to serve 1–4 family homes in the upstate and downstate regions.

23 Beginning in 2026, the Affordable Multifamily Energy Efficiency Program will be administered for the downstate multifamily market by Con Edison and National Grid while NYSERDA will administer ratepayer-funded energy upgrade incentives for upstate LMI multifamily homes.

24 Examples include those owned by utilities (e.g., Con Edison's steam system), cooperatives (Rochester District Heating Cooperative), municipal utilities (Jamestown BPU), and campus environments (universities, hospitals, and industrial parks).

25 Examples from other jurisdictions, including Europe, show that networks integrated with thermal storage can shift electric production of heat by hours, days and even up to a week in some cases to align heat production when it is the cheapest and when the grid is least constrained. A core component of this load shifting

opportunity is thermal storage, which is the least expensive type of energy storage: a 2021 study ("Our Technology," Fourth Power, https://gofourth.com/our-technology/) found thermal energy storage around $25/kWh, compared to a 2022 study that priced battery electric storage over $250/kWh. Such low-cost storage would not only provide huge benefits to the energy system but also allow deeper market penetration for intermittent renewable energy sources.

[26] Municipal examples outside the United States where low-carbon thermal energy networks (TENs) are being deployed at scale, including in Denmark, rely on local heat planning to identify areas with characteristics that should be prioritized to be served with TENs, and align other planning and financial incentives to support development in these priority areas. Integration of heat planning into existing community-based land use planning frameworks helps build support for reasonably placed TENs while ensuring communities understand the range of options available to support their community's heating and cooling needs. Local jurisdictions will play a key role in identifying opportunities for TENs deployment at large scale by aligning their local planning and zoning frameworks with heat planning activities. Ensuring their access to vetted codes, standards, and best practices for geothermal and TEN design, construction, and operation will be vital to the deployment and operation of successful networks.

[27] Case 22-M-0429, Proceeding on Motion of the Commission to Implement the Requirements of the Utility Thermal Energy Network and Jobs Act, Order on Developing Thermal Energy Networks Pursuant to the Utility Thermal Energy Network and Jobs Act.

[28] "PSC Adopts Initial Utility Thermal Energy Networks Rules," (Press Release, Department of Public Service [DPS], July 18, 2024), https://dps.ny.gov/news/psc-adopts-initial-utility-thermal-energy-networks-rules.

[29] Case 22-M-0429, Proceeding on Motion of the Commission to Implement the Requirements of the Utility Thermal Energy Network and Jobs Act, Order Providing Guidance on Development of Utility Thermal Energy Network Pilot Projects, issued September 14, 2023.

[30] "Governor Hochul Announces Decarbonization Leadership Program to Reduce Carbon Emissions at State Facilities," (Press Release, Office of Governor Kathy Hochul, October 10, 2023), https://www.governor.ny.gov/news/governor-hochul-announces-decarbonization-leadership-program-reduce-carbon-emissions-state.

[31] See Case 24-E-0165, Proceeding on Motion of the Commission Regarding the Grid of the Future.

[32] Distributed System Implementation Plans are biannual filings by the six investor-owned utilities reporting on the implementation of a Distributed System Platform.

[33] Participation in these programs is low; only around 5 percent of eligible customers are currently enrolled in heating, ventilation, and air conditioning load control programs and 2 percent opt into time-of-use or peak pricing rates.

[34] "New York's Grid Flexibility Potential Volume I: Summary Report." (Brattle, January 2025), https://www.brattle.com/wp-content/uploads/2025/02/New-Yorks-Grid-Flexibility-Potential-Volume-I-Summary-Report.pdf.

[35] The Long Island Single-Family Residential Storage Incentive serves customers in the Public Service Enterprise Group Long Island territory.

[36] "Map of District Energy in North America", International District Energy Association, https://www.districtenergy.org/resources/resources/system-maps.

[37] *2024 Steam Decarbonization Study & Implementation Plan*, (Con Edison, 2024) https://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={80DD0994-0000-C630-B204-DB157875101F}.

[38] *New York State Hydrogen Assessment, Final Report* (NYSERDA, April 2025), www.nyserda.ny.gov/publications.

[39] *Hydrofluorocarbon Emissions Inventory in New York State*, (NYSERDA, July 2021), www.nyserda.ny.gov/publications.

[40] *New York State Climate Action Council Scoping Plan*, (New York State Climate Action Council, 2022), www.climate.ny.gov/ScopingPlan.

[41] "Climate Change Regulatory Revisions," DEC, September 2024, https://dec.ny.gov/regulatory/regulations/proposed-emergency-recently-adopted-regulations/climate-change.

[42] "Protecting Our Climate by Reducing Use of HFCs," U.S. Environmental Protection Agency, October 1, 2024, https://www.epa.gov/climate-hfcs-reduction.

[43] Chris Bataille, "Decarbonizing Steel and Cement," Center on Global Energy Policy at Columbia, August 8, 2023, https://www.energypolicy.columbia.edu/decarbonizing-steel-and-cement/.

[44] "Why the Built Environment?," Architecture 2030, https://www.architecture2030.org/why-the-built-environment/.

[45] "NYS Buy Clean Concrete Standards," New York State Office of General Services, June 2022, https://ogs.ny.gov/nys-buy-clean-concrete-guidelines-0.

[46] Nicholas B. Rajkovich, et al. "New York State Climate Impacts Assessment Chapter 04: Buildings." *Annals of the New York Academy of Sciences* 1542, no. 1 (2024):214–252. https://doi.org/10.1111/nyas.15200.

[47] "New York State Adaptation and Resilience Plan," DEC, https://dec.ny.gov/environmental-protection/climate-change/climate-change-adaptation-resilience-planning/new-york-state-adaptation-and-resilience-plan.

[48] "Model Local Laws to Increase Resilience," DOS, https://dos.ny.gov/model-local-laws-increase-resilience.

[49] "Resilient Retrofits," New York State Homes and Community Renewal (HCR), January 16, 2025, https://hcr.ny.gov/resilient-retrofits.

[50] "Hurricane Ida Long-Term Recovery and Resiliency," HCR, https://hcr.ny.gov/general-ida-programs.

New York State Energy Plan

VOLUME II | Energy and Our Lives

Transportation

09

2025 NEW YORK STATE ENERGY PLAN

Key Terms Used in This Chapter

FOR THE COMPLETE GLOSSARY ➜

Active Transportation: Active Transportation includes human-powered modes of transportation—walking, bicycling, and operating a wheelchair—along with small-scale electric vehicles such as e-bikes and e-scooters (also known as “micromobility”).

Electric Vehicles (EVs): Vehicles powered by electricity from an external source stored onboard in a battery, including both battery-electric vehicles (BEVs), which run exclusively on electricity, and plug-in hybrid electric vehicles (PHEVs), which run exclusively on electricity for a limited range and then are powered by an internal combustion engine.

Light-Duty Vehicles (LDVs): On-road vehicles under 8,500 lbs. gross vehicle weight rating (GVWR), Class 1 and 2a, per the U.S. Environmental Protection Agency (U.S. EPA) classification system.

Managed Charging: The practice of controlling the speed and/or time at which an EV is charged for the purpose of minimizing charging during times of peak electricity usage and minimizing charging costs for the EV driver.

Medium- and Heavy-Duty Vehicles: On-road vehicles over 8,500 lbs. gross vehicle weight rating, Class 2b through 8, per the U.S. Environmental Protection Agency classification system.

Micromobility: Any low-speed, human or electric-powered transportation device, including bicycles, scooters, electric-assist bicycles (e-bikes), electric scooters (e-scooters), and other small, lightweight, wheeled conveyances.

Transit-Oriented Development (TOD): Dense, pedestrian-oriented, mixed-use development located near (usually within a quarter- or half-mile radius of) direct transit access. TOD integrates multiple mobility modes, including walking, biking, micromobility, and various forms of public transit, to provide residents with convenient and efficient transportation options beyond personal vehicles.

Transportation Systems Management and Operations (TSMO): Focuses on operational improvements that can maintain and even restore the performance of the existing transportation system before extra capacity is needed.

Transportation Demand Management (TDM): Managing demand is about providing travelers, regardless of whether they drive alone, with travel choices, such as work location, route, time of travel and mode. In the broadest sense, demand management is defined as providing travelers with effective choices to improve travel reliability.

Vehicle-Grid Integration: Vehicle-to-Grid (V2G) technology allows EVs to both draw electricity from the electric grid to charge the EV's battery and also discharge the EV's battery to sell power back to the electric grid.

Vehicle Miles Traveled (VMT): The amount of travel for all vehicles in a geographic region; calculated by adding up all miles driven by all motorized vehicles.

Zero-Emissions Vehicles (ZEVs): Vehicles powered by energy sources that result in no tailpipe emissions, such as battery-electric vehicles (BEVs) and hydrogen fuel cell electric vehicles (FCEVs). Plug-in hybrid electric vehicles (PHEVs), which run exclusively on electricity for a limited range and then are powered by an internal combustion engine, are also considered ZEVs under certain regulations.

Key Findings → Transportation

New York's robust transportation system strengthens the health, safety, economic vibrancy, livability, and sustainability of communities throughout the state by allowing New Yorkers to get where they need to go. The transportation sector is one of the State's largest energy users and it also is a major contributor to greenhouse gas (GHG) emissions and local air pollution. This chapter provides an overview of the State's approach to shifting toward a transportation system that reduces emissions while providing affordable, reliable, and healthy transportation options to all travelers and commercial entities and promoting sustainable land use patterns. It outlines major initiatives underway and recommends continued and additional actions.

- **Investment in multiple modes of transportation is necessary to support diverse travel needs and provide affordable, accessible options for all New Yorkers.** These investments should recognize the diversity of land use patterns that exist throughout the State. Supporting transit-oriented development (TOD) that provides reliable access to public transportation and active transportation while linking clean transportation networks through options such as shared mobility (carsharing and bike sharing) and vehicle charging hubs will make more diverse travel options viable and affordable for New Yorkers in all types of communities while reducing overall emissions and reliance on personal vehicles. These investments support broader initiatives, such as Smart Growth and TOD, that promote energy efficient land use patterns.

- **Continued public and private investment will help make zero-emissions vehicles (ZEVs) a more affordable and reliable option for New York drivers and fleet operators.** Investment in public and semi-public charging infrastructure in priority locations will help reduce electric vehicle (EV) "range anxiety" by making access to charging more reliable and increasing convenience, and investment in hydrogen supply and fueling options will help develop clean long-range trucking and non-road options. Policies and regulations alongside incentives that make zero-emission passenger vehicles, medium- and heavy-duty vehicles, and non-road equipment more available and affordable for New Yorkers can help ZEVs reach price parity and widespread consumer and fleet adoption.

- **Collaboration between State agencies, local governments, and other entities is vital to the success of transportation investments.** Government coordination is particularly important for the advancement of active transportation projects and transit projects while collaboration with private industry is a key component for the build-out of infrastructure supporting ZEVs.

- **Minimizing the costs to electric ratepayers associated with transportation electrification is important and requires multiple approaches.** Managed charging can reduce the impact of EVs on the electric grid and the need for additional infrastructure, and it will grow in importance as more New Yorkers drive and charge EVs. Ensuring that utility infrastructure can be built in time to support the build-out of ZEV infrastructure is critical to ensuring a smooth and reliable transition to clean transportation options.

- **Continued investment in workforce development within the transportation sector is needed.** Workforce development investments are necessary to both maintain the current transportation system and support the maintenance of a zero-emission transportation system in the future. These investments should address recruitment, training, and retention in both the public and private sectors. There should also be targeted efforts to ensure that workforce development programs benefit individuals from disadvantaged communities.

- **Investment in other alternative fuels can play a role in the reduction of transportation GHG emissions and diversify fuel supply.** While a shift to zero-emission fuels (electricity and hydrogen) is the sector priority, other fuels like renewable diesel and other biofuels can be an effective option in harder-to-electrify market segments and provide a transitional pathway to accelerate the inclusion of more subsectors in achieving emissions reductions as more complex long-term ZEV solutions, such as hydrogen and advanced electrification, evolve.

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1. Overview

New York's robust transportation system strengthens the health, safety, economic vibrancy, livability, and sustainability of communities throughout New York State. It allows New Yorkers to get where they need to go, supporting critical activities ranging from emergency response and commerce to recreation and social connectivity. The transportation sector accounts for approximately 40 percent of final energy use in the state, as well as the majority (80 percent) of the statewide consumption of petroleum products in the form of motor gasoline, aviation fuel, and diesel. It is also one of the largest sources of greenhouse gas (GHG) emissions in the state (28%), accounts for 44 percent of total fuel combustion emissions, and is a major contributor to local air pollution.[1] Different modes of transportation have different energy and emission intensities, with transportation sector emissions dominated by fossil-fueled mobile source (i.e., sources that can move) road users including passenger cars and trucks, commercial light-duty trucks, motorcycles, buses, and heavy-duty trucks. "Active transportation" modes (e.g., walking, biking, and rolling [using a wheelchair or scooter to get around]) represent travel options that do not contribute to emissions. Non-road transportation includes aviation, marine, rail, and equipment and mobile generators used for agriculture, construction, commercial, industrial, home and landscaping use, recreation, and more.

Fuel economy improvements and greater adoption of zero-emission vehicles (ZEVs) reduce the energy demand of individual vehicles, but increases in vehicle miles traveled (VMT) from both passenger vehicles and freight can offset increasing efficiency over time.[2] Strategies that reduce VMT and encourage a switch to ZEVs and equipment are thus necessary to achieve long term emission reductions while also improving local air quality and providing New York travelers with a greater variety of affordable, reliable transportation options.

2. Snapshot of New York's Current Transportation Network

2.1. Extent of the Transportation Network

New York State has one of the largest and most diverse multimodal transportation networks in the nation, reflective of the large population and highly variable land use patterns statewide. This variation in land use patterns and transportation needs in turn causes variation in the transportation system's energy demand, fuel use, and air pollutant emissions throughout the State. The New York City metropolitan area (which includes New York City, Long Island, and the Lower Hudson Valley) is home to almost two-thirds of New Yorkers and is characterized by high population density and a heavily built environment, with many downstate communities highly reliant on walking, biking, and robust public transportation systems. Meanwhile, other areas of the State have more variation in land use patterns and population densities compared to downstate, containing a mix of urban, suburban, and rural areas. Many mid-sized cities and villages were planned in a pedestrian-oriented manner, while their surrounding suburbs have grown in a manner reliant on vehicular travel to access traditional downtowns and employment centers. Upstate transit authorities serve these mid-sized cities through a mix of fixed- and flex-route services.

Workday commutes, short trips, and the movement of freight comprise most of the daily travel statewide. New York State's transportation network supports more than 115 billion annual vehicle miles of travel (as of 2022), countless pedestrian, bicycle, and other human-powered active transportation trips, 1.8 billion annual public transportation trips (as of 2023), and almost 50 million annual passenger enplanements (as of 2022).[3] More than 11 million on-road vehicles are registered in New York State, the large majority of which are passenger vehicles.[4]

The transportation network also moves 936.5 million tons (valued at over $1.2 trillion) of freight goods annually (as of 2021) via truck, rail, plane, and ship.[5] As of 2023, the freight network includes 1,730 interstate miles, 3,795 active rail miles, 8 major ports, and 6 major air cargo facilities.[6] The maritime transportation sector, which includes ports, terminals, and vessels, supports the State's energy goals by providing energy-efficient freight transportation. It is also a sector that is actively pursuing emissions reduction, electrification, and decarbonization through innovation and heavy investment from federal and State sources. The transportation network also plays a vital role in supporting incident management statewide, allowing police, national defense, healthcare workers, firefighters, and other emergency responders to quickly and efficiently mobilize wherever needed.

2.2. Maintaining and Improving the Transportation Network

Continuing maintenance, rehabilitation, replacement, and modernization of this transportation network ensures that transportation investments address future societal needs, improve resiliency, and align with the State's emission reduction and overall energy goals. These efforts depend on the cooperation of municipal, regional, and State level decision makers, who each have responsibilities for certain portions of the network. The New York State Department of Transportation (DOT) works with federally mandated Metropolitan Planning Organizations (MPOs) in New York's 14 metropolitan areas with over 50,000 residents and consults with local decision makers in rural areas not covered by an MPO to ensure a coordinated planning approach across the state. The transportation system is also dependent on the availability of a skilled private and public sector workforce that includes diverse roles such as road maintenance crews, mechanics, engineers, planners, snowplow operators, truck drivers, transit workers, and many others. With the emergence of electric vehicles (EVs) there is a pressing need to develop a workforce to attend to the planning, installation, and maintenance of charging infrastructure.

As the transportation network has expanded and grown in complexity, maintenance needs and associated costs have grown in parallel. New York State gained approximately 129,000 acres of developed land between 2001–2021, yet nearly one-third of this development was in counties that experienced population decline from 2000–2020. This trend is particularly pronounced in Upstate New York, where population only grew by 1.8% from 2000–2020 yet approximately 105,000 acres were developed.[7] New land development necessitates the creation of new transportation infrastructure to support it, and maintenance needs of this new infrastructure place additional strain on already limited transportation funding. These challenges highlight the need to prioritize multimodal transportation investments that support not only emissions reductions, but also the efficient use of funding and sustainable land use patterns.

2.3. Meeting Energy Planning Goals in the Transportation Sector

DOT's Statewide Transportation Master Plan (Draft) lays out a vision where transportation strengthens the health, safety, economic vibrancy, livability, and sustainability of communities throughout New York State.[8]

Consistent with this vision, the State will work with public and private stakeholders to accelerate a shift toward a transportation system that minimizes and reduces GHG emissions while providing affordable, reliable, and healthy transportation options to all members of the travelling public and promoting sustainable land use patterns. Continued public and private investment in active transportation, public and private EV infrastructure, public transportation, reducing congestion, and shared mobility are all actions that are intended to help achieve this vision. These actions will be targeted to address specific barriers to broader adoption of clean transportation technologies as well as broader sector-wide policies that align market incentives. The GHG reduction achieved by each of these approaches will depend on the land use context within which they are implemented, necessitating alignment with municipal policies and private sector engagement.

Achieving emissions reductions and reduced energy use will also require major public and private investments in new technologies. Since 2010, when the first commercially available EVs reached the market, New York has enacted policies, statutes, and regulations and committed nearly $3 billion in investments to encourage further adoption of these cleaner vehicles. In 2024, EVs made up nearly 10 percent of new vehicle registrations in the state, with battery-electric vehicles (BEVs) making up the majority (61%) of EV registrations and plug-in hybrid EVs (PHEVs) making up the balance (39%).[9] Regulations that New York has adopted will require all new light-duty vehicle (LDV) sales to be zero-emission by 2035, with zero-emission vehicles also making up an increasing percentage of medium- and heavy-duty vehicle sales by 2035. Accompanying public and private investments in charging infrastructure, electric utility capacity, and vehicle incentives to reduce the upfront cost of these vehicles to consumers will be needed to realize the desired emission reductions.

In accordance with the Climate Act, at least 35% of the State's clean energy and energy efficiency programs, projects or investments must benefit disadvantaged communities (DACs),[10] Investments in public transportation, active transportation, and ZEV infrastructure can substantially improve air quality, workforce opportunities, and overall quality of life within communities across the State. This is especially true in DAC areas, which experience disproportionate exposure to vehicle emissions.

New York State is working to provide people of all ages, abilities, incomes, and backgrounds living, working or visiting New York State with access to more travel choices that enable travelers to avoid wear and tear on personal vehicles and save money on transportation.

3. State of the Sector

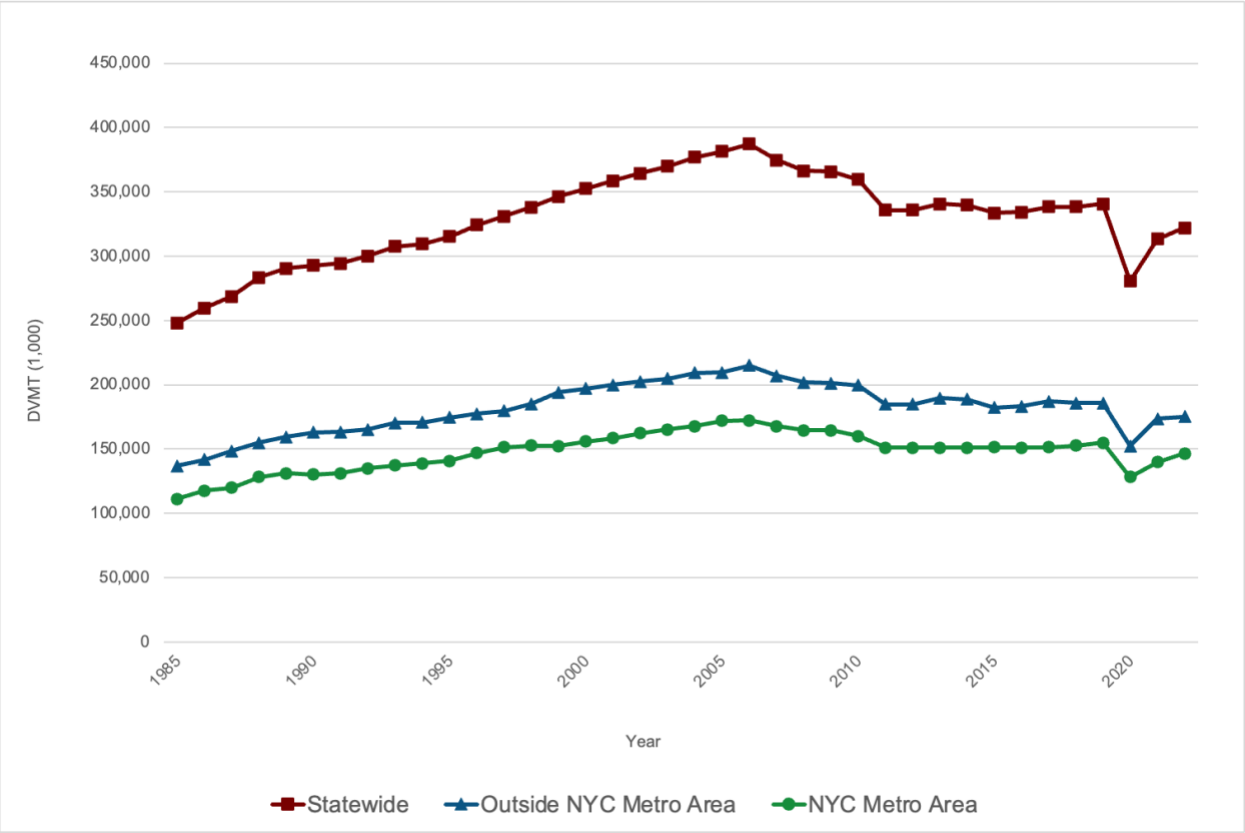
Roadway travel is typically expressed in Vehicle Miles Traveled (VMT). VMT includes all roadway traffic, including trucks, buses, and personal vehicles regardless of trip purpose. In essence, VMT is a measure of transportation system use, demonstrating the vehicular movement of people and goods and the energy

used to support that movement. As population and travel demand increases, VMT increases. Higher VMT is often also associated with greater economic resources.

New York State's roadway system is used extensively on a daily basis. According to estimates derived from DOT's statewide traffic count system, in 2022, about 321 million vehicle miles were driven on New York roads every day. As reflected in Figure 1, Daily VMT (DVMT) steadily increased until about 2007, when it peaked and began declining. After 2011 and until the COVID-19 pandemic in April 2020, DVMT leveled off. Notably, the COVID-19 pandemic impacted travel significantly as the majority of residents faced travel restrictions and had to work remotely. Going forward, travel trends and policies related to telecommuting, freight delivery, and public transportation will continue to impact roadway travel.

Figure 1: Daily Vehicle Miles Traveled (DVMT) New York State 1985-2022

Source: DOT Highway Data Services Bureau



Consistent with trends in VMT, transportation sector emissions in New York State were 1% higher in 2022 than they were in 1990, but they have fallen nearly 18% since 2005.[11] Transportation sector emissions accounted for 43% of total fuel combustion emissions in 2022. Additionally, 2022 transportation emissions increased 13% relative to 2020, representing a return to historic trends as the economy recovered from the impacts of the COVID-19 pandemic. Burning petroleum-based fuels made up the majority (51%) of New York fuel combustion emissions in 2022; these are the main fuels used in transportation.

Transportation fuels used in New York include motor gasoline, diesel, electricity, compressed natural gas (CNG), and blended biofuels (ethanol and biodiesel). Gasoline use in New York State peaked at approximately 140 million barrels per year in 2006; through 2022, usage is down 22 percent, to 109 million barrels.[12]

Reducing energy use and GHG emissions from transportation, both on an absolute basis and on a per-mile basis, can be achieved through multiple strategies, including: providing travel options that use more efficient transportation modes, including transit and active transportation; improving overall system efficiency by implementing strategies that include land use planning, transportation system design, and goods movement management; and transitioning to low- and zero-emission vehicles.[13]

One program that is currently aiming to reduce single-occupant vehicles (SOVs), VMT, and GHG emissions is DOT's Statewide Mobility Services Program which provides resources, tools and information on sustainable transportation options such as carpooling, vanpooling, transit trip planning, and micromobility services throughout New York.[14] The program works closely with employers, universities, local mobility programs and initiatives, organizations, and individuals to find easy, affordable, reliable, and safe alternatives to driving alone. On an annual basis it has been estimated that that the program helps eliminate approximately 1,400,000 SOV trips, equating to 14,000,000 VMTs.

While the State will continue to support a range of transportation preferences, strategic decisions should be made in consideration of both individual community needs and other emerging trends affecting the transportation system. For example, investments in improving the resiliency of the transportation system have become increasingly important as New York experiences more frequent extreme weather events. Identifying where each strategy will achieve the greatest outcome while effectively meeting the transportation needs of each community is essential to achieving sustainable results.

3.1. Smart Growth

Smart Growth is a holistic, community-centered planning and development approach that emphasizes efficient and strategic land use practices with the goal of creating livable, sustainable, and resilient communities with multiple transportation options. The dense land use patterns of communities in the Metropolitan New York City area enable more efficient mobility options such as public transportation, but a majority of the State (and U.S. as a whole) is typified by sprawling, low-density land use patterns that foster personal car use. New York State began officially addressing this challenge with the passage of the Smart Growth Infrastructure Policy Act (SGIPA) in 2010, which established "Smart Growth Criteria" focused on sustainable development, community-based planning, and the provision of mobility choices. Additional criteria and "model local laws" for Smart Growth were introduced by the 2014 Community Risk and Resiliency Act. At the local level, communities throughout the State have also begun increasingly supporting these principles through updates to their comprehensive plans, zoning regulations (i.e., ordinances, local laws), and various other policies.

New York State provides technical assistance and capacity building support to help municipalities progress transportation planning that emphasizes creating livable and sustainable communities. One example of this support is **New York "Rural Connect,"** an initiative funded through the U.S. Department

of Transportation's **Thriving Communities** Regional Pilot Program,[15] led by DOT and supported by the New York State Department of State (DOS). Through **Rural Connect**, the State will provide technical assistance and training to five rural New York State municipalities in areas such as identifying/applying for grant opportunities, project management, and comprehensive planning. The successful implementation of Smart Growth principles statewide depends on cooperation between municipalities, State agencies, regional organizations (such as MPOs), and other community stakeholders.

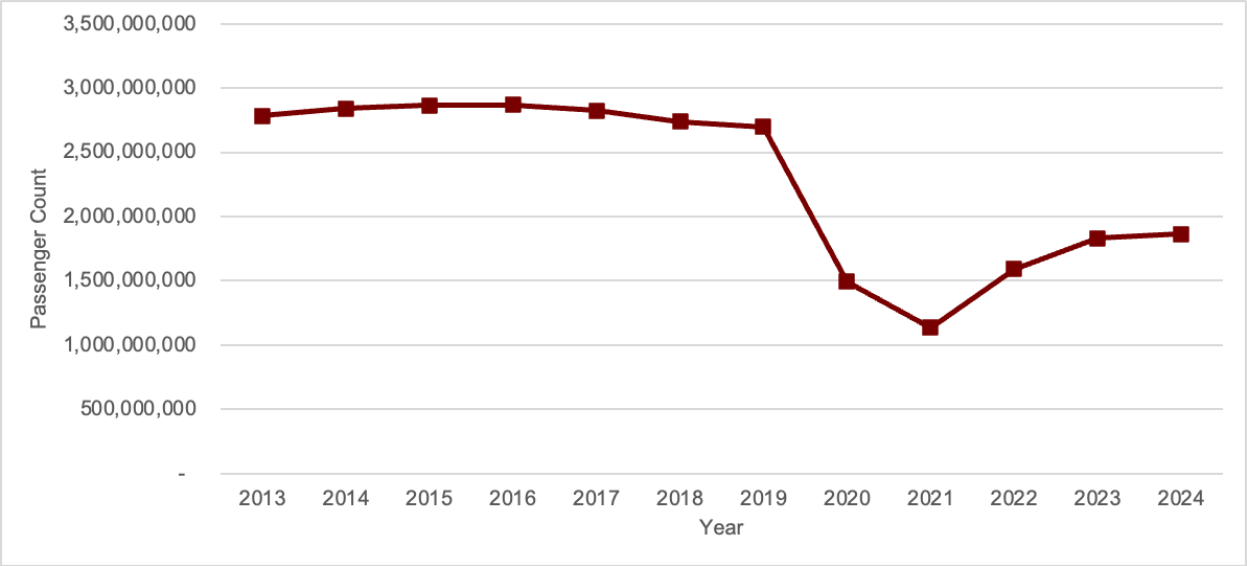
3.2. Public Transportation

Public transportation is vitally important and is one of the most energy-efficient travel options available. In FY 2026, the State plans to provide roughly $9 billion in operating aid to mass transit systems.[16] This funding supports the operation of 130 major transit authorities throughout the State. Interstate transit operators, such as Amtrak and Greyhound bus service, help to facilitate statewide travel for those reliant on public transportation.

Figure 2, below, provides information on public transportation usage statewide from 2013 to 2024. Notably, transit ridership plummeted across the state in 2020 and 2021, due largely to the COVID-19 pandemic, but began to recover from 2022–2024.

Figure 2: Statewide Public Transportation Ridership 2013–2024

Source: DOT Public Transportation Bureau[17]



3.2.1. Public Transportation in Metropolitan New York City Area

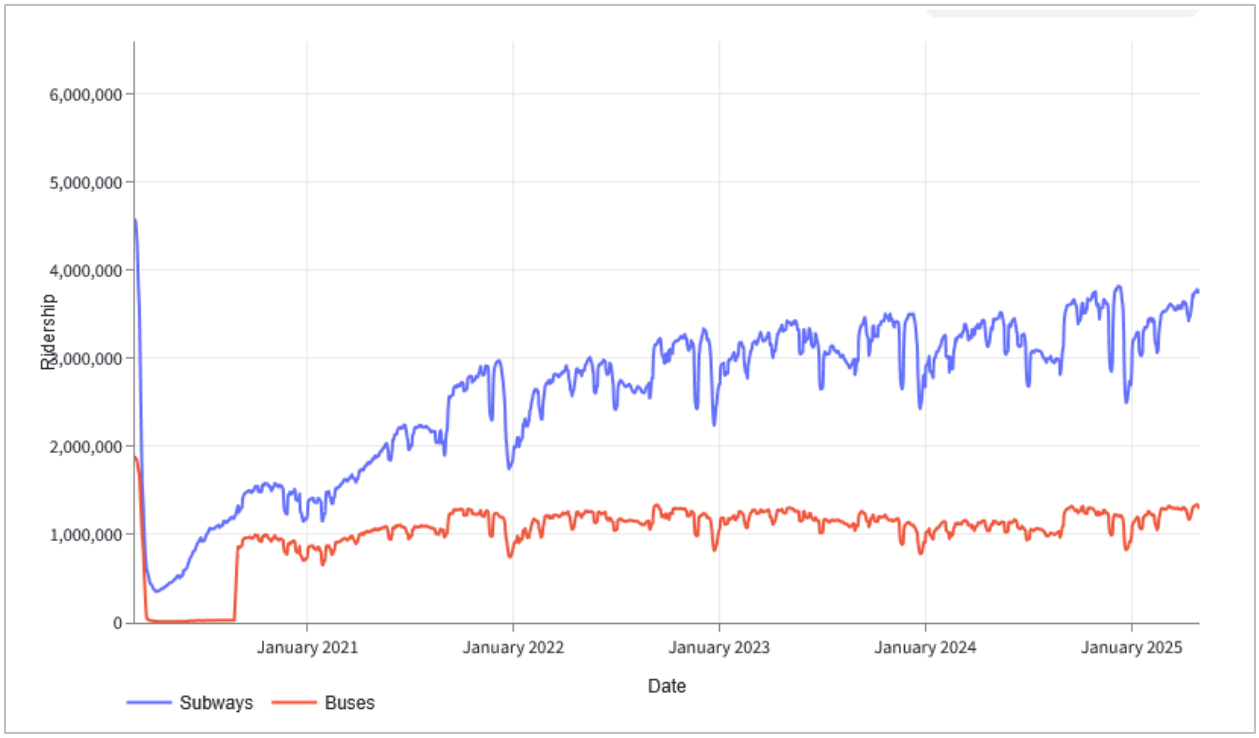
Transit service in the greater Metropolitan New York City area is largely coordinated by the Metropolitan Transportation Authority (MTA), which manages North America's largest transportation network, serving 15.3 million people across a 5,000-square-mile travel region encompassing New York City, Long Island, southeastern New York State, and parts of Connecticut.[18] The MTA network comprises the nation's largest bus fleet and more subway and commuter rail cars than all other U.S. transit systems combined, and includes New York City Transit, the Long Island Rail Road (LIRR), and the Metro-North Railroad

(Metro-North). Additional transit providers operating in Downstate New York include the Westchester County Bee Line System and Suffolk County Transit.

As illustrated by Figure 3, New York City Transit subway and bus ridership has begun to recover since the pandemic. In 2020, annual subway ridership dropped to 640 million and annual bus ridership dropped to 382 million.[19] In 2024, New York City Transit achieved daily subway ridership between 2.5 and 3.8 million (with 1.2 billion in annual ridership) and daily bus ridership between 0.8 and 1.3 million (with 409 million in annual ridership).[20, 21]

Figure 3: MTA Daily Bus and Subway Ridership, March 2020 through June 2025

Source: MTA



New York City subway trains and buses share real time arrival and departure data with travelers and utilize integrated payment methods for ease of use via a "tap and go" system that allows payment via contactless credit or debit card, smartphone, wearable device, or OMNY card.[22] Public transportation in New York City requires ongoing resources for maintenance and to respond to increasing transit demand for new routes and facilities, with these needs heightened by the system's expansive size and usage.

Notably, transit ridership in New York City area has continued to increase with the introduction of Congestion Pricing, which went into effect January 2025 and charges fees for vehicles entering the designated "congestion pricing zone" of Manhattan's Central Business District during peak travel times, with the proceeds used to fund future MTA projects. Transit ridership has increased considerably since the program went into effect, with a 9% increase in subway usage and increases of 10% and 7% on the LIRR and Metro-North, respectively, as travelers seek to avoid paying the vehicle fee. As shown in Table

1, as of September 2025 there have been 10% to 14% fewer vehicles entering the Central Business District compared to historical averages in each month since February 2025, reducing congestion and improving commuting times for both automobiles and transit bus riders.[23]

Table 1: Reduction in Vehicle Entries into New York City Central Business District

Source: MTA[23]

Month	Average Daily Entries	Daily Baseline (Historical Average)	Change from Baseline	Change from Baseline (%)	Total Fewer Entries per Month
January 2025	533,526	580,500	-46,974	-8%	-1,268,298
February 2025	541,309	613,900	-72,591	-12%	-2,032,548
March 2025	560,255	642,500	-82,245	-13%	-2,549,595
April 2025	568,143	644,400	-76,257	-12%	-2,287,710
May 2025	580,226	647,200	-66,974	-10%	-2,076,194
June 2025	570,328	662,400	-92,072	-14%	-2,762,160
July 2025	553,293	616,600	-63,307	-10%	-1,962,517
August 2025	553,269	641,300	-88,031	-14%	-2,728,961
September 2025	571,544	632,500	-60,956	-10%	-1,828,680

3.2.2. Public Transportation Outside the Metropolitan New York City Area

Public Transportation in other areas across the State outside the Metropolitan New York City area features a variety of land use patterns that include small towns, rural areas, and midsize cities surrounded by suburbs. Upstate transit authorities serve these mid-sized cities through a mix of fixed and flex route services, some incorporating bus rapid transit along more heavily traversed routes. The Niagara Frontier Transit Authority (NFTA) also operates a light rail service, the Buffalo Metro Rail. However, providing transit service to sprawled suburban municipalities within the larger metropolitan areas has been and remains a challenge.

Rural public transportation systems typically serve communities with populations less than 50,000 through a variety of public transportation modes, including demand response, traditional fixed route, deviated fixed route services and vanpool. Regional systems do not exist in most rural areas and services are provided by an individual municipality or county primarily within their own borders. This creates an organizational and financial burden for these entities, many of which have limited staff and budgets. This also limits the availability of cross-county travel to employment, services and major destinations that are not within a resident's home county. Currently, DOT is testing a pilot Technical Assistance Program for Rural Transit (TAP RT) to support rural communities to help improve or develop public and specialized transportation in their area. This initiative will also facilitate recommendations for more efficient or additional transit that will provide increased mobility options and services for disabled individuals.

3.2.3. Bus Rapid Transit

Bus Rapid Transit (BRT) is a high-quality bus-based transit system that delivers fast and efficient service by having stops at highly frequented passenger locations along specific corridors. Bus Rapid Transit lines may include dedicated bus lanes, traffic signal priority, updated fare collection systems, and enhanced stations along designated routes. BRT is growing throughout the downstate and upstate regions. BRT has been implemented in all five boroughs of New York City[24] as well as three corridors in the Capital Region.[25] Design is underway for the Bailey Avenue corridor in Buffalo[26] and planning is in progress in Syracuse,[27] Suffolk County,[28] and Rochester.[29]

3.2.4. Institutional Partnerships and Universal Access

To increase ridership, many transit agencies have developed institutional partnerships that provide fare-free access to transit services for students, employees, and other affiliates of regional institutions such as colleges/universities, government agencies, hospitals, and major employers. These "universal access" programs typically utilize modern fare technology, allowing individuals to board by scanning a student or employee ID card or using a mobile application linked to their account. Such programs often increase ridership without requiring significant service expansion.

Agencies with robust universal access programs have experienced the strongest post-COVID ridership recoveries. For example, the Capital District Transportation Authority (CDTA) partners with 45 institutions, including all major colleges and hospital systems in the region.[30] CDTA's ridership rose from a pandemic low of 9.8 million in SFY21 to 18.4 million in SFY25, surpassing its pre-pandemic level of 15.3 million. In St. Lawrence County, ridership grew from 59,818 in 2020 to 159,407 in 2024, fueled by similar partnerships with colleges and universities in their service area.

3.3. Vehicular Transportation Management

The smooth functioning of the transportation system is supported by both the management of transportation demand and capacity. Currently, traveling by car is the only viable option for many New Yorkers. Additionally, first responders such as police, firefighters, and medical personnel heavily rely on the road network to fulfill their duties. The road network also facilitates large-scale response and evacuation during large-scale emergencies, such as the extreme weather events that are becoming more frequent throughout the State. Any congestion on this road network negatively reduces the capabilities of first responders, threatens the safety and convenience of the traveling public, and adds to transportation costs for everyone by increasing fuel consumption and ensuing GHG and co-pollutant emissions.

As significant capacity expansion to address congestion (such as adding new lanes or roadways) is often not fiscally or operationally viable or desirable, local and recurring constrictions in traffic flow (i.e., bottlenecks) are most often addressed using demand management strategies. Transportation System Management and Operations (TSMO) is a set of strategies that can reduce congestion on the existing road network without expanding capacity. Technological advances allowing for real-time delivery of traffic information help to manage demand and improve the efficiency of roadways across the State.

Through its TSMO strategies, DOT actively monitors the operations of the highway network to reduce congestion, and the fuel consumed by vehicles operating on congested facilities. Some of the various TSMO strategies that DOT has deployed include Traffic Incident Management (TIM), Emergency Management Systems, and Traffic Signal Optimization, all three of which can help reduce traffic congestion and emissions. TIM activities are led by DOT's network of ten Transportation Management Centers (TMCs). The focus of these efforts is on:

- Safe and rapid traffic incident detection and clearance
- Management of planned and unplanned events such as construction, emergencies, high traffic special events (e.g., concerts, sporting events, the New York State Fair, etc.).

DOT accomplishes these strategies by:

- Deploying and using technology to monitor traffic conditions—including cameras, detectors, communications, and advanced traffic management systems.
- Coordinating multi-agency planning and response, including with State Police, local traffic and law enforcement, transit agencies, and management of the Highway Emergency Local Patrol (HELP) roadside assistance program.
- Communicating to the public about detours and route and modal alternatives through variable message boards, the 511NY.org system, and other public and private travel and navigation applications and outlets (e.g., Google, WAZE, Apple Maps, etc.).

Currently, DOT helps maintain traffic signals that are dispersed across the State and managed with varying degrees of connectivity and operations protocols. On local roadways, municipalities make sure traffic signals are properly installed and maintained within their jurisdiction. DOT provides coordination to improve traffic signal management spanning from design, operations, management, and maintenance to the ultimate replacement of deficient traffic signals. This includes upgrades to detection, communication and controller technology on state roadways, and in some cases even establishing communications to signals in the first place. This action also includes coordination of traffic signals with local jurisdictions and introducing signal priority for emergency, transit, and commercial vehicles. Traffic Signal Optimization synchronizes groups of traffic signals to allow increased flows of traffic along designated corridors in urban, suburban, and rural areas without stopping.

In terms of freight operations, the State continues to invest in opportunities to shift truck freight to other more efficient modes, such as rail or maritime shipping. For instance, DOT administers the Passenger and Freight Rail Assistance Program to provide funding for freight rail and port improvements as well as passenger rail enhancements. Since 2022 this program has awarded over $187 million for rail and port projects.

3.4. Active Transportation and Micromobility

"Active transportation" is human-powered means of transportation, such as walking and bicycling, along with other human-scaled devices, referred to as micromobility which includes electric bicycles ("e-bikes") and electric scooters ("e-scooters"). Active Transportation is low-cost, creates little to no GHG emissions, and in some cases promotes healthy lifestyles. Making these options a viable alternative to vehicular travel is key to New York's efforts to reduce GHG emissions while also promoting affordability and public health. New York residents without access to private automobiles, are not able to use one, or prefer not to drive, can particularly benefit from active transportation-oriented connections to jobs, educational opportunities, and public services.

Similar to national statistics, in New York State, roughly 53 percent of average daily trips, regardless of transportation mode, are a distance of less than three miles.[31] Given typical travel patterns, a large percentage of these trips were made by automobile. Local travel of less than three miles could potentially be completed by walking or bicycling.

Certain areas of the State do have a connected network for walking, rolling, and bicycling that includes sidewalks, bike lanes, dedicated shared use paths for pedestrians and cyclists, and recreational trails. However, in many places statewide, the current roadway configuration reflects an automobile-centric design. Multiple wide travel lanes, narrow shoulder widths, limited or missing sidewalks or bicycle infrastructure, and high-speed travel all present a challenge for the active transportation traveling public. These existing conditions frequently deter bicyclists and pedestrians from traveling along roadway corridors or serve as a barrier from accessing adjacent active transportation networks on both State roads and local streets.

State-owned and maintained roadways may serve as the primary commercial corridors and main streets of communities statewide, or as connector roads between small and rural communities. In many cases, these roads, whether in urban, suburban, or rural settings, may be challenging to navigate for non-motorized travelers. Facilities and infrastructure that accommodate walking, rolling, and bicycling work best when they interconnect with each other, forming a network. Short, disconnected sidewalks, trails, or bike lane segments can be frustrating for those who rely on them to access jobs, school, the grocery store, or other destinations. These isolated facilities can limit the options for those looking for different ways to travel within their community.

Active transportation has significant potential for expanding the reach of New York State's many public transportation systems. Encouraging transit customers to walk, bike, or use micromobility modes for the "first and last mile" (a term used to describe the trip between a person's home or work and a transit stop or station) can help to reduce congestion and improve local air quality by replacing car trips. It can also reduce the need to build large parking lots and garages at major transit stations, allowing more opportunities for transit-oriented development (TOD)[32] such as housing, business, civic, and recreational uses. Finally, enabling biking and walking to transit can potentially increase ridership by providing lower-cost options which can be especially beneficial for New Yorkers without access to an automobile. While DOT plays an important role in helping residents walk, roll, and bicycle along state roadways to reach bus

stops and transit stations, there are also current and future opportunities for DOT to facilitate installation of additional transit shelters, bike parking, and bike share stations on State roadways.

3.4.1. Current Policies and Plans for Active Transportation

New York State has already implemented several laws and policies to address active transportation challenges, chief among them the 2011 New York State Complete Streets Act, which requires State, county, and local agencies to consider the convenience and mobility of all users when developing transportation projects that receive State and federal funding. The Complete Streets Act is complemented by the 2010 SGIPA. The values embodied in the SGIPA and Complete Streets Act are interwoven in DOT's Statewide Transportation Master Plan (Draft) and the ongoing Active Transportation Strategic Plan (ATSP) (expected completion in 2026). The Transportation Master Plan spells out a vision of transportation choices for all and community centered planning, understanding that resilient, sustainable, and thoughtfully built transportation infrastructure can positively contribute to peoples' everyday lives. The ATSP will reflect New York State's recognition that facilities for walking, biking, and other forms of active transportation are important to the daily lives of New Yorkers, playing a vital role in providing connections both within and between communities. It will serve as a strategic guide for DOT's active transportation efforts.

3.4.2. Existing Bike Share and Micromobility Programs

Citi Bike is the nation's largest bike share program with 25,000 bikes and more than 1,500 stations spanning Manhattan, Brooklyn, Queens, and the Bronx—as well as Jersey City and Hoboken.[33] Usage metrics indicate that in as densely populated a municipality as New York City, Citi Bike is a popular choice to meet daily transportation needs.

In addition to Citi Bike, several bike shares can be found across the State. Examples of these include CDPHP Cycle!,[34] serving Albany, Schenectady, and Troy and HOPR in Rochester.[35] While these other bike shares don't compare in size and ridership to Citi Bike, they serve an important need and are becoming increasingly popular. New York's bike share programs, along with others throughout the country, generally offer both traditional pedal bikes and pedal-assist E-bikes. Bike shares are expected to continue to grow across the State and are expected to increasingly incorporate E-bikes and E-Scooters.

The DOT Statewide Mobility Services (SMS) Program has been expanding such efforts through partnerships with organizations like the Long Island Bike Co-Operative, which refurbishes and donates pre-owned bikes.[36] In early 2024, the SMS Program collaborated with the Co-Operative to bring bikes to community-based organizations in disadvantaged areas, increasing access to alternative transportation options. A bike library, as organized by the SMS Program, allows patrons of a public library or community organization to borrow a bike for free. These programs are especially impactful in lower-income communities and communities with limited public transportation and other transportation options. As of April 2025, 24 bikes have been distributed among four bike-borrow programs on Long Island, with expansion planned for across the State.

With the emergence of electric micromobility, namely E-scooters, on April 17, 2020, the State amended Chapter 71 of Vehicle and Traffic Law for the Operation of Electric Personal Assistive Mobility Devices

and Operation of Electric Scooters (Title 7, Articles 34-C & 34-D), providing roadway rules and regulations for how these newer forms of transportation could operate.[37] This includes the age 16 requirement to operate, maximum speeds (20 mph for E-bikes and 15 mph for E-scooters), disengagement of motors when idle, ability of municipalities to further regulate speed limits (30 mph or less) headwear requirements, and the inability to utilize sidewalks.

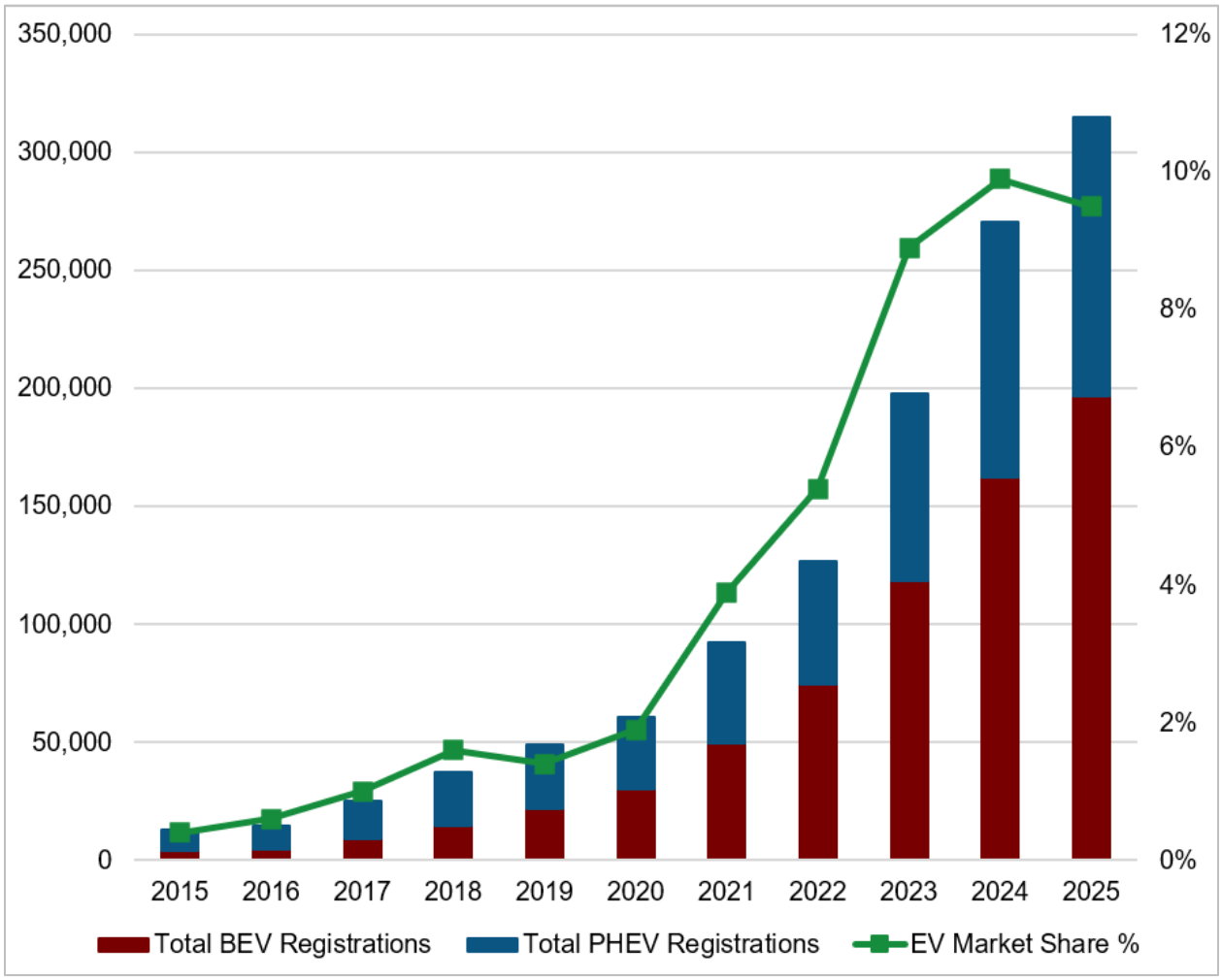
3.5. Clean Vehicle Technologies

3.5.1. Electric Vehicle Sales Growth and Technology Advances

Over the past decade, the use of clean vehicle technologies, in particular electric vehicles (which includes both battery-electric vehicles [BEVs] and plug-in hybrid vehicles [PHEVs]), has grown rapidly. The number of EVs registered in New York State has grown by more than 2,000 percent since 2015, from about 13,000 vehicles to more than 315,000 in September 2025 (see Figure 4). The number of models available has also grown, from about 20 in 2015 to more than 150 in 2025.[38] In 2025, EVs made up just under 10 percent of all new vehicle sales in New York State, although they still only account for about 2.9 percent of all registered vehicles.

Figure 4: EVs Registered in New York State (left axis) and Market Share as a Percent of All New Vehicle Sales (right axis)

Source: Atlas Public Policy EValuateNY and EV Hub EV Market Dashboard.[39] Note: 2025 vehicle count and market share are through August 2025.



To accompany the growth in EVs, charging stations have also proliferated. As of October 2025, there are more than 18,000 public charging ports – which includes more than 2,600 direct current fast charging ports (DCFCs), and more than 15,000 Level 2 chargers – at roughly 5,000 locations across the state.[40] Additionally, there are more than 4,000 "semi-public" ports at workplaces and multifamily buildings across the State, which serve multiple employees and tenants but not the broader public. The pace of charging station buildout has been nearly as fast as the pace of EV adoption, rising 1,300 percent since 2015 and 300 percent since 2019. Public DCFC stations have expanded rapidly in recent years, from about 500 in 2019 (which were almost exclusively for Tesla drivers) to more than 2,600, including a mix of plug types, in October 2025.[40]

Medium- and heavy-duty vehicles have not switched to alternative fuels as rapidly as LDVs to date but are electrifying quickly. More than 12,000 Class 2b through 8 electric trucks and buses are now registered in New York State, 80 percent of which were introduced to the state in 2024 and 2025. More than 95 percent of these are Class 2b and Class 3 pickup trucks and vans. In 2024, EVs made up more than 13 percent of all Class 2b and 3 new vehicles registered in statewide. In addition to electric vehicles, medium-duty vehicles in New York State run on other alternative fuels.[41] Nearly 3,000 vehicles in New York State currently run on CNG and nearly 1,000 run on propane, most of which are buses and large trucks.[42]

The underlying technology behind electric vehicles has improved dramatically over the last decade. As shown in Figure 5, the average range of a new light-duty BEV registered in New York in 2025 is 300 miles, nearly double the average BEV range in 2015, while the average manufacturer's suggested retail price (MSRP) of the vehicles fell by about 35 percent (Figure 6). Light-duty BEVs are approaching price parity with similar internal combustion engine-powered vehicles.[43] EV efficiency and cold-weather performance have also improved, thanks in part to innovations like heat pumps. More than a dozen EV models now achieve an equivalent of more than 115 miles per gallon.[44] At the same time, charging speeds have dramatically increased. Whereas many BEVs charged at a maximum of 50 kW in 2015, today many can charge at 300 kW or more, adding 150 miles of range in about 10 minutes. Many of the DCFC stations that are being installed today are capable of providing at least 150 kW, and many can provide 350 kW.

Figure 5: Average New Vehicle Electric Range for BEVs and PHEVs, 2015 to 2025

Source: Atlas Public Policy EValuateNY

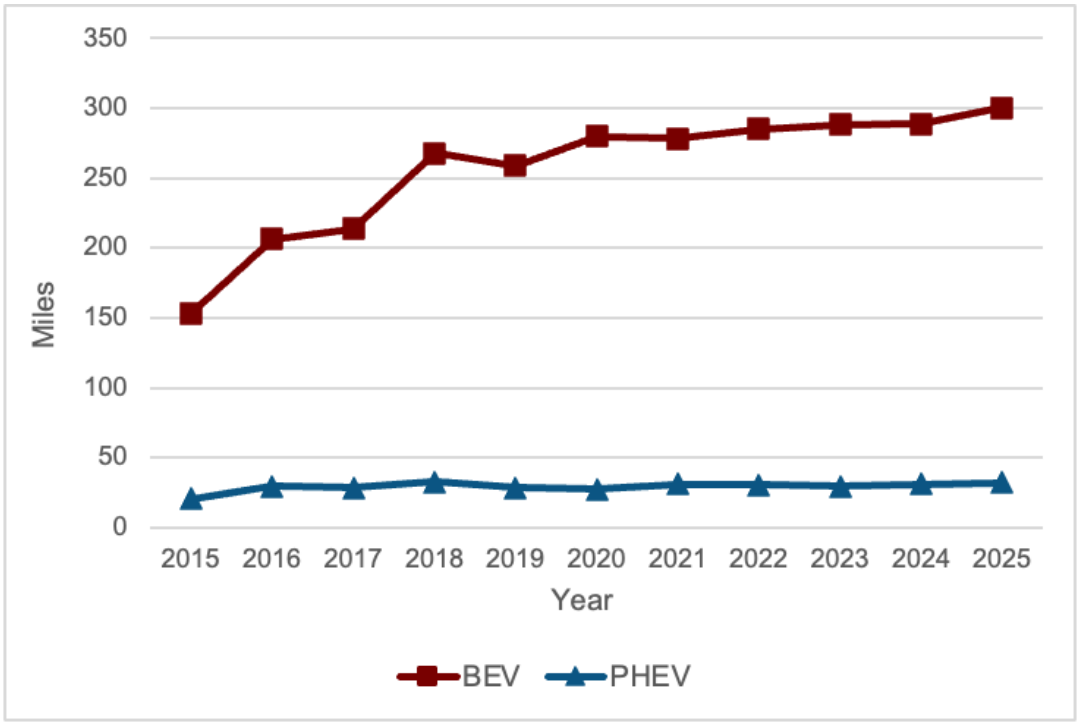
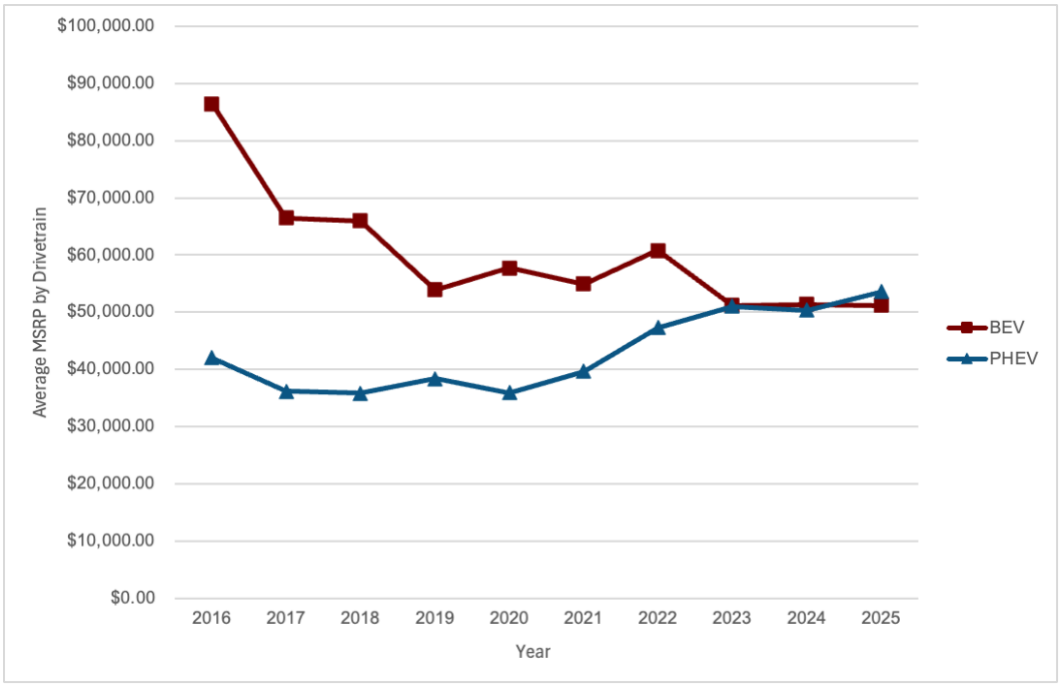


Figure 6: Average New Vehicle Manufacturer's Suggested Retail Price (MSRP) for BEVs and PHEVs, 2015 to 2025

Source: Atlas Public Policy EValuateNY[45]



Market growth has been driven by a combination of increased consumer interest, vehicle incentives from the State and federal government, investments in charging infrastructure, and regulatory requirements that push the auto manufacturers to sell more EVs. New York State is investing nearly $3 billion in electrifying its transportation sector. In addition, the new $1 billion Sustainable Future Program in the FY2026 State Budget includes a portion of funding specifically allocated to invest in the transportation industry, including charging infrastructure for passenger vehicles and medium to heavy-duty vehicles. There are a range of initiatives to grow access to EVs and improve clean transit for all New Yorkers, including the **EV Make Ready Program**,[46] **EVolve NY**,[47] the **Drive Clean Rebate** for EVs,[48] the **New York Truck Voucher Incentive Program (NYTVIP)**,[49] the **New York School Bus Incentive Program**,[50] **Charge Ready NY**,[51] and the **Direct Current Fast Charger Program**.[52]

Alongside the abovementioned incentive programs, New York State has also adopted regulations that encourage automakers to increase their sales of ZEVs in New York State. In December 2022, the New York State Department of Environmental Conservation (DEC) adopted the Advanced Clean Cars 2 rule, (see, 6 N.Y.C.R.R. Part 200 and 218) which requires automakers to sell an increasing percentage of light duty ZEVs in the State starting in 2026. The rules, which allow for a number of different approaches and include built-in flexibility mechanisms, aim for 35% of light-duty sales to be ZEVs in 2026, increasing up to 100% by 2035.

In December 2021, DEC adopted the Advanced Clean Trucks rule (see, 6 N.Y.C.R.R. Part 200 and 218), which requires manufacturers of Medium- and Heavy-Duty Vehicles (MHDVs) to sell an increasing percentage of ZEVs in the State starting in 2025. This rule also allows for different approaches and includes built-in flexibility mechanisms. It requires varying levels of ZEV sales based on vehicle weight class and body type, starting between 7% and 11% in 2025 and increasing to between 40% and 70% by 2035.

New York's ability to implement and enforce the Advanced Clean Cars 2 and Advanced Clean Trucks rules is currently subject to litigation challenging the federal government's attempt on June 12, 2025 to revoke the federal preemption waivers for these rules using the Congressional Review Act.[53, 54] New York State has established an interagency working group focused on the successful implementation of the clean vehicle transition and enhancing existing efforts to build out electric vehicle charging infrastructure.[55] New York State is also a member of the U.S. Climate Alliance Affordable Clean Cars Coalition.[56]

Additionally, in 2022 New York State enacted a requirement in statute that starting in 2027, all new school bus purchases must be ZEVs, and by 2035, all school buses in the State must be ZEVs. $500M has been allocated to support the transition to zero-emission school buses through the Environmental Bond Act, and NYSERDA has established the NY School Bus Incentive Program (NYSBIP) to assist school districts in meeting the zero-emission bus timelines.[57] While there are no similar requirements for non-road vehicles, New York State has set a target of 100 percent ZEV sales for non-road vehicles by 2035.[58]

3.5.2. EVs and the Electric Grid

Electrifying the transportation sector involves a major shift in the way vehicles are fueled. Rather than relying on gas stations, EVs can be charged at virtually any building with electrical access. This shift from

petroleum-based fuels to electricity results in a major reduction of GHG emissions and an increase in energy efficiency (according to the U.S. Environmental Protection Agency, EVs are far more energy efficient than gasoline or diesel vehicles—EVs convert 87 to 91 percent of energy into moving the vehicle, even after accounting for electricity generation and line losses, versus 16 to 25 percent for gasoline and diesel vehicles).[59] As more of the transportation sector is electrified, it will also result in an increase in overall electrical use in the State and possibly an increase in peak electricity use. However, actions like managed charging can reduce peak load increases and reduce costs for both drivers and electric ratepayers.

While access to the electric grid is pretty much ubiquitous in the built environment, there are many places that might require more electric power availability than currently available in order to charge EVs. Most vehicles are charged at home, and more than 90 percent of current EV users have access to home charging, according to a survey conducted by the National Renewable Energy Laboratory (NREL) on behalf of NYSERDA. Home charging tends to be relatively low-powered but can still be up to 19 kW, which is a large load for a single-family house. Clusters of EVs in a single neighborhood could require local transformer upgrades as power demand exceeds the existing transformers' rated capacity. Approaches like managed charging allow drivers and/or electric utilities to schedule charging times to charge at off-peak times. At this time, New York State utilities offer residential managed charging programs that incentivize EV drivers to charge at off-peak times, with the potential to generate substantial savings for drivers. Participating in managed charging programs can lower the likelihood of overburdened electrical distribution equipment, reducing the need to spend ratepayer dollars to upgrade equipment, and save drivers money. These benefits are made possible by two main approaches to managed charging: passive and active strategies that help align vehicle charging with grid needs and cost savings.

Residential managed charging can effectively reduce electricity demand peaks because with slower charging over a longer period of time, it is generally easier to shift charging to times when electricity use is lower, and electricity is less expensive. Managed charging can be passive, where EV owners react to price signals, or active, where a utility or third party actively controls an EV's rate of charging remotely. Often, passive managed charging can achieve a substantial reduction in peak electricity loads and customer savings but can sometimes create new spikes in electricity demand (for example, if lower-cost charging begins at 11 p.m., many EV drivers may program their cars to start charging at that time, creating a spike). Active managed charging can generate the greatest savings but can be complex to operationalize and relies on more sophisticated technology and communications between vehicles, chargers, and utilities. Active managed charging can result in a smoother electric load curve and the greatest reduction in electric system costs, which can then be passed on to ratepayers through bill savings. Studies done for NYSERDA have found that managed charging has the potential to reduce the cost of EV charging and the demands on the electric grid by more than 25%, which could result in a reduction of peak demand by gigawatts when EVs are widely adopted.[60] This reduction in peak demand can potentially lead to lower costs for all ratepayers.

The larger challenge for EVs and the electrical grid are higher powered charging stations. This includes high-powered DCFC stations (which provide 150 kW or more) where EVs can charge quickly, as well as

fleet depots that may include dozens or even hundreds of slower Level 2 chargers (which provide between 6 kW and 19 kW). Some fleet depots housing larger vehicles may even have large numbers of fast-charging equipment, which could be necessary because of the large batteries used by these vehicles. Fleets often use advanced managed charging systems to level out their electricity demand throughout the day, thereby minimizing demand charges and electricity costs. DCFC stations do not have the same time-of-day flexibility as other EV charging stations because people generally come to charge at these locations because they need to charge quickly and do not want to wait until off-peak hours, but these stations can manage their charging through technologies like on-site battery energy storage systems (BESS), which can charge at off-peak times and reduce electricity demand during peak times.

Some EVs can also export power, either to a building (called vehicle-to-building, V2B power) or to the electric grid itself (called vehicle-to-grid, V2G, power). V2B offers an opportunity for EVs to provide local, mobile backup power in emergencies, essentially acting as clean mobile generators. V2G power is a way to monetize the EV's battery while it is not in use for driving. Studies have found that vehicles could earn hundreds of dollars per year through V2G participation, which can help increase operational savings from EVs.[61] V2G systems may require different interconnection technology than typical EV charging stations. New York utilities are actively pursuing V2G projects, which are expected to become more common in the coming years. The Public Service Commission (PSC) is addressing V2G through the Grid of the Future Proceeding, Case 24-E-0165. A recent report commissioned by NYSERDA and DPS found that EV charging, including both V2G and managed charging, offers the largest source of potential grid flexibility between now and 2040.[62]

3.5.3. Other Alternative Fuels

While liquid and gaseous alternatives to petroleum-based transportation fuels, such as CNG, propane, and biofuels, have been available for decades, none have made major inroads in the New York market. The primary use of biofuels in New York State transportation is ethanol blended with gasoline in a 10 percent blend (E10). Higher blends used for flex-fuel vehicles (E85) were more popular earlier in the 21st century but have generally faded in popularity in the last decade. There are currently about 75 gas stations that sell E85 in New York State, a small increase from the 63 stations that sold E85 in 2020.[63] Aside from the minimal blend of biodiesel in standard diesel (<5%), biodiesel is generally available for purchase from fuel distributors in the state and tends to be used at private fueling facilities for fleet use, but there are few public fueling stations that offer biodiesel for purchase by the general public. Renewable diesel, a drop-in fuel derived from fats and plant-based oils that is chemically identical to petroleum-derived diesel fuel, is becoming more widely available in New York State. It does not require a separate fueling infrastructure and can be blended freely with petroleum diesel. Large fleets like New York City have made commitments to purchase renewable diesel to power their fleets. Sprague Energy opened the first retail station specifically selling renewable diesel in 2024 and operates terminals for renewable diesel in the Bronx and Albany as of the end of 2024.[64] The price of renewable diesel has become more competitive with diesel, especially in places like California that have policies that support its production, like a Low Carbon Fuel Standard.[65]

CNG and propane have had some success in niche markets within the medium- and heavy-duty vehicle sectors, but, as noted above, remain a very small portion of the overall market. There are about 20 public CNG stations in New York State, with another 20 private stations, and there are approximately 20 stations that provide propane for fueling vehicles. CNG vehicles are available in a number of vocations and weight classes, but most on the road tend to be Class 4-8 straight trucks and tractors. Renewable natural gas (RNG), natural gas captured from landfills, digesters, wastewater treatment facilities, and other similar processes and cleaned to be usable for transportation use has seen increased use and interest. While burning RNG has similar tailpipe emissions to CNG derived from fossil fuel sources, the lifecycle GHG emissions can be much lower.[66] RNG has been a more widely used transportation fuel in places that have implemented low-carbon fuel standards and similar policies but still has a limited reach.

Hydrogen fuel cell vehicles are available in certain market segments, but the vehicles, fuel, and infrastructure remain expensive. Hydrogen fuel cell vehicles (FCEVs) offer the potential for faster refueling, longer ranges, and better performance carrying heavy loads compared to BEVs, and they have zero tailpipe emissions.[67] In New York State, on-road FCEVs were first tested more than two decades ago but were not commercially available for many years. Recently two transit operators, New York City Transit (NYCT) and Rochester's Regional Transit Service (RTS), moved forward with the purchase of FCEV transit buses in 2024. Most other market segments in New York State do not currently have FCEV options available. Fuel cells are already used in some non-road vehicles, especially forklifts. Hydrogen-powered marine vessels are in use in some parts of the world.

One challenge related to hydrogen-powered transportation is the distribution of hydrogen to fueling facilities. Hydrogen can be produced onsite using electrolysis (the process of using electricity to split water molecules into hydrogen and oxygen molecules, which, if powered with carbon-free electricity, can create GHG-free hydrogen) or can be delivered by truck or pipeline. Delivery by truck can be expensive, energy-intensive, and prone to losses, especially if hydrogen is stored under high pressure. Other solutions include storing hydrogen as ammonia and cracking ammonia molecules apart (creating hydrogen and nitrogen molecules), but these solutions can be energy intensive as well and are in the early stages of commercialization.

The State is advancing maritime and ports decarbonization initiatives as well. The maritime and ports sectors in New York State are critical components of the State and national economies where they facilitate commerce, create good jobs, and promote economic growth. Because of the integral nature of the maritime sector and ports in New York, these facilities are at the forefront of climate adaptation and are poised to be near-term actors. To support the energy needs of this sector, DOS is leading a collaborative statewide Maritime and Ports Asset Inventory and Needs Assessment to identify port energy infrastructure and availability, including electrification, decarbonization, and alternative fuels opportunities and needs.[68] The State, more broadly, is evaluating potential decarbonization pathways for maritime facilities, alternative fuel technologies, current fuel delivery and storage mechanisms at ports, and near-term feasibility of certain vessel types making the switch to alternative fuels (e.g., ferries).

For a full review of alternative fuels, see the Low-Carbon Alternative Fuels chapter of this Plan.

4. Outlook (2025 – 2040)

The next fifteen years will be categorized by continued use of New York State's available powers to advance clean transportation options and efficiency in transportation.

ZEV sales in all market categories are expected to grow at an increasing pace, spurred on by investments and market demand. The focus for policymakers over the next five years (2025 to 2030) is on improving the economics of ZEVs to achieve relative parity in total cost of ownership (and in some LDV market segments, upfront price parity) with internal combustion vehicles. By 2040, in the core planning case all LDV sales and most MHDV sales are projected to be zero-emission, and ZEVs are expected to have made their way prominently into the used vehicle market as well. Cleaner fuels, like hydrogen, renewable diesel, and sustainable aviation fuel, should be widely available for hard-to-electrify market segments and for vehicles remaining in use that have not yet switched to zero-emission fuels.

New York will continue to work to increase both the supply of and demand for transit, electric micromobility, and active modes of transportation, including a focus on efficient land use. The State's investments are expected to reflect this priority. New York transit operators are expected to regain ridership lost during COVID and aim for further increases in ridership beyond previous levels. This could be achieved through partnerships with employers, economic development organizations, and municipalities. New York expects to see an increase in services like BRT, shared mobility programs, and bike and pedestrian infrastructure in areas that have traditionally had strong transit service — and many that have not.

5. Themes and Recommended Actions: Accessible and Affordable Transportation Choices

5.1. Improve Interaction Between Land Use and Transportation

Compact neighborhoods and location-efficient development make walking, bicycling, or taking public transportation more viable options. The integration of land use and transportation planning is a vital step in enabling this type of development and will lead to less energy-intensive transportation options for communities across the state.

For example, transit-oriented development (TOD) is a land use approach that focuses on development around well-utilized transit routes. Transit-oriented development integrates multiple mobility modes, including walking, biking, micromobility, and various forms of public transit. Its primary goal is to reduce VMT for residents relying on transit who otherwise may need to drive or utilize other methods to reach a primary transit system. Location-efficient development and TOD may seem the most logical in dense, space-constrained communities, but it is also a strategy for suburban or rural towns and villages to develop walkable areas and reduce their residents' reliance on single-occupancy vehicles. Given that location-efficient development is a land use strategy as well as a transportation one, success requires working closely with planning officials as well as transportation leaders. On the transportation side, this is best done by understanding the development opportunities surrounding existing and future

transportation hubs, including the impact that additional development may have on ridership. The Smart Growth chapter of this Plan discusses smart growth planning in greater detail.

Recommendations

- New York State should prioritize and coordinate investments in location-efficient areas to enable compact development, where feasible. This includes enhancing interagency coordination to encourage more active transportation and public transportation use as well as locating housing and mixed-use development in location-efficient areas. See the Smart Growth chapter of this Plan for detail.

- New York State should develop resources to support local governments' Smart Growth development. Led by DOS in consultation with other state agencies and authorities, this may include developing a guidebook to help communities navigate State programs and policies, design manual(s) for local governments and developers to advise on incorporating Smart Growth principles into neighborhoods in different contexts (rural, suburban, urban), model Smart Growth local laws, or best practices. See the Smart Growth chapter of this Plan.

5.2. Expand Public Transportation Across New York State

Enhancing public transportation through increased availability, accessibility, reliability, and affordability will expand transportation options and reduce emissions and air pollution. Ways to achieve these goals include transit enhancements, improving connectivity and convenience, and fleet modernization. A practical goal is for transit around the State to rebound to their 2019 pre-COVID ridership levels.

Community-based service enhancements, based on local input, would help tailor upgrades based on the needs and desires of the locales served. This could include increasing transit routes, frequency, and/or stops and shelters. It should also include partnerships between mobility providers, neighboring communities, and major employers. Policy and program transit development should recognize that shifts in transportation patterns take time: transit enhancements, such as increases in service area and more frequent service, need to be consistent in order to drive ridership in concert with land use evolution, and therefore need to be maintained for the long term based on appropriate planning rather than increasing or decreasing in response to short-term existing ridership. To encourage ridership, transit needs to be convenient, competitive, and reliable in terms of travel times. This can be achieved by employing real-time technology such as electronic customer information, trip planning and fare payment apps, and bus signal prioritization.

Transit fleets around the state have begun converting to electricity and hydrogen, including in Buffalo, New York City, and the Capital District. Outcomes and lessons learned from the 2025 Zero Emission Transit Transition pilot projects will help inform DOT's planning for the eventual transition of all the transit fleet throughout the State.[69] This near-term action is critical in meeting the State's energy efficiency and climate goals.

5.2.1. Systemwide Route Restructurings and Service Redesign

While transit agencies routinely adjust routes and schedules, comprehensive network redesigns are necessary every 5–10 years to align services with evolving travel patterns. These restructurings reallocate resources to communities with the greatest demand, improving system productivity and reducing energy use by focusing service where it will be most utilized. Though some lower-demand areas may experience service reductions, the net effect is a more efficient and effective system. However, policy should not result in reactive scheduling based on existing ridership and should instead provide consistent routing and sufficient frequency of service to drive ridership by making transit more competitive and convenient—recognizing that developing ridership in conjunction with land use changes is a slow process that relies on developers and riders knowing that their service lines will persist for years to come.

Another useful component of reliable and competitive public transportation is dedicated bus lanes, especially in congested areas, along with BRT infrastructure (e.g., platforms and bus stop bulb-outs): these not only make transit more competitive—they also signal a permanence akin to rail lines, where developers and riders can rely on lines for the long term.

The post-COVID shift toward telework has further underscored the need for system redesigns. Recent or upcoming system redesigns in New York State include Suffolk County Transit (2023), Central New York Regional Transportation Authority (commonly referred to as “Centro”) in Rome (2024), and MTA in Queens (Summer 2025). Other transit agencies, such as Westchester County, are in the planning stages for future implementation. These redesigns are most successful when paired with other system improvements such as BRT implementation, microtransit deployment, or new universal access partnerships.

5.2.2. Bus Rapid Transit

In corridors with high transit demand but without the population density or land use characteristics to justify light rail investments, BRT offers a cost-effective alternative. BRT enhances traditional fixed-route bus service by improving speed, reliability, frequency, and passenger amenities through features such as dedicated lanes, signal priority, advanced fare collection, and uniquely branded buses and stations. These improvements increase both ridership and operational efficiency, resulting in greater service productivity. While BRT has been implemented throughout various parts of New York State, there is still opportunity to continue identifying key areas or corridors of high population density where light rail investment may not be justified.

5.2.3. Institutional Partnerships and Universal Access

Institutional partnerships and universal access to public transportation continue to advance throughout the state, as many agencies have already embraced this concept. Between upstate providers such as Centro, CDTA, and the Rochester-Genesee Regional Transportation Authority (RGRTA) as well as the major providers downstate, New York State transit agencies have made a tremendous amount of progress, though opportunities remain. These programs increase ridership without requiring significant service expansion. By filling excess capacity with new riders, transit systems improve efficiency and reduce energy use per passenger trip.

5.2.4. Microtransit

Microtransit is an emerging solution for providing transit in areas where fixed-route service is not viable due to low population density, disconnected land use, or limited pedestrian infrastructure. Microtransit offers flexible, demand-responsive service using smaller vehicles and app-based booking, typically operating without fixed routes or schedules.

Although microtransit is less productive on a per-vehicle basis since each vehicle carries fewer passengers than a transit vehicle, it can be more energy-efficient than underused fixed routes by offering better coverage and using right-sized vehicles. Microtransit is particularly effective when paired with route restructurings, enabling agencies to concentrate fixed-route service in high-demand corridors while preserving coverage through microtransit.

Current microtransit deployments in New York State include CDTA,[70] Centro,[71] RGRTA,[72] Nassau Inter-County Express (NICE),[73] and Suffolk County Transit.[74] Planning efforts are underway in Buffalo (NFTA) and Westchester County. DOT is in process of providing funding to support more microtransit efforts across the state including in rural areas.

Support for microtransit development is available through:

- NYSERDA's Clean Mobility Program,[75] which offers technical assistance and implementation funding to projects that improve zero-emission connections to public transportation and showcase innovative shared transportation options through planning and demonstration projects.
- DOT's new Innovative Mobility Initiative,[76]will fund technology, vehicles, and operating costs for pilot programs statewide.

5.2.5. Zero-Emission and Low-Emission Transit

To further the role of public transportation in reducing energy use, transit fleets themselves can shift from diesel to low- and zero-emission propulsion systems. These transitions not only reduce fuel consumption but also improve air quality and support broader climate goals.

A variety of State and federal programs offer technical assistance and funding for planning, facility construction, and vehicle procurement for low- and zero-emission transit, including:

- NYSERDA – **Clean Mobility Program**[77] and **Truck Voucher Incentive Program**[78]
- DOT– **Zero Emission Transit Transition (ZETT)** [79] and **National Electric Vehicle Infrastructure (NEVI) Program**[80]
- DEC – **Municipal Zero-emission Vehicle (ZEV) Program**[81]
- OGS – **New York State Clean Fleet Plan**[82]
- Federal Transit Administration – **Low or No Emission Grant Program**[83] and **Bus & Bus Facilities**[84]
- Department of Energy

- Maritime Administration (MARAD) – **Port Infrastructure Development Program**[85]

New York transit systems currently operate a mix of clean propulsion technologies:

- **Hybrid-electric** – NYC/MTA, Westchester County/Bee-Line, Capital Region/CDTA, Broome County/B.C. Transit, Tompkins County/TCAT
- **Compressed Natural Gas** – primarily in Buffalo/NFTA, Syracuse/Centro, and Nassau County/NICE
- **Propane** – Allegany County
- **Battery-electric** – MTA, Capital Region/CDTA
- **Hydrogen-electric** – Rochester / RGRTA

Recommendations

Transportation agencies across New York State should work together with other agencies to:

- Expand public transportation through transit service enhancements, improving affordability, connectivity and convenience.
- Modernize transit fleets through the broader transition to zero-emission transit buses.
- Introduce BRT where there is high transit demand but without the population density or land-use characteristics to justify light rail investments.
- Support shared mobility services that provide access to affordable, flexible transportation options that connect more people to transit and provide additional options in communities with limited transit.
- Offer microtransit services, which can be more efficient than underused fixed routes by offering wider coverage (i.e., rural or suburban communities) and using right-sized vehicles.
- Identify multiple metrics to measure performance on improving mobility options in New York State (e.g., transit trips, EV charging stations, etc.)

5.3. Expand Active Transportation and Micromobility

DOT is in the process of developing the ATSP, which will set the state to help facilitate improved opportunities for walking, rolling, and bicycling throughout New York State. The ATSP will aim to improve active transportation networks along state roads for which DOT has jurisdiction. The intent is to use a data driven approach to identify linkages based on active transportation trip potential and to provide guidance to expand access to active transportation, including micromobility. DOT recognizes that the state roadways only form a small portion of a communities' transportation network. As such, the ATSP will also provide the tools, templates and guidance for regional and municipal planners to enhance and expand active transportation networks both within and between communities. This includes forming state and local partnerships to fill in network gaps with pedestrian and bicycle infrastructure such as

paths, on-street bike lanes, traffic calming measures, improved crosswalks, better lighting, and enhanced public transportation stops.

Initiatives Underway to Assist Municipalities

The state has also created several funding and incentive programs to assist local governments and municipalities in the implementation of active transportation efforts. These include the Climate Smart Communities program and federal programs administered by DOT, such as the Transportation Alternatives Program (TAP) and the Congestion Mitigation Air Quality Improvement (CMAQ) Program.[86]

NYSERDA administers two transportation programs specifically aimed at increasing mobility options, including active transportation. These two programs, the Clean Mobility Program[87] and the Clean Transportation Prize initiative,[88] are described below.

NYSERDA's **Clean Mobility Program** helps communities plan and implement transportation alternatives to reduce reliance on personal vehicles, including programs focused on active transportation. The program, which launched in 2024 and focuses on DACs, helps communities plan and implement zero-emission transportation options such as bike share, bike ownership programs, microtransit, and EV car share.

Similarly, NYSERDA's **Clean Transportation Prize** initiative, which launched in 2022, was designed to ensure that the benefits clean transportation were not felt solely by those with the means to buy personal electric vehicles. The Prize program focuses on electrifying transportation, reducing air pollution, and increasing clean mobility options in disadvantaged communities across New York State. Prize recipients are working on bike share and microtransit projects, as well as launching the MTA's first two hydrogen transit buses, among other projects.

Recommendations

- New York State should continue to enhance transportation planning to enable more walking and bicycling opportunities.
- New York State should develop municipal guidance resources, such as a template for site plan and other land use regulations that localities could adopt that require developers to include active transportation and transit amenities within commercial and residential developments where feasible.

5.4. Expand Transportation System Operational Strategies

As described in the previous section, the state will continue to focus on efforts to improve vehicular transportation efficiency and emission reduction by investing in strategies to improve transportation system operations but also address system resiliency. Throughout New York, many communities are often faced with unpredictable and increasingly severe weather-related events. The unique challenges vary across the state; for example, New York City and Long Island see more emergencies related to storm surge and flooding, while communities in Western New York often face lake-effect snowstorms. These events all have potential to impede access to critical services and goods, making emergency management and preparation vital for maintaining community lifelines such as the power grid, fuel

networks, and the transportation system. Common practices that can be broadly applied, across the unique contexts and differences in weather-related events, that communities may face include:

- Identify key local agency partners such as planning partners, roadway and maintenance teams, and transportation technology teams.
- Identify employers that provide vital goods and services (e.g., transportation, hospitals, pharmacies, energy & utility providers, human service organizations).
- Create community outreach and engagement plans.
- Support real-time information sharing to community members.
- Ensure first responders can reach and assist people in need.
- Create a vulnerability assessment map.
- Expand investment in regional data sharing.

6. Themes and Recommended Actions: Zero Emissions Vehicles

6.1. Electrification of Light Duty Vehicles

The share of new vehicle sales in New York that are ZEVs will continue to grow over the next decade due to a combination of market forces, consumer preferences, and requirements for automakers to increase their sales of ZEVs. However, the pace and scale of this increase is not a foregone conclusion. New York's policies and activities are two factors which may influence how consumers react to ZEVs and how quickly ZEV market share grows.

6.1.1. EV Charging

Modeling informing the State Energy Plan and other modeling exercises project that the light-duty ZEV market will continue to be almost exclusively electric vehicles, as opposed to hydrogen fuel cell vehicles. A key factor for expanding EV adoption is the expansion of charging infrastructure. While government support is critical to quickly building EV charging stations in the near-term, the goal is to transition to a stage in the market where site owners and charging station developers can realize attractive returns on their investments and charging is a service that is provided by the private market.

EV charging is very context-specific, and different types of charging make more sense in different operating environments. Level 2 charging stations are most appropriate in residential settings and at public or semi-public places where people will be parked for longer durations, such as:

- Long-dwell-time public locations with a high likelihood of longer distance traveler use, such as tourist attractions (e.g., parks, theaters, stadiums, museums).
- Public charging stations likely to be used by local residents without access to home charging.
- Workplace locations, especially those serving employees with a lower likelihood of home charging access.

- Multi-unit dwellings serving residential parking needs.

Access to home charging is one of the biggest indicators of whether a person considers purchasing an EV.[89] Installing Level 2 charging at places like multifamily buildings and workplaces can help provide options for people without home charging access. This is particularly important in New York, which has a higher percentage of housing considered to be multifamily buildings (52.7%) than any other state, by a wide margin.[90]

DCFC stations make the most sense at public locations along travel corridors and at locations within communities that can serve high-mileage drivers and residents without easy access to reliable Level 2 charging. Public and semi-public charging in DACs can be especially important. A focus on DCFC and Level 2 stations at multifamily buildings in DACs will help expand opportunities for DAC residents to purchase or lease EVs.

Fleets also require charging stations, often at their depots. Fleets may also rely on public or semi-public or shared charging hubs to charge their fleets, especially if there are space or power constraints at their depots or if they typically do not return to depots every day or travel longer routes than the range of their batteries.

Key barriers to sustainable economics of EV charging that have not yet been resolved include consistent local permitting practices across the State (which can add costs and slow the process for building new charging stations) and ongoing uptime and maintenance issues.

Managing the electrical load from both public and private charging stations helps minimize the overall cost of charging and the costs associated with charging station installations. At the PSC's direction, New York's investor-owned utilities have introduced managed charging programs to incentivize residential customers to reduce their electricity use at peak hours (see Case 18-E-0138). Similar programs also encourage commercial EV charging station owners to reduce electricity use at peak hours (see Case 22-E-0236). Participation in these programs has been mixed, and the State's electric ratepayers would benefit from greater uptake of these programs and related vehicle-grid interactive technologies that reduce electric grid impacts and turn EVs into grid assets.

Charging equipment should be appropriate for the context of its use and New York State entities funding charging equipment should aim for consistency in technical requirements across funding programs, to ensure easy cross-program participation and enable a consistent customer experience at charging stations across the state. Public charging stations that may require payment for electricity provided should be able to meet accuracy and measurement standards so the validity of the public sale of energy can be verified and accountable. The National Institute of Standards (NIST) Electrical Vehicle Supply Equipment Program (EVSE) establishes key standards for equipment testing.[91]

Recommendations

- New York State agencies should prioritize funding for charging station locations with the highest impact on EV adoption and that will be the most likely to be financially self-sufficient in the future. Consistent with this approach, agencies should continue offering mechanisms for funding

support, such as targeted funding programs for specific types of charging installations, utility make-ready programs, and EV-supportive electricity tariffs, while monitoring station economics to determine appropriate funding levels and program efficacy.

- The State should continue to focus on building out DCFC infrastructure along major travel corridors. Continuing support for public and semi-public Level 2 charging that supports New Yorkers who don't live in single-family homes will also greatly increase the number of people who ultimately buy EVs.
- State agencies should coordinate programs to develop consistent technical standards across programs and, wherever possible, similar application processes to increase ease of access for users. Funding programs should prioritize transparency and require charging station operators to provide uptime and availability information to the funding agencies and the public.
- New York should increase workforce development to train more EV installers and technicians to keep pace with the rapid expansion of new and existing EV charging infrastructure.
- NYSERDA should expand efforts to encourage local governments to adopt best-practice policies around permitting of EV charging stations.
- NYSERDA should work with the EV charging industry to provide better information about the benefits of installing charging stations at commercial sites, in terms of increased revenue, tenant and employee attraction/retention, and other measurable data points.
- The PSC and utilities should continue to advance load management and managed charging programs to increase participation and effectiveness. Efforts should include education and program design that makes customer participation easier and more beneficial, and should expand opportunities for flexible EV load, including through V2G adoption. The PSC should explore additional measures to streamline and modernize the interconnection process to better support flexible interconnection.
- New York should consider ways to allow emerging technologies, such as wireless charging and charging paired with on-site energy storage, to participate in its charging programs, while taking into consideration project benefits and costs.

6.1.2. EV Incentives

As of 2025, EVs are approaching price parity with internal combustion engine (ICE) vehicles; in some market segments EVs are already cost-competitive with ICE vehicles, especially when considering total cost of ownership (TCO).[92] However, there are still many consumers who are reluctant to buy EVs, and purchase incentives can offer an additional reason to move forward with an EV purchase. Given potential shifts in federal policy, New York's Drive Clean Rebate may take on more significance as New York tries to aggressively ramp up EV sales over the next decade. Expanding consumer choice and the availability of EVs for New York's car buyers will also help increase sales, and New York should take steps to make EVs as easily available as possible.

Many low- and moderate-income (LMI) car buyers do not typically buy new vehicles.[93] Ensuring that lower income New Yorkers can participate in a clean transportation economy means both ensuring access to clean public transportation and other mobility options and enabling opportunities for them to purchase clean personal vehicles if needed. Higher incentives for LMI EV buyers and incentives for the purchase of used EVs by LMI buyers can help bridge the gap to expand EV adoption among this demographic.

Other types of vehicles could also benefit from incentives and contribute to meeting New York's climate and affordability goals. Electric-assist bicycles have grown dramatically in popularity since they were legalized in New York State in 2020.[94] They offer a more affordable alternative electric transportation option for many New Yorkers but remain significantly more expensive than traditional bikes. Introducing incentives for e-bikes, especially if targeted at LMI buyers, could introduce clean transportation to a wider swath of the population.

Recommendations

- New York State should continue to fund the Drive Clean Rebate as a method of advancing EV adoption alongside support for EV charging and look for opportunities to increase its impact and cost-effectiveness through higher, more targeted incentives, as feasible.
- New York State should evaluate adding incentives for LMI EV buyers of new and used EVs.
- New York State should continue to support state fleets in incorporating light duty ZEVs into their fleets in accordance with Executive Order 22.[95]
- New York State should identify opportunities to animate the market for e-bikes, especially for LMI buyers and delivery workers, through public-private partnerships and targeted funding.

6.2. Electrification of Medium/Heavy Duty Vehicles and Non-road Vehicles

MHDVs and non-road vehicles are major energy users within the transportation sector and substantial contributors to the sector's GHG and local criteria pollutant emissions. Both industry segments have opportunities to electrify and move to ZEVs but are still in the early stages. MHDVs are a priority for New York State to electrify, with particular attention on electrifying school buses.

ZEV deployment in the MHDV sector has lagged behind the LDV sector, but progress is starting to accelerate. Notably, the market for electric school and transit buses are nearing maturity as multiple manufacturers have ZEV models available, including the leading manufacturers in the market segments, and many of these vehicles have been deployed. Other MHDV market segments are also ramping up offerings from both established OEMs and new vehicle startups, in introducing new vehicles. Several companies have introduced or announced ZEV versions of class 3 vans, class 6 box and work trucks, class 7 tractors, and light-duty delivery vans.

6.2.1. MHDV Charging

MHD ZEVs face similar but different charging challenges than LDVs. Different vehicle classes, vocations, and use cases will require very different charging arrangements. MHDVs that return to depots each night

and do not exceed their charging range on a daily basis will likely be able to charge at relatively slow speeds overnight or between trips. MHDVs that do not regularly return to the same place or that usually exceed their electric range on a daily basis will rely more on en-route charging. Public charging serving MHDVs will likely follow different business models than charging for LDVs; public charging for MHDVs is more likely to follow a shared model where fleets may reserve a percentage of charging time, rather than the "first-come, first-served" model that public LDV charging typically uses. Charging speeds are also expected to be much higher for public/shared MHDV charging (at least 350 kW, with 1 MW and up likely). These high-powered charging installations, and even depot charging installations (which could consist of hundreds of medium-powered chargers between 25 and 150 kW), will likely require substantial utility upgrades and expensive equipment. There is a strong societal benefit to these installations, as diesel MHDVs are major contributors to poor air quality and the associated negative health impacts.

Identifying the appropriate charging power and approach is critical to making MHD EVs work in fleets while reducing the cost of installations. NYSERDA and the electric utilities have been working with fleets, especially school bus fleets, to help develop fleet electrification plans that analyze routes, depots, and available vehicles, and develop a phased approach for integrating EVs into the fleets. This type of approach would be helpful for a wide range of fleets in New York to ensure that they are making appropriate investments and pursuing a viable, well-considered strategy to electrification.

In 2023, the PSC announced proceeding 23-E-0070, Proceeding on Motion of the Commission to Address Barriers to Medium- and Heavy-Duty Electric Vehicle Charging Infrastructure. This proceeding builds on the Medium- and Heavy-Duty pilot program (part of Case 18-E-0138) and aims to address EV charging needs for medium- and heavy-duty vehicles and remove market barriers. As of 2025, this proceeding is still ongoing. Stakeholder comments and preliminary research shows that the capacity needed to charge these vehicles will be significant and likely not follow the same duty cycles as LDVs.

The proceeding is accompanied by the Proactive Planning Proceeding (Case 24-E-0364) that is designed to proactively examine load patterns from both transportation and buildings and grid needs at the distribution level. The findings will allow the utilities to deploy distribution-level upgrades ahead of need, thereby reducing costs, avoiding over- or under-building and modernizing our electric system.[96] These proactive utility investments will support the buildout of EV infrastructure in locations where the State and utilities anticipate necessary grid upgrades.

Recommendations

- The PSC should continue its ongoing MHD Make Ready proceeding and development of its proactive investment strategy for utility upgrades supporting EV infrastructure.
- NYSERDA and DPS should further investigate shared public site business models for MHD charging and work to remove any barriers to enabling the construction and possibly make-ready financial support for these types of sites.

- New York State (led by NYSERDA, DOT, and the New York State Thruway Authority) should identify and fund opportunities for installing MHD EV charging stations at public truck parking locations.
- New York State should make available additional funding (as feasible) to support EV charging installations supporting public fleets like school buses, transit buses, and state and municipal fleet trucks.
- New York should expand the availability of funding (as feasible) to support fleet electrification plans for more types of fleets.
- New York should develop roadmaps for the electrification of target market segments and work with industries to identify near-term and longer-term actions that will help electrify those market segments.

6.2.2. MHD EV Incentives

The upfront cost of MHD EVs remains significantly higher than that of diesel equivalents. The TCO of these vehicles is closer, but many fleets cannot currently justify the investment in EVs based on the high upfront costs. NYSERDA's New York Truck Voucher Incentive Program and School Bus Incentive Program have helped bring down the upfront cost, but both are limited in scope and eligibility. New York should aim to achieve successes in sub-markets where the switch to EVs is most viable, such as local delivery vehicles and school buses, and expand focus to additional fleets as the technology and economics become more favorable in those areas.

Financing and leasing for MHD EVs has also been a barrier to market entry. Especially in the early days of the MHD EV market, little is known about the residual value of the vehicles, which is a requirement for financial institutions to lend money or lease the vehicles. Reducing the risk associated with getting the residual value wrong can help increase lending around MHD EVs, and gathering and disseminating market data around residual values will help accelerate market participation by lenders.

Recommendations

- New York State should expand funding for MHD EV incentives and increase opportunities for participation in existing programs through enhanced eligibility. Funding should focus on priority market segments where zero-emission solutions are commercially available and phase in additional market segments as they become commercially available.
- New York State should study options for regulatory approaches to achieve higher MHD EV adoption.
- New York State should continue to support state fleets in incorporating MHD ZEVs into their fleets in accordance with Executive Order 22.
- NYSERDA should pilot approaches for reducing MHD EV residual value risk in the financial sector through partnerships with the private sector.

- NYSERDA, DEC, NYPA, DPS, and other agencies involved with funding MHD EVs, and EV charging should collect and analyze usage, efficiency, and charging data associated with these vehicles to provide better information about vehicle performance and economics to the market.

6.3. Electric School Buses

New York has taken a nation-leading approach to electrifying its school bus fleet, with requirements that all new school buses purchased after July 1, 2027, be zero-emission, and all school buses in operation as of July 1, 2035, must be zero-emission. While many of the recommendations described above related to MHD electrification are also relevant to school bus electrification, some additional recommendations relevant specifically to school buses are warranted.

Recommendations

- New York State should work with school districts to complete individualized fleet electrification plans for every school district by the end of 2028. These plans will guide schools in their phase-in of electric school buses (ESBs).
- New York State should set further guidance for schools by providing interim targets between the start of ESB purchases and the completion of fleet electrification. This could also include additional flexibility based on how the fleets incorporate other opportunities to lower emissions, such as using low-carbon biofuels.
- New York State should continue to develop resources to assist fleets in their electrification process, including updates to NYSERDA's Electric School Bus Roadmap and Guidebooks, improved range estimates and total cost of ownership estimates, and explanations of how to work with utilities to reduce electrification costs.
- New York State should ensure that schools are able to purchase electric school buses at prices that reflect the current status of battery prices and manufacturing costs, and that the state contract for electric school buses adequately reflects these prices.

6.4. Non-road Vehicles

Non-road engines and equipment sometimes overlap with on-road MHDVs but have many specific use cases that are unique and pose specific problems to transition to electric or hydrogen power. These applications are particularly challenging to electrify given the high cost of equipment, relatively low turnover, and, frequently, grid-constrained locations.

In the non-road sector, several zero-emission applications have reached early market entry phases, including yard hostlers, yard equipment, transportation refrigeration units, port and airport ground support equipment, automated guided vehicles, harbor craft vessels, and railcar movers.[97] Although the non-road sector is less mature than LDV segments and some MHDV segments, major non-road OEMs and new vehicle startups have started to introduce zero-emissions and hybrid options. Some agricultural equipment manufacturers with electric production or prototype models include Solectrac, Monarch, and John Deere. Some construction OEMs with electric models and prototypes include Caterpillar, Volvo, Komatsu, and Hyundai.

Non-road applications have specific safety and operational considerations, including those that operate in industries such as aviation, ports, and construction.[98] At this time, New York State is beginning to support demonstrations through NYSERDA's clean mobility and Vehicle-Grid Integration (VGI) funding opportunities. To continue this shift to zero-emission options, New York State should continue seeding the market for demonstrations and pilot programs, knowing that many of these areas will require more bespoke solutions to move away from fossil fuel sources. The State expects many of these sectors to move towards hydrogen as a fuel source, which will change the industry's energy landscape.[98]

Another challenge for this market is the rural nature of many of their uses, particularly for farming equipment and long-distance heavy-duty trucking. Rural areas are uniquely grid constrained, which creates opportunities to innovate including battery storage, vehicle-to-grid integration, and portable energy generation such as solar panels. This area requires further investment to be able to fully estimate its energy burden for electrification and other zero-emission operations.

Recommendations

- New York State should consider expanding its Make Ready efforts to incorporate non-road vehicle needs.
- New York State should undertake further in-state demonstrations and market and fleet studies for non-road market segments, which will help expand understanding of the decarbonization opportunities in these hard-to-electrify sectors. This includes farm vehicles, construction equipment, maritime vessels, and other sectors that face challenges including high equipment cost, relatively low turnover, and often grid-constrained locations.

6.5. Other Alternative Fuels

There is a need for further demonstrations of in-service hydrogen fuel cell vehicles and fueling infrastructure. These technologies have been used in small numbers, but for them to be more widely adopted it will be important to gather more in-service data and share lessons learned and best practices. Depending on how the market evolves, broader investments in hydrogen fueling infrastructure may be warranted. New York State should continue working with local authorities, such as municipal fire marshals, to demonstrate the safety of hydrogen fuel cell vehicles and identify safe options for operating these vehicles in tunnels and on bridges.

New York State should also continue to encourage demonstration-scale and larger rollouts of advanced biofuels, including sustainable aviation fuel (SAF) and renewable diesel. Published test results of the performance of these fuels can help encourage more end users to integrate these fuels into their operations. Market-based policies that encourage the use of these fuels could lead to the voluntary introduction of substantial quantities of these fuels into the market in NYS. State leading-by-example policies and procurements could also pave the way to broader use.

6.6. Alternative Fuel Research

Over the coming years, New York can help bring new technologies to market that support the needs of the evolving markets for EVs and other clean-fueled vehicles, non-road equipment, and vessels. Many of

the technologies necessary to improve the performance and minimize the costs associated with these vehicles have not yet been commercialized. NYSERDA has historically funded these types of R&D projects and will continue to do so. Some of the key topics for NYSERDA future product development and demonstration may include:

- Further investigation into effective managed charging and technologies that support vehicle-grid interaction is important to maximize the ratepayer benefits of transportation electrification and minimize the cost of installing charging equipment to power the State's EVs.
- Continued support for the development of technology improvements that improve battery fire safety and mitigate risks associated with e-bike batteries and other lithium-ion batteries used in transportation.
- Additional research to bring down the cost of hydrogen fueling infrastructure and the generation or transportation of hydrogen for use as a transportation fuel is needed to improve the economics of hydrogen fuel cells.
- Additional research in port and vessel decarbonization and feasibility of zero emission vessels or alternative fuels.
- Additional research and in-state pilot projects for zero emission locomotives.
- Additional research and in-state pilot projects for zero emission non-road applications, especially for large emitters operating in populated areas such as construction equipment, marine port equipment, and intermodal facilities.

7. Themes Recommended Actions: Sustainable Transportation Construction Considerations

7.1. Reducing the Use of GHG-intensive Materials in Constructing Transportation Systems

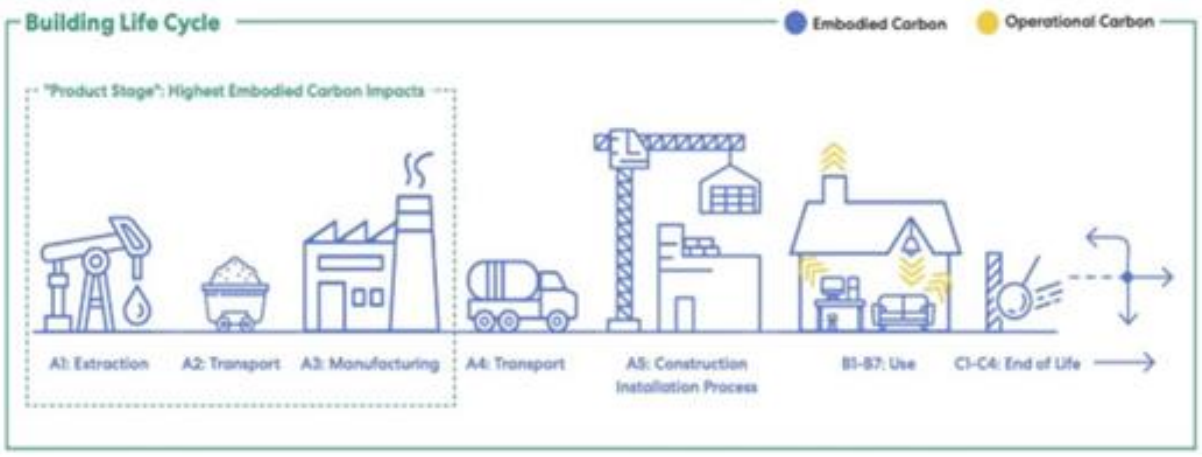
Embodied emissions are GHGs emitted during a material's life cycle, created by activities like mining, raw material harvesting, processing, manufacturing, transporting, installing and using products and materials, and end-of-life emissions associated with the disposal of those materials. Increasing demand for low-emission construction materials will spur manufacturers to reduce the impacts of their processes and products, making cleaner alternatives more available. New York State recognizes the opportunity to accelerate the growth of this demand via public procurement directives, given that nearly 50% of all cement and 20% of all steel that is purchased in the United States is paid for with tax dollars.[98]

Embodied emissions are estimated using life cycle analyses (LCA) and expressed as GHG emissions intensity (kilograms CO_2-equivalent [kg CO_2e]) per physical units of a product used (e.g., ton, cubic foot). Environmental Product Declarations (EPDs) are the most common way of quantifying and reporting the environmental impacts of a product, frequently compared to the "nutrition label" of a construction product. To date, EPDs have been a voluntary reporting tool, so most products with EPDs tend to have lower environmental impact, since higher polluting facilities have no incentive to produce an EPD. As New York and other jurisdictions start to rely on EPDs as a regulatory reporting tool, it is important to standardize assumptions so all products are evaluated evenly. Product stage EPDs quantify the embodied

emissions associated with raw material extraction through production of a given product (stages A1 to A3), also known as “cradle-to-gate” (see Figure 7 below).

Figure 7: What is Included in Embodied Carbon Calculations

Source: *Carbon Leadership Forum[99], with edits by Parson Healthy Materials Lab[100]*



When new buildings and infrastructure projects are constructed and renovated, clear and cost-effective opportunities exist for reducing embodied emissions associated with construction materials. Selecting and procuring lower-embodied emissions materials is possible if transparency exists around the embodied emissions associated materials or product, to allow for comparison of similar products or of entire construction options. In addition, reuse of existing infrastructure and materials where practical, rather than demolishing and constructing again, can generate large emissions savings. The reuse of existing structures and materials can save significant amounts of new GHG from being emitted.

While all construction materials have embodied emissions, the highest impact materials are those that have a high greenhouse gas footprint, are used in significant quantities, and where substantially lower-intensity product alternatives exist.

Initiatives Underway

As part of New York State’s commitment to lead by example under Executive Order 22, State projects are accounting for embodied emissions in procurements associated with capital projects and reporting on data to increase transparency and provide data to inform future decisions. As of January 1, 2025, State projects that meet minimum size thresholds have begun collecting product stage EPDs from awarded contractors for ‘covered materials’ including asphalt mixtures, concrete mixtures, steel, and glass.[101]

Acceptable EPDs under Executive Order 22 are third-party verified (also known as “type III”) and are product-, facility-, or supply chain-specific (rather than industry average EPDs), which allow for more transparent quantification of a product’s environmental impact. Through the collection of EPDs, the State will: drive the demand for and creation of EPDs in the market; create a market for low embodied carbon construction materials; and start to benchmark New York State’s performance on the environmental impact of its construction materials—with a view to setting limits in the future.

Increasing demand for low-emission building materials through public procurements will support local manufacturing facilities producing these products, create a long-term market signal for the demand of these products, and increase the availability of low-emission alternatives for private sector projects as well. Specific methods of reducing the emissions-intensity of a given building material vary by subsector (such as cement, glass, and steel).

Buy Clean Concrete Guidelines

In December 2021, Governor Hochul signed into law Chapter 724 of the Laws of 2021, relating to provisions in state procurement contracts involving the use of low embodied carbon concrete. The law adds a new section 136-d ("SFL § 136-d") to the State Finance Law which requires the Office of General Services ("OGS") to establish guidelines requiring the procurement of low embodied carbon concrete on appropriate projects. Effective in 2022, the law applies to State procurement contracts involving the use of low embodied carbon concrete, on State agency projects deemed appropriate by OGS, as defined in the guidelines. From 2025 onward, State agency contracts shall include the minimum standards for low embodied carbon concrete in all relevant authorized contracts.[102]

State Finance Law § 136-d applies to any State agency contract equal to or greater than $1 million and includes use of at least 50 cubic yards of concrete for building projects. For transportation projects, this applies to contracts equal to or greater than $3 million that include a concrete pay item with an estimated quantity of at least 200 cubic yards.

The Law is intended to increase the use and innovation of low-carbon concrete in state procurement projects. The corresponding Buy Clean Concrete Guidelines, which cover concrete mixes only, were developed in 2023 with input from a diverse group of stakeholders in concrete and government procurement. The guidance applies to State Agencies and is focused on EPD requirements and global warming potential (GWP) thresholds for concrete. As of January 1, 2025, contracts for relevant State agency projects will require concrete mixes procured to certify a GWP lower than the established limit in the relevant compressive strength category (

Table 2), in the form of an EPD, and additional certifications as required by each agency.

Table 2: Maximum Global Warming Potential Limits for Low Embodied Carbon Concrete (relevant for Phase 1 and Phase 2)

Source: OGS, NYS Buy Clean Concrete Guidelines

Notes:

- These limits reflect 150% of the Eastern Region average GWP figures from the National Ready Mix Concrete Associations' "A Cradle-to-Gate Life Cycle Assessment of Ready-Mixed Concrete Manufactured by NRMCA Members – Version 3.2 "(Jul 2022), page 62-66
- In 2027, pending availability of sufficient data for analysis, New York State will revise (lower) the concrete GWP limits in the table shown above.

Specified compressive strength (f'c in PSI)	Maximum Global Warming Potential Limits for Low Embodied Carbon Concrete (kilograms of carbon dioxide equivalent per cubic yard - CO_2e kg/y^3)
0 - 2500	275
2501 - 3000	302
3001 - 4000	360
4001 - 5000	434
5001 - 6000	458
6001 - 8000	541

Lower Embodied Carbon Material Use in the Transportation Sector

As of May 1, 2024, the New York State Department of Transportation implemented Performance Engineered Mixture (PEM) Concrete requirements.[103] These specification changes are part of the Department's effort to improve the performance of concrete and meet the targets of the Climate Leadership and Community Protection Act, Buy Clean Concrete guidelines, and Executive Order 22. The use of PEM for concrete and the associated optimized concrete mixture design approach can reduce environmental impacts by decreasing the amount of cement required while achieving improved performance characteristics.

Pilot Project Observations

DOT's observations from 10 pilot projects comparing PEM Concrete versus Class HP (high performance) Concrete revealed that the use of 8,800 cubic yards of PEM Concrete resulted in:

- Increased strength from a Design Strength of 3,000 PSI to 4,000 PSI.
- Less observed cracking due to shrinkage during the drying and hardening process.
- 662,000 less pounds of cement used.
- 595,800 less pounds of CO_2 emitted, based on a typically used conversion of 0.9 lbs of CO2 per pound of cement produced.

PEM Concrete also is expected to have a longer life, require less maintenance, and reduce CO_2. DOT's efforts continue through ongoing research to evaluate construction materials and products that meet performance criteria and have "substantially lower[1]" levels of embodied GHG emissions associated with all relevant stages of production, use, and disposal as compared to the estimated industry averages of similar materials or products.

Recommendations

- Collect better lifecycle embodied emissions data for covered materials to identify the best opportunities for achieving material performance and emission reductions.
- Update material specifications in a manner that supports construction performance and drives scale and progress toward lowering embodied carbon emissions in high volume construction materials to achieve New York's 2050 climate goals.

- Evaluate opportunities to further State procurement processes for large projects to evaluate whole-building or whole-project emissions that account for the trade-offs between material intensity, lifespan, maintenance, and energy use.
- Coordinate with other States and jurisdictions on standardized reporting requirements and methods used in EPDs.
- Support market development of technologies and firms to produce affordable, low-carbon materials within New York State.
- Investigate market-based opportunities to encourage the development of EPDs and the procurement of low-emitting products in private-sector construction.

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New York State Energy Plan

VOLUME II | Energy and Our Lives

Smart Growth

10

Key Terms Used in This Chapter

FOR THE COMPLETE GLOSSARY ➜

Home Rule: A form of government exercised by local governments (counties, cities, towns, and villages) is authorized by Article IX of the New York State Constitution[1] as implemented through the enactment of statutes like the Statute of Local Governments and the Municipal Home Rule Law. Statutes like these outline and otherwise grant a range of powers and the procedures for their exercise, including the ability of cities, towns, and villages to regulate land use and zoning and the ability of all local governments to enact local laws, undertake comprehensive planning, own and maintain municipal property and roadways, and levy local taxes. Because cities, towns, and villages control most zoning and land use decisions, the State typically assumes an advisory and funding role with land use planning—encouraging and incentivizing the adoption of Smart Growth practices. (Note: major renewable energy facilities are permitted in accordance with State regulations by the Office of Renewable Energy Siting and Electric Transmission [ORES] of the New York State Department of Public Service [DPS]. See Section 5.3 for additional detail).

Smart Growth: A planning and development approach that integrates equity, economic vitality, environmental sustainability, energy, public health, healthy aging, and climate resilience to create livable, sustainable communities for people of all ages, incomes, backgrounds, and abilities. The New York State Department of State recognizes ten guiding principles for Smart Growth land use planning:[2, 3]

- Develop plans and land use regulations that allow for and encourage mixed-use neighborhoods.
- Enable a diverse mix of housing types, providing opportunity and choice for all.
- Prioritize infill and redevelopment of existing buildings to revitalize neighborhoods and downtowns, including areas around public transit.

1 N.Y. Const. art. IX, § 2, https://dos.ny.gov/system/files/documents/2025/01/constitution-january-1-2025.pdf.

2 These Smart Growth principles guide the New York State Department of State's Smart Growth Community Planning Program and are informed by the original principles developed by the Smart Growth America Network and the criteria outline in the State Smart Growth Public Infrastructure Policy Act.

3 Smart Growth Network and U.S. Environmental Protection Agency, This Is Smart Growth, April 2014, https://www.epa.gov/sites/default/files/2014-04/documents/this-is-smart-growth.pdf; State Smart Growth Public Infrastructure Criteria, New York State Senate, Environmental Conservation, Chapter 43-B, § 6-0107 (2015), https://www.nysenate.gov/legislation/laws/ENV/6-0107.

- Provide well-planned, equitable, and accessible public spaces.
- Encourage compact neighborhood design and concentrated development around existing infrastructure.
- Preserve open space, agricultural resources, and natural resources.
- Prioritize transportation options such as walking, cycling, and public transportation.
- Promote climate resiliency and adaptation, preferably through nature-based solutions, and reduce greenhouse gas emissions.
- Build on unique traits to create an attractive and welcoming community with a strong sense of place.
- Engage in an inclusive, collaborative public planning process that considers the needs and character of the community.

Sprawl: Low-density, automobile-dependent development that spreads beyond urbanized areas into rural and natural landscapes. It often results in inefficient land use and loss of agricultural and open lands while also stretching and straining water, transportation, and energy infrastructure, as well as other municipal services.

Transit-Oriented Development (TOD): Dense, pedestrian-oriented, mixed-use development located near (usually within a quarter- or half-mile radius) of direct transit access. TOD integrates multiple mobility modes, including walking, biking, micromobility, and various forms of public transit, to provide residents with convenient and efficient transportation options beyond personal vehicles.

Location-Efficient Areas: Compact, resilient neighborhoods characterized by walkability, a mix of land uses, close proximity to everyday destinations, and reduced reliance on automobiles.

Green Infrastructure: Infrastructure that uses vegetation, soils, and natural processes to manage stormwater through filtration, infiltration, and evapotranspiration.[4] It also contributes to cooling urban areas and mitigating the urban heat island effect.[5]

4 About Green Infrastructure," U.S. Environmental Protection Agency, (EPA), February 13, 2025, https://www.epa.gov/green-infrastructure/about-green-infrastructure.

5 Reduce Heat Islands," U.S. EPA, April 22, 2025, https://www.epa.gov/green-infrastructure/reduce-heat-islands.

Key Findings → Smart Growth

Smart Growth is a holistic, community-centered planning and development strategy that emphasizes efficient, strategic land use practices to foster livable, sustainable, resilient, healthy, and energy-efficient communities. Key planning principles that guide Smart Growth include: incorporating a diverse mix of land uses, transportation options, and housing types; accounting for climate resiliency, adaptation, and mitigation; designing accessible public spaces and preserving open space; and following inclusive and community-based planning processes. This chapter provides an overview of the State's approach to Smart Growth, outlines major initiatives underway, and recommends continued and additional actions.

- **Smart Growth development patterns and practices** promote communities that rely less on energy-intensive transportation and infrastructure where feasible, making them more walkable, bikeable, and transit-accessible. Strategic land use planning that promotes compact, dense, and mixed-use communities, alongside the conservation of open spaces such as forests, farmland, public parks, and coastal areas, can significantly reduce transportation-related energy use and make communities more livable, resilient, healthy, and equitable. Policies and programs that support local governments in implementing Smart Growth planning and development are essential to developing more energy-efficient communities across the State and can provide direction to energy system planning to support a high density of users.

- **By encouraging greater density and integrating Green Infrastructure and energy-efficient site design, Smart Growth practices can reduce energy use and support the revitalization of downtowns and neighborhoods.** Higher-density and infill development enables more energy-efficient buildings and optimizes energy infrastructure use, limiting the expansion and operational costs of energy-intensive systems. Such energy savings can add reliability and resilience to the grid and provide flexibility to meet growing energy needs. Green Infrastructure, a key Smart Growth strategy, naturally manages stormwater and helps cool communities, contributing to additional energy savings.

- **Proactively integrating energy infrastructure into land use planning and zoning** offers opportunities to coordinate efficient energy production, storage, and distribution, thereby enhancing community resilience. Compact, mixed-use development creates a critical mass of energy users and supports the more efficient utilization of energy infrastructure.

- **Achieving Smart Growth energy outcomes requires strong inter-governmental and inter-agency collaboration.** While land use planning and zoning authority largely resides with local governments, the State can play a vital role in supporting local governments with Smart Growth land use planning and zoning and by aligning its planning efforts and investments with Smart Growth principles. Intergovernmental coordination and collaboration can reinforce Smart Growth initiatives and inform energy systems planning, such as siting of renewables, grid infrastructure improvements, and grid integration.

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1. Overview

Smart Growth is a holistic, community-centered planning and development approach that emphasizes efficient, strategic land use practices to foster livable, sustainable, resilient, healthy, and energy-efficient communities. This framework primarily seeks to strengthen and improve existing neighborhoods by supporting diverse housing options; non-automotive transportation modes, such as walking, biking, public transit, and micromobility; accessible green and public spaces; and a strong sense of place rooted in local identity and character.

In New York and throughout the U.S., sprawling development has increased energy consumption by fostering dependence on private automobiles rather than public transit, walking, or biking. Buildings in these areas are typically larger and less energy-efficient per capita, lacking the shared energy benefits of denser, connected structures. This type of development also consumes significant land, competing for the natural and agricultural resources of New York. Additionally, the infrastructure required to support and maintain sprawl is more extensive, driving up both energy demand and the costs of construction and upkeep.

The Smart Growth approach can increase efficiency by reducing energy usage associated with the transportation system and the built environment. Compact neighborhoods that integrate a mix of land uses—residential, commercial, recreational, natural, civic, and cultural—create communities where daily needs are accessible without an overreliance on any specific transportation mode. This planning approach can lead to lower energy demands for transportation, buildings, and infrastructure while supporting proactive planning for renewable energy development.

2. Smart Growth in New York State

2.1. Opportunities

There are opportunities to support and accelerate the adoption and implementation of Smart Growth policies across New York State, in turn reducing the energy use associated with transportation and the built environment and providing coordinated opportunities to produce, distribute, and store energy.

Smart Growth's Application for All Communities

Smart Growth development is appropriate for any community, whether rural, suburban, or urban, as the strategies can be scaled and crafted to fit into the local context. For example, urban areas with direct access to reliable public transit are ideal for implementing transit-oriented development (TOD)[1] districts because of the potential to live and work in an area where a private automobile is not necessary, thus reducing vehicle miles traveled (VMT). Further, these districts facilitate the development of denser, mixed-use buildings, usually using existing infrastructure, which creates energy savings in contrast to more sprawling development. Given the location of transit stations in New York State, TOD districts are most appropriate for communities served by the Metropolitan Transit Authority (MTA) in downstate New York and in upstate metropolitan areas served by consistent and frequent bus (or Metro Rail in Buffalo) service, like the Capital District Transportation Authority's (CDTA) Bus Rapid Transit service, BusPlus.

Rural areas may focus on strategies to preserve the rural landscape, including agricultural land, and support the local economy by concentrating development and redevelopment in core neighborhoods, hamlets, or villages. While rural areas may not be as easily accessed by mass transit, these communities can improve pedestrian and bike infrastructure and concentrate mixed-use development in municipal centers and other previously developed areas. In conjunction with electric vehicles (EVs) and charging stations, these transportation strategies can help communities realize energy reductions associated with the transportation sector and provide a greater variety of travel options. Further, Smart Growth planning in rural areas can help incorporate renewable energy facilities into their local landscapes while balancing other local needs.

Suburban areas may evaluate opportunities to create neighborhood centers by changing zoning regulations to allow for a better mix of uses and higher densities, while enhancing pedestrian networks and development in a way that increases public transit viability and opportunities to use non-vehicular transportation options. Many sprawling suburban communities have not planned for or created municipal centers of activity; Smart Growth provides them the opportunity to do so.

Interest in Smart Growth Communities

Preference for Smart Growth development patterns provides an opportunity. A survey conducted in the top 50 metropolitan statistical areas in the United States by the National Association of Realtors in 2023 found that 56 percent of respondents preferred houses with small yards in neighborhoods where it is convenient to walk to amenities over homes in traditional suburban neighborhoods where driving is necessary.[2] The survey also revealed that having homes with easy access to shops and parks within a community, sidewalks and places to take walks, and were within a short commute to work were mostly seen as somewhat or very important by respondents.[2] Such preferences align with Smart Growth development practices and support the feasibility of compact, dense, and location-efficient communities. In New York, the continued interest in—and over-subscription to—the Downtown Revitalization Initiative and NY Forward programs (which encourage community revitalization consistent with Smart Growth principles) demonstrates a strong market and desire for Smart Growth communities in both the public and private sectors, as well as the role of the State in realizing this demand and proliferating Smart Growth patterns that benefit New York's energy system.

Smart Growth and Major Investments

Major economic development projects and infrastructure investments offer prime opportunities to incorporate Smart Growth principles. Projects like Micron Technologies, a semiconductor fabrication facility which has the potential to bring more than 64,000 residents to the Central New York region by 2041, or other similar major investment projects are an opportunity for the State to support coordinated and proactive land use planning that ensures development occurs in a coordinated, regional approach in accordance with Smart Growth practices.[3] Other projects, like the I-81 viaduct removal in Syracuse or the Reimagining I-787 initiative in Albany, present opportunities to rectify the damage caused by these urban highways and integrate better community-based land use practices. Such initiatives present significant opportunities to transition away from recent sprawling land-use patterns and realize the energy savings associated with compact communities in location-efficient areas.

2.2. Transportation Trends

In New York State, transportation trends are increasingly aligning with Smart Growth principles to prioritize sustainable development, reduced environmental impact, and improved quality of life. This shift includes programs and policies that promote reducing VMT, increasing transit usage, growing the EV market, and increasing the number of charging stations, which all reduce petroleum usage and emissions.

Vehicle Miles Traveled

Smart Growth practices can help clean transportation alternatives expand in geographical reach and commuter participation, thereby reducing dependence on the automobile in communities, decreasing VMT, and ultimately reducing the energy used by the transportation sector. Shared mobility programs, such as carshare, on-demand micro-transit, bikeshare, and public transit, are effective at reducing VMT. For example, research estimates one carsharing vehicle removes between 4 and 15 vehicles from the road, with associated VMT reductions ranging between 3 percent and 63 percent.[4] Carsharing programs in New York State are growing, including Ithaca Carshare, DRIVE powered by CDTA, and Floshare.

Walking, biking, and other micromobility options, like e-bikes, provide other ways to expand travel choices that enable travelers to avoid wear and tear on personal vehicles, save money on transportation, and help reduce VMT. The New York State Department of Transportation (DOT) is currently developing a new Active Transportation Strategic Plan, which will update the plan for pedestrian and bike infrastructure. Project MOVER, a NYSERDA-supported project based in Westchester County, aims to increase non-vehicular transportation use through an e-bikeshare program, an e-bike library (for long-term bike rentals), an e-bike rebate program, and infrastructure improvements to promote safe biking on streets.[5] Currently, there are at least 10 bike share networks active in New York State. Such efforts can work well with and support initiatives to revise land use policies.

Transit Usage

Statewide, many transit systems are still experiencing reduced ridership compared to pre-pandemic levels. The Niagara Frontier Transit Authority, serving Niagara and Erie counties, saw total bus and rail ridership of approximately 15.5 million in FY 2024, up 6.5 percent over the previous year, but still down from pre-pandemic levels.[6] The Capital Region's CDTA has continued to see ridership increases with 18.5 million rides in FY 2025, which is a 12 percent increase over FY 2024 ridership. CDTA ridership exceeds pre-pandemic ridership.[7,] Metro North Railroad and Long Island Rail Road ridership has in general not reached pre-pandemic levels but is generally showing[8] While these are just a few of the transit systems in operation statewide, they do indicate that transit ridership is trending upward, despite not yet recovering its pre-pandemic levels. Complementary Smart Growth land use policies around transit stations can increase ridership and support the viability of consistent transit services because of a density of potential users.

Electric Vehicles

Smart Growth practices include the expansion of the EV market in the near-term to reduce transportation-related energy use, and New York State's market embodies this shift. There are about

275,000 EVs registered in New York State today, with the number of new EV registrations rising exponentially year over year. In 2024, there were approximately 93,000 new EV registrations, compared to approximately 42,000 in 2022, and just over 6,000 in 2019.[9] The Transportation chapter of this Plan provides greater insight into EV trends.

Charging Stations

Community and workplace charging opportunities help facilitate the EV transition by offering sustainable, equitable, and accessible transportation options for all New Yorkers. While homes remain the most common place to charge a personal EV, more chargers are being installed at workplaces; transit stations; along highways; and in grocery, recreation, and retail centers. The Transportation chapter of this Plan provides greater insight into charging station trends.

3. Relevant Policies and Programs

There are a number of existing State programs and policies that contribute to Smart Growth and align with its principles. Clean transportation and building decarbonization programs are initiatives that are directly tied to energy, while programs that contribute to Smart Growth development have indirect impacts on energy use. The existing policies and programs offered by the State can be organized into six general categories:

- **Investing in Community Cores.** These programs support public and private investment to add housing and jobs, restore historic structures, enhance recreation and tourism opportunities, and improve public spaces.
- **Creating Environmentally Sustainable Communities.** These programs help local governments take actions to reduce GHGs and adapt to climate change.
- **Revitalizing Vacant and Abandoned Areas.** These programs and policies seek to revitalize vacant and abandoned areas, including brownfields, and return them to productive use, facilitating infill development in existing communities.
- **Building Alternative Transportation Infrastructure.** This set of complementary programs and policies supporting alternative transportation contributes to Smart Growth and enables non-automotive transportation.
- **Conserving Open Space and Agricultural Lands.** These programs and policies seek to develop or expand parks, preserve critical habitats, protect water quality, and preserve farmland.
- **Supporting Equitable and Inclusive Communities.** These policies help guide State and local government(s) with the development of inclusive communities for people of all ages, incomes, and abilities.

Table 1 and Table 2 provide a high-level overview of the programs and policies that contribute to Smart Growth in New York State.

Table 1: Smart Growth Planning and Policy Processes

Planning/ Policy Process	Description	Agencies Involved	Implementation Date
Investing in Community Cores			
Smart Growth Public Infrastructure Policy Act of 2010	The Smart Growth Public Infrastructure Policy Act seeks to maximize the social, economic, and environmental benefits from public infrastructure development by minimizing the costs of sprawl development facilitated by funding or development of new or expanded transportation, sewer and wastewater treatment, water, education, housing, and other publicly supported infrastructure. The Act provides Smart Growth public infrastructure criteria for investments.	State infrastructure agencies	2010
Revitalizing Vacant and Abandoned Areas			
Land Bank Act	The Land Bank Act permits municipalities to apply for and create land banks in their own communities to acquire real property that is tax delinquent, tax foreclosed, vacant, and/or abandoned and to use the tools of the program to facilitate the return of these properties to productive use.	Empire State Development	2011
Building Alternative Transportation Infrastructure			
Complete Streets Act	The Complete Streets Act requires State, county, and local agencies to consider all roadway users of all ages and abilities when developing transportation projects that receive State and federal funding. This includes consideration of pedestrians, bicyclists, public transportation users, and motorists, and includes children, seniors, and persons with disabilities.	State department or agency with jurisdiction over such applicable transportation projects	2011
Active Transportation Strategic Plan	The New York State Department of Transportation (DOT) is currently developing a strategic plan to improve walking, bicycling, using micromobility, or using a wheelchair statewide. The Plan will provide direction and guidance for future investments.	DOT	2025
Supporting Equitable and Inclusive Communities			
Pro-Housing Community Program	The Pro-Housing Community Program certifies municipalities that are working to address the statewide housing shortage. Certified municipalities are eligible for a preference in scoring for certain State discretionary grants.	Agencies, offices, and departments over which the Governor has executive authority; public benefit corporations, public authorities, boards, and commissions for which the Governor appoints the chair, chief executive, majority of board members (excluding the Port Authority of New York and New Jersey), any interstate or international authorities as defined in Section 2 of the Public Authorities Law, and any local authorities as defined in Section 2 of the Public Authorities Law.	2023
Thriving Communities	The Thriving Communities program led by DOT, funded by a grant from the U.S. Department of Transportation (USDOT), will provide five rural communities with State-led technical assistance, public education and awareness, and capacity-building with the goal of implementing community-based transportation improvements coordinated with land use.	DOT, DOS	2024
New York State Master Plan for Aging	The Master Plan for Aging is a comprehensive roadmap to coordinate existing and new State policies and programs to ensure that older adults can have fulfilling and safe lives as they age. This includes the goal of having community design and housing options that are accessible for all members of a community, consistent with smart growth.	DOH, New York State Office of the Aging	2022

Prevention Agenda 2019-2024	The Prevention Agenda is the blueprint for State and local action to improve the health and well-being of all New Yorkers. The Agenda includes goals related to improving the design and maintenance of the built environment to promote health and sustainability, including objectives for increase alternative transportation usage.	DOH	2024
Conserving Open Space and Agricultural Lands			
Open Space Conservation Plan	The 2016 Open Space Conservation Plan describes the current open space conservation goals, actions, tools, resources, and programs administered by the State and federal agencies and conservation nonprofits.	DEC, OPRHP, DOS, AGM, DOT	2016
Community Preservation Fund	Article 2, Chapter 24, Section 6-S of the General Municipal Law established community preservation fund, enabling any town or city in Putnam, Ulster, or Westchester counties to establish a community preservation fund using real estate transfer tax, subject to the requirements of Section 6-S. The preservation fund shall help with preservation of open space, including parks, nature preserves, aquifer recharge areas, historic places, other critical areas.		2007 2019
25 Million Trees by 2033	The 25 Million Trees by 2033 initiative encourages New Yorkers to plant trees and expand forests to improve the health of the community, the environment, the economic, and mitigate the impacts of climate change.	DEC	2024

Table 2: Smart Growth Programs and Initiatives

Program/ Initiative	Description	Agencies Involved
Investing in Community Cores		
Downtown Revitalization Initiative	The Downtown Revitalization Initiative, begun in 2016, seeks to accelerate the revitalization of downtowns through a process that pairs strategic planning with funds for immediate implementation of projects. This program implements Smart Growth principles by supporting complete streets, mixed-use and infill development, energy-efficient buildings, and a diverse mix of uses in downtowns and municipal centers.	DOS, ESD, HCR, NYSERDA
NY Forward	NY Forward, created in 2022, supports the revitalization of smaller communities, with a focus on hamlets, villages, and neighborhood scale commercial centers. NY Forward, like the Downtown Revitalization Initiative, implement Smart Growth by supporting complete streets, mixed-use and infill development, energy-efficient buildings at an appropriate scale.	DOS, ESD, HCR, NYSERDA
Adirondack Park and Catskill Park Community Smart Growth Program	Since 2007, the Environmental Protection Fund (EPF) has included funding dedicated to supporting Smart Growth in New York State via a series of competitive grants to municipalities and not-for-profit partner organizations. DEC distributes a portion of these funds within the Adirondack and Catskill Parks to support sustainable development, environmental protection, and community livability.	DEC
Smart Growth Community Planning Grant Program	Beginning in 2021, the Smart Growth Community Planning Program provides grant funding to local governments to develop or update comprehensive plans, area plans, or zoning ordinances consistent with smart growth principles.	DOS
NY Main Street Program	Since 1985, the NY Main Street Program provides resources to invest in projects that provide economic development and housing opportunities in downtowns, with the goal of stimulating investment and establishing and sustaining downtown and neighborhood revitalization efforts.	HCR
Building Cleaner Communities Competition	Launched in 2018, the Building Cleaner Communities Competition, formerly the Carbon Neutral Community Economic Development Program, provides incentives to buildings that support regionally significant, carbon-neutral, and resilient projects statewide.	NYSERDA
Historic Preservation Tax Credits	Expanded in 2009, this program offers tax incentives for the rehabilitation of historic commercial and residential properties with buildings listed in the State or National Register of Historic Places, or in a listed historic district.	OPRHP
Restore New York Communities Initiative	The Restore New York Communities Initiative provides municipalities with financial assistance for the revitalization of commercial and residential properties, encouraging community development and neighborhood growth through the elimination and redevelopment of blighted structures.	ESD
Strategic Planning and Feasibility Studies Program	New York State Empire State Development (ESD) provides grants to communities for a variety of strategic development plans, studies, and analyses, some of which involve land use, including comprehensive and area plans, feasibility studies, housing studies and site/facility assessments.	ESD
Creating Environmentally Sustainable Environments		
Climate Smart Communities	Climate Smart Communities, started in 2009, is a multi-agency program that helps local governments take action to reduce GHG emissions and adapt to a changing climate, including grants that can be used for smart growth strategies such as reducing VMT, construction of on-road or off-road facilities for non-motorized forms of transportation, and transit improvements that can increase ridership and provide access to daily needs. The program also funds studies or analysis, such as zoning buildout analysis or zoning code updates, or programs to support densification or implementation of smart-growth strategies that reduce the need for passenger vehicles.	DEC, NYSERDA, NYPA, DOS, DOH, DOT
Clean Energy Communities	Clean Energy Communities, initiated in 2016, is a program that helps local governments implement clean energy actions, reduce energy costs, create jobs, and improve the environment. The program provides tools, technical assistance, and funding to help communities complete clean energy projects.	NYSERDA
Smart Growth Countywide Resiliency Planning Program	The Smart Growth Countywide Resiliency Planning Program provides grant funding to counties to develop resilience plans to help them address climate change risks and vulnerability by identifying science-based adaptation and mitigation strategies that are climate adaptive.	DOS

Urban Farms and Community Gardens Grant Program	The Urban Farms and Community Gardens Grant Program, launched in 2022, offers funding to support the development and expansion of community gardens, school gardens, and urban farms across the state, working to expand the number and size of green spaces in the built environment.	AGM
Green Resiliency Grants	Green resiliency grants are designed to help flood-prone communities implement Green Infrastructure projects to mitigate the effects of climate change.	EFC
Local Waterfront Revitalization Program	The Local Waterfront Revitalization Program is a land and water use program that results in the development of a vision for a community waterfront, adapts State coastal policies to the local needs, and helps communities protect, preserve, and enhance its waterfront resources. Projects from participation in the program often include enhancements to public spaces and resiliency improvements.	DOS
Clean Energy and Land Use Resources	NYSERDA has developed several resource guides on model strategies and regulations regarding land use policies and clean energy, as well as websites dedicated to large-scale thermal and distributed energy resources. Examples include: • New York State Solar Guidebook [https://www.nyserda.ny.gov/All-Programs/Clean-Energy-Siting-Resources/Solar-Guidebook] • New York State Wind Energy Guidebook [https://www.nyserda.ny.gov/All-Programs/Clean-Energy-Siting-Resources/Wind-Guidebook] • Clean Energy and Your Comprehensive Plan [https://www.nyserda.ny.gov/All-Programs/Clean-Energy-Siting-Resources/Comprehensive-Plan-Guide]	NYSERDA
Revitalizing Vacant and Abandoned Areas		
Brownfield Opportunity Areas Program	Started in 2003, the Brownfield Opportunity Area Program provides communities grant funding and technical assistance to develop area-wide, community-based plans to effectively redevelop brownfields and other vacant and abandoned sites, transforming them into catalytic properties that facilitate community investment and improvement.	DOS
Brownfield Cleanup Program	The Brownfield Cleanup Program, enacted in 2003 and amended in 2008 and 2015, encourages private-sector cleanup of brownfields to promote redevelopment and revitalize communities.	DEC
Building Alternative Transportation Infrastructure		
Clean Mobility Program	The Clean Mobility Program provides for community led planning and demonstration of mobility services and infrastructure to improve transportation access, especially in underserved communities	NYSERDA
Clean Transportation Prizes	Clean Transportation Prizes help communities identify innovative clean transportation solutions, primarily in disadvantaged communities, to improve mobility options, job opportunities, and air quality in communities where projects are being implemented	NYSERDA
Conserving Open Space and Agricultural Lands		
New York Environmental Protection Fund	The New York Environmental Protection Fund (EPF) provides funding for projects that protect the environment and enhance communities. EPF funding is used by multiple state agencies to cover a range of programs: The Farmland Protection Implementation Grants Program protects agricultural and farmland. The Office of Parks, Recreation, and Preservation can purchase property for state parks. EPF funds can be used by DEC to acquire land to be included in Forest Preserves, State Nature and Historical Preserves, State Historic Sites, Unique Area, and other categories.	AGM, DEC, OPRHP
Clean Water, Clean Air and Green Jobs Environmental Bond Act of 2022.	The Bond Act provides not less than $150 million for farmland protection and easements and not less than $300 million for open space land conservation projects, which may include costs associated with recreation infrastructure.	DEC, Environmental Facilities Corporation, DOS, OPRHP, AGM, NYSERDA, DOT, NYSHCR, NYSOGS
Water Quality Improvement Project for Source Water Protection	This program provides funding to municipalities, land trusts, and soil and water conservation districts to purchase land and/or conservation easements in order to protect public drinking water sources.	DEC

4. Outlook

Integrating energy planning, decarbonization, and economic development can be facilitated by a significant shift from sprawling suburban development patterns to Smart Growth land use patterns, which are characterized by compact and resilient areas that offer walkability, a mix of uses, proximity to daily destinations, and reduced reliance on automobiles. This development pattern would be complemented by open space conservation efforts and align with the State's transportation and other infrastructure investments.[10]

Smart Growth is a cross-sector strategy that complements energy goals between sectors, including transportation, buildings, and electricity. Increasing clean transportation options is envisioned to include shared mobility alternatives and non-motorized modes to reduce the number of personal vehicle trips, accompanied by investments in expanded public transportation, micromobility, biking, walking infrastructure, and Smart Growth. The implementation of Smart Growth land use practices is a critical step to enable New Yorkers to travel without using a personal car and have shorter and fewer trips because of reduced distances between their homes, jobs, schools, and services. Smart Growth also can improve the energy efficiency of buildings with the shared heating and cooling efficiencies of dense development accompanied by public realm improvements, such as Green Infrastructure and passive neighborhood design. Land use policies can help communities plan for renewable energy generation and storage and create feasible opportunities for distributed energy resources (DERs).

Cross-sector strategies shared by transportation, agriculture, and land use can enhance and accelerate adoption and integration of Smart Growth practices. Strategies include promoting mobility- and transit-oriented development; expanding Smart Growth awareness; promoting urban forest cover; avoiding agricultural and forested land conversion; developing geospatial and other resources; supporting planning assistance for regions, counties, and municipalities; and aligning State funding priorities.

5. Themes

5.1. Transportation, Energy Use, and Smart Growth

The implementation of strategic Smart Growth land use planning, development, and infrastructure can result in compact, mixed-use neighborhoods that are less dependent on energy-intensive transportation. Neighborhoods that offer a mix of land uses near one another tend to be more walkable, bikeable, and less reliant on automobiles. Residents in compact, mixed-use neighborhoods can have a wider range of efficient transportation options, including mass transit and other shared-use mobility (e.g., carshare, carpooling, shuttles), walking, biking, and micromobility. Research has shown that Smart Growth strategies influence travel behavior. One report found that compact development could reduce VMT by 20 to 40 percent per capita compared to sprawling development patterns.[11] Other studies have shown that people living in compact communities tend to walk more frequently and have shorter commutes.[12] Beyond reducing VMT and associated petroleum use, compact development concentrates activity, creating a mass of energy and other infrastructure users in locations informed by local Smart Growth land use policies. Such land use practices lend predictability to the planning, improvement, and deployment of energy infrastructure that can serve a density of users. By contrast, land use policies that

enable sprawling development across large areas complicate planning for future energy demand and stretch the infrastructure needed to support it.

In New York State, land use planning authority is delegated to local governments (counties, cities, towns, villages) and zoning authority is delegated to cities, towns, and villages under statutes that implement the Home Rule provisions of the New York Constitution—with exceptions that include the siting and permitting of major renewable energy facilities (over 25 megawatts [MW]), which is handled at the State level. Because local governments have significant planning and zoning authority, they can strongly influence development patterns within the community.

The exercise of land use planning authority could contribute to inconsistent regional land use, transportation, and economic development planning and coordination across the state. This in turn could result in inefficient land use patterns, limited coordination transportation networks, and consumption of open space and natural resources. As a result, Smart Growth is often implemented on a project-by-project basis. While individual developments may incorporate Smart Growth principles, the broader localized planning framework may limit creation of cohesive, compact, and mixed-use neighborhoods at scale. The State can collaborate with municipalities to incentivize and encourage Smart-Growth-aligned land use regulations and provide technical assistance for adoption of Smart Growth land use strategies by cities, towns and villages, as well as facilitate more widespread adoption of more comprehensive county and regional planning to ensure aligned outcomes. This approach could lead to greater energy reductions and infrastructure predictability at a regional level rather than municipality by municipality.

Access to mass transit and complementary land use patterns that support compact development around mass transit is an opportunity to reduce VMT and add more density to areas already served by energy infrastructure. However, mass transit is largely concentrated in urban areas where a certain density and critical mass of users make it viable; yet, in those areas, limited service remains a barrier to full utilization. Smart Growth land use patterns in those areas, often referred to as Transit-Oriented Development (TOD), could increase the pool of potential transit users and better integrate the role of mass transit in a community. For areas without such access, expanding mass transit requires complementary land use policies and regulations to allow for density, which, when coupled with coordinated investments in transit and mobility options, could sustain public transportation and make reducing VMT more feasible. Again, such strategies could lead to a mass of users in location-efficient areas, thereby allowing for reduced transportation energy use while providing for predictable energy system planning.

Open space conservation is essential for supporting the development of compact neighborhoods and the success of non-automobile transportation options, as well as for ensuring predictable energy system planning. Open space conservation helps contain new development by directing it into more appropriate areas, preserving critical natural and working lands. Without land conservation, Smart Growth patterns rely entirely on encouraging development in appropriate areas, leaving open space vulnerable to development that can easily erase the gains of other Smart Growth efforts. However, a general absence

of regional, coordinated planning poses a barrier to ensuring that natural and working lands are being protected in areas most vulnerable to sprawling development.

Initiatives Underway

As noted in Tables 1 and 2, there are numerous policies, programs, and initiatives that contribute to Smart Growth land use patterns and practices. Many of those listed policies and initiatives further the goal of reducing VMT, encouraging more compact communities with a density of community users, adding predictability to the energy system planning process and making communities less dependent on energy-intensive transportation infrastructure.

Recommendations

- **Prioritize and coordinate investments that facilitate compact, location-efficient development, where feasible.** This could include funding for infrastructure improvements and consideration of increased subsidies for housing or mixed-use developments in location-efficient areas, to reduce transportation energy use.

- **Support non-vehicular mobility investments.** The State should support investments in and incentives for projects that encourage travelers to use active and public transportation modes, such as bike, pedestrian, micromobility and shared-use mobility, transit, car-free streets, or complete streets to help reduce VMT.

- **Facilitate communications across State, local, and regional levels to proactively plan for public transit needs** including coordination among municipal planners, economic development officials, Industrial Development Agencies (IDAs), metropolitan transportation organizations, and transit entities about planning, zoning, and projects that will impact transit ridership. In particular, this should include communications with involved entities on projects related to affordable housing and equitable access to transit.

- **Develop resources to support local governments' Smart Growth development.** Led by the New York State Department of State (DOS) in consultation with other State agencies and authorities, this may include developing a guidebook to help communities navigate State programs and policies; design manual(s) for local governments and developers to advise on incorporating Smart Growth principles into neighborhoods in different contexts (i.e., rural, suburban, urban, TOD); model Smart Growth local laws, such as inclusionary zoning regulations (i.e., ordinances, local laws); renewable energy siting; and accessory dwelling unit regulations, or best practices on topics such as resilience, energy savings, parking policies, natural and working lands, community engagement, and equity.

- **Support local governments with the development of natural resource inventories, critical and vulnerable areas assessments, and other local and regional Smart Growth planning and decision-making resources to inform the conservation of natural, working lands and reinforce Smart Growth land use patterns, leading to more compact communities and energy infrastructure.** Support local governments with these activities, such as maps to identify suitable reforestation locations, highest value cropland, and idle lands for farming. DOS, the New York

State Department of Environmental Conservation (DEC), and the New York State Department of Agriculture and Markets (AGM) would work in concert and with local and regional planning entities to conduct this work.

5.2. Energy-Efficient Built Environments

The form of the built environment impacts energy consumption, as low-density, sprawling land use patterns require more energy for the operation of buildings and infrastructure, resulting in more energy needed to power the built environment. Sprawling development patterns also contribute to greater energy loss through longer-distance transmission, which could be mitigated through Smart Growth development. As New York State advances energy efficiency and efficient electrification (see also the Buildings chapter of this Plan), Smart Growth land use policies, tools, and techniques can complement those efforts and reduce the energy used in the built environment, thereby improving grid reliability and resilience, reducing line loss, and helping the State anticipate energy demands and direct resources and investments.

The development of dense, multi-use buildings, supported by Smart Growth practices, can help the State, communities, and residents realize energy savings. Dense buildings, particularly multifamily construction, are more energy-efficient than single-family detached homes due to their smaller unit size and shared walls, which allow for shared heating and cooling.[13] A denser concentration of buildings also creates a greater critical mass of energy users, which makes investments in clean, distributed, community-based energy systems and supporting infrastructure more economically feasible and predictable.

Additionally, energy savings can be realized through more compact infrastructure networks, which are heavily informed by land use regulations. Suburban development typically requires substantially more infrastructure than communities built in accordance with Smart Growth principles. A 2013 Smart Growth America[14] study found that the upfront infrastructure costs of Smart Growth development are, on average, 38 percent less than the infrastructure costs associated with suburban development.[15]

Similar to transportation, local land use authority can impact uniform adoption of land use patterns statewide. Local land use policies directly influence the ability to build more energy-efficient development, as zoning regulations establish where development is allowed and define rules regarding permitted uses and dimensional regulations. Many current zoning regulations consist of single-use districts and have strict dimensional requirements, like setbacks, building size and height, and lot sizes. Smart Growth land use policies, if adopted locally, would add more flexibility to planning and zoning regulations, allowing for the development of denser buildings and mixed-use infill development, which are more energy-efficient and could utilize existing infrastructure.

Additionally, local governments can support other opportunities to reduce energy use in the built environment by incorporating more environmentally sustainable and energy-efficient design strategies for building and neighborhoods into local regulations (i.e., ordinances, local laws), such as net-zero and passive design. Communities with such guidelines can take advantage of passive heating and cooling by considering building orientation, ventilation, shading, pervious surfaces, and other elements into

building and neighborhood development, thereby reducing energy needs by capitalizing on the natural elements. Smart Growth planning resources can help local communities integrate strategies into land use policies, particularly in existing neighborhoods where sites, street grid designs, and building orientation may not be conducive to passive design strategies or are barriers to realizing the benefits of more energy-efficient design.

Smart Growth also aims to integrate Green Infrastructure into development. Incorporating features such as rain gardens, bioswales, and trees into the built environment can reduce the energy needed to filter and manage stormwater in developed areas, while also helping conserve water and recharge aquifers. Trees, in particular, provide cooling for urban heat islands through shade and evapotranspiration, thereby reducing energy usage, especially during periods of heat and peak energy demand. Similarly, infrastructure like urban agriculture and community gardens help to reduce stormwater runoff and provide cooling from the urban heat island affect by providing porous topsoil to absorb and filter rainwater and increasing vegetative cover.[16] Green Infrastructure can be incorporated into local land use and development regulations through site development requirements or stormwater regulations.

Initiatives Underway

As noted in Tables 1 and 2, there are numerous policies, programs, and initiatives that contribute to Smart Growth land use patterns and practices. Many of those listed policies and initiatives further the goal of reducing energy consumption associated with buildings and the built environment.

Recommendations

- **Make energy-efficient, environmentally sustainable design more accessible to local governments and private developers.** DOS, DEC, and other State agencies should collaborate to continue developing resources, such as a guidebook(s) or design manual(s) for local governments to use in their comprehensive planning, design guidelines, capital improvement planning, or other activities as well as resources that can be shared with private developers to support more energy-efficient design. This may include incorporating content developed in the New York State Office of General Services' (OGS) Decarbonization and Climate Resiliency Design Guide, as appropriate. This would also extend to guidance about how to incorporate Green Infrastructure in planning, zoning, and capital improvements (such as streetscape design standards).

- **Quantify the energy use and fiscal impacts of Smart Growth development.** Led by DOS, this may include a quantification of the impacts of the built environment components (infrastructure location and extent, density, GI, building type and design, etc.) to help the State and local governments understand the short- and long-term impacts of the development of the built environment.

- **Prioritize and coordinate funding and incentives to encourage the development of housing, commercial, mixed-use, and community development projects in location- and energy-efficient neighborhoods served by existing infrastructure, where feasible.** This includes expanding opportunities to redevelop distressed, vacant, abandoned, contaminated, and

brownfield sites. Regular support should be provided for programs like Restore NY and the Environmental Restoration Program, along with continued investment in projects within designated Brownfield Opportunity Areas.

5.3. Clean Energy Generation, Distribution, and Storage

Advancing progress toward the State's renewable energy generation goals requires substantial deployment of renewable energy technologies. Holistic, community-based Smart Growth planning can help communities anticipate and accommodate renewable energy generation, distribution, and storage facilities. This approach can reduce land conversion, minimize land-use conflicts, support local economies, and align with compact, mixed-use development. Such development patterns also create a diverse and dense energy user base, strengthening the case for investment in localized, efficient energy infrastructure like distributed energy systems.

Land-based renewable energy sources in New York State are mainly comprised of wind or solar photovoltaic (PV) facilities, which can be accompanied by battery energy storage systems (BESS). A major renewable energy facility is a renewable energy system with generating capacity of 25 MW or higher and any co-located BESS system storing generated renewable energy.[17] Major renewable energy facilities are permitted by ORES. Renewable projects below 5 megawatt alternating current (MWac) are classified as a distributed energy resource (DER) and must have a customer(s) to purchase the electricity.[18] Most DER projects are community solar projects, residential/commercial rooftop solar projects, combined heat and power (CHP) micro-grids, or small ground mounted solar.[18] DER projects and large-scale renewable (LSR) projects that generate below 25 MWac are subject to local permitting and land use approvals.

Major Renewable Energy Facilities

While major renewable energy facilities are permitted by ORES, municipalities (counties, cities, towns, villages) and their land use policies do have a role in the permitting process of these facilities as siting permits require compliance with applicable local laws and ordinances except for those that are "unreasonably burdensome in view of the [Climate Act] targets, and the environmental benefits."[19] While there are existing opportunities for municipalities and communities to give feedback on draft permits through public comment or raise substantial and significant issues as an involved party to the permitting process, intentional and proactive Smart Growth land use planning can further help municipalities meaningfully engage with project applicants to ensure that the installation of a facility does not conflict with the protection of natural resources and reduces or avoids impacts on agricultural lands and avoids fragmenting these resources, while also providing benefits to the community.

Other Renewables and Distributed Energy Systems

Intentional and proactive Smart Growth planning can also help communities consider all factors, including local resources, the local economy, and health and safety of residents as they relate to LSRs below 25 MW and DERs, both of which are subject to local planning and zoning. A sound comprehensive plan that assesses appropriate locations, infrastructure, and mitigation measures for renewable energy facilities can help ensure that a municipality's zoning regulations and environmental review findings are informed by all relevant factors and alternatives evaluated during the planning process. Intentional and

clear planning and zoning also facilitate the development of renewable energy options by developers or private individuals by having transparent rules and regulations.

In addition to the installation of renewable energy production facilities, primarily from solar, Smart Growth planning can also help communities assess other renewable energy opportunities. Because Smart Growth development lends to a critical mass of users, distributed energy systems such as building and parking lot solar arrays or community solar projects, can make investments in such infrastructure more viable, beneficial and reliable. District energy systems have long offered the opportunity for multiple buildings to benefit from a central plant, which helps deliver heating and cooling services to connected buildings in dense settings, such as mixed-use neighborhoods, college or university campuses, and military bases. While these systems have historically been fossil-fuel-based, newer technologies (e.g., thermal energy networks) are now generating heating and cooling using thermal sources, including geothermal, surface water, waste heat, and the air. These systems can be strategically deployed; however, they require the right mix of land uses and density to make them feasible, which can be accomplished through Smart Growth's encouragement of compact, mixed-use development.[20]

Battery Storage

Battery energy storage and related technologies are a component of renewable energy development that are needed to manage flow and ensure energy can travel to areas of demand, while also adding resilience to the electric system. Battery energy storage technologies, like previous generations of energy storage systems (e.g., gas stations or oil and fuel distribution businesses), have land use implications and will require regulations to protect a community's health and safety. When developing or updating comprehensive plans and zoning, communities will need to assess the implications of different battery sizes/types/purposes to determine appropriate locations, mitigation measures, and safety measures. This component of the renewable energy system should be considered in community comprehensive plans and zoning ordinances.[21]

As with transportation and the built environment, local land use controls will affect the deployment of renewable energy facilities outside of those large-scale projects permitted at the State level, as local governments can determine permitted uses, locations, site requirements, and more through zoning ordinances. To advance the State's renewable energy goals, it is important to encourage, assist, and support local governments to plan for renewable energy as a complementary component of their local controls. This can be accomplished through developing and providing technical assistance, resource guides, and other tools to help local governments prepare for and engage in renewable energy planning.

Initiatives Underway

As noted in Tables 1 and 2, there are various tools that support the integration of renewable energy infrastructure into planning, which will support the development of renewable energy to advance the State's renewable energy goals while balancing community needs and interests.

Recommendations

- **Continue to develop local land use best practices and tools to support planning for and appropriate siting of renewable facilities, battery storage, and clean distributed energy**

systems in developed areas. DOS, NYSERDA, and DPS should continue to develop and disseminate resources for local governments, including exploring new tools for assessing appropriate locations for clean energy systems as well as strategies to avoid adverse impacts to surrounding lands and mitigate community impacts.

- **Enhance technical assistance to minimize impact of energy siting on natural and working lands.** DOS, AGM, DEC, and NYSERDA should collaborate with community stakeholders, the agriculture and forestry sector, the solar industry, and utilities to develop and disseminate planning tools and resources to minimize the impact of energy siting on natural and agricultural lands. These tools include mapping to help municipalities undertake a comprehensive evaluation of the potential for renewable energy development in their communities and to plan proactively for deployment that maximizes local benefit and minimizes impact on lands with high-quality soils, forests, and other competing uses as well as strategies to avoid adverse impacts to surrounding lands and provide for community benefit. These tools should also assist municipalities in considering co-location opportunities for agriculture and renewable energy generation.
- **Enhance technical support for clean energy projects**. DOS and NYSERDA should collaborate with counties and regional planning boards to provide support to help local governments plan for and review clean energy projects including wind, solar, transmission, distribution, storage, and vehicle charging.

5.4. Inter-governmental Collaboration

Collaboration and coordination between levels of government are key to achieving Smart Growth development patterns and associated energy reductions, as well as enhancing opportunities for the planning and development of renewable energy facilities. Coordinated land use planning and implementation can better inform the siting of renewable energy facilities, grid infrastructure improvements, grid integration, and mitigation of the potential challenges associated with transitioning the grid to renewable energy sources. While local governments (counties, cities, towns, villages) have primary land use planning authority, and cities, towns, and villages primary zoning authority, collaboration on land use across jurisdictions could prevent and mitigate the effects of a patchwork of land use regulations across municipal boundaries and inconsistent regional planning and cooperation, which can complicate long-term planning for the state energy system. The need for collaboration extends across levels of government, which, through coordinated planning and programs, can support Smart Growth land use at the local level. Because Smart Growth (and community planning and development in general) is holistic and complex, collaboration among and between levels of government is essential to achieve and maximize outcomes.

General Municipal Law Section 239-m requires that any city, town, or village in a county with a planning agency or regional planning council must refer certain land use and zoning matters to such county or regional planning council for the coordination and consideration of potential intermunicipal and countywide impacts before taking final action. This review process could help promote consistent land use practices across municipal borders and coordinate actions that may impact multiple communities.

Similarly, this process would provide more predictability and standardization of land use policies needed for energy system planning. However, there are some challenges that potentially limit the effectiveness of this process as related to Smart Growth: the scope of this review is limited by the type and location of the proposed action within the county; the level of review provided can vary significantly across the state; and Smart Growth principles are not part of the review criteria.

At the local government level, the capacity to plan for and implement Smart Growth practices is often limited. Many municipalities lack full time planning staff and are limited in their ability to gather and analyze relevant information to inform decision-making about Smart Growth. Without relevant and current data to guide and inform development decisions, local planning boards and elected officials may continue to favor existing development patterns by default, as they are unable to assess all potential impacts of land use decisions. In some instances, particularly in rural areas with limited planning staff and resources, county planning departments or regional planning councils have provided local land use planning support; however, this support may not be available to all municipalities.

There are numerous programs identified in this chapter that encourage and facilitate Smart Growth land use practices; however, there is an opportunity for greater coordination among these programs, as well as the infrastructure investments supported by State agencies. For example, there is an opportunity to increase coordination on standards and expectations for funded plans between DEC and DOS, both of which offer funding for Smart Growth comprehensive plans. Key to coordination would be shared data that aligns with Smart Growth criteria to ensure state funding agencies are making decisions using the same data and analyses. Enhancing existing data in a shared data portal could help agencies coordinate planning decisions and project implementation more effectively.

These and other opportunities for inter-governmental collaboration are addressed more broadly in the Local, Regional, and Federal Government Collaboration chapter of this Plan.

Initiatives Underway

As identified in Tables 1 and 2, there are various programs and initiatives that promote inter-governmental collaboration related to promoting and integrating Smart-Growth-aligned policies and practices into local planning.

Recommendations

- **Expand Smart Growth planning and zoning programs.** The State should continue programs to support Smart Growth planning and zoning and consider opportunities to prioritize and coordinate funding for infrastructure, planning, and design grants that most clearly support Smart Growth principles and outcomes and reduced energy use. This would also include State support for Smart Growth planning programs to assist local governments with developing and adopting Smart-Growth comprehensive plans, areas plans, zoning, and generic environmental impact statements to accelerate compatible development.
- **Conduct public education campaign to promote Smart Growth.** Led by DOS, this would involve developing and launching a multi-dimensional public education campaign on the benefits,

energy implications, and best practices for implementing and sustaining Smart Growth development.

- **Develop data and analysis to facilitate Smart Growth-aligned statewide and local planning and investment.** Led by DOS, this would include developing a user-friendly data portal to support a statewide planning framework and provide local governments with baseline data to enable Smart Growth planning. This would incorporate existing State data and develop new data sets and analysis to provide a centralized, user-friendly repository of data resources useful to state agencies to inform planning and investments and regional/county/local planners in the development of Smart Growth land use plans, zoning codes, and development projects. This should include relevant data and planning tools that can allow local governments to visualize and assess socioeconomic information, environmental conditions, vulnerability and impacts, infrastructure, energy impacts, renewable energy development opportunities, and associated analysis that can help inform planning and land use decisions. Information may also be used to monitor and track progress of implementation of Smart Growth practices and direct and indirect outcomes.

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[13] Daniel Hernandez, Matthew Lister, and Celine Suarez, *Location Efficiency and Housing Type: Boiling it Down to BTUs*, (U.S. EPA, March 2011), https://www.epa.gov/sites/default/files/2014-03/documents/location_efficiency_btu.pdf.

[14] Founded in 2000, this organization continues to support the implementation of Smart Growth practices to the present day.

[15] Daniel Hernandez, Matthew Lister, and Celine Suarez, *Location Efficiency and Housing Type: Boiling it Down to BTUs*, (U.S. EPA, March 2011), https://www.epa.gov/sites/default/files/2014-03/documents/location_efficiency_btu.pdf.

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New York State Energy Plan

VOLUME II | Energy and Our Lives

Economic Development, Industry, and Agriculture

11

Key Terms Used in This Chapter

FOR THE COMPLETE GLOSSARY ➜

Industrial Sector: Includes businesses focused on the mass production of goods, often involving machinery, technology, and a significant workforce.

Manufacturing Sector: Encompasses firms that transform raw materials into finished goods.

Agricultural Sector: Grows crops, raises livestock, and harvests plants and animals from their natural habitats.

Low-carbon Fuels and Energy Sources: Produce significantly fewer greenhouse gas emissions during their lifecycle compared to traditional fossil fuels.

Carbon Capture Utilization and/or Storage (CCUS): CCUS technologies capture carbon dioxide (CO_2) emissions from large sources, like power plants and industrial facilities, or directly from the atmosphere, which is then either repurposed or stored.

Industrial Process Emissions: Emissions that occur when industrial processes cause the release of pollutants and greenhouse gases.

Life cycle analysis (LCA): Evaluates the potential environmental impacts associated with a product, process, or service throughout its entire life cycle.

Embodied Emissions: The total greenhouse gas emissions generated throughout the entire life cycle of a product, particularly emphasizing the stages before its operational use. This includes the extraction of raw materials, manufacturing, transportation, construction, and disposal at the end of its life.

Key Findings → Economic Development, Industry, and Agriculture

Powering New York's industries with clean, reliable, and affordable energy can catalyze local economic development and speed the energy transition across sectors. Continued interagency collaboration can ensure that the State can meet significant growth in industrial energy demand in a way that leverages energy efficiency, supports local communities, and aligns with the State's clean energy goals. Clean energy investments in these productive sectors of the economy will promote job growth and investments while localizing supply chains, reducing costs, and ensuring the availability of clean energy products. This chapter provides an overview of the State's approach to bringing together energy and economic development objectives, outlines major initiatives underway, and recommends continued and additional actions.

- **Energy use in the industrial sector is expected to have unprecedented growth over the coming years.** New York State agencies and authorities should continue and enhance their collaboration to provide reliable power to the sector. Economic development agencies, energy policymakers, regulators, utilities, power generators, and the system operator should support electric system improvements to maximize economic benefits while ensuring new developments support local communities, reduce pollution, and align with New York's climate goals.

- **Economic development programs and rate design can drive New York's competitiveness.** Continued investments in programs that lower energy and site interconnection costs for commercial and industrial users, such as NYPA's hydropower programs and POWER UP, are crucial to remaining competitive with other states. New York should maintain or enhance these programs. Rate design strategies can also be implemented to encourage more efficient energy use and reduce peak system needs and capacity investments.

- **System demands from large, energy-intensive industrial users will require investments in the energy system and provide an opportunity to stimulate the development of new, clean, firm generation.** Expanded generation and transmission investments can support the provision of clean, reliable power to new energy-intensive industries and contribute to overall system resiliency. New York should strategically partner with large energy-intensive industrial customers to leverage purchasing power and procure zero-emission resources.

- **The clean energy transition is an economic development opportunity for New York industries.** By fostering a domestic clean energy supply chain—attracting and expanding clean energy manufacturers, the companies that supply them, and other clean energy professionals and organizations—New York can generate local economic benefits through job creation and increased tax revenues. Localized clean energy supply chains can reduce procurement lead times, minimize transportation-related emissions, and accelerate the transition across major sectors by facilitating the manufacture of electric heat pumps, batteries, grid equipment, and low embodied emission construction materials.

- **Cost-effective investments in industrial energy efficiency and electrification can reduce energy use and on-site combustion.** Efficiency measures can deliver cost-effective improvements to industrial facilities in the short term, including but not limited to the insulation of process heating equipment and heat recovery, improvements in motors, turbines, and engines, and improved process control and site management. There are also commercially available electric alternatives for facility heating, ventilation, and air conditioning (HVAC) and low- to medium-temperature process heating through infrared, microwave, or radio frequency heating. State support through technical and financial assistance can help accelerate the deployment of these technologies.

- **Waste heat from industrial processes can be put to productive use.** Waste heat capture leverages existing resources as an effective way to reduce investments in or the expansion of generation, transmission, and distribution systems to serve thermal energy or electrification loads.

- **In the medium and long-term, New York can support industrial decarbonization through a diverse research, development, and demonstration (RD&D) portfolio of emerging technologies.** New York will need to leverage a wide array of emerging solutions to achieve emission targets: low-carbon fuels and energy sources, carbon capture utilization and storage (CCUS), the electrification of high-temperature processes, and novel production processes. (See the Energy Innovation chapter of this Plan for further discussion.)

- **Agricultural operations can leverage energy efficiency, efficient electrification, and on-site energy production.** New York State's agricultural sector can reduce costs, energy use, and carbon emissions through investments in energy efficiency and efficient electrification. Additionally, deploying distributed renewables or leveraging agricultural waste products for alternative fuels can lower costs and increase the resilience of the energy system.

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1. Overview

Over the course of this Plan's time horizon, New York will need to rapidly scale up its supply and diversity of clean energy technologies to meet growing industrial energy demands. New York currently ranks as a top 10 manufacturing state, having generated over $90 billion in manufacturing activity in 2024.[1]

New York has received unprecedented new investments for in-state manufacturing, including Micron's planned microchip fabrication plant that would account for $100 billion in new investment, making it the largest semiconductor fabrication facility in the history of the United States.[2]

As other new, energy-intensive industries consider New York for their operations, the demand on the State's energy system will be increased. Economic development strategy can focus public support on large industries expected to provide value to the State's economy, supply chains, and workforce, including semiconductors, transportation equipment, agribusiness, and other advanced manufacturing and materials processing—including but not limited to the manufacturing related to clean energy technologies.

The industrial and agricultural sectors rely heavily on energy use to enhance their productivity and competitiveness, while contributing to New York's economy by providing goods and products, infrastructure investments, and local (i.e., in-state) jobs. Today these sectors are at an inflection point, with federal trade policy and State climate policy collectively altering their long-term outlook. Federal trade policy and industrial investments have increased interest in U.S. manufacturing, and State goals call for the electrification of major energy end-uses—including some industry and agriculture. These simultaneous trends will increase demand for clean electricity, power-ready sites, and electric consumer products, while industrial and agricultural facilities are modernized to reduce emissions and on-site combustion.

Industry is expected to see notable energy demand growth from 2025–2040, as new manufacturing projects and other large loads enter service.[3] Planning for this new energy use is key to ensuring continued opportunities for economic growth in the state. New York has an opportunity to modernize existing industries, attract new ones, and increase investments in the energy system to support these industries. Treating the energy transition as an economic development opportunity can help the State meet its climate obligations, reduce local air pollution, and strengthen New York's economy through clean manufacturing and agricultural production.

The State Energy Plan should address the short- and mid-term investment strategies that will ensure existing and new facilities have access to reliable and affordable power, while strategically attracting new industry and minimizing environmental impacts. Ensuring this supply of clean energy, in addition to New York's world class workforce and markets, will position New York to attract strategic industries.

This chapter will review New York's related energy planning objectives, describe the needs of specific industrial subsectors, and consider strategies focused on power supply and more efficient energy usage to support the State's industrial and agricultural output. The chapter includes the following sections:

1. **Meeting the energy needs of industry and other large energy users.** Key considerations include how the State can reliably meet the energy needs of large, energy-intensive users.
2. **Strategies to attract and power new industries.** To attract relevant manufacturers, New York is committed to ensuring competitiveness and providing State support for site selection, incentives, and local connectivity.
3. **Strategies to reduce energy waste and emissions from industrial and agricultural operations.** NYSERDA, ESD, the New York State Department of Public Service (DPS), NYPA, and the Department of Agriculture and Markets (AGM) all work with businesses in the industrial and agricultural sectors to provide technical and financial support to make operations more efficient while reducing pollution and carbon emissions.

2. State of the Sector and Progress Report

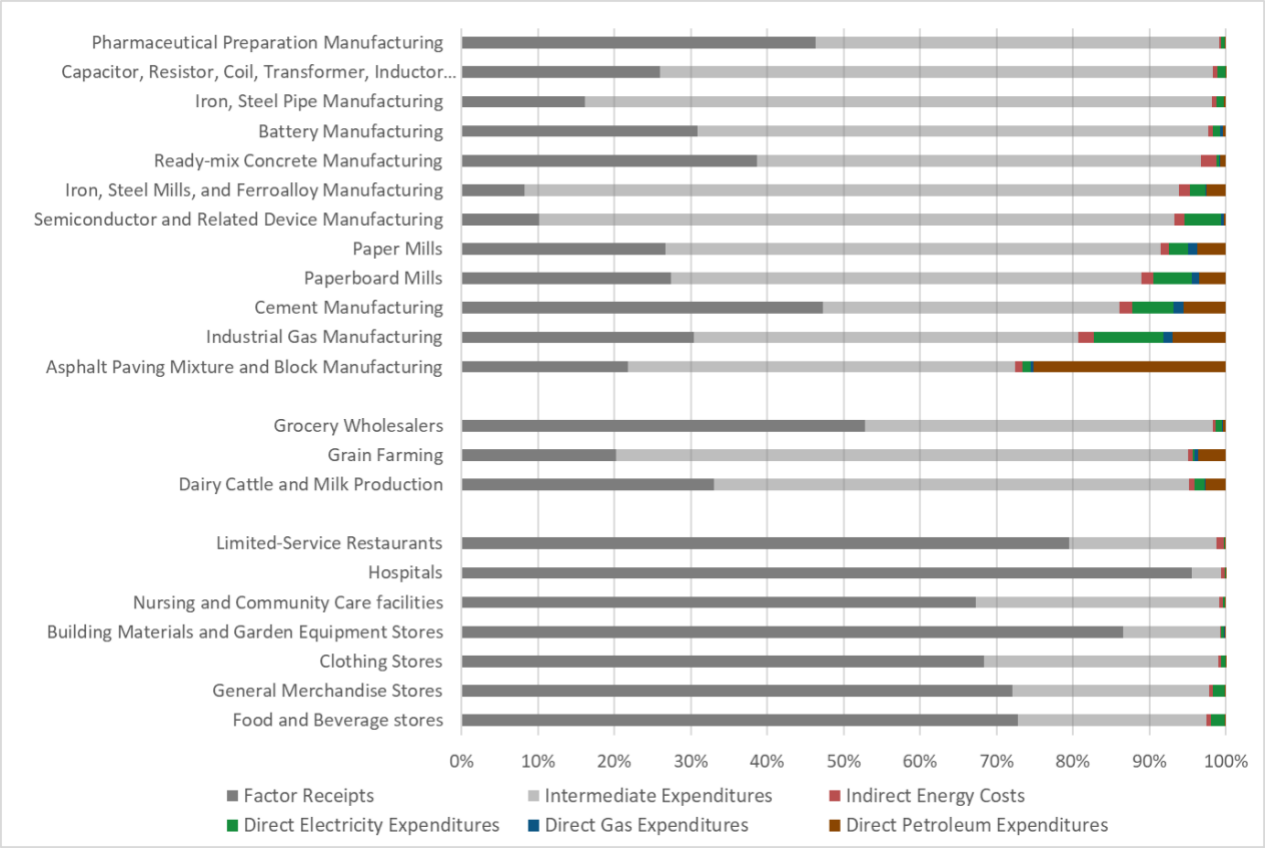
2.1. Energy Considerations for Business

The State's affordable power programs for industry have supported New York's competitiveness. While energy costs are an essential component of continued competitiveness, they are one of many factors an operator considers when siting their business. On average, energy makes up two percent of New York businesses' total expenditures.[4] This share is markedly higher for certain energy-intensive manufacturing industries, such as asphalt manufacturing, industrial gas manufacturing, fertilizer manufacturing, and aluminum manufacturing (28, 20, 16, and 17 percent, respectively). Just 18 percent of industries—representing 20 percent of the State's total manufacturing output—have energy cost shares above this two percent average. Most consumer goods and services, including essential services like hospitals and educational institutions, also see energy costs below this average. Energy costs make up less than one percent of expenditures for hospitals and two percent for grocery stores. Energy affordability across all cost categories is important, but energy cost improvements offer only limited benefit in terms of the overall cost picture that non-energy intensive New York businesses face.

Figure 1 below shows energy as a share of total expenditures for a sample of New York industries. Energy costs can be incurred in two ways: directly incurred to support operations and production, or indirectly as costs embedded in intermediate expenditures. For example, cement manufacturing direct energy costs make up roughly 12 percent of expenditures. When including the indirect energy costs embedded in the intermediate expenditures, such as the fuel share of transportation costs, the share rises to 14 percent.

Figure 1: Energy Costs as a Share of Total Costs, Select New York Industries (2023)

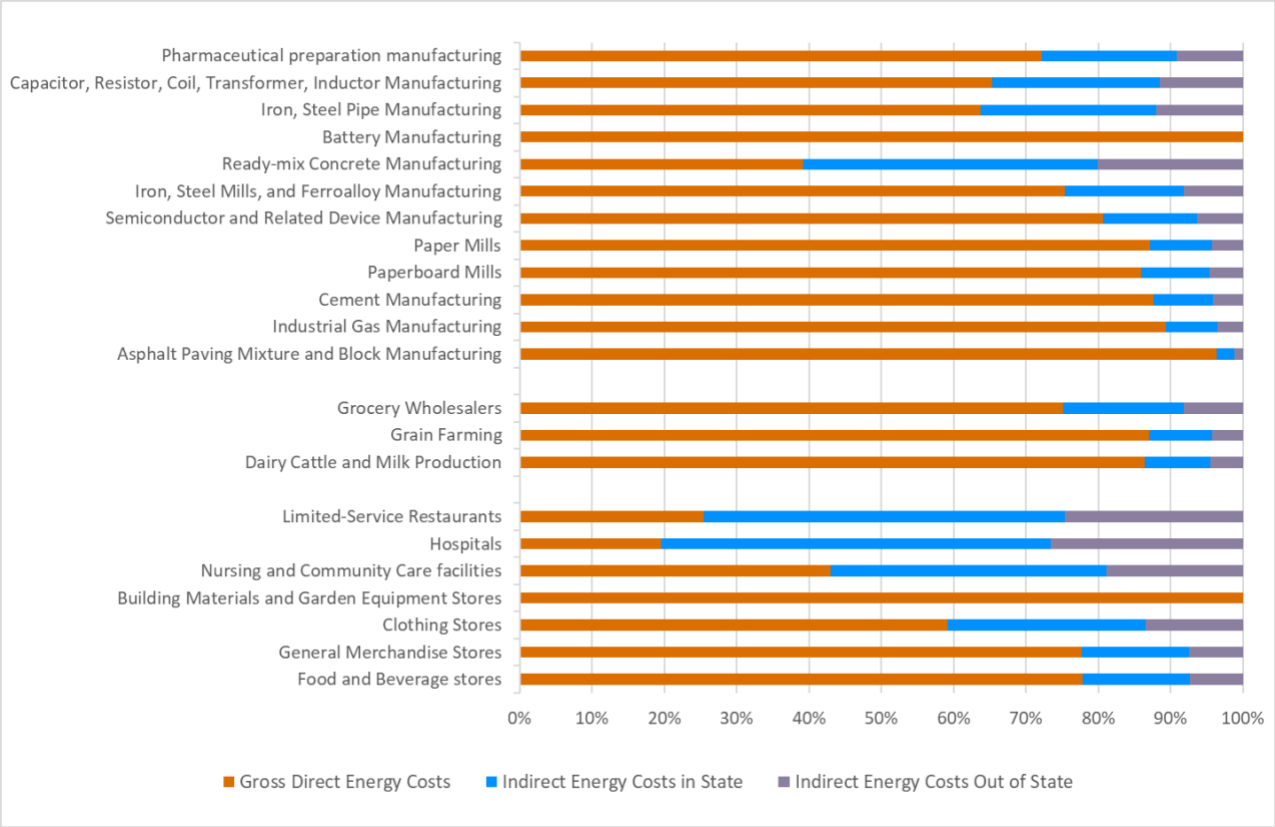
Source: Based on analysis conducted for NYSERDA by BW Research. Data is from IMPLAN for calendar year 2023, from the State Industry Balance Sheets, Commodity Demand, and Social Account Matrix.



Industry exposure to direct and indirect energy costs varies. Industries with higher transportation expenditures (food, health care, and some retail) are more exposed to indirect energy costs, much of which is incurred out-of-state (see Figure 2). The varying energy expenditure profiles of New York's industries will require differently tailored sets of policy levers to support affordability and reliability.

Figure 2: In-State and Out-of-State Indirect Energy Expenditure by Industry, 2023

Source: Based on analysis conducted for NYSERDA by BW Research. Data is from IMPLAN for calendar year 2023, from the State Industry Balance Sheets, Commodity Demand, and Social Account Matrix.



Consistent with the Climate Act, the State should be attentive to the differing impacts of energy and climate policies for New York businesses. While the State will continue to pursue general energy affordability for all economic sectors, energy-intensive and trade-exposed businesses merit focused attention to safeguard their economic competitiveness. These are generally manufacturing businesses, with certain industrial sectors experiencing greater costs than others.

As noted above, energy costs are just one energy-related input considered by businesses looking to locate in New York. First and foremost, private investors and large manufacturers need a clear path to reliable power in a reasonable amount of time before the manufacturer will make a site selection and invest in New York State. A NYSERDA-conducted survey of large industrial customers from the Site Selector's Guild indicated that that electric power capacity and the availability of development-ready sites with sufficient infrastructure capacity are the top two drivers of a firm's site selection decision (energy costs did not rank among top survey responses).[5] Energy capacity planning, prioritizing investments into existing site inventory, and identifying new sites will contribute to bolstering New York's competitiveness.

2.2. Economic Development

New York's economic development strategy has led to the rapid scaling of clean energy technologies in New York, including the development of 130 megawatts (MW) of new offshore wind at the South Fork Wind Farm, and dozens of clean technology manufacturing projects.[6]

As New York welcomes new industry partners, extensive cross-agency collaboration will be needed to balance the needs for energy supply and reliability while advancing economic development goals, climate goals, and ensuring affordability. Currently DPS, NYPA, NYISO, NYSERDA, and ESD contribute to efforts to ensure the State can reliably meet the energy needs of large, energy-intensive users, while ESD, NYSERDA, and NYPA contribute to the implementation of New York's economic development strategy. To attract key manufacturers and other high-impact industries, the State provides affordable power, support for site selection, economic incentives, and facilitation of local connectivity. A range of State-led programs are designed support New York's economic development strategy, summarized in Table 1.[7]

Table 1: Summary of Key Statewide Economic Development Initiatives

Agency	Focus Areas	Description	Key Programs
DPS		Advancing grid planning and the Clean Energy Zones initiative	
ESD	Strategic Business Development	Tax credits, site management and readiness, technical assistance	Excelsior Jobs Program with Green Project enhancement, FAST NY, Green CHIPs NY, Restore NY, Export Marketing Assistance Service Programs (EMAS), POWER UP
	Small Business Support	Loans, technical assistance, and capital access for early- to mid-stage small business, business expansion and equity capital for high growth innovation start-ups	Entrepreneurship Assistance Centers (EAC), NYS Contract Reporter, Linked Deposit Program, Capital Project Loan Fund, Job Development Authority (JDA) Direct Loan Program, and other loan and investment programs.
NYPA	Low-cost power programs	Cost competitive, firm, clean power sources for industry.	Industrial Economic Development Program, Preservation Power, ReCharge NY, Expansion Power (EP) and Replacement Power (RP) (aka WNY Hydropower), etc.
	Revolving Loan Funds		Greater Massena Economic Development Fund; North Country Economic Development Fund; Niagara Economic Development Fund
NYSERDA	Site Readiness	Strategic research and program support to identify and attract clean energy industries and promote their competitiveness.	Build it Clean. Build it Here., Build Ready, and strategic market research.
SUNY	Small Business	Small Business Support	Small Business Development, etc.

2.2.1. Empire State Development

As New York's lead economic development agency, ESD has ten Regional Offices, a Strategic Business Division, the Governor's Office of Semiconductor Expansion, Management and Integration (GO-SEMI), and several other divisions to assist new and existing manufacturers through economic assistance in the form of loans, tax credits, and grants, as well as technical assistance.[8] Cleantech and Renewable Energy are among ESD's target industries, as well as other industries essential to building out the clean energy supply chain—for example, semiconductors, industrial systems, and materials processing. ESD's programs are designed to assist manufacturers ready to expand with site selection support, support of infrastructure upgrades and other site readiness, and connectivity to local businesses. Core programs include:

- The **Excelsior Jobs Program**, which provides fully refundable tax credits tied to job creation, including an enhancement for green projects.[9] This program has been successful in attracting 3,400 new jobs and $1.8 billion in investment across 18 green projects.[10]
- The **Green CHIPS Incentive** provides incentives for semiconductor manufacturing and supply chain projects that meet robust job and investment criteria and adopt sustainability measures to mitigate the project's greenhouse gas emissions and other environmental impacts.
- **NY Ventures** provides pre-seed funding to Series B equity investment capital for high-growth innovation start-ups across New York State, as well as managers of funds that invest capital in innovation start-ups.
- **The Division of Science, Technology and Innovation (NYSTAR)** funds over 90 centers and resources across the State, including Centers for Advanced Technology, Centers of Excellence, Incubators, Hot Spots, Accelerators, and Venture Competitions. As New York State's National Institute of Standards and Technology (NIST)-designated Manufacturing Extension Partner (MEP), NYSTAR has designated 11 MEP centers—one in each economic development region and one statewide—to assist manufacturers with any challenges they are facing. This includes assistance with certifications, lean workouts, technology infusion (Industry 4.0), and supply chain development, among other services.

To meet the need for new manufacturing sites, New York is working to ensure that shovel-ready sites are enhanced with energy infrastructure investments. ESD's FAST-NY Shovel Ready Grant Program (FAST-NY) provides funding to prepare and develop sites across New York to jump-start shovel-readiness and capitalize on high-value opportunities. Funds are provided for pre-development activities and general infrastructure investments that will attract many eligible industries in high-tech manufacturing, semiconductor manufacturing, Cleantech and renewable energy, life sciences, agribusiness, optics, transportation equipment, materials processing, industrial machinery manufacturing, and other advanced manufacturing. These sites can also be used for interstate distribution and logistics.

Spotlight: FAST-NY Awardees

City of Rome, Oneida County ($24 million grant). The Triangle Site at Griffiss International Airport is adjacent to Wolfspeed and Micron, positioning it to be New York's premier semiconductor supply chain campus, offering up to 50 MW of power. The site is being improved with electrical upgrades, the extension of municipal water, sanitary sewer and natural gas pipelines, transportation and access upgrades, and the completion of general site work. This will unlock up to 2.6 million square feet of new construction and the potential for 3,000 new jobs on this 332-acre site. The campus is in a moderately distressed community and provides accessible workforce amenities, housing, recreation, and transit. Total project cost: $26 million.

Town of Coeymans, Albany County ($17 million grant). A new electrical transmission line and two substations will serve the Port of Coeymans. These upgrades will add 50 MW of capacity to the Coeyman's Industrial Park, which is currently power-constrained, with the capacity to provide up to 100 MW for potential future development. Coupled with access to navigable waterways and developable acreage, delivering power to this site will provide the State with a key strategic asset for industrial machinery manufacturing as well as Cleantech and renewable energy manufacturing. Total project cost: $83.8 million.

County of Monroe IDA (COMIDA) ($20 million grant). The site in the Town of Webster is being developed to attract agribusiness and industrial machinery manufacturing. Funding will be used to upgrade the existing electrical infrastructure. Total project cost: $27 million.

Since formally launching in December 2022, FAST-NY has announced four rounds of grant awards, totaling $232 million for 32 projects across the State, transforming over 4,000 acres of previously underutilized land. Over $80 million of the $232 million was for electrical infrastructure upgrades and plans for utility connections. The FY2026 budget allocates an additional $100 million to FAST-NY. Beginning in 2025, the $300 million POWER UP Fund will support the proactive development of electric capacity to create power-ready sites and attract new businesses to the State. The POWER UP Fund is discussed in additional detail in Section 4.2.4.

2.2.2. New York Power Authority

NYPA's low-cost power programs are a pillar of the state's economic development strategy. Additionally, its revolving loan and proceeds support a broad variety of relevant regional economic development activities, including funding for electric vehicle (EV) infrastructure and equity for clean energy companies. Since the enactment of the Climate Act, NYPA has prioritized support for the State's priority industries and has launched statewide initiatives in support. These efforts include:[11]

- **Preservation Power.** 490 MW of competitively priced, clean hydropower available to new or expanding projects in St. Lawrence, Franklin, and Jefferson Counties.
- **ReCharge NY.** 910 MW of New York hydro and market power that may be allocated to small and large businesses that support regional and statewide priorities, including climate goals.
- **Western New York Hydropower**. Also known as Expansion Power (EP) and Replacement Power (RP), is comprised of 695 MW generated at NYPA's Niagara Power Project in Lewiston that may be allocated on a competitive basis to qualified businesses within a 30-mile radius of the Niagara Power Project.
- **St. Lawrence County Economic Development Power (SLCEDP)** is comprised of 20 MW of hydropower generated at the St. Lawrence Franklin D. Roosevelt Power Project. This new supply will be available to St. Lawrence County businesses.

NYPA's role will continue to evolve as it builds additional low-carbon energy resources, as discussed in the Electricity chapter of this State Energy Plan.

2.2.3. New York State Energy Research and Development Authority

NYSERDA strategically identifies key clean energy industries and ensures New York remains a competitive market for these firms. NYSERDA catalyzes new clean energy supply chain development in the State through targeted investments, business support, coordination across agencies, marketing the State to the business community, and fostering the clean energy workforce and innovation ecosystem. For example, NYSERDA played a critical role in fostering a local market for offshore wind, including investments to grow the offshore wind supply chain, workforce, port infrastructure, and hosting cross-cutting advisory working groups.

NYSERDA's research informs State policy to best attract and maintain clean energy technology developers and relevant clean energy supply chains. As the State's leader in developing clean energy solutions and informing clean energy policy, NYSERDA is uniquely to positioned to connect the research and market needs related to the clean energy transition to the State's economic development policies. This work informs New York's "Build it Clean. Build it Here." campaign, designed to market the State's competitive positioning as a hub for the clean energy industry.[12]

NYSERDA also supports ESD in tailoring parts of the State's economic development policies to best meet the needs of clean energy partners. This includes planning and site identification work that informs FAST-NY, as well as the development of targeted business development and marketing. NYSERDA also develops resources designed to be leveraged by regional developers and economic development organizations.

2.3. Industry and Agriculture

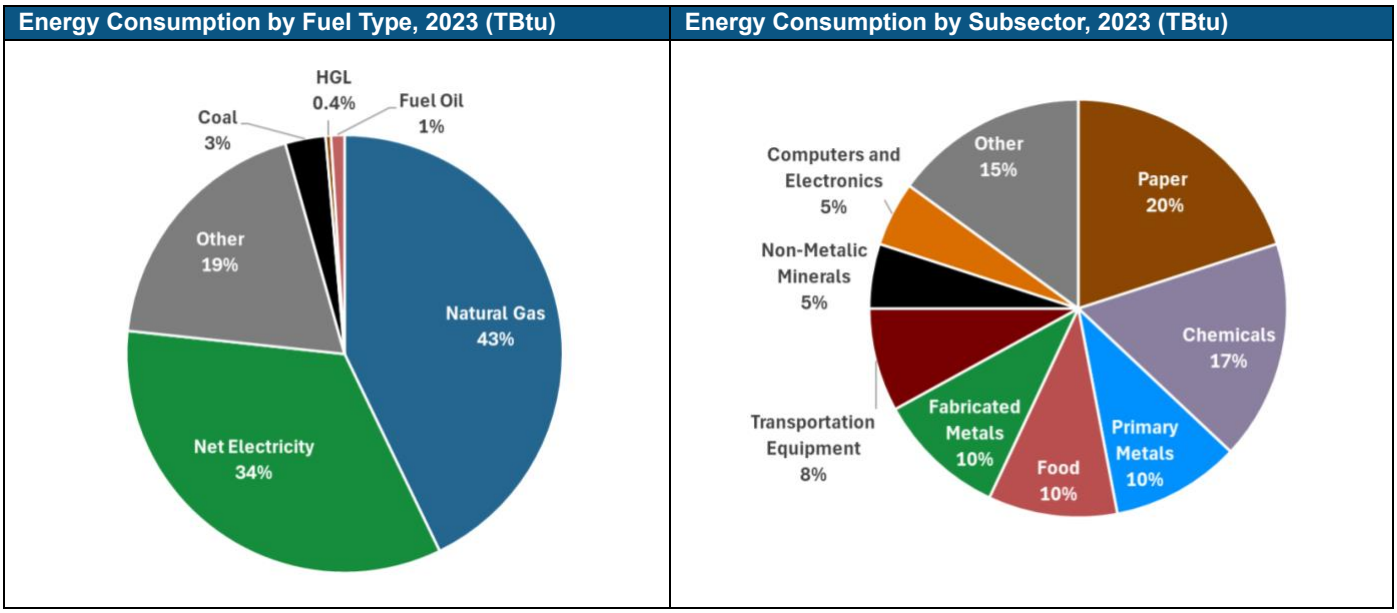
The U.S. Energy Information Administration defines the industrial sector as "all facilities and equipment used for producing, processing, or assembling goods," including manufacturing, agriculture, mining, oil and gas extraction, and construction.[13] With such diverse subsectors, industry uses energy in more unique ways and relies on more types of fuels than other sectors. In 2022, New York's industrial sector accounted for roughly 8 percent of the net energy use statewide.[14] Fossil fuels serve most industrial demand, with natural gas and petroleum products accounting for 38 percent and 28 percent of industrial energy use, respectively. Electricity accounts for 23 percent of industrial energy use, and wood meets 10 percent of demand (primarily in the paper sector). Coal, waste energy, and solar thermal constitute the remaining energy sources.

In 2024 NYSERDA published the Phase 2 Industrial Facility Stock Study (Stock Study), with a follow-up report examining Decarbonization Potential in the Industrial Sector released in September 2025 (Potential Study).[15] These studies worked to better understand New York's manufacturing sector by taking stock of facilities and major equipment statewide, and subsequently identify opportunities to convert this equipment to low-emission alternatives. The Stock Study found that New York's manufacturing sector accounts for roughly 150 trillion British thermal units (TBtu) of energy use annually,[16] divided between several key subsectors: paper (20 percent), chemicals (17 percent), primary

metals (10 percent), food (10 percent), fabricated metals (10 percent), and transportation equipment (8 percent) (Figure 3). Process heating stands out as the major end-use across subsectors, accounting for 55 percent of manufacturing demand in 2023. Manufacturing demand for lighting as well as HVAC is second largest among end-uses (19 percent), while machine is third (15 percent). Proposed strategies throughout this chapter leverage insights from these studies.

Figure 3: New York's Manufacturing Energy Use by Fuel and Subsector

Source: New York Statewide Industrial Facilities Stock Study – Phase Two Final Report [16]



The agricultural sector is more difficult to track using currently available data; many sources divide agriculture by end-use into buildings, transportation equipment, and industrial equipment, so it is difficult to determine the true scale of agricultural energy use. The U.S. Department of Agriculture (USDA) Agricultural Census does provide some key data points.[17] Between 2017 and 2022, the number of farms contracted by nearly 10 percent: the number of small (i.e., sub-1,000-acre) farms decreased by 9 percent and large (i.e., over-1,000-acre) farms increased by 12 percent; meanwhile, the overall acreage remained largely unchanged, indicating consolidation within the sector. The value of purchased fuels increased from $238 million to $403 million over this same period. Similarly, the value of purchased fertilizers, limes, and chemicals also increased from $354 million up to $568 million. Overall, the cost of these energy and energy-intensive inputs increased 64 percent from 2017–2022. To balance out these inputs, the value of products sold annually increased by over $2.5 billion from 2017–2022, nearly 50 percent growth. This increased output, coupled with a decrease in number of farms statewide, shows that the agricultural sector is consolidating and becoming more reliant on energy inputs for their production.

Key State programs that support energy and climate goals in New York's industrial and agricultural sectors are summarized in Table 2.

Table 2: Key Industrial and Agriculture Programs
Note: * See the Section 2.2 for a full description of these initiatives

Agency	Focus Areas	Description	Key Programs
Agriculture and Markets	Resiliency	Programs to promote agricultural resiliency	Climate Resilient Farming Program
ESD	Strategic Business Development	Tax credits	Green CHIPs NY
NYPA	Low-cost power programs	Cost competitive, firm, clean power sources for industry.	Preservation Power; ReCharge NY; Expansion Power (EP) and Replacement Power (RP) (aka WNY Hydropower); etc.
NYSERDA	Industrial Demonstrations	Funding for industrial sector decarbonization projects	Commercial & Industrial Carbon Challenge Program
	Industrial & Ag Technical Assistance	Programs to support engineering, training, and energy management	Ag Energy Audit; FlexTech; On-site Energy Manager; Strategic Energy Management

2.3.1. Department of Agriculture and Markets

AGM has a mission to promote New York State agriculture and its high-quality and diverse products, foster agricultural environmental stewardship, and safeguard the State's food supply, land, and livestock to ensure the viability and growth of New York's agricultural producers. They work to protect and enhance New York State's natural resources and working landscapes[18] and promote sustainable animal production agriculture.

AGM's New York State Climate Resilient Farming Program provides financial assistance to farmers to help them reduce greenhouse gas emissions and increase resilience to climate change. It offers funding for projects related to agricultural waste management, water management, and soil health systems.

2.3.2. NYSERDA

NYSERDA's work in the industrial and agriculture sectors, examples of which are listed below, promotes the adoption of energy-efficient technologies and business practices and seeks to find next-generation solutions for sustainable manufacturing and agriculture. Additionally, NYSERDA's research informs State policy to best attract and maintain clean energy technology developers and companies which would comprise the clean energy supply chains.

- The **Agricultural Energy Audit Program** offers free energy audits to help eligible farms identify ways to save energy and money on utility bills. Reports include recommendations for energy efficiency measures.
- **The Flexible Energy Assistance (FlexTech) Program** offers a wide range of cost-shared technical services to help businesses examine energy usage patterns and make cost-effective clean energy decisions.
- The **On-site Energy Manager Program** offers a cost-share for industrial facilities to hire a dedicated full-time or part-time on-site energy manager. Energy managers help identify energy projects, including operations and maintenance improvements, energy efficiency upgrades, water saving improvements, and more.

- **The Strategic Energy Management (SEM) Program** is a training program that provides a comprehensive approach to aligning energy efficiency with business practices and goals to achieve long-term benefits. Instead of managing energy saving projects one by one, SEM gives industrial facilities tools to manage energy in a coordinated and strategic manner.
- The **Commercial & Industrial Carbon Challenge** program provides awards to manufacturers that execute large energy and greenhouse gas emission abatement projects at their facilities. The program encourages industrial companies to explore and pilot the next generation of decarbonization technologies and opportunities.

2.3.3. Industrial and Agriculture Policy Developments

Executive Order 22 - Leading by Example, directs State agencies to accelerate efforts to make their facilities and operations more sustainable, with a focus on reducing embodied carbon in construction materials used in State infrastructure projects. It requires the reporting and disclosure of commonly used materials to drive demand for low-embodied carbon options and aims for a 30 percent reduction in carbon emissions from concrete by 2028. In guidance released in January 2025, the Office of General Services (OGS) defined the covered materials as concrete mixes, asphalt mixes, steel products, and glass products.[19]

The Low-Embodied Carbon Concrete Leadership Act (LECCLA) mandates OGS to establish guidelines concerning the procurement of low-embodied carbon concrete. In January 2025 rules took effect setting maximum embodied carbon allowances, and project sizes which must follow these rules.[20] The law requires OGS to reassess and lower these thresholds every two years, with an update due to take effect in January 2027.

3. Outlook (2025 – 2040)

While industry makes up less than ten percent of energy use in New York State, the industrial sector's energy use is expected to grow significantly between 2025–2040. The Pathways Analysis developed for the State Energy Plan forecasts about a 20 percent growth in final energy use (across all fuel types) from the industrial and agricultural sectors by 2040. This growth is driven by large electric loads, which are expected to increase by 50 TBtu between 2025 and 2035.

Emerging and fast-growing, energy-intensive industries (like data centers, AI servers, microchips, and the onshoring of large-scale manufacturing) are all expected to put upward pressure on electric demand. Between 2024 and 2026, New York is expected to see between 1 and 2 gigawatts (GW) in new large-load projects across the state.[21] As of July 2025, there was just over 6 GW in large loads requesting electric service in NYISO's Interconnection Queue.[22] As discussed in the Electricity chapter of this Plan, growth in electric demand is not unique to industry and is also expected from the electrification of buildings and transportation.

Looking forward, the provision of low-cost bulk energy is important to the growth of the industrial and agricultural sectors. State agencies will need to collaborate and partner with utilities and industry to ensure that this growth uses energy efficiently and is in line with State energy and climate goals. In addition to meeting new demand growth, the industrial and agricultural energy transition will need to

modernize existing operations with clean energy alternatives, alternatives for high-heat processes, and enhanced materials management to reduce emissions from other on-site processes.

The State has an opportunity to match industries necessary to the clean energy transition with industrial investments to enhance local economic development and job creation, while supporting the production of equipment vital to transitioning other sectors of the economy. Recent economic disruptions (e.g., COVID labor and supply shocks, inflation, federal trade policy) have also demonstrated the benefits of local and resilient supply chains.

4. Themes and Recommended Actions

4.1. Meeting the Energy Needs of Industrial and Agricultural Energy Users

Industrial and agricultural activity is closely intertwined with the State's energy systems and provides benefits such as economic development and resiliency, as well as local job creation. Existing facilities value and benefit from affordable energy access and rely on a range of energy sources to maintain their production. Aligning economic development and energy policy requires identifying energy system constraints and future needs and taking actions to address these needs.

4.1.1. Electricity

Industrial operations generally require access to the electric grid, and more and more facilities will require bulk electricity. Advancing access to low-cost, low-emission electricity not only provides economic advantages to businesses and consumers in New York State but also offers a pathway to reduce pollution in the sector.

The Electricity chapter of this Plan discusses multiple initiatives underway to ensure that growing demand for power in New York State is met in a timely, coordinated, and cost-effective manner. These include:

- Stepped-up procurements for large-scale renewable generation and improvements to the interconnection process to the bulk power grid.
- The ongoing Coordinated Grid Planning Proceeding, among other planning processes, to identify necessary transmission and distribution investments.
- Collaboration among several State agencies to develop a Clean Energy Zones initiative that will synchronize the development of new sources of load, and the transmission extensions and clean generation additions needed to serve them.
- The "0x40" Proceeding, led by DPS, to convene stakeholders and collaborate on solutions to achieve the State's Climate Act decarbonization targets.

In addition, through novel industrial rate designs, such as dynamic electricity-pricing models, the State can support cheaper and cleaner electricity generation and avoid costly new infrastructure. Examples of such rate designs could include:

- Differentiating transmission, distribution, and demand charges based upon on-peak and off-peak usage.
- Incentivizing industrial energy managers to participate in on-site energy generation, efficiency measures to reduce demand, or flexible management to reduce system peak.
- Providing sample tariffs to value the storage and/or recycling of thermal energy. Waste heat from industrial processes or data centers can be stored or recycled for reuse on- or off-site. Creating standardized contracts or tariff guidelines for these thermal resources can help create additional revenue streams for industrial facilities and help serve nearby sources of demand.

Beyond energy generation and rates, the State also needs to bolster transmission and distribution investments to help meet rising demand from new load growth, including large energy users. At present, it can take upwards of four years to build new transformers or substations, far too long for a company to wait to begin operations. Transformer supply chain issues must be resolved so that the delivery time for transformers and other transmission equipment can be shortened. It also presents an opportunity for public-private partnerships to expand and improve the State's energy networks. Extending transmission and electrical infrastructure to more sites around the State will help unlock economic growth and significantly enhance the ability to connect New Yorkers with the advanced manufacturing jobs of the future.

Data centers are projected to be a major driver of new industrial load.[23] In recent years, the power demands from data centers have grown exponentially to support digital businesses like AI and cloud computing. These industries are rapidly expanding and a full understanding of the dynamics of their long-term energy needs, related to both total consumption and demand flexibility, are still uncertain. Moreover, market competition has created pressure for project developers to bring data centers online quickly, often seeking swift regulatory approval for power services or development at power-ready sites. Given the desire to rapidly go to market, reporting suggests that many new large load interconnection requests have been submitted to multiple Regional Transmission Organizations (RTOs) despite only intending to build a project in a single jurisdiction.[24] This imposes risks to ratepayers when RTOs invest in system upgrades to meet new demand forecasted based on interconnection requests only to have those requests withdrawn if projects locate elsewhere. While these data centers introduce a range of possible economic opportunities and potential energy system efficiencies, the planning considerations for such loads are complex.

In general, expanding the electric customer base should bring in new utility revenue and spread system costs over a larger rate base. Nonetheless, the magnitude of new large industrial users has raised concerns of ratepayers subsidizing these industries, due to market structures that are not designed for this emerging trend. However, New York has processes in place to determine who pays for the cost of new infrastructure to meet new demand. When a new large load wishes to connect to the New York electric grid, it must go through an interconnection process to ensure the system can safely and reliably accommodate the new demand.

For transmission-level connections (typically greater than 10 MW), the process is governed by the NYISO under its Open Access Transmission Tariff (OATT).[25] New York's load planning process is designed such that added energy system build-out or upgrade costs are fairly allocated to the user that necessitates such costs, consistent with "beneficiary pays" cost-causation principles.[26] However, the State recognizes that such loads may trigger other system costs or impacts not captured by this accounting, and is committed to analyzing these dynamics, following ongoing research, and monitoring market dynamics in other jurisdictions.[27]

4.1.2. Gas

In New York State, industrial end-users account for about 7 percent of natural gas consumption and gas is the largest source of energy in the sector. Gas is used for diverse purposes, ranging from chemical production and process heating to a variety of manufacturing activities. New industrial facilities—small and large—that are being planned and constructed in New York consistently look to use natural gas as an input to their production processes.

While nearly all gas consumers in New York rely on supplies imported from out-of-state through large transmission pipelines, larger industrial gas consumers commonly connect directly to the gas transmission system, rather than relying on Local Distribution Companies (LDCs) which serve smaller industrial consumers. Since large gas consumers contract directly with suppliers, their access to gas depends on cost and transmission pipeline capacity, rather than on the availability of distribution infrastructure. By contrast, smaller industrial customers that access gas via the distribution mains owned and operated by LDCs are subject to tariffs and the LDC's gas capacity and ability to extend service when and where they are needed.

The Public Service Commission's (PSC) Gas Planning Proceeding informs gas system planning, but focuses on residential and commercial customers, not industrial facilities. The PSC's planning proceeding, which was established to avoid moratoria and to facilitate planning in light of the Climate Act's emissions reduction targets, relates to LDCs' gas distribution systems. It does not direct LDCs to limit gas access for industrial consumers, today or in the future.

Recommendations

- **DPS** should continue to convene the Coordinated Grid Planning Proceeding and the Clean Energy Zones initiative detailed in the Electricity chapter of this Plan. These efforts will help to drive investments into the electric grid that improve availability and reliability, while helping to synchronize the development of new sources of load, and the transmission extensions and clean generation additions needed to serve them.
- **DPS, NYPA, and NYSERDA** should continue to advance integrated planning practices that enable investments necessary for industrial electrification to be coordinated and optimized across the gas and electric systems.
- **DPS** should continue to engage utilities and stakeholders to pursue new rate designs and demand side programs that provide competitive utility rates, reduce the cost of industrial

electrification, and incentivize reduced or flexible usage of energy from on-site energy generation, demand management, and/or storage or recycling of thermal energy.

- **DPS, ESD, NYPA, and NYSERDA** should examine opportunities and challenges presented by emerging energy-intensive subsectors, including data centers, to best accommodate new load while balancing State policy goals and targeted support to industries that create wider community, economic, and workforce benefits.
- **DPS, in coordination with NYSERDA and the NYISO**, should consider additional tools to assess risks and minimize system costs from new large loads, including revisions to interconnection processes or new cost recovery mechanisms.

4.2. Attracting New Industrial Development

Attracting new industry can create economic opportunities for New Yorkers through job creation, increased tax revenue, increased consumer spending, community development and revitalization, and if done strategically, can accelerate the clean energy transition by attracting clean energy supply chains. State and federal support is already rapidly transforming upstate New York into a global hub for advanced manufacturing—particularly in semiconductors,[28] clean tech,[29] and agribusiness.[30]

To continue attracting new—and maintain existing—industry, the State must balance several important priorities including ensuring that firms have access to: sufficient shovel-ready and power-ready sites; reliable, affordable, and clean power; the necessary skilled workforce and expertise; and tailored State support. Comprehensive energy planning is a critical piece to ensure that these users have access to affordable, clean power, while balancing the existing energy needs of the State.

4.2.1. Site Readiness and Energy Infrastructure

Large-scale manufacturing and industrial firms require sufficient shovel-ready and power-ready sites, or enhanced power-connectivity to electrify existing facilities. ESD routinely receives requests for more than 50 MW of power from companies interested in locating to or expanding in New York, but sites of at least 200 acres and 50 MW or more of capacity are in high demand and short supply. Many Cleantech manufacturers that produce solar panels, wind turbines, EVs, and batteries do not proceed beyond the site selection stage to even consider the incentives offered by the State, and as a result, New York is losing these investments to the “Battery Belt” emerging in the Midwest and the South. Sites must be open and ready for business and locating at a power-ready site can shave years off the timeline between site selection and a plant’s opening day.

As mentioned above, the State must also invest in transmission, distribution, and clean generation infrastructure to ensure that the State can provide reliable and ample power. Reliability of clean power across the life of the plant is a critical factor for new industry in considering a site, as it supports the many firms who have independently established decarbonization goals.

The ability to develop on-site generation or co-location with firm power sites may also be considered to address reliability concerns. The Department of State's Brownfield Opportunity Area (BOA) Program works to maximize the value of previous industrial and commercial sites, leveraging existing infrastructure including connections to the electric grid and pipelines. Through this program, local governments and community-based organizations can apply for funding to collaborate on area-wide redevelopment planning in areas with a legacy of contamination. The BOA Program works to revitalize economically distressed areas through redevelopment of brownfields and other vacant, abandoned, or underutilized properties into productive uses, meeting the needs of today's communities.

4.2.2. Clean Energy Supply Chains

One of the key strategic priorities of the Scoping Plan for the Climate Act is to build out a robust, export-oriented supply chain for clean energy technologies that provides high-quality jobs and creates opportunities for businesses and entrepreneurs statewide.[31] By treating the energy transition as an economic development opportunity, New York can capture opportunities for new investments, drive the transition to a clean energy economy, support manufacturers in developing local production and new clean energy products, and build out local clean energy supply chains. The Scoping Plan calls for the need to identify "specific businesses and technologies that could benefit, in part through incentives for private investment" from the work New York is undertaking toward the Climate Act targets and "include an enhanced marketing strategy to attract these manufacturing and clean-tech businesses to New York, with a specific focus on in legacy/rust belt cities and Disadvantaged Communities."[32]

Fostering these supply chains will be crucial for the provision of a wide array of goods and services necessary for the clean energy transition, including but not limited to battery and storage technologies, grid and generation equipment, low-embodied emission materials, heat pumps, and renewable energy system components. In-state supply chains offer numerous benefits, including resilience against potential supply disruptions, reduction of transportation-related environmental harms, economic growth opportunities, and leadership in innovation. New York State can support supply chain development and new clean energy business growth by inducing demand for the next generation of products, regulating the environmental attributes of the key products in the built environment, and strategically investing in new technologies in partnership with private sector stakeholders.

Since 2019, New York has announced 45 Cleantech manufacturing projects totaling more than $4.8 billion in investments and approximately 8,500 jobs created or retained.[33] The State can build on this momentum by continuing to proactively identify opportunities, invest in strategies to attract firms, and build a coalition of partners statewide to help catalyze and align public and private investments to accelerate clean industry growth in New York. The State can leverage this work to address gaps in New York's clean energy market and to target priority needs to support the energy transition.

To attract and expand in-state clean energy supply chains, including technologies critical to scaling renewable energy, New York must continue to establish itself as a competitive business destination for industry. Analysis has shown that other states are drawing a higher number of more substantial projects, usually through bundled incentives, with incentive-to-capital investment ratios reaching as high as 28

percent.[34] Currently, New York offers limited programs outside of offshore wind that are specifically targeted for clean energy manufacturing.

4.2.3. State Support for New Industries

Policymakers can provide a variety of incentives to manufacturers or other industry to locate in their state. For example, ESD's Excelsior Jobs Program offers refundable tax credits to qualifying businesses operating predominantly in targeted industries, encouraging them to expand and invest in New York State. However, the State could increase the competitiveness of these credits by layering on additional tailored incentives, especially for target industries. New York has adopted this strategy to successfully attract offshore wind supply chains through targeted investments and initiatives that foster partnerships between wind developers and manufacturers.

Firms also benefit from State support into site identification, site development, business development, and financial support that helps to mitigate early-stage financial risk. While New York is competitive on utility costs, taxes, and expertise, New York does not have long-standing programs that offer direct financial assistance. Particularly in cases where firms are providing new technologies that are capital-investment-sensitive, these firms prefer cash incentives—such as assistance for higher acquisition cost and construction costs. Flexible incentive funds, such as discretionary closing funds, can help offset upfront costs and provide more flexibility for new technologies looking to locate in the State, which should be managed by ESD to provide businesses with the ease of engagement with one NYS point of contact.

In designing programs to build up industry, the State can promote the development of underutilized areas, promote Minority/Women-owned Business Enterprises (MWBE) to fulfill State contracts, and ensure that benefits accrue to Disadvantaged Communities (DACs). For example, NYSERDA's Build Ready Program partners with local communities to identify opportunities for and support the development of revenue-generating clean energy projects on underutilized land.

Continued investments in workforce development and RD&D also play a role in attracting key industries. As noted in the Clean Energy Jobs and Just Transition chapter of this Plan, fully realizing the potential of the impending energy transition will necessitate growth in the State's workforce as well as skills development to operate emerging technologies. In the industrial sector, this requires training the next generation of workers with an understanding of the business value of energy efficiency, the necessary training to leverage emerging decarbonization methods and technologies, and the ability to innovate and grow new ventures in clean energy. Likewise, investments into RD&D can maintain and expand manufacturing excellence in the State and advance the attainment of our emissions goals while meeting the energy needs of new and growing industries and improving affordability.

4.2.4. Policy and Program Initiatives Underway

The Fiscal Year 2025–2026 Enacted Budget contains critical tools to help New York develop and improve sites to attract more investment and create opportunities for New Yorkers. This budget increases the initial $300 million provided for the FAST-NY program to develop shovel-ready sites by an additional $100 million. The program prioritizes sites that can accommodate advanced manufacturing, including

semiconductors, supply chain projects, Cleantech, and green economy projects. This new funding will continue to focus on equipping sites with utility access (including renewable, clean energy).

The Fiscal Year 2025–2026 Enacted Budget funds $100 million for the new POWER UP program, as a part of a $300 million appropriation over three years, to fund the proactive development of the electric infrastructure for power-ready sites. POWER UP funds can be used to alleviate bottlenecks to connect businesses to power and proactively upgrade electrical infrastructure at sites to rapidly accommodate future commercial and industrial investment opportunities. By injecting State funding into the needed energy infrastructure improvements, POWER UP can help defray electric rate increases for regional ratepayers.

POWER UP will facilitate collaboration between ESD and DPS to address economic development challenges involving power. ESD will provide economic development expertise to ensure the fund focuses on the preparation of sites that are strongly positioned to host manufacturing operations and create jobs. DPS will provide expertise in utility capital planning and will identify opportunities for project sites that can bundle multiple clean energy resources.

The State is active in promoting regional supply chains for critical areas of the clean energy economy. As an example, the Governor has announced a $500 million investment in the establishment of port infrastructure, manufacturing, and other supply chain infrastructure to advance the offshore wind industry. To support these investments, a consortium of State actors works in concert to spur and showcase regional supply chain opportunities, including NYSERDA, the Center for Economic Growth, ESD Hudson Valley Economic Development Corporation (HVEDC), Nassau County Industrial Development Agency (IDA), New York City Economic Development Corporation (NYCEDC), the Orange County Partnership, and the Suffolk County Industrial Development Agency (IDA).

The State has also instituted policies and regulations to create conditions that will spur the demand for products in the clean energy economy. Executive Order 22 and LECCLA both aim to promote low-embodied carbon materials and improve the sustainability of construction practices in the State. This benefits industry and industrial decarbonization by creating new market demand for construction materials produced efficiently with regards to energy and emissions.

Recommendations

- New York should continue and enhance interagency coordination to meet the energy needs of new, large customers. Expanded collaboration between **NYSERDA, DPS, ESD, NYPA, and DEC** will be essential to driving New York's competitiveness.
- **ESD, in collaboration with NYSERDA**, should continue to invest in site readiness. New York needs more large sites with access to competitive and adequate electricity supply. Without these sites, the State will not be positioned to accommodate the coming demand from advanced manufacturing and technology companies, putting the State at risk of missing out on potentially tens of thousands of jobs and potentially billions of dollars in new investments. When possible, these efforts should prioritize brownfield redevelopment to leverage existing, underutilized sites.

- **NYSERDA and NYPA, in coordination with ESD**, should identify and attract key in-state clean energy supply chain opportunities, including the development of marketing campaigns and other targeted programs. Attracting these industries could further amplify the benefits of clean energy development, including through job creation, added tax revenue, and more resilient supply chains.
- New York should leverage opportunities to stimulate the development of clean, firm energy supply, developing partnerships with energy intensive industry to explore the development of clean energy resources.
- **ESD, in coordination with NYSERDA, DPS, and DOS** should continue to ensure consideration of disadvantaged communities and MWBEs when making economic development investments, as applicable.

4.3. Energy Efficiency and Electrification in the Manufacturing Sector

The industrial manufacturing sector provides strong opportunities to reduce energy use and emissions, as energy consumption is centralized into key equipment, and facilities often have dedicated energy managers. On the other hand, manufacturers place a high value on equipment reliability and availability, and usually require a faster return on investment than other sectors of the economy. Currently, low-emission technologies struggle to compete with entrenched fossil fuel technologies, which are more widely available, making them less expensive and facility managers reluctant to switch to emerging technologies. Additionally, as discussed above, expanded power capacity to electrify facilities can be a long and expensive process. In the short-term, energy efficiency and electrification offer strong options to transition to low-emission industrial equipment, but deployment will require State support, both technical and financial.

Process heating accounts for most of the manufacturing sector's energy demand, but most of its uses are for low (<140°C) and medium (140°C–300°C) temperature processes which can be electrified through technologies like infrared, microwave, or radio frequency heating. The most impactful sectors to target vis a vis process heating would be the State's food, chemicals, metals, and transportation equipment sectors. Some high-heat processes are starting to use electric technologies to preheat materials, and then fossil fuels to achieve the final required temperatures.

Beyond electrification of process heating, there are strong opportunities to capture and recycle waste heat, treating it as a thermal resource to recycle into useful forms. This could be internal to industrial facilities, recycling heat to be reused on later processes. Thermal storage processes, such as boilers to store hot water, can be useful to store this heat until it is needed or prices from other sources increase. Thermal storage has the advantage of being the lowest cost source of energy storage.[35,36] Additionally, waste heat can be connected to nearby sources of heat demand via a Thermal Energy Network. This can leverage the waste heat to displace other sources of thermal generation, and potentially add another revenue stream to industrial facilities who are able to provide a steady supply of waste heat. After process heating, boilers and motors provide the most opportunity for energy and carbon savings in the

sector, followed by general building efficiency measures for industrial sites, such as HVAC and lighting upgrades.

These manufacturing investments would have additional benefits to the State. New York's manufacturing sector is already one of the cleanest and most efficient, using far less energy per units produced than the nationwide average.[37] Continued investments would help extend this advantage and support local industries. Using less energy while enhancing energy networks to serve manufacturers also brings resiliency benefits to the State. The industrial sector relies heavily on large amounts of energy; therefore, securing a stable supply creates a more stable economy in New York and hedges against potential disruptions. Finally, industrial plants, especially those combusting fuel on-site, tend to be highly polluting. With over 60 percent of industrial facilities in New York located either in or near a DAC,[38] reducing energy use and converting facilities from fuel to electric power would reduce pollution in these communities, improving air quality and public health.

4.3.1. Policy and Program Initiatives Underway

Recent State and federal studies have examined the potential to reduce energy use and greenhouse gas (GHG) emissions in the industrial sector. NYSERDA's Industrial Stock and Decarbonization Potential studies were discussed above. Separately, the U.S. Department of Energy (DOE) produced a Commercial Liftoff Series,[39] examining decarbonization potential in industry as well as subsector specific reports on cement production, chemicals and refining, and carbon management. These studies found the most short-term potential in energy efficiency investments, followed by electrification, whereas carbon capture, utilization, and storage (CCUS) was most impactful in the long-term. (For a more detailed description of CCUS, see Section 4.4.2).

Spotlight: Industrial Energy Management

Byrne Dairy, located in East Syracuse, NY, participated in the NYSERDA's On-site Energy Manager Program. They tapped CHA Consulting, Inc. to provide a full-time staff energy manager for a 13-month period. In that time, the energy manager worked with staff to identify energy savings opportunities, promoted continuous improvement, and developed implementation strategies for energy management.

A total of 41 energy projects were identified, with 11 projects selected for implementation. They exceeded their goal of a 5.5 percent reduction in site energy use, with a simple investment payback of 2.5 years. In addition, several projects had ancillary benefits such as product, O&M, water, and boiler chemical savings.

NYSERDA also supports more efficient energy use at industrial facilities through various programs. As noted in Section 2.3.2, The FlexTech and SEM programs offer technical and engineering support for companies and facilities to improve their energy efficiency, while the On-Site Energy Manager Program offers to share 75 percent of the salary cost of a dedicated energy manager for a minimum term of 12 months to manage energy use and enhance productivity. Two programs also provide matching funds to invest in energy upgrades. The Commercial and Industrial Carbon Challenge program (also described in

Section 2.3.2) provides awards to facility investments, including electrifying of steam production, electrifying mining equipment, CCUS, biofuel production, and low-carbon inputs for cement production. The **Heat Recovery Program** also provides financial support for facilities to capture and recycle their waste heat, reducing their heating needs and energy demand.

Recommendations

- **NYSERDA should continue to provide technical assistance to energy-intensive industrial facilities** to facilitate cost-effective energy efficiency and decarbonization upgrades. NYSERDA should also provide financial support to help these facilities implement deeper energy efficiency and decarbonization projects, as funding is available.
- In the near- to medium-term, **NYSERDA and the PSC should prioritize high-efficiency and electric process heating**. Increased insulation, electric boilers, electric pre-heating, and infrared, microwave, and radio frequency heating can all reduce energy use and on-site combustion in the industrial sector. Recycled waste heat can also power additional processes or be resold as a valuable resource into Thermal Energy Networks.
- **NYSERDA, in coordination with ESD, should help facilities maximize the value of energy used in process heating.** On-site equipment, thermal energy networks, and heat sharing agreements can help recycle heat in facilities or capture heat as an energy supply for nearby thermal needs.
- **DEC, in coordination with NYSERDA, should examine the benefits of clean energy investments in industrial facilities**, including the public health benefits of reduced pollution.

4.4. Additional Approaches to Industrial Sector Decarbonization

4.4.1. The NYSERDA Industrial Potential Study indicates that energy efficiency and electrification of thermal loads can account for the majority of short-term decarbonization in the manufacturing sector, and as such, should remain the primary solutions for this goal.[40] However, in their current state of development, these efforts alone will be insufficient to reduce the sector's energy emissions in line with the State's Climate Act targets in the medium- and long-term. This is most acutely due to process temperature requirements and manufacturing process integration challenges. In many cases, there are no electric alternatives for providing the medium and high operating temperatures (>140°C) required in certain manufacturing processes (Low-Carbon Fuels and Energy Sources

Low-carbon fuels and energy sources provide a solution for decarbonizing manufacturing for those subsectors and businesses that cannot electrify operations due to their inability to reach higher operating temperatures. These solutions can include, but are not limited to:

- Biomass fuels – the direct combustion of biomass material or fuels derived from process and/or refining biomass material.
- Hydrogen – the direct combustion of hydrogen blends or the combustion of hydrogen derived fuels like ammonia or methanol.
- Geothermal heat – sourcing heat from geologic formations.

- Nuclear-derived heat – sourcing heat from fissile material, particularly from micro- and small modular reactors for industrial heat.
- Solar Thermal – using solar arrays to heat water directly rather than producing electricity.

In addition to their beneficial temperature capacities, low-carbon fuels and energy sources can also carry other benefits. The complexity of reconfiguring manufacturing to accommodate electrified equipment can present barriers related to operations and maintenance, workforce training, and quality control. For example, a site may be configured such that excess heat from a fossil-fuel-driven manufacturing process is collected and used to drive a separate process at the facility. Replacing the gas-fired equipment with electric equipment will eliminate the useful excess heat, requiring reengineering of the secondary process as well. This can have cascading effects that impact multiple systems across a plant. Replacing fossil fuels with alternative, low-carbon fuels and energy sources can reduce or eliminate the need for process reengineering.

Spotlight: Biofuels

Cascades is one of the largest paper packaging and hygiene product manufacturers in North America. In 2021, the company's Containerboard Packaging plant in Niagara Falls, NY was awarded just over $2 million from NYSERDA's Commercial and Industrial Carbon Challenge program to execute a biogas project. The plant is in the process of upgrading their waste biodigester system to efficiently capture methane streams that would otherwise be flared. The methane will be processed through a newly installed purification process so that it can be directly combusted in the plant's boilers. This system will yield an estimated 400 MMBtu of low-carbon gas per day and reduce the plant's reliance on delivered fossil gas.

Utilization of alternative fuels is particularly attractive in certain subsectors capable of generating such fuels onsite. For example, manufacturing pulp and paper products involves the processing of large quantities of biomass. This leads to significant biomass waste streams. These waste streams can be further processed or refined to provide fuel, as happens in anaerobic digester systems.

As noted in the Low-Carbon Alternative Fuels chapter of this Plan, these solutions should be carefully managed to realize fuel-cycle GHG reductions and avoid other environmental or health impacts. In addition, the supply of alternative fuels will be limited due to a limited supply of available feedstocks and competition from other end-uses and other states or provinces in the region with similar decarbonization goals. As additionally discussed in the Low-Carbon Alternative Fuels chapter, the State prefers waste-based feedstocks sourced in-state for alternative fuel production. Industrial and agricultural facilities with significant biomass-based waste streams could leverage these waste streams for their own use, such as an on-site production and use of biogas. As the alternative fuels market develops, there may be further interest from producers in the available waste streams within the state.

Advanced nuclear energy systems are capable of generating heat at temperatures above 700°C that can be used in industrial applications. As noted in the Nuclear chapter of this Plan, these solutions present a

complex series of challenges related to technology feasibility and cost, regulatory needs, safety, and waste management. Moreover, there are siting concerns regarding the co-location of nuclear reactors with industrial facilities that will require the thoughtful development of frameworks for community engagement and information sharing.

Full utilization of hydrogen fuel in industry poses operational barriers that will need to be addressed. While New York is not pursuing gas-hydrogen blending in the gas transportation network, industrial sites producing hydrogen on-site can explore gas-hydrogen blends in combustion infrastructure. These blends can more easily integrate into existing gas equipment at lower blend rates. However, replacement or modifications of existing industrial equipment are needed to combust blends with higher concentrations of hydrogen. This is due to differences in the required composition and characteristics of hydrogen versus natural gas. New safety systems are also necessary to account for increased flammability and differences in hydrogen flame characteristics.

4.4.2. Carbon Capture, Utilization, and Storage

CCUS is the application of a system to capture Carbon Dioxide (CO_2) and other emissions from a point source, like an industrial flue stack, before the emissions are released into the atmosphere. The captured CO_2 can then be utilized for other purposes or stored in a long-term geological reservoir. CO_2 is already utilized in the production of a wide variety of goods and efforts are underway to find additional innovative uses (see “Spotlight: Carbon Utilization”).

Spotlight: Carbon Utilization

AIRCO, based in Brooklyn, NY, is an innovative startup working to create synthetic fuels from CO_2 captured from industrial point sources and green hydrogen. They currently have commercial partnerships with JetBlue and Virgin Airways related to their sustainable aviation fuel, AIRMADE SAF. Displacing traditional, fossil-derived jet fuel with their SAF alternative helps recycle waste CO_2 with beneficial global warming impacts.

AIRCO participated in the Year 1 Cohort of the Carbon2Value Initiative, a collaborative venture for CCUS startups administered by the Urban Future Lab, Greentown Labs, and the Fraunhaufer USA with support from NYSERDA. This support encourages new business growth in the State’s clean energy economy while simultaneously aiding in the decarbonization of the industrial sector.

CCUS, like alternative fuels and energy sources, can help overcome the challenges posed by high temperature requirements in manufacturing, but the technology has other unique benefits as well. The processes used to manufacture certain products can generate GHG emissions that are not related to energy consumption. Rather, the emissions result directly from chemical reactions or physical transformations of materials. For example, the production of aluminum most often involves an electrolysis process where carbon anodes react with oxygen or fluorides to produce CO_2 and perfluorocarbons (PFC), very potent greenhouse gases. Other sources of manufacturing process

emissions in New York State include cement, chemicals, glass, semiconductor, iron and steel, hydrogen, and lead production. Solutions like CCUS will be needed to eliminate these types of manufacturing process emissions.

CCUS offers near-term benefits apart from process emission mitigation solutions that make it likely to be utilized by manufacturers working to reduce emissions. There are certain applications of CCUS that are already mature and widely available, whereas many electrified solutions for replacing fossil fuel-based equipment are in earlier stages of development with more limited market availability. Given the limitations on supply for alternative fuels discussed in the chapter on that subject, CCUS may prove preferable to certain subsectors for addressing high-temperature manufacturing processes.

While CCUS offers benefits, there are important limitations to its use. CCUS systems impose an additional energy load in the facilities in which they are deployed. The magnitude of this energy load is correlated to the concentration of CO_2 in the waste gas stream: the more diffuse the CO_2, the more energy required to remove it. These concentrations are highly variable across different manufacturing subsectors. Employing CCUS in facilities with less concentrated gas streams is not currently economically feasible. Application in these facilities would depend on the development of breakthrough approaches.

Optimal CCUS use demands that there are options for durable, long-term storage of the captured emissions. This requires well-tested and robust utilization pathways or storage media. While pathways for carbon utilization are very actively under development in the market, the technical and economic feasibility for many remain uncertain. While many aspects of long-term storage in geologic media are well understood, with technology readily available to facilitate it, the cost of such operations are likely to be prohibitive in the short- and medium-term. Moreover, there are additional regulatory, safety, and cost barriers to building out a CO_2 transportation and storage system in New York.

4.4.3. Novel Manufacturing Processes

Process innovation is a general term for novel methods of manufacturing products with more favorable energy or emissions characteristics. Given the heterogenous nature of manufacturing subsectors and their unique processes, providing a comprehensive overview of the methods and technologies under consideration is impracticable (see “Spotlight: Industrial Energy Management,” for an illustrative example).

These novel methods can include new physical or chemical conversion pathways for raw materials. These conversion pathways often work by leveraging electricity rather than heat to drive processes, remaking the process to manufacturing a good that typically requires medium-to-high heat to be produced (>140°C). However, this will result in additional demand being imposed on the electric grid from industrial efforts to decarbonize.

The technologies and processes being developed to alter manufacturing processes are at very early technical readiness levels and will face both known and unknown technical hurdles in order to reach maturity. Furthermore, developing, scaling, and ultimately deploying these technologies will require significant investments.

4.4.4. Initiatives underway: policy processes and programs

NYSERDA is actively researching the characteristics and potential of multiple alternative fuels, low carbon energy sources, and CCUS opportunities, with an acknowledgement of utilization in industry. The following research efforts have been recently completed or are underway to better inform the State's industrial strategy:

- New York State Hydrogen Assessment (2025)
- Analysis of the Potential Scale and Impacts from the Use of Anaerobic Digester Gas and Renewable Natural Gas for Hard-to-Decarbonize Energy Uses in New York State (Forthcoming)
- Blueprint for Consideration of Advanced Nuclear Energy Technologies (2025)
- Potential for Renewable Natural Gas in New York State (2022)
- Advanced Nuclear Request for Information (2025)
- Potential for Carbon Capture, Utilization, and Storage Technologies in New York State (2018)

NYSERDA offers many programs to research, develop, and demonstrate the capacity of these many solutions. Technical assistance programs can offer support for companies and facilities to identify opportunities to generate or utilize low-carbon fuels and energy sources, innovate processes, or deploy CCUS technologies. The Commercial and Industrial Carbon Challenge program provides capital awards for facility investments aimed at reducing the emissions in industrial facilities, welcoming all types of technology applications for doing so (see "Spotlight: Biomass Fuels"). Additional capital support has been made available for development and demonstration projects through the NYSERDA Innovation team's portfolio of programs.

The federal government has likewise been active in supporting alternative fuels and energy sources of importance to energy, though federal policy priorities are uncertain at present.

Recommendations

- **NYSERDA, in coordination with researchers in the state university systems and non-academic institutions,** should continue to support research, development, and demonstration activities for promising industrial decarbonization solutions in high-temperature electrified heat, low-carbon fuels and energy sources, CCUS, and novel process development. Such support will occur in New York.
- **NYSERDA** should continue to provide technical assistance and capital support for manufacturing facilities for cost-effective decarbonization upgrades.
- **NYSERDA, DPS, and AGM** should prioritize strategies, policies, and programs that support the use of low-carbon fuels and energy sources in:
    - Subsectors with limited capacity for decarbonization through electrification and efficiency.

    - Close proximity to the energy or fuel source to reduce midstream transportation complications (e.g., fugitive emissions, pipeline costs) and to promote offtake clustering.

- As offtake potential for alternative fuel and energy sources in industry materializes, **NYSERDA and ESD** should increase efforts to provide market intelligence to industrial sector stakeholders to ensure awareness of opportunities.
- **NYSERDA, ESD, and DOS** should pursue risk-sharing mechanisms with the federal government and/or industry to reduce the potential barriers of any novel decarbonization strategies or methods, including:
    - Advanced Nuclear siting partnerships,
    - Demand-clusters for alternative fuels, and
    - Novel process pilots.
- When opportunities for CCUS deployment arise, **DEC and NYSERDA, along with local development authorities**, should work to connect potential sources of captured carbon with facilities that can leverage carbon for productive utilization or with geologic sequestration sites.

4.5. Agricultural Energy Use, Energy Efficiency, and Electrification

Agriculture is a vital industry in New York State, which ranks among the top-producing states for dairy, fruits, and several other commodities. As agriculture depends on the weather and specific climatic conditions, this sector faces extraordinary challenges from climate change. Farms are adapting by using more energy, whether it is barn cooling and ventilation on dairy farms, frost protection on vineyards and orchards, more energy-intensive inputs like fertilizers or chemicals, or incorporating more controlled environment agriculture (e.g., greenhouses, container farming, and indoor farming).

Energy efficiency measures and best practices can be utilized on farms now even while farms continue to adapt to a changing climate. Numerous programs, at both the federal and State level, have been set up to provide grants or low-interest loans to adopt best energy efficiency practices on farms. NYSERDA has compiled tools and resources to help New York farms make informed energy decisions that will save money, boost productivity, and improve operations. NYSERDA also offers programs for farms to conduct no-cost energy audits, which uncover opportunities to reduce and conserve energy through the deployment of energy efficiency best practices. The State would benefit from additional data to measure the energy use on farms and increased use due to climate change. New York State should invest in research that better quantifies on-farm energy uses across major commodities agricultural production systems.

Efficient electrification is defined as the process of replacing fossil fuels with electricity to reduce emissions and energy costs. Many agricultural applications can be converted to high-efficiency electricity use. As climate change continues to add stress to agricultural output (e.g., drought conditions for growing crops, and heat stress on livestock), demand for energy will increase. By converting appropriate applications to electrification using variable speed pumps, cooling fans, frost protection, etc., less fossil

fuels will be needed. Much of this electrification requires utility upgrades, such as three-phased power. This comes at a high upfront cost to the farm and community and can be cost-prohibitive.

Beyond electrifying agricultural operations, concerns have been raised over New York's farmland being converted to host renewable energy infrastructure. The Environmental Impacts chapter of this plan, Section 2.3. Land Use discusses this topic further.

4.5.1. Policy Process, Program Initiatives, and Market Adoption Underway

NYSERDA and AGM can develop new programs and enhance existing ones to support the utility upgrade costs for three-phased power enabling increased adoption of electric equipment. The existing NYS Climate Resilient Farming (CRF) Program has helped farms adapt by providing cost-share funding to boost irrigation capacity by replacing diesel powered water pumps with high-efficiency electric pumping. The CRF Program could help cover costs to upgrade facilities to three-phase power if it is required for a climate adaptation/resiliency measure such as irrigation or frost protection. Additionally, AGM and NYSERDA collaborate on two working groups, the Agricultural Technical Working Group, and the Farmland Protection Working Group, to convene stakeholders and advance state goals and policy in this sector.

Some common agricultural best management practices implemented to protect water quality or lower agricultural emissions also have energy savings when adopted. Practices such as reduced tillage on fields not only boosts soil health and quality but also requires fewer tractor passes over the field. This energy savings can be quantified by measuring the reduction in gallons of fossil fuels needed to grow crops. Furthermore, helping farms to manage nutrient applications can reduce the amount of synthetic fertilizer. These fertilizers are fossil-fuel-intensive to produce so reductions in their use reduces emissions and conserves energy resources. Other best management practices such as prescribed rotational grazing and the use of cover crops may promote reductions in fossil fuel use of farm machinery and/or increase soil health and nutrient crop use efficiency.

CRF together with agricultural water quality programming provides technical and cost-share assistance for the adoption of conservation practices. Administered by the NYS Department of Agriculture and Markets and the NYS Soil and Water Conservation Committee and locally led by County Soil and Water Conservation Districts, these programs assist farmers to protect water quality, reduce agricultural greenhouse gas emissions and adapt to a changing climate. Many of these conservation practice systems can reduce energy inputs on farms. However, more information and data are needed to better quantify energy efficiency benefits.

Recommendations

- **AGM, in coordination with NYSERDA**, should support efficient electrification systems on farms including three-phased power upgrades.
- **AGM** should expand the NYS Climate Resilient Farming Program to support adaptation projects that also reduce GHG emissions or at least do not increase emissions.

- **AGM, in coordination with DEC**, should support the measurement, monitoring, and verification of energy use in the agricultural sector, as well as efficiency co-benefits associated with the adoption of conservation management best practices.
- **AGM and NYSERDA** should continue their collaboration and support for local jurisdictions on solar siting and agricultural lands. Productive dual-use strategies should be identified and prioritized on productive farmland. The State should continue to encourage siting large-scale solar projects on brownfields, landfills, and other underused spaces, while projects that impact farmland receive additional scrutiny.

4.6. Agricultural Renewable Energy Production

Agriculture is a very energy-intensive industry, and some end uses cannot currently be electrified or are challenging to electrify with considerable upfront costs. For these applications it is important to consider low-carbon fuels as a dispatchable resource that could be used now and into the future or serve as a bridge to technological advances in energy and electrification. Biodiesel could be produced and refined on site for use in agricultural equipment.

New York State can support farmers and help meet state clean energy and environmental goals through planning for the continued reduction of methane through alternative manure management systems. Manure storage is the largest source of agricultural emissions since the 1990 baseline. The storage of manure is an important practice to facilitate nutrient management, reducing the need for synthetic fertilizers and mitigating runoff for the improvement of water quality. However, the treatment and storage of livestock manure can produce methane through the anaerobic decomposition of the manure and be used as a productive fuel.

The alternative manure management strategies (detailed in the Climate Act Scoping Plan) can reduce methane emissions through on-site investments designed for each farm, such as methane destruction systems, anaerobic digester systems, composting, and other innovative systems that collect, capture, destroy, or utilize methane from manure storage. This biogas can be used as a fuel on-site or shipped to supply other sectors. The limited supply of biogas or RNG produced from manure management or other waste streams should be targeted to strategic uses such as locations where it can provide electric system capacity for buildings and transportation electrification by alleviating system constraints or RNG for industrial processes including food production such as fluid milk processing. Though biogas may be used on-site, RNG and other alternative fuels will need to be produced, transported, stored, and used at scale to meaningfully contribute to the decarbonization of the energy system.

New York State should expand support for the advancement of energy production and methane mitigation following full life cycle analyses, including measurement and abatement of methane leakage, consideration for avoided emissions, and future innovations. Programs that incentivize or permits to build anaerobic digestion should require systems be built (or retrofitted) for maximum methane mitigation to ensure development of well-managed, low-emission biogas or RNG production such as utilizing emissions minimizing technologies and techniques, minimizing fossil fuel use in biogas or RNG

production, minimizing emissions from biosolids/digestate, and consideration of a regulatory framework to ensure best practices.

The State should develop and apply standards for leak detection and repair from energy production systems. These standards will also include monitoring to guide management to minimize losses and optimize GHG emissions reduction benefit. New technologies such as drones make leak detection much simpler and affordable.

The State should align manure management systems designed for energy production, organic waste management, and methane mitigation with markets and private-sector investments (e.g., clean transportation standard, industry net zero initiatives, and others). NYSERDA and DPS, along with utilities and energy market participants, should identify energy pricing models and conduct a market-based study for waste-generated biogas. When on-site use of this fuel is not possible, improved connections between markets and farms can help match this new supply with market demand biomethane and other organic co-products generated by such on-farm systems, such as electricity, heat, gas, and organic soil amendments.

4.6.1. Challenges and Barriers

One challenge to this strategy is in the size and scale needed for system efficiency and cost effectiveness. Typically, anaerobic digesters are used on a large-scale dairy farm as a manure treatment and handling method where the project scale is sufficient to achieve economic feasibility. However, smaller-scale anaerobic digestion systems may provide an option for small- to medium-sized farms but would need to be coupled with strong incentives and perhaps new technology demonstration for large-scale adoption. Small-scale digesters may intake manure along with food waste to produce energy at the farm. Benefits of these systems include reduced odor, pathogen reduction, processing of food wastes and substantially reduced methane emissions. The addition of food wastes boosts biogas production and helps institutions comply with the State's Food Donation and Food Scraps Recycling Law that took effect in January 2022.

Notably, food waste may have two to three times more energy potential per unit mass than manure, making co-digestion an effective method to increase energy output while reducing methane emissions from the degradation of food wastes. This biogas output may also be used in a combined heat and power (CHP) system to generate electricity and heat energy for the grid and farm. In most cases, the onsite electricity generation from anaerobic digestion systems will exceed the farm's usage. Currently, the value structure for excess power production to be supplied to the grid is not sufficient for farms to make investments in anaerobic digestion/CHP systems.

Biogas may be upgraded to biomethane or RNG through carbon capture and removal. However, small scale digesters generally cannot connect to the natural gas pipeline grid for RNG injection as it is not cost-effective to upgrade to pipeline quality and cover grid interconnection costs at a small scale. Biomethane can potentially be used for vehicle fueling, boiler fueling, or other equipment that require a lower percentage of methane in the gas. Still there are significant challenges in matching variable energy use needs with a constant and continuous production of gas as well as higher relative capital and on-going costs associated with small-scale biomethane production.

4.6.2. Current Policies, Program Initiatives, and Market Drivers

In recent years, the California Low Carbon Fuel Standard (LCFS) and federal Renewable Fuel Standard (RFS) have been the primary market force for RNG development of large-scale anaerobic digestion systems on dairy farms in New York State.

The LCFS provides payment to farms by allowing them to generate and sell credits for capturing methane gas produced from animal manure, incentivizing the reduction of GHG emissions by converting waste into a usable fuel source, which can then be sold to energy companies required to meet the LCFS carbon intensity standards. This also incentivizes energy developers to invest in biogas capture technology on farms.

The RFS is a federal program that mandates the incorporation of renewable fuels into the nation's transportation fuel supply. Each year, the U.S. Environmental Protection Agency (EPA) issues RFS rulemakings with volume requirements for certain renewable fuel categories and sets those volumes through annual renewable volume obligations (RVO). RVOs are the volumetric biofuel targets for obligated parties, such as refiners and importers of petroleum-based gasoline or diesel fuel. A Renewable Identification Number (RIN) is a unique number that tracks each gallon of renewable fuel in the United States. RINs are used to ensure compliance with the federal RFS. Because of feedstock requirements for RINs, use of food waste for RNG production is discouraged. There is also uncertainty with the value for LCFS and RINs due to the potential for changes in California and federal policy.

With support and incentives from the State, this market uncertainty and the under-utilized potential of food waste could potentially drive interest of RNG developers to consider new RNG projects that take both manure and food waste and produce RNG for use on-site or regionally located to supply hard-to-electrify/decarbonize industrial customers, including dairy processing facilities, via low-risk long-term purchase agreements. A similar approach might be possible for bringing food waste and manure from other farms to existing digesters with spare capacity or an ability to expand capacity.

4.6.3. Opportunities for State Action

New York State could create programs to facilitate both pilot projects for small-scale systems that incorporate new and innovative technologies for electricity or RNG generation, as well as large-scale community anaerobic digestion projects for multiple farms and food waste feedstocks. A program for small-scale anaerobic digestion could pilot and demonstrate new and innovative technologies for the use of biogas and RNG. For example, linear generator systems could potentially be used in small to large scale systems to cost effectively produce electricity from dairy anaerobic digestion. Large-scale community digestion projects may allow many smaller facilities to participate in a digestion project. These centralized anaerobic digestion systems could be co-located with hard to electrify/decarbonize industrial/food processing campuses. Many of these facilities currently require natural gas for sustained high-temperature process heating or treating raw materials. Much of this natural gas usage could potentially be replaced by lower carbon RNG**.**

Most recently, digesters built in New York State were driven mainly by market-based incentives from the California LCFS or the federal RFS RINs value. These systems do not intake food waste but could do so—

with an appropriate incentive structure. A program could be created to spur a market for RNG in New York State. Industrial facilities could purchase this RNG to ensure a predictable pricing structure in the long term. Due to New York State's methane goals and the Food Donation and Food Scraps Recycling Law, a program could encourage the addition of food waste. These systems could create a steadier supply of biogas, farmers could receive tipping fees, and energy developers could enter into a long-term contract with an industrial facility in the same region.

Recommendations

- **NYSERDA, in coordination with AGM,** should continue to support research, development, demonstration, and deployment of RNG, electricity, and biogas production from on-farm waste sources, such as co-digestion of anaerobic manure and food waste for strategic and limited use. Such support will occur in New York.
- **NYSERDA, in coordination with AGM and DPS,** should facilitate in-state pilot projects for small-scale digestion systems that incorporate innovative technologies that maximize production of electricity, biogas, or RNG, while also maximizing emissions reductions.

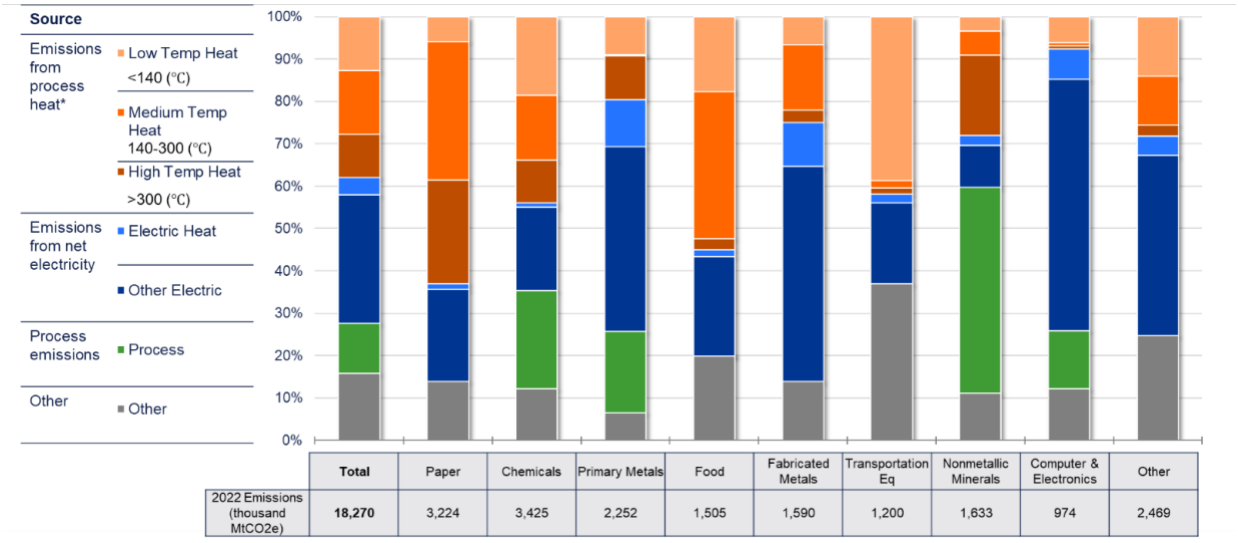
). While high-temperature electric alternatives are under development, it may be several years before they are available for many manufacturing processes.

This presents a need for additional solutions that can be met with the utilization of low-carbon fuels and energy sources, CCUS technologies, and novel process innovations. These solutions are varied both in technical detail and market readiness and will require financial support for continued research, development, and demonstration.

Figure 4: New York Manufacturing Sector 2023 Emissions by energy end-use. Source Phase 2 Industrial Potential Study.

Source: Assessment of Energy Efficiency, Electrification, and Decarbonization Potential for the New York State Industrial Sector: Phase 2[40]

Note: Emissions factors were derived from the Fossil and Biogenic Fuel Whitepaper.[41]



	Total	Paper	Chemicals	Primary Metals	Food	Fabricated Metals	Transportation Eq	Nonmetallic Minerals	Computer & Electronics	Other
2022 Emissions (thousand MtCO2e)	**18,270**	3,224	3,425	2,252	1,505	1,590	1,200	1,633	974	2,469

4.6.4. Low-Carbon Fuels and Energy Sources

Low-carbon fuels and energy sources provide a solution for decarbonizing manufacturing for those subsectors and businesses that cannot electrify operations due to their inability to reach higher operating temperatures. These solutions can include, but are not limited to:

- Biomass fuels – the direct combustion of biomass material or fuels derived from process and/or refining biomass material.
- Hydrogen – the direct combustion of hydrogen blends or the combustion of hydrogen derived fuels like ammonia or methanol.
- Geothermal heat – sourcing heat from geologic formations.
- Nuclear-derived heat – sourcing heat from fissile material, particularly from micro- and small modular reactors for industrial heat.
- Solar Thermal – using solar arrays to heat water directly rather than producing electricity.

In addition to their beneficial temperature capacities, low-carbon fuels and energy sources can also carry other benefits. The complexity of reconfiguring manufacturing to accommodate electrified equipment can present barriers related to operations and maintenance, workforce training, and quality control.[42] For example, a site may be configured such that excess heat from a fossil-fuel-driven manufacturing process is collected and used to drive a separate process at the facility. Replacing the gas-fired equipment with electric equipment will eliminate the useful excess heat, requiring reengineering of the

secondary process as well. This can have cascading effects that impact multiple systems across a plant. Replacing fossil fuels with alternative, low-carbon fuels and energy sources can reduce or eliminate the need for process reengineering.

Spotlight: Biofuels

Cascades is one of the largest paper packaging and hygiene product manufacturers in North America. In 2021, the company's Containerboard Packaging plant in Niagara Falls, NY was awarded just over $2 million from NYSERDA's Commercial and Industrial Carbon Challenge program to execute a biogas project. The plant is in the process of upgrading their waste biodigester system to efficiently capture methane streams that would otherwise be flared. The methane will be processed through a newly installed purification process so that it can be directly combusted in the plant's boilers. This system will yield an estimated 400 MMBtu of low-carbon gas per day and reduce the plant's reliance on delivered fossil gas.

Utilization of alternative fuels is particularly attractive in certain subsectors capable of generating such fuels onsite. For example, manufacturing pulp and paper products involves the processing of large quantities of biomass. This leads to significant biomass waste streams. These waste streams can be further processed or refined to provide fuel, as happens in anaerobic digester systems.

As noted in the Low-Carbon Alternative Fuels chapter of this Plan, these solutions should be carefully managed to realize fuel-cycle GHG reductions and avoid other environmental or health impacts. In addition, the supply of alternative fuels will be limited due to a limited supply of available feedstocks and competition from other end-uses and other states or provinces in the region with similar decarbonization goals. As additionally discussed in the Low-Carbon Alternative Fuels chapter, the State prefers waste-based feedstocks sourced in-state for alternative fuel production. Industrial and agricultural facilities with significant biomass-based waste streams could leverage these waste streams for their own use, such as an on-site production and use of biogas. As the alternative fuels market develops, there may be further interest from producers in the available waste streams within the state.

Advanced nuclear energy systems are capable of generating heat at temperatures above 700°C that can be used in industrial applications. As noted in the Nuclear chapter of this Plan, these solutions present a complex series of challenges related to technology feasibility and cost, regulatory needs, safety, and waste management. Moreover, there are siting concerns regarding the co-location of nuclear reactors with industrial facilities that will require the thoughtful development of frameworks for community engagement and information sharing.

Full utilization of hydrogen fuel in industry poses operational barriers that will need to be addressed. While New York is not pursuing gas-hydrogen blending in the gas transportation network, industrial sites producing hydrogen on-site can explore gas-hydrogen blends in combustion infrastructure. These blends can more easily integrate into existing gas equipment at lower blend rates. However, replacement or modifications of existing industrial equipment are needed to combust blends with higher concentrations

of hydrogen. This is due to differences in the required composition and characteristics of hydrogen versus natural gas. New safety systems are also necessary to account for increased flammability and differences in hydrogen flame characteristics.[43]

4.6.5. Carbon Capture, Utilization, and Storage

CCUS is the application of a system to capture Carbon Dioxide (CO_2) and other emissions from a point source, like an industrial flue stack, before the emissions are released into the atmosphere. The captured CO_2 can then be utilized for other purposes or stored in a long-term geological reservoir.[44] CO_2 is already utilized in the production of a wide variety of goods and efforts are underway to find additional innovative uses (see "Spotlight: Carbon Utilization").

Spotlight: Carbon Utilization

AIRCO, based in Brooklyn, NY, is an innovative startup working to create synthetic fuels from CO_2 captured from industrial point sources and green hydrogen. They currently have commercial partnerships with JetBlue and Virgin Airways related to their sustainable aviation fuel, AIRMADE SAF. Displacing traditional, fossil-derived jet fuel with their SAF alternative helps recycle waste CO_2 with beneficial global warming impacts.

AIRCO participated in the Year 1 Cohort of the Carbon2Value Initiative, a collaborative venture for CCUS startups administered by the Urban Future Lab, Greentown Labs, and the Fraunhaufer USA with support from NYSERDA. This support encourages new business growth in the State's clean energy economy while simultaneously aiding in the decarbonization of the industrial sector.

CCUS, like alternative fuels and energy sources, can help overcome the challenges posed by high temperature requirements in manufacturing, but the technology has other unique benefits as well. The processes used to manufacture certain products can generate GHG emissions that are not related to energy consumption. Rather, the emissions result directly from chemical reactions or physical transformations of materials. For example, the production of aluminum most often involves an electrolysis process where carbon anodes react with oxygen or fluorides to produce CO_2 and perfluorocarbons (PFC), very potent greenhouse gases. Other sources of manufacturing process emissions in New York State include cement, chemicals, glass, semiconductor, iron and steel, hydrogen, and lead production. Solutions like CCUS will be needed to eliminate these types of manufacturing process emissions.

CCUS offers near-term benefits apart from process emission mitigation solutions that make it likely to be utilized by manufacturers working to reduce emissions. There are certain applications of CCUS that are already mature and widely available, whereas many electrified solutions for replacing fossil fuel-based equipment are in earlier stages of development with more limited market availability. Given the limitations on supply for alternative fuels discussed in the chapter on that subject, CCUS may prove preferable to certain subsectors for addressing high-temperature manufacturing processes.[45]

While CCUS offers benefits, there are important limitations to its use. CCUS systems impose an additional energy load in the facilities in which they are deployed. The magnitude of this energy load is correlated to the concentration of CO_2 in the waste gas stream: the more diffuse the CO_2, the more energy required to remove it. These concentrations are highly variable across different manufacturing subsectors.[46] Employing CCUS in facilities with less concentrated gas streams is not currently economically feasible. Application in these facilities would depend on the development of breakthrough approaches.

Optimal CCUS use demands that there are options for durable, long-term storage of the captured emissions. This requires well-tested and robust utilization pathways or storage media. While pathways for carbon utilization are very actively under development in the market, the technical and economic feasibility for many remain uncertain. While many aspects of long-term storage in geologic media are well understood, with technology readily available to facilitate it, the cost of such operations are likely to be prohibitive in the short- and medium-term. Moreover, there are additional regulatory, safety, and cost barriers to building out a CO_2 transportation and storage system in New York.

4.6.6. Novel Manufacturing Processes

Process innovation is a general term for novel methods of manufacturing products with more favorable energy or emissions characteristics. Given the heterogenous nature of manufacturing subsectors and their unique processes, providing a comprehensive overview of the methods and technologies under consideration is impracticable (see “Spotlight: Industrial Energy Management,” for an illustrative example).

These novel methods can include new physical or chemical conversion pathways for raw materials. These conversion pathways often work by leveraging electricity rather than heat to drive processes, remaking the process to manufacturing a good that typically requires medium-to-high heat to be produced (>140°C). However, this will result in additional demand being imposed on the electric grid from industrial efforts to decarbonize.

The technologies and processes being developed to alter manufacturing processes are at very early technical readiness levels and will face both known and unknown technical hurdles in order to reach maturity. Furthermore, developing, scaling, and ultimately deploying these technologies will require significant investments.

4.6.7. Initiatives underway: policy processes and programs

NYSERDA is actively researching the characteristics and potential of multiple alternative fuels, low carbon energy sources, and CCUS opportunities, with an acknowledgement of utilization in industry. The following research efforts have been recently completed or are underway to better inform the State’s industrial strategy:

- New York State Hydrogen Assessment (2025)
- Analysis of the Potential Scale and Impacts from the Use of Anaerobic Digester Gas and Renewable Natural Gas for Hard-to-Decarbonize Energy Uses in New York State (Forthcoming)

- Blueprint for Consideration of Advanced Nuclear Energy Technologies (2025)
- Potential for Renewable Natural Gas in New York State (2022)
- Advanced Nuclear Request for Information (2025)
- Potential for Carbon Capture, Utilization, and Storage Technologies in New York State (2018)

NYSERDA offers many programs to research, develop, and demonstrate the capacity of these many solutions. Technical assistance programs can offer support for companies and facilities to identify opportunities to generate or utilize low-carbon fuels and energy sources, innovate processes, or deploy CCUS technologies. The Commercial and Industrial Carbon Challenge program provides capital awards for facility investments aimed at reducing the emissions in industrial facilities, welcoming all types of technology applications for doing so (see “Spotlight: Biomass Fuels”). Additional capital support has been made available for development and demonstration projects through the NYSERDA Innovation team’s portfolio of programs.

The federal government has likewise been active in supporting alternative fuels and energy sources of importance to energy, though federal policy priorities are uncertain at present.

Recommendations

- **NYSERDA, in coordination with researchers in the state university systems and non-academic institutions,** should continue to support research, development, and demonstration activities for promising industrial decarbonization solutions in high-temperature electrified heat, low-carbon fuels and energy sources, CCUS, and novel process development. Such support will occur in New York.
- **NYSERDA** should continue to provide technical assistance and capital support for manufacturing facilities for cost-effective decarbonization upgrades.
- **NYSERDA, DPS, and AGM** should prioritize strategies, policies, and programs that support the use of low-carbon fuels and energy sources in:
    - Subsectors with limited capacity for decarbonization through electrification and efficiency.
    - Close proximity to the energy or fuel source to reduce midstream transportation complications (e.g., fugitive emissions, pipeline costs) and to promote offtake clustering.
- As offtake potential for alternative fuel and energy sources in industry materializes, **NYSERDA and ESD** should increase efforts to provide market intelligence to industrial sector stakeholders to ensure awareness of opportunities.
- **NYSERDA, ESD, and DOS** should pursue risk-sharing mechanisms with the federal government and/or industry to reduce the potential barriers of any novel decarbonization strategies or methods, including:
    - Advanced Nuclear siting partnerships,

  - Demand-clusters for alternative fuels, and
  - Novel process pilots.

- When opportunities for CCUS deployment arise, **DEC and NYSERDA, along with local development authorities**, should work to connect potential sources of captured carbon with facilities that can leverage carbon for productive utilization or with geologic sequestration sites.

4.7. Agricultural Energy Use, Energy Efficiency, and Electrification

Agriculture is a vital industry in New York State, which ranks among the top-producing states for dairy, fruits, and several other commodities. As agriculture depends on the weather and specific climatic conditions, this sector faces extraordinary challenges from climate change.[47] Farms are adapting by using more energy, whether it is barn cooling and ventilation on dairy farms, frost protection on vineyards and orchards, more energy-intensive inputs like fertilizers or chemicals, or incorporating more controlled environment agriculture (e.g., greenhouses, container farming, and indoor farming).

Energy efficiency measures and best practices can be utilized on farms now even while farms continue to adapt to a changing climate.[48] Numerous programs, at both the federal and State level, have been set up to provide grants or low-interest loans to adopt best energy efficiency practices on farms. NYSERDA has compiled tools and resources to help New York farms make informed energy decisions that will save money, boost productivity, and improve operations.[49] NYSERDA also offers programs for farms to conduct no-cost energy audits, which uncover opportunities to reduce and conserve energy through the deployment of energy efficiency best practices.[50] The State would benefit from additional data to measure the energy use on farms and increased use due to climate change. New York State should invest in research that better quantifies on-farm energy uses across major commodities agricultural production systems.

Efficient electrification is defined as the process of replacing fossil fuels with electricity to reduce emissions and energy costs. Many agricultural applications can be converted to high-efficiency electricity use. As climate change continues to add stress to agricultural output (e.g., drought conditions for growing crops, and heat stress on livestock), demand for energy will increase. By converting appropriate applications to electrification using variable speed pumps, cooling fans, frost protection, etc., less fossil fuels will be needed. Much of this electrification requires utility upgrades, such as three-phased power. This comes at a high upfront cost to the farm and community and can be cost-prohibitive.

Beyond electrifying agricultural operations, concerns have been raised over New York's farmland being converted to host renewable energy infrastructure. The Environmental Impacts chapter of this plan, Section 2.3. Land Use discusses this topic further.

4.7.1. Policy Process, Program Initiatives, and Market Adoption Underway

NYSERDA and AGM can develop new programs and enhance existing ones to support the utility upgrade costs for three-phased power enabling increased adoption of electric equipment. The existing NYS Climate Resilient Farming (CRF) Program has helped farms adapt by providing cost-share funding to boost irrigation capacity by replacing diesel powered water pumps with high-efficiency electric pumping. The CRF Program could help cover costs to upgrade facilities to three-phase power if it is required for a

climate adaptation/resiliency measure such as irrigation or frost protection. Additionally, AGM and NYSERDA collaborate on two working groups, the Agricultural Technical Working Group, and the Farmland Protection Working Group, to convene stakeholders and advance state goals and policy in this sector.

Some common agricultural best management practices implemented to protect water quality or lower agricultural emissions also have energy savings when adopted. Practices such as reduced tillage on fields not only boosts soil health and quality but also requires fewer tractor passes over the field. This energy savings can be quantified by measuring the reduction in gallons of fossil fuels needed to grow crops.[51] Furthermore, helping farms to manage nutrient applications can reduce the amount of synthetic fertilizer. These fertilizers are fossil-fuel-intensive to produce so reductions in their use reduces emissions and conserves energy resources.[52] Other best management practices such as prescribed rotational grazing and the use of cover crops may promote reductions in fossil fuel use of farm machinery and/or increase soil health and nutrient crop use efficiency.

CRF together with agricultural water quality programming provides technical and cost-share assistance for the adoption of conservation practices. Administered by the NYS Department of Agriculture and Markets and the NYS Soil and Water Conservation Committee and locally led by County Soil and Water Conservation Districts, these programs assist farmers to protect water quality, reduce agricultural greenhouse gas emissions and adapt to a changing climate.[53] Many of these conservation practice systems can reduce energy inputs on farms. However, more information and data are needed to better quantify energy efficiency benefits.

Recommendations

- **AGM, in coordination with NYSERDA**, should support efficient electrification systems on farms including three-phased power upgrades.
- **AGM** should expand the NYS Climate Resilient Farming Program to support adaptation projects that also reduce GHG emissions or at least do not increase emissions.
- **AGM, in coordination with DEC**, should support the measurement, monitoring, and verification of energy use in the agricultural sector, as well as efficiency co-benefits associated with the adoption of conservation management best practices.
- **AGM and NYSERDA** should continue their collaboration and support for local jurisdictions on solar siting and agricultural lands. Productive dual-use strategies should be identified and prioritized on productive farmland. The State should continue to encourage siting large-scale solar projects on brownfields, landfills, and other underused spaces, while projects that impact farmland receive additional scrutiny.

4.8. Agricultural Renewable Energy Production

Agriculture is a very energy-intensive industry, and some end uses cannot currently be electrified or are challenging to electrify with considerable upfront costs. For these applications it is important to consider low-carbon fuels as a dispatchable resource that could be used now and into the future or serve as a

bridge to technological advances in energy and electrification. Biodiesel could be produced and refined on site for use in agricultural equipment.

New York State can support farmers and help meet state clean energy and environmental goals through planning for the continued reduction of methane through alternative manure management systems.[54] Manure storage is the largest source of agricultural emissions since the 1990 baseline. The storage of manure is an important practice to facilitate nutrient management, reducing the need for synthetic fertilizers and mitigating runoff for the improvement of water quality. However, the treatment and storage of livestock manure can produce methane through the anaerobic decomposition of the manure and be used as a productive fuel.

The alternative manure management strategies (detailed in the Climate Act Scoping Plan) can reduce methane emissions through on-site investments designed for each farm, such as methane destruction systems, anaerobic digester systems, composting, and other innovative systems that collect, capture, destroy, or utilize methane from manure storage. This biogas can be used as a fuel on-site or shipped to supply other sectors. The limited supply of biogas or RNG produced from manure management or other waste streams should be targeted to strategic uses such as locations where it can provide electric system capacity for buildings and transportation electrification by alleviating system constraints or RNG for industrial processes including food production such as fluid milk processing. Though biogas may be used on-site, RNG and other alternative fuels will need to be produced, transported, stored, and used at scale to meaningfully contribute to the decarbonization of the energy system.

New York State should expand support for the advancement of energy production and methane mitigation following full life cycle analyses, including measurement and abatement of methane leakage, consideration for avoided emissions, and future innovations. Programs that incentivize or permits to build anaerobic digestion should require systems be built (or retrofitted) for maximum methane mitigation to ensure development of well-managed, low-emission biogas or RNG production such as utilizing emissions minimizing technologies and techniques, minimizing fossil fuel use in biogas or RNG production, minimizing emissions from biosolids/digestate, and consideration of a regulatory framework to ensure best practices.

The State should develop and apply standards for leak detection and repair from energy production systems. These standards will also include monitoring to guide management to minimize losses and optimize GHG emissions reduction benefit. New technologies such as drones make leak detection much simpler and affordable.

The State should align manure management systems designed for energy production, organic waste management, and methane mitigation with markets and private-sector investments (e.g., clean transportation standard, industry net zero initiatives, and others). NYSERDA and DPS, along with utilities and energy market participants, should identify energy pricing models and conduct a market-based study for waste-generated biogas. When on-site use of this fuel is not possible, improved connections between markets and farms can help match this new supply with market demand biomethane and other organic co-products generated by such on-farm systems, such as electricity, heat, gas, and organic soil amendments.[55]

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Renewable Identification Number (RIN) is a unique number that tracks each gallon of renewable fuel in the United States. RINs are used to ensure compliance with the federal RFS.[59] Because of feedstock requirements for RINs, use of food waste for RNG production is discouraged. There is also uncertainty with the value for LCFS and RINs due to the potential for changes in California and federal policy.

With support and incentives from the State, this market uncertainty and the under-utilized potential of food waste could potentially drive interest of RNG developers to consider new RNG projects that take both manure and food waste and produce RNG for use on-site or regionally located to supply hard-to-electrify/decarbonize industrial customers, including dairy processing facilities, via low-risk long-term purchase agreements. A similar approach might be possible for bringing food waste and manure from other farms to existing digesters with spare capacity or an ability to expand capacity.

4.8.3. Opportunities for State Action

New York State could create programs to facilitate both pilot projects for small-scale systems that incorporate new and innovative technologies for electricity or RNG generation, as well as large-scale community anaerobic digestion projects for multiple farms and food waste feedstocks. A program for small-scale anaerobic digestion could pilot and demonstrate new and innovative technologies for the use of biogas and RNG. For example, linear generator systems could potentially be used in small to large scale systems to cost effectively produce electricity from dairy anaerobic digestion.[60] Large-scale community digestion projects may allow many smaller facilities to participate in a digestion project. These centralized anaerobic digestion systems could be co-located with hard to electrify/decarbonize industrial/food processing campuses. Many of these facilities currently require natural gas for sustained high-temperature process heating or treating raw materials. Much of this natural gas usage could potentially be replaced by lower carbon RNG**.**

Most recently, digesters built in New York State were driven mainly by market-based incentives from the California LCFS or the federal RFS RINs value. These systems do not intake food waste but could do so—with an appropriate incentive structure. A program could be created to spur a market for RNG in New York State. Industrial facilities could purchase this RNG to ensure a predictable pricing structure in the long term. Due to New York State's methane goals and the Food Donation and Food Scraps Recycling Law, a program could encourage the addition of food waste. These systems could create a steadier supply of biogas, farmers could receive tipping fees, and energy developers could enter into a long-term contract with an industrial facility in the same region.

Recommendations

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- **NYSERDA, in coordination with AGM and DPS,** should facilitate in-state pilot projects for small-scale digestion systems that incorporate innovative technologies that maximize production of electricity, biogas, or RNG, while also maximizing emissions reductions.

- **NYSERDA, in coordination with AGM,** should support applied research and in-state demonstration projects for community anaerobic digestion for multiple farms and food waste supplies for use locally or regionally for difficult-to-electrify end uses.

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1 New York ranks ninth. U.S. Bureau of Economic Analysis, SAGDP2 Gross Domestic Product (GDP) by State, accessed June 3, 2025, https://apps.bea.gov/itable/?ReqID=70&step=1&_gl=1*x2g2zl*_ga*MTA0OTYyMTY3NC4xNzQ4OTg5MjQ3*_ga_J4698JNNFT*czE3NDg5ODkyNDckbzEkZzEkdDE3NDg5OTA0MzIkajQ3JGwwJGgw#eyJhcHBpZCI6NzAsInN0ZXBzIjpbMSwyOSwyNSwzMSwyNiwyNywzMF0sImRhdGEiOltbIlRhYmxlSWQiLCI1MDUiXSxbIk1ham9yX0FyZWEiLCIwIl0sWyJTdGF0ZSIsWyIwIl1dLFsiQXJlYSIsWyJYWCJdXSxbIlN0YXRpc3RpYyIsWyIxMiJdXSxbIlVuaXRfb2ZfbWVhc3VyZSIsIkxldmVscyJdLFsiWWVhciIsWyIyMDI0Il1dLFsiWWVhckJlZ2luIiwiLTEiXSxbIlllYXJfRW5kIiwiLTEiXV19.

2 "Micron In Central New York," Empire State Development (ESD), accessed July 3, 2025,https://esd.ny.gov/micron.

3 As described in the Pathways Analysis chapter of this Plan, several large manufacturing and data-center projects are projected to enter service this coming decade, which will add roughly 16 terawatt hours of electricity demand, or over 75 percent of total industrial electricity demand today. This assumption follows the NYISO 2025 Load and Capacity Data Report ("Gold Book").

4 This figure excludes electric power generators, utilities, and other related industries, whose energy expenditures are significantly higher (averaging roughly 36 percent). Energy costs are defined here as direct expenditures on electricity, natural gas, petroleum, and other fuels, namely refined petroleum products, coal, wholesale services of petroleum and petroleum products, and crude petroleum. Based on analysis conducted for NYSERDA by BW Research. Data is from IMPLAN for the calendar year 2023, from the State Industry Balance Sheets, Commodity Demand, and the Social Account Matrix.

5 The Site Selectors Guild is an association of professional site selection consultants who provide location strategy to corporations internationally.

6 Based on internal NYSERDA tracking of new projects.

7 Industrial Development Agencies and Authorities have played a key role in facilitating the development of new renewable energy projects, primarily through tax exemptions. Other regional programs are available through New York's utilities, including but not limited to Central Hudson Gas & Electric Corporation programs to support manufacturers, infrastructure investments from Niagara Mohawk Power Corporation d/b/a National Grid, and industrial efficiency programs through Consolidated Edison Company of New York, Inc.

8 Technical assistance is provided by ESD's Entrepreneurship Assistance Centers and Manufacturing Extension Partnerships, both of which are funded by New York State Technology Alliance for Research.

9 A green project is generally defined as a project to make products or develop proven technologies that are ready to be commercialized and moved into markets and that are aimed at reducing greenhouse gas emissions or supporting the deployment or adoption of clean energy.

10 Internal data from ESD.

11 Preservation Power, Western New York Hydropower, and the St. Lawrence County Economic Development Power are all available to customers adding at least 100 kilwatts of new electric load to their meters, and with a demonstrated long-term commitment to Western New York through job creation and capital investments in local facilities.

12 "Build It Clean, Build It Here," New York State, accessed July 5, 2025, https://builditclean.ny.gov/.

13 "State Energy Data System 2022, Consumption Technical Notes," U.S. Energy Information Administration (EIA), page 245, www.eia.gov/state/seds/sep_use/notes/use_technotes.pdf. The EIA definition also includes forestry, fishing, and hunting, which will not be addressed in this chapter.

14 "Patterns and Trends: New York State Energy Profile," (NYSERDA, December 2024), https://www.nyserda.ny.gov/About/Publications/Energy-Analysis-Reports-and-Studies/Patterns-and-Trends.

15 "Assessment of Energy Efficiency, Electrification, and Decarbonization Potential in the New York State Industrial Sector: Phase Two," (NYSERDA, September 2025), https://www.nyserda.ny.gov/-

/media/Project/Nyserda/Files/Publications/building-stock-potential-studies/25-24-Assessment-of-Energy-Efficiency-Electrification-and-Decarbonization-Potential.pdf.

16 "New York Statewide Industrial Facilities Stock Study – Phase Two Final Report," (NYSERDA, June 2024), https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Publications/PPSER/Program-Evaluation/Matter-No1602180NYSERDA-Industrial-Facilities-Stock-Study-Phase-Two-Report-September-2024.pdf

17 *Census of Agriculture, 2022, National Agricultural Statistics Service,* U.S. Department of Agriculture, www.nass.usda.gov/Publications/AgCensus/2022/Full_Report/Census_by_State/New_York/.

18 A "working landscape" is land actively used for production, such as farming, forestry, or ranching, while also supporting a healthy ecosystem and biodiversity.

19 "Executive Order 22: Embodied Carbon Guidance," (New York State Office of General Services [OGS], January 2025), ogs.ny.gov/executive-order-22-embodied-carbon-guidance.

20 "NYS Buy Clean Concrete Rules," (OGS, accessed June 2025), ogs.ny.gov/nys-buy-clean-concrete-guidelines-0.

21 New York Independent System Operator (NYISO) notes that there is significant uncertainty due to the pace at which these projects will proceed and the ultimate electric demand that will need to be served.

22 "Energy-Intensive Projects in NYISO's Interconnection Queue." NYISO, as of August 26, 2025; accessed October 16, 2025, https://www.nyiso.com/-/energy-intensive-projects-in-nyiso-s-interconnection-queue.

23 "Power Trends Report," NYISO, 2025. www.nyiso.com/power-trends.

24 Peter Freed and Allison Clements, "How to Reduce Large Load Speculation? Standardize the Interconnection Process." Utility Drive, February 19, 2025, www.utilitydive.com/news/data-center-large-load-interconnection-process-clements/740272/

25 The process begins with the developer submitting an interconnection request to the NYISO. There are three main stages in the process: (1) a system impact study to analyze how the new load will affect grid reliability and identify necessary system upgrades, (2) a facilities study to define the design, cost, and schedule for those upgrades, and (3) an interconnection agreement to formalize responsibilities and terms of operation. The NYISO, in coordination with the utility, conducts the system impact study and determines the necessary system upgrades. The utility is responsible for the facilities study, the interconnection agreement, and the construction of the necessary upgrades. Costs for the new large load interconnections are determined through the system impact study and facilities study.

26 "Open Access Transmission Tariff, Section 31.5 Cost Allocation and Cost Recovery," NYISO, Section 31.5.4.2 Cost Allocation Principles.

27 States and other regulatory bodies are still adapting to these new market conditions in a variety of ways (Ohio has moratorium due to volume of requests; Texas requires data centers to have flexible loads; Minnesota has an annual fee based on peak load; PJM requires a set of specific additional requirements; and the North American Electric Reliability Corporation is actively working on a set of new reliability standards for large loads).

28 "$10 Billion Partnership to Bring Next Generation R&D Center to NY CREATES' Albany Nanotech Complex," (Press Release, Office of the Governor, December 11, 2023), www.governor.ny.gov/news/governor-hochul-announces-10-billion-partnership-bring-next-generation-research-and.

29 "Governor Hochul Announces $160 Million Federal Investment from the National Science Foundation to the New Energy New York Storage Engine to Leak the Nation in Battery Technology and Manufacturing," (Press Release, Office of the Governor, January 29, 2024), www.governor.ny.gov/news/governor-hochul-announces-160-million-federal-investment-national-science-foundation-new

30 "Governor Hochul and the Coca-Cola Company Celebrate Groundbreaking of New fairlife® Production Facility in Monroe County—the Largest Dairy Production Facility in the Northeast," (Press Release, Office of the Governor, April 12, 2024), www.governor.ny.gov/news/governor-hochul-and-coca-cola-company-celebrate-groundbreaking-new-fairlifer-production.

31 New York State Climate Action Council, *New York State Climate Action Council Scoping Plan: Chapter 22*, page 428.

32 New York State Climate Action Council, *New York State Climate Action Council Scoping Plan: Chapter 22*, page 428.

[33] Based on internal NYSERDA tracking of new projects.
[34] Based on NYSERDA analysis of several different data sources.
[35] Adewale Odukomaiya et al., "Addressing Energy Storage Needs at Lower Cost via On-Site Thermal Energy Storage in Buildings," 2021, *Energy & Environmental Science*, https://pubs.rsc.org/en/content/articlepdf/2021/ee/d1ee01992a.
[36] Wesley Cole and Akash Karmakar, "Cost Projections for Utility-Scale Battery Storage: 2023 Update," June 2023, *National Renewable Energy Laboratory*, NREL/TP-6A40-85332, https://docs.nrel.gov/docs/fy23osti/85332.pdf.
[37] "Patterns and Trends: New York State Energy Profiles: 2007-2021," (NYSERDA, November 2023), Table 2-16a and Table 2-16b.
[38] See Phase 1 Industrial Stock Study, page 60.
[39] "Pathways to Commercial Liftoff," U.S. Department of Energy (DOE), https://liftoff.energy.gov/about-the-liftoff-reports/.
[40] "Assessment of Energy Efficiency, Electrification, and Decarbonization Potential for the New York State Industrial Sector: Phase 2," NYSERDA.
[41] "Fossil and Biogenic Fuel Greenhouse Gas Emissions Factors," NYSERDA, Report Number 22-23, September 2022, revised May 2023,www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Publications/Energy-Analysis/22-23-Fossil-and-Biogenic-Fuel-Greenhouse-Gas-Emission-Factors.pdf.
[42] "Industrial Decarbonization Roadmap," U.S. DOE, September 2022, https://www.osti.gov/servlets/purl/1961393.
[43] Jeffrey Rissman, *Zero-Carbon Industry*, Columbia University Press, 2024.
[44] In order for CCUS to have beneficial impacts, care must be taken to ensure that utilization and storage do not simply delay the ultimate release of the CO_2 into the atmosphere in a short period of time. Utilization pathways should be subject to robust Lifecycle Analyses and storage sites should be continuously monitored to verify that there are no leaks.
[45] Jeffrey Rissman, *Zero-Carbon Industry*.
[46] "Potential for Carbon Capture, Utilization, and Storage Technologies in New York State," (NYSERDA, July 2020), www.nyserda.ny.gov/-/media/Project/Nyserda/files/Publications/Research/Environmental/20-13-Carbon-Capture-Utilization-and-Storage-Technologies.pdf.
[47] "Understanding and Preparing for Our Changing Climate," NYSERDA, accessed July 3, 2025, https://nysclimateimpacts.org/.
[48] "Energy Best Practices for Agriculture," NYSERDA, accessed July 5, 2025, www.nyserda.ny.gov/All-Programs/Agriculture-Energy-Assistance/Energy-Best-Practices-for-Agriculture.
[49] "Agriculture Energy Assistance," NYSERDA, accessed July 3, 2025, www.nyserda.ny.gov/All-Programs/Agriculture-Energy-Assistance#:~:text=The%20Inflation%20Reduction%20Act%20is,incentives%20for%20additional%20cost%20savings.&text=provide%20opportunities%20for%20farms%20to,that%20reduce%20greenhouse%20gas%20emissions.
[50] "Energy Best Practices for Agriculture," NYSERDA.
[51] Zane Helsel, Robert Grisso, and Vern Grubinger, "Reducing Tillage to Save Fuel," April 3, 2019, *Farm Energy*, https://farm-energy.extension.org/reducing-tillage-to-save-fuel/.
[52] "Nutrient Management," United States Department of Agriculture, Accessed July 3, 2025, www.farmers.gov/conservation/nutrient-management#:~:text=Nutrient%20management%20is%20an%20important,cost%2Deffective%20role%20to%20play.
[53] "Soil & Water Conservation Committee," New York State Department of Agriculture and Markets, accessed July 3, 2025, https://agriculture.ny.gov/soil-and-water/soil-water-conservation-committee.
[54] "Chapter 15. Agriculture and Forestry," Climate Act Scoping Plan, accessed July 3, 2025, https://climate.ny.gov/resources/scoping-plan/-/media/project/climate/files/Chapter15AgricultureandForestry.pdf
[55] "Chapter 15. Agriculture and Forestry," Climate Act Scoping Plan.

[56] "Food Donation and Food Scraps Recycling Law," New York State Department of Environmental Conservation, accessed July 3, 2025, https://dec.ny.gov/environmental-protection/recycling-composting/organic-materials-management/food-donation-scraps-recycling-law.

[57] Sarah Vafiadis and Lauren Ray, "Small-Scale Anaerobic Digestion System Technology," October 3, 2024, https://ecommons.cornell.edu/server/api/core/bitstreams/2cbfe405-a09e-4df9-b46f-9b5808e39617/content.

[58] "Overview of Low Carbon Fuel Standard & Dairy/Swine Manure Fuel Pathways," California Air Resources Board, March 29, 2022, https://ww2.arb.ca.gov/sites/default/files/2022-04/dairy-ws-session-9-CARB.pdf.

[59] "Alternative Fuels Data Center: Renewable Identification Numbers," U.S. DOE, accessed July 3, 2025, https://afdc.energy.gov/laws/RIN.html.

[60] Adam Simpson and Keith Davidson, "High-efficiency and Ultra-low Emissions Linear Generator Demonstration Project in Southern California," California Energy Commission, last updated May 6, 2024, www.energy.ca.gov/publications/2024/high-efficiency-and-ultra-low-emissions-linear-generator-demonstration-project.

New York State Energy Plan

VOLUME II | Energy and Our Lives

Clean Energy Jobs and a Just Transition

12

Key Terms Used in This Chapter

FOR THE COMPLETE GLOSSARY ➜

Energy Worker (Job): Any worker (job) that is directly involved with the research, development, production, manufacture, distribution, sales, implementation, installation, maintenance, or repair of components, goods, or services related to the energy system. These workers also include supporting services including but not limited to consulting, finance, tax, and legal services related to energy.

Clean Energy Worker (Job): Any energy worker (job) that is directly involved with work related to the following clean energy sectors: renewable electric power generation; grid modernization and energy storage; building decarbonization and energy efficiency; renewable fuels; and clean and alternative fuels transportation.

Fossil Fuel Worker (Job): Any energy worker (job) that is directly involved with work related to energy derived from fossil fuels, including electric generation, delivered fuels, internal combustion vehicles, and/or natural gas distribution.

Project Labor Agreement (PLA): Labor Law §222(1) provides that a PLA is a pre-hire collective bargaining agreement between a contractor and a bona fide building and construction trade labor organization establishing the labor organization as the collective bargaining representative for all persons who will perform work on a public work project, and that only contractors and subcontractors who sign a pre-negotiated agreement with the labor organization can perform work.

Labor Peace Agreement (LPA): Agreements between employers and a union, limiting certain actions from both sides for a specified period of time. LPAs may require management to remain neutral and not interfere in any union organizing, and the union to avoid strikes or other activities that could seriously interrupt workplace operations.[1]

Prevailing Wage: A wage standard required by federal and State law for certain publicly funded or assisted projects. Prevailing wages define the hourly wages, benefits, and

1 "Climate Jobs Institute," School of Industrial and Labor Relations at Cornell University, accessed July 20, 2025, https://www.ilr.cornell.edu/climate-jobs-institute.

overtime rates for a particular geographic area, for a particular trade, as determined by the United States Department of Labor or the New York State Department of Labor (DOL). In New York State, the DOL's Bureau of Public Work and Prevailing Wage Enforcement is responsible for enforcement of state prevailing wage requirements.[2]

Registered Apprenticeship Programs: Programs that offer standardized training for workers to learn the skills and abilities they will need to be a fully functioning journeyworker in a specific trade/occupation. They utilize an "earn-while-you-learn" model, including a minimum of 2,000 hours of paid on-the-job training combined with related instruction, often provided in a classroom and/or lab setting. They can be operated by a single employer or a group of employers, and with or without the participation of a labor union. In New York State, programs must be registered with the DOL.[3]

Pre-apprenticeship Programs: Programs or a set of services designed to prepare individuals to enter and succeed in an apprenticeship program. By definition, a pre-apprenticeship program has a documented partnership with at least one apprenticeship program. Pre-apprenticeships help individuals meet the entry requirements for apprenticeship programs and ensure they are prepared to be successful in their apprenticeship.[4]

Direct Entry Programs: New-York-State-approved pre-apprenticeship programs that can help workers get the skills they need to meet the minimum requirements of a New York State Registered Apprenticeship program. Successful participants have a direct opportunity to interview with a sponsor of a New York State Registered Apprenticeship program. Direct Entry providers are required to have agreements with NYS Registered Apprenticeship program sponsors to ensure the availability of jobs with those sponsors. Direct Entry programs cannot charge tuition.[5]

Apprenticeship Utilization: A requirement that a certain percentage of labor hours for a given project be performed by Registered Apprentices.

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2 "Bureau of Public Work and Prevailing Wage Enforcement," New York State Department of Labor (DOL), accessed July 20, 2025, https://dol.ny.gov/bureau-public-work-and-prevailing-wage-enforcement.

3 "Registered Apprenticeship: A Different Kind of Higher Ed.," DOL, accessed July 2, 2025, https://dol.ny.gov/apprenticeship/overview.

4 "Workforce Development and Training Definitions," New York State Energy Research and Development Authority (NYSERDA), 2025, https://www.nyserda.ny.gov/All-Programs/Clean-Energy-Workforce-Development-and-Training/Resources/Definitions.

5 "Apprenticeship Direct Entry," DOL, accessed July 1, 2025, https://dol.ny.gov/direct-entry.

Microcredentials: Flexible and compact academic credentials created to meet specific workforce needs. Often credit bearing, these empower individuals with essential skills, knowledge and practical experience in high-demand fields and are designed to be stackable and build into degrees.

Priority Populations: These include veterans; individuals with disabilities; low-income individuals, whose household's total income is below or at 60 percent of the State Median Income or whose household has been determined eligible for or is receiving assistance through the Home Energy Assistance Program, Temporary Assistance for Needy Families, Supplemental Nutrition Assistance Program, or other human service benefit programs; incumbent or unemployed fossil fuel workers; previously incarcerated individuals; 16- to 24-year-olds who are enrolled in or have completed a comprehensive work preparedness training program such as those offered by Boards of Cooperative Education Services, technical high schools, Conservation Corps, YouthBuild, and AmeriCorps; homeless individuals; and single parents.[6]

Disadvantaged Communities (DACs): The Climate Act defines disadvantaged communities as communities that bear burdens of negative public health effects, environmental pollution, and impacts of climate change and possess certain socioeconomic criteria, or comprise of high concentrations of low- and moderate-income households. DACs are identified using criteria established by the Climate Justice Working Group.

6 "Workforce Development and Training Definitions," NYSERDA, 2025.

Key Findings → Clean Energy Jobs and a Just Transition

New York's energy workforce is essential to the safe and reliable construction and operation of our energy system. The energy system is also a meaningful job creator and driver of economic growth.

In New York, clean energy jobs are among the fastest-growing employment sectors, due in part to meaningful State investments. To bolster the creation of high-quality jobs, local economic benefits, and a just transition for energy workers, continued State support for workforce development coupled with labor standards is essential to advancing progress on New York's energy transition. This chapter provides an overview of the State's energy sector workforce and major initiatives and recommends continued and additional actions.

- **As of 2024, over 326,000 workers are employed in New York's energy sector. More than half of these workers make up one of the most mature and steadily growing clean energy workforces in the country.** Public and private investments into clean energy projects and workforce training have enabled New York's clean energy workforce to grow by 31 percent since 2015. Broadly, energy sector jobs are expected to grow by another 17 percent over the next 15 years.
- **Continued State investment in workforce development is essential for advancing the energy transition.** State support bolsters private sector efforts to meet the scale of workforce training needed for this rapidly changing sector. State investments should support employers in "upskilling" their employees through additional training, micro-credentials, and certifications; facilitate the placement of entry-level workers in jobs, apprenticeships, or paid internships; connect fossil fuel workers with opportunities to pivot to the clean energy economy; and provide wraparound services to improve accessibility.

- **Enhanced awareness and accessibility of workforce development programs can facilitate equitable participation of workers from members of Disadvantaged Communities (DACs) in the clean energy workforce.** By prioritizing access to workforce trainings, the State can improve DAC representation within the clean energy workforce and deliver benefits of the transition to these communities. Accessibility can be improved by partnering with trusted community organizations, providing opportunities for DAC representation amongst trainers and educators, tailoring communications campaigns, and providing wraparound services.

- **Labor standards are a key tool to improve the quality of life of energy workers, minimize inequality, generate local economic benefits, and improve project quality.** Where relevant, New York should continue to drive policy that promotes job quality for energy projects, such as by encouraging project labor agreements, prevailing wage standards, labor peace agreements, apprenticeship requirements, community benefits plans, workplace health and safety requirements, and/or Buy American standards. Further research should identify gaps and opportunities for high-quality clean energy jobs.

- **To support a just transition for energy workers, it is essential to build out safety nets for workers at risk of job loss due to energy transition policies.** New York created the Office of Just Energy Transition (OJET) to guide the State's just transition programs. The State should build on this effort by expanding research to understand the impacts on workers, particularly natural gas distribution and other fossil fuel workers. This research should consider expanded just transition policies and programs, such as a "community assurance fund" to provide financial support to displaced workers or businesses.

- **Coordination between State agencies and industry partners is needed to optimize workforce development program design, respond to existing gaps, and publicly communicate opportunities and needs in the clean energy industry.** Multiple State agencies administer clean energy workforce programs, including the New York State Energy Research and Development Authority (NYSERDA), New York State Department of Labor (DOL) and OJET, the State University of New York (SUNY), Empire State Development (ESD), the New York Power Authority (NYPA), the New York State Department of Environmental Conservation (DEC), the New York State Department of Transportation (DOT), and the New York State Department of State (DOS). State agencies should continue to partner with local and non-governmental workforce training providers to ensure the effectiveness of clean energy workforce development programs.

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1. Overview

New York's energy workforce is essential to the safe and reliable design, construction, and operation of our energy system. The State's energy system is also a meaningful job creator and driver of economic growth. As the system transitions, new economic opportunities will emerge: to meet its clean energy goals, New York will need to rapidly deploy new energy infrastructure, adopt new technologies, accelerate building decarbonization activities, and efficiently manage existing systems. These goals can only be met by growing and supporting a well-trained workforce to carry out transformational work across the entire energy system.

Through workforce development programming and funding, the State will play an important role in accelerating the training, upskilling, and placement of New Yorkers into the roles needed to support this work. The State's efforts to expand the clean energy workforce can also improve the quality of life of New Yorkers by prioritizing labor protections and promoting representation and job opportunities for DAC communities and Priority Populations, such as veterans, low-income individuals, and displaced fossil fuel workers.

New York's Scoping Plan commits to undertake a strategy that ensures the transition to a clean energy economy is a just transition. A just transition ensures new opportunities and targeted support for workers, businesses, and communities who rely on fossil-fuel related employment and tax revenue that may decrease because of the State's energy policies. The Scoping Plan outlines three central recommendations to ensure a just transition for workers:[1]

1. The State should require robust labor standards and worker-focused procurement standards on clean energy, resilience, and other emissions reduction and adaptation projects;
2. The State should make concerted efforts to increase clean energy workforce diversity and equity statewide through recruitment efforts, retention policies, and promotion opportunities, with a special emphasis on prioritizing incumbent fossil fuel workers and members of DACs; and
3. The State must enact measures to protect wages, benefits, and other favorable terms and conditions of employment for any worker who loses their job because of climate change mitigation efforts.

In pursuit of these principles, New York State has invested extensively in clean energy workforce development programs, built out labor protections for State-supported clean energy projects, invested in economic development that support revitalization, invested in site re-use planning, and, when possible, supported shovel-ready projects that use union labor.[2,3] These State investments have been made in collaboration with critical partners in organized labor, local government, educational institutions, non-profits, and the private sector. These efforts have resulted in one of the largest clean energy workforces in the country: New York State's clean energy job growth rate dramatically outpaces overall statewide job growth and offers a 12 percent wage premium compared to traditional energy jobs, in addition to higher unionization rates compared to the State average (see Section 2 for additional detail).[4]

Interagency collaboration and coordination have been a cornerstone of New York State's energy transition strategy. Together, State agencies and authorities have invested more than $213 million since 2016 into workforce development programs that support training and upskilling for clean energy jobs,

with roughly $34 million annually in 2023 and 2024.[5] The programs are being implemented to meet the Climate Act's targets that 35 percent, with a goal of 40 percent, of investments flow to DACs. These programs are implemented across multiple agencies, including NYSERDA, DPS, DOL, SUNY, NYPA, ESD, DEC, and DOS, and are designed to leverage private, federal, and other funds to maximize impact.[6,7]

Over the next 15 years, the State must continue to address existing and projected workforce needs and improve access to clean energy jobs. The State will continue to invest in training and development pipelines that develop the workers that will transition the energy system, with a focus on supporting members of DACs, and Priority Populations, such as veterans, low-income individuals, and displaced fossil fuel workers. This includes attracting and upskilling workers to decarbonize the buildings and transportation sectors, expand renewable power, and develop and scale new clean firm technologies such as advanced nuclear energy. It also includes evolving the State's strategy to support the natural gas distribution workforce as the State pursues decarbonization goals. Simultaneously, the State will continue to work strategically so that training pipelines focus on industry demand and lead to clear employment outcomes for trainees.

New York State will continue to advance clean energy job quality, working towards the goal that every dollar the State invests in clean energy also contributes to creating jobs that are safe, pay a living wage, support career growth, and have collective bargaining rights, or other important labor protections.[8] Upholding labor standards improves the livelihood of New York's workers, addresses income inequality, supports community development, and ensures the strength and longevity of New York State's clean energy industry.

This chapter provides an overview of the State's progress in developing labor standards for clean energy jobs and catalogs key State agencies and their role in building out the clean energy workforce. The chapter concludes with a strategic vision for robust workforce development for clean energy jobs, high-quality labor standards for the jobs to come, increased access to clean energy jobs in DACs, and a continued just energy transition in New York State that includes support for the existing fossil fuel workforce. These recommendations stem from the Economic Impacts: Jobs Analysis chapter of this Plan, which offers estimates of the jobs New York State can expect as we continue our energy transition over the coming 15 years.

2. State of the Sector and Progress Report

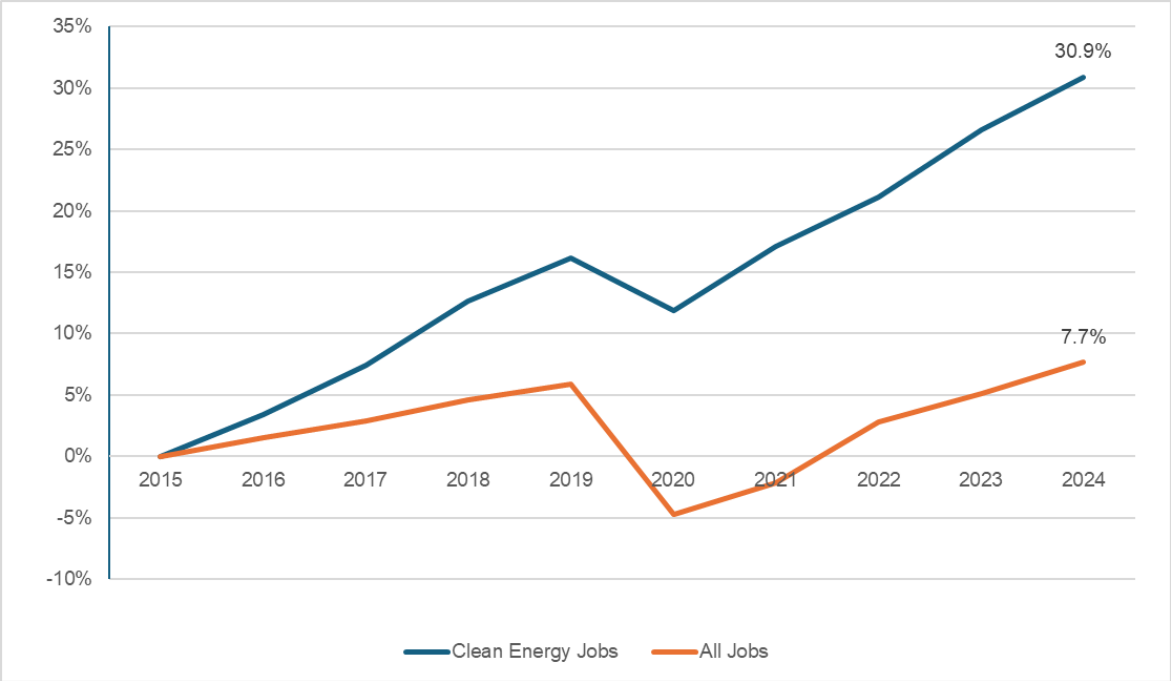
New York's energy sector employs over 326,000 workers across a variety of sectors and energy sources, including electric generation, energy utilities, building decarbonization and energy efficiency, transportation, and fuel delivery. Over half of these jobs are in the clean energy sector.[9,10]

2.1. Clean Energy Jobs in New York

The clean energy industry is growing and evolving rapidly. Nationally, new clean energy jobs have been added at twice the rate of overall job growth, and similarly in New York, clean energy jobs are among the fastest growing employment sectors.[11] While clean energy jobs make up just 2 percent of the statewide workforce, the number of clean energy jobs increased roughly 31 percent over the last decade, exceeding statewide job growth (see Figure 1). Combined public and private investments in clean energy have climbed dramatically over the last decade, growing from roughly $506 million annually in 2012 to

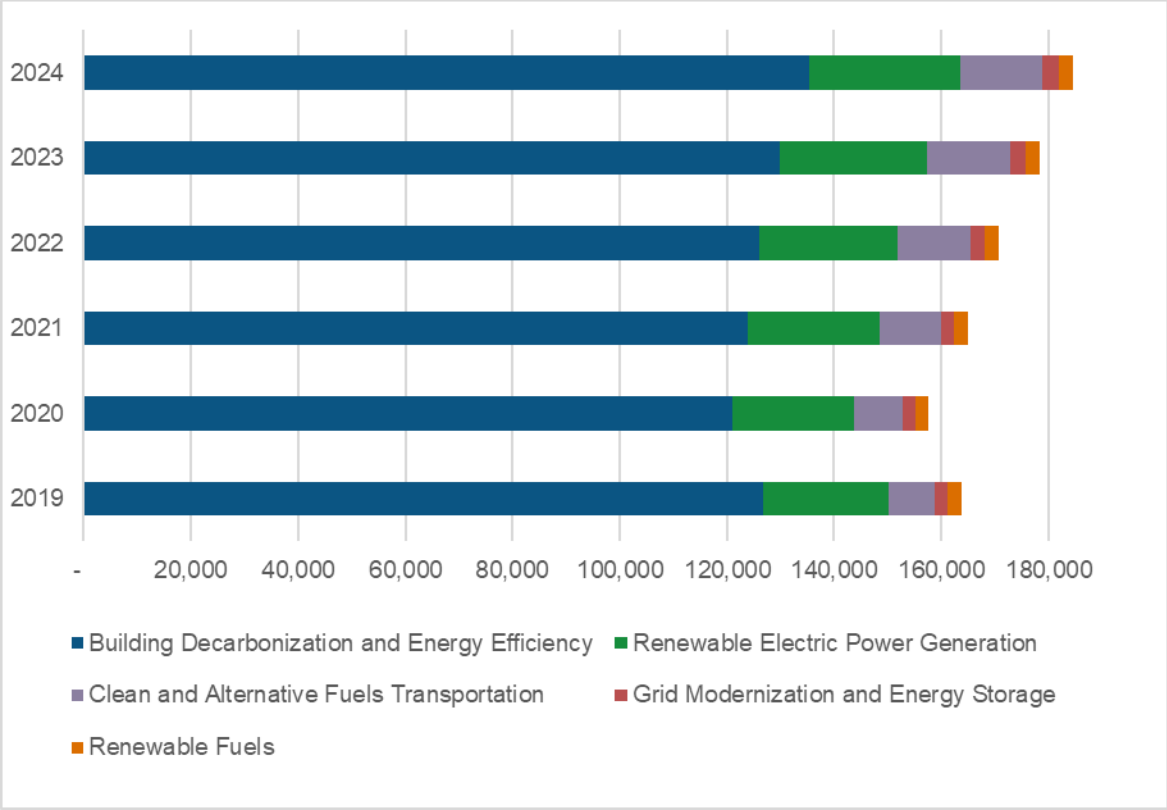
$6 billion in 2024.[12] Significant job growth can be expected to continue as clean energy industry investments expand to support decarbonization, though the most impacted sectors and sub-sectors will shift and evolve as new technologies emerge and others mature.

Figure 1: Cumulative growth in New York jobs since 2015[13]



Of the 184,537 clean energy jobs in New York, more than 70 percent are concentrated in building decarbonization and energy efficiency roles, while the remainder are distributed across clean transportation, renewable power generation, renewable fuels, and grid modernization and energy storage (see Figure 2). Approximately three-quarters of New York's clean energy jobs are in installation, maintenance, repair, or other support services. The remaining quarter are engaged in professional services, sales, utilities, and a small share in manufacturing.

Figure 2: New York Clean Energy Jobs by Sector[14]



Despite impressive growth, New York's clean energy industry faces persistent challenges. In 2024, three quarters of clean energy employers reported difficulties hiring.[15] As demand grows for many key clean energy jobs, this hiring difficulty may be an obstacle to meeting the State's goals. Nationally, solar photovoltaic installers and wind turbine technicians are among the fastest-growing occupations, with projected job growth rates of 48 percent and 60 percent, respectively, over the next decade—far exceeding the average for all occupations (4 percent). Other key roles, such as electricians (11 percent growth); heating, ventilation, and air conditioning (HVAC) mechanics and installers (9 percent); and plumbers, pipefitters, and steamfitters (6 percent) are also expected to grow faster than the economywide average.[16] In New York State, demand for these same occupations is anticipated to continue rising.[17] As clean energy technologies advance, employers are expected to face ongoing challenges upskilling their workforce to keep pace with this evolution.

> *"The need for workers [...] is corroborated by SUNY's own experience in constructing and operating clean energy buildings, which encounter a shortage of electricians, HVAC technicians, energy managers, and other skilled trades."*
>
> - *SUNY 2025–2030 Climate and Sustainability Action Plan*

This increase in demand comes at a time when occupations in the trades already face labor shortages. A shrinking construction trades workforce could impede the building of new clean energy infrastructure.

Slower uptake into the construction trades has led to concerns regarding available skilled workers, amplified by potential future shortages as existing workers retire and competition increases.[18]

2.2. Clean Energy Job Quality in New York

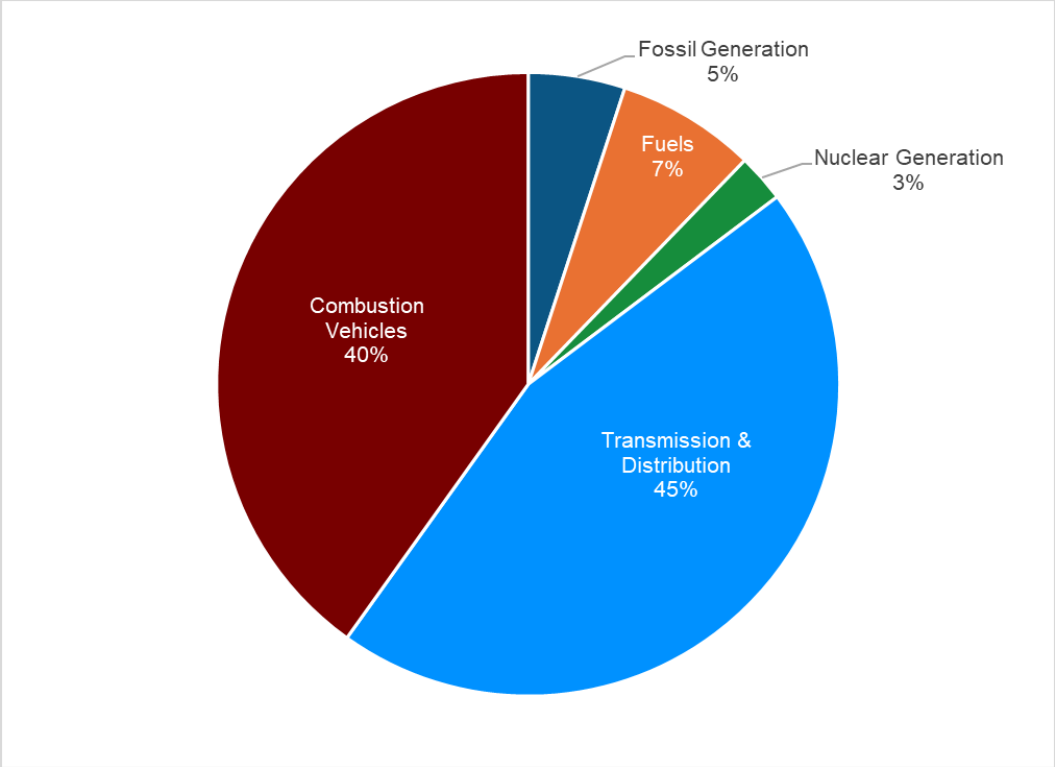
Roughly 13 percent of clean energy jobs in New York are unionized, a rate higher than other energy jobs in the state (9 percent). The State's clean energy jobs pay on average a 12 percent wage premium compared to traditional energy jobs, indicating higher job quality within this industry.[19, 20] High wages in the clean energy industry also increase workers' ability to afford their cost-of-living expenses and support themselves and their families.

However, DAC and low-income communities face unique barriers to accessing jobs and job training in clean energy. Generally, barriers to employment within clean energy include those common across the economy, as well as some specific to the Clean Energy ecosystem. The Climate Solutions Accelerator of the Genesee/Finger Lakes reports that common barriers to clean energy jobs "include the low appeal of the trades for many job seekers and students, as well as challenges around transportation and childcare. In Clean Energy-related workplaces, these can be heightened, especially since work sites are often dispersed (homes) and outside urban areas (solar farms, for example)."[21] For example, while the Climate Act requires that 35 percent of the benefits of clean energy investments to accrue to DACs, roughly 30 percent of NYSERDA's 2024 workforce development trainees were DAC residents.[22]

2.3. Other Energy Jobs In New York

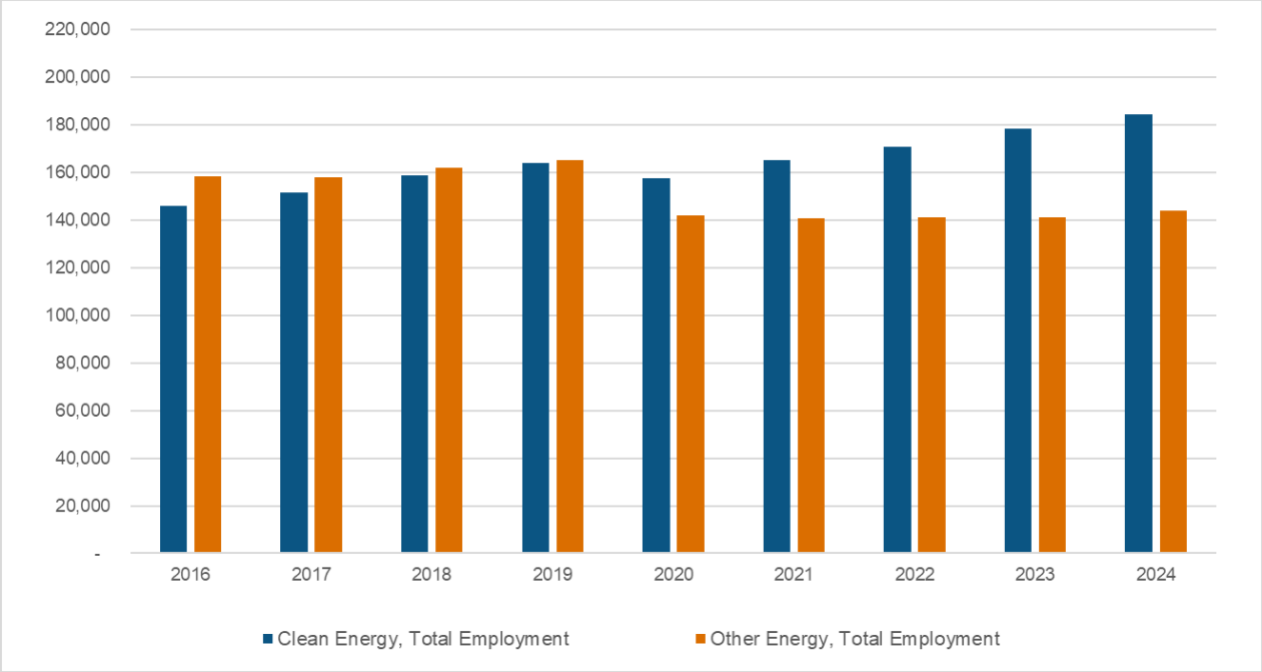
New York also employs 142,020 energy workers outside of the clean energy sectors defined above. These jobs include work in the transmission and distribution sector, the combustion vehicle sector, in delivered fuels, fossil-based generation, and in nuclear generation (see Figure 3). Roughly half of these jobs (75,755) are fossil fuel workers.

Figure 3: Other Energy Jobs in New York (2025)



Following the COVID-19 pandemic, energy jobs outside the clean energy sector decreased roughly 14 percent between the end of 2019 and the end of 2020 (Figure 4). Since then, the number of jobs has remained relatively flat, with a modest (two percent) increase in 2024, attributable to new jobs in transmission and distribution. Fossil jobs followed the same trends following the pandemic, with jobs remaining through 2024 and with losses mostly in combustion vehicle and delivered fuels subsector. In the coming years, the number of fossil jobs may decline as the State works toward its decarbonization goals, including minimizing emissions from the natural gas distribution system, fossil fuel power stations, and vehicles. However, the magnitude and pace of this shift depend on both policy design and market conditions. [23]

Figure 4: Clean Energy and Other Energy Jobs in New York since 2016



New York is committed to helping fossil fuel workers transition to clean energy jobs, including those in and from DACs. As a first step in worker tracking, New York State has updated the Worker Adjustment and Retraining Notification (WARN) system, which requires employers give early warnings of closures and layoffs and indicate whether the closure or layoff is due to the energy transition.[24] This allows the State to provide resources and services to specific energy workers who are facing imminent unemployment. Moving forward, DOL's worker tracking will continue to expand so that New York State is able to proactively identify at-risk workers who are most in need of upskilling, reskilling, and connections to new jobs before plant closures occur.

2.4. Labor Policy Developments

2.4.1. State Policy

New York State has advanced workforce protections and high-road labor standards for categories of clean energy projects, by implementing requirements for project labor agreements, prevailing wages, or pre-apprenticeships and apprenticeships, to name a few. Additionally, the State has undertaken new efforts to track displaced fossil fuel workers and to connect these workers with renewable projects. Table 1 summarizes the relevant energy workforce laws and policies.

Table 1: Summary of Relevant State Clean Energy Labor Laws and Policies

Law/Policy	Technology Area	Effective Date	Description
New York State Labor Law § 224-d	Renewable Energy Systems	Enacted 2021	Extends prevailing wage requirements to certain renewable energy projects which involve the procurement of renewable energy credits by a public entity. Amended in 2025 to extend apprenticeship requirements for construction work.

Public Authorities Law § 1005(27-a)	NYPA-Owned Renewable Electricity	Amendment Effective 2023	Requires PLAs, apprenticeship agreements, and agreements with labor for project maintenance and operation. Encourages prioritization of transitioning workers who have lost their employment or will be losing their employment in the non-renewable energy generation sector.
New York State Public Buildings Law § 91(7)	Decarbonization of State-owned facilities	Amendment Effective 2023	Requires PLAs and payment of prevailing wages for decarbonization of State-owned facilities.
Utility Thermal Energy Network and Jobs Act (UTENJA)	Utility Thermal Networks	November 2023 (Commission Order), Pilot under development as of 2025	Extends prevailing wage and direct entry pre-apprenticeship requirements to thermal energy projects. Gives hiring priority to utility workers transitioning from fossil fuel jobs; operations and maintenance positions must first be offered to these displaced workers.
Wage Requirements New York Sun (NYSERDA)	On-Site and Community Solar	April 2022	NY-Sun projects over 1MW must pay prevailing wages. Projects that comply are eligible for a Prevailing Wage Adder, the amount based on project size and location.
Creation of the DOL Office of Just Energy Transition (OJET)	Sector-Wide	Office opened in 2023	Supports both new workers and workers transitioning from the fossil fuel sector to quality jobs in clean energy, with a focus on serving traditionally underrepresented groups. Collaborates with NYPA on the utilization of funding pursuant to PAL 1005(27-d) for clean energy workforce development initiatives.
$1 Billion Sustainable Future Program	Various	FY2026 Budget	Projects that receive at least $100,000 require apprenticeship agreements and consideration of pre-apprenticeship direct entry programs for the recruitment of local and/or disadvantaged workers. All construction and maintenance projects over $5 million require PLAs.

2.4.2. National Policy

The 2022 Federal Inflation Reduction Act (IRA) authorized federal financial support to clean energy with a focus on high-quality labor standards and an emphasis on job quality. Most notably, the IRA's clean energy tax credits—a critical source of funding for large-scale renewable development and efficiency investments—included additional incentives for projects with prevailing wages or registered apprenticeship requirements.[25] However, shifting priorities—including halted federal programs, tax credits, and mixed market signals—within the federal administration has dampened public clean energy investments, though the full extent of the impacts on the industry is not yet clear. [26]

Despite the shifting priorities at the federal level, state-to-state coordination continues to drive national change for clean energy jobs. Governor Hochul is a member of the United States Climate Alliance (USCA), a bipartisan coalition of 24 governors securing America's net-zero future by advancing state-led, high-impact climate action.[27] The USCA governors represent approximately 60 percent of the U.S. economy and 55 percent of the U.S. population. In 2024, the USCA launched the Climate-Ready Workforce Initiative, which commits to training 1 million new Registered Apprentices by 2035. In collaboration with other states, New York remains committed to growing career pathways in climate and clean energy fields through the gold standard Registered Apprenticeship model.

2.5. State Workforce Development Programs

NYSERDA serves as the leading State agency responsible for promoting clean energy workforce development, alongside key clean energy workforce training initiatives at DOL, SUNY, ESD, NYPA, DEC, and others. As described below, other State agencies have expanded their roles in the clean energy workforce development ecosystem in recent years. Table 2 summarizes the key State entities involved in supporting clean energy workforce development activity.

Table 2: Summary of Ongoing New York Workforce Development Programs[28]

State Entity	Description	Relevant Funding Streams
NYSERDA	Administers roughly $180 million of clean energy workforce development programming focused on supporting capacity building and wage support.	Apprenticeship and Pre-apprenticeship Clean Energy Training; Offshore Wind Training Institute; Energy Efficiency and Clean Technology Training; Building Operations and Maintenance Training; and more.
DOL OJET	Up to $25 million annually in clean energy workforce development, allocated from NYPA.	$5 million for Growing the Clean Energy Workforce; $4 million Renewable Energy Training Initiatives; $7 million for electric vehicle skills training program, $5 million for Support Services Fund.
NYPA	Up to $25 million in funding to allocate to clean energy workforce development. Funding is administered in collaboration with OJET.	See NYPA programs in section 2.5.5.
SUNY	Targeted clean energy training programs across the education spectrum, including pre-college, undergraduate, graduate, technical, and community colleges.	$8 million for Offshore Wind Training Institute; Agricultural and Clean Energy Technology Center; $5 million in HVAC training; $2.6 million in SUNY Transformation Fund grants for training on building and vehicle electrification; and many other relevant, programs in renewable energy and green buildings. $28.2 million in SFY26 budget to SUNY for free community college for adult learners in high-demand fields, including green technologies.
ESD OSWD	Roughly $9 million in grants awarded as of July 25 toward clean energy-related workforce development training for underserved populations.	Workforce Development Capital Grant and Pay for Performance Grant Programs
DEC	$4 million in grant funding to support skills training and career placement for young New Yorkers in green industry jobs.	Green Jobs for Youth Program, funded through the State's Environmental Protection Fund
DOT	Partnership with SUNY Cobleskill to train existing fleet technician to support the electrification of DOT's fleet.	

2.5.1. NYSERDA Workforce Development Programs

New York State contributes to the development of its clean energy workforce by financing a variety of workforce training programs, including pre-apprenticeships and apprenticeships. NYSERDA's workforce development programs help upskill existing workers and train and place new workers across all clean energy sectors, including building decarbonization, energy storage, solar, onshore and offshore wind, electric transmission and distribution, and electric vehicle (EV) charging. In conjunction with DOL, NYSERDA has expanded its approach from funding standalone training programs to funding activities that support training and placing individuals in high-quality clean energy jobs. NYSERDA's programs broadly support two types of activities:[29]

- **Capacity building** funding is available to clean energy workforce training organizations and supports the development of training curricula, instructor training, and equipping learning labs for hands-on-training. Example programs include the Apprenticeship and Pre-apprenticeship Clean Energy Training (PON 5437) to prepare trainees for employment in clean energy; Energy Efficiency and Clean Technology Training (PON 3981) that provides hands-on experience; and Offshore Wind Training (PON 4595).
- **Wage support** is available to clean energy employers to subsidize the cost of hiring and training new clean energy workers, interns, and climate justice fellows. Example programs include On-the-Job Training (3982), Clean Energy Internships (PON 4000) and Climate Justice Fellowship (PON 4772).

To date, NYSERDA has funded training for 32,000 clean energy workers (2018–2024), about a sixth of the number of clean energy jobs expected in the coming years, highlighting the need for additional investment. By the end of 2025, NYSERDA will have met its training goal of more than 40,000 clean energy workers.

NYSERDA's clean energy career awareness activities across the state provide young people with an opportunity to explore a variety of pathways to contribute to an expanding clean energy economy (see example below on NYSERDA's partnership with Roadtrip Nation). For example, NYSERDA funded the training of 400 educators through the Clean Energy for Educators initiative, which provided educators with professional learning and networking opportunities to increase the number of young people interested in careers in clean energy. Especially as demand for skilled trades increases, there is a need to provide young people with early exposure to these career options. To support this, NYSERDA has leveraged its partnerships with labor organizations to engage schools statewide with skilled tradespeople and increase awareness of earn-as-you-learn models.

In 2023, NYSERDA partnered with Roadtrip Nation to create a 4-part docuseries called "Empowered State" to explore careers and innovations in clean and renewable energy through the eyes of three young adults. NYSERDA also worked with Roadtrip Nation to create a community portal to host additional clean energy career content and resources.[1]

2.5.2. DOL Clean Energy Workforce Development Programs

In April 2023, DOL established the Office of Just Energy Transition (OJET) to support training for clean energy jobs and connect transitioning fossil fuel workers to opportunities for upskilling, reskilling, and new job opportunities in renewables. OJET offers resources to identify skills and occupations within the clean energy economy. OJET also facilitates critical connections and engagement between clean energy industry employers, training providers, and job seekers, including K-12 clean energy career awareness. From 2024-2025, OJET has launched four funding streams to support a just energy transition, with a unique focus on wraparound services for workers-in-training.

- **Growing the Clean Energy Workforce (GCEW):** These grants support the creation and expansion of clean energy training programs and pre-apprenticeship opportunities in building electrification, renewable energy, EV charging, or energy-intensive industries. Funding also covers wraparound services for program participation, such as transportation and childcare support. [30]
- **Renewable Energy Training Initiatives (RETI)**: These funds are allocated directly to local Workforce Development Boards to support workers transitioning away from fossil fuel work and residential clean energy workers in the areas of weatherization and building performance.
- **Electric Vehicle Skills Training Program**: These funds will support the expansion and development of EV training programs specializing in maintenance and repair for vehicles and charging stations.

- **Support Services Fund**: This fund will strengthen the availability of supportive services for participants enrolled in a clean energy training program, including but not limited to childcare, transportation, student fees, and books.

2.5.3. SUNY Clean Energy Workforce Development Programs

SUNY is uniquely positioned to respond to regional clean energy training needs and maintains extensive partnership programs with community-based organizations, Boards of Cooperative Educational Services (BOCES), local governments, and State agencies. SUNY's campuses serve as "living labs" for building decarbonization training. SUNY's 2025–2030 Climate and Sustainability Action Plan highlights the expansion of its clean energy workforce training as a key priority. Central to SUNY's objective is to "facilitate New Yorkers' transition to well-paid careers in the climate and sustainability field, with a particular focus on environmental justice communities and displaced workers." [31] In particular, SUNY aims to:

- Increase its credit and non-credit workforce training programs to address the evolving workforce needs for green jobs, including internships and P-TECH programs;
- Increase enrollment, retention, and completion of green workforce development programs; and
- Increase green jobs pathways and placements in climate and sustainability-related industries, especially for residents of disadvantaged communities, adult learners, and other individuals who face barriers to participating in the green energy field.

In addition to its role in educating New York's future workforce across its 64 schools, including 30 community colleges, SUNY also administers several clean energy training programs.

- **Offshore Wind Training Institute (OWTI)** has created and expanded programs to prepare students and transitioning workers for careers in the offshore wind industry. It is spearheaded by Stony Brook University and Farmingdale State College in partnership with NYSERDA and has funded more than 20 programs across New York State.
- **As one of SUNY's campus "living lab" programs, the renewable energy and STEM center at Suffolk County Community College** launched in 2023 and houses the National Grid training center, an offshore wind training center, HVAC programs, and other clean energy training programs. The center brings together State, local, and private capital investments with academic programs and union and private partnerships.[32]
- **$2.6 million in Economic Transformation Fund grants** to 12 schools in late 2024 to develop academic and training programs for building and/or vehicle electrification.[33]
- **The SUNY Clean Energy Microcredential Initiative** is a joint $5M grant from NYPA and DOL. The program features three projects: scaling enrollment in existing clean energy microcredentials already underway at SUNY campuses; extending the program's reach by developing new clean energy microcredentials at campuses not yet offering them; and introducing a first-of-its kind pilot program of microcredentials to recognize clean energy instruction and related internships

for P-Tech students. Together the program will create 800 new seats in clean energy microcredentials across two- and four-year campuses as well as prepare a critical evaluation of how microcredentials can be implemented at P-Tech. All microcredentials are credit-bearing and stackable to a degree, providing early entry into the workforce and the opportunity for learners to continue their education while they work.

- **Free Community College** for green technologies and other high-demand fields, including green technologies. The New York State Opportunity Promise program makes community college free for eligible adults (25-55, who have not attained a college degree) to pursue associate degrees in high-demand fields like healthcare, science, technology, engineering, green technologies and math. The State allocated $47 million for the first year of the program, including $28 million for SUNY.

2.5.4. ESD Clean Energy Workforce Development Programs

In April 2022, New York State ESD established the Office of Strategic Workforce Development (OSWD) to administer $350 million in workforce development funding, aiming to better align training efforts with the needs of employers across the state. OSWD's grant programs focus on employer-driven, high-demand training in statewide priority sectors, including clean energy, construction, and advanced manufacturing. OSWD's programs also emphasize creating opportunities for underserved populations, including those not in the labor force, unemployed and underemployed workers, and low-income individuals.[34] To date, OSWD grants have helped launch new workforce training initiatives and have strengthened existing programs at community colleges, state universities, BOCES, and union-led organizations, with a focus on expanding access and opportunities in high-growth industries like clean energy.

OSWD's programs offer hands-on experience, industry-recognized credentials, and support services such as stipends, transportation, and childcare to remove barriers to employment. These programs also aim to increase exposure to clean energy and adjacent workforce fields with high employability or direct entry to apprenticeships and/or immediate employment, and to increase enrollment and completion of clean energy related trainings statewide.

2.5.5. NYPA Clean Energy Workforce Development Programs

NYPA's programs focus on creating energy career pathways through fellowships and career academies for middle and high school students; project based paid internships and industry recognized certification for community college students; and training in emerging technologies. NYPA's EV Workforce Pathways program, for example, trains the next generation of automotive technicians who will support the State's electric vehicle transition. Since 2021 NYPA has collaborated with 22 auto-tech programs to provide resources and training equipment. Program stakeholders and recipients include BOCES, Career and Technical Education High Schools and Community Colleges throughout New York State.

In May 2023, NYPA was granted expanded authority to assist the State in meeting its decarbonization goals, including directives to administer up to $25 million annually in clean energy workforce development programs in collaboration with DOL.[35] In March 2024, NYPA and DOL entered into a

Cooperative Agreement for programs related to workforce training, retraining and apprenticeship opportunities in the renewable energy field. In its first year of funding, NYPA launched new workforce development initiatives and contributed funding to expand the capacity of existing workforce development programs.[36]

As the program matures, NYPA will expand its focus to education development and training workers earlier in the pipeline. In collaboration with DOL, NYPA has already awarded $5 million to SUNY to administer the SUNY Clean Energy Microcredential Initiative, with an emphasis on funds that support DACs and the provision of wraparound services, such as tuition, transportation, and childcare.[37] NYPA has also provided funding for specialized training on advanced building weatherization techniques and skill in building and transportation electrification to 80 participants, and is supporting the Clean Energy Training Academy and Internship Program to prepare New York City Housing Authority residents for careers in the clean energy sector.[38]

2.5.6. DEC Green Jobs for Youth

In 2025, The New York State Department of Environmental Conservation (DEC) announced $4 million in grants for Green Jobs for Youth workforce programs that are developed or funded by community-based organizations in or serving environmental justice and disadvantaged communities. The initiative helps prepare youth between the ages of 17 to 24 for jobs in the green economy through workforce development, skills training, and certification. This grant was last offered in 2017, with approximately $1 million helping train and educate more than 370 participants and 59 youth placed into jobs to date.

Funding for DEC's Green Jobs for Youth Grants is provided by the State's Environmental Protection Fund (EPF) as part of New York State's ongoing commitment to environmental justice.

2.5.7. DOT Fleet Technician Workforce Development Efforts

The New York State Department of Transportation (DOT) has built critical partnerships and programs to address worker and skill gaps in the fleet technician workforce. DOT has partnered with SUNY Cobleskill to train existing fleet technicians in the skills needed for fleet conversions to electric, plug-in hybrid, and alternative-fuel powered vehicles. To bring new workers into the transportation technician industry, DOT strategically recruits from BOCES, high schools, and colleges across New York State and has a goal to launch an apprenticeship program to bring new transportation technicians into the State workforce.

2.5.8. Non-Governmental and City Programs

State government programs are part of a much larger ecosystem of clean energy workforce training programs across New York. Non-profit training providers, labor unions, pre-apprenticeships, employer-based training programs, universities and community colleges, and grade schools and BOCES all offer critical programs, degrees, and credentials to prepare the clean energy workforce. For example, BOCES serve all upstate districts and play an important role in rural communities. City government offices, such as the New York City Mayor's Office of Talent and Workforce Development, create local plans and offer their own funding for clean energy workforce training. Continued collaboration between State, non-governmental, and local government programs will be critical to prepare the current and future clean energy workforce.

3. Outlook (2025 – 2040)

Under the Additional Action scenario of the State Energy Plan Pathways Analysis, energy sector jobs are expected to grow by 17 percent, or roughly 80,000 jobs between 2025 and 2040. The electric sector will experience the fastest growth at 44 percent (or 59,000 net jobs), followed by the buildings sector with 23 percent growth (38,000 net jobs). In the electricity sector, increases are concentrated largely in zero emissions energy sources such as solar, wind, and nuclear, as well as in storage and electric distribution jobs. In the buildings sector, increases are expected in both commercial and residential work, with the most dramatic increases expected in residential shell work, where workforce demand is expected to more than triple by 2040. This expected growth will create a significant need for clean energy workforce training as well as extensive coordination across State agencies. Net jobs in the transportation and fuels sector are expected to decrease between 2025 and 2040 – by 11 percent and 9 percent, respectively – consistent with decreased investments in fossil fuels modeled in the Additional Action scenario. Additional results are discussed in the Economic Impacts: Jobs Analysis chapter of this Plan.

4. Themes and Recommended Actions

New York's energy workforce policies should include both protective and proactive measures that support a just transition to a decarbonized economy.[39] Protective policies provide workers impacted by State climate policies with support systems and safety nets when making the transition to new employment and upskilling. Protective policies also require that new clean energy jobs are high-quality, safe, well-paying, and inclusive, especially when these jobs are supported by State investments. Simultaneously, proactive policies provide an ecosystem of clean energy schooling, training, and employment opportunities for New York residents, with an emphasis on creating pathways for DACs. Proactive policies are responsive to emerging industries, existing industries that must expand to support the State's climate goals, and industries that may shrink because of these goals. To arrive at a set of truly transformative just transition policies, New York should consider the following mix of protective and proactive recommendations.

4.1. Workforce Development Funding

Strategically developed workforce development programs can build up enough capacity of skilled workers and contractors so that the State can meet the needs of its clean energy ambitions across the electricity, building decarbonization, and transportation sectors. Workforce development will need to support the operations and expansion of existing technologies, while supporting the scale up of emerging energy systems including thermal energy networks and advanced nuclear. Extensive coordination is needed to ensure that the pipeline of jobs will materialize for these trained workers. Table 2, above, summarizes the key State-led workforce development initiatives currently underway. As the clean energy industry evolves, these programs will need to adapt to changing needs. The sections below highlight several sector-specific considerations.

4.1.1. Building Decarbonization and Resiliency

To enable a scaling of investments into efficient, low-carbon, and resilient buildings, the State will need to invest in expanding and advancing buildings workforce capacity to keep pace with evolving demand. The workforce that supports energy efficiency upgrades and other related building decarbonization work

currently makes up more than 70 percent of New York's clean energy workforce, and will play a critical role in implementing large-scale investments in energy efficiency, weatherization, electrification, and integrating new energy sources into existing buildings—as well as the engineering, policy, planning, research, and administrative capacities that will support the modernization and transformation of our building stock. At the same time, buildings across New York State will likely continue to be exposed to more extreme flooding, precipitation, wind, and heat events due to a changing climate, highlighting the need to embed resiliency measures in the State's residential, commercial, and institutional buildings.

The prioritization of energy efficiency and weatherization investments will facilitate the State's decarbonization efforts. The scale of efficiency work needed will require expanded workforce capacity across a range of occupations, including energy auditors, code inspectors, insulation installers, plumbers, steamfitters, pipefitters, glaziers, electricians, HVAC technicians, and more. These demands will compound the already-high demand for workers in this sector. In a 2025 survey, building decarbonization employers indicated difficulty hiring qualified workers among key occupations despite expecting continued growth in demand, pointing to the existing need to scale up this workforce.[40]

The buildings transition will also rely heavily on emerging and quickly evolving technologies being adopted at scale. Advanced HVAC technologies will be an important tool to improve building efficiency, and HVAC training and workforce program development will be critical as New York's buildings transition to newer heat-pump-based systems and other high-efficiency technology. To maximize impact, training programs should reflect feedback from operational experience and industry demand.

4.1.2. Electricity

As discussed in the Electricity chapter of this Plan, the State must tailor its workforce development programs to attract an adequate and skilled labor pool to support the near- and long-term needs of the electricity sector. In particular, support for training and retraining will be needed to expand and modernize the State's electric transmission and distribution infrastructure to support increased demand for electricity, the integration of renewable energy, as well as substantial planned utility spending on the distribution system to enhance reliability and resiliency, including breaker replacements, system hardening, automation, substation upgrades, and storm response measures. Additionally, training will be needed to support the management, maintenance, and upgrading of existing clean electric generation facilities and the construction, installation, and operation of new clean generation resources including onshore and offshore wind, distributed and large-scale solar, energy storage, as well as potential future development of advanced nuclear and other emerging clean firm technologies.

4.1.3. Transportation

Continued investments into EV deployment in New York are essential to lowering the State's transportation-related emissions. As discussed in the Transportation chapter, there is a pressing need to develop a workforce to perform the planning, installation, and maintenance of vehicle charging networks. This need can be supported through workforce development targeted to training EV installers and technicians to keep pace with the rapid expansion of new and existing charging infrastructure.

4.1.4. State Funding for Direct Entry and Pre-Apprenticeship Programs

New York State should continue funding clean energy skills training as part of Direct Entry and other pre-apprenticeship programs, to prepare workers for entry into Registered Apprenticeships that support clean energy projects, particularly in industries and occupations with projected worker shortages.[41] Registered Apprenticeships are an important tool for economic mobility and growth. While New York State Registered Apprenticeships remain the gold standard of workforce development for middle-skill workers in high-demand occupations, New Yorkers in DACs have historically faced barriers to entering careers in the building trades. To help expand Registered Apprenticeship opportunities for all New Yorkers and to fill gaps in clean energy labor supply, New York State should commit long-term funding to Direct Entry and pre-apprenticeship training providers that are preparing workers for clean energy trades, such as electricians, plumbers, roofers, manufacturing, supply chain, and more. Funding requirements should prioritize job placement, retention, and environmental justice goals.

4.1.5. Prioritizing Early Education

There is a particular need for more outreach at the K–12 and college levels to attract the next generation of clean energy workers. Nonprofit organizations in the clean energy space have already begun developing education and training for young people. DOL should continue working with these organizations to more deeply incorporate clean energy education into its existing teacher ambassador program. Agencies including DOL and NYSERDA should also coordinate on forthcoming K–12 career outreach, such as providing teachers with clean energy curriculum resources.

4.1.6. Clean Energy Career Training on SUNY Campuses

To expand the pipeline of clean energy workers and help existing energy workers build the skills they need to keep pace with technological advances, SUNY offers accredited training onsite in clean energy industries, career support services, and prepares trainees for certifications and basic skills for entry-level jobs in renewable-related industries. With close coordination between DOL, the State Workforce Investment Board, BOCES, and SUNY, an expanded training curriculum could respond to market demand so that trainees have a clear career path into the industry.[42,43]

The dynamic SUNY clean energy educational offerings connect individuals to training opportunities across the State through campus-specific training centers. The Clean Energy Hubs may act as credible messengers to connect interested community members to local training opportunities. DOL should also help refer transitioning fossil fuel workers to these SUNY training centers, particularly for micro-credentials or certificates that they would need to transition into a clean energy career.

Recommendations

- **NYSERDA, DOL, and ESD should identify opportunities to incentivize and bolster workforce training participation in key occupations** where shortages are projected (such as technicians, construction trades, and manufacturing). Workforce development efforts should also prioritize:
    - The need to expand the capacity of the energy efficiency workforce and target the development of installation and operation skills for high-efficiency HVAC equipment;

  - A growing demand for building and maintaining new transmission and distribution infrastructure;
  - Further investments in energy storage, distributed and large scale solar, thermal energy networks, and wind;
  - Building up transferrable skills that would support future nuclear development; and
  - Training to support the expansion and operations of EV charging infrastructure.

- **DOL, NYSERDA, and ESD should continue funding Direct Entry and pre-apprenticeship programs** that support clean energy projects, including identifying any need for additional long-term State funding.

- **NYSERDA and DOL should expand clean energy career awareness in K-12 schools across New York State** and initiatives to provide educational resources.

- **New York State should continue and expand investments into clean energy career training curriculums** on SUNY campuses and BOCES across the state.

4.2. Labor Standards

As summarized in Table 1, the State has made progress on enacting labor standards for clean energy projects. Minimum labor standards are effective tools to improve job quality and project outcomes, and contribute to creating jobs that are safe, pay a living wage, support career growth, and have collective bargaining rights.[44] For example, prevailing wage requirements can ensure that minimum pay standards are met, while Project Labor Agreements and Labor Peace Agreements are used to protect the rights of covered workers. Safety requirements can protect workers from dangerous working conditions, such as extreme weather and other workplace hazards. Labor standards also improve project outcomes, timelines, and final work products, the result of standardized training and high productivity. Additionally, Buy America Provisions can drive economic growth, and good wages for energy sector workers can bolster affordability for workers and their families. However, the clean energy industry is highly varied, and as a result may require specific labor standards to guarantee high job quality.

To remain proactive in its commitment to high-quality clean energy jobs, New York State should assess the coverage of labor standards across energy sectors to ensure that workers are well-protected. This would allow the State to better identify opportunities to expand coverage, especially where State funds support the underlying clean energy project. Research should include a focus on the gaps in labor standard coverage for battery storage and distributed energy resources projects, as well as in emerging technologies including advanced nuclear energy. Where minimum labor standards are not relevant, this research should explore other policies to ensure job quality, such as ensuring on-the-job safety, regular pay, opportunities to aggregate smaller projects, and access to benefits, especially for energy projects supported through State funding.

Recommendations

- **DOL and NYSERDA should undertake research that analyzes the labor standards that apply to clean energy jobs.** This analysis should identify gaps in labor standard coverage and consider policy actions that can ensure clean energy jobs are high quality.

4.3. Accessibility and Awareness of Clean Energy Jobs and Job Training in Disadvantaged Communities

New York State prioritizes clean energy workforce development funding for members of DACs and other priority groups, such as veterans, transitioning fossil fuel workers and low-income New Yorkers; however, the State can do more to ensure that its workforce development initiatives are reaching these communities, as they have less than proportional participation rates in clean energy jobs and training programs. To continue attracting New Yorkers, especially residents of DACs, the State will need to continue to partner with trusted community organizations to bring DAC members into the unionized trades through career and industry awareness.

A 2025 survey found that nearly two-thirds of New Yorkers looking for work had not considered working in the clean energy industry.[45] Low participation may be due to the low awareness of clean energy and what clean energy jobs can look like. Work in clean energy can take many forms across many occupations ranging from solar panel installer, HVAC repair, operating engineer, administrative support, researcher, energy auditor, and so on. Clean energy work can also include the development of small businesses or entrepreneurial activities.

While New York State needs to increase awareness of clean energy job opportunities, the State also needs to consider and address barriers to participation through the provision of wraparound services. These services can lower cost barriers or other obstacles associated with obtaining clean energy job training, such as the cost of certification, the cost of transportation, the need for job stipends, the cost and availability of housing or lodging, childcare support, and re-entry supports.[46] Wraparound services can also include funding that supports job placement and retention. State-level communications and engagement campaigns should amplify clean energy job trainings and related wraparound services.

State support can also facilitate small businesses entering the clean energy industry. Small business loans and support centers, like those discussed in the *Economic Development, Industry, and Agriculture* chapter, provide technical assistance, and expanded capacity for new companies. Funding and other support, including incubator programs, can play an important role in allowing for start-ups, small business, MWBEs, and residents from DACs to play a role in deploying clean energy solutions.

4.3.1. Communicating Opportunities in Clean Energy

When possible, State agencies, education providers at all levels, and industry partners should coordinate communications campaigns that clearly articulate clean energy careers, entrepreneurship, and training opportunities. Campaigns should provide relevant education on clean energy topics, generate interest in clean energy careers, and communicate why entering this market can be a community and/or family wealth-building opportunity. The State should remain committed to communicating about programs through community spaces, educational spaces, school curricula, job fairs, and other relevant community networks, including NYSERDA's Regional Clean Energy Hubs.

4.3.2. Wraparound Services Funding for Trainees

State agencies are keenly aware that barriers to entry can often prevent members of DACs from starting and completing job training programs, including both pre-apprenticeship and apprenticeship training.

Often, the lack of wraparound services, including supports for childcare, transportation, housing, health care, and mentorship, can act as a barrier. State agencies receive workforce development funding from various sources, some with more or less flexibility to fund such services. As such, State workforce development offices must continue to collaborate to fund wraparound services for trainees. Such collaboration may also extend to non-profit providers, or other entities that can help fill funding and coordination gaps based on existing successful wraparound service programs.

4.3.3. Clean Energy Job Training for Currently and Formerly Incarcerated New Yorkers.

DOL should expand existing environmental literacy programs in correctional facilities to include specific clean energy job training and expand programming to more facilities. This program expansion would provide a path to good jobs in clean energy, while also expanding the pool of eligible clean energy workers in high-need occupations.

4.3.4. Research on Jobs for Disadvantaged Community Members

To the extent possible, New York estimates the number of clean energy jobs located in DACs as well as the number of DAC residents in clean energy jobs. However, current efforts do not provide further granularity beyond these estimates. Additionally, NYSERDA currently monitors job retention 12 months post-training but does not have access to retention rates beyond that. Continued analysis, as well as the expansion of tracking efforts, is needed to measure the long-term placement success rates of the State's clean energy workforce development investments.

Recommendations

- **New York State should consider launching new statewide communications campaigns** to promote inclusive participation in clean energy careers.
- **New York State** should continue to identify and pursue opportunities to carve out funding for and expand access to wraparound services, such as childcare, transportation, and job placement to remove barriers to participation.
- **DOL should expand clean energy training programs in correctional facilities.**
- **NYSERDA, in collaboration with DOL, should identify new ways to study and track the representation and long-term hiring and retention of individuals from DACs in clean energy jobs,** especially individuals who have completed State-funded training.

4.4. Just Transition Policies

The State is committed to creating pathways for New Yorkers to move into new, high-quality clean energy jobs and to support those transitioning out of fossil-fuel -based employment or other energy sectors impacted by the State's energy policy. Currently, there are roughly 75,000 jobs in fossil fuel electric generation plants, the natural gas distribution system, the transportation and storage of delivered fuel, and other related fossil fuel jobs. Over the time horizon of this plan, jobs impacts in these subsectors are expected to vary, with some anticipated to occur sooner than others.

Well-designed workforce and labor policy can promote a just transition for these workers through a combination of proactive investments into efforts such as retraining, upskilling, or right of first refusal for workers transitioning into clean energy fields. The State should also consider protective measures for fossil workers who are negatively affected by the State's climate policy but for whom transitioning to a clean energy field is not possible. All just transition programs should be created and implemented with input from the most impacted workers.

4.4.1. Research on Mapping New York's Fossil Fuel Workforce

Further research is needed to better understand the employment impacts of transitioning the various fossil fuel subsectors. This research should quantify and qualify the State's fossil workforce, including an assessment of the occupations, skills, wages, age, and location of workers across the subsectors. This research should estimate the short- and mid-term workforce needs to support possible transition activities and serve as a baseline to support the assessment of possible just transition policies.

This research should examine the natural gas distribution subsector to support ongoing gas utility long-term planning activities and State policy development. Analysis of this subsector should consider the potential employment impacts of changes to ongoing maintenance of the existing distribution systems, civil engineering efforts to ensure the continued safe operation of such systems in service territories that continue to host such systems, the safe decommissioning of sections of the systems, and the construction and installation of equipment to support non-pipeline alternatives, alternative fuels, and other related decarbonization activities. Additionally, this research should highlight existing fossil fuel occupations with highly transferrable skills to the clean energy sector, such as in distributed thermal networks, nuclear energy, or otherwise.

A better understanding of the State's fossil workforce will enable future research to explore the protective transition policies identified in the following section.

4.4.2. Safety Net Policies for Workers at Risk of Job Loss Due to Climate Change Mitigation Policies

While many of the skillsets of New York's impacted energy workers may be transferrable, transitioning to a new career may not be a strong option depending on age, lack of regional opportunities, or the pay differential for new roles. In addition to the displaced worker tracking and associated support that OJET offers specifically for impacted fossil-fuel workers (see Table 1), New York must research and develop adequate safety net measures to support workers who may be negatively impacted due to climate policies.

The detailed understanding of the State's fossil workforce established by the research in Section 4.4.1 will enable additional research that estimates the potential impacts of policies like a bridge to retirement for older fossil workers, wage guarantees for fossil workers transitioning into lower roles, support to pension funds impacted by the transition, or support to communities built around transitioning industries.

Recommendations

- **NYSERDA and DOL should undertake research to assess the employment impacts of transitioning subsectors, in particular natural gas distribution,** to address a dearth of research

on the topic at the state and national level. This research should be designed to better inform how to craft and prioritize just transition policies.

- **NYSERDA and DOL should analyze potential safety net measures to support workers impacted by climate mitigation policies.** Such measures could include wage guarantees, bridge to retirement, transitional opportunities, and/or support for communities facing plant closures.
- **New York State should consider a Just Transition Fund, with dynamic support from multiple sources, that could support the funding of safety net measures mentioned above.**

4.5. Continue and Expand Statewide Workforce Development Coordination Efforts

As training and research needs expand and evolve, and as more State agencies join the clean energy workforce development ecosystem, further coordination will be needed to fill gaps in programming and prioritize the dissemination of resources where they are needed most. Interagency cooperation also supports streamlined processes and improves program outcomes. Statewide coordination should continue to include relevant local and non-governmental workforce training providers, including labor unions, non-profit training providers, wraparound service providers, municipal and county governments, community-based organizations (particularly those serving DACs), workers impacted by climate mitigation policies, and employers.

4.5.1. Align Statewide Definitions of Clean Energy Occupations and Industries

To make clean energy jobs accessible to wide range of communities, the State should offer clear tools and education on the industries that are expanding, the jobs that will be available in those industries, and the training programs needed to obtain those jobs. Many State agencies have already developed similar resources, such as DOL's Green Topics Dashboard, NYSERDA's Energize Your Future, and NYSERDA's Offshore Wind Training tool.[47]

To increase clarity and consistency, the State needs to collaboratively define clean energy industries and jobs. Developing a standardized mechanism statewide for defining, measuring, and projecting clean energy occupations will streamline implementation of workforce development programming, including delivering and making accessible career opportunities within and to members of DACs, veterans, and incumbent fossil fuel workers.

4.5.2. Align and Streamline Work Requirements

To facilitate a prepared and adequate clean energy workforce, New York State should identify opportunities to better align and streamline regulatory requirements, licensing, and training processes for clean energy jobs. The State should continue its current effort to review the available Civil Service titles that can address future clean energy needs within State government. Additionally, the State should review differences in regional licensing requirements that may provide barriers to accomplishing clean energy transition work.

Recommendations

- **DOL should coordinate with partner agencies to streamline State program evaluations and facilitate study of career pathways.**

- **DOL should continue coordinating with other State agencies in the GreenNY Council,** including the Department of Civil Service, to modernize and adjust civil service titles to meet clean energy labor demands within State government jobs.

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1 *New York State Climate Action Council Scoping Plan*, (New York State Climate Action Council, 2022), https://climate.ny.gov/Resources/Scoping-Plan.

2 See *Table 1* for an overview of bills and budget allocations since the Climate Act that aim to improve job quality and increase workforce development in clean energy.

3 For example, NYSERDA's Just Transition Site Reuse Planning Program provides communities with planning and technical support services to inform future decision making at the local level to help mitigate any negative impacts of pending or future fossil fuel power plant closures.

4 *2025 Clean Energy Industry Report*, (NYSERDA, 2025), www.nyserda.ny.gov/About/Publications/New-York-Clean-Energy-Industry-Report.

5 NYSERDA has invested roughly $180 million since 2016, New York Power Authority $25 million since 2023, and Empire State Development $8 million since 2023.

6 NYSERDA develops clean energy workforce policies, research, and workforce development programs, which are reviewed by the Department of Public Service to ensure consistency with utility programs and the prudent use of ratepayer funds.

7 DOL's Office of Just Energy Transition supports training for clean energy jobs and connects transitioning fossil fuel workers to opportunities for upskilling, reskilling, and new job opportunities in renewables.

8 "U.S. Departments of Labor, Commerce announce coordinated effort to create good jobs, promote equity throughout the workforce," (Press Release, U.S. Department of Labor, June 21, 2022), www.dol.gov/newsroom/releases/osec/osec20220621.

9 The Clean Energy Industry Report defines a clean energy job as one where a worker spends any amount of their labor hours directly involved in the research, development, production, manufacture, distribution, sales, implementation, installation, or repair of components, goods, or services related to the following sectors: renewable electric power generation; grid modernization and energy storage; building decarbonization and energy efficiency; renewable fuels; and clean and alternative fuels transportation.

10 NYSERDA, "2025 Clean Energy Industry Report."

11 *United States Energy & Employment Report 2024*, (U.S. Department of Energy, October 1, 2024), www.energy.gov/policy/us-energy-employment-jobs-report-useer.

12 NYSERDA, "2025 Clean Energy Industry Report."

13 NYSERDA, "2025 Clean Energy Industry Report."; U.S. Bureau of Labor Statistics, *Quarterly Census of Employment and Wages (QCEW)*, distributed by U.S. Bureau of Labor Statistics, accessed September 2025. www.bls.gov/cew/data.htm.

14 NYSERDA, "2025 Clean Energy Industry Report."

15 NYSERDA, "2025 Clean Energy Industry Report."

16 U.S. Bureau of Labor Statistics, *Employment Projections*, distributed by U.S. Bureau of Labor Statistics, accessed February 2025, www.bls.gov/emp/; U.S. Bureau of Labor Statistics, QCEW.

17 DOL, *New York State Long-Term Occupational Projections*, distributed by DOL, accessed June 2025, https://dol.ny.gov/long-term-occupational-projections.

18 Sophie Huang. "Rebuilding the Construction Trades Workforce," The Harvard Joint Center for Housing Studies, June 5, 2024, www.jchs.harvard.edu/blog/rebuilding-construction-trades-workforce; Ezra Greenberg, Erik Schaefer, and Brooke Weddl. "Tradespeople wanted: The need for critical trade skills in the US." McKinsey & Company, April 9, 2024. www.mckinsey.com/capabilities/people-and-organizational-performance/our-insights/tradespeople-wanted-the-need-for-critical-trade-skills-in-the-us.

19 NYSERDA, "2025 Clean Energy Industry Report."

[20] Initial reports have indicated areas for improvement and future research regarding job quality. For example, research from the Cornell Climate Jobs Institute highlights difficulties faced by some solar workers in New York. See *Exploring the Conditions of the New York Solar Workforce*, (Cornell Climate Jobs Institute, April 2024), www.ilr.cornell.edu/climate-jobs-institute/public-impact-0/climate-jobs-institute-unveils-exploratory-study-new-york-solar-industry

[21] Erica Rosenberg, *The Finger Lakes Clean Energy: Current State and Future Prospects,* (CGR, August, 2024), https://static1.squarespace.com/static/5f69141a20665f4000eb34a2/t/6762f1995ed8a7033417f6e9/1734537628470/Clean+Energy+Jobs+Report+Final.pdf.

[22] NYSERDA, *NYSERDA DAC Investments and Benefits 2020-2024*, distributed by NYSERDA, accessed July 1, 2025, https://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={30392196-0000-C12E-925F-4C0CFCF5789D}.

[23] Potential fossil plant closures were identified in Appendix D of the Scoping Plan. Under the 2023-2024 Enacted State Budget, NYPA will seek to retire its seven small natural gas power plants in New York City and Long Island so long as the retirements do not result in more than a de minimis increase in air emissions in disadvantaged communities and the plants are not needed for emergency power or electric system reliability; *Small Natural Gas Power Plan Transition Plan* (NYPA, May 2025), www.nypa.gov/-/media/nypa/documents/document-library/renewables/sngpp-transition-plan.pdf.

[24] DOL, "Apprenticeship Direct Entry;" "Worker Adjustment and Retraining Notification (WARN)," DOL, n.d., https://dol.ny.gov/worker-adjustment-and-retraining-notification-warn%29%3A.

[25] "Treasury, IRS release guidance on the prevailing wage and apprenticeship requirements for increased credit and deduction amounts under the Inflation Reduction Act," (Press Release, Internal Revenue Service, June 18, 2024), https://www.irs.gov/newsroom/treasury-irs-release-guidance-on-the-prevailing-wage-and-apprenticeship-requirements-for-increased-credit-and-deduction-amounts-under-the-inflation-reduction-act. Also see U.S. Internal Revenue Code §§ 30C, 45, 48, 179D.

[26] *SNAPSHOT: Trump's Unfolding Energy Crisis*," (Climate Power, October 2025), https://climatepower.us/energy-crisis/.

[27] "U.S. Climate Alliance Launches Governors' Climate-Ready Workforce Initiative, Aims to Train 1 Million New Registered Apprentices by 2035," (Press Release, United States Climate Alliance, September 23, 2024), https://usclimatealliance.org/press-releases/building-a-climate-ready-workforce-sep-2024/.

[28] Not included in this table is the DOS Code Enforcement Training Program.

[29] A snapshot of NYSERDA's workforce development programs can be found at https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Publications/Fact-Sheets/workforce-fact-sheet.pdf. Open solicitations and funding opportunities are continually updated and available at www.nyserda.ny.gov/Funding-Opportunities/Current-Funding-Opportunities.

[30] "Workforce Governance: Funding Opportunities - Review Current & Archived Funding Opportunities Including Additional Resources," DOL, accessed July 5, 2025, https://dol.ny.gov/funding-opportunities-0.

[31] *SUNY Climate and Sustainbility Action Plan 2025-2030*, (State University of New York [SUNY], 2025), www.suny.edu/media/suny/content-assets/documents/sustainability/Sustainability-Plan.pdf.

[32] "Renewable Energy/STEM Center," Suffolk County Community College, accessed July 5, 2025, www.sunysuffolk.edu/stem/stem-center.jsp.

[33] Grantees were Adirondack Community College, Alfred State College, SUNY Canton, SUNY Cobleskill, Columbia-Greene Community College, SUNY Delhi, Farmingdale State College, Monroe Community College, SUNY Morrisville, Schenectady Community College, Suffolk Community College, and Ulster Community College.

[34] "Office of Strategic Workforce Development," (ESD, n.d.), https://esd.ny.gov/office-strategic-workforce-development.

[35] "Legislation Gives New York Power Authority Additional Authority to Advance Renewable Energy Generation and Decarbonization in New York State," (Press Release, NYPA, May 3, 2023), www.nypa.gov/news/press-releases/2023/20230503-legislation.

[36] "Governor Hochul Announces $11.6 Million to Develop Clean Energy Industry Workforce," (Press Release, New York State Governor's Office, May 21, 2024), www.governor.ny.gov/news/governor-hochul-announces-116-million-develop-clean-energy-industry-workforce.

[37] NYPA issued its request for proposals in July 2024 and made two tranches of awards. At the close of the 2024-25 fiscal year, NYPA will have awarded $25 million inclusive of the $9 million to DOL and $5 million to SUNY.

[38] A full list of NYPA's approved workforce development and training investment can be found in Appendix G to the 2025 NYPA Renewables Strategic Plan (www.nypa.gov/public-hearings).

[39] Todd E. Vachon. *Clean Air and Good Jobs: US Labor and the Struggle for Climate Justice,* Philadelphia, PA: Temple University Press, 2023.

[40] NYSERDA, *2025 Clean Energy Industry Report*.

[41] DOL. *Apprenticeship Direct Entry.*

[42] Additional information about the State Workforce Investment Board is available at: https://dol.ny.gov/new-york-state-workforce-investment-board.

[43] Boards of Cooperative Educational Services partner with nearly all of the State's school districts to offer career and technical training for high school students and adult learners. See: https://www.boces.org/services/

[44] "US Departments of Labor, Commerce announce coordinated effort to create good jobs, promote equity throughout the workforce," (Press Lease, U.S. Department of Labor, June 21, 2022), https://www.dol.gov/newsroom/releases/osec/osec20220621.

[45] NYSERDA, *2025 Clean Energy Industry Report*.

[46] New York City Housing Authority's Clean Energy Academy is an example of a program that offers wraparound supports (e.g., a $1,500 job stipend).

[47] "Energize Your Future," NYSERDA, accessed July 5, 2025, https://www.nyserda.ny.gov/All-Programs/Clean-Energy-Workforce-Development-and-Training/Energize-Your-Future; "Exploring Occupations by Green Topic," DOL, accessed July 5, 2025, https://dol.ny.gov/exploring-occupations-green-topic; "Offshore Wind Training New York & New Jersey," New Jersey Economic Development Authority and NYSERDA, accessed July 5, 2025, https://www.offshorewindtraining.org/.

New York State Energy Plan

VOLUME II | Energy and Our Lives

Energy Innovation

13

Key Terms Used in This Chapter

FOR THE COMPLETE GLOSSARY ➜

Research, Development, and Demonstration (RD&D): Research, development, and demonstration includes basic research, applied research, experimental development (directed to producing new products or processes or to improving existing products or processes), and demonstration to show feasibility and benefits in a real-world setting.

Commercialization: Commercialization programs help bring beneficial energy technologies and services to market through technical assistance, financing, customer discovery, and further product development.

Innovation Ecosystem: Innovation ecosystems are communities of interacting stakeholders engaged in producing, enhancing, and creating novel methods, products, and processes.

Key Findings → Energy Innovation

New York boasts one of the largest, most mature clean energy workforces, advanced markets for clean energy technologies, and extensive research and innovation hubs. As New York works to scale up its existing supply and adoption levels of clean energy technologies to advance ambitious goals and meet growing energy demands, innovation will be key to its success. This chapter provides an overview of the State's approach to energy innovation, outlines major initiatives underway, and recommends continued and additional actions.

- **Continued State investments in energy research, development, and demonstration (RD&D) help enable New York's transition to a clean energy economy.** State investments in innovation can accelerate the energy transition by introducing new products and services into the market whose cost and performance benefits far exceed incumbent technologies. Opportunities exist across the entire energy system, including grid modernization and reliability, clean firm power generation, energy storage, low-carbon alternative fuels, and efficient heating and cooling technologies. Aligning RD&D investment plans with the needs of the market, ratepayers, and disadvantaged communities (DACs) is important for defining and prioritizing opportunities and improving market adoption.
- **Continued State investments in commercialization can accelerate the deployment of widely beneficial energy technologies.** Commercialization programs help bring beneficial energy technologies and services to market through technical assistance, financing, customer discovery, and further product development. Commercialization programs can provide a draw for manufacturers to develop new products and increase their business activity in New York by introducing and scaling technologies developed in-state or by bringing promising technologies to New York.

- **Strengthening partnerships that leverage New York's innovation ecosystem will foster economic development, create jobs, and provide greater leverage for State investments.** New York is one of the leading clean energy innovation hubs in the country thanks to the strong, mutually beneficial partnerships across State agencies, universities, and the private sector. Coordination among statewide and regional technology partnerships is critical to continue driving innovation, attracting new talent and industry, and meeting the market's energy needs. Continuing to foster synergistic relationships between State agencies, authorities, and other partners can ensure the State's significant research, education, industrial, manufacturing, and finance sectors are leveraged to drive innovation.

- **The State's investments in its education systems provide key talent, leadership, and cutting-edge research and product development needed for the energy transition**. New York's education system serves as the linchpin of the State's clean energy innovation portfolio by driving research and commercialization efforts and hosting large-scale demonstration projects. Investing in the State's clean energy technology education pipeline can also produce the talent needed to develop and scale emerging energy technologies. Despite robust job growth, New York faces a high demand for highly trained energy innovation professionals. Without more targeted education and training programs, critical research and demonstration projects can face prolonged timelines and reduced output.

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1. Background: The Innovation Process

New York's nation-leading clean energy goals have already helped catalyze a robust clean energy industry. The State boasts one of the largest, most mature clean energy workforces, advanced markets for clean energy technologies, and extensive research and innovation hubs. Public and private investment in clean energy companies has been significant: between 2022 and 2024, investments averaged $6.1 billion, a roughly 50 percent increase compared to the 2021 to 2023 period. Growth can be expected to continue as New York remains committed to expanding existing markets and fostering the growth of emerging technologies.

Over the course of the Plan's time horizon, New York will need to scale up its existing supply and adoption levels of clean energy technologies to advance ambitious goals and growing energy demands. Innovation will be key to this success. This State Energy Plan should support an investment strategy that ensures that new industries can be reliably powered in the near term while developing and commercializing affordable clean energy technologies to meet future demand, especially as electrification efforts and new energy intensive users increase demand on the electric system. The existing initiatives and strategies outlined in this chapter position the State well to scale up key clean technologies identified in the Plan (including but not limited to technology focus areas in Table 1).

Investing in energy innovation programs provides a greater variety of technology options and ensures that New York retains the capacity to scale critical technologies necessary for meeting its energy goals supported by a thriving innovation ecosystem. The State's leadership and commitment to technology innovation will be needed to help counter uncertainty in the federal policy context, including cuts to the US Department of Energy (DOE) technology research and demonstration budgets that risk stalling momentum on advancing new technologies to commercial adoption, tax policy that undermines private-sector confidence to invest in energy systems, and risks to the country's global position in leading technology development. In contrast, New York's continued commitment to innovation and market development—such as incentivizing clean energy supply chains to locate within the State—can attract investment, improve supply chain resilience, and drive long-term economic competitiveness for New Yorkers. By acting decisively, the State can retain its role as a national anchor for clean energy innovation and bring value to New York's economy and national security.

The New York State Energy Research and Development Authority (NYSERDA) leads the State's clean energy innovation, research, and deployment programs. Empire State Development (ESD) leads critical efforts to provide support for innovation and business development activities for new and existing New York businesses. The New York Power Authority (NYPA) pilots early-stage technologies, enables simulations to de-risk new technologies, and mobilizes new technologies to scale. The State's academic institutions, including the State University of New York (SUNY), play a vital role in fostering New York's research and innovation ecosystem. Together, NYSERDA, ESD, SUNY, and NYPA regularly coordinate activities with other relevant agencies on policy, procurement, and community engagement. As New York welcomes new industry partners, extensive cross-agency collaboration will be needed to ensure that the associated energy demand can be met with clean energy supplies.

1.1. Technology Life Cycle and De-risking

New technologies take time to mature, particularly in energy where various trade-offs, such as cost, performance, land-use, and community benefits must be considered. The life cycle of new energy technologies can be broken down into the following stages: research and product development, demonstration and validation, commercialization, market adoption, and scale up (see Figure 1). Typically, the public sector—whether state, federal, or otherwise—invests in the earlier stages and provides funding to evaluate the performance and benefits, lowering risk for private investors and enabling beneficial technologies, solutions, or services to reach a greater scale. This intervention can result in fast-tracking solutions, returning them to research, or eliminating them from consideration.

Figure 1: Maturation Stages of Innovation Investments

Sustained support throughout the later stages of the lifecycle, such as demonstration, commercialization, and market adoption, also plays an important role. Innovation programs accelerate the transition from lab to market by reducing financial risk, aligning technologies with regulatory frameworks, and facilitating partnerships with private industry. Commercialization programs can also play a role in identifying and importing mature, proven technologies from other markets and scaling their deployment to meet the State's energy needs. If market adoption occurs, scaling up product supply and manufacturing to needed levels must be considered throughout the process. The ability to manufacture products in New York State to meet market demand in New York can result in economic growth and in certain cases, cost reductions.

The maturation of clean energy investments can be tracked by several metrics, such as Technology Readiness Level (TRL), Commercial Readiness Level (CRL), and Adoption Readiness Level (ARL). ARL has more recently been employed as a holistic framework for predicting the deployment and scale-up of energy technology investments. For example, NYSERDA's Innovation & Research team[1] is transitioning to the use of ARL to account for technical, market, policy, and other ecosystem factors to better evaluate appropriate projects and track progress toward stated goals. This evolving and adaptable framework, combined with coordinated research, development, and demonstration (RD&D) projects and strategic partnerships, is expected to improve success rates and enable more precise tracking of meaningful progress. This includes not only financial outcomes but also measurable energy and non-energy benefits. Additionally, based on historical trends, investments in innovation are projected to yield broader economic growth benefits.[2,3]

1.2. Innovation and Clean Energy Affordability and Access

Investments into clean energy innovation programs have demonstrably positive effects on the deployment of emerging technologies, lowering energy system costs, increasing energy efficiency, and providing positive environmental impacts. Investments in innovation drive down the cost of more energy-efficient consumer products and equipment, reduce overall costs of the energy system, as well as

improve reliability. For example, national investment in energy technology innovation, development, and market adoption has led to a substantially lowered cost of wind, solar, large-scale batteries, heating, and cooling technologies.[4,5] In a similar manner, other candidate clean firm power generation resources can achieve cost reductions over time through successive learning cycles due to innovation, labor and technology optimization.[6,7]

Successful innovation can also unlock advanced grid capabilities such as dynamic line rating, power flow control, streamlined integration of demand response, virtual power plants, grid interactive buildings, electric vehicles, and flexible industrial processes. These advancements can reduce the need for unnecessary transmission buildouts, lower system costs, and enhance the reliability of the electrical grid as it transitions to a new mix of energy generation sources.[8] Examples of these strategies include:

- **Grid Modernization Cost Savings[9]:** Funding dynamic line ratings enables utilities to optimize electricity flow without costly new transmission lines, reducing congestion-related expenses and stabilizing rates.
- **Technology Cost Compression:** Investments in advanced building envelopes, heat pumps[10], and geothermal loops help lower upfront costs, eventually curbing overall electricity demand and easing pressure on retail prices.
- **Enhanced Reliability Measures:** Utility-scale long-duration storage and other advanced technologies serve as crucial buffers during power fluctuations or emergencies, mitigating large-scale outages and ensuring a more resilient energy system for all New Yorkers.

These investments, over the long term, result in more affordable energy and a cleaner environment. Strategic innovation investments can ensure that environmental benefits, cost savings, and revenue opportunities accrue to disadvantaged communities (DACs). Additionally, investments in innovation can also de-risk and identify optimal siting locations for microgrids and community-owned power systems, which can lower energy costs and support local job growth. Select NYSERDA case studies are summarized in Section 2.1.

2. State of the Sector: New York's Innovation Ecosystem

Innovation ecosystems are communities of interacting stakeholders engaged in producing, enhancing, and creating novel methods, products, and processes that support goals such as the deployment of zero-emission energy generation, transmission modernization, and energy storage. These ecosystems provide the infrastructure, resources, and supportive environment needed to drive RD&D and commercialization of novel solutions. Looking ahead, a strong innovation ecosystem will continue to enable the transition to an equitable clean energy economy.[11]

New York boasts one of the most robust innovation ecosystems in the United States, ranked third nationally (after California and Texas) in both clean energy and technology sector jobs and second (to California) in total RD&D spending. [12,13,14] New York State promotes innovation by providing subject matter expertise, strategic connections, convening opportunities, and targeted financial incentives to support small businesses across industries including, but not limited to, life sciences, cleantech, and

artificial intelligence (AI). For hardware-based technologies, the State has established more than a dozen shovel-ready sites for manufacturing and industry since 2021, incentivizing companies (including Wolfspeed and Micron) to grow their operations in the State. New York is home to eleven “Research 1” (R1) higher education research institutions, tied with California for the most of any U.S. state, underscoring New York as a critical player in fostering research and innovation.[15]

A holistic Innovation ecosystem across the State helps enable the maturation of needed energy technologies and businesses. New York is now home to over 650 cleantech small businesses, making it the second-largest hub in the U.S. after California.[16] Despite these high rankings, the number of North American cleantech investment deals has recently declined by 25 percent in 2023 relative to the 2021 peak,[17] with more recent reports suggesting a reduced level and stabilization in in 2024 and 2025 relative to 2023. [18,19] Complementary funding sources and technology development funding in the State can help enable continued cleantech ecosystem growth despite this recent decline.

New York is committed to a dynamic clean energy innovation ecosystem to expand the supply of reliable clean energy sources, reduce greenhouse gas (GHG) emissions, and ensure clean energy affordability and accessibility for all New Yorkers. The Scoping Plan for the Climate Act called for expanded investment in innovation essential to “advancing a full portfolio of options and mitigating risk” to meet the 2050 targets set out in the Climate Act. The Scoping Plan also called for targeted innovation in technologies that support decarbonizing buildings, long-duration storage, flexible electric loads, carbon sequestration solutions, low-global-warming-potential (GWP) refrigerants, and alternative fuels from agricultural residues, among others.

Building on the success of past investments, New York continues to support innovation that delivers tangible benefits, including building sensors and controls for more efficient heating and cooling, ground source heat pumps, and grid-responsive technologies.[20,21] These efforts are helping to scale up high-impact local energy industries for dynamic load management alongside encouraging the growth of key local energy ecosystems including battery storage, offshore wind, and transportation technologies (see insets).

New York's leadership on batteries and energy storage innovation has been recognized by major federal awards:

New-York-based coalitions, led by the State University of New York at Binghamton (Binghamton University), were the only entities in the United States to have won all three recent place-based economic development competitions from the U.S. Economic Development Administration (EDA) and the National Science Foundation (NSF). Funding for these initiatives to date exceeds $100 million. Both ESD and NYSERDA provided financial, advisory and letters of support.

The Binghamton University-led "Upstate New York Energy Storage Engine" initiative was awarded up to $160 million over ten years from the NSF to establish an industry hub for energy storage componentry. ESD is providing up to $16 million of additional state match funding for this program.

The Binghamton University-led New Energy New York consortium was awarded an EDA Tech Hub designation for end-to-end battery development and manufacturing. This national designation helps unlock federal funding opportunities and serves as a nationwide highlight of the region as a leader in energy storage technologies.

ESD and NYSERDA Jointly Support Scale-Up of Clean Ammonia-to-Power Technology in New York

Amogy, a Brooklyn-based startup developing ammonia-to-power systems. With NYSERDA and ESD support, Amogy located to the Brooklyn Navy Yard in Kings County, formed a contract manufacturing agreement with Rochester-based PEKO Precision Products and successfully demonstrated an ammonia-powered tugboat on the Hudson River. The company subsequently raised more than $270 million in funding to further scale its technology for maritime use, and more recently, for carbon-free power generation, a capability important to leverage toward New York's goals for a zero-emissions electric grid. Amogy's trajectory highlights how strategic state support can accelerate commercial readiness and attract large-scale investment to New York.

New York's clean energy innovation strategy is supported by programs administered by NYSERDA, ESD, SUNY, and NYPA, alongside the broader innovation ecosystem that includes industry, utilities, national labs, academic and financial institutions, non-profits and community organizations. Table 1 provides an overview of key New York clean energy innovation programs and investments.

Table 1: Overview of Key Current Statewide Energy Innovation Programs

Agency	Focus Areas	Relevant activities	Initiatives
NYSERDA	Commercialization & Ecosystem Support	Facilitate RD&D and commercialization efforts, business support and training for startups, scale up support for key energy technologies	Carbontech Development Initiative (CDI), Activate New York, The Clean Fight, Scale for ClimateTech; Venture for ClimateTech, ClimateTech Expertise Network (formerly Entrepreneur-In-Residence)
	Grid Modernization	RD&D and commercialization to support a high-performing future grid	High Performance Grid, Future Grid Challenge, Grid Climate Ready Capital; Grid of The Future Study, BIL Grid Resilience Formula Funding
	Power Generation & Storage	RD&D, and commercialization to support novel forms of zero emissions power, advanced nuclear, and energy storage.	National Offshore Wind R&D Consortium (NOSWRDC); Long-Duration Energy Storage; Advanced Battery Innovation Demonstrations
	End-Use Technologies	RD&D and commercialization to improve building energy efficiency, clean modes of transportation, industrial and data center load management	NextGen Buildings, NextGen HVAC, Enabling Innovative Clean Energy Building Solutions, Empire Technology Prize, Clean Transportation Prize Initiative, E-mobility Technologies,
	Energy Focused Environmental Research	Research and studies providing objective, scientific information to guide policy decision-making & investment in technology	Advanced Nuclear Master Plan, New York Hydrogen Assessment, Evaluating Emission-Free Technologies for New York's Energy Future; and technical analyses of Energy Efficiency, Alternative Low-carbon Fuels, Large Scale Renewables, Emissions, and Energy Assurance and Emergency Plans
	Alternative Fuels, Thermal Energy Networks & Negative Emissions Technologies	RD&D and commercialization of carbon capture, carbon sequestering products, zero-emissions fuels for heat, power and transportation.	Natural Carbon Solutions; Clean Hydrogen Innovation; Utility Thermal Network Technical Support; Low carbon fuels production and application in hard-to-electrify sectors
	Climate Resilience Innovation	RD&D to mitigate impacts of climate change on the energy system.	Market Characterization & Design; Technical Assistance for MUNIs and COOPs for grid resilience.
ESD	Innovation Financing	Provides equity investment capital to pre-seed through Series B innovation start-ups in clean energy. It also has a program where it makes commitments to venture capital fund managers, including those supporting climate and clean energy start-ups.	NY Ventures (various funds).
	Innovation & Commercialization Programs	Administration of innovation centers and hubs, grants support innovation activity, technical assistance for small- and medium-size firms.	Division of Science, Technology and Innovation (NYSTAR), which includes Centers for Advanced Technology, Centers of Excellence, Manufacturing Extension Partnership centers, incubators, hot spots, accelerators and venture competitions.

Agency	Focus Areas	Relevant activities	Initiatives
SUNY	Education and Research Capacity	With 64 campuses, SUNY is the largest comprehensive university system in the US, educating approximately 468,000 students, 7,500 degree and certification programs.	SUNY Climate Research Task Force.
	Research & Commercialization Programs	Numerous ongoing research programs across campuses, including battery storage technology at Binghamton, wind and solar technologies at many schools, and materials for the nuclear industry at Stony Brook. SUNY has launched a climate research task force that build on these efforts to develop a clean energy research strategy.	SUNY Energy Research Centers and Commercialization Hubs; Decarbonization Leadership Program; NENY Battery Tech Hub; Stony Brook Advanced Energy Research and Technology Center, University at Buffalo Renew Institute, and the Binghamton University S3IP Center of Excellence.
	Demonstration of Clean Energy at Scale	SUNY has ambitious plans to decarbonize its campuses to meet Climate Act goals, has clean energy master plans for all campuses, is part of the State's Decarbonization Leadership Program, and has secured over $100 million in Bond Act and other State funding for implementing thermal energy networks.	SUNY-NYSERDA innovation partnership.
	Workforce Development	Offering nearly 2 million workforce and professional development programs.	See the Clean Energy Jobs and a Just Transition chapter of this Plan for additional discussion.
NYPA	Advanced Grid Innovation Lab (AGILe)	Digital twin to derisk new technologies through modeling	Testing of transmission, distribution, DER technologies and cybersecurity under a broad range of scenarios.

2.1. NYSERDA

NYSERDA engages with various stakeholders across the entire New York State innovation ecosystem to develop and expand relevant programming with a focus on accelerating solutions that provide affordable and reliable electricity and energy, and create additional benefits to the environment, public health, and the economy. Stakeholders include ratepayers, the Public Service Commission (PSC), public and investor-owned utilities, businesses (early-stage and established), State, federal and municipal governments, private investors, academic institutions, as well as community groups and non-governmental organizations.

Informed by engagement with these key stakeholders, NYSERDA creates value through programs that accelerate the path to market for key technologies and services through lowered costs and improvements in performance. NYSERDA's programs accomplish this by:

- **De-risking clean energy technology development and deployment** and enabling aspects of the energy transition that appear unlikely to happen otherwise, generally by providing non-dilutive capital with performance-based contracts.
- **Expediting and scaling the energy transition** with validation, adoption, and business support through incubators, customer matching activity, and commercialization training.
- **Improving ultimate ratepayer affordability** by lowering costs and increasing access to beneficial technologies.

- **Enabling greater co-benefits** through supporting needed supply chains, manufacturing and job growth, while supporting environmental quality.
- **Aligning innovation ecosystem to policy goals** serving as a liaison between regulators and companies, ensuring all supported technologies align with policy goals and ratepayer benefits.

Before any innovation investment or program is approved for implementation, stakeholder engagement as well as a rigorous set of criteria is used to evaluate the potential benefits, and establish a clear market need, a clear role for NYSERDA to add value, non-duplication of existing efforts, and a clear case for potential rate payer benefits. Impacts of these investments are assessed using several indicators, including funding leveraged for every dollar of investment by NYSERDA from co-investment and revenue, as well as energy related impacts after a technology has been deployed. Alongside direct investment that supports new product development and demonstration, NYSERDA supports research that delivers objective information to the public, such as trade-offs in cost, performance, and other attributes of forward-looking energy technologies that influence and coordinate other investors and industry.

Between 2016 and 2023, $490 million in funding was committed across focus areas summarized in Table 1.[22] To date, impacts of these investments include commercialization of over 200 products, replication of 985 demonstrated technologies, nearly $20 million in product revenue, and over $3.5 billion in leveraged funds from other sources. In addition, NYSERDA-sponsored research produced nearly 250 peer-reviewed publications to support energy investments, policy initiatives, and general information to be disseminated in the public interest.[23] Specific examples include:

- **The National Offshore Wind Research & Development Consortium (NOWRDC).** Established in 2018 as a not-for-profit public-private partnership, NOWRDC focuses on advancing offshore wind technology in the United States. NYSERDA provided $20.5 million in funding, leveraging an additional $35 million from the DOE, Virginia, Massachusetts, California, Maine, Maryland and New Jersey. Results of impacts to date suggest that deploying innovations supported by NOWRDC lowers the Levelized Cost of Energy (LCOE) by up to 10% and increase annual energy production up to 4% from offshore wind.
- **Grid Modernization**. $6 million awarded to Central Hudson for grid modernization (including sensors, smart inverters, automated transmission and distribution management systems), helped increase grid efficiency, reduce costs and improve reliability by predicting and withstanding power outages. Impacts included $41.7 million in avoided electrical upgrades and $28 million in environmental benefits from 740,000 avoided metric tons of CO_2 (over 20 years), as well as improvements in reliability. NYSERDA's investments de-risked key innovations and leveraged $53 million in investment by Central Hudson, with the total estimated benefits valued at $12.83 for every $1 of NYSERDA investment.
- **RD&D for End-Use** in buildings have catalyzed significant co-investment to replicate and scale up demonstrated technologies, such as drilling equipment and ground source heat pumps by Dandelion Energy and window mounted heat pumps by Gradient. Together, these two examples

leverage over $200 million of additional investment from $2 million of initial NYSERDA investment.

NYSERDA's commercialization programs support the conditions necessary for new technologies to enter and grow in the New York market to enable a greater scale of impact. NYSERDA's commercialization programs fund organizations that provide structured business development services, access to partners and investors, technical assistance, and facilities to accelerate time to market. Over the past six years, the number of incubators and accelerators in New York has more than doubled and companies supported by NYSERDA-backed incubators have reported bringing products to market up to four times faster than those without similar support. Participants in NYSERDA-supported programs reported, on average, 16 times higher revenue than peer companies. Key programs include:

- **ClimateTech Expertise Network & For ClimateTech:** One of the persistent challenges for early-stage climate ventures is access to capital. NYSERDA provides capital and technical assistance to help companies secure follow-on investment and scale their operations. Between 2018 and 2023, companies supported through the ClimateTech Expertise Network and the Venture and Scale for ClimateTech initiatives raised approximately $1.6 billion in follow-on funding. This includes private investment, venture capital, and federal grants. NYSERDA has directly engaged over 800 entrepreneurs across New York through the ClimateTech Expertise Network.

- **M-Corps Initiative:** NYSERDA has emphasized the importance of connecting[24] energy innovation with local manufacturing. NYSERDA's M-Corps initiative supports startups in transitioning from prototyping to production, with a specific emphasis on working with New-York-based manufacturers. M-Corps provides funding and technical support to facilitate design optimization, secure production partnerships, and reduce the time to manufacturing readiness.

- **Carbon Tech Development Initiative:** In 2021, NYSERDA launched the Carbon Tech Development Initiative to leverage the State's academic research base and industrial capabilities to improve the efficiency and cost of capturing CO_2 and converting it into commercially viable products such as fuels, building materials, and industrial inputs. The initiative aims to advance lab-to-market transitions, support early-stage demonstration, and attract commercialization partners. While still in its early stages, the initiative has contributed to placing New York in a leadership role in driving these enabling technologies to market and attracting new businesses and talent.

In October 2025, the New York State PSC approved the NYSERDA petition regarding a $412.3 million 2026-2030 Innovation and Research (I&R) portfolio, providing a 5-year guideline for innovation investments.[25] Under these guidelines, NYSERDA will begin implementation in 2026 through further collaboration with the PSC, DPS and relevant stakeholders.

2.2. ESD

ESD plays a key role in spurring and supporting new clean energy industry growth by providing resources to new and existing New York businesses to develop and scale innovative technologies, including clean energy technologies. Through NYSTAR and NY Ventures (part of the Small Business and Technology

Development Division), ESD provides grants, technical assistance, equity capital, and other services to support incubators, innovation hubs, and small businesses. Key programs include:

- **Centers of Excellence and Centers for Advanced Technology:** These programs have established University-based centers focused on specific areas of technology. State funding is used to support collaboration between academia and private industry to help companies advance and succeed. There are several centers supporting clean energy development, including the Center for Future Energy Systems at RPI and the Advanced Energy Research and Technology Center at Stony Brook University.
- **State-certified Incubators and Hot Spots**: NYSTAR has twenty certified incubators across New York State, as well as ten certified Hot Spots (one in each economic development region). These aid early-stage startups with everything from space and equipment to curriculum and networking.
- **Accelerators and Venture Competitions:** NYSTAR oversees seven accelerators and venture competitions statewide. These are eligible both to NY-based startups, as well as are an attractor for startups globally that want to set up substantial operations in New York State. These span a number of technology areas, though most have cleantech-relevant companies included in their cohorts each year.
- **NY Ventures**: This program provides direct equity investments, matched to private sector investors, in high-growth innovation start-ups across the state. For example, NY Ventures recently invested $250,000 in the pre-seed financing round for Exodys Energy, a company that is working on recycling used nuclear fuel for a closed-loop nuclear system.
- The **Emerging and Regional Partner Fund** and the **Community and Regional Partner Fund** make investment commitments to venture fund managers including those that support clean energy and climate solutions start-ups.

2.3. SUNY

SUNY is involved in several facets of New York's innovation ecosystem: education, research, development, commercialization, and the demonstration of the adoption of clean energy at scale. As one of the largest university systems in the United States, SUNY serves nearly 1.3 million students in credit-bearing courses and programs and continuing education and community outreach programs.[26] In its Climate and Sustainability Action Plan, SUNY has committed to over 150 climate innovation-focused actions, including:

- **Educating the next generation of change agents.** Just as the higher education sector mobilized for the 1960s Space Race, today's institutions are poised to respond to the climate crisis by expanding both classroom and experiential learning opportunities. These initiatives are designed to deepen students' understanding of how climate change impacts communities, while highlighting pathways for leadership, innovation, and economic mobility.

- **Doubling investment in climate and clean energy research**. This includes establishing a dedicated Climate Research Task Force and launching at least one new center or innovation hub to advance agricultural technology, clean energy solutions, and resilient food systems.[27]
- **Decarbonizing SUNY's built environment.** With a portfolio encompassing 111 million square feet, about 40% of New York State's public building space, SUNY is pursuing deep decarbonization through early adoption of energy efficiency measures, renewable energy, thermal energy networks, and scalable demonstration projects. The system also seeks to double its on-site renewable energy generation to 66,000 megawatt hours.

Through its multi-campus Clean Energy Consortium, Offshore Wind Training Institute, and other faculty communities of practice, SUNY is developing a number of academic and training programs developed in collaboration with energy employers and other businesses in the clean energy innovation space. Programs range from advanced degrees in engineering, environmental services, and design and innovation, to certificate programs in welding, manufacturing, building management, and offshore wind technology.

2.3.1. Research and Commercialization

SUNY serves as the linchpin of the State's clean energy research and innovation portfolio. As a nationally recognized leader in clean energy research, SUNY holds one of the largest university-owned clean energy patent portfolios in the country. The 64-campus system includes three campuses at the forefront of clean energy advancement: Stony Brook University Advanced Energy Research and Technology Center, the University at Buffalo RENEW Institute, and Binghamton University's S3IP Center of Excellence.

Beyond these flagship centers, SUNY houses other key energy innovation initiatives, such as the Center for Sustainable Materials Management at SUNY ESF, which leads applied research on waste and the circular economy, and the Upstate 2.0 partnership between Cornell and SUNY ESF, which was awarded an NSF Regional Innovation Engines grant to develop fossil fuel replacement, robotics, and agricultural technologies. SUNY is also working with NYPA on a DOE research grant to site a commercial scale energy storage system that uses batteries with alternative materials to rare earths.

SUNY launched a Climate Research Task Force modeled on successful research strategic efforts for Artificial Intelligence (AI), biochemistry, quantum mechanics, and other areas that have provided a roadmap for funding and efforts. The Climate Research Task Force will look at clean energy technology, embodied carbon, and materials used in the advanced energy sector (including nuclear), among other areas of focus.

2.3.2. Demonstration of Clean Energy at Scale

SUNY's extensive facilities—2,833 buildings and 111 million square feet of owned and/or operated space—generate most of SUNY's Scope 1 and 2 GHG emissions. The State-owned facilities at SUNY campuses account for approximately 40 percent of all State-owned and managed buildings that need to be decarbonized to meet Climate Act and EO22 goals.[28] SUNY has committed to address this challenge and demonstrate decarbonization at scale by transitioning buildings' heating, cooling, lighting, and power systems from fossil fuels to clean electricity. In addition, SUNY is determined to reduce Scope 3

emissions used to create construction materials (embodied carbon) and emissions in the demolition and disposal of buildings after their useful life.

Facilities in the SUNY system are already cleaner and more efficient following successive implementation of projects addressing energy efficiency, building control, lighting, and other areas to meet Executive Order 111 (2004), Executive Order 88 (2012), and the State University Construction Fund's Directive 1B-2, which requires all SUNY projects to meet the NY Stretch Energy Code (2020).[29] Through renovations and new construction that meet the above standards, SUNY has decreased energy use in buildings by 12 percent since 2015, even as it expanded its total footprint by five million square feet. Overall, SUNY has reduced its energy use intensity (EUI) by 16.5 percent in the same period (and by approximately 22 percent between 2005 and 2024).[30] As a result of these initiatives, SUNY has reduced its gross Scope 1 and 2 GHG emissions by over 35 percent compared to 1990 levels, on track to meet the Climate Act's interim goal of a 40 percent reduction by 2030. This progress is continuing under EO22. For example, under the New York Power Authority's (NYPA) BuildSmart 2025 program, SUNY aims to reduce energy use by an additional 4.4 trillion British Thermal Units (tBTUs) by 2025.

Future deep decarbonization will require maintenance of that progress as well as a new approach to developing campus-wide heating and cooling infrastructure. In early 2024, SUNY completed 28 Clean Energy Master Plans for State-operated campuses, with four more in progress. These Clean Energy Master Plans, funded by NYSERDA and other sources, set a pathway to dramatically decarbonize facilities to net zero emissions by implementing geothermal heat pumps, district thermal energy systems, using waste heat from data centers and other sources, and full electrification of building heating and cooling systems. Around the same time, the Governor's Decarbonization Leadership Program was announced, under which NYPA will develop action plans for 15 of the top emitters statewide, which includes seven SUNY campuses.

SUNY is working with NYPA to ensure that the BuildSmart 2025 program builds on prior plans and advances projects for early completion. As a demonstration of support, Governor Hochul announced that SUNY can immediately invest $100 million in funds allocated by the New York State Clean Air, Clean Water, and Green Jobs Bond Act to design and build innovative thermal energy networks, renewable solar power generation, and other clean energy technologies. In addition, SUNY was allocated $140 million for thermal energy networks from the Sustainable Futures Fund that was created in the FY26 budget. Finally, SUNY is exploring opportunities to develop energy performance contracts and public-private partnerships.

Net zero ETEC building at University at Albany

ETEC is UAlbany's newest state-of-the-art and environmentally sustainable facility, a 246,000 square foot building that houses researchers, educators and entrepreneurs under the same roof as some of UAlbany's fastest-growing programs, including atmospheric sciences. ETEC aligns with SUNY's goal to achieve net zero carbon emissions and has received LEED Platinum certification, the highest level awarded by the Green Business Certification Inc. for energy-efficient and sustainable buildings. A

geothermal field of 190 wells and solar panels on the Uptown Campus Podium combine to save about 70 percent in energy costs, efficient fixtures reduce water usage by 40 percent, and the site includes green stormwater management including a porous parking lot and a teaching green roof.

SUNY Oneonta Clean Energy Demonstration Site

The SUNY Oneonta campus will serve as the site for long-duration energy storage (LDES) demonstration projects capable of delivering electricity for 10-24 hours. The demonstration will examine the effectiveness of innovative zinc-manganese technologies—from non-rare earth US-sourced abundant minerals—cost-effective in enhancing the resilience of New York's electrical grid and to contribute to the State's climate goals. This site will serve as one of two in support of a project developed by the New York Power Authority (NYPA), Rockland County-based Urban Electric Power (UEP). and Electric Power Research Institute (EPRI). The Project is supported by a $6.5 million award from the U.S. Department of Energy, and a $1 million award from the New York State Energy Research and Development Authority (NYSERDA), which were both, awarded in 2024.

2.4. The Broader Innovation Ecosystem of New York State

In addition to the targeted initiatives led by State agencies identified above (and summarized in Table 1), New York is home to a thriving innovation ecosystem comprised of numerous interconnected public and private entities. State government programs anchor and support this ecosystem with essential funding, expertise, and policy guidance, and play a critical coordinating role in fostering collaboration. This integrated approach helps innovations to transition efficiently from concept to commercialization while balancing economic growth with equitable impacts on all communities. Key elements of the State's innovation ecosystem include:

- **Educational Institutions** drive clean energy innovation in New York through advanced RD&D, workforce training, and public-private partnerships that accelerate technology development, support decarbonization, and fuel economic growth. In addition to the SUNY system, this includes Cornell University, Columbia University, New York University (NYU), City University of New York (CUNY) system, University of Rochester, Rensselaer Polytechnic Institute (RPI), Rochester Institute of Technology (RIT), Syracuse University, Clarkson University, and the New York Institute of Technology (NYIT).
- **Laboratories and Research Centers** throughout the State funded by a mix of private and public funds that are or can be applied toward energy innovation. Major facilities include GE Vernova Lab (GE Vernova), AGILe (NYPA), Advanced Energy Research Technology Consortium (AERTC) (Stony Brook University), ETIC (NYIT), Brookhaven National Laboratory, and the IBM Watson Research Laboratory.

- **Research and Technology Consortia** that focus on advancing innovation in a technology sector of interest. These entities unite researchers, developing and mature companies, manufacturers, and supply chains to promote and accelerate new technology to market. Leading examples include the New York Battery and Energy Storage Technology Consortium (NY-BEST), the National Offshore Wind R&D Consortium, and AERTC.
- **Venture-Focused Organizations** throughout the State provide support and funding for startup companies including incubators and accelerators, investor associations, and public-private organizations that foster collaboration and facilitate technology transfer and demonstration. Some leading examples include The Clean Fight, Launch-NY, Columbia Technology Ventures, the New York Climate Exchange, Urban Futures Lab at NYU, National Grid Ventures, the Long Island High Tech Incubator (LIHTI), Newlab, and the RIT Venture Creation Incubator.
- **Economic Development Organizations** in every region of the State that focus on attracting and retaining companies and jobs. These organizations often fund other elements of the innovation ecosystem, such as incubator and accelerator programs. This includes the ten Regional Economic Development Councils and the New York City Economic Development Corporation, in addition to ESD (which works statewide through its NYSTAR and other programs).
- **Military Installations** that can play a collaborative role in piloting advanced energy technologies to ensure resilience in operations as well as efficiency, including Fort Drum, Fort Hamilton, New York Air National Guard, Kings Point, and West Point.
- **Other private industry** includes major advanced manufacturers located in New York, investor-owned utilities with innovation initiatives such as ConEd and National Grid and tailored financial products across various financial institutions.

3. Recommendations

New York State can progress toward its long-term energy and climate goals by continuing to advance its clean energy innovation strategy and supporting a broad range of technologies and applications, including grid modernization, end-use energy applications in buildings, transportation and industry, power generation and energy storage, alternative fuels, carbon capture, and overall resilience and reliability of the energy system. Investments have the potential to enable a more affordable and reliable energy system, strengthen the State's innovation ecosystem and support economic growth.

As New York State anticipates emissions targets outlined by the Climate Act, continued investment in refining innovation programs and expanding commercialization capacity—through expanded manufacturing support, deeper capital networks, and public-private partnerships—will remain essential. New York will continue to evaluate emerging markets and identify opportunities where the State can mobilize existing capacity and assist in addressing barriers. The State should pursue the following recommendations over the time horizon of the plan:

- **NYSERDA, PSC, ESD, SUNY, and NYPA should continue to invest in in-state RD&D aligned with key priorities, policies and needs across all energy sectors.** This includes de-risking new

technologies by validating them in use cases for cost and performance benefits to accelerate deployment.

- **NYSERDA, SUNY, ESD, along with the broader innovation ecosystem, should continue to support commercialization activities across State innovation investments and beyond.** This includes activities such as supporting local startup growth and bringing market-ready products and businesses to New York State that have demonstrated performance in other states and countries. It further includes coordination and outreach across different states and organizations, as well as improving metrics of success with consideration of energy, financials, economic growth, and local communities.
- **NYSERDA, PSC, SUNY, together with other agencies and authorities, should continue to commission studies and performance evaluations** to provide objective information to the public on the trade-offs in cost, performance, environmental benefits, and policy compatibility of emerging technologies important for New York State's future energy portfolio.
- **NYSERDA, ESD, SUNY, and NYPA should work to strengthen and formalize partnerships across the statewide innovation ecosystem.** This includes working with other agencies, private organizations, and universities to accelerate deployment of key enabling technologies, aligning the broader innovation ecosystem, and activities such as developing strategic market roadmaps and matching appropriate demonstration sites (e.g., SUNY campuses, healthcare facilities, and municipalities) with first-of-a-kind demonstrations that have potential for widespread replication.
- **NYSERDA, ESD, and SUNY** should coordinate with other State agencies, universities, municipalities, and community organizations to consider development of a set of effective and feasible best practices for integrating the priorities, needs, and participation of disadvantaged communities (DACs)—including demonstration sites, project participation, and benefits assessments—given that investments in new services and technologies are an opportunity for improvements in energy affordability, reliability and new jobs that can all better serve DACs.
- **NYSERDA, ESD, SUNY, NYPA, and other partners in the New York innovation** ecosystem should build upon successful models to leverage economies of scale to accelerate cost reductions and market adoption of key energy technologies. Examples include collaboration between NYSERDA, the New York City Housing Authority (NYCHA), and NYPA on the design and demonstration of window-mounted heat pumps, where multiple stakeholder inputs were used to optimize and establish a strong demand signal, incentivizing manufacturers to invest in facilities needed to scale up a beneficial product for the broader New York market.
- **SUNY should continue to prioritize and expand its clean energy research and education portfolio and continue to identify opportunities to leverage SUNY's expansive physical footprint** (111 million square feet of conditioned space or 40 percent of the state's footprint, including 54,000 acres) to support clean energy demonstration sites, as well as support needed education and training for emerging energy technologies.

- **SUNY should continue to leverage its climate research task force** model to develop and advance a clean energy research strategy that builds on ongoing research programs across multiple SUNY campuses.

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21 "Innovation & Research," NYSERDA, accessed 2025, www.nyserda.ny.gov/All-Programs/Innovation-at-NYSERDA/Grid-Modernization.

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[24] Through the ClimateTech Commercialization Support initiative, NYSERDA targeted commercialization support to the Southern Tier of New York—a region that previously had limited entrepreneurial resources. This support helped expand access to business development services, contributing to significant regional gains. According to analysis by Saoradh Enterprise Partners, the Southern Tier now ranks first in the nation for per capita cleantech employment among innovation hubs.

[25] James Denn, "PSC Approves $412.3 Million Budget for Innovation & Research Portfolio," *New York State Deapartment of Public Service*, October 16, 2025, https://dps.ny.gov/news/psc-approves-4123-million-budget-innovation-research-portfolio (and see October 17th, 2025 "Order authorizing the 2026–2030 Innovation and Research Portfolio").

[26] "What is SUNY?" The State University of New York (SUNY), accessed May 29, 2025, www.suny.edu/about/.

[27] "Chancellor King Kicks Off SUNY Climate Research Task Force as Part of New York Climate Week," *SUNY*, September 24, 2025, www.suny.edu/suny-news/press-releases/9-25/9-24-25/crtf.html.

[28] Signed on September 20, 2022, Executive Order 22 Leading by Example directs State agencies to accelerate efforts to make State facilities and State operations more sustainable. A new first-of-its-kind interim design guide for State buildings standardizes recommendations for increasing energy efficiency, designing for zero emissions and climate resiliency in State buildings. This will help ensure that State investments effectively reduce emissions and deliver long-term benefits for New Yorkers, with integration into State projects beginning in 2025.

[29] In 2007, the SUNY Board of Trustees required that all new buildings meet at least a Leadership in Energy and Environmental Design Silver standard. Directive 1B-2 has built on that effort and requires all new construction at SUNY to be designed to achieve net zero carbon and be electricity-ready.

[30] This progress was made through energy efficiency, building control, lighting, and other retrofits with short paybacks. In addition, campuses switched out their dirtiest fuels like oil and coal. Binghamton University, for example, converted its central plant boilers from coal to natural gas and biomass.

New York State Energy Plan

VOLUME II | Energy and Our Lives

Environmental and Climate Justice

14

Key Terms Used in This Chapter

FOR THE COMPLETE GLOSSARY ➜

Climate Justice: Justice that links development and human rights to achieve a human-centered approach to addressing climate change, safeguarding the rights of the most vulnerable people and sharing the burdens and benefits of climate action and its impacts equitably and fairly.[1]

Climate Justice Working Group (CJWG): This body was created by the Climate Act and is composed of representatives from environmental justice communities across the state, including three from New York City, three from rural areas, and three from urban communities in upstate New York. It also includes representatives from the New York State Departments of Environmental Conservation (DEC)—which chairs the CJWG—Health (DOH), Labor (DOL), and the New York State Energy Research and Development Authority (NYSERDA).[2] The Climate Act requires the CJWG to establish criteria to identify DACs for the purposes of: (1) emissions reductions (greenhouse gases and co-pollutants), (2) regulatory impact statements, and (3) the allocation of investments related to the Climate Act.[3]

Community Air Monitoring (CAM) Initiative: The Climate Act required DEC to develop a CAM program to identify and measure air pollution in priority DAC locations that have the highest potential exposure burdens to air pollutants.[4] DEC used mobile air monitoring to conduct street-by-street assessments in 10 DACs. Using these results, community input, and other data, DEC is identifying air pollution sources and prioritizing areas of concern near sensitive sites such as schools and nursing homes. To guide this process, DEC established Community Advisory Committees (CACs) in each of the 10 DACs. These CACs will collaborate with DEC, the CJWG, and other state agencies to develop strategies aimed at reducing air pollution in DACs.

1 "Principles of Climate Justice," Mary Robinson Foundation – Climate Justice, https://www.mrfcj.org/principles-of-climate-justice/ accessed December 8, 2025.
2 N.Y. ECL § 75-0115 (2019).
3 N.Y. ECL § 75-0111(1)(b).
4 N.Y. ECL § 75-0115 (2019)

Disadvantaged Communities (DACs): The Climate Act defines DACs as communities that bear burdens of negative public health effects, environmental pollution, impacts of climate change, and possess certain socioeconomic criteria, or comprise high-concentrations of low- and moderate-income households. DACs are identified using criteria as established by the CJWG.[5] On March 27, 2023, the CJWG voted to approve the DAC criteria.[6] Indigenous Nations and Indigenous Peoples are included in the DAC criteria as individual members of census tracts as counted by the U.S. Census Bureau in counts of American Indian and Alaska Native population (a selected indicator) and as citizens of sovereign Nations or residents of Nation-owned territory if the Nation-owned territory (either sovereign territory or owned) exceeds five percent of the area of a census tract.

Indigenous Nations: Refers to any State- or federally-recognized Indigenous Nations (as indicated on the New York State Office of Parks, Recreation & Historic Preservation "Indigenous Nation Areas of Interest in New York State" map[7]), Nation-owned parcels, current reservation boundaries, or lands held in trust by the federal government for that Indigenous Nation. Nine Indigenous Nations reside within, or have common geographic borders with, New York State: Cayuga Nation, Oneida Indian Nation, Onondaga Nation, Saint Regis Mohawk Tribe, Seneca Nation of Indians, Shinnecock Indian Nation, Tonawanda Seneca Nation, Tuscarora Nation, and Unkechaug Indian Nation. The United States formally recognizes all but the Unkechaug Nation. The State of New York recognizes all nine Nations.[8]

Distributional Equity: Refers to the fair distribution of the benefits and burdens of energy policies and programs. In an equitable energy system, all communities receive a fair share of clean energy investments, job opportunities, cost savings, and pollution reductions.[9]

Energy Burden: The percentage of gross income that a household spends on energy. It is calculated by dividing the average housing energy cost by the average annual household income. When a household is described as energy burdened, that generally means that it spends more than six percent of household income on energy.[10]

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5 N.Y. ECL § 75-0101(5) (2019).

6 "Disadvantaged Communities Criteria," New York State Climate Act, https://climate.ny.gov/Resources/Disadvantaged-Communities-Criteria accessed December 8, 2025.

7 "Indigenous Nation Areas of Interest in New York State" New York State Office of Parks, Recreation & Historic Preservation, last updated August 2024, https://www.arcgis.com/home/item.html?id=59341d9537b54e439e2581e5ef468ad2.

8 New York State Climate Justice Working Group (CJWG) and New York State Department of Environmental Conservation (NYSDEC), 2023 Disadvantaged Communities Criteria Final Report, (New York State Climate Action Council, January 14, 2025), https://climate.ny.gov/-/media/Project/Climate/Files/Disadvantaged-Communities-Criteria/Technical-Documentation-on-the-Disadvantaged-Communities-Criteria---Final-Version.pdf.

9 American Council for an Energy-Efficient Economy, Energy Equity: Conceptual Framework, January 2021, https://www.aceee.org/research-report/e2101.

10 "Low-Income Energy Affordability Data (LEAD) Tool" U.S. Department of Energy, https://www.energy.gov/scep/low-income-energy-affordability-data-lead-tool, accessed December 8, 2025.

Energy Justice: Refers to the goal of achieving equity in both the social and economic participation in the energy system, while also remediating social, economic, and health burdens on those communities historically disadvantaged by the energy system. Energy justice in New York centers the concerns of DACs and aims to make energy more accessible, affordable, clean, and democratically managed for all communities. The practitioner and academic approaches to energy justice emphasize these process-related and distributive justice concerns.[11]

Environmental Justice: The fair treatment and meaningful involvement of all people regardless of race, color, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including a racial, ethnic, or socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies.[12]

Priority Populations: Veterans; Individuals with disabilities; Low-income individuals, whose household's total income is below or at 60% of the State Median Income, or whose household has been determined eligible for or is receiving assistance through the Home Energy Assistance Program (HEAP), Temporary Assistance for Needy Families (TANF), Supplemental Nutrition Assistance Program (SNAP), or other human service benefit programs; Incumbent or unemployed fossil fuel workers; Previously incarcerated individuals; 16- to 24-year-olds who are enrolled in or have completed a comprehensive work preparedness training program such as those offered by Boards of Cooperative Education Services (BOCES), technical high schools, Conservation Corps, YouthBuild, and AmeriCorps. The training program must include a combination of rigorous clean energy education with hands-on technical training. Eligibility of work preparedness programs under this category will be considered on a case-by-case basis; Homeless individuals; Single parents.

Procedural Equity: This refers to fair and transparent processes used for decision-making, resource allocation, and policy development. Decisionmakers create inclusive and accessible processes for developing and implementing clean energy programs such that all stakeholders have equitable access to participate.[13]

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11 "Section 1 – Defining Energy Justice: Connections to Environmental Justice, Climate Justice, and the Just Transition," Initiative for Energy Justice, n.d., https://iejusa.org/section-1-defining-energy-justice/.

12 Commissioner Erin M. Crotty "Commissioner Policy 29, Environmental Justice and Permitting," (NYSDEC, last updated March 19, 2003), https://dec.ny.gov/regulatory/guidance-and-policy-documents/commissioner-policy-29-environmental-justice-and-permitting.

13 American Council for an Energy-Efficient Economy, Energy Equity: Conceptual Framework, January 2021, https://www.aceee.org/research-report/e2101.

Key Findings → Environmental and Climate Justice

The benefits and burdens of energy systems and the impacts of climate change are experienced differently across communities. The concept of energy justice recognizes these disparities and aims to address social, economic, environmental, health, and other dimensions. Actions in the energy sector can help reduce the cumulative burdens faced by disadvantaged communities (DACs) by improving energy affordability and local air quality, increasing economic opportunity, and advancing additional community priorities. This chapter provides an overview of the State's approach to environmental, climate, and energy justice, outlines major initiatives underway, and recommends continued and additional actions.

- **Meaningful community involvement in energy project development is important.** The participation of New Yorkers in shaping the development of clean energy projects that will impact their communities helps make sure local needs and priorities are addressed.
- **Inclusive outreach strategies are important to achieving New York's commitment that at least 35 percent—with a goal of 40 percent—of the overall benefits from clean energy and energy efficiency investments are directed to DACs.** To support strong participation in clean energy programs, inclusive outreach strategies are key to overcoming mistrust, misinformation, language barriers, and low program awareness. Effective outreach needs to be community-based and culturally responsive to drive meaningful participation.
- **Procedural equity is grounded in meaningful stakeholder engagement in clean energy planning and program design to identify solutions to multiple burdens and barriers.** Advancing procedural equity under the Climate Act requires substantive participation of DAC stakeholders in clean energy planning and program design. Expanding stakeholder networks involved in State processes to include community-based organizations (CBOs) and local voices—especially those addressing social determinants of health—will help State clean energy policies be responsive to community needs and contribute to improved quality of life.

- **Clean energy investment presents opportunities for job creation and economic development in DACs.** Procurement and contracting can help increase the participation of Minority- and Women-Owned Business Enterprises (MWBE) and Service-Disabled Veteran-Owned Businesses (SDVOB) in energy initiatives, while community partnerships, workforce training, and unionized apprenticeships can support people living in DACs to pursue green careers. The commitment of directing at least 35 percent of all clean energy investment benefits to DACs should be optimized by configuring programs to capitalize on these opportunities.

- **Clean energy investments aimed at reducing air pollution in DACs are critical to advancing health equity.** Incorporating strategically designed, locally focused air pollution mitigation projects in DACs into broader clean energy investment portfolios can ensure meaningful and equitable health outcomes for New Yorkers.

- **Energy efficiency and clean energy policies should maximize the energy security, safety, health, and comfort of low-income households while reducing their energy burden.** To meaningfully advance energy justice, New York State must prioritize health and energy security, safety, and affordability for low-income households. This includes the strategic deployment of decarbonization measures that lower energy costs, preserve housing for low- to moderate-income (LMI) residents, and expand access to clean transportation and efficient heating and cooling solutions.

- **Interagency coordination is key to optimizing clean energy benefits for DACs.** Continued and stronger coordination among state agencies, utilities, and nonprofit organizations can support streamlined applications, better-coordinated programs and engagement models, and community partnerships to increase DAC resident participation and maximize the benefits of clean energy programs.

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1. Overview

The benefits and burdens of energy systems, as well as the impacts of climate change, are experienced differently across communities. The concept of energy justice recognizes these disparities and aims to address the social, economic, environmental, and health burdens faced by those communities historically disadvantaged by energy systems. The climate justice provisions of the Climate Act[1] are drivers to help advance equity, focused on delivering benefits of clean energy investments to disadvantaged communities (DACs), including Indigenous Nations.

1.1. Environmental and Health Burdens

Disadvantaged communities have historically experienced persistent environmental and health burdens that will require significant effort to address. These burdens are evident in climate and environmental data, population and health characteristics, and the infrastructure and sites linked to energy production and consumption.

Additionally, careful consideration and a deep commitment to government-to-government consultation is needed for any new or existing energy infrastructure near or likely to impact Indigenous Nations to avoid any disproportionate impacts.

Now-shuttered coal-fired power plants, as well as other industrial facilities pocketed across the state, have often left behind hazardous waste contamination. This legacy endures in the form of brownfields, Superfund sites, and coal ash disposal sites, many of which are in or adjacent to disadvantaged communities.

Furthermore, fossil power plants, which in many cases are many decades old, continue to emit harmful air pollutants, compounding the health risks for disadvantaged communities located nearby. Freeways and land uses such as waste transfer stations, bus depots, and warehouses and logistics centers have disproportionately been sited in low-income communities and disadvantaged communities, attracting heavy bus and truck traffic to those neighborhoods and resulting in high concentrations of vehicle emissions.[2,3] Exposure to these pollutants are associated with risks of respiratory and cardiovascular conditions and may be correlated with elevated rates of asthma and heart disease in disadvantaged communities.[4]

1.2. Energy Insecurity and Energy Burdens

Energy insecurity occurs when households cannot afford to meet their energy needs. At the end of 2024, nearly 1.4 million NYS households were in arrears with outstanding balances on their utility bills, and over 237,000 New York households experienced disconnection from their energy services that same year due to non-payment of utility bills.[5] These dynamics further exacerbate disparities in health and quality of life for vulnerable populations.

Climate change is deepening these disparities as well as making energy insecurity more life threatening. As extreme temperatures become more common, access to reliable energy for heating and cooling is increasingly critical. Low-income and DAC residents often live in older housing[6] that is more likely to have

inadequate heating and cooling systems and poor insulation, which exacerbates energy burdens and poses serious health risks during periods of extreme cold or heat.

1.3. Clean Energy as a Tool for Justice

Residents of disadvantaged communities face multiple environmental stressors and clean energy initiatives can help advance progress in several ways, including to:

- Alleviate household energy costs through weatherization and efficiency programs.
- Reduce fossil fuel combustion in buildings, transportation, and power generation to improve air quality.
- Promote economic development through green job creation.
- Advance community priorities through meaningful collaboration in planning clean energy programs and projects.

Clean energy delivers job opportunities as discussed in the Clean Energy Jobs and a Just Transition chapter, as well as local public health benefits, as discussed in the Public Health Impacts Analysis chapter of this Plan.

2. State of the Sector

This section provides a high-level overview of ongoing policy and programmatic initiatives aimed at advancing energy justice across New York State. The first three parts focus on key Climate Act targets: addressing barriers and opportunities to expand clean energy access and resilience, identifying disadvantaged communities, and tracking the clean energy benefits accruing to disadvantaged communities. The fourth part examines energy affordability and quality of life considerations, with cross-references to discussions in other chapters of this Plan. The last section elevates the distributional and procedural equity mechanisms that facilitate meaningful disadvantaged community inclusion in decision-making and implementation. While not exhaustive, the examples highlighted illustrate significant efforts underway to promote equitable outcomes.

2.1. Disadvantaged Communities Barriers and Opportunities Report

The Climate Act directed the New York Power Authority (NYPA), DEC, and NYSERDA to produce a *Disadvantaged Communities Barriers & Opportunities* report.[7] Released in 2021, the report identified four overarching categories of barriers that hinder equitable community access to clean energy.

1) **Physical and Economic Structures and Conditions:**
    - Aging housing stock requiring structural repairs before energy upgrades can be completed.
    - Deferred maintenance resulting in health hazards like lead, mold, and asbestos.
    - Economic and social structures that create barriers, such as the split incentive in rental properties where landlords must initiate upgrades, but tenants bear the utility costs.
2) **Financial and Knowledge Resources and Capacity:**

- Limited time, personnel, and data systems for community-based organizations to pursue clean energy opportunities.
- Diminished access to credit and financing options in DACs.
- Funding constraints for government agencies, limiting the scope of publicly financed clean energy programs.

3) **Perspectives and Information:**
   - Community mistrust of utilities and state agencies due to historical experiences of neglect and discrimination.
   - Misinformation that leads to skepticism of clean energy programs.
   - Insufficient community campaigns, bureaucratic complexity, and opaque processes curtail awareness and participation.
4) **Programmatic Design and Implementation:**
   - Gaps in information when establishing program benchmarks and objectives.
   - Complex eligibility requirements that exclude vulnerable populations.
   - Insufficient emphasis placed on community centered design.
   - Limited scope of interagency coordination.

The report also identified key opportunities to overcoming obstacles, organized into three strategic themes:

- **Ensure Processes are Inclusive:** Increase community engagement in decision-making processes.
- **Streamline Program Access:** Simplify applications and reduce barriers to access.
- **Address Emerging Issues:** Enhance adaptive capacity for climate and energy risks.

As outlined in the following sections, New York State has begun implementing solutions aligned with these themes. Additional recommendations for consideration can be found at the end of this chapter.

2.2. Directing Benefits from Clean Energy Investments to Disadvantaged Communities

Under the Climate Act, State agencies, authorities, and entities direct at least 35 percent, with a goal of 40 percent, of the overall benefits from clean energy and energy efficiency investments to DACs. This includes energy investments across key focus areas: housing, workforce development, pollution reduction, low-income energy assistance, energy, transportation, and economic development—all guided by the DACs' criteria established by the CJWG.

The Climate Act established the CJWG to identify DACs across New York State that should be prioritized for targeted GHG emissions and co-pollutant reductions, clean energy and energy efficiency programs,

projects and investments, and the prevention of disproportionate burdens. This 13-member body combined subject matter expertise with community-knowledge and lived experience to develop the DAC criteria through a three-pronged approach:

- **Data-Driven, Ground-Verified Burdens:** Indicators were evaluated based on data quality, statewide coverage and granularity, accuracy, and correlations to other indicators. Every census tract in New York State is ranked based on 45 indicators, spanning environmental and climate burdens, population health, and socioeconomic vulnerabilities. The top 35 percent of tracts with the highest burdens across these critical quality-of-life indicators are designated as DACs.
- **Inclusion of all Federally and/or State-Recognized Indigenous Nations that are co-located within New York State's borders:** This acknowledges the history of displacement and forced removal from Indigenous ancestral lands, as well as contemporary evidence of socioeconomic, public health and environmental vulnerabilities.[8]
- **Inclusion of all Low-Income Households:** All households earning at or below 60 percent of the statewide median income are included for the purpose of DAC investments and benefits accounting to ensure low-income households across the state remain a priority for program investment, regardless of the census tract they are located in.

Following input from New Yorkers on draft criteria, the CJWG voted to approve the final DAC criteria in March 2023. The CJWG is required to convene at least annually to review and, if necessary, adjust the criteria based on new data and scientific findings. As part of its annual review, in February 2025, the CJWG voted to update the data sources for the DAC criteria. As a result, an updated map is expected to be released in the latter part of 2025. For an interactive map of the DACs across the State and additional documentation, visit the DAC criteria section under the Resources tab of the Climate Act's website.[9]

2.3. Tracking Investments and Reporting Benefits to Disadvantaged Communities

New York State has begun and will continue to further develop the tracking and reporting of investments and benefits to DACs. Compliance with the 35 percent minimum investment requirement will focus on place-based investment, i.e., those projects that can reasonably prioritize or target investments to individuals, households, businesses, and other entities within specific geographic areas, or directly serving low-income households, identified by the DAC criteria.

Reporting is underway focusing on ratepayer programs within the New York State Public Service Commission's (PSC) jurisdiction, including NYSERDA's Clean Energy Fund portfolios. Ratepayer-funded clean energy programs are expected to represent a substantial portion of the State's place-based DAC investment. From 2020–2023, 47 percent of place-based ratepayer-funded energy efficiency and electrification related investments were in a DAC or serving low-income households.[10]

NYSERDA and DEC are collaborating with other agencies on guidance applicable to all reporting entities in the State. Statewide DAC reporting is in development to provide a comprehensive understanding of progress and guide investment over future years. For more information, visit the Resources section of the New York State Climate Act website.[11]

2.4. Energy Affordability and Cost of Living

Across the State, low-income New Yorkers have the highest energy and transportation cost burden. On average, New York households in the lowest income earning quintile (the bottom fifth) devote 9 percent of their income to household energy expenses and nearly 5 percent to transportation energy expenses for a total of 14 percent of household income devoted to energy expenses. For comparison, the table displayed below shows the energy and transportation burdens across all income quintiles.[12]

Table 1: New York State 2022-23 Consumer Expenditure Survey

Source: U.S. Bureau of Labor Statistics. Consumer Expenditure Surveys. New York: 2022 and 2023.

Burden	**Lowest income quintile**	**Second quintile**	**Third quintile**	**Fourth quintile**	**Highest income quintile**
Household energy burden	9.4%	5.8%	3.5%	2.6%	1.5%
Transportation energy burden	4.9%	3.7%	3.2%	2.2%	1.1%
Household energy plus transportation energy burden	14.2%	9.5%	6.7%	4.8%	2.6%

Disruptions to the continuity of federal funding for the Low-Income Home Energy Assistance Program (LIHEAP), the Weatherization Assistance Program (WAP), and other social safety net programs—by the current U.S. Administration or a future one—would worsen the already significant challenges of energy burden faced by low-income New Yorkers. When every dollar is precious, even a small bill increase can have a significant impact on a household's financial stability. Recognizing how lowering energy bills can help New Yorkers living paycheck to paycheck cover other basic expenses, New York State has programs in place to support energy efficiency investments in homes for all consumers, with focused investments in DACs and for LMI households.

Consistent with the Barriers and Opportunities report findings highlighted earlier in this section, DAC residents often face significant hurdles to accessing energy efficiency retrofits and electrification upgrades. These challenges include high upfront costs of clean energy interventions in LMI households, needed repairs before energy projects can start. Another major obstacle is New York's aging housing stock. According to the 2021 American Community Survey, New York State has the oldest owner-occupied housing stock in the nation, with a median age of 62 years, much greater than the national median of 40 years.[13] These structures are often poorly insulated with inefficient appliances. Some buildings contain mold, lead, asbestos, and other health and safety risks that need to be addressed before energy efficiency retrofits can start. Additionally, income disparities correlate with the age and condition of housing.

As discussed in the Buildings chapter of this Plan, the clean energy transition offers a transformative opportunity to invest in and expand access to affordable and quality housing that is comfortable, energy efficient, and resilient. Prioritizing State support for LMI households and buildings in DACs to make energy-related upgrades will help make homes and communities healthier places to live.

On May 15, 2025, the PSC issued orders advancing ratepayer-funded energy efficiency and building electrification (EE-BE) programs for 2026-2030.[14] The EE-BE LMI Portfolio and Non-LMI Portfolio orders authorize a total of $5 billion in programs between 2026-2030 and guide investment by the utilities and NYSERDA in the next phase of ratepayer-funded building decarbonization programs. The orders include a focus on ensuring that at least 35 percent, with a goal of 40 percent, of ratepayer-funded investments are collectively made within geographic DACs and require utilities and NYSERDA to engage with stakeholders in the development and performance of programs. This is in parallel with continued investment in LMI housing energy efficiency and electrification outside of geographic DACs statewide.

The Transportation chapter of this Plan considers actions to expand clean transportation options, which also is critical to improving quality of life and reducing pollution and economic burdens in DACs. The Electricity chapter of this Plan speaks to continued investment in clean electricity, which will be the main fuel source replacing fossil fuels currently used in buildings and transportation. The Electricity chapter also addresses State laws that govern the siting and permitting of energy generating facilities, including consideration of whether a facility may cause or contribute to a disproportionate pollution burden on a DAC.

2.5. Procedural and Distributional Equity in Action

Procedural Equity: New York State has undertaken a government-wide effort to strengthen procedural equity across its programs by fostering meaningful public engagement. Examples include DOL's outreach to outdoor workers in shaping extreme heat guidance; DOS's engagement of communities in brownfield revitalization paired with renewable energy; DEC's Community Air Monitoring and other initiatives to improve access to public comment periods; and the DPS Energy Policy Planning Advisory Council (EPPAC), which strives to advance inclusivity in grid and transmission planning. The State also prioritizes transparency through hybrid meetings when required under the Open Meetings Law.

These agencies also participate in NYSERDA's Energy Equity Collaborative (EEC), a key interagency and community partnership co-designed with New York-based DAC-serving organizations to ensure meaningful input in shaping energy and related infrastructure decisions. The EEC centers the voices of disadvantaged communities in clean energy planning. A 13-member Steering Committee of CBOs co-leads the EEC with NYSERDA, guiding its structure and advising on early-stage planning. Community partners participate in one of four topic-specific working groups, listed below, that meet regularly with NYSERDA and other agency staff to co-develop strategies on policy, program design, and outreach.

- **Energy Transition:** Focuses on inclusive co-design and accountability for renewable energy projects and clean transportation initiatives, disseminating accessible program information, and facilitating novel community ownership options for clean energy projects.
- **Housing and Building Efficiency and Electrification:** Aims to improve outreach to DAC renters and homeowners, enhance collaboration with state agencies, and remove barriers to accessing NYSERDA resources for home and building electrification.

- **Workforce Development and Economic Opportunities:** Works to create pathways into energy sector careers, ensure community benefits from clean energy projects, and boost MWBE and SDVOB participation in energy initiatives.
- **Engagement and Access:** Develops frameworks for engagement and governance to improve procedural equity, transparency, and accessibility in NYSERDA and State climate and energy programs.

The PSC recently issued its EE-BE Orders for the period of 2026–2030, which continues to direct ratepayer funded support for the EEC and more generally to fund engagement for the development of building decarbonization programs in DACs.

Distributional Equity: New York State is implementing enhanced outreach strategies to more effectively engage every New Yorker, especially those living in DACs, in the development of a resilient and transformative clean energy economy. The goal is to ensure widespread public awareness of State climate and clean energy policies and make programs easily accessible so the benefits of the transition are equitably distributed, and all New Yorkers can enjoy a decent quality of life. Achieving this requires deliberate, sustained outreach in DACs where barriers to program uptake are often the greatest. Fundamental to this effort is the formation of strong partnerships with community leaders, local businesses, and institutions. This approach extends to targeted efforts by agencies such as the Department of Agriculture and Markets and the Soil and Water Conservation (SWC) Committee that are working to expand program access for beginning and first-time participating farmers through elevated communication and outreach to underserved agricultural communities. County SWC Districts have played a crucial role in reaching DAC farmers with a greater emphasis on projects within watersheds that serve these communities. A strong example of climate, environmental, and energy justice combined, this effort reduces emissions from food production and transport while bolstering resilience through a local, healthy food system.

A key initiative of New York State's work to build a thriving and inclusive clean energy economy is the Regional Clean Energy Hubs (Hubs) established by NYSERDA in 2022. Twelve Regional Clean Energy Hubs are located in each of the ten Economic Development Regions of New York State, with three Hubs in New York City to reflect its population density. Each Hub is made up of trusted, community-based organizations that are embedded in the regions they serve and bring experience spanning clean energy, energy efficiency, workforce and economic development, education, health, and housing. The Hubs assist individuals, small businesses, and affordable housing owners by providing information about clean energy benefits, ways to reduce energy use and costs, and how to make more informed energy decisions. Through multidisciplinary partnerships, Hubs deliver on several key areas of work:

- **Outreach & Awareness:** Hubs focus outreach and marketing on DACs to increase access and participation in clean energy programs. Messaging centered on affordability and bill savings has proven most effective for engaging DAC and LMI customers.

- **Energy Education:** Hubs offer energy literacy sessions and distribute self-install kits with items like low flow shower heads and LED bulbs. Follow ups after 60–90 days assess usage and program interest.
- **Partnerships:** Hubs leverage existing and new relationships with organizations in DACs to extend program reach and speed adoption.
- **Project Coordination:** Hubs help residents apply for programs and loans, refer them to partners, and align NYSERDA-funded projects with other local, state, and federal programs.
- **Equitable Engagement & Regional Capacity Building:** Hubs develop Regional Assessment and Barriers Analyses (RABAs) and Outreach and Equitable Engagement Plans to guide outreach and ensure funded efforts yield tangible benefits for DACs.
- **Workforce and Small Business Development:** Hubs work with local trainers and clean energy companies to expand career pathways and business opportunities for DAC residents.
- **Local Project Support:** Hubs pilot innovative strategies to reduce engagement barriers–like murals in the Southern Tier and contractor training in the North Country.
- **Community Campaigns:** Hubs lead targeted community campaigns to promote clean energy solutions, such as a community solar campaign underway in Western New York.

As of June 2025, more than 60 Hub organizations are working across New York State to ensure that LMI households and DACs, who often face the highest energy burdens, are prioritized for participation in and benefit from clean energy programs. In just over three years the Hubs have supported more than 7,000 customers, made over 13,000 program referrals, and organized or participated in more than 6,000 outreach events, including at food pantries, festivals, career fairs, and housing expos.

3. Recommended Actions to Accelerate Progress Towards an Equitable and Just Energy System

This section presents six themes with recommendations consistent with the chapter's key findings, each accompanied by a non-exhaustive list describing relevant past and ongoing initiatives for context. These initiatives expand on or are supplementary to those described in the previous section. While each initiative is listed once, under the theme to which it is directly relevant, it may also serve as a meaningful example for several other recommendations.

As noted in the Overview, Indigenous Nations are included in the State's definition of DACs. In recognition of Indigenous Nation sovereignty, please refer to the Local, Regional, and Federal Government Collaboration chapter of this Plan for discussion of New York State's engagement with Indigenous Nations and inter-government consultation.

3.1. Improved Engagement

New York State is committed to advancing equity in the energy sector by fostering community engagement and creating more opportunities for DACs to help shape policies, programs, and projects at every stage, from early ideas to implementation. In turn, this input can help improve access to clean

energy services and benefits in DACs. Community-led and community-involved processes offer a key avenue to support the tangible growth of a local clean energy economy within DACs, yielding cost savings, good green jobs, lower pollution, and small business development.

Major Initiatives: Procedural Equity

- **Community Air Monitoring (CAM) Initiative:** To ensure meaningful community involvement in the CAM initiative, DEC established Community Advisory Committees (CACs) in each of the 10 DACs selected for mobile monitoring. These CACs serve as platforms for local stakeholders to engage with CAM results and contribute to the development of community-guided mitigation strategies to reduce air pollution. DEC outlined a collaborative framework to facilitate this engagement, appointing a trusted community representative, or "co-convener," for each CAC. These co-conveners gather input, discuss findings, and identify priority areas for pollution reduction. Collectively, the CACs collaborate with the DEC, CJWG, and other state entities to prioritize recommendations and identify responsible parties for implementing actions.

- **DAC Consultant Pool**: NYSERDA has established a program for CBOs serving or representing DACs to apply to be paid for time dedicated to informing NYSERDA initiatives as part of the DAC Consultant Pool of qualified organizations. A range of CBOs are eligible to apply, including grassroots advocacy organizations, faith-based groups, environmental and climate justice organizations, as well as individual nonprofits, coalitions, and firms based in and with a substantial connection to those residing in DACs. Qualified applicants in the pool are available to work with NYSERDA staff through a variety of paid services. This helps NYSERDA alleviate obstacles for DAC representatives to participate in and inform how DACs can receive an equitable share of the benefits from clean energy investments and programs. The DAC Consultant Pool is the way NYSERDA engages organizations participating in the Energy Equity Collaborative initiative described earlier.

- **EPPAC:** Established by the PSC in August 2023, this council was intentionally designed to include DAC representatives as essential stakeholders in decision-making processes. EPPAC is structured to ensure that participants have a designated role and a strong platform to offer input during deliberations. Their inclusion exists at every stage of the EPPAC's grid and transmission planning work, from conducting initial assessments and scenario modeling to evaluating bulk power needs. The Council provides a model for meaningful participation, where DAC representatives can actively shape processes, co-create criteria, and access the same information as all other stakeholders.

- **Offshore Wind Environmental Justice Technical Working Group (OSW EJ-TWG):** In 2023, NYSERDA established the OSW EJ-TWG, joining the four OSW TWGs established in 2017 under the New York State OSW Master Plan. The OSW EJ-TWG is an independent advisory body led by NYSERDA to directly engage environmental and climate justice organizations, Indigenous Nations, OSW developers, federal agencies, workforce development organizations, and other stakeholders committed to a just transition who have an inherent interest and ability to develop the OSW industry in New York State. The OSW EJ-TWG provides a forum for discussion between

key parties working on New York State OSW projects that supports transparency, collaborations, data sharing, advice, and guidance to help steer New York State's efforts in ensuring OSW development prioritizes and benefits DACs.

Major Initiatives: Distributive Equity

- **DEC EJ Grants:** DEC's Office of Environmental Justice offers competitive grants to support and empower communities as they develop and implement solutions that significantly address environmental issues, harm, and health hazards, build community consensus, set priorities, and improve public outreach and education. Since 2006, DEC has awarded nearly $17 million in Community Impact Grants, with an additional $5.9 million made available in May 2025. Recent awardees included the GreenTech HVAC Training Initiative, which trains residents of the Rockaway Peninsula in the installation, maintenance, and operation of energy efficient HVAC systems. In the Binghamton region, the Clean Energy Empowerment project is helping residents understand clean energy career opportunities and how energy systems in their homes function, how to navigate energy improvement programs, and how to advocate for themselves with a utility. The New Rochelle EJ Initiative is amplifying two key programs that support air and water quality by educating the public on findings, raising awareness, and developing solutions for clean and green infrastructure.

- **Inclusive Solar Adder, Community Benefit Projects:** For community solar, NYSERDA provides a bonus incentive for project developers who undertake a combination of the following qualifying activities: offering bill discounts, providing workforce training and making hiring commitments of priority populations, demonstrating a close partnership throughout the project's development process with CBOs and stakeholders who represent the community where the project is sited, establishing community based or participant ownership models, prioritizing customers in DACs with Limited English proficiency, and siting the project within a DAC that serves eligible subscribers within the surrounding community.

- **NYSERDA Climate Justice Fellowship:** This workforce development initiative provides professional development training/mentoring to support full-time, year-long Climate Justice Fellowships for individuals from DACs and/or priority populations to advance climate justice and clean energy priorities for DACs.

- **NYSERDA's Clean Mobility Program:** This program, which focuses on DACs, helps communities plan and implement zero-emission transportation options such as bike share, bike ownership programs, micro transit, and EV car share. It provides funds for a planning track that supports local governments, transit agencies, and CBOs in evaluating needs and developing transportation solutions that match local priorities. Program funds are also awarded to projects on a demonstration track that expands mobility services and provides a model for replication elsewhere in the State.

Recommendations

- **New York State should conduct outreach to increase participation in energy planning and regulatory processes from more frontline nonprofits, faith-based institutions, CBOs, Indigenous Nation-led organizations, and Indigenous Nations** that can provide input that reflects the full spectrum of DAC needs, characteristics, and health vulnerability indicators.
- **New York State should conduct robust and inclusive engagement with DACs, including Indigenous Nations, during the siting and** development of large-scale energy projects. This engagement and consultation should utilize best practices and align with the requirements of forthcoming regulations under the Renewable Action Through Project Interconnection and Deployment (RAPID) Act and the Environmental Justice Siting Law, as applicable. Specifically, the RAPID Act requires developers to provide proof of consultation with local governments and Indigenous Nations before submitting a permit application to the Office of Renewable Energy Siting and Electric Transmission (ORES) and funds to support municipalities, local agencies, and community intervenors to participate in the process. The RAPID Act also requires meetings with local community members, including any DAC identified in the project study area. The EJ Siting Law, amending the Uniform Procedure Act, requires DEC to consider whether issuing an applicable permit may cause or increase a disproportionate pollution burden on a DAC.
- **New York State should sustain and expand the capacity for agency staff to support DAC stakeholder engagement in the early-stage design of clean energy programs** as well as in energy-related regulatory and public comment processes. This should include efforts such as ensuring language access through translation and interpretation, providing plain language explanations, conducting supplemental outreach during public comment periods, and increasing overall efforts to actively engage DAC stakeholders in decision-making processes.
- **New York State should support technical and operational capacity-building for CBOs that have a proven track record of serving or representing DACs, including Indigenous Nations.** This would:
    - Increase program participation among residents and small businesses within DACs.
    - Enhance local engagement and support planning, including the provision of legal and technical expertise, to facilitate community-led or community-owned clean energy projects. This includes Indigenous Nation-owned energy projects through Tribal Energy Development Organizations (TEDOs) to support Indigenous Nations' priority of developing local opportunities. See the Government Collaboration chapter of this Plan for more information about Indigenous Nation-owned energy projects.
    - Identify opportunities to improve CBO business models, securing additional revenue or funding to sustain their mission.
    - Reduce administrative burdens related to grant applications.

- **To build on and strengthen existing efforts that support host communities to benefit from energy projects in transparent, inclusive, and locally responsive ways**, New York State should conduct research into best practices for developing project benefits and translate findings into a *Best Practices Guide* for community benefit agreements (CBAs). This effort should draw from recommendations regarding CBA best practices underway in both the OSW EJ-TWG and the EEC's Energy Transition and Workforce Development and Economic Opportunities Working Groups. The resulting *Best Practices Guide* could be used to:
    - Support host communities in discussions with project developers under the engagement requirements of the RAPID Act.
    - Guide communities seeking to develop CBAs for other energy and supply chain projects outside the RAPID Act's scope.
    - Assist State entities in implementing programs where CBAs may apply.

3.2. Inclusive Outreach

Findings from the New York State DAC Barriers and Opportunities report and recent insights from the Hubs RABAs highlight that inadequate outreach by program implementers remains a persistent barrier to DAC participation in clean energy programs. Failure to meet communities where they are and build meaningful local presence has left knowledge gaps and lowered participation rates and benefits. Bridging these gaps through intentional, inclusive, creative, and culturally competent outreach is critical to maximizing the full potential of well-designed, justice-aligned clean energy efforts.

Major Initiatives

- **NYSERDA's Clean Transportation Prize Initiative:** This initiative supports projects that enhance mobility and cut emissions in DACs. For example, in Buffalo's lower east side, an area with high energy burden and dependence on public transportation, the Local Initiatives Support Corporation leveraged prize funding to engage residents in an e-bike program, thereby increasing the mobility options for commuters in the area.
- **NYPA's Environmental Justice Program:** This program provides tools, resources, and educational programming to communities near NYPA's statewide facilities and assets. Its Science, Technology, Engineering, and Mathematics (STEM) Education initiative offers energy-related, age-appropriate programs for students in Grades 3–12. NYPA's Adult Energy Literacy Program empowers residents to make positive energy choices for their families and communities, while also funding the retrofitting of old shipping containers into indoor hydroponic gardens. This food production system increases year-round access to organic fresh fruits and vegetables, using energy-efficient LED lighting in a controlled environment that significantly reduces energy, water, and land use compared to conventional farming. NYPA also provides weatherization workshops to community organizations that host indoor food production systems.

- **DEC's Climate Smart Communities (CSC) Program:** This program helps local governments take action to reduce GHG emissions and adapt to a changing climate. It offers grants, leadership recognition, and free technical assistance. Communities with a high proportion of low-income households or geographically designated DACs are eligible for 'no match' grants for EV charging stations from DEC's Municipal Zero Emission Vehicle Program. The Central NY Regional Planning & Development Board has partnered with DEC to develop regional maps that show EV charging station deserts in DACs and reveal the best locations for new EV charging stations, an example of targeted technical assistance and outreach through the program.

Recommendations

- **New York State should work proactively to address language barriers that may hinder participation in beneficial programs and regulatory processes by developing, regularly reviewing, and improving language access plans.** Building on the progress of New York State's current language access policy,[15] which took effect in 2022, State energy agencies and authorities that interact with the public should continue exploring ways to expand service provision through enhanced language access. Beginning with the 12 most spoken non-English languages in the state, efforts may include:
    - Regularly reviewing and improving language access plans and materials considered vital documents under the State's Language Access Law.
    - Translating outreach materials into languages commonly spoken in the communities served.
    - Hiring multilingual staff fluent in the primary languages spoken in target areas.
- **New York State should consider opportunities to leverage the forthcoming Extreme Heat Action Plan (EHAP) urban heat island map and DEC's Community Air Monitoring results to assist in conducting additional targeted customer outreach for clean energy programs such as weatherization, clean heating and cooling, solar + storage, and other green infrastructure.** These technologies can offer critical protection from extreme heat events and improved air quality, especially in neighborhoods with high vulnerability, offering compelling reasons for community engagement.
- **New York State should prioritize expanding community-based outreach and engagement strategies** that build trust and provide information about clean energy choices as well as increase program participation. Strategies should emphasize culturally relevant communication, face to face engagement, customer testimonials that highlight health and affordability benefits, and stronger partnerships with schools, community and health centers, and local businesses.

3.3. Air Pollution Reduction

Air pollution from fossil fuel combustion can disproportionately burden DACs, leading to health, social, and economic costs. Section 7(3) of the Climate Act requires that, "in considering and issuing permits, licenses, other administrative approvals and decisions, including but not limited to the execution of

grants, loans, and contracts, pursuant to Article 75 of the Environmental Conservation Law, all state agencies, offices, authorities, and divisions shall not disproportionately burden DACs" and "shall also prioritize reductions of greenhouse gas emissions and co-pollutants in DACs." Major in-state sources of air pollutants include diesel and gasoline-powered vehicles, onsite combustion of oil and natural gas in residential and commercial buildings and industrial facilities, and fossil fuel-fired power plants. While important programs are already underway, there is a critical need for more targeted strategies to reduce exposure to harmful emissions.

Major Initiatives

- DEC promulgated regulations, known as the **"Peaker Rule,"** to reduce harmful NO_x emissions from fossil-fuel fired simple cycle combustion turbines. As of May 1, 2025, 37 "peaking" units have retired. The retired units represent one gigawatt (GW) of older fossil fuel-fired generation and a significant reduction of pollution. In addition to shutdowns, additional emission controls were installed on 43 units totaling about 1.27 GW. Implementation of the rule is ongoing.

- DPS and NYSERDA launched the **Energy Storage Roadmap** in 2024 to deploy 6 GW of energy storage capacity by 2030 and an interim target of 1.5 GW by 2025. Energy storage systems will play a pivotal role in replacing fossil-fuel-fired peaking power plants statewide with renewable energy, reducing emissions from units which are disproportionately located in or nearby DACs.

- **PSC's Coordinated Grid Planning Processes:** Initiated in August 2024, this initiative charged utilities with identifying and implementing electric grid upgrades to support electrification in transportation and buildings and to address future capacity bottlenecks. To date, this pro-active funding has been meaningful in the South Bronx, which has some of the highest asthma rates in the U.S. This includes the Zerega Avenue Expansion, a Con Edison project designed to enable fleet electrification through improved grid capacity, and the Hunts Point Upgrade, a targeted pollution reduction strategy addressing a geographic area with elevated air pollution levels through electrification.

- **NYPA's Decarbonization Leadership Program:** New York's 2023–2024 Enacted State Budget authorized and directed NYPA to develop decarbonization action plans for 15 of the highest emitting State facilities. The decarbonization action plans will be developed with a focus on detailed investigation of large energy systems, analysis of energy efficiency measures, and the feasibility of using clean energy and thermal energy networks. The plans will evaluate the condition of existing systems, identify barriers to implementation, and consider the impact on maintenance costs and customer operations. The assessments will explore additional decarbonization measures, such as electrifying transportation resources and installing on-site distributed energy resources. NYPA expects to complete the Decarbonization Action Plans for all the identified state facilities by January 31, 2026. In a notable example, NYPA and OGS released an Energy Master Plan in May 2024 focused on decarbonization for the Empire State Plaza's 98-acre government complex in Albany. The multi-phased approach aims to transform the complex from utilizing an inefficient fossil fuel system into becoming a model of energy efficient clean energy infrastructure. Located in a DAC, the decarbonization of the Empire Plaza will not only

save New York State money through modern energy efficient infrastructure but also deliver significant health improvements and economic opportunities to the surrounding community.

- **Deactivation of small NYPA plants in New York City and Long Island:** The 2023-24 Enacted State Budget requires NYPA to deactivate its small plants in NYC and Long Island by 2030, provided this will not cause more than a de minimis net increase in emissions in DACs and that the plants are not needed for emergency or reliability purposes. On May 9, 2025, NYPA released its *Small Natural Gas Power Plant Transition Plan* in consultation with the PEAK Coalition, outlining its approach to analyzing emissions and grid reliability on a plant-by-plant basis. NYPA will assess potential emission increases and determine whether each plant is essential for reliability or emergency power. If not, NYPA will proceed with deactivation, gathering public input and coordinating with DPS, NYSERDA, the New York Independent System Operator, and other stakeholders. For plants that cannot be retired without harmful impacts, NYPA will revisit the decision every two years. NYPA is also exploring repurposing sites for energy storage and has entered into four non-binding agreements with developers to build storage facilities.

Recommendations

- **NYSERDA, in coordination with State and local agencies, should continue to advance retrofit offerings for homes and multifamily buildings that improve indoor air quality and address existing health and safety needs**, with particular emphasis on advancing these measures for projects located within DACs, including Indigenous Nations, and for LMI households.
- **New York State should explore all pathways to increased deployment of medium- and heavy-duty electric trucks and buses, along with charging infrastructure where feasible, to maximize health benefits for populations living near high-traffic roadways in DACs.** See the Transportation chapter of this Plan for more detail.
- **To advance the benefits from electrification and clean energy, New York State should pursue strategies to reduce GHG emissions and air pollutants—with particular consideration to projects across the energy, building, waste, and transportation sectors that are identified or informed by the CJWG and the DAC Community Advisory Committees of the CAM Initiative.** This approach will help ensure air pollution reductions and equitable investment outcomes.

3.4. Clean Energy Affordability and Security

For many households, upgrading building envelopes and installing efficient appliances results in improved health, safety, and comfort in the home, and lower energy bills. Utilizing clean and efficient modes of transportation, such as public transit and electric vehicles, can also help households manage transportation costs. Removing barriers to clean energy technology adoption is essential to advancing both energy affordability and quality of life, by expanding access to energy services, enhancing comfort, and improving financial stability.

As New York State transitions to clean energy, ensuring affordability for LMI and DAC households is a central priority. The state has made important progress through weatherization and efficiency programs,

utility bill assistance, and clean energy deployment paired with utility bill credits, such as the Statewide Solar for All program.[16] These efforts provide crucial support for the longer-term affordability benefits of energy efficiency improvements and reducing the use of fossil fuels. As fossil fuel price volatility continues to burden New Yorkers that pay directly for the use of fossil fuels in their homes and drive internal combustion engine vehicles, bill assistance programs remain critical for low-income households.

Major Initiatives

- **NYSERDA's Empower+ Program:** This program assists low- and moderate-income households in saving energy and money by funding energy improvements to their primary residences, starting with comprehensive home energy assessments that inform customized energy plans. The Empower+ Program team collaborates with the Regional Clean Energy Hub Program to recruit local contractors into the Program's network, including to expand the pool of contractors available for implementation in DACs. Comparable energy efficiency assistance is available through the **Long Island Power Authority's Home Comfort Plus Program** which serves income eligible households in Long Island with similar energy-saving and electrification solutions.

- Administered by New York State Homes and Community Renewal (HCR), the **Weatherization Assistance Program (WAP)** delivers energy saving enhancements at no cost to income eligible households across the state. By sealing the building envelope, installing high efficiency lighting and appliances, and upgrading aging HVAC systems, WAP cuts energy usage while improving indoor comfort. Coupled with lowering utility bills, WAP retrofits reduce exposure to extreme indoor temperatures and environmental pollutants – thereby reducing energy insecurity and enhancing the health and safety of homes in DACs.

- HCR's new **Green Small Buildings Program** will assist eligible homes with making energy-efficient upgrades, including heat pumps.

- **The PSC's Energy Affordability Program (EAP),** established in 2016, sets a goal to ensure that low-income households will pay no more than six percent of annual household income toward energy bills. The Energy Affordability Program supports this goal and is administered through major electric and gas utilities to provide low-income customers with energy bill payment assistance through monthly tiered discounts. As part of this, the PSC's Statewide Solar for All Program provides added utility bill discounts to customers taking part in its EAP that live in a DAC, which increases the equitable distribution of solar power generation and simplifies the process for community solar project developers to secure customers. In July 2025, the PSC adopted an **Enhanced Energy Affordability Program** to extend energy bill discounts to additional households below the median income.

- Through the **PSC's Energy Affordability Guarantee Pilot**, a first-in-the-nation pilot program, low-income home heating and cooling equipment will be fully electrified through NYSERDA's EmPower+ Program. Participating households will pay no more than six percent of their annual income on electricity. For more information, refer to the Energy Affordability Impacts Analysis chapter of this Plan.

- **NYPA's Renewable Energy Access and Community Help (REACH) Program:** Set up in conjunction with the PSC in 2024, this initiative enables EAP-participating electricity customers in DACs served by the six major investor-owned electric utilities to receive bill credits through the production of renewable energy products. NYPA will develop a portfolio of renewable energy generation projects and distribute a portion of the revenue from these projects, along with third-party contributions, to the state's participating investor-owned utilities, who will generate bill credits for REACH beneficiaries. Bill credits will start to flow to REACH beneficiaries when funds become available from new renewable energy generating projects and other sources. Several projects have already been identified to be developed under NYPA's REACH Program, with estimated completion dates as early as 2027.

Recommendations

- **New York State should increase outreach within DACs** to ensure residents who are eligible for bill assistance can participate in available programs.
- **Relevant New York State agencies should continue prioritizing weatherization and efficiency retrofit programs** as foundational strategies for affordability. Greater emphasis should be placed on integrating funding for deferred maintenance into whole-home upgrade strategies that improve health, comfort, and lower energy burdens. This should include exploring funding options to address structural issues that often prevent home energy improvement projects from beginning. See also the Buildings chapter of this Plan.
- **New York State should explore holistic decarbonization interventions within DACs.** A multi-disciplinary approach that combines transportation decarbonization, building energy retrofits, onsite renewable energy, and relevant non-energy programs–- such as health and housing – can reduce barriers and generate greater beneficial impacts than if these interventions are pursued separately.
- **New York State should adopt a strategic approach to address transportation deserts that most severely impact commuters in LMI households and DACs.** This includes scaling successful models from the Clean Mobility and Transportation Prize Programs and expanding access to a range of transit options and active transportation. See also the Transportation chapter of this Plan.

3.5. Clean Energy Investment and Jobs

Clean energy investments can be a powerful engine of economic growth across New York State, particularly in DACs. These investments should promote education, create quality jobs with opportunities for career advancement, and catalyze development for businesses that have historically faced unfair barriers to competition.

Major Initiatives

- **Tier 1, Land-Based Large Scale Renewables:** In awarding renewable energy certificates, NYSERDA solicits proposals from project developers. The solicitations invite bidders to state

incremental economic benefit dollars or spending in New York State, including how much of their proposed spending will be realized in DACs. In evaluating bid proposals, NYSERDA assigns a higher weight in scoring for spending that is focused on benefiting DACs. Funds can be invested in job training, partnerships to promote STEM education, and improvements in local infrastructure such as schools, roads, and community centers, among other commitments.

- With an emphasis on equity and inclusion, **NYSERDA's Energy Efficiency and Clean Technology Training Program** expands New York State's training infrastructure and capacity to strengthen the pipeline of skilled talent for the energy efficiency and clean technology labor market. Projects funded through this solicitation develop and deliver technical training, relevant education, and hands-on experience to ensure that new and existing workers, apprentices, journeypersons, and students have the skills and qualifications required to meet industry demand. Preference is given to projects that include or are led by MWBEs or SDVOBs; projects that are focused on DACs and/or priority populations; and qualifying union-led and pre-apprenticeship projects.
- Through the **P-12 Schools Initiative**, NYSERDA provides support for New York State's schools to reduce their energy use and emissions while introducing students to sustainability careers at a young age. These programs include the On-site Energy Manager Program, Flexible Technical Assistance Program, Electric School Buses, Building Operations and Maintenance Training and the Large-scale Thermal Program, and the Clean Educators Workshop. These programs create healthier learning environments and model sustainable energy. In addition, the Clean Energy for Educators Workshop provides teachers with no cost training on integrating clean energy into their curriculum; priority to attend the workshops is given to teachers who teach in DACs.

Recommendations

- **NYSERDA (including the Clean Energy Hubs), NYPA, DOL, the State University of New York (SUNY), and Empire State Development should further synchronize workforce development programs** to close equity gaps in job access for priority populations. See the Clean Energy Jobs and a Just Transition chapter of this Plan for further detail.
- **New York State should continue to integrate on-the-job training opportunities,** and strong labor standards into transportation infrastructure and clean energy projects, to expand quality workforce opportunities in DACs.
- Building on proven models, **New York State should explore expanding renewable energy and energy efficiency retrofit programs that procure goods and services from MWBEs and SDVOBs.** For example, as part of expanded procurement from the above-mentioned entities, the State could improve coordination, vendor data management, and targeted outreach to businesses.
- In continuation of the State's work to design programs to generate equitable economic benefits for DACs, **the State should expand access to program offerings that incentivize investments in DACs, including opportunities to support projects in and owned by Indigenous Nations**.

3.6. Interagency Coordination

To improve how DAC stakeholders and residents experience State clean energy programs, agencies and authorities need to strengthen coordination across programs, engagement efforts, services, and partnerships with external organizations. A more unified and strategic approach would lead to programs that better address persistent problems while delivering multiple benefits. This could include developing simplified, cross program application processes and coordinating public engagement efforts to reduce duplication, avoid scheduling conflicts, and prevent stakeholder fatigue.

Major Initiatives

- The **Extreme Heat Action Plan (EHAP)**[17] Working Group for New York State brings together staff experts from 25+ state agencies to address the impacts of extreme heat. Led by DEC and NYSERDA, the EHAP Working Group coordinates the development and implementation of commitments across the Plan. This interagency effort focuses on protecting vulnerable populations, particularly in DACs, and building community resilience. Refer to the Climate Change, Adaptation, and Resilience chapter of this Plan for a further description of EHAP.

- **New York State Healthy Homes Value-Based Payment Pilot:** This is a joint initiative of NYSERDA and DOH intended to develop a framework that allows New York State's managed care organizations to fund residential healthy homes interventions as part of their value-based payment arrangements with healthcare providers within the Medicaid Healthcare Delivery System. The Pilot aims to implement 300 healthy homes interventions in the homes of eligible Medicaid members, intended to reduce energy use and utility costs; improve asthma-related health outcomes; reduce unintentional household injury; improve occupant comfort and safety; and reduce Medicaid utilization associated with avoidable urgent care, emergency department visits, and hospitalizations. It demonstrates interagency collaboration toward shared goals.

- Established by a PSC order in 2016, the **New York State Low-Income Energy Task Force (LIETF)** promotes interagency coordination with the goal of streamlining services, reducing administrative burdens, and ensuring programs reach the low-income households they are intended to serve. LIETF focuses on publicly funded low-income programs, including Empower+, the Weatherization Assistance Program, and utility run affordability programs. Facilitated by DPS and comprised of NYSERDA, HCR, & OTDA, the task force collaborates with the steering committee members of EEC and other community-based organizations to discuss strategies to improve program access and lower energy burdens.

Recommendations

- Through LIETF, **New York State should support cross-agency efforts to streamline application processes and work to develop a universal application for income eligible programs serving overlapping populations**. Refer to the Buildings chapter for additional discussion.

- **New York State should pursue more consolidated funding applications for communities and local governments**—where doing so would streamline processes and better leverage resources for clean energy.

- **NYSERDA should continue expanding the interagency membership and collaboration within the Energy Equity Collaborative (EEC) to strengthen cross-sector planning.** This should support more coordinated stakeholder engagement and strengthen interagency involvement across all EEC working groups, including Energy Transition, Workforce and Economic Development, Housing and Buildings, and Engagement and Access.

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1 For example, provisions related to DACs (ECL § 75-0101(5)), CJWG (ECL § 75-0111), Section 7(3) (Laws of 2019, Chapter 106), and the Bond Act (ECL 58-1101).

2 *EJNYC: A Study of Environmental Justice Issues in New York City*, (NYC Mayor's Office of Climate and Environmental Justice, March 2024), https://www.nyc.gov/assets/climate/downloads/pdfs/EJNYC_Report.pdf.

3 Haley M. Lane, Rachel Morello-Frosch, Julian D. Marshall, and Joshua S. Apte. "Historical Redlining Is Associated with Present-Day Air Pollution Disparities in U.S. Cities." Environmental Science & Technology Letters 2022 9, no. 4, 345-350, https://pubs.acs.org/doi/10.1021/acs.estlett.1c01012.

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New York State Energy Plan

VOLUME II | Energy and Our Lives

Local, Regional, and Federal Government Collaboration

15

Key Terms Used in This Chapter

FOR THE COMPLETE GLOSSARY ➜

Regional Planning Commission: A quasi-governmental body (also referred to as a committee, board, or council) that supports municipalities within a defined region by providing planning, coordination, and technical assistance. These organizations help local governments, often facing capacity constraints, address issues that cross jurisdictional boundaries, including transportation, land use, environmental sustainability, economic development, and regional infrastructure.[1]

Indigenous Knowledge: A body of observations, oral and written knowledge, innovations, practices, and beliefs developed by Indigenous peoples through interaction and experience with the environment. It is applied to phenomena across biological, physical, social, cultural, and spiritual systems. Indigenous knowledge can be developed over millennia, continues to develop, and includes understanding based on evidence acquired through direct contact with the environment and long-term experiences, as well as extensive observations, lessons, and skills passed from generation to generation.[2] Coordination with Indigenous Nations, and the respectful incorporation of Indigenous knowledge should honor Indigenous Nation sovereignty.

Indigenous Nations: Any State- or federally-recognized Indigenous Nation (as indicated on the New York State Office of Parks, Recreation and Historic Preservation's "Indigenous Nation Areas of Interest in New York State" map[3]), Nation-owned parcels, current reservation boundaries, or lands held in trust by the federal government for that Indigenous Nation. Nine Indigenous Nations reside within, or have common geographic borders with, New York State: Cayuga Nation; Oneida Indian Nation; Onondaga Nation; Saint Regis Mohawk Tribe; Seneca Nation of Indians; Shinnecock Indian Nation; Tonawanda Seneca Nation; Tuscarora Nation; and Unkechaug Indian Nation. The United States formally recognizes all but the Unkechaug Nation. The State of New York recognizes all nine Nations.[4]

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Key Findings → Local, Regional, and Federal Government Collaboration

The success of New York's clean energy transition depends on the robust, coordinated collaboration across all levels of government. From local municipalities to regional planning bodies, Indigenous Nations, and the federal government, consistent and transparent communication, coordination, and engagement strengthens collective understanding and enables effective collaboration. This chapter describes major initiatives underway and recommends continued and additional actions to build capacity and partnerships across government entities. Recent changes in energy policy at the federal level have created uncertainty, stressing the need for continued coordination and collaboration for the benefit of New Yorkers.

- **The State's commitment to its energy policy and climate goals has promoted coordinated energy planning and development across all levels of government, spurred innovation, and created resources and tools that enable New Yorkers to better plan for the future.** While there have been delays and challenges in meeting certain energy milestones and current federal uncertainty, the advancements made to date would not have been possible without landmark, coordinated State-level actions and clear policy priorities.

- **Local governments play a critical role in comprehensive energy planning and enhancing community resilience.** Local governments and municipal land use planning play vital roles in New York's ability to achieve a clean energy future through their authority to conduct comprehensive planning and land use policies. Earlier chapters—including Climate Change, Adaptation, and Resiliency; Buildings; and Environmental and Climate Justice—highlight ways to more effectively integrate renewable energy into local land use planning and zoning, equitably equip local leaders across the state to explore energy efficient strategies, and provide the tools and support to encourage informed and responsible energy development. The success of the State's energy transition requires active collaboration and partnership with local governments and meaningful coordination with host communities to understand and support their unique local perspectives and needs.

- **Holistic, State-led planning is essential to guiding regional clean energy investments.** Programs such as NYSERDA's Build Ready initiative and the Department of Public Service's (DPS) proposed Clean Energy Zones are designed to unlock economic growth and lower the overall cost of New York's clean energy transition. Since the electric grid is interconnected and spans multiple localities, infrastructure must be planned as part of an integrated system. New York is working to encourage the development of regional concentrations of clean energy generation alongside the transmission needed to deliver power reliably. These efforts also create opportunities for early, more meaningful engagement between those supporting and developing energy infrastructure and potential host communities.

- **New York State has built strong regional partnerships that are necessary to advancing a just transition.** Continued collaboration across all levels of government, including with Indigenous Nations, allows partnerships between developers, government officials, and a range of interested parties to pursue shared clean energy goals, amplify impact, and support benefits directed toward DACs. As federal policy remains uncertain and key programs face potential cuts, New York must remain diligent, seeking new opportunities for progress through proactive cooperation, innovation, and targeted investment.

- **New York must remain actively engaged in federal energy policymaking to ensure its unique interests, needs, and priorities are represented and that its sovereignty in energy decision-making is retained.** The State's distinct energy infrastructure, governance structures, and decarbonization policies require a tailored approach—not a "one-size-fits-all" model. Without meaningful and consistent consideration from the federal government level, New York will face increased costs, implementation inefficiencies, and potential conflicts and confusion between State and federal jurisdictions.

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1. Overview

A core principle of this Plan is that every New Yorker deserves access to safe, reliable, and affordable energy. The success of New York's clean energy transition depends on the robust, coordinated collaboration across all levels of government. From local municipalities to regional planning bodies, Indigenous Nations, and the federal government, consistent and transparent communication strengthens collective understanding and enables effective collaboration.

Collectively, partnerships among local, regional, Indigenous Nation, State, and federal entities are critical to the successful implementation of the State Energy Plan. A coordinated approach streamlines energy and climate planning and enables decision-making that appropriately considers economic growth, local planning, long-term resilience, and benefits to disadvantaged communities (DACs).

This plan incorporates and reflects local and regional energy strategies, including municipal zoning, policies, programs, the development of local clean energy resources, and major statewide initiatives to further climate and energy. It also examines the roles of local, State, and federal governments in areas such as siting and permitting of energy infrastructure, transportation networks and building stock, and development of clean energy supply chains. Leveraging available State and federal funding remains a central priority across these efforts.

The Plan recognizes that local governments are essential partners in achieving this goal and are actively engaged in energy planning and decision-making processes, particularly in ensuring future planning incorporates the priorities of disadvantaged communities (DACs) and facilitates access to Just Transition resources.

Regional variabilities and characteristics within the State must also be acknowledged. The downstate and upstate regions have considerably different resources, populations, infrastructure and needs with regard to energy planning.[1] The downstate region, particularly New York City and Long Island, has a high population density and greater grid demands that have been predominantly met with decades-old fossil fuel-fired generation resources, yet the region has greater access to public transportation, compact development, and opportunities to inject large amounts of renewable energy loads. Upstate, the population and development patterns are more dispersed, there is greater land availability, the grid is supported by primarily carbon-free resources, and personal vehicles are utilized more frequently. These regional differences can cause differences in priorities as decarbonization objectives are applied across economic sectors. Therefore, it is important for energy planning to consider these differences and recognize that strategies for achieving those objectives and the overall State goals will necessarily vary across regions and their access to particular resources.

2. Local Government Roles in Advancing State Energy Goals

Local governments are critical partners that contribute to the overall success of the New York State Energy Plan. They are often the first point of contact for community members engaging with energy-related decisions and projects, and they hold key responsibilities in land use, building codes, and infrastructure planning. Municipalities that successfully engage residents and interested parties can help them coordinate across groups and address concerns and understand priorities.

2.1. Land Use Planning and Zoning

Comprehensive planning is authority held by local governments (counties, cities, towns, villages). Cities, towns, and villages have authority over local land use decisions through zoning regulations. Comprehensive planning goals and policies are implemented through zoning and other land use regulations, all of which can affect the development of energy projects. These regulations determine where and what types of development may occur. Coordination between the State and local governments can support land use strategies related to renewable energy and energy efficiency. The New York State Department of State (DOS) offers land use resources and training programs for local officials, and various State agencies provide discretionary grants and incentive programs that can influence local planning and land use decisions.

2.1.1. Facility Siting and Permitting

The energy facility siting process in New York State can occur through more than one pathway, depending on the technology, locality, size, and complexity of a proposed facility.

Local governments have a role in permitting energy infrastructure such as solar, energy storage, and wind. Across the more than 1,600 municipalities in the State, many local governments have adopted local regulations (i.e., ordinances, local laws) outlining clear pathways for permitting energy projects in accordance with local land use constraints, priorities, and future plans for their communities. Local governments may also serve as lead agency under the State Environmental Quality Review Act (SEQRA) requirements for many of the smaller projects.[2] In these ways, local governments can determine permitted uses, locations, site requirements, and more through zoning regulations (i.e., ordinances, local laws) and other mechanisms. For renewable energy generators, such as wind and solar, local governments retain sole permitting authority for projects under 25MW in size. Local governments are also responsible for permitting stand-alone energy storage systems of all sizes. For larger projects, including projects that include energy storage, i.e., co-located storage, the State takes on the responsibility of permitting but local governments remain important partners in the process.

The Office of Renewable Energy Siting and Electric Transmission (ORES) situated within the DPS is authorized to permit most new transmission and major renewable energy projects greater than 25MW. ORES regulations recognize that public participation is a critical part of the siting process. The regulations require applicants to share information with the public at multiple points in the process to ensure both transparency and accessibility to communities and local government representatives. ORES regulations include structured opportunities for local input, requiring applicants to meet with the chief executive officer of any municipality within which a proposed facility would be located, as well as any local agencies identified by the chief executive officer. ORES regulations also stipulate that projects must comply with all applicable local laws, except for portions of those laws that are deemed unreasonably burdensome. While the regulations also set forth the minimum required engagement, applicants are strongly encouraged to conduct additional engagement to identify and address the concerns of local agencies and communities.

A host community in the context of energy is the local population situated in an area where an energy project, such as a large-scale solar or wind farm, is developed. These communities are directly impacted

by the project, in both positive and negative ways. Many large-scale clean energy programs identify mechanisms that provide local benefits to host communities, including NYSERDA Tier 1 large-scale renewables and federally required funds for nuclear safety and preparedness. State agencies, particularly the New York Department of State, provide educational opportunities to municipal land use officials to best position host communities for successful projects. These trainings may be expanded to include siting for energy, energy storage, nuclear, and data center projects and can educate local government officials on important aspects of the siting process including Community Benefit Agreements (CBA) with project developers. The DPS also provides similar information sessions and education for interested parties on how to participate in its and the Public Service Commission's (PSC) proceedings.

Intentional and proactive land use planning and zoning help local governments and developers plan for and coordinate on energy infrastructure development. Using programs like Smart Growth and other agency resources and technical assistance, including those for comprehensive planning, local governments are often better equipped to meaningfully engage with developers and inform facility designs to be protective of public spaces, natural resources, and agricultural lands, while also providing local benefits.

2.1.2. Building and Energy Codes

DOS Division of Building Standards and Codes provides a variety of services related to the development, administration, and enforcement of the Uniform Fire Prevention and Building Code (Uniform Code) and the State Energy Conservation Construction Code (Energy Code) in New York State. The Uniform Code and Energy Code, which sets a minimum building standard for energy efficiency in NYS, are typically enforced by municipalities through their local building or code enforcement departments. The Uniform Code is applicable in all local governments in New York State except New York City, which has its own construction codes and administrative procedures. The Energy Code is applicable throughout the State. NYS Executive Law §379 provide a process for local governments (cities, towns, and villages) and Nassau County to adopt more restrictive standards than the Uniform Code, and NYS Energy Law §11-109 provides a process for municipalities (counties, cities, towns, villages, school districts, or district corporations) to adopt local energy conservation construction codes more stringent than the State's Energy Code.

DOS works with local governments by providing technical support, training, and resources for municipal and local code enforcement officials on the Uniform Code and Energy Code, including dedicated training sessions when new versions of the codes are released. The PSC is responsible for determining whether the electric grid can reasonably accommodate requests for new or expanded electric service under the proposed zero-emission requirement in the proposed State Energy Code for new construction.

2.1.3. Local Transportation Planning

Local governments, including cities, towns, villages, and counties, own and maintain the vast majority of New York's roadway network. As a result, transportation investments made at the local level play a critical role in shaping statewide energy use and greenhouse gas (GHG) emissions from the transportation sector. Given the interconnected nature of the transportation network across municipal and jurisdictional boundaries, coordination between New York State and local governments is essential

to advancing energy-efficient transportation technologies and practices. Local transportation projects typically receive a combination of State and federal funding, with the Consolidated Local Street and Highway Improvement Program (CHIPS) representing the largest source of State aid. In localities with less than 50,000 residents, local governments consult directly with the NYS Department of Transportation (DOT) to propose projects for inclusion in the 4-year Statewide Transportation Improvement Program (STIP).

2.1.4. Local Government Energy Leadership

Local governments play a unique and highly visible role in advancing the State's clean energy and climate goals. Because municipalities are often the first point of contact for residents and businesses, their actions can shape public understanding and acceptance of clean energy solutions in tangible ways. Local governments can lead by example through the use of their own facilities and properties to demonstrate clean energy and electrification projects that directly benefit the community. They also engage residents more frequently than state or federal entities, providing valuable opportunities to encourage local participation and adapt clean energy initiatives to local needs.

Both upstate and downstate regions play critical roles in advancing the State's clean energy priorities.

New York City, home to almost half of New York State residents, is implementing a range of innovative and successful clean energy programs. Initiatives include the New York City Accelerator program that offers free resources and training to building owners and industry professionals, the NYC Department of Citywide Administrative Services (DCAS) that advances sustainability targets and innovation (e.g., with a goal to install 100MW of solar on buildings by 2030), the City Economic Development Corporation's Green Economy Action Plan that has invested over $725 million and generated $87 billion in GDP, and the Blue Highways program that moves freight by water to lower emissions and boost economic growth. The complex interconnections between City and State policies and programs warrant close coordination to ensure steady progress toward our respective goals and shared benefits.

Statewide, many local governments across New York State have proactively advanced clean energy in a way that considers unique local contexts by developing their own climate action plans and clean energy strategies, as well as participating in programs like NYSERDA's Clean Energy Communities program, NYS DEC's Climate Smart Communities program, NYS DOS' Smart Growth, Community Planning programs, and other State sponsored programs.

Despite significant local energy leadership, the capacity constraints faced by local governments are a significant challenge where there continues to be opportunities for meaningful partnership with the State to address. The lack of critical local capabilities often makes it difficult to participate in large-scale development project reviews, reap the benefits of State and federal programs, effectively implement codes, and fully support their residents. Local leaders are also faced with a complex range of energy-related decisions such as renewable energy development, building efficiency, EV infrastructure, grant support, and climate adaptation and resilience. Without specialized knowledge or technical skills and accessible data and planning tools, it can be challenging for local officials to confidently invest in and plan for their futures.

Local governments can advance equitable clean energy initiatives by aligning their non-energy functions with sustainability goals. Erie County launched the Erie County Low Income Program for Sustainable Energy (ECLIPSE), which brings together the Departments of Environment and Planning, Social Services, and Public Works—alongside a community solar provider—to integrate utility bill discounts into existing low-income assistance programs such as Home Energy Assistance Program (HEAP) and Supplemental Nutritional Assistance Program (SNAP). This creative use of clean energy can support the development of new community solar in Western New York, while also channeling the benefits to those who stand to benefit the most.

2.2. Strategies to Support Local Energy Policies and Climate Action

The State has long provided resources and recognition for local governments that implement climate adaptation and mitigation initiatives. Through the NYSERDA Clean Energy Communities (CEC) Program, the New York State Department of Environmental Conservation (DEC) Climate Smart Communities (CSC) Program, the DOS Smart Growth program, and others, local governments have been able to demonstrate leadership, receive grants to advance clean energy objectives, and receive technical support to prioritize, plan, and execute projects. Several of these initiatives are further described below to illustrate how local governments are advancing clean energy goals through targeted support and cross-agency collaboration.

2.2.1. Clean Energy Communities

Beginning in 2016, the NYSERDA CEC program has assisted municipalities with reducing energy use and advancing clean energy. The program has three main components: 1) a menu of High Impact Actions, or proven actions that reduce emissions from energy systems, are within municipal jurisdiction, and have clear, achievable implementation steps; 2) support from regionally embedded technical assistance providers; 3) recognition through Clean Energy Community designation, and 4) grants to implement clean energy projects. When a community completes enough high impact actions, they unlock the ability to achieve designation and grants.

The CEC program has demonstrated broad success, with over 900 municipalities representing more than 90 percent of New York State's population. The program effectively serves the full diversity of communities across the State, from small rural towns to large cities. The median population of participating communities is approximately 3,500, underscoring the program's success in engaging smaller, often under-resourced communities to elevate clean energy as a local priority. The program is also designed to include communities for whom climate change may be a sensitive subject, promoting cost-saving actions that allow municipalities to reinvest in clean energy or other community needs.

2.2.2. Climate Smart Communities

Since its launch in 2009, the interagency CSC Program, led by the Department of Environmental Conservation (DEC), has offered leadership recognition and capacity building for local governments engaged in climate change mitigation and adaptation. Starting as a 10-point climate pledge, the program

has grown to include the CSC Certification program, CSC grants, and a network of statewide coordinators providing direct technical assistance to municipalities.

There are currently 462 municipalities that have pledged to become registered Climate Smart Communities. The certification program was launched in 2014 and provides an extensive resource library and roadmap to success for local government climate action. At present there are 168 communities which have demonstrated significant progress to become certified Climate Smart Communities. In total, there are over 17.9 million New York residents living in a registered or certified community.

Since 2016, the DEC Office of Climate Change has offered funding through its Municipal Zero-Emission Vehicle (ZEV) Program and the CSC Grants Program. DEC has awarded over $21.6 million under the Municipal ZEV Program to add electric vehicles to municipal fleets and to support electric vehicle charging and hydrogen fueling stations that are primarily for public use. The CSC grants support planning and implementation of climate change mitigation and adaptation projects. More than 209 CSC grants have been awarded totaling over $70 million. Since 2022, the DEC has also funded regional CSC coordinators who offer free technical assistance to communities across all 10 regions of New York, facilitating local action to reduce GHG emissions and to adapt to climate change through outreach, planning, education, and capacity building.

2.2.3. Smart Growth and Community Planning Programs

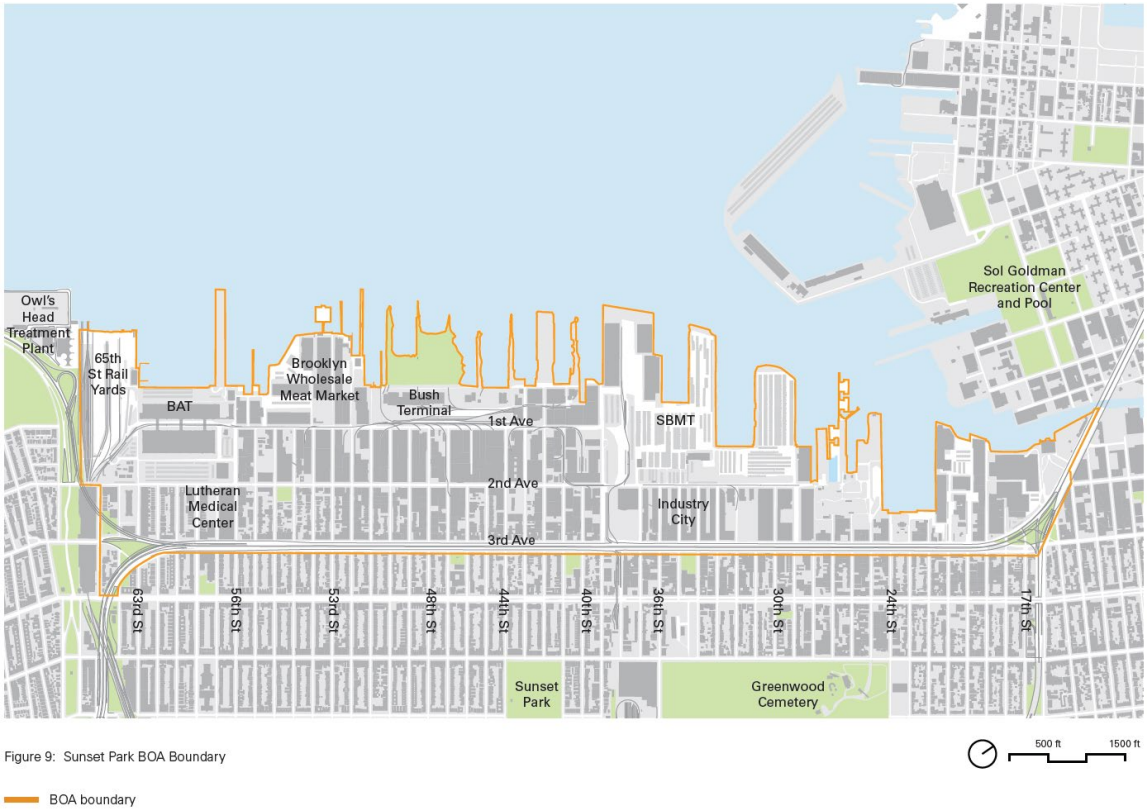
Beginning in 2021, DOS began providing grant funding to local governments to develop or update comprehensive plans, area plans, or zoning ordinances that align with ten Smart Growth principles. The Smart Growth initiative complements several long-standing, flagship programs administered by DOS, including the Brownfield Opportunity Area (BOA) Program, the Local Waterfront Revitalization Program (LWRP), the Downtown Revitalization Initiative, and NY Forward.

These planning programs provide tools for intentional community action. For example, the Town of East Hampton on Long Island who finalized their LWRP in 2007[3] ultimately became the Nation's first community to host a utility-scale offshore wind farm, the South Fork Wind Project.[4] Additionally, East Hampton is also participating in NYSERDA's Build Ready Program to explore developing new parking lot and ground-mount solar projects on underutilized lands.[5] The BOA program has similarly supported communities with energy projects, such as the development of solar farms on landfills and prepared a community to host a major offshore wind hub. In collaboration with the State, these programs ensure coordinated and well-planned development and invite ample public participation in the community planning process.

The state designated Sunset Park BOA positioned UPROSE to partner with key government and private sector players in New York's emerging offshore wind industry. The BOA, consisting of the industrial area of the Sunset Park neighborhood in Brooklyn, included the goal to "brand the area as a green business cluster" by supporting businesses in the growing green economy and Just Transition from an extractive to a regenerative economy. Since that plan was finalized, UPROSE has focused on keeping industrial uses along the Sunset Park waterfront, advancing their Green Resilient Industrial District (GRID) plan, and utilizing BOA pre-development funding to develop a supply chain feasibility analysis, a real estate and contextual analysis, and an offshore wind landscape analysis in collaboration with the DOS, NYC Economic Development Corporation, the Mayor's Office of Environmental Remediation, the City Council, the Brooklyn Borough President's Office, and other relevant governmental and private industry to ensure best outcomes. UPROSE's success lies in its consistent forward-thinking, community-based planning, as well as leveraging relationships such as its long-term partnerships with New York State and others.

Figure 1. Sunset Park BOA boundary with Major Landmarks, from the Sunset Park Brownfield Opportunity Area Nomination Study Report (March 2013)

Source: Sunset Park BOA Step 2 Nomination Study[6]



2.2.4. NYSERDA Build Ready

NYSERDA's Build-Ready program partners with local communities across New York State to identify and advance underused properties, including brownfields, landfills, existing or former commercial and industrial sites, and dormant electric generating properties for renewable energy projects.[7] Sites are identified through a top-down desktop analysis or through site nominations from entities such as local governments. NYSERDA then prepares these challenging sites for development, advancing them to a "build-ready" stage, so that private renewable energy developers can ultimately construct and operate clean energy projects. Based on a five-year review completed in September 2025, NYSERDA proposes several enhancements to better meet program goals over the coming five-year period, including a new partnership with Economic State Development to support its Power Up and Fast NY Programs.[8] This adaptive approach would use separate sources of funding to reduce burdens on rate payers. NYSERDA plans to operate the Build-Ready program through 2030 based on this new model utilizing new market insights.

2.2.5. NYSERDA Just Transition Site Reuse Planning Program

The Just Transition Site Reuse Planning Program is designed to provide communities with planning and technical support services to inform future decision making at the local level to help mitigate negative impacts of pending or future fossil fuel power plant closures. NYSERDA takes proactive steps to assist municipalities with site reuse planning to help communities spur diversified economic development and thrive in the transition to a clean energy economy. This program does not play a role in the identification of specific power plant closures, but rather aims to provide communities, at no cost to them, resources to evaluate options. To date, communities across New York have developed or are actively developing reuse plans for approximately 15 power plants sites. The Just Transition and Site Reuse program supports these efforts by enabling municipalities to perform technical feasibility studies, engage local constituents to ensure that plans reflect community needs and priorities, and assess the potential impact of power plant closures, including effects on tax revenues, employment, and local economies.

2.2.6. Local Hazard Mitigation Planning

Comprehensive plans often address vulnerabilities specific to a community's locale, but there are other planning processes like Local Hazard Mitigation Plans[9] that can also reflect local consideration of climate risk. DHSES supports the development of FEMA-approvable local hazard mitigation plans by administering grants and by providing technical assistance. All counties in the State are developing or have approved Local Hazard Mitigation Plans. These plans form the foundation of a community's long-term strategy to identify hazards, assess risks and vulnerabilities, and develop mitigation strategies that can be funded using a wide range of resources. By reducing disaster losses and breaking the cycle of disaster damage, reconstruction, and repetitive damage, local governments will be better equipped to reduce risks to people, property, economies, and natural environments.

2.3. Local Government Outlook

Local governments serve critical functions for their constituents but have faced resource challenges. Overall, local government employment has been declining in New York State since the 2008 financial crisis, straining the capacity of current employees. This is at odds with national trends of increased local

government employment. COVID-19 lockdowns and the subsequent economic recovery amplified these trends, as many municipal employees either left the workforce entirely or pursued higher-paying opportunities in a competitive job market. Some governments experienced funding shortfalls due to decreased tax revenue resulting from reduced economic activity. Additionally, local governments will continue to face climate-related emergencies, including localized heat stresses, severe weather events, and flooding driven by climate change. These affect businesses, residents, essential services (such as water, sewer, and transportation), and both the natural and built environments.

Ongoing financial and human resource constraints are expected to persist, limiting the capacity of municipalities to effectively respond to energy and emergency challenges. These trends highlight the continued need for State support in helping municipalities exercise their local leadership in advancing coordinated, strategic energy and climate policies.

2.3.1. Recommended Actions with Local Governments

Local governments have the ability to effectuate change and improve the quality of life in their communities. This is because local leaders are often best positioned to identify the unique opportunities and challenges of the areas they serve and then galvanize community action. New York State is poised to help its local governments achieve more.

- **Empower local governments to make informed decisions by increasing accessibility to climate & energy data.** Local governments would benefit from having streamlined processes for accessing resources and support data collection and analysis. There are a range of mapping and data portals available at the state, regional, and national levels, as well as interactive dashboards that are becoming more accessible and prevalent. Additionally, many chapters in the State Energy Plan identify new tools for advancing the State's energy priorities. Centralized, user-friendly data resources can help to inform planning and investments and allow local governments to visualize and assess socioeconomic information, environmental conditions, vulnerability and impacts, infrastructure, energy impacts, and clean energy development opportunities. Improving accessibility to these resources and making good, actionable information readily available will enhance decision-making. Finally, the State should assess how to seamlessly integrate data refinements into these tools, from coordinated scientific research and monitoring programs to socioeconomic analyses and more, so that the latest information is always available to constituents, especially as federal resources – such as the National Climate Assessments and various environmental screening or mapping tools – have recently been taken offline.

- **Encourage adoption of municipal clean energy policies attuned to local conditions.** By supporting and incentivizing comprehensive and smart growth planning and zoning, the State will help local governments prepare for their clean energy future, participate in facility project reviews and development, and support smart growth principles and outcomes. A sound comprehensive plan that assesses various locations and energy development scenarios can help ensure that a community's zoning regulations, environmental review, alternatives, and findings are informed by all relevant factors. Effective, intentional planning and zoning also facilitate the

development of renewable energy options by having transparent rules and regulations. Where appropriate, expanding smart growth planning programs to assist local governments with developing and adopting area plans, zoning, and impact statements that consider smart growth principles can help accelerate compatible development.

- **Increase local capacity by providing State support and guidance for energy planning.** The State should strengthen collaboration and provide additional training and educational opportunities for municipal officials, local leaders, and residents to fully understand benefits of clean energy facilities, including employment opportunities that support a just transition and meaningful, long-term coordination with host communities. These trainings should provide clear instructions for the types of actions municipalities can take to contribute to State energy goals, including implementing baseline practices (before best practices), enacting resiliency and adaptation programs, and enhancing participation in state and local clean energy siting and review processes. Each program, including newly created initiatives, should make training, guidance documents, technical support, and educational resources for local governments available to encourage early adoption and improve local success rates. This can include training the local government workforce through further coordination with statewide associations including the NYS Association of Counties, NYS Conference of Mayors, and the NYS Association of Towns. The NYS Association of Towns has already begun a partnership with SUNY to provide microcredentials for municipal employees.[10] Knowledge sharing is also a key element of capacity building, particularly in small, rural communities. By increasing collaboration with municipalities to receive technical support, learn from one another, and build a network of local practitioners, communities will be empowered to advance clean energy policies at the local level and more effectively participate in State processes. For federal programs and funding, the State should be positioned to assist municipalities by serving as an intermediary between the local and federal levels of government.

3. Regional Coordination to Advance State Energy Goals

Collaboration and coordination can be multi-municipal and across multiple levels of government. There are two generalized types of regional coordination for the purposes of this section. Within the State, intrastate partnerships and cohorts are formed to develop programs, streamline decision-making, and solicit community feedback. The State also seeks intergovernmental coalitions where there are shared goals with neighboring States or nations to expand access, innovate, and create efficiencies. In each instance, these partnerships are bespoke and evolve to meet the needs of participating jurisdictions.

3.1. Regional Coordination Roles

Regional coordination occurring within New York as well as through intergovernmental partnerships can serve multiple purposes, such as influence-boosting coalition building, improved government efficiencies, and providing signals and incentives for energy markets and researchers.

3.1.1. Coalition Building

Coalition building is one of the primary reasons for seeking out regional partnerships. Municipal-based Regional Planning Commissions and Metropolitan Planning Organizations (MPOs) support energy planning by ensuring that economic development and transportation investments are coordinated and meet regional needs, both present and future. Multi-state and national coalitions demonstration the power of collective action. For example, organizations like the Regional Wildlife Science Collaborative (RWSC) and Mid-Atlantic Regional Council on the Ocean (MARCO) have enabled coastal states like New York to more effectively partner on shared ocean priorities, including addressing research needs and enhancing data accessibility for better decision-making. Whether formal or informal and regardless of size, organizations play a crucial role in addressing shared interests, challenges, or opportunities, leading to better decision-making. By collaborating, regional partnerships can amplify their influence, raise public awareness and support common goals, and drive more impactful policy changes than organizations operating independently.

3.1.2. Increasing Efficiencies, Equities, and Knowledge Exchange

Regional coordination also brings together experts from various fields to tackle complex issues more effectively. New York State has formed or participated in various planning bodies and technical working groups to achieve greater efficiencies and equities. Examples include the CAC, Climate Justice Working Group, and renewable energy Technical Working Groups (TWGs) to address regional solar and offshore wind development challenges. One hallmark of coordinating bodies like these is creating tangible, high-quality products that address inequities in current frameworks, such as establishing the State's DAC criteria or coordinating across the East Coast to create a fisheries Regional Fund Administrator to distribute direct resources to those locally affected. These and other efforts help uncover data and information gaps, prioritize research needs, and provide critical forums to ensure decision-making is based upon the best available science and considers the needs of those most affected.

3.1.3. Market-driven Change & Innovation

Cross-governmental policies focused on affordability, improving community health, and strengthening the energy workforce and supply chain can serve as powerful incentives driving regional collaboration. Initiatives are diverse and may encompass advancing research and innovation in energy efficiency or clean energy technologies, exploring incentives to promote wider adoption, providing financial support to improve affordability, and supporting market development to grow the clean energy workforce, strengthen regional supply chains, and foster a sustainable circular economy for clean energy solutions. Continued regional collaboration on system reliability issues is also necessary to ensure future analyses that drive State planning and implementation of the State's energy policy goals benefit from accurate assumptions to inform success. In some instances, collaborations involve public-private partnerships or formal financing agreements, which can enhance project longevity but may also create challenges for intergovernmental cooperation.

Table 1: Regional Organizations that Assist in Advancing New York State Energy Policy

Regional Organizations	Coalition Building	Knowledge Exchange	Markets & Innovation
Regional Planning Commissions (RPCs)	X	X	
Metropolitan Planning Organizations (MPOs)	X	X	
Mid-Atlantic Regional Council on the Ocean (MARCO)	X	X	
Northeast Regional Ocean Council (NROC)	X	X	
U.S. Climate Alliance (USCA)	X	X	
NYS Climate Action Council (CAC)	X	X	X
NYS Climate Justice Working Group		X	
Offshore Wind Technical Working Groups (TWGs)		X	
Regional Offshore Science Alliance (ROSA)	X	X	
Regional Wildlife Science Collaborative (RWSC)	X	X	
New York State Reliability Council (NYSRC)		X	X
New York Independent System Operator (NYISO)		X	X
Northeast States Interregional Transmission Collaborative	X	X	X
National Offshore Wind Research & Development Consortium (NOWRDC)		X	X
11-State Initiative for a Regional Fisheries Administrator	X	X	
Emergency preparedness planning (ad hoc)		X	
Centers of Excellence / Centers for Advanced Technology		X	X
New York Green Bank		X	X
New York Battery and Energy Storage Consortium (NY BEST)			

3.2. Intrastate Strategies to Support Energy Policies & Climate Action

New York State encourages progress by spearheading regional and statewide planning efforts that provide policy direction for long-range planning by industries, investors, municipalities, and other sectors. Holistic and inclusive State-led planning efforts can also encourage knowledge exchange and coalition building, which are essential for energy planning. As outlined in the chapters on Buildings, Climate Change, Adaptation and Resiliency, Electricity, Low-Carbon Alternative Fuels, Energy Affordability Impacts, Transportation, and Environmental Impacts, New York is promoting strategic regional coordination to grow local knowledge, tackle industry lifecycle challenges such as waste management, and advance regional energy and economic development. Several of these initiatives are highlighted in greater detail below.

3.2.1. Regional Economic Development Councils

The Regional Economic Development Councils (REDCs) support the State's innovative approach by empowering regional organizations to create pathways to prosperity, which are outlined in regional strategic plans. Through the REDCs, community leaders, business and academic experts, and members of the public in each region of the State apply their unique knowledge of local priorities and assets to guide State investments that support job creation and economic growth. Each Regional Council has become the voice of the region, advising agencies on the programs and projects most valuable to the

region. Having awarded over $8 billion in NYS funding to more than 10,000 projects, the REDCs play a critical role in advancing NY's economic development priorities needed to drive a clean energy future.

3.2.2. Metropolitan Planning Organizations

As required by 23 CFR 450.310, an MPO is the policy board of an organization created and designated to carry out the metropolitan transportation planning process. MPOs play an important role in energy-related initiatives by administering federal funds and integrating energy-efficient transportation practices and renewable energy into transportation planning. MPOs are required to represent localities in all urbanized areas (UZAs) with populations over 50,000, as determined by the U.S. Census. They play a heightened role in urbanized areas with populations over 200,000, which are designated as "Transportation Management Areas" (TMAs). New York State's 14 MPOs represent local governments in Statewide Transportation Improvement Program consultation, helping to promote a coordinated approach to transportation planning amongst multiple municipalities. This coordinated approach helps support the advancement of transportation projects that promote emission reductions and serves the needs of all New York State residents and visitors.

3.2.3. Clean Energy Zones

As announced in the 2025 State of the State address, Governor Hochul directed State agencies to unlock economic growth and reduce the cost of the State's clean energy transition by identifying Clean Energy Zones (CEZs). In May 2025, the PSC acknowledged that coordinating transmission and large-scale renewable generation development in specific areas of the State could reduce costs and risks. The PSC directed the DPS to establish a process for defining and identifying these zones for integration into the Commission's existing planning processes and renewable energy procurements. The Commission further directed DPS to evaluate how a CEZ designation could foster greater community engagement and economic development.[11] This is an example of holistic, State-led planning efforts designed to provide a pathway for earlier engagement between the State's power sectors and potential host communities.

3.3. Intergovernmental Strategies to Support Energy Policies & Climate Action

States also collaborate with other governments where large-scale challenges on priority energy and climate issues persist. As identified in earlier chapters on Electricity, Nuclear, Affordability, Environmental Impacts, and Environmental Justice and Climate Justice, among others, New York's leadership and consistent policies have paved the way for interstate and national collaboration. Several of these initiatives are highlighted in more detail below.

3.3.1. Regional Greenhouse Gas Initiative

RGGI is a 10-state[12] cooperative effort to reduce GHG emissions from the electric power plants greater than 25 MW[13] through a market-based cap-and-trade program. Since its establishment as the nation's first mandatory market-based emissions reduction program in 2009, RGGI has helped reduce New York's electric sector carbon dioxide emissions by 50 percent. Proceeds generated through RGGI's quarterly allowance auctions have yielded over $2 billion for New York.[14] The State directs these funds into complementary strategies that increase renewable energy, energy efficiency, and carbon abatement,

through an approved operating plan. RGGI is a successful state-led model that could be replicated where other regional energy challenges and associated cost impacts are faced.

3.3.2. Northeast States Collaborative on Interregional Transmission

Launched in June 2023, the Northeast States Collaborative on Interregional Transmission brings together representatives from 10 states to enhance coordination in interregional transmission planning.[15] The initiative aims to reduce costs for ratepayers, enhance system reliability, and support state energy policies. On July 9, 2024, the member states formalized their partnership by signing a memorandum of understanding. Since then, the Collaborative has released a white paper on *Equipment Standardization and Supply Chain Considerations for Offshore Wind Transmission* (October 2024) and a *Strategic Action Plan* (April 2025).[16] The plan outlines actionable steps for state, regional, and federal policymakers to advance interregional transmission solutions. Key actions include issuing a Request for Information ("RFI"; issued July 2025) for potential interregional transmission projects that provide reliability benefits and cost savings for consumers. The Plan also identifies transmission equipment standardization efforts to support a unified and comprehensive approach to transmission investments.

3.3.3. Regional Coordination Emergency Preparedness Coordination

As noted in the Emergency Preparedness chapter, New York State Agencies routinely engage in multistate and regional collaboration regarding energy assurance planning and response. This collaboration occurs regularly throughout the year and is enhanced during potential energy disruptions, including ahead of major storms or other conditions which could affect energy markets in New York State as well as neighboring states.

3.3.4. Advanced Nuclear First Mover Initiative

New York is co-leading a 10-state consortium to explore innovative advanced nuclear technologies, consider and mitigate potential risks, and drive down costs. In partnership with the National Association of State Energy Officials (NASEO), the consortium will bring together market actors to accelerate advanced nuclear projects by formulating supportive adoption strategies, identifying supply chain needs, streamlining the permitting process, developing effective financing structures, and creating public-private partnerships.

3.3.5. Indigenous Nations

Indigenous Nations can bring a wealth of knowledge and expertise to energy and resilience planning. New York is working to collaborate with Indigenous Nations regarding shared climate and energy priorities while respecting different approaches according to each Nation's policies, processes, and protocols. The nine federally and State-recognized Indigenous Nations collocated within the State's borders include: Cayuga Nation, Oneida Indian Nation, Onondaga Nation, Poospatuck or Unkechaug Nation (State-recognized), Saint Regis Mohawk Tribe, Seneca Nation of Indians, Shinnecock Indian Nation, Tonawanda Band of Seneca, and Tuscarora Nation.[17]

Energy and climate issues are deeply intertwined, and Indigenous communities acutely understand this. Current challenges include access to energy infrastructure, food and water insecurity, land contamination, public health and safety issues, as well as impacts to culturally significant resources

including loss of use, degradation of quality, and altered visual landscapes. In addition to seeking improved processes and resolution on these issues, some Indigenous Nations have identified opportunities for collaboration with New York State and its partners to increase energy affordability, reduce energy cost burdens, and pursue clean energy development. These opportunities include large-scale land-based wind and solar projects, electric vehicle charging infrastructure. Nations are also interested in building decarbonization through energy efficiency and electrification including related health and safety retrofits needed to make housing ready for weatherization, flooding, and other hazards, distributed solar generation, and the deployment of solar-plus-storage to support climate resilience. The State recognizes the importance of advancing energy resilience and climate adaptation through inclusive collaboration with Indigenous Nations to create forward-looking, sustainable solutions and long-lasting partnerships.

New York State agencies and authorities currently engage with Indigenous Nations on a range of energy-related issues, and there remain opportunities to strengthen and expand this collaboration. DEC's Office of Indian Nation Affairs engages with Indigenous Nations to address environmental and cultural resource issues of mutual concern through government-to-government consultation and coordination. NYSERDA has engaged with Indigenous Nations on a range of clean energy topics, including offshore wind development, support through Regional Clean Energy Hubs, siting of large-scale solar and wind projects, solar-plus-storage resources, grid interconnection, electric vehicles, workforce development and building electrification, among others. DOT's Office of Government and Community Relations coordinates with Indigenous Nations throughout transportation planning efforts. Pursuant to the RAPID Act, the DPS's proposed ORES regulations (revised October 2025) include mandatory pre-consultation procedures with Indigenous Nations prior to filing applications and a series of submission requirements to ensure Indigenous Nations are kept apprised of filings for major renewable energy generation and electric transmission projects. Recognizing the need for greater focus, Governor Hochul appointed the State's first Deputy Secretary for First Nations in 2023 with the goal of strengthening nation-to-nation relationships with Indigenous Nations in New York. The State and its respective agencies have made progress and are working to increase opportunities for meaningful collaboration with Indigenous Nations.

Increasing collaboration has many benefits. Indigenous communities have place-based experiences and relationships with the land and water that can provide a comprehensive outlook on the interconnectedness across systems.[18] These foundational concepts of cultural preservation, environmental stewardship, and adapting and innovating to a changing environment can offer valuable insights in energy planning and development, so long as Indigenous communities retain their individual knowledge and their cultural heritage is protected and respected.[19] Given their status as sovereign governments with their own respective governance structures and policies, collaborating with Indigenous Nations can also potentially provide unique opportunities for developing energy partnerships that meet the State's and Nations' energy priorities. Energy and resilience planning spans jurisdictions and should be cognizant of the need for Indigenous Nation self-determination and sovereignty.[20] Indigenous Nations that are collocated within New York have a breadth of energy priorities and may be interested in collaborating with New York State to achieve respective energy priorities. Some Indigenous

Nations are working to develop and own distributed and largescale renewable energy projects on and off territory through Tribal Energy Development Organizations and other vehicles as a means to achieve energy sovereignty and create local economic opportunities.[21,22] A Tribal Energy Development Organization (TEDO) is a special purpose vehicle statutorily recognized by the U.S. Department of Energy that can consist of any enterprise, partnership, consortium or other type of business organization that is engaged in the development energy resources and is wholly owned by Indian tribes or Indian tribes and partner [23,24]

Indigenous Nations that have received NYSERDA funding through various programs to develop clean energy projects include: In 2017, the Seneca Nation utilized funding from NYSERDA's Land-Based Wind Incentive Program, the U.S. Department of Energy (DOE), and additional sources to develop a 1.5 MW Vensys wind turbine.[25, 26] The St. Regis Akwesasne Housing Authority used NYSERDA funding through the Affordable Solar Predevelopment and Technical Assistance program, DOE funding along with other funding sources to develop a 1.2 MW solar farm that has been providing affordable energy to St. Regis Mohawk Nation residents since 2020. In 2021, the Shinnecock Nation, SUNation and the Long Island Progressive Coalition, completed the installation of solar panels on a Tribal government preschool building.

The latter two examples demonstrate the additional federal resources that have been available to Indigenous Nations to help support the renewable energy transition and bolster energy sovereignty. Between 2010 and 2024, more than 240 Indigenous Nation energy projects have received federal funding, with estimated lifetime savings totaling nearly $530 million.[27] Additional resources are available that may assist Indigenous Nations in adaptation planning.[28] These resources identify existing tools, frameworks, and needs for enabling sovereignty and equitable distribution of benefits through climate and energy planning. It is worth noting uncertainty regarding funding for renewable energy projects on the federal level increases the need for the State to collaborate with Indigenous Nations to support their energy priorities.

In acknowledgment of environmental disparities faced by many Indigenous Nations and the history of displacement and forced removal from Indigenous ancestral lands, as well as contemporary evidence of socioeconomic, public health and environmental vulnerabilities Indigenous communities experience, census tracts with greater than or equal to 5 percent of federally-designated reservation territory and State-recognized Nation-owned land are included as Disadvantaged Communities as established by the Climate Justice Working Group.[29]

To learn more about how New York State applies these criteria to prioritize clean energy investments—ensuring that Indigenous Nations benefit from the transition to a clean energy economy—please refer to the Environmental Justice and Climate Justice chapter.

3.4. Regional Outlook

New York State has long worked with its government partners and will continue to build on successful regional initiatives to help maintain momentum, particularly amid changes in federal policies. The State Energy Plan Pathways Analysis shows that additional governmental and private action will help lower

energy usage and support gradual market penetration of clean energy technologies. The Pathways Analysis assumes existing policies, incentives, and financial assistance remains intact, though as described in this chapter and elsewhere in this Plan, the current federal and global economic context is one of great uncertainty which impacts long-term planning, investment decisions, and the pace of transition. As a result, New York is expected to increasingly seek out regional partnerships to ensure a reliable energy supply and delivery and progress toward state energy goals.

The shifting federal landscape has also reinforced the importance of regional coordination on a range of topics. Recent federal energy policy and research priorities and adjusted regulatory processes have placed greater emphasis on intrastate coordination and regional alliances with other states, industrial partners, and non-government organizations. In many cases, New York is a founding member or already participates in such partnerships formed over the past 5-10 years. Access to federal data and information has also been affected, with an estimated 47 energy websites, 94 governance and partnership sites, 175 climate or conservation and 123 environmental justice websites changing since the start of 2025.[30] Fostering regional partnerships will allow New York State to leverage regional expertise, potential cost savings, and identify mechanisms to provide critical energy tools and programs that New Yorkers need.

3.4.1. Recommended Actions through Regional Coordination

New York State has built strong regional and interstate partnerships that are necessary to reinforce a just transition to its clean energy work. New York State has found from previous partnerships that enhancing resilience of communities and infrastructure requires mainstreaming climate change considerations into energy standards, planning decisions, and regulatory programs.

- **The State should continue to explore intrastate and intergovernmental partnerships to advance energy and adaptation solutions.** The State should be nimble and continue fostering cooperation to seek out opportunities for progress and uplifting disadvantaged communities, particularly given near-term federal policy uncertainties and unprecedented reductions in federal programs and resources. The State can address vulnerabilities in the State's energy system to climate hazards and extreme weather events through regional partnerships, building from lessons learned and resource sharing.
- **Develop State capacity and engagement strategies that specifically support cross-border issues of energy planning with Indigenous Nations.** This includes developing more internal capacity to build mutually beneficial relationships with Indigenous Nations and Indigenous People's Organizations to achieve the mutual energy and climate goals of New York State and Indigenous Nations. For example, this would build upon the work of agencies such as NYSDEC, which created an Office of Indian Nation Affairs in 2022 along with staff capacity to liaise with Indigenous Nations, and NYSERDA's ongoing process to develop an Indigenous Nation partnership and engagement strategy. Other agencies should explore similar approaches, including clearly articulating when, with a focus on early engagement, and how government-to-government consultation and engagement should occur for energy planning processes. Government-to-government consultation and collaboration should address capacity building to

remove barriers to accessing program resources and support Indigenous Nations and Indigenous Peoples to participate in and benefit from energy sector planning.

- **With federal shifts in policy and resources, the State should continue collaborating with external partners to provide transparent data and reporting on health, environmental, and economic outcomes of the clean energy transition.** These tools and resources will inform future planning efforts to address affordability concerns and provide opportunities for improving outcomes, which are particularly important considering the anticipated economic-development driven load growth and long-term electrification of transportation and buildings. Data informed feedback loops will also be important for climate resilience, informing adaptation measures and future emergency preparedness responses.
- **The State should continue to leverage regional partnerships to promote strategic investment, innovative technologies, accelerate adoption, and expand clean energy workforce opportunities.** These are common themes across sectors (e.g., buildings, electric, transportation, nuclear, etc.). By supporting renewable energy manufacturing and renewable energy facilities, workforce development programs and intergovernmental partnerships the State can address impacts faced by disadvantaged communities. These partnerships and related actions will help improve the health, economic, and environmental well-being of these communities.

4. Federal Coordination to Advance State Energy Goals

The federal government plays a role in providing the broader policy and market context for energy planning within which the states operate, and it can leverage this role to help shape markets. The federal government's size and influence enable it to shape and drive national and global energy technology markets in ways that individual states cannot. Generally, the federal government establishes national energy policy, provides funding and investments, and regulates interstate transmission of energy, while protecting national interests. States have autonomy in determining the characteristics of the energy supply, regulating the distribution of energy, setting retail rates, and implementing their own energy strategies within the limits of State jurisdiction.

Recent changes in energy policy at the federal level have created uncertainty, stressing the need for continued coordination and collaboration for the benefit of New Yorkers. For instance, in early 2025 the President signed a series of executive orders aimed at reversing course on key energy policies, including calling to eliminate appliance standards and climate policies, withdrawing consideration of any area in the Outer Continental Shelf for wind energy leasing, and expediting oil and gas permitting and leasing. Government reorganization efforts have reduced the federal workforce, including at agencies critically tied to energy planning and siting energy infrastructure. Federal funding for clean energy projects and programs has been rescinded while the administration is simultaneously calling for streamlined environmental permitting and the accelerated build out of energy-intensive facilities such as artificial intelligence (AI) data centers and, in many instances, the fossil power plants needed to supply them. Moves are also underway to eliminate or privatize federal research and data programs, restructure federal decision-making processes, and implement emergency regulatory procedures which could create new vulnerabilities for certain energy projects. Additionally, information has been suppressed or deleted

about environmental justice, climate change, and the health impacts associated with these factors. The ultimate impact of these executive actions remains to be seen; however, in and of themselves have caused considerable speculation and uncertainty in the markets that are influenced by these federal policies.

4.1. Federal Government Roles

4.1.1. Regulations, Standards, and Permitting

Energy is regulated at the federal level via several primary agencies.

- Federal Energy Regulatory Commission (FERC) – Regulates interstate transmission of electricity, natural gas, and oil, and is responsible for hydropower plant licensing. Has backstop authority to permit certain electric transmission facilities.
- Department of Energy (DOE) – Responsible for establishing energy efficiency standards and policies for appliances and equipment.
- Department of Interior (DOI) – Responsible for development of resources on the outer continental shelf, including offshore wind planning and leasing through the Bureau of Ocean Energy Management (BOEM) and enforcement of regulated activities through the Bureau of Safety and Environmental Enforcement (BSEE).
- Nuclear Regulatory Commission (NRC) – Regulates the nuclear power industry and oversees the storage and disposal of nuclear waste.

These agencies can play important roles in establishing national rules, programs, and standards that provide guidance to States, energy market participants, and interested parties. FERC's regulatory efforts include a recent rulemaking that would establish standards for long term electricity transmission planning across the country, including New York. This is key to the successful and efficient rollout of grid modernization technologies, ensuring better communication across and within systems, particularly as operators seek to identify disturbances and respond to them (e.g., cyber security). However, recent Executive Orders under the current federal administration have challenged the independence of some regulatory bodies, causing uncertainty. Given the interrelationship between FERC and the PSC's statutory responsibilities, FERC's determinations will affect the State's energy objectives.

U.S. DOE has authority to undertake grid planning and enhancement initiatives, such as National Interest Electric Transmission Corridors (NIETC) and grid upgrades to implement America's Artificial Intelligence Action Plan. NIETCs are designated areas where the agency determines that new transmission is necessary to reduce congestion that adversely impacts ratepayers, among other factors. DOE makes these determinations on the basis of system studies and consultations that include States. As of this date, there are no NIETCs proposed for designation in New York although DOE has proposed to designate a Lake Erie -- Canada Corridor. DOE could continue to conduct studies and may announce additional designations in the future and has the authority to permit transmission in an NIETC over the objections of States. Furthermore, to enact America's Artificial Intelligence Action Plan,[31] DOE launched its Speed to Power initiative in September 2025. This initiative aims to build out large-scale transmission and

generation projects to increase grid reliability to match the pace of AI development as well as support advanced manufacturing. Existing funding programs, such as those initiated through DOE's Grid Deployment Office in prior administrations to support renewable energy, are anticipated to be leveraged to meet current federal priorities.[32]

National energy efficiency standards resulting from the DOE's Appliance and Equipment Standards Program have historically offered a uniform set of requirements across the nation, providing manufacturers relief from having to navigate a patchwork of standards. With few exceptions, states are prevented from setting standards for products that are already regulated by the U.S. DOE, which is referred to as federal preemption. However, states can set standards for products and appliances that are not regulated by the DOE as New York has done under the requirements of the Advanced Building Codes, Appliance and Equipment Efficiency Standards Act of 2022.

The federal government also plays a role in permitting specific energy projects when they are on federal lands. Coastal state waters extend out to three nautical miles from the coastline; the federal government has primary jurisdiction over waters beyond that point. Therefore, when it comes to developing resources like offshore wind that largely fall within federal jurisdiction, BOEM is the lead federal agency with responsibility for siting and leasing offshore wind areas, overseeing permitting processes, and enforcing compliance with all applicable safety, environmental, and conservation laws and regulations. BOEM coordinates these activities with other federal permitting agencies and coastal states.

BOEM generally schedules oil and gas lease sales within the framework of a five-year national program and applies a similar five-year planning horizon for offshore wind leasing. Following the issuance of revised offshore wind regulations in 2024, BOEM is now required to establish a five-year offshore wind leasing schedule. Additionally, the agency has incorporated permitting efficiencies designed to shorten project review times while maintaining high standards for environmental protection and safety. Importantly, BOEM and BSEE renewable energy regulations have been slated for sunsetting,[33] which would inject additional uncertainty in offshore project planning and reviews.

U.S. Army Corps of Engineers (USACE) undertakes federal civil works projects and regulates activities in the nation's waters, many of which can have implications on energy projects operating in or near the waterways. The USACE mission is broad and includes undertaking coastal storm damage reduction projects, maintaining federally authorized navigation channels and structures, and undertaking environmental restoration. A major component of the USACE regulatory program is protecting waters from irresponsible and unregulated discharges of dredged or fill material.

4.1.2. Coordination and Partnerships

Where states and the federal government have shared goals, purposeful collaboration can be key to advancing common interests. The federal government can play a role either via formal partnerships or informal coordination to strengthen cooperation across authorities having jurisdiction or to define new processes for emerging technologies that may not fit well into existing processes. Strategic partnerships and collaborations can accelerate the development of emerging industries that were not anticipated when existing rules, regulations, and processes were originally established.

NYSERDA also collaborates with the DOE to manage the West Valley Demonstration Project, which includes demolition and decommissioning of the buildings and support structures at the former spent nuclear fuel reprocessing facility. DOE provides funding to support the State's responsibilities at the site, and a cost-share is provided through the New York State budget.

To meet statutory obligations, the President of NYSERDA serves as the Governor's designated State Liaison Officer (SLO)[34] to the U.S. NRC, acting as the primary communication link between the State and the NRC—a role that exists in all 50 states. NYSERDA also regularly coordinates with the DOE.

Under Section 7-101 of the New York State Energy Law, NYSERDA is responsible for coordinating state programs related to atomic energy, advising and assisting the Governor and Legislature on such matters, and recommending policies that promote the peaceful use of atomic energy while protecting public health, safety, and the broader public interest. NYSERDA is also tasked with aligning New York State's atomic energy initiatives with those of the federal government and other states.

Regional Ocean Partnerships (ROPs) are organizations voluntarily convened by governors working in collaboration with federal and Indigenous governments to address ocean and coastal issues of common concern in that region, including offshore wind planning and development. New York State is a founding member of the Mid-Atlantic Regional Council on the Ocean (MARCO) which coordinates with federal and non-federal partners through the Mid-Atlantic Ocean Planning Committee (OPC). New York is also an ex-officio member of the Northeast Regional Ocean Council (NROC). The Bipartisan Infrastructure Law (BIL) established funding to implement these shared regional ocean priorities, which include ocean energy development and maintaining ocean data that is useful in offshore spatial planning for energy facilities, though this too is in jeopardy.

4.1.3. Funding

The federal government plays a significant role in energy planning and policy development via its use of funding and financing programs. Support can come in a variety of forms, from grants to tax credits to loan guarantees, and often the effectiveness of the support mechanism is tied closely to how durable they are over time.

DOE's State Energy Program provides New York State with formula funding annually for use in improving energy efficiency, developing renewables, promoting economic development, delivering emergency planning and response, and reducing imported oil reliance. NYSERDA leverages this funding to develop and synthesize data and coordinate planning activities through its State Energy Plan, Climate Action Council Scoping Plan, and Clean Energy Industry Report as well as State Energy Emergency Planning. Similarly, the Federal Highway Administration (FHWA) is responsible for distributing the majority of New York's federal transportation funding, which is then administered by DOT. This funding includes support for emissions reduction initiatives such as the Congestion Management Air Quality Improvement Program (CMAQ), the Transportation Alternatives Program (TAP), and the Carbon Reduction Program (CRP). Effective distribution of these funds requires close collaboration among the FHWA, DOT, MPOs, and local governments. In 2023, DOT worked with FHWA to develop a Carbon Reduction Strategy, which describes the state's plan for reducing transportation emissions. The consistency of annual funding for these programs has improved state planning around the appropriate use of those funds.

The federal government also uses funding to advance energy research and development, often seeking to lower the cost of emerging technologies and reduce financial risks to the private sector. Long-standing federal efforts around new technology development and early market support have successfully advanced technologies and supported long-term economic growth of markets. There is also a national security play in investing in technology development. Owning energy technologies and controlling the development of them is key to successfully competing with other nations and ensuring domestic resource diversity. Without control over the full range of potential technologies, a nation becomes vulnerable to others gaining the upper hand. If a deliberately narrowed set of technologies begins to fail, there will be limited capacity to build resilience into the system.

Over the last five years, U.S. Congress passed landmark legislation directing historic investments that have aligned with New York State's climate goals and bolster renewable energy, electric vehicles, energy efficiency, and economic development, including the BIL, Inflation Reduction Act (IRA), and CHIPS and Science Act. These significant pieces of legislation represent support for demonstration of infrastructure investments that are necessary for grid modernization, resiliency, and reliability. This legislation has recently been targeted by the current Congress and federal administration and the recent 2025 Federal Budget Reconciliation Bill (H.R. 1) repealed authority and unobligated funding for several significant federal energy and environmental programs supported by the legislation. The New York State Governor's Office and relevant state agencies have worked closely with federal partners to administer funding made available through these initiatives. They continue to actively engage with New York's Congressional Delegation—both in the Senate and the House—to ensure that this and future funding, as well as related efforts, benefit all New Yorkers, particularly the most vulnerable communities.

In July 2024, the Accelerating Deployment of Versatile, Advanced Nuclear for Clean Energy (ADVANCE) Act was passed with bipartisan support, easing regulations to accelerate the development and deployment of advanced nuclear technologies and strengthen U.S. leadership in this space. The law directs the NRC to streamline its licensing and permitting processes, including authorizing combined licenses for reactors at existing sites, facilitating licensing at brownfield locations, and supporting the licensing of small modular reactors (SMRS). New York State is working with DOE, other "first mover" states, and private industry to better understand the potential landscape for nuclear project development in New York, including launching a Master Plan for Responsible Advanced Nuclear Development to develop recommendations for implementation.

However, the long-term durability of some of these historic investments is eroding. The current federal administration has prompted a reassessment of various policies and programs, with efforts underway to scale back or eliminate many of them. This sheds light on a key challenge of federal stimulus initiatives; they often arrive in short bursts, offering only temporary boosts rather than sustained support. In contrast, long-term measures—such as consistent tax policy—provide greater stability and predictability, allowing markets and investors to plan more effectively. While grants can stimulate market activity in the short term, they alone are rarely sufficient to drive lasting change. Tax policy, on the other hand, has proven more effective in catalyzing meaningful and sustained investments, especially in sectors like energy infrastructure. Unfortunately, the 2025 Federal Budget Reconciliation Bill that was signed into law in July 2025, also made changes to the longer-term tax credit policies for specific technologies, including

wind and solar projects, providing a rapid phase down of credits compared to other technologies and adding strict supply chain requirements to be eligible for the credits. These actions will provide additional headwinds for achievement of New York's energy goals.

While the future of this funding is uncertain under the current federal administration, New York will continue to collaborate with its Congressional delegation and federal counterparts to advance clean energy policy where possible.

BIL/IIJA/IRA/CHIPS and Science Act

- **Bipartisan Infrastructure Law (BIL)/Infrastructure Investment and Jobs Act (IIJA) -** Passed in 2021 the IIJA authorized $1.2 trillion (including $550 billion in new spending) through FY 2026 for investments in energy, transportation, water, and broadband, with many funding programs supporting emissions reduction projects. Funds are distributed to the states via both formula and competitive grant programs, thus collaboration between NYS agencies and federal agency partners is necessary to ensure their effective and efficient implementation.
- **IRA -** IRA, passed by Congress in 2022, provided $370 billion in funding for clean energy and environmental justice initiatives nationwide, representing the largest investment in climate action by the U.S. government. It also included expanded tax credits to incentivize investments in clean energy.
- **CHIPS and Science Act -** Passed in 2022, the CHIPS and Science Act provided over $50 billion to strengthen our country's position in semiconductor research, development, and manufacturing while investing in American workers. With congressional support, New York State was able to obtain significant federal funding and attract numerous semiconductor companies including Micron, GlobalFoundries, and Wolfspeed. New York has enacted its own Green CHIPS law, offering up to $10 billion in economic incentives for environmentally friendly semiconductor manufacturing and supply chain projects operating within the State. These State incentives, in combination with federal support and private investments, are attracting thousands of jobs and billions of dollars to solidify New York as the nation's leader in the domestic reshoring of semiconductor manufacturing.

4.2. Federal Outlook

Governments, markets, and businesses like certainty and predictability. It allows for more measured decision-making, action, and longer-term planning. Yet, while federal energy policy tends to remain relatively consistent within a single four-year presidential term, it is reasonable to expect shifts in priorities and goals as administrations change—especially over the 15-year timeframe addressed by this State Energy Plan. At the present time, there are significant shifts in federal energy policy with the aforementioned Executive Orders, budget reconciliation bill, and rescission of funding and tax credits for wind and solar technologies. Therefore, monitoring and engaging with federal energy agencies and policy makers will be crucial to ensure New York's interests are well represented and that the State retains sovereignty in energy decision-making. Given New York's unique energy infrastructure, needs, institutional frameworks, and processes, the State should advocate for federal policies that reflect a tailored approach rather than a one-size-fits-all solution. Without such consideration, New York risks

facing higher costs, inefficiencies in implementation, and potential conflicts between state and federal jurisdictions.

New York must remain diligent in its participation in federal energy policy dialogue and seek areas of common goals and opportunities for collaboration (including technology development and pursuing federal funding opportunities) that can be leveraged for maximum benefits to New Yorkers. In the near term, there are potential synergies in new tech development and early market support (including for nuclear, long duration storage, hydrogen, and possibly fuels and carbon management technologies), reshoring of manufacturing/domestic manufacturing, and expansion of the electric grid to meet growing energy needs.

4.2.1. Recommended Actions with the Federal Government

Recognizing this Plan projects out to a 15-year horizon, the State should proactively prepare for evolving federal landscapes—positioning itself to capitalize on opportunities when interests align, while also remaining ready to address federal actions that may hinder its progress.

- **New York State should actively seek opportunities for federal partnerships and collaboration across all levels of government and industry.** Given the pace of change needed, the state must be prepared to harness federal opportunities as they arise by pursuing partnerships, while not relying solely on them to drive progress. Continued coalition-building alongside industries and the federal government can be used to identify additional opportunities for public-private partnerships and provide a range of benefits (e.g., efficiencies, economic growth, sustainability, service delivery). Areas ripe for near-term engagement include nuclear energy advancement, such as rulemaking, siting, risk-sharing, and bulk purchasing, as well as innovation efforts that are likely to favor dispatchable emissions-free resources including hydrogen, long-duration energy storage, and grid solutions.
- **The State should advocate for its interests at the federal level** by seeking flexibility in policies that preserve state sovereignty in energy decision-making and take into account New York's unique structures, processes, and needs. Additionally, the State should explore mechanisms to improve regulatory efficiency and coordination across federal, state, and local processes.

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2025 NEW YORK STATE ENERGY PLAN

Key Terms Used in This Chapter

FOR THE COMPLETE GLOSSARY ➜

Advanced Clean Cars II (ACC II): A regulation adopted by New York State that will require all new passenger cars and trucks sold in New York State to be zero-emissions by 2035.

Advanced Clean Trucks (ACT): A regulation adopted by New York State that requires manufacturers of vehicles greater than 8,500 pounds to sell an increasing number of zero-emission vehicles (ZEVs) in New York State.

Alternative Fuels: Liquid or gaseous fuel derived from biomass or clean energy such as biodiesel, renewable natural gas (RNG), renewable diesel, hydrogen, sustainable aviation fuel (SAF) and synthetic fuels.

Building Shell Upgrades: Upgrades to a building protecting the interior from outside temperatures and moisture to cut energy use and enhance indoor comfort through measures such as air sealing, insulation, and window upgrades.

Capacity Factor (in the context of power generation): Measures the ratio of a power plant's actual generation relative to the maximum amount it could generate annually if producing at full capacity without any interruption.

Combustion (in the context of power generation): Generators that burn fuel, often gaseous or liquid, to produce electricity. Within the State Energy Plan, potential combustion fuels include natural gas, renewable natural gas, fuel oil, and hydrogen.

Dispatchable Emissions-Free Resources (DEFRs): Firm electric generation resources that can be rapidly turned on or off, or adjusted as needed, to meet electricity demand with low to no emissions. Note a formal definition of eligibility is still being developed in the Public Service Commission (PSC) Zero by 40 Proceeding. These may be needed to provide electricity during extended periods of high demand and/or low renewable generation, such as winter weeks with increased heating loads from heat pumps coupled with lower renewable output, when short-duration storage would be insufficient to meet demand. Some DEFRs can also provide zero-emission energy outside of challenging days and weeks.

Hybrid Heat Pump: A heat pump system installed that is not sized to meet the full heating load of the building, requiring the use of a supplemental heating system during the coldest hours of the year.

Investment/Production Tax Credit (ITC/PTC): U.S. federal tax credits designed to promote clean energy development. The ITC provides a tax credit based on a percentage of the upfront investment cost to build eligible renewable energy projects. The PTC offers a tax credit based on the amount of electricity a qualifying renewable facility generates over time. Credits deployed and extended under the Inflation Reduction Act have since been significantly changed as a result of H.R. 1.

PATHWAYS Model: An economy-wide stock rollover model that calculates stocks, sales, energy use, and greenhouse gas emissions from transportation, buildings, industry, and other sectors, and captures interactions among measures to create a detailed picture of the energy system through 2050.

RECAP Model (Resource Adequacy): A loss-of-load-probability model designed to evaluate the resource adequacy of electric power systems, including systems with high penetrations of renewable energy and other dispatch-limited resources such as hydropower, energy storage, and demand response.

RESOLVE Model (Capacity Expansion): An electricity resource planning model that identifies optimal long-term electric generation and transmission investments subject to reliability, policy, and technical constraints.

Sales Share: The percent (%) of building or transportation stock units purchasing equipment in a given year that adopt the target technology (e.g., residential housing units purchasing equipment in a given year that adopt the target technology such as high-efficiency heat pumps as the primary heating system or efficient shell packages).

Sensitivity: A modeling case built off an existing scenario with a targeted variable(s) changed to explore specific questions on the future of the energy system. Examples of sensitivities run for the Final State Energy Plan include the “Zero Carbon Firm” and “Federal Policies” sensitivities. These differ from the scenarios within the model that change multiple variables to reflect potential energy futures of these updated variables acting at the same time.

Stock Share: The percent (%) of building or transportation stock units that are present in the economy in a given year, as a percentage of the total building or transportation stock units of a given category (e.g., the number of light-duty battery electric vehicles on the roads as a share of total light-duty vehicles on the road).

Upstream Emissions (in the context of fossil fuel production): Out-of-state greenhouse gas emissions associated with the extraction, transmission, and use of fossil fuels imported into the State.

Zero by 40 (or 0x40): New York State Climate Act target for zero-emission electricity.

Key Findings → Pathways Analysis

To support energy planning in a time of significant federal policy uncertainty, the State is evaluating multiple scenarios that show future energy pathways for New York—called the "Pathways Analysis." This analysis explores how the State's energy supply and delivery systems will meet forecasted energy needs through 2040 in a manner that advances multiple objectives of the State: reliable, clean, and affordable energy; economic development; equity; and a healthy environment.

- **The energy system will undergo a meaningful transformation in final energy demand between 2025 and 2040**, even as all resources that contribute to meeting energy needs today continue to be important at the end of the planning period.
- **Future electricity demand is projected to grow due to new large loads and electrification of transportation and buildings.** In all pathways, new large loads interconnecting to the system will drive growing electricity demand, across both annual loads and peaks.
- **Meeting this growing electricity load while maintaining system reliability, will require investments in expansion of the electricity system under all pathways.** Renewable energy, nuclear, new transmission and battery storage are foundational to decarbonizing the state's electricity system while meeting the growing demand.
- **Reliably integrating large quantities of variable renewable energy into the electricity system will require flexibility and balancing over multiple timescales.** While the process for establishing the definition of zero-emission generation is still underway, the modeling assumes that the remainder of multi-day reliability needs are met by generators powered by green hydrogen. Under this assumption, the **combustion generation fleet remains critical.**

- **The gas system transformation is pathway dependent, with all scenarios outside of No Action seeing a decline in consumption through 2040.** At the same time, in all scenarios, the gas system remains an important energy delivery system.
- **The modeling finds that existing State policies are laying the groundwork for further economy-wide emissions reductions,** with significant contributions from power generation, transportation, buildings, and fugitive emissions including methane and hydrofluorocarbons (HFCs). However, the State is currently not on track to meet the 2030 emissions limit with core planning scenarios achieving 40 percent emissions reductions in 2037–2038.
- Regardless of the specific future pathway for New York's energy system, c**ontinued investment to maintain and modernize existing infrastructure, replace aging equipment, and purchase fuels to meet energy needs will be necessary.**
- **Recent federal policy changes have shifted costs toward New Yorkers as tax credits and incentives for clean devices and renewable resources have been repealed.**
- Across each of the scenarios, **the emissions mitigation achieved via State policies yields societal benefits that exceed the incremental costs** of the scenario in total over the planning period and in each individual year.

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1. Overview

The 2025 State Energy Plan Pathways Analysis provides an analytic lens on how New York's energy system could change over the coming decades using a scenario-based approach. The analysis focuses on identifying common themes and major drivers of change. It highlights the challenges and benefits associated with reducing fossil fuel dependence, scaling clean energy technologies, and meeting growing energy demand from new large commercial and industrial loads as well as building and transportation electrification.

This analysis draws on the best available data through October 2025. Conducted by Energy and Environmental Economics, Inc. (E3), informed by input and analysis across State agencies and improved by public comments[1], this work estimates stocks and sales of key energy technologies, energy demand, supply, greenhouse gas (GHG) emissions, and cost implications across multiple scenarios. The modeling integrates technical assumptions, policy trajectories, and sectoral detail, providing a foundation for evaluating tradeoffs and informing energy planning.

This chapter outlines the modeling framework, summarizes core scenarios, and presents key findings to inform decisions about energy investments and infrastructure planning in the years ahead and the discussion in other chapters of this Plan. The Annexes offer greater detail on the modeling methodology, input data, data sources, scenario assumptions, and results. Model inputs and assumptions are compiled in more detail in Annex 1, and key outputs in Annex 2.

The Pathways Analysis aggregates key input data from NYSERDA's industry studies and programs and uses a stock turnover approach to model equipment stocks over time across key energy sectors, such as buildings and transportation. This approach helps in understanding the deployment of technologies like heat pumps, electric vehicles (EVs), and efficiency measures. The Pathways Analysis produces an outlook on fuel use, electric loads and peaks, and gross and net GHG emissions by sector.

In addition, the Pathways Analysis includes an assessment of the energy supply sectors and how the energy supply across the economy changes over time to meet projected demand. This energy supply outlook captures changes in the gas system, fuel system, and electric sector. The electric sector toolkit includes capacity expansion and dispatch capability, which builds upon the electric system to meet demand load shapes while maintaining reliability standards and achieving scenario-specific constraints such as specified renewable build or policy targets like a zero-emissions grid by 2040. It enables exploration of contributions from various resources, such as solar, wind, batteries, and combustion units, to the generation mix over time.

While the Plan primarily focuses on energy sectors, it also includes high-level representations of emissions from non-energy sectors like waste and agriculture based on New York State Department of Environmental Conservation (DEC) forecasts. This comprehensive approach allows for an assessment of the impacts of non-energy sectors on economy-wide emissions limits. The toolkit also includes modules for analyzing refrigerant emissions and fugitive gas system emissions, while receiving information on air quality and health outcomes from parallel analysis.

1.1. Draft to Final Changes

Between the publication of the Draft State Energy Plan in July 2025 and this final Plan, the Pathways Analysis was updated to reflect the latest available information, new policy developments, and feedback from stakeholders and the public. This section summarizes the key updates integrated into the final analysis.

The Analysis was updated with the most current data inputs available through October 2025. Given the limited amount of time for new input dataset publications between Draft and final analyses, the majority of inputs remain the same. Key data refreshes include the incorporation of the latest U.S. Energy Information Administration's (EIA) Annual Energy Outlook (AEO) projections, which inform forecasts for key end use device sales, such as zero emission vehicles; the latest filings on State and utility energy efficiency and electrification programs; latest upstream emission factors from the DEC GHG Inventory; and the latest NYSERDA electric resource supply curves, along with updated resource and fuel costs. Furthermore, modeling details were refined, such as the estimated commercial equipment lifetimes, to better reflect current technology performance and turnover rates.

The framework was also updated to incorporate significant federal and State policy developments since the Draft was issued. The most prominent of these are changes in federal incentives created through the federal Inflation Reduction Act (IRA). In June 2025, the federal reconciliation act, H.R.1, revoked many federal IRA incentives. Revoking federal IRA incentives has profound implications for clean energy deployment, technology costs, and consumer adoption across the economy, reflected in the current Plan. In addition, the final Analysis accounts for other changes to federal and state policy. The Analysis accounts for the financial impacts of federal tariff structures and changes in methane leakage and hydrofluorocarbon (HFC) leakage regulations. In addition, the final Plan includes the state-level directive to NYPA to construct a nuclear project in upstate New York.

In response to extensive public and stakeholder feedback on the Draft Plan, this final Plan also features expanded analysis on several key themes, including a more detailed exploration of the potential role of nuclear energy and new sensitivities designed specifically to assess the impacts of the new federal policy landscape. While these updates refine the results, the foundational, macro-level trends and conclusions observed in the Draft Plan remain consistent. The fundamental challenges and opportunities, such as new large loads, expanded electrification in the transportation and building sectors, the corresponding expansion of the electric grid, and the significant role of energy efficiency, are reaffirmed in this final Plan.

The final Plan incorporates simultaneous updates to data (e.g., AEO), policy (e.g., IRA), and modeling assumptions (e.g., equipment lifetimes). As a result, a direct comparison of scenario outputs between the Draft and final versions cannot be used to isolate the impact of any single factor, such as federal policy. To understand the specific, discrete impacts of federal policies or other key uncertainties, readers are directed to review the new sensitivity analysis presented in Section 2.1.

2. Scenario Design

Given long-term uncertainty, the Pathways Analysis takes a scenario-based approach which allows exploration of outputs across different potential energy futures. These scenarios are briefly summarized in the table below, with more details available in Annex 1.

Table 1. Summary of scenarios

Scenario	Assumptions	Purpose
No Action	Includes Federal incentives and legacy NY policies but excludes the Climate Act and more recent additional State and Local climate measures. Federal incentives reflect those in place in October 2025 when the analysis was conducted	Counter-factual baseline to gauge relative impacts and incremental benefits and costs of State action
Current Policies	Layers on top of the No Action case the current progress toward achievement of enacted State and local policies (e.g. Clean Energy Standard progress, building code updates, Advanced Clean Cars/Trucks)	Illustrates what existing commitments achieve under current market conditions and headwinds
Additional Action	Includes Current Policies plus ongoing progress toward adoption of clean technologies through a mix of future programs and investments aligned with recommendations in the State Energy Plan	Core planning case for the Energy Plan, reflecting ambitious but achievable progress
Net Zero A	Accelerates adoption of clean energy technologies in all sectors toward achievement of economy-wide net zero by 2050, emphasizing all electric space heating	Reflects what is needed for full achievement of the 2050 emission limit with a smaller gas network
Net Zero B	Accelerates adoption of clean energy technologies in all sectors toward achievement of economy-wide net zero by 2050 with greater use of supplementary gas heating systems	Reflects what is needed for full achievement of the 2050 emission limit with a larger gas network

The first scenario is **No Action**. It includes historical policies, market-driven adoption, and federal programs (such as appliance efficiency and Corporate Average Fuel Economy (CAFE) standards) but excludes New York's Climate Act and other recent State and local clean energy policies. This scenario provides a baseline to assess the incremental benefits and costs of state action. This analysis includes federal clean energy and emissions programs as of October 2025; the future of such programs remains uncertain so further changes to federal regulatory and policy frameworks are explored in sensitivity analysis, in recognition of uncertainty.

The second scenario, **Current Policies**, builds on the No Action case by incorporating progress toward achievement of enacted State policies and local actions across sectors. In the buildings sector, this includes utility- and state-funded programs promoting energy efficiency and heat pump adoption, advanced building codes, and the implementation of all-electric new construction.[2] Utility- and State-funded programs include Clean Heat, Empower+, Direct Injection, and housing programs implemented through Housing and Community Renewal (HCR). In the transportation sector, the scenario considers progress towards achieving the Advanced Clean Cars (ACC) and Advanced Clean Trucks (ACT) standards. Although future implementation of these standards remains uncertain due to federal actions, they are included as current policy since outcomes of legal and regulatory processes are not yet determined. In the electricity sector, this scenario assumes progress toward the Climate Act's zero-emission electricity

goal by 2040 ("0x40"), with near-term trajectories informed by the Clean Energy Standard (CES) Biennial Review. These trajectories account for near term deployment challenges. Comparing this scenario to No Action helps illustrate the added benefits and costs of current State and local policies. As a bottom-up assessment of the energy future under current policies, this case is one of the two main planning cases developed for the State Energy Plan.

Since the publication of the Draft Plan, changes in federal policies have adversely impacted expected progress on clean energy policies across the economy, including in electricity generation, transportation, buildings, and non-energy sectors. While State policies are an essential backstop to decarbonization, there is future risk of further federal policy headwinds. The impacts of federal policy changes and the future risks of further rollback are investigated in more detail in federal policy sensitivities, described more in Section 2.1.

The third scenario, **Additional Action**, builds on Current Policies by showing ongoing acceleration in the adoption of clean energy technologies. This change could result from new policies, investments, environmental market mechanisms, or other initiatives as described in the State Energy Plan. As a forward-looking case that assumes continuous improvement, it serves as the core planning scenario for the State Energy Plan.

The final two scenarios, Net Zero A and Net Zero B act as a point of comparison to understand what would be needed to achieve the economy-wide 2050 emissions targets, including 85% reductions in gross emissions and net-zero, including significant increases in electricity use and the steep declines in other fuel consumption, driven by widespread efficiency and electrification.

The key difference between the two Net Zero scenarios lies in building heating technologies:

- **Net Zero A** emphasizes all-electric heating.
- **Net Zero B** assumes greater adoption of supplementary heating systems, where more customers retain a gas backup for the coldest days.

Although heat pump customers with supplementary heating systems use significantly less gas in Net Zero B, managing their backup use would require careful coordination. If the backup use can be coordinated successfully, this approach may significantly reduce peak electricity demand and underscores the potential value of maintaining a larger residual gas network. This Analysis does not perform a detailed modeling of the gas network.

2.1. Federal Policy Sensitivities

In addition to the five core cases described above, the Plan includes two sensitivities built off the Current Policies scenario. These sensitivities investigate the impact of federal policies already enacted and future federal policy uncertainty. Since the publication of the Draft Plan, changes to federal policies have already affected the outlook in the state's electricity, transportation, buildings, and non-energy sectors. While there are important State policy backstops which can enable continued decarbonization and emissions reduction, the State policy backstops cannot mitigate the totality of all the recent, or forthcoming, federal changes. The State policy backstops, shown in Table 2, are included in all policy

scenarios modeled, except for targeted sectors in the Further Rollback scenario where a federal rollback eliminates the State backstop; these are described in the Table.

The two federal policy sensitivities illustrate the impact of recent federal policy changes and potential future federal policy changes. By re-instating federal policies such as the IRA, the **Pre-Rollback** sensitivity illustrates what a Current Policies world would look like if federal policies were consistent with those in January 2025. This scenario gives an initial estimate of the scope of emissions, cost, and infrastructure change caused by the rollback of the IRA. In comparison, the **Further Rollback** sensitivity explores the potential for future federal policy rollbacks which could negatively impact State energy and climate objectives.

Table 2. Sectoral federal policies analyzed in the federal policy sensitivity analysis.

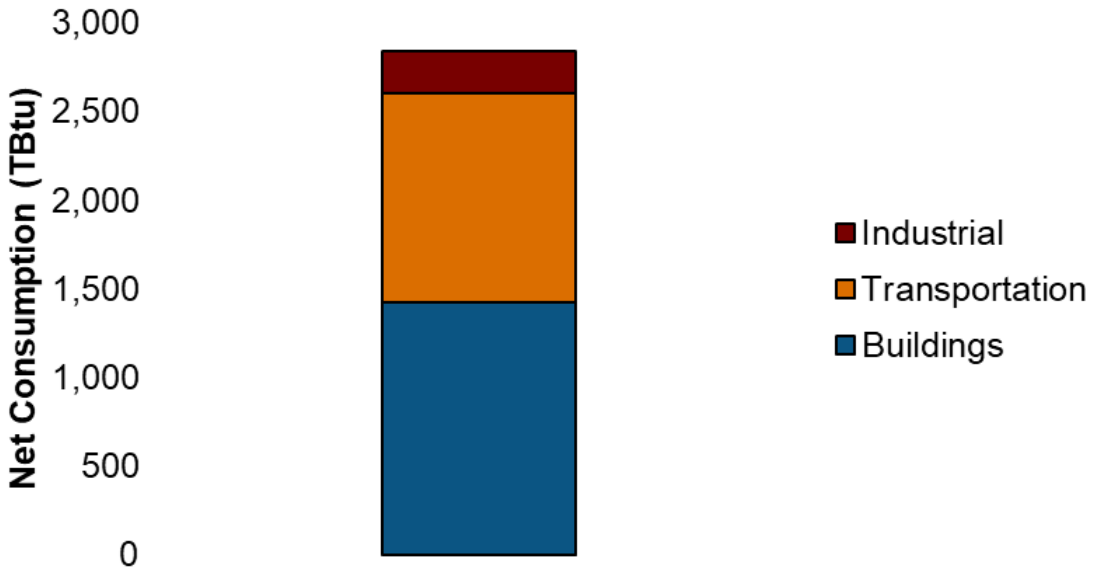
The magnitude of cost or emissions impact is indicated by the column "Impact." Federal policies included in the Pre-Rollback *sensitivity are listed under "Federal Policies in Place in January 2025". The "State Policy Backstops" list example NY State policies in place as of October 2025. Under "Future Federal Policy Risks", several potential federal policy outcomes are explored. Policy outcomes modeled in the* Further Rollback *sensitivity are indicated in bold text.*

Sector	Impact	Federal Policies in Place in January 2025 (Pre-Rollback sensitivity)	State Policy Backstops (kept in Current Policies core)	Future Federal Policy Risks (bolded explored in Further Rollback sensitivity)
Electricity	High	Significant clean energy production and investment tax credits (up to 50% Investment Tax Credit); reduced tariff and permitting uncertainty	State backstop includes Clean Energy Standard programs and 0x40 progress	Renewables excise tax; further domestic-content rules, additional tariffs, **permitting constraints,** power plant regulations
Transportation	High	Significant clean vehicle tax credits (e.g. up to $7,500/LDV); EPA tailpipe standards	State backstops of ACCII/ACT and vehicle incentives	**ACCII/ACT waiver repeal risk**
Methane	Medium	Emission fees (up to $60/ton methane)	In-state leakage backstopped by NYSDEC Part 203	**More EPA rule repeals possible,** but in-state methane leakage remains backstopped by NYSDEC regulations
Buildings	Low	Building energy tax credits (e.g., up to $2,000 per residential heat pump and efficiency incentives)	State and utility funded electrification and efficiency, all electric new construction and other codes remain	**DOE appliance standards repeal risk**, grant funds
IPPU	Low	EPA AIM Act and Technology Transitions to reduce HFC emissions	HFC emissions reductions backstopped by NYSDEC Part 494	**Further repeals** may erode ability for State backstop to hold, given market availability/impacts

3. Energy Demand Sectors

Based on information in NYSERDA Patterns and Trends for New York State, the sectors with the most energy consumption today include buildings (50%) and transportation (40%), with industry making up much of the remainder (Figure 1). The analysis of the energy demand sectors utilizes E3 PATHWAYS model, a bottom-up, technology-rich tool that operates on a stock-turnover framework to project long-term energy consumption.

Figure 1. Energy consumption by sector in New York (2023)



3.1. Buildings

Residential and commercial buildings remain the largest energy consumers in the state, primarily due to space conditioning (heating, ventilation, and air conditioning, or HVAC) and water heating. While the state's overall population is expected to remain stable, based on projections from Cornell's Program on Applied Demographics, a shift from upstate to downstate will increase aggregate cooling loads and reduce heating demand.[3] In addition, multiple studies conclude that climate change will increase the frequency and severity of extreme summer temperatures.[4,5] Climate trends are expected to increase summer cooling demands, and warmer winters are expected to reduce overall winter heating demands. The Pathways analysis, consistent with the NYSERDA Climate Impacts Assessment, accounts for increased warming, but this effect remains relatively modest within the 2040 timeframe of the State Energy Plan. Further information on modeling methods is available in the Appendix.

Across all scenarios, key drivers of change include energy efficiency investments, HVAC equipment turnover and new technology adoption, and new construction with improving efficiency. In the **No Action** case—absent State policy—heat pump and efficiency adoption continue at a moderate pace, driven primarily by consumer preferences. New construction is largely natural gas, and many buildings with existing oil and electric resistance switch to gas. However, even as gas customer counts increase,

replacements in kind of gas equipment lead to lower consumption due to the impact of federal appliance standards.

In contrast, the Current Policies and Additional Action scenarios feature stronger State and local policy influence. Measures such as efficiency and electrification programs, advanced building codes, and all-electric new construction drive higher rates of heat pump and efficiency adoption. The projected trajectories for heat pump and efficient envelope sales and stocks under these varying policy conditions are detailed in Figure 2 and Figure 3, respectively.[6] Energy efficiency measures remain foundational due to lower costs and higher project returns. Across the building stock, whole home building envelope upgrades (shell measures) outpace heat pump adoption in both scenarios. New building codes taking effect in the mid-2020s will further improve both envelope and equipment efficiency, mitigating load growth from electrified heating. By 2040, heat pump sales outpace the sales of gas equipment in the Additional Action scenario.

Achieving net-zero emissions economy-wide requires more aggressive action, as reflected in the Net Zero scenarios. These scenarios require near-universal efficiency upgrades with a focus on building shell upgrades and heat pump adoption. Due to the long service life of HVAC systems, achieving 2050 net-zero economy-wide emissions requires 100% heat pump sales by 2035—a significant increase above current adoption trajectories under existing State policies.

Figure 2. Residential heat pump sales share and stock trajectory

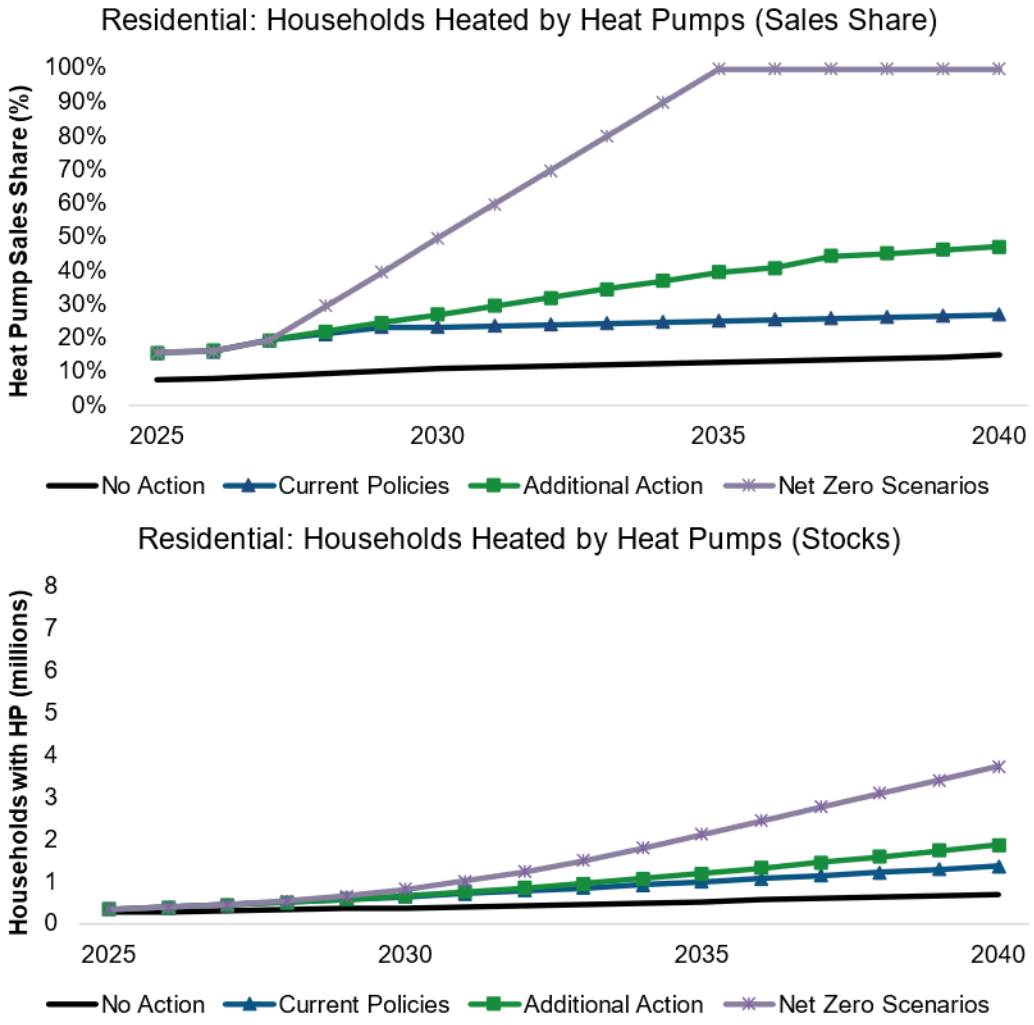


Figure 3. Commercial heat pump sales share and stock share trajectory

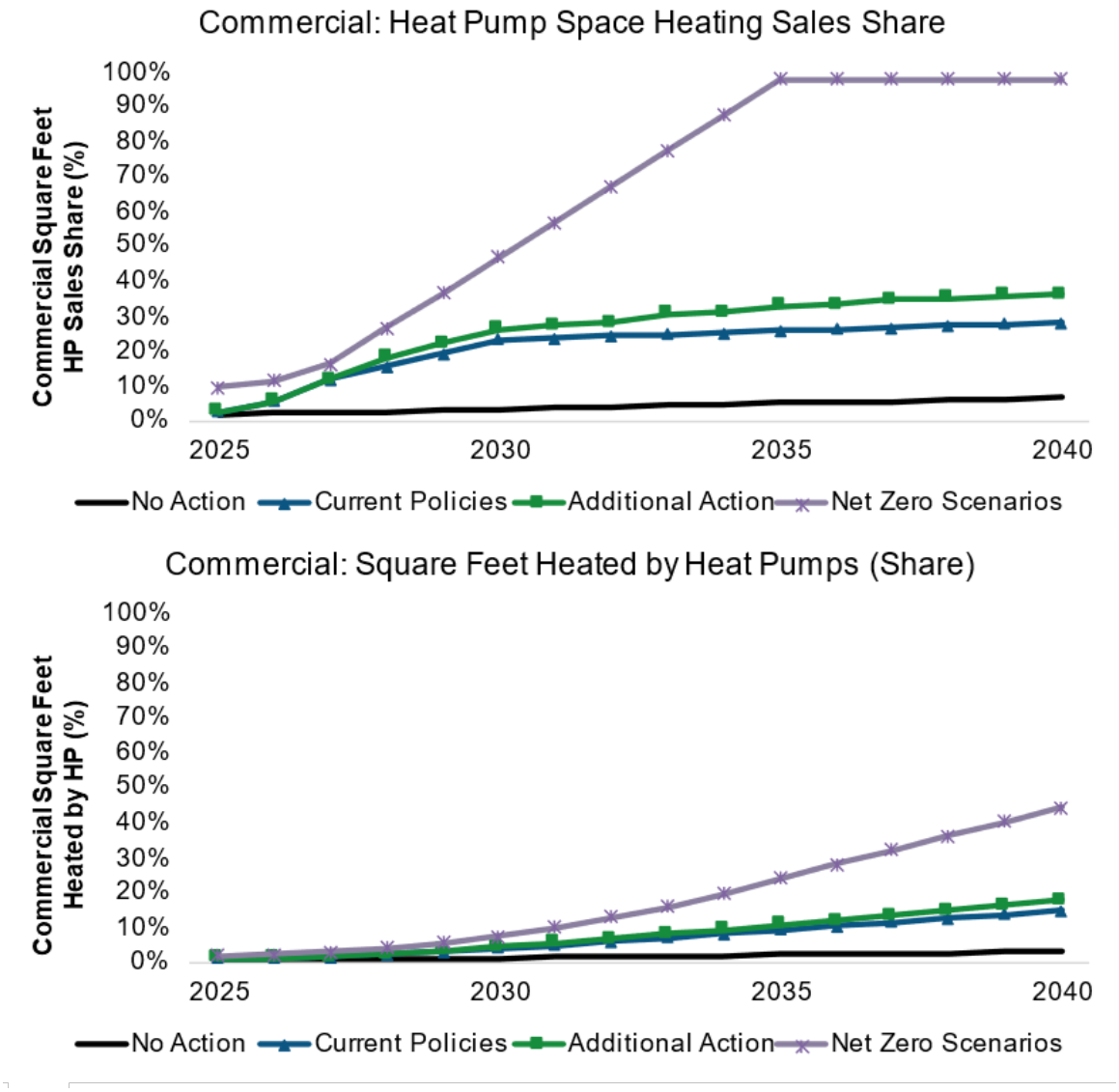
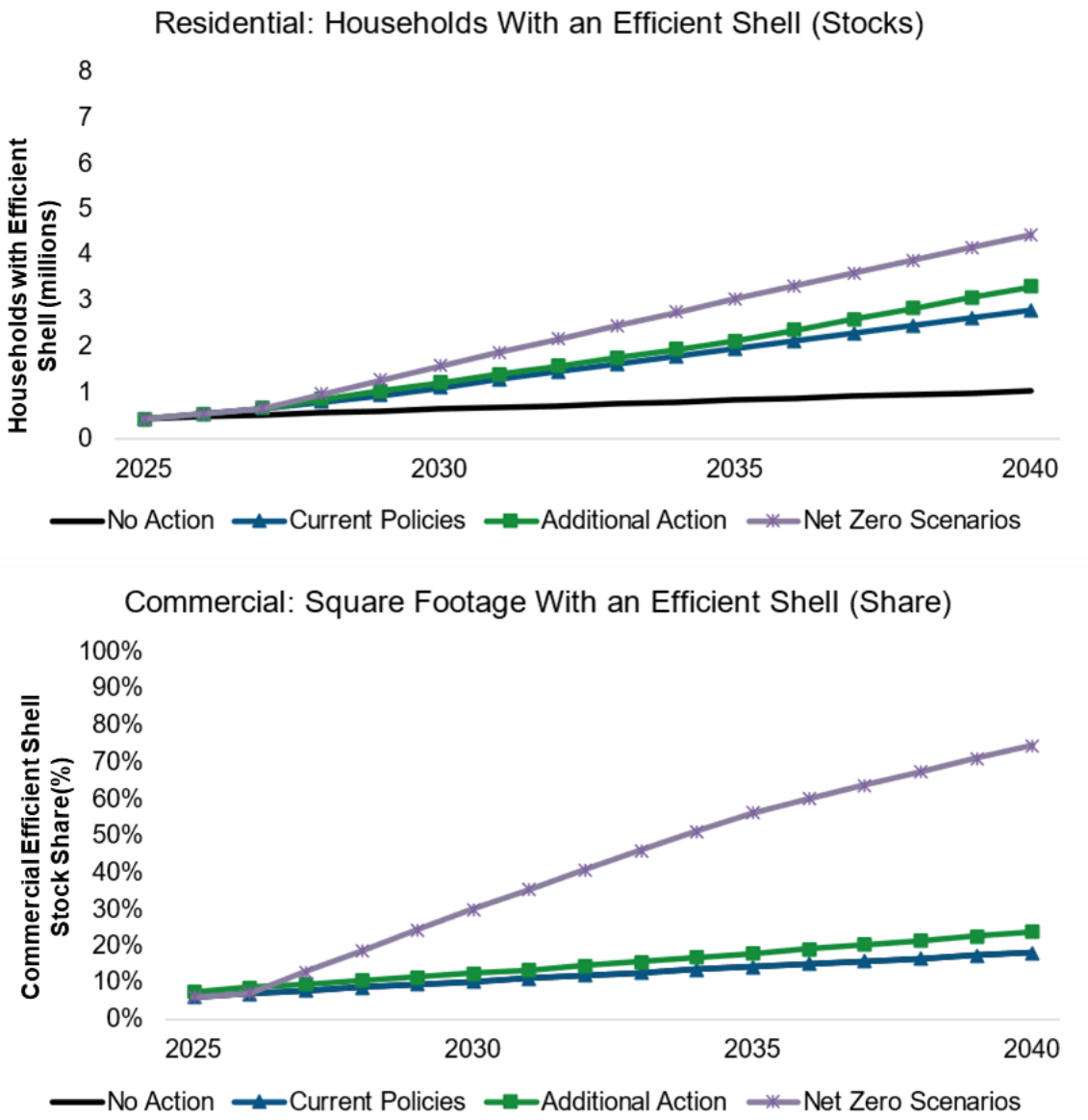


Figure 4. Residential and commercial efficient building shells stock trajectory



Heat pump adoption varies substantially by scenario. In all cases, cold-climate air source heat pumps (ASHPs) dominate, with a notable role for ground source heat pumps (GSHPs). Most heat pumps sold in the state are already cold-climate models, so all ASHPs discussed in this analysis are cold-climate models.[7] ASHPs are more efficient than electric resistance heating but lose efficiency during the coldest periods, increasing peak electricity demand although still less than resistance-only systems. Heat pumps with supplementary heating backup rely on combustion or thermal systems to provide heat during the coldest periods. GSHPs, by contrast, maintain efficiency even in extreme cold with minimal performance loss and in this analysis also serve as a proxy for thermal networks. To represent potential for a lower range of electric peak system impacts in the more highly electrified Net Zero scenarios, the Net Zero B scenario includes a larger share of ASHPs with fuel backup than the Net Zero A scenario. For reference, the total number of households in New York in 2025 is roughly 7.8 million.[8]

Table 3. Summary of residential heat pump and efficient shell retrofits

Scenario	2040 heat pump share of annual heating system sales	2040 heat pump stock	2040 efficient shell stock
No Action	15%	718 thousand	1 million
Current Policies	27%	1.4 million	2.8 million
Additional Action	47%	1.9 million	3.3 million
Net Zero A/B	100% (by 2035)	3.7 million	4.4 million

Table 4. Residential household heating stocks, 2040

Device	No Action	Current Policies	Additional Action	Net Zero A	Net Zero B
Heat Pumps	0.72	1.38	1.88	3.74	3.74
ASHP	*0.56*	*1.03*	*1.38*	*2.61*	*2.22*
ASHP with supplemental heating system	*0.03*	*0.08*	*0.10*	*0.32*	*0.70*
GSHP	*0.12*	*0.28*	*0.40*	*0.82*	*0.82*
Electric	0.55	0.47	0.46	0.35	0.35
Gas	4.80	4.38	3.91	2.46	2.46
Other	1.23	1.07	1.04	0.75	0.75

Another important lever for decarbonizing the buildings sector is renewable fuel blending. All scenarios include current State policy requiring all heating oil sold in state to contain at least 20% biodiesel (B20) by 2030. The Additional Action and Net Zero scenarios also include renewable natural gas blending for 2040. Under the Additional Action case, at least 24 TBtu of renewable natural gas is blended annually by 2040, or 3% of annual building pipeline gas use. The Net Zero cases build upon this target by aiming for a blending of 109 TBtu, or 33% of building pipeline gas use, by 2040. Blending at rates up to 33% is only achievable in the Net Zero cases alongside significant reductions in gas throughput from increased efficiency and electrification.

3.1.1. Federal Policy Sensitivities

In New York State, the impact of rescinded IRA grant funds and tax credits differ. New York State agencies were well positioned to take early advantage of IRA grant funds as State and Local agencies applied for, received, and spent a significant portion of available grant funds. As a result, the rollback of further IRA incentives in this analysis is restricted to the loss of tax credits to individual households. This loss of federal IRA incentives represents a significant cost shift to New Yorkers, totaling an estimated $1.5 billion through 2032 ($1.2 billion on an NPV basis). Without these incentives, the building stock is expected to remain less efficient, increasing energy consumption by 2% (25 TBtu) and reducing the residential heat pump stock by approximately 200,000 units in 2040. This results in an estimated emissions increase of 2 MMT (relative to a Current Policies estimate of 64 MMT).

Despite this setback, State policies and incentives remain impactful drivers and provide a crucial backstop for continued progress as discussed in section 2.1. However, further rollback of federal

appliance standards could introduce less efficient equipment, increasing building energy use by a further 25 TBtu. These changes, combined with increased emissions from fugitive natural gas in upstream out of state supply chain due to methane regulation repeals cause GHG emissions by to increase by 4 MMT in 2040.[9] Diminished appliance standards would also significantly increase customer fuel costs, with New Yorkers facing an estimated $85-310 million per year in higher natural gas and fuel oil expenses.

3.2. Transportation

The transportation sector consumes the second most energy in the state, behind buildings. Most of this energy use comes from fuel consumption in light-, medium-, and heavy-duty vehicles, with the remaining transportation sector energy consumption coming from non-road vehicles such as airplanes, trains, and boats. More detail on the data sources used to benchmark transportation sector stock and energy use is available in the Appendix and accompanying Annexes.

Across all scenarios, many fundamental contributors to transportation demand remain consistent. Fleet size per capita in each region stays flat, and aviation demand continues to grow. Household migration from upstate to downstate shifts on-road transportation energy demand downstate, especially for the light-duty vehicle fleet. The shift reduces the statewide vehicle stock over time as there are fewer vehicles per capita downstate.

Two primary methods enable transportation sector GHG emission reductions – zero emission vehicle adoption and renewable fuel blending. The major driver of change between the scenarios is the accelerating shift towards zero emission vehicles (ZEV) across vehicle segments, a shift which is already underway. Electric vehicles are the most common ZEV throughout the study period. However, there is also a targeted role for hydrogen fuel cell vehicles, especially in the heavier duty truck segment. The No Action case sees some adoption of electric vehicles as a result of organic market adoption (Figure 5 and Figure 6).

Figure 5. Light-Duty Vehicle Zero Emissions Vehicle (ZEV) sales share

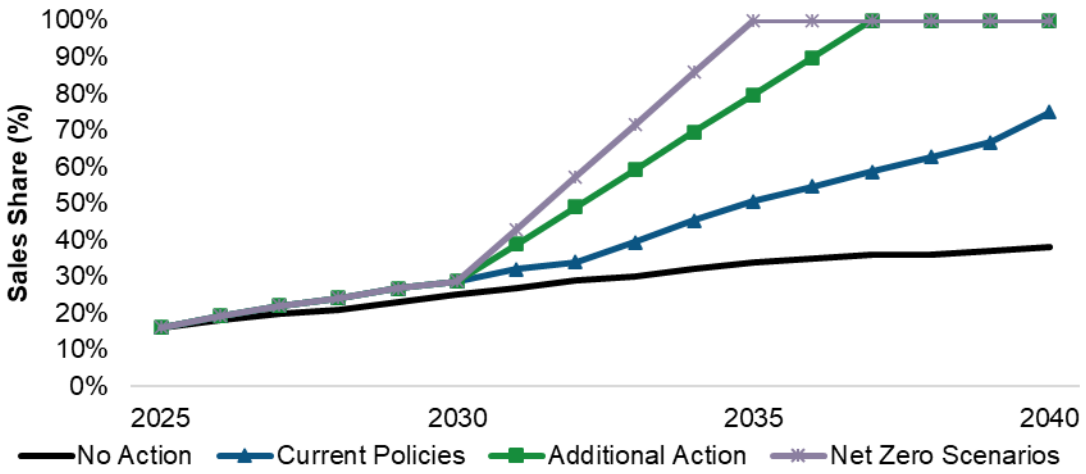
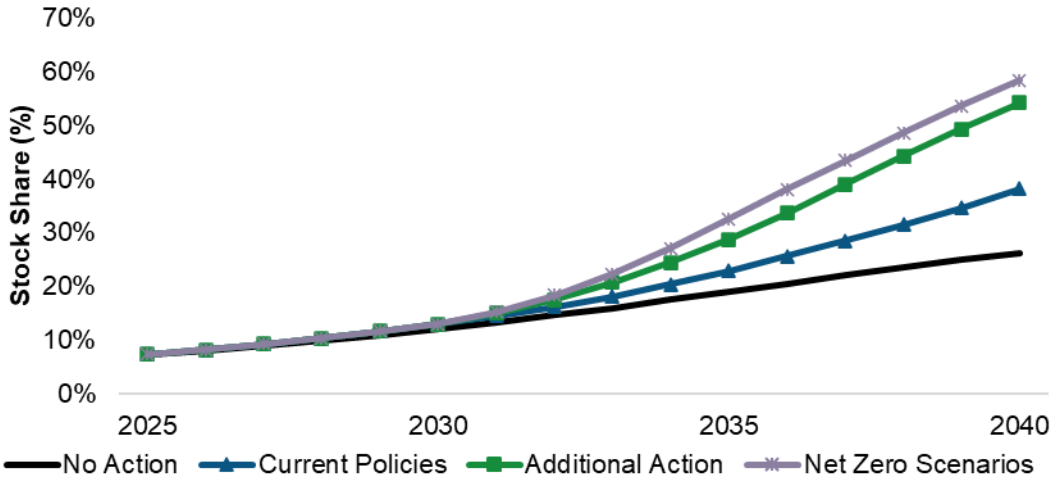


Figure 6. Light-Duty Vehicle ZEV stock share



The Current Policies case sees significant additional electrification across vehicle segments, driven by a combination of State incentives and the backstop of ACC II and ACT[10,11]. Different trajectories towards achievement are assumed across the cases, reflecting uncertainty on current and near-term progress towards achieving the ACC II and ACT policy targets. The Current Policies scenario estimates an 8-year delay in achievement of the ACC II 100% ZEV LDV sales share target (hitting the target in 2043), and a 5-year delay in achievement of the ACT 100% ZEV MHDV sales share target (hitting the target in 2050). This is based on a comparison of current progress toward deployment relative to the deployment pace seen in California, as well as projected delays in EV sales growth after the rollback of IRA tax credits. The Additional Action case assumes that the trajectory is consistent through 2030, but acceleration post-2030 results in achievement of both the ACC target by 2037 and ACT target by 2047.

The future of ACC II and ACT are uncertain given federal action against the California waiver, which allows states to pursue more ambitious electric vehicle sales mandates.[12] Multiple states, including New York, have filed a lawsuit challenging this.[13] ACC II and ACT are still included in the policy cases given this

uncertainty. The impact of potential rollback of ACC II and ACT is investigated in more detail in the Further Rollback sensitivity, seen in 3.2.1.

The Net Zero cases further accelerate the pace of adoption, especially in the medium and heavy-duty vehicle fleet where these sectors achieve 100% ZEV sales shares by 2040 (Figure 7 and Figure 9). In heavier vehicle classes where battery-electric solutions face greater challenges for long-haul and heavy-load duty cycles, hydrogen fuel cell vehicles are expected to constitute a more substantial share of new ZEV sales. In comparison to the building sector, existing State policies drive fairly aggressive adoption of low emission technology (*i.e.,* ZEVs). The narrow gap between ZEV sales in Additional Action and Net Zero scenarios reflect the ambition of existing transportation policies. Due to the significant growth in ZEVs, the share of total transportation energy demand met by electricity and hydrogen grows to 13% by 2040 in the Additional Action case, and reaches 28% in the Net Zero cases (Figure 11, Figure 12, and Figure 13).

Figure 7. Medium-duty vehicle ZEV sales share

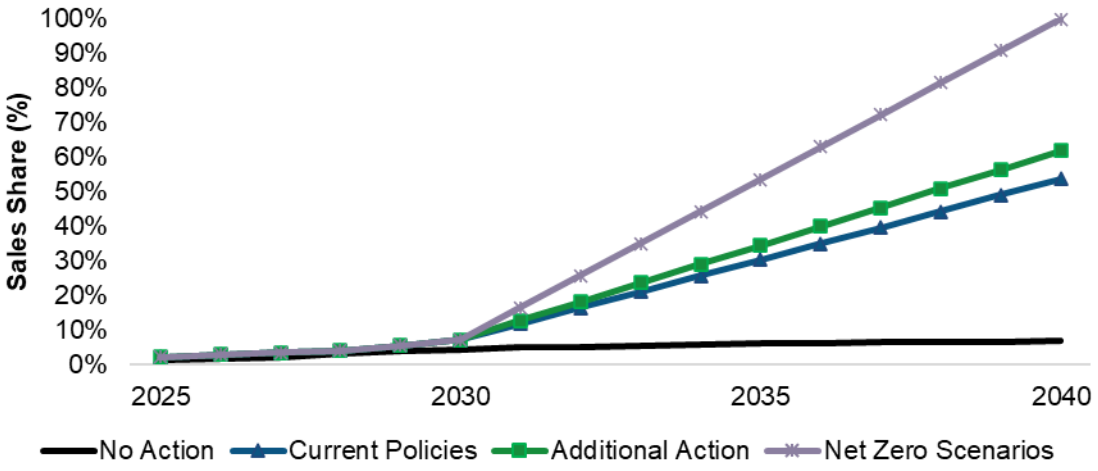


Figure 8. Medium-duty vehicle ZEV stock share

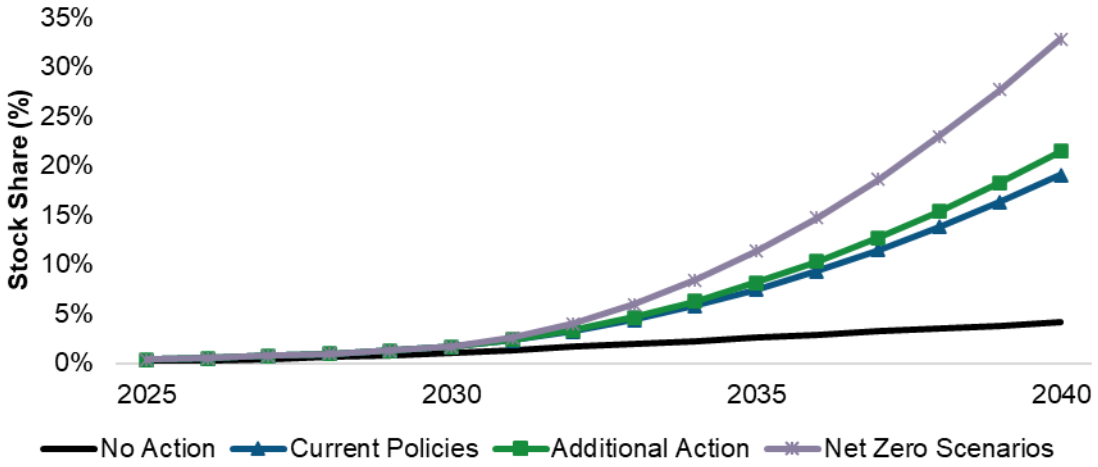


Figure 9. Heavy-duty vehicle ZEV sales share

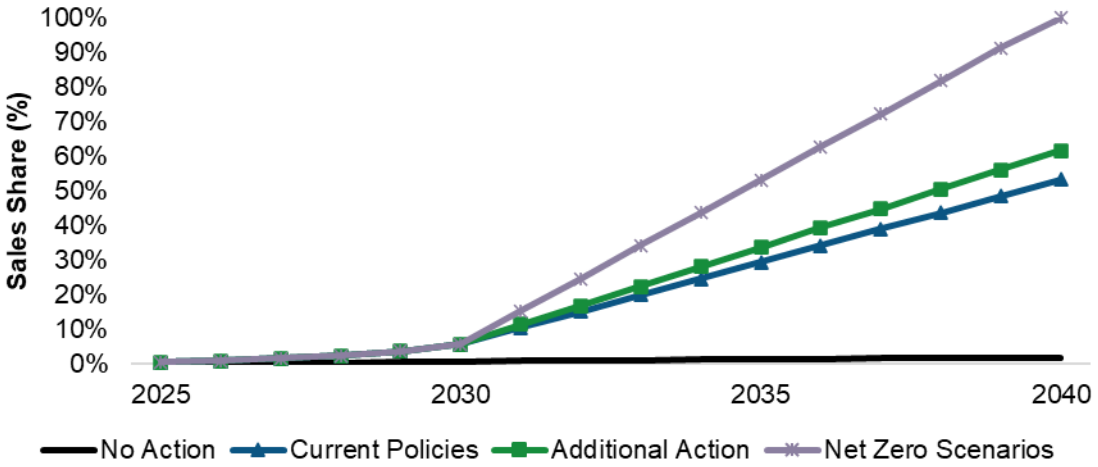
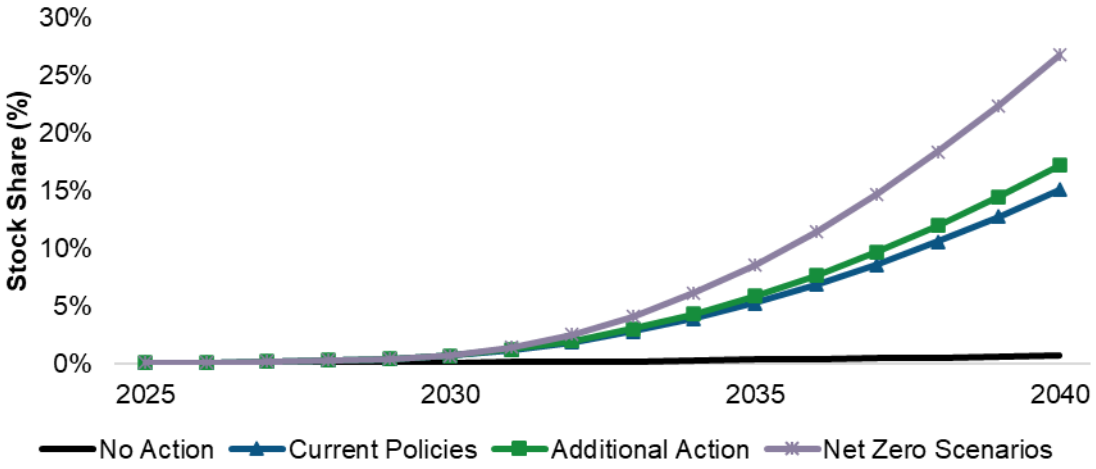


Figure 10. Heavy-duty vehicle ZEV stock shares



Another important lever for decarbonizing the transportation sector is renewable fuel blending. The Additional Action case layers in renewable fuel blending at a scale of 20% renewable distillate, even as overall distillate use declines, and 35% sustainable aviation fuel by 2040. The Net Zero cases build upon this to hit 33% renewable distillate by 2040 in addition to 35% sustainable aviation fuel.

Figure 11. Transportation renewable diesel blend

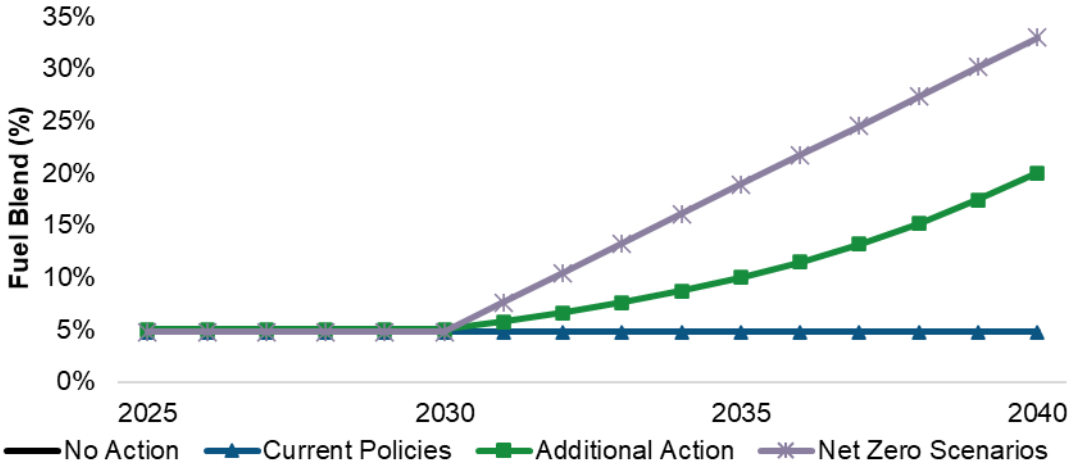


Figure 12. Transportation sustainable aviation fuel blend

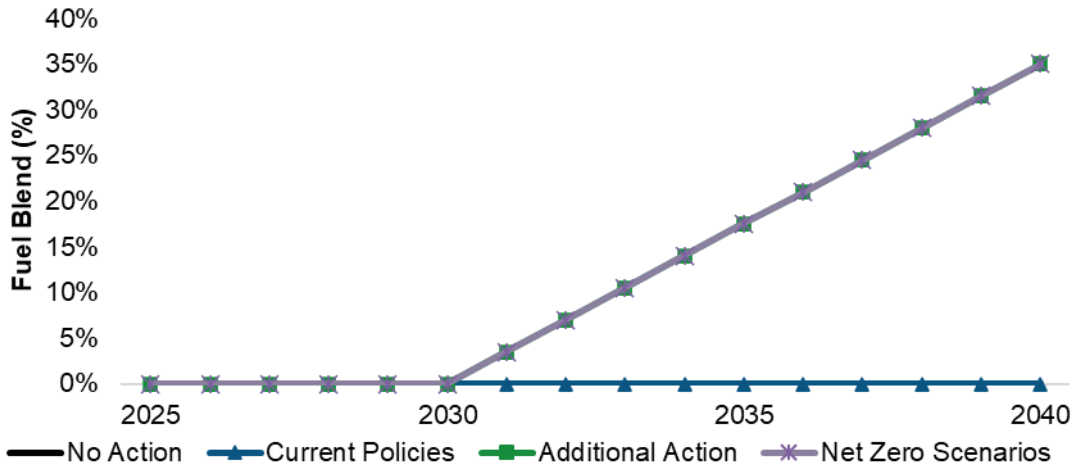
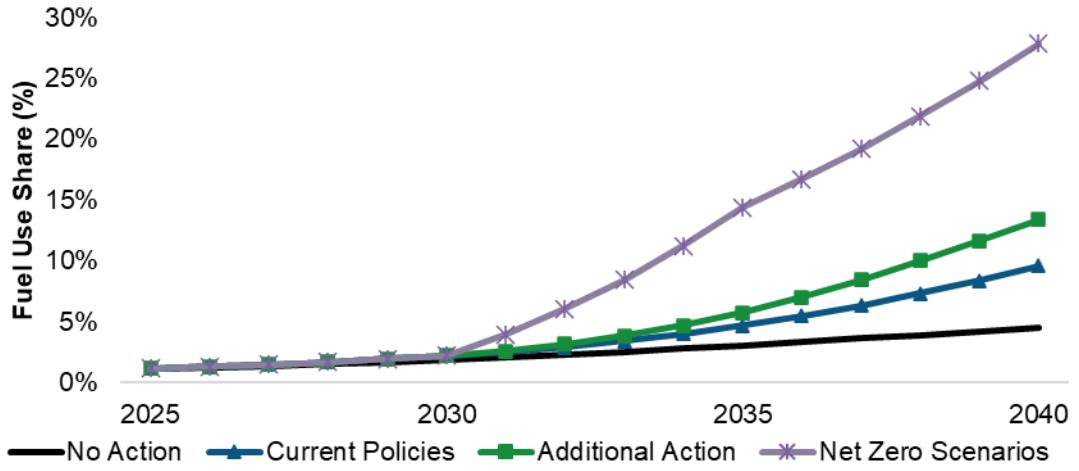


Figure 13. Transportation electricity and hydrogen fuel demand share



3.2.1. Federal Policies Sensitivities

Comparing the Pre-Rollback scenario to Current Policies, the loss of federal EV tax credits represents a significant cost shift to New Yorkers, estimated at $4.5 billion through 2032 ($3.6 billion on an NPV basis). This loss is expected to significantly slow adoption, reducing the projected light-duty ZEV stock by 1.2 million vehicles and the medium- and heavy-duty ZEV stock by 5,000 vehicles in 2040. This slowdown results in an estimated 5 MMT increase in emissions.

State policies like ACCII and ACT remain crucial backstops. However, without federal support, achieving these standards will likely be delayed. A Further Rollback scenario, which assumes the removal of New York's ACCII/ACT waiver and a rollback of federal CAFE standards, presents a significant risk of reduced ZEV adoption. This would prevent the ACCII/ACT standards from being met, reducing the 2040 ZEV stock by an additional 430,000 light-duty vehicles and 64,000 medium- and heavy-duty vehicles compared to

the Core scenario. This leads to a 5 MMT emissions increase and increases fuel expenditures for New Yorkers, who would face $900 million to $1.6 billion per year in increased fossil fuel expenses by 2040.

3.3. Industry

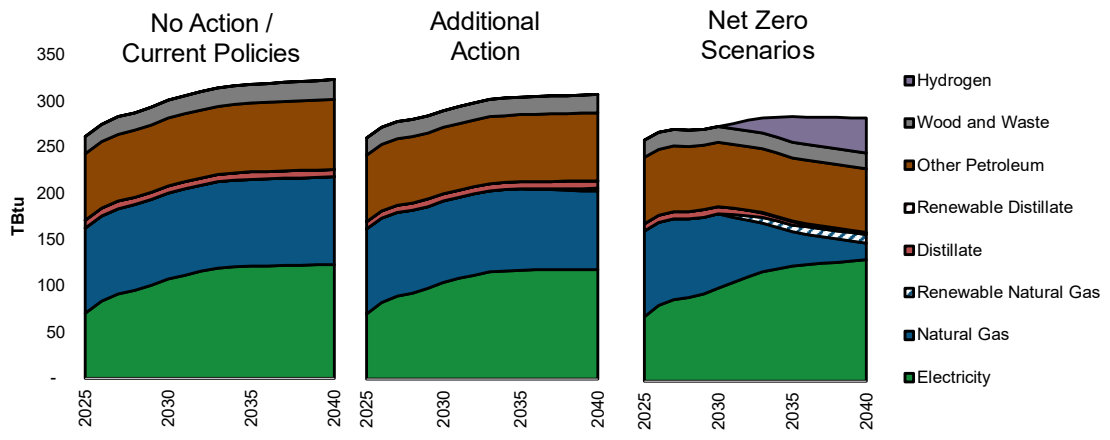
Industry currently accounts for 10% of statewide energy use, or 250 TBtu, as shown in Figure 14. However, new industrial projects are expected to account for a significant share of new load growth over the planning horizon. Several large manufacturing and data-center projects are expected to enter service this coming decade. By 2040, new industrial projects are expected to demand approximately 16 TWh of electricity annually, equivalent to 75% of the industrial electricity demand today.[14] Planning for this new energy use is key to ensuring continued opportunities for economic growth in the state. The pace, magnitude, and location of new large load growth is a significant source of planning uncertainty and should continue to be monitored.

On top of these discrete large loads, all scenarios see further growth based on the AEO.[15] Industrial actors are often seeking opportunities to improve process efficiency. The AEO considers such efficiency improvements while developing energy trends, which inform the No Action and Current Policy scenarios' industrial energy projections (Figure 14). While it is likely that federal policy headwinds will affect the market for clean industry technologies such as energy efficiency and electrification, the extent of federal policy change, including funding recission, is uncertain. As a result, the final Plan does not include significant changes as compared to the Draft Plan, where overall adoption of these technologies in the No Action and Current Policy scenarios was already modest.

The Additional Action scenario introduces more cost-effective energy efficiency as identified in the State's Industrial Potential Study while the Net Zero cases layer on more energy efficiency and fuel switching to electricity, hydrogen, and renewable fuels (Figure 14).

Figure 14. Annual industrial energy demand across scenarios

Note: Industrial activity grows consistently across all scenarios.



4. Energy Supply Sectors

4.1. Gas

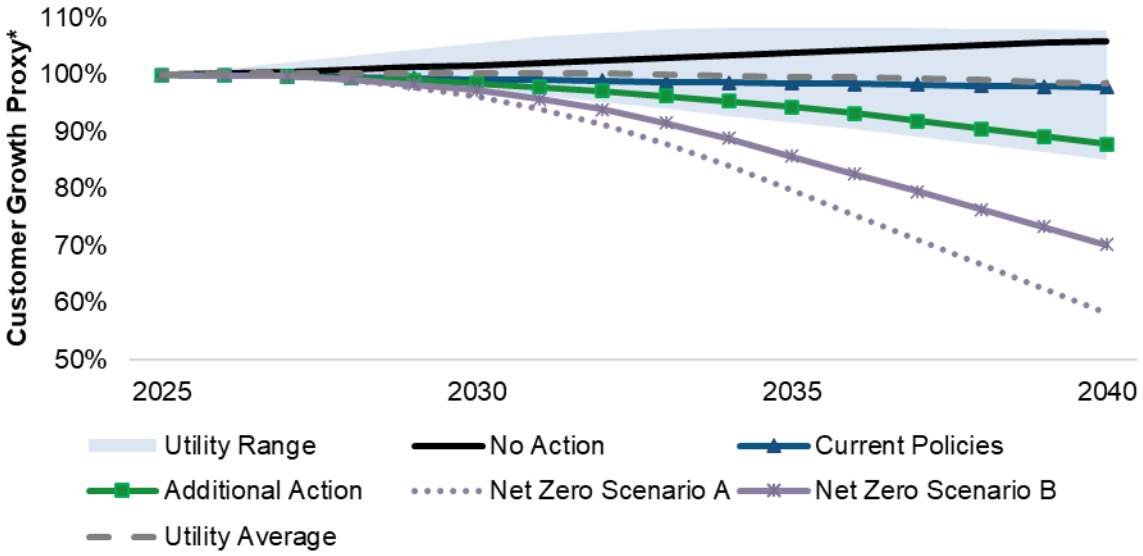
New York's natural gas system is a critical energy-delivery asset that requires continued investment to ensure safe and reliable service. When planning for system reliability, utilities distinguish between firm customers, who are guaranteed an uninterrupted supply for essential needs like heating, and interruptible customers, who agree to have their service curtailed during periods of system stress in exchange for lower rates. Firm customers are predominantly residential and commercial users. Their demand defines the system's peak capacity requirements. Interruptible customers, by contrast, are typically large industrial facilities, power plants, or manufacturers that can switch to a backup fuel like oil or propane on short notice. The number of residential and commercial customers serves as an important indicator of the system's core service obligations. Figure 15 shows the rate of change in the number of residential gas heating customers across scenarios, indexed to 2025. As the Pathways analysis does not model individual gas customer counts, the number of residential gas heating devices is used as a proxy for the number of residential gas customers. In reality, many customers today and future heat pump adoptees may retain a gas water heater or stove, leading to more moderated changes in customer counts.

As seen below, in the No Action case, absent new State and local policies, the number of firm residential customers is projected to grow due to new construction and conversions from oil or electric-resistance heating. By contrast, the Current Policies and Additional Action scenarios show that well-executed electrification programs and all-electric new construction could stem this near-term growth. The most pronounced contraction occurs in the Net Zero scenarios, driven by the acceleration of building electrification. In Net Zero B, which anticipates a larger remaining gas network as many heat pump customers retain a supplementary gas backup, each customer would need to use substantially less gas to stay within the economy-wide emissions caps.

A comparison to utility forecasts reveals significant regional uncertainty. The most conservative, highest annual throughput cases from individual utility long-term plans collectively suggest a flat statewide gas customer count, roughly aligned with the projections in the Current Policies case. However, this topline number masks wide regional divergences, with some utilities forecasting customer gains while others project declines. Notably, when more ambitious cases from the utility LTPs are considered, they show declines in both customer counts and gas throughput that are similar to the policy scenarios modeled in the Pathways Analysis. Even with a potential statewide leveling-off of customer numbers, maintaining service reliability may necessitate targeted infrastructure investments due to regional demand shifts, peak day needs, and the enduring need for firm supply.

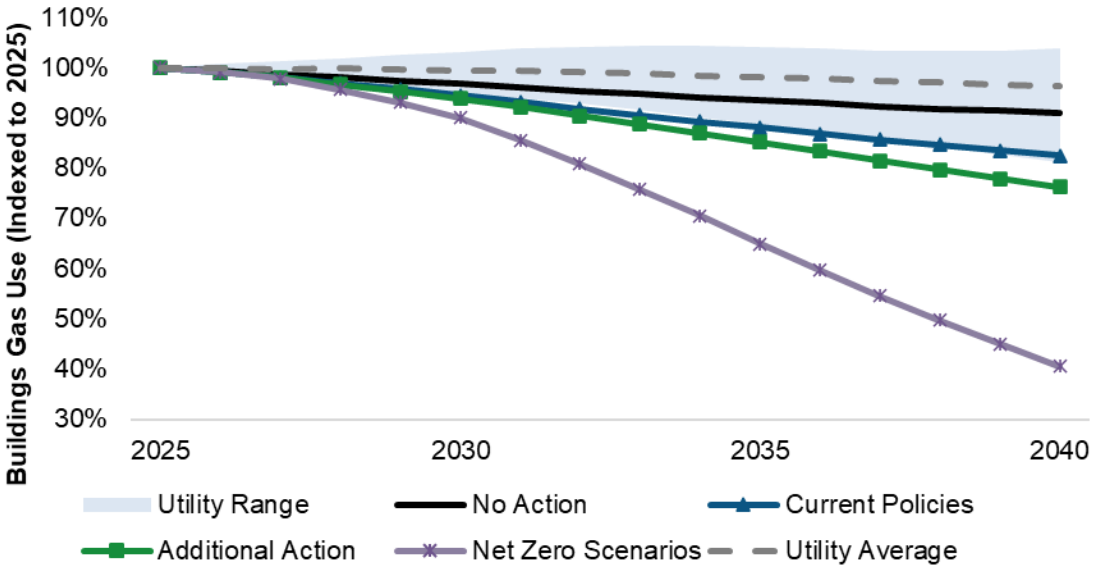
Figure 15: Residential Gas Customer Count

*Note: *PATHWAYS data uses residential HVAC gas connections as proxy for customer growth, while utility range reflects aggregate residential and commercial data due to lack of disaggregated data across all utilities*.



Just as there is uncertainty in the number of firm gas customers, building sector gas consumption also varies across the scenarios. Across all scenarios modeled for the State Energy Plan, statewide residential and commercial gas consumption declines due to improved energy efficiency and increased electrification, as seen in Figure 16. By 2040, gas throughput to buildings in the Current Policies and Additional Action scenarios falls 15-21% below 2025. Electric sector modeling suggests an additional 360-450 TBtu of potential reductions from non-firm electric customers in the Additional Action scenario. While this will lead to meaningful carbon benefits, expected gas consumption declines may not have a significant impact on system infrastructure needs as these customers typically have interruptible service, and gas distribution networks are more strongly indexed to firm customer counts. The Net Zero cases see substantial consumption declines with accelerated building electrification and shell adoption. Comparison to utility LTP forecasts suggest a range of potential consumption scenarios. As seen with gas customer counts, there is regional variability in the gas throughput change seen in the most conservative cases in utility LTPs, as highlighted in Figure 16, below.

Figure 16. Buildings gas throughput



In addition to electrification-induced gas customer reductions, Renewable Natural Gas (RNG) blending is another mechanism for decarbonizing the sectors relying on the gas system. RNG blending reaches 109 TBtu in the Net Zero cases by 2040. Due to the Climate Act treatment of biogenic consumption, RNG consumption still produces GHG emissions under the gross emissions target. This means RNG blending alone, without significant reductions in pipeline throughput, would not be a feasible pathway to achieving long term Climate Act emissions targets.

Methane leakage, counted on a 20-year global-warming-potential basis to align with Climate Act accounting, magnifies the gas system's climate impact. State action can, and does, play a significant role in mitigating these emissions. Under the No Action baseline scenario, methane system leakage is forecast to decline slightly, from roughly 14 million metric tons in 2024 to 12 million metric tons in 2040. In all policy scenarios, this decline is accelerated due to the impacts of a reduced gas system size and state actions to reduce leakage. Current State pipeline leakage reduction efforts include the DEC Part 203 on upstream and midstream gas, the New York State Public Service Commission (PSC) leak-prone pipe replacement programs, and voluntary utility commitments. All of the policy scenarios achieve significant reductions. By 2030, the scenarios achieve 65% reductions in GHG emissions relative to 2024; this increases to between 85-90% GHG emissions reductions by 2040.

4.2. Electricity

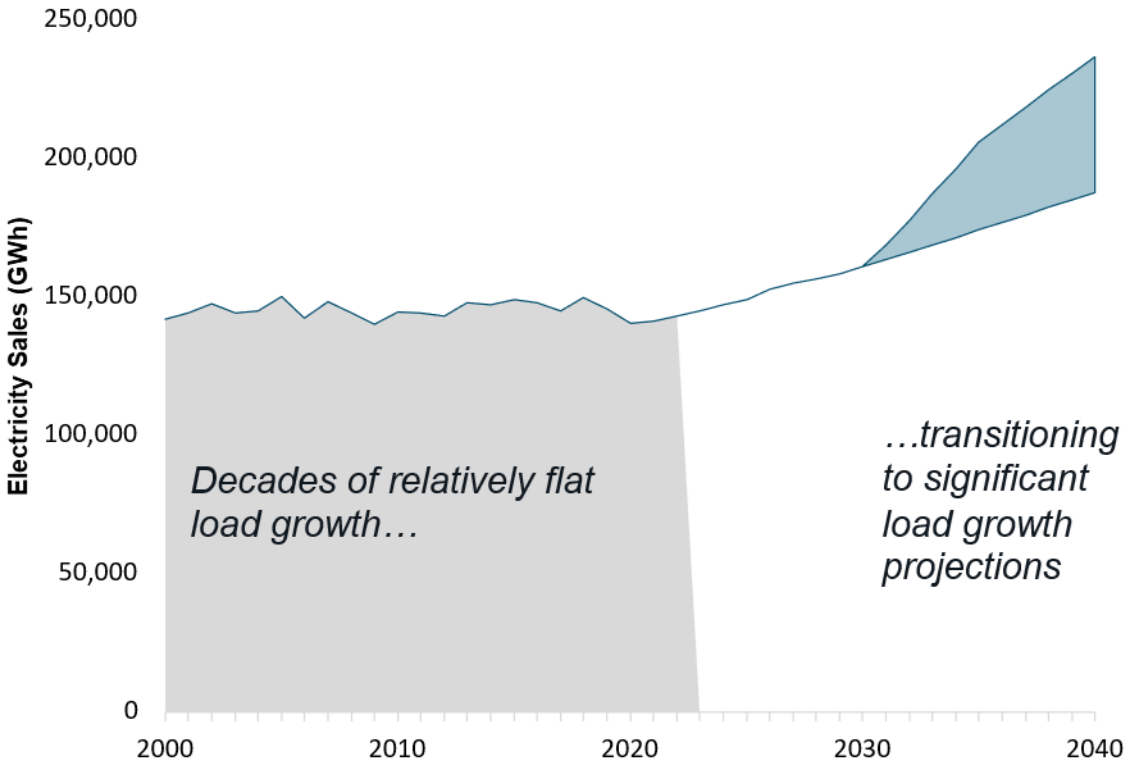
The electric supply analysis relies on an optimization modeling framework designed to identify the most cost-effective generation portfolios to reliably meet growing electricity demand and policy considerations.

4.2.1. Load and Peak

After decades of relatively flat electricity demand, New York's electricity sector is entering a new era of significant growth (Figure 17). Driven by increases in large commercial and industrial loads coupled with

the electrification of transportation, buildings, and industry, all future scenarios point towards a substantial increase in electricity consumption and the need for a corresponding expansion of the electric system.

Figure 17. Historical New York State load growth[16]



All scenarios project significant load growth. By 2030, electricity demand is expected to increase by approximately 11-13 TWh from 2025 levels, reaching a total of 171-173 TWh. This initial increase is largely driven by new commercial and industrial projects, as forecasted in the New York Independent System Operator (NYISO) 2025 Gold Book's "Large Loads" projections, as well as increased EV adoption.

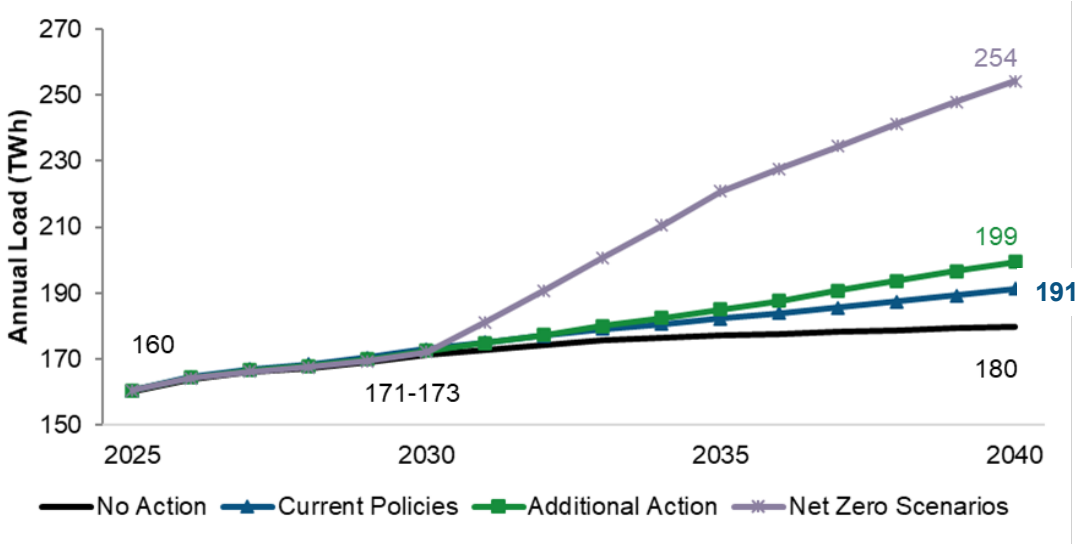
Beyond 2030, the scenarios diverge more significantly:

- The **No Action** scenario sees demand reaching 180 TWh by 2040, driven by continued EV adoption and additional large industrial loads.
- The **Current Policies** scenario projects 191 TWh by 2040, with more aggressive vehicle electrification. Growth from residential and commercial customers switching to heat pumps is largely offset by concurrent gains in building shell efficiency across the entire stock.
- The **Additional Action** scenario anticipates 199 TWh by 2040. As in the Current Policies scenario, growth from residential and commercial customers switching to heat pumps is largely offset by concurrent gains in building efficiency across the entire stock. While there is significant annual and peak load growth through 2040, much of this growth is not driven by state clean energy

policy. 50% of the electric load increase and 75% of the peak demand increase in this scenario are also included in the No Action scenario.

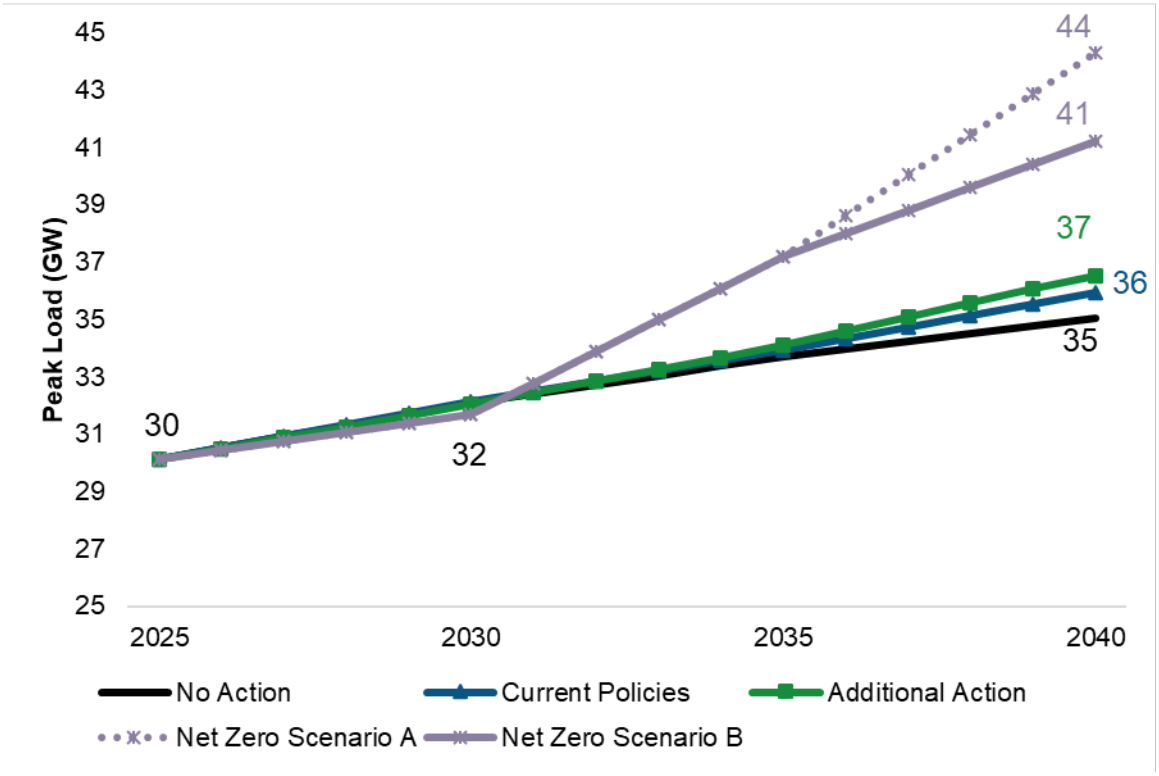
- The **Net Zero** scenarios show the highest demand, with both reaching 254 TWh by 2040 due to the comprehensive electrification of buildings and industry.

Figure 18. Annual load forecast (without electrolysis demands)



Median peak demand also varies with similar drivers as annual loads. By 2040, the No Action scenario projects a median peak of 35 GW. Current Policies and Additional Action scenarios forecast median peaks around 36 and 37 GW, respectively. Large loads and vehicle electrification are major contributors to peak growth, with building shell efficiency across the entire stock largely offsetting heat pump contributions to peak. Net Zero A scenario shows a significantly higher peak at 44 GW, while Net Zero B scenario projects 41 GW, with 3 GW reduction achieved from customers with supplemental heat backup who can switch to gas on the coldest days.

Figure 19. Annual peak load forecast (without flexible load impacts)



The timing of system peak is critical for electric system planning. Under No Action, Current Policies, and Additional Action scenarios, the power system remains summer-peaking through 2040. However, the gap between summer and winter peaks declines meaningfully in the policy cases. This narrowing gap may necessitate a review of the potential risk of non-firm generators that do not have oil backup. Net Zero A scenario, with its high percentage of fully electrified homes, demonstrates a clear shift to a winter-peaking system by 2040, with a median winter peak of 44 GW compared to a summer peak of 41 GW. Net Zero B scenario, with a 2040 winter peak of 41 GW and a summer peak also of 41 GW, is a dual peaking system, where both seasons' peaks could conceivably occur depending on the weather and must be carefully planned for.

Table 5. Peak demand projections by scenario, 2030 and 2040 (annual peak bolded)

*Note: *Additional Action remains summer peaking through 2040, but by mid-century the winter peak continues to grow faster than the summer peak and this scenario becomes dual peaking.*

	2030		2040	
Season Peak (GW)	**Winter**	**Summer**	**Winter**	**Summer**
No Action	23	**32**	23	**35**
Current Policies	24	**32**	28	**36**
Additional Action	24	**32**	32	**37***
Net Zero Scenario A	25	**32**	**44**	41
Net Zero Scenario B	24	**32**	**41**	**41**

All state policy cases (Current Policies, Additional Action, and Net Zero) include flexible buildings and vehicle loads. The Current Policies and Additional Action cases assume that, by 2040, up to 20% of light-duty vehicles and 10% of water heaters have some capacity to shift their demand behavior to avoid system peak impacts. Under the Net Zero cases this penetration of flexibility increases to 40% of light-duty vehicles, 30% of water heaters, and 30% of space heaters.[17] These demand-side resources provide similar hourly and sub-hourly balancing services to the system as battery storage, supporting the integration of renewable energy by shifting demand to better align with times of high renewable output.

4.2.2. Electricity Supply Resource Mix

The analysis identifies portfolios of resources and infrastructure investments across the scenarios that meet projected loads and peaks at lowest cost, subject to reliability constraints and compliance with policy requirements applicable under each scenario.

Since the Draft State Energy Plan, dynamics in the electric sector have shifted significantly, primarily due to major federal policy changes and updated cost projections. These changes include the elimination of IRA tax credits for key resources like wind and solar for most of the modeling horizon, the introduction of new tariffs affecting power sector components, and the availability of an updated NYSERDA renewable supply curve benchmarked to the latest solicitation data and inflationary pressures.[18] Cumulatively, these changes result in substantially higher resource costs, with noteworthy impacts on renewables, storage, and hydrogen. For example, renewable credits now phase out before 2030, and tariffs are modeled to add over 20% to storage costs through 2030.

In light of these headwinds and new cost realities, the analysis incorporates more conservative near-term procurement assumptions. The 9 GW by 2035 offshore wind target is removed, consistent with federal policy headwinds regarding the ability to permit and construct new offshore wind resources during the current administration. The 70% renewable electricity constraint is also removed, and the model instead implements minimum annual near-term build rates in line with the pace seen in the CES Biennial Review. These near-term build rates vary by scenario, at 2.8 TWh per year for Tier 1 resources through 2035 in the Current Policies and Additional Action scenarios and 3.9 TWh per year for the Net Zero scenarios.

Considering recent State policy action regarding the feasibility of nuclear power expansion in state, new nuclear is included as a candidate resource in all scenarios. Build potentials and costs are defined for new projects at existing nuclear and greenfield sites, based on the Zero by 40 Technoeconomic Assessment. A minimum procurement of 1 GW by 2040 is assumed in the policy cases, reflecting the Governor's directive to NYPA, and the model can select additional nuclear capacity if found to be economic. Renewable electricity capacity grows in every pathway analyzed, but the magnitude and composition of the resource builds varies greatly. Reflecting the new cost and procurement constraints, the target of 70% renewable electricity is now met between 2036-2040. In addition, the inclusion of new nuclear enables policy-compliant cases to realize the zero-emission target by 2040.

Current Policies and Additional Action Variants

Building off the conceptual framework of the constrained build sensitivity performed in the Draft Plan, for the Current Policies and Additional Action scenarios the analysis examined the portfolio impacts of two variants that varied how much new nuclear and transmission capacity can be developed in the next 15 years. For each scenario, the "3.3 GW Nuclear" variant allows for greater expansion of nuclear through 2040 (up to 3.3 GW) and intrastate transmission, while another variant "2.2 GW Nuclear" assumes a smaller maximum amount of incremental nuclear available (up to 2.2 GW) and lower cost transmission headroom is available. These variants explore the tradeoffs of greater reliance on nuclear and transmission versus greater reliance on other resources like offshore wind, reinforcing the value of pursuing a mix of resources with optionality.

No Action Scenario

This scenario, which excludes the Climate Act and more recent New York State clean energy policies, such as 0x40, and reflects only modest adoption of clean energy technologies, projects a substantial increase in natural gas-fired capacity and generation through 2040. By 2040, a net increase of approximately 4 GW statewide in combustion capacity relative to current levels is anticipated, with most additions occurring upstate and some in Zone J. A substantial number of existing units reach their assumed end-of-life age threshold of 60 years over the modeling period. Due to these retirements, capacity requirements, and load growth 17 GW of new combustion-based units are built by 2040. These fossil fuel-fired units provide an additional 36 TWh of generation in 2040 compared to current levels. This increased reliance on natural gas is driven by overall load growth, nuclear retirements[19], the assumed absence of power imports via the Champlain Hudson Power Express (CHPE), and a lack of policy drivers for alternative resource additions. This buildout of combustion resources exceeds existing capacity in several zones, suggesting the need for greenfield siting.

Wind and solar capacity in the No Action scenario reaches 10 GW in total by 2040, with almost all sourced from existing and near-term contracted additions. The primary exception is the economic addition of 2 GW of battery storage absent State policies. Without any policy support for low-carbon energy, it is assumed that all nuclear facilities retire at the end of their 60-year licenses, which expire between 2029 and 2046. This creates a near-term challenge, as 5 GW new combustion capacity is needed as early as 2030, which may be difficult to procure given current demand levels for gas generators. This need is mitigated in other cases by nuclear license extensions upstate and policy-driven resource additions like CHPE and increased battery storage.

Summarized capacity and generation results for the No Action scenario are included in Figure 20 and Figure 22 below, while incremental capacity addition and retirements are included in Figure 21.

Figure 20. No Action Total Installed Capacity

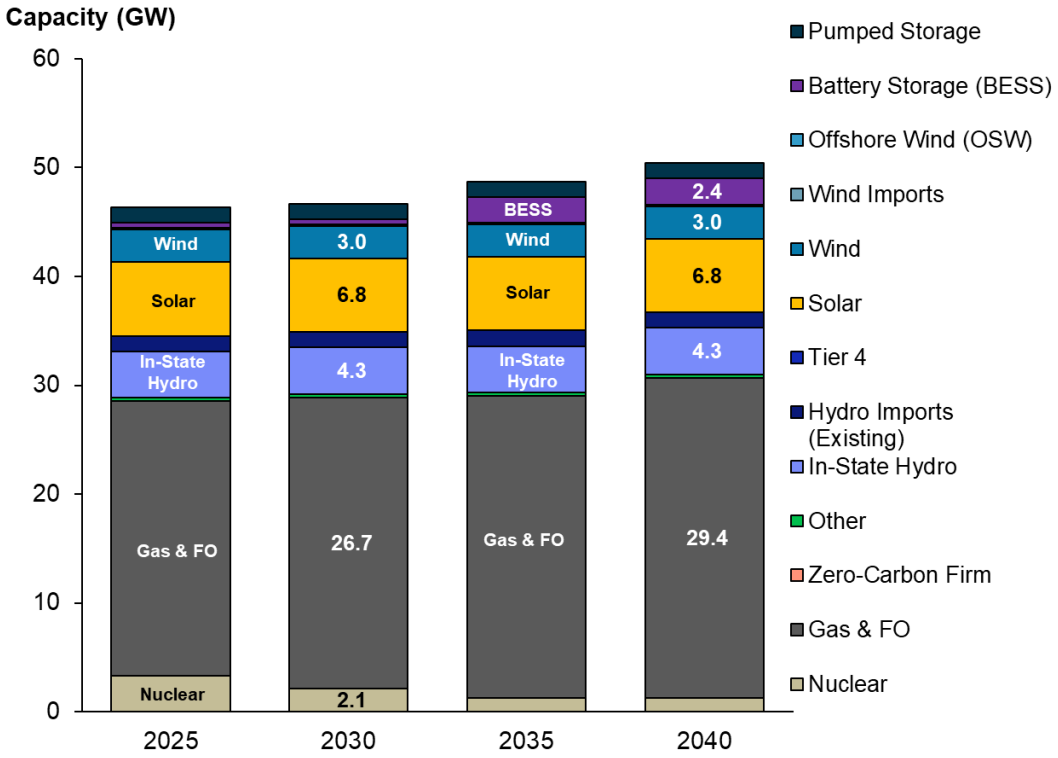


Figure 21. No Action Incremental Capacity Additions and Retirements

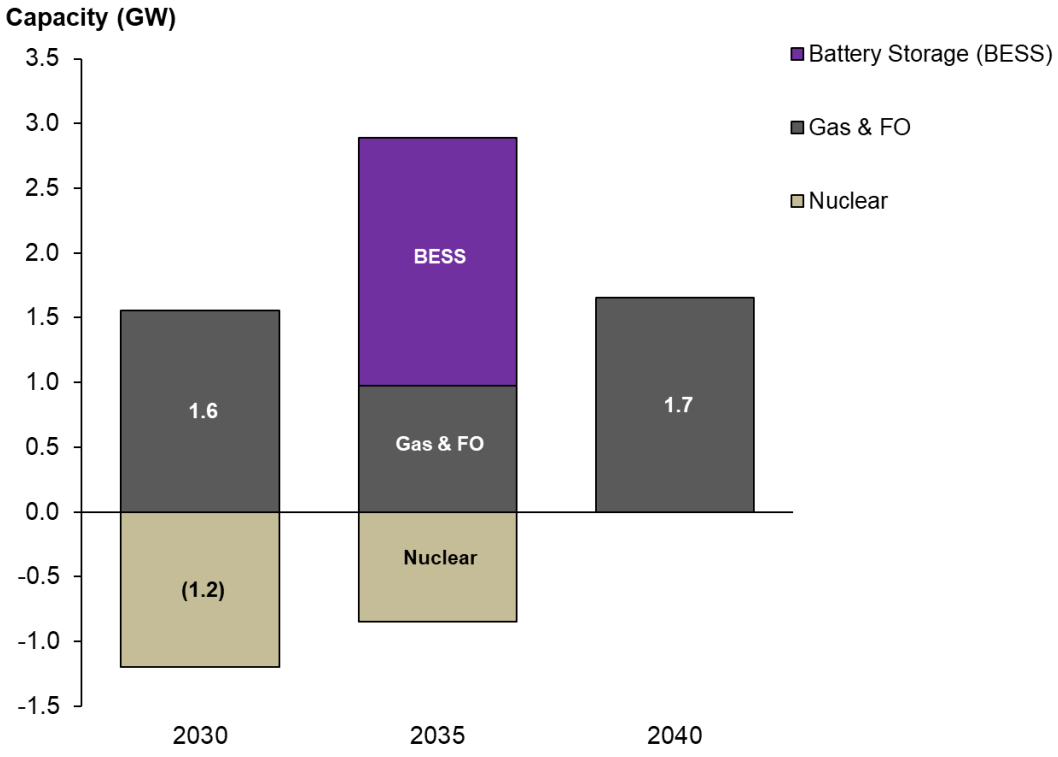
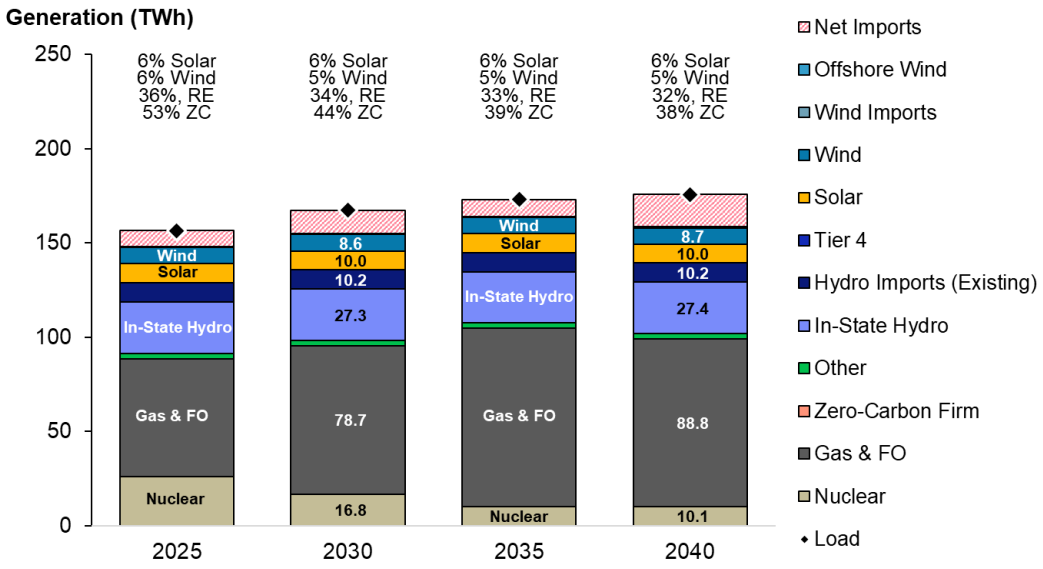


Figure 22. No Action Generation



Current Policies Scenario

Relative to the No Action scenario, the Current Policies scenario has greater load and peak growth driven by State actions. State actions include policies influencing vehicle electrification and electric sector policies. In light of federal policy changes since the publication of the Draft, the Current Policies scenario does not assume achievement of the 9 GW offshore wind target. It also does not include realization of 70% renewable electricity by 2033 as modeled in the Draft. The scenario instead assumes near-term renewable resource minimum annual build limits in line with the pace seen in the CES Biennial Review. The Current Policies scenario achieves the zero-emission electric sector target by 2040 and other State specific targets, including 10 GW solar PV by 2030 and 6 GW storage by 2030. It also includes CHPE, the Long Island Public Power Transmission Need, the extension of all existing nuclear units through 2050, and at least 1.1 GW new nuclear in line with the Governor's announcement directing New York Power Authority to develop at least one new nuclear energy facility with a capacity of at least 1 GW.[20]

As introduced previously, to explore different pathways to these goals two variants were modeled for the Current Policies and Additional Action scenarios: 2.2 GW Nuclear and 3.3 GW Nuclear.

The 2.2 GW Nuclear variant relies on both new renewable and nuclear investments to provide the majority of zero-emissions energy. Growing loads and near-term build constraints mean that the system decarbonizes at a slower pace from now until 2035 and makes the most progress from 2035 to 2040. This portfolio sees the full 2.2 GW of new nuclear that is available built by 2040, with 1.1 GW at existing nuclear sites and 1.1 GW greenfield in Zone F. Between 2025 and 2040, this is paired with the addition of 5 GW of land-based wind, 23 GW of solar, and 5 GW of offshore wind. The system achieves 75% renewable generation by 2040 (achieving 70% renewable generation in the 2036-2040 time frame). Between 2025 and 2040, 13.5 GW of fossil fueled combustion capacity reaches end-of-life retirement age and is retired. To maintain reliability, 3.5 GW of new combustion capacity is built or repowered, such that total combustion capacity in 2040 is 15 GW. Between 2035 and 2040, this combustion capacity is

converted to hydrogen and contributes 4 TWh of zero-emissions energy during challenging periods in 2040. In addition to this zero-emissions combustion capacity, battery storage, nuclear, and renewable resources, all contribute to maintain reliability.

The 3.3 GW Nuclear variant relies more heavily on new nuclear, coupled with new transmission and a reduced, but substantial, expansion of the renewables portfolio to reach 0x40. This scenario selects all 3.3 GW of new nuclear available by 2040, investing in 2.2 GW at existing nuclear sites and 1.1 GW greenfield in Zone F. Alongside the increased nuclear capacity, 3 GW of new offshore wind investments occur, which is 2 GW lower than in the 2.2 GW Nuclear variant. In this case, the 70% renewable electricity target is realized in 2040 (vs. 75% in the 2.2 GW Nuclear variant). New transmission upgrades are critical to help deliver the new nuclear resources from upstate to downstate. New E to G transmission is built to the estimated right-of-way (ROW) expansion limit of 1,000 MW, relieving the Total East and UPNY-SENY grouped interfaces. Starting early in 2035, transmission capacity is also added between I and J and reaches 1,250 MW of new capacity by 2040. In addition to enabling increased delivery of nuclear generation, these transmission additions also slightly affect the timing and location of renewable and storage additions.

Relative to the No Action scenario, the Current Policies variants add an incremental 5 GW of land-based wind and 3-5 GW of offshore wind alongside 22-23 GW of incremental solar capacity and 5-6 GW of battery storage toward achievement of 0x40.[21] To achieve the zero emissions 2040 target, 15 GW of zero-carbon firm resources, primarily existing gas combined cycle gas turbines (CCGTs) and combustion turbines (CTs), are converted to run on hydrogen by 2040 to provide reliability. These are augmented by 4-5 GW of nuclear, including 2.2-3-3 GW of new nuclear, which provides additional capacity and zero-carbon generation. The total combustion capacity in 2040 is approximately 9-10 GW lower than at the start of the modeling period, with all NYISO zones having comparable or lower combustion capacity than today even as peak demand grows, reflecting the value of new resources like CHPE, storage, and nuclear that can provide contributions to reliability. For additional detail on peak contribution of different resources, see the Appendix. For instance, by 2040, NYISO A-E is projected to have 3.6 GW of combustion capacity, NYISO J 5.3 GW, and NYISO K 2.5 GW. Between 2036 and 2040, in addition to converting existing combustion generation assets to be able to combust hydrogen, an additional 3.4 GW of hydrogen-ready combustion generation must be built to meet reliability needs.

Statewide installed capacity and capacity changes by period for the Current Policies scenario are included in Figure 23 and Figure 25, below, while incremental capacity addition and retirements are included in Figure 24.

Figure 23. Current Policies, Total Installed Capacity: 2.2 GW Nuclear Variant (left) vs 3.3 GW Nuclear Variant (right)

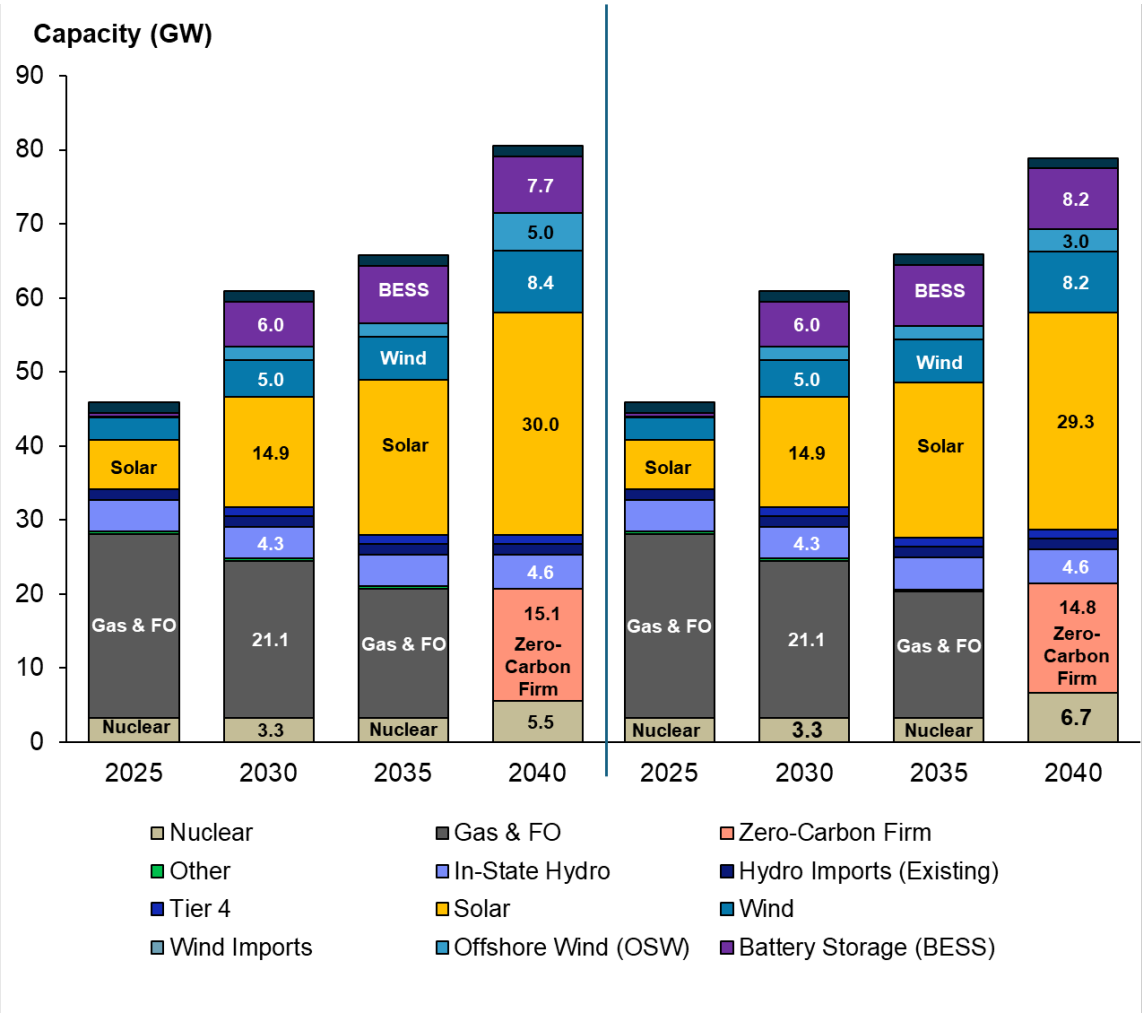
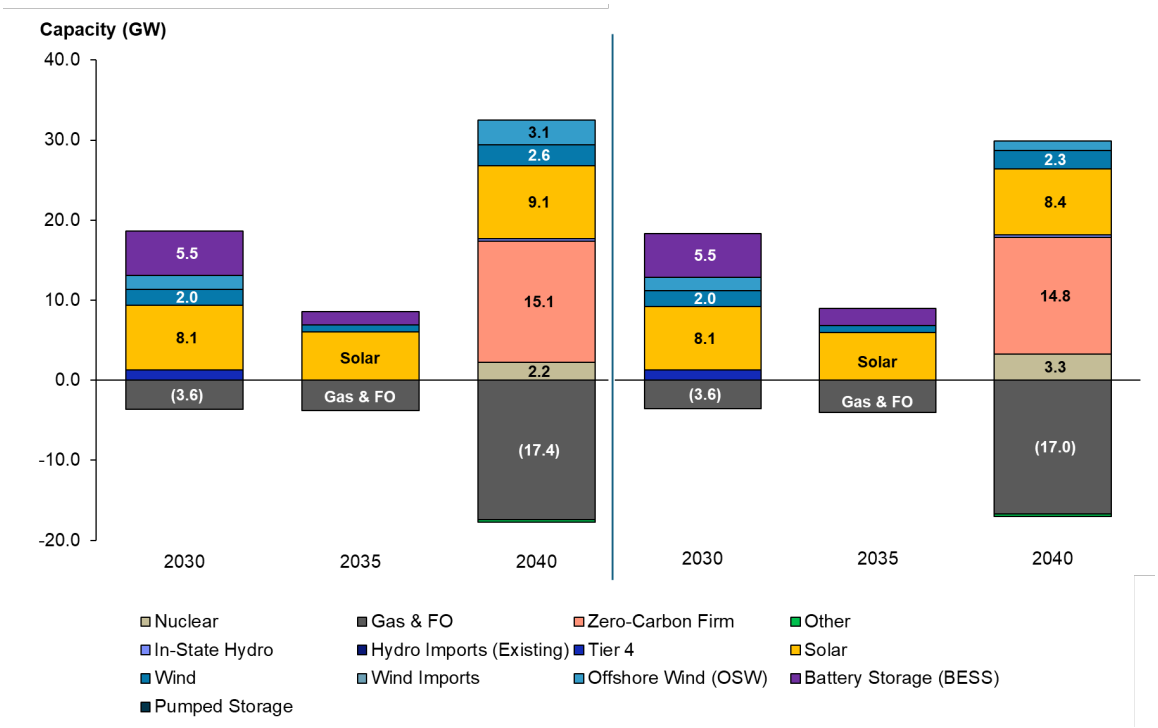


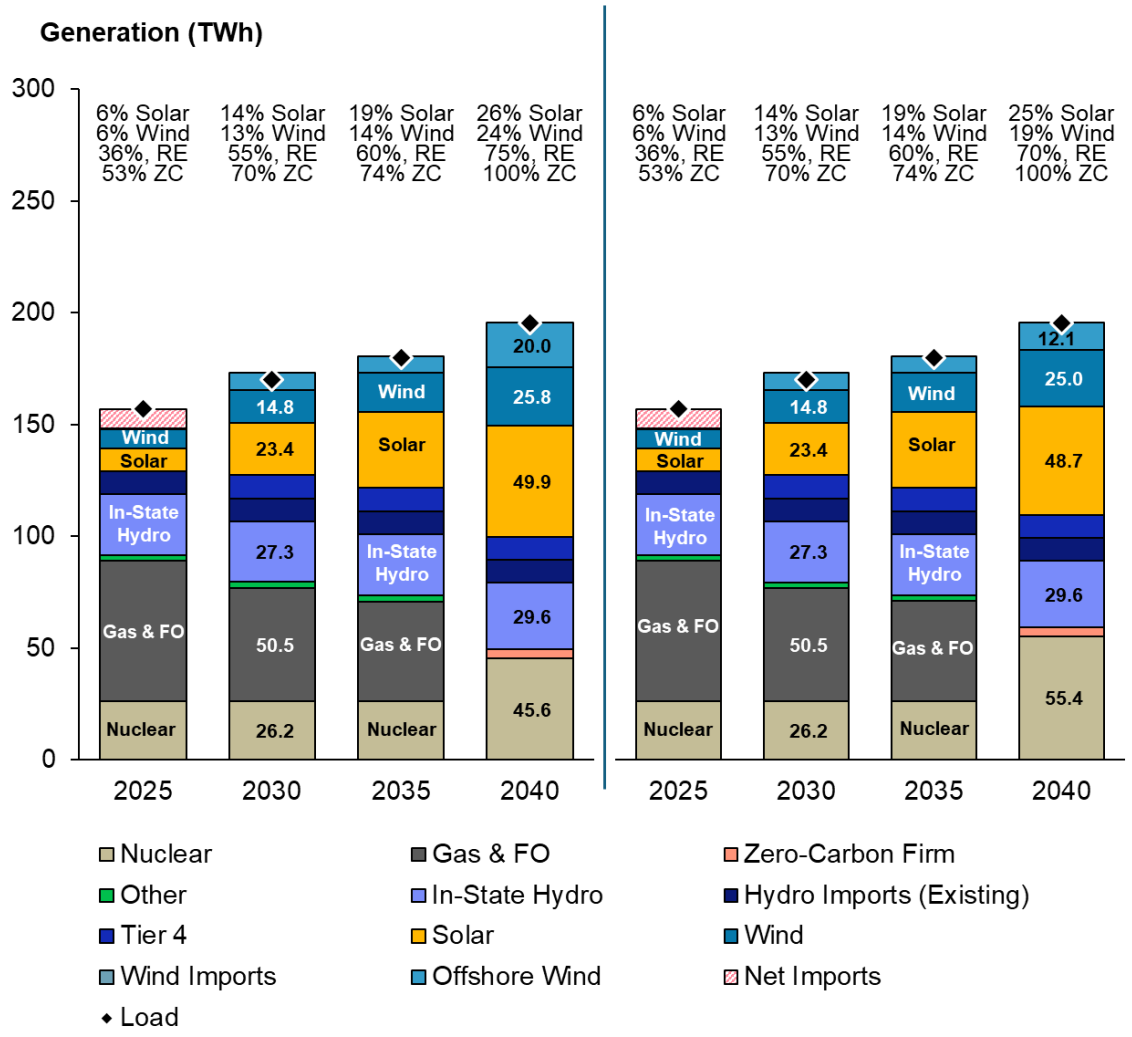
Figure 24. Current Policies, Incremental Capacity Additions and Retirements by Period: 2.2 GW Nuclear Variant (left) vs 3.3 GW Nuclear Variant (right)



Hydrogen-based combustion resources are just one of many emerging technologies that could provide firm dispatchable power to support achievement of a zero-emissions electricity system. Consistent with past analysis practices, green hydrogen is used in this modeling as a proxy resource.[22] This chapter further includes a sensitivity that explores the value of using renewable natural gas (RNG) rather than hydrogen for firm power generation, finding that the use of RNG lowers system costs and reduces deployment challenges related to infrastructure buildout, generator retrofits, increased load, and higher fuel costs for hydrogen. Due to the high costs of hydrogen, hydrogen-based combustion units are rarely dispatched except during the most challenging reliability periods, providing about 4 TWh of power annually. A discussion of the capacity factor and utilization of these resources is included in section 4.2.3.

Both variants rely on large-scale capacity investments which introduce siting and construction risks. The 2.2 GW Nuclear variant relies on a 5 GW buildout of offshore wind, carrying a greater risk associated with siting uncertainty considering potential federal headwinds. Conversely, the 3.3 GW Nuclear variant includes a more aggressive 3.3 GW nuclear buildout by 2040, which is also dependent on the construction of significant new upstate-to-downstate transmission capacity. Despite these differences, both variants require a substantial mix of new nuclear and renewable investments to meet the State's 2040 zero emissions electricity goal. Furthermore, while 2.2 GW Nuclear does not require the same near-term transmission additions, new upstate-to-downstate transmission is added after 2040 in that case as well, highlighting the long-term value of transmission upgrades in both variants.

Figure 25. Current Policies, Annual Generation: 2.2 GW Nuclear Variant (left) vs 3.3 GW Nuclear Variant (right)



Additional Action Scenario

Annual and peak load growth increases further under the Additional Action scenario relative to the Current Policies scenario, due to additional policy actions. However, the Additional Action scenario's higher demand is met by an electricity generation mix broadly similar to the Current Policies scenario. As in the Current Policies scenario, two variants were run for the Additional Action scenario.

The 2.2 GW Nuclear variant builds all 2.2 GW of new nuclear available by 2040 (1.1 GW at existing nuclear sites and 1.1 GW greenfield in Zone F). Between 2025 and 2040, this is paired with the addition of 6 GW of land-based wind, 24 GW of solar, and 7 GW of offshore wind investments, achieving 76% renewable generation by 2040 (achieving 70% renewable generation in the 2036-2040 time frame). To maintain reliability while the size of the combustion fleet declines from retirement new combustion capacity is added. By 2040, 13 GW of fossil units retire; to maintain reliability, the system builds (or repowers) 3.5 GW of new combustion capacity, including 3 GW in Zone J. All Zone J repowering occurs by 2035 as a result of delayed offshore wind buildout given federal permitting headwinds. This results in a

net decrease in combustion capacity from 25 GW in 2025 to 15 GW in 2040. The remaining 15 GW of combustion capacity in 2040 are converted to hydrogen in the 2036-2040 time frame, to align with the zero-emissions energy target by 2040. These units contribute 4 TWh of hydrogen-powered generation in 2040 during challenging periods. A total of 9 GW of battery storage also contributes to reliability.

The 3.3 GW Nuclear variant relies more heavily on new nuclear, coupled with new transmission and a different expansion of the renewables portfolio to reach 0x40. This includes a larger 3.3 GW nuclear build by 2040 (2.2 GW at existing nuclear sites and 1.1 GW at greenfield sites). This is offset by a smaller renewable build, with 5 GW of offshore wind built (2 GW lower than in the 2.2 GW Nuclear variant). Consequently, renewable achievement in 2040 is limited to 71% (vs. 76% in the 2.2 GW Nuclear variant; this variant achieves 70% renewable achievement between 2036-2040). With more nuclear builds upstate, this scenario requires a lower buildout of other combustion units statewide. Specifically, it relies on 600 MW less new combustion capacity in downstate zones in 2035 and 2040 relative to the 2.2 GW Nuclear variant, reducing the need for downstate combustion generation. New transmission upgrades are selected in the 3.3 GW Nuclear variant to deliver the new nuclear resources from upstate to downstate. New E to G transmission is built to the estimated right-of-way (ROW) expansion limit of 1,000 MW, relieving the Total East and UPNY-SENY grouped interfaces. Starting early in 2035, transmission capacity is also added between I and J, adding over 800 MW of transmission capacity by 2040. In addition to enabling increased delivery of nuclear generation, these transmission additions also slightly affect the timing and location of renewable and storage additions.

Total capacity and capacity changes by period are summarized in Figure 26 and Figure 28 below, while incremental capacity addition and retirements are included in Figure 27.

Figure 26. Additional Action, Total Installed Capacity: 2.2 GW Nuclear Variant (left) vs 3.3 GW Nuclear Variant (right)

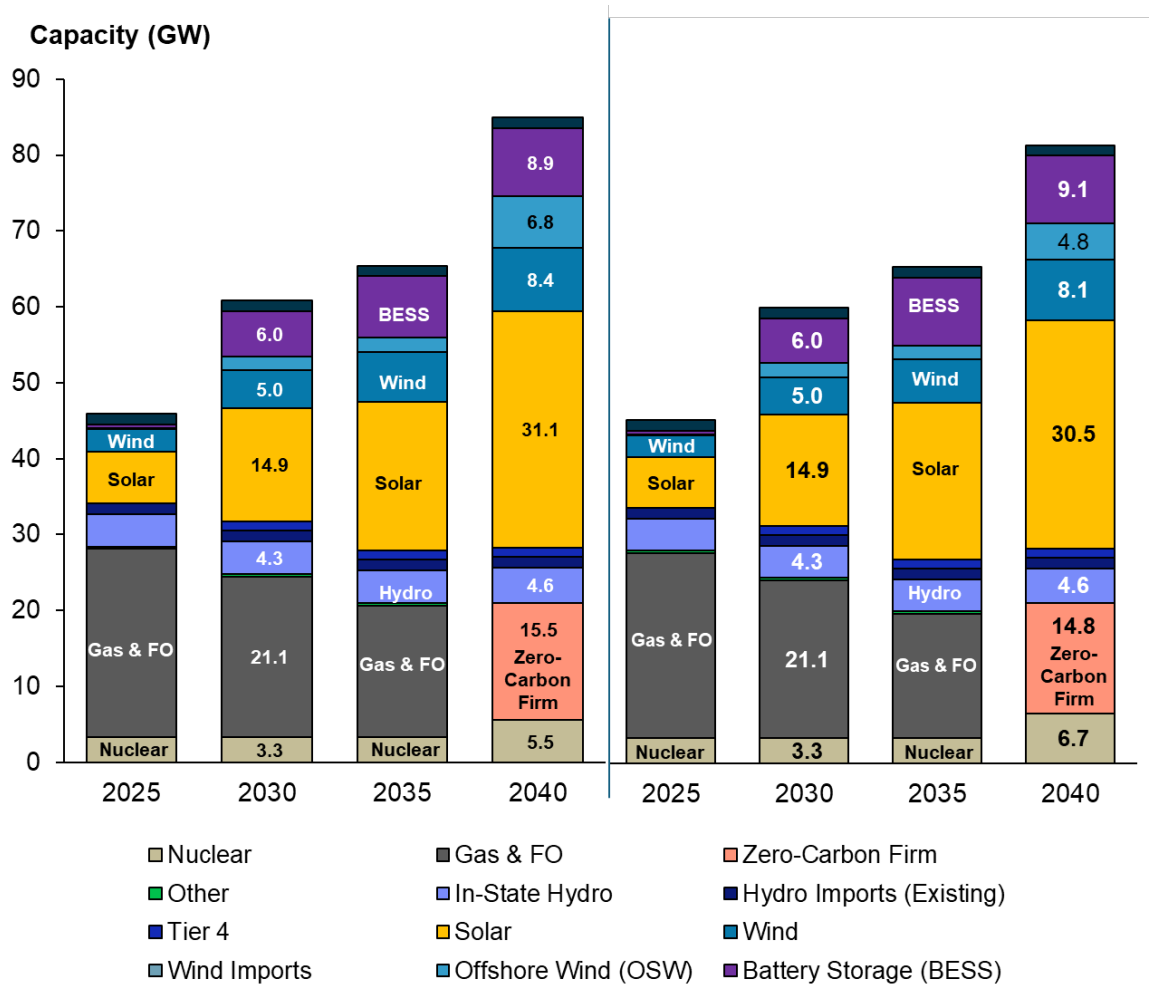
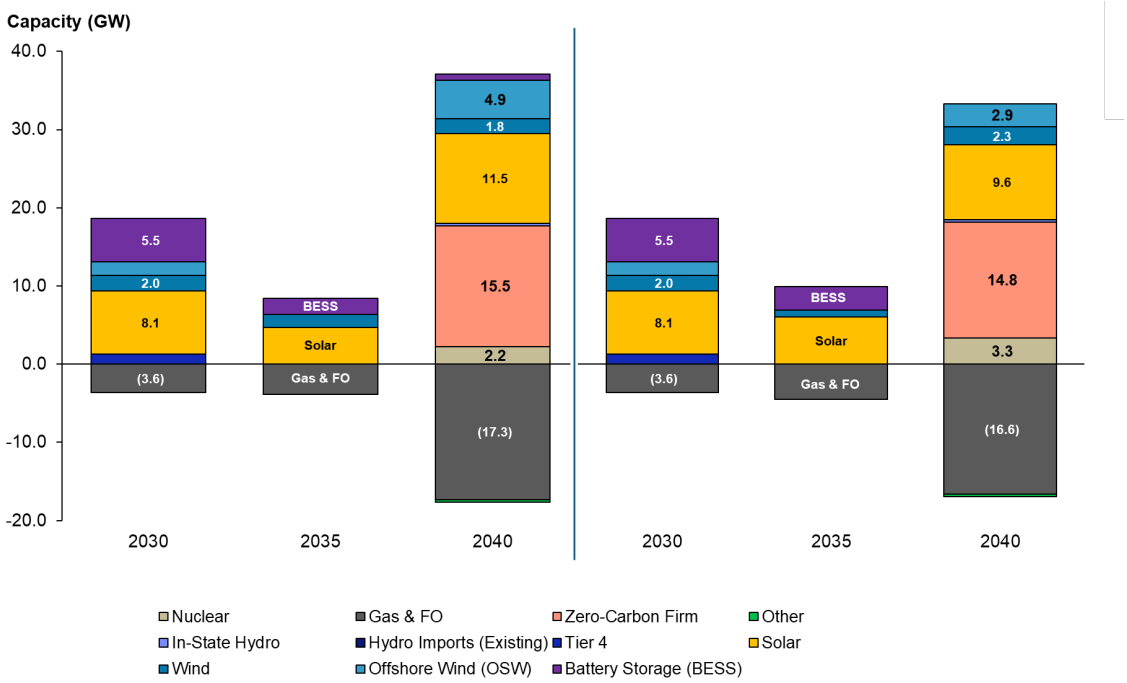


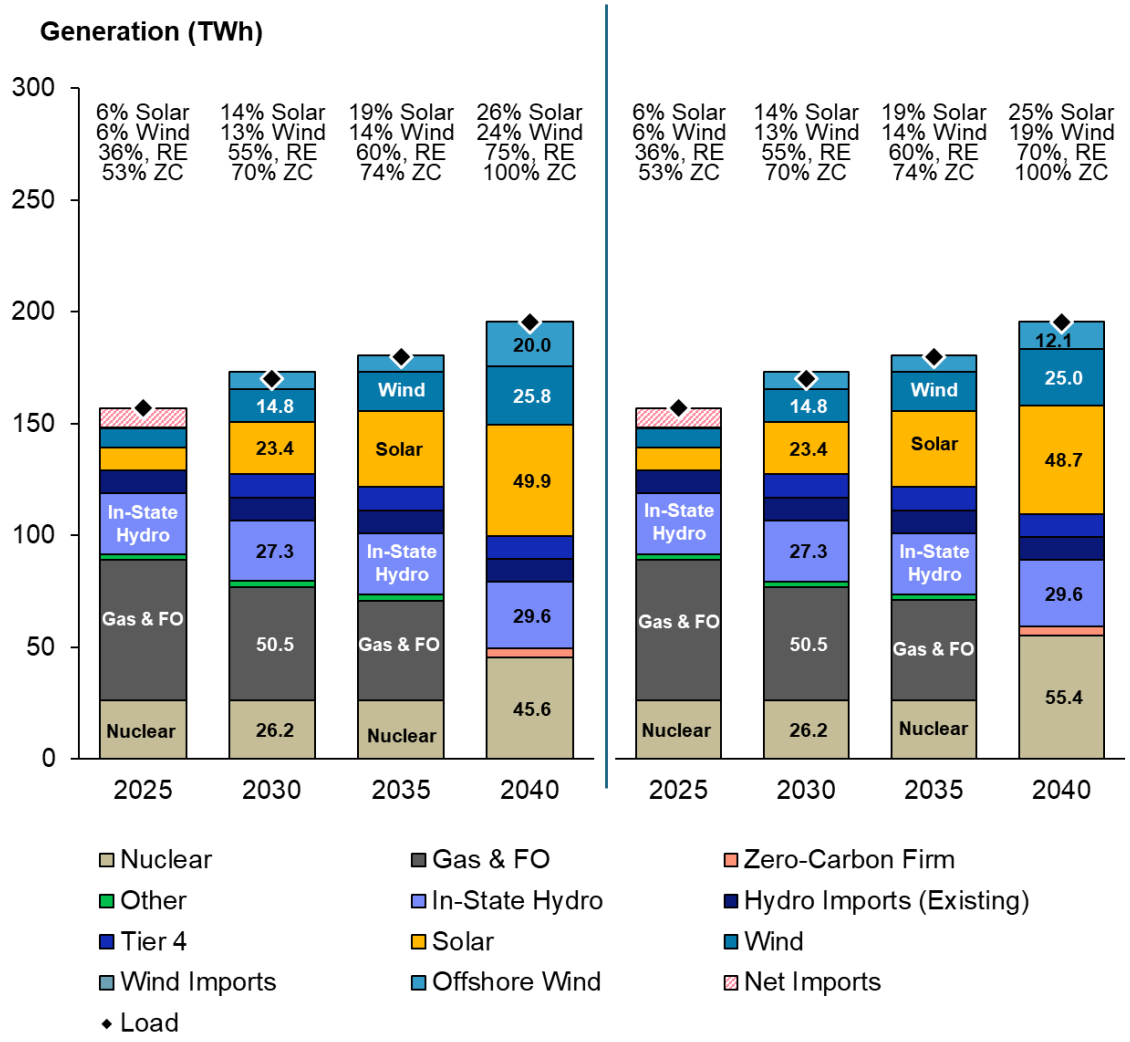
Figure 27. Additional Action, Incremental Capacity Additions and Retirements by Period



Combustion resource builds by 2040 are very similar to those in the Current Policies scenario. Between 2035 and 2040, about 3.5 GW of combustion capacity is repowered and made hydrogen-ready, in parallel with conversions of the remaining existing gas fleet to be hydrogen compatible. In both of the Additional Action variants, the 2040 combustion fleet is significantly smaller than in 2025. Of the 14-15 GW of statewide capacity in both variants, Zones A-E are projected to have 2.3 GW of combustion capacity, Zone F has 3 GW, Zones G-I have 1.7 GW, Zone J has 6.1-6.8 GW, and Zone K has 1.6-1.7 GW by 2040. For additional detail on peak contribution of different resources, see the Appendix.

Like Current Policies scenario, these combustion resources are dispatched infrequently to meet needs in the most constrained hours. These resources provide roughly 4 TWh of power annually. Full generation results for the Additional Action scenario are included in Figure 28.

Figure 28. Additional Action, Annual Generation: 2.2 GW Nuclear Variant (left) vs 3.3 GW Nuclear Variant(right)



Like the Current Policies scenario, the Additional Action variants rely on large-scale infrastructure investments which carry siting and construction risks. The 2.2 GW Nuclear variant relies more heavily on renewable sources, particularly 7 GW of offshore wind. This significant offshore wind investment carries risk related to development and buildout, especially considering federal policy headwinds. In comparison, the 3.3 GW Nuclear variant requires a more aggressive 3.3 GW buildout of new nuclear capacity. This necessitates significant accompanying transmission to deliver the new upstate nuclear resources to downstate load centers. In both cases, a mix of new nuclear and renewable resources is needed to meet policy goals. While the 3.3 GW Nuclear variant builds new upstate-to-downstate transmission before 2040, additional transmission is also expected to be required after 2040 in the 2.2 GW Nuclear variant. highlighting the value of transmission enhancements in all pathways.

Net Zero Scenarios (A and B)

The Net Zero cases see the largest levels of annual load growth, with total loads approaching 270 TWh by 2040 in both cases, approximately 70% increase relative to 2025 levels. Growing loads and near-term build constraints mean that the system decarbonizes at a slower pace from now until 2035 and makes the most progress from 2035 to 2040. On an annual basis, these loads are met predominantly with renewables, which serve 75% of loads by 2040 (inclusive of both in-state and imported hydro). Existing and new nuclear generators provide most of the rest of the needed generation. Due to the high costs of hydrogen fuel, combustion resources are still only utilized sparingly, with an annual capacity factor of 3%. Varying degrees of supplementary heating, explored in the two cases, impact firm resource builds.

The Net Zero A case relies heavily on new nuclear, renewables, and transmission buildout. A total of 4.4 GW of new nuclear is built by 2040, with 2.2 GW at existing nuclear sites in Zone C and 2.2 GW at greenfield sites in Zone F. Between 2025 and 2040, renewable investments add 13 GW of land-based wind, 34 GW of solar, and 9 GW of offshore wind. A total of 9 GW of battery storage also contributes to reliability. Combustion capacity additions are substantial. As 13 GW of fossil units retire, 9 GW of new combustion capacity is built by 2040, resulting in a net reduction of the combustion fleet by 3.5 GW relative to 2025. These resources contribute 5.5 TWh of hydrogen-powered generation in 2040 during challenging periods, such as during periods of high demand and low renewable output in the winter. Under the deep all-electric heating deployment of Net Zero A, large amounts of downstate combustion turbines (CTs) are needed to meet winter peak load growth. Zones J and K need 8 GW of CTs, including 7 GW of new/repowered assets. This includes a substantial buildout of 4 GW of new CTs in Zone J between 2030-2035 to backfill local retirements and maintain reliability.

Several major transmission upgrades are selected in the Net Zero A scenario to help deliver the new nuclear resources from upstate to downstate. New E to G transmission utilizes the full estimated existing ROW limit of 1,000 MW in addition to 550 MW of new greenfield transmission, over 1,000 MW of new F to G transmission within existing ROW is built, both E to G and F to G upgrades significantly relieve the Total East and UPNY-SENY grouped interfaces, and small upgrades are also selected from G to H.

Net Zero B has similar total energy requirements to Net Zero A but features lower system peak needs due to the 3 GW of peak reduction from more heat pump heating customers with supplementary heating systems. This scenario also relies on 4.4 GW of new nuclear by 2040 (2.2 GW at existing sites and 2.2 GW at greenfield sites in Zone F). The renewable build is identical to Net Zero A: 13 GW of land-based wind, 34 GW of solar, and 9 GW of offshore wind. It includes 8 GW of battery storage (1 GW less than Net Zero A). The peak reduction in Net Zero B avoids the need for about 3 GW of zero-carbon firm capacity statewide relative to Net Zero A by 2040. Net Zero B's emphasis on demand-side technologies which can reduce peak load impacts, in this scenario modeled explicitly as hybrid heat pumps, leads to 6 GW fewer CCGTs and CTs than today's system, reflecting the value of supplementary heating to mitigate electric system needs. As 13 GW of fossil units retire, only 7 GW of new combustion is built by 2040 (2 GW less than Net Zero A). These units contribute 4.8 TWh of hydrogen-powered generation in 2040. Crucially, there is reduced downstate peaking capacity needs. Only 6 GW of CTs are needed in Zones J and K (vs. 8 GW in Net Zero A), including 5 GW of new/repowered assets. The size of the fleet remains slightly smaller than the existing fleet in New York City (Zone J), while it expands slightly in Long Island

(Zone K) in 2035. However, this scenario still requires a significant 4 GW buildout of new combustion turbine (CT) capacity in Zone J between 2030-2035 to backfill local retirements. This scenario also avoids any buildout of new CTs upstate, while Net Zero A requires almost 1 GW of new CTs in those zones. Transmission upgrades are selected to deliver the upstate nuclear resources and are very similar to Net Zero A. In both cases, the pace of additions will require significant acceleration of the current rate procurement between now and 2040.

Figure 29 summarizes installed capacity results for both Net Zero scenarios, while Figure 30 shows the incremental capacity additions and retirements by period for Net Zero Scenario B.

Figure 29. Net Zero A and B, Installed Capacity Results: Net Zero A (left), Net Zero B (right)

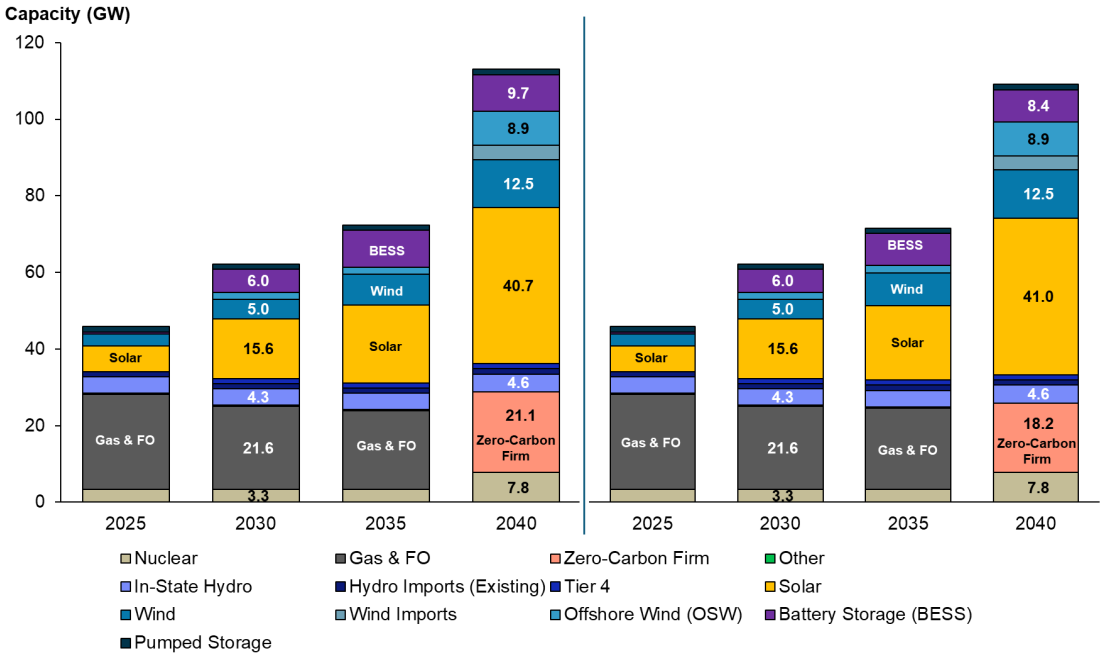
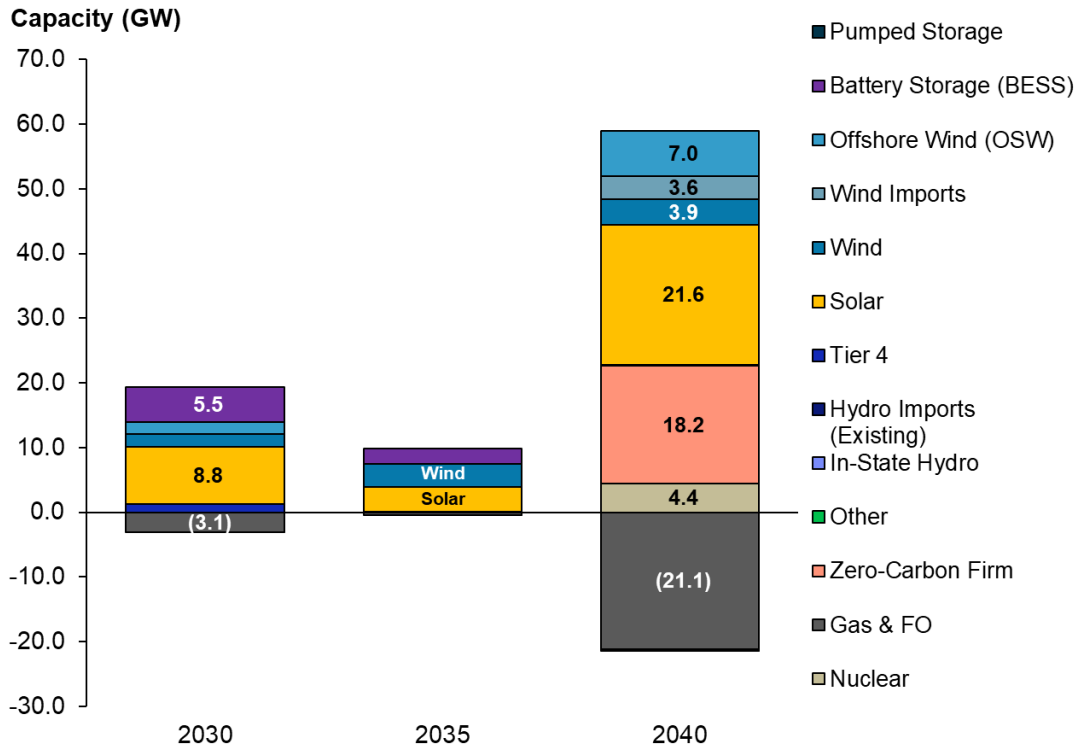
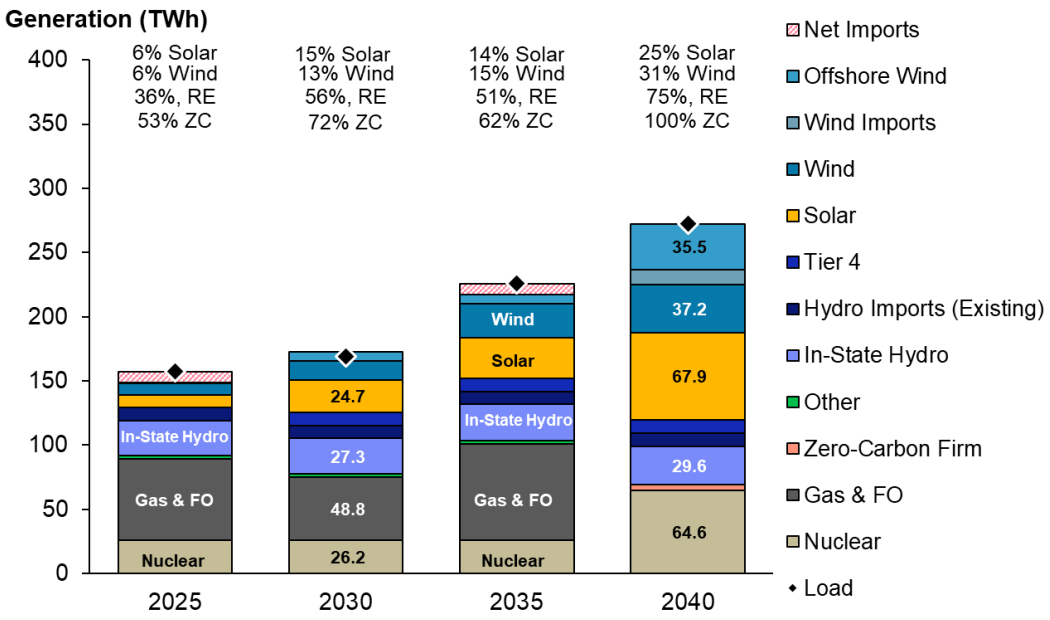


Figure 30. Net Zero B, Incremental Capacity Additions and Retirements by Period



On an annual basis, loads are met predominantly with renewables, which serve 75% of electricity demand by 2040, inclusive of both in-state and imported hydro. New and existing nuclear generators, all of which are assumed to receive license extensions in these cases, provide 65 TWh; this represents 24% of annual energy generation and provides most of the rest of the needed generation. Due to the high costs of hydrogen fuel, combustion resources are only utilized sparingly, even in cases with higher annual demand, and generate primarily during challenging periods of high load and low renewable output. These resources contribute 4.8 to 5.5 TWh in 2040. Complete generation results for Net Zero B are included in Figure 31, below. Due to comparable annual loads, the Net Zero A and Net Zero B generation results are very similar.

Figure 31. Net Zero B, Annual Generation



Utilization of Zero-Carbon Firm Resources

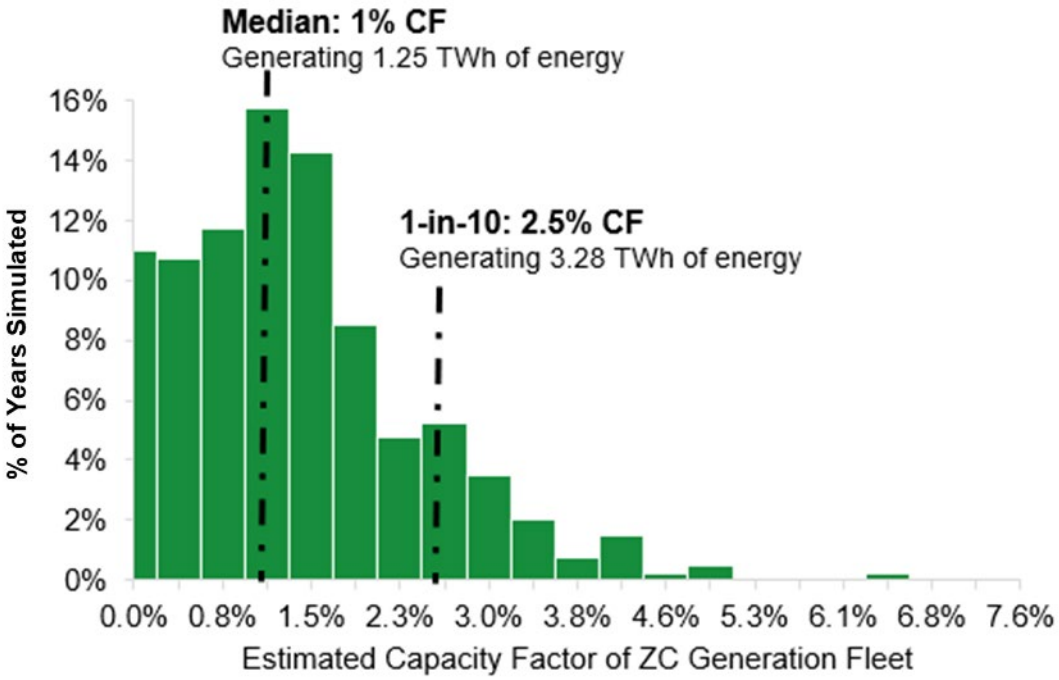
Across all scenarios that achieve a zero-emissions electricity sector by 2040, there is a need for firm resources that can support system reliability during challenging periods such as during multi-day periods of high load and low renewable output. In addition to the state's existing and planned zero-carbon firm resources (including nuclear, in-state hydro, and imported hydro resources), in the core Plan modeling the remainder of this need for zero-carbon firm capacity can be met by a combination of new nuclear and utilization of hydrogen in combustion-based generation resources; however, the need could also be met by other possible emerging clean firm technologies that were not studied within this framework. The Zero by 40 Technoeconomic Assessment examined a number of emerging technologies that could meet these system needs and included a detailed evaluation of each technology's performance attributes, technological readiness, emissions, costs, and other considerations.

The Plan's analytical framework pairs a capacity expansion model with a resource adequacy model, which simulates hundreds of years of plausible weather conditions to ensure systemwide and local reliability criteria are met. The final Plan leveraged resource adequacy modeling performed as part of the Draft Plan, as well as other studies of reliability needs in New York State[23], [24], to inform a minimum capacity factor for combustion resources utilizing hydrogen to operate each year. Due to its very high fuel costs, hydrogen utilization is generally limited to the most challenging reliability periods, which results in low utilization rates for these units.

The resource adequacy model was used to examine the range of utilization needs of zero-carbon firm capacity across a wide distribution of weather conditions; for example, during challenging weather years, such as a year with colder than average winter temperatures and lower than average solar and wind output, zero-carbon firm resource utilization would increase. This analysis provided insight into the potential range of utilization of hydrogen resources, informing how much hydrogen would need to be

produced in New York State to facilitate zero carbon dispatch under normal (or median) conditions, and under more extreme conditions. The results of this evaluation are summarized in Figure 32 below.

Figure 32. Additional Action, Zero-Carbon Firm Utilization Across 400 Simulated Weather Years



This analysis indicated that in a typical year, these resources would be needed to produce about 1.3 TWh in the Draft Additional Action scenario, equating to a 1% capacity factor for the combustion capacity fleet in 2040. A more conservative standard looking at 1-in-10 weather conditions—that is higher winter peak energy needs that only occur once every ten years in the historical and simulated weather record—sees a need for over 3 TWh from these resources, equating to a 2.5% capacity factor for the combustion fleet. Some few simulated years show needs greater than this level, though in the vast majority of years generation needs from these resources is far lower.

In addition to weather conditions, sub-zonal and local transmission constraints may also impact the utilization of zero-carbon firm resources if other resources cannot be delivered into load pockets.

Several other studies, including the Power Grid Study and the Grid Performance Gaps Study, have examined a broad range of factors that may impact the utilization of combustion resources utilizing relatively high-cost, zero-emissions fuels.[25] [26]

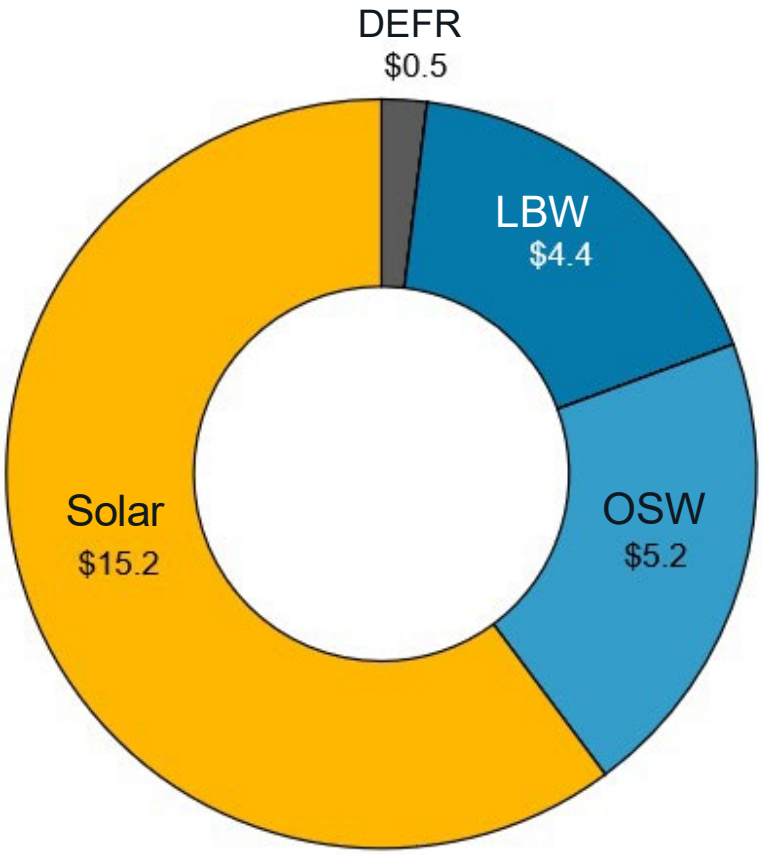
Based on the resource adequacy findings in Figure 32 above and a survey of the available literature, the final Plan modeled a minimum annual capacity factor for combustion resources of 3%, a standard roughly equivalent to, and slightly more stringent than, the 1-in-10 result above. This serves as an effective planning signal to drive sufficient investment in hydrogen electrolyzers and associated renewable generation in the modeled cases, in order to ensure there is adequate fuel production to maintain reliable operations across a range of future weather expectations.

4.2.1. Electric Sector Sensitivities

Federal Policy Support Sensitivity

A sensitivity analysis was performed on the Current Policies scenario to investigate the impact of changes in federal policies, including renewable tax credits and tariffs. The analysis found that these federal policy changes result in over $25 billion in lost tax credits for New York's power sector through 2040, on a gross cost basis. Changes in overnight capital costs through 2040 are summarized in Figure 33 below. Additional cost increases (not shown) are expected to result from tariffs, as well as lost learning related to delayed industry progress.

Figure 33. Loss in Tax Credits to New Yorkers due to Federal Policy Rollbacks, Overnight Capital Costs through 2040 (2024 $B)



A blend of utility-scale and distributed solar accounts for the majority of lost tax credit and tariff impacts, followed by onshore wind, offshore wind, and dispatchable emissions- free resources (DEFRs). While near-term progress in contracting renewables and storage helps capture some credits before they are lost, significant impacts occur due to accelerated phase outs. The later phaseout of incentives for nuclear, coupled with longer project lead times, enables credits through the 2040 modeling period.

Beyond direct costs, recent federal actions also impact permitting and the overall pace of deployment. Future federal policy uncertainty persists, including future decisions around grandfathering projects, the

scale and legality of import tariffs, and the duration of these policy changes, which could all further impact the results.

Zero-carbon Firm Resource Sensitivities – RNG and No Nuclear

Additional sensitivity analysis was performed on the Additional Action planning scenario to explore tradeoffs related to the availability of different zero-carbon firm resources. As described in the Zero by 40 Technoeconomic Assessment, hydrogen carries significant deployment barriers, including challenges related to the buildout of infrastructure, renewables, plant upgrades, and electrolyzers. RNG carries advantages as a drop-in replacement to conventional fuels. An RNG combustion sensitivity in which the model could select RNG as the zero-carbon firm resource instead of green hydrogen, was found to reduce costs by $2.9 billion in NPV through 2040, with further savings anticipated beyond that date, as well as avoid technical challenges, driven by:

- Lowering fuel costs, as RNG is estimated at approximately 2.5 times less expensive than green hydrogen.
- Avoiding converting the combustion resource fleet for hydrogen compatibility
- Avoiding some technical challenges of H2 including buildout of infrastructure, renewables, and electrolyzers

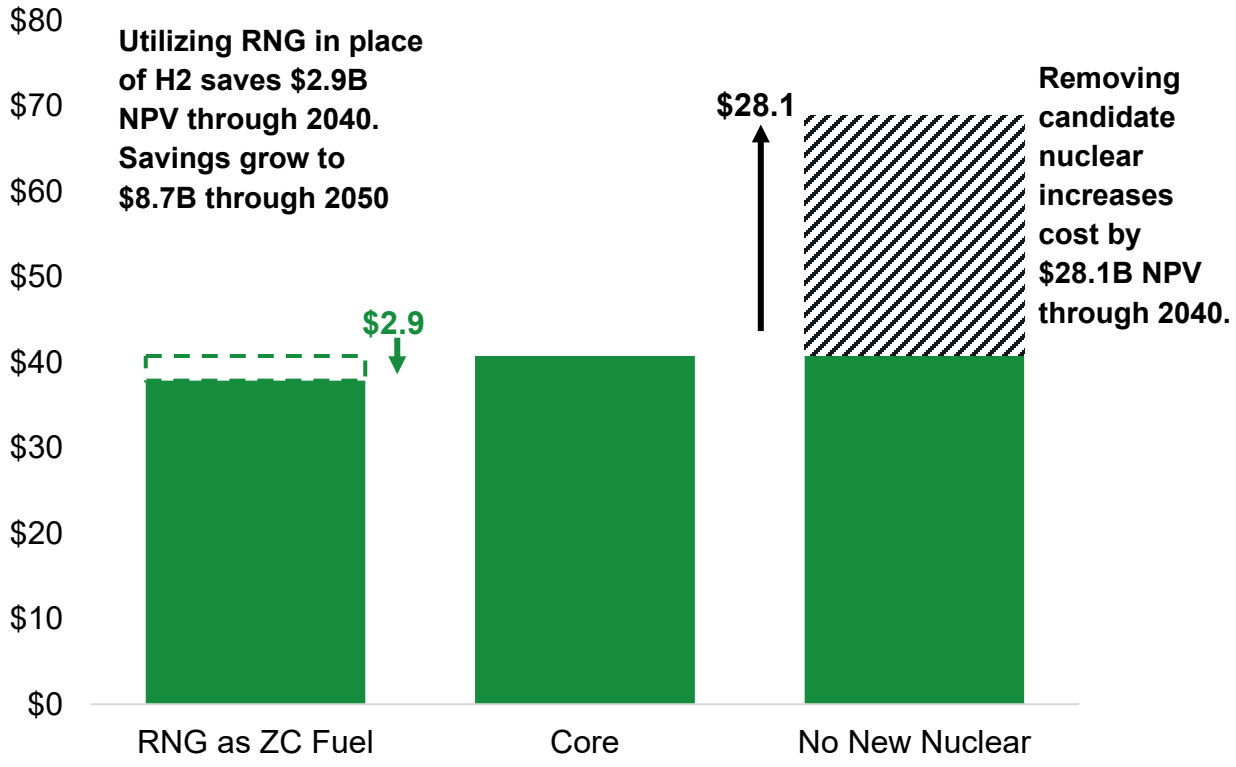
In this RNG sensitivity, the fleet of combustion resources still operates at a very low 3% annual capacity factor due to high fuel costs and the relative benefits of renewables and nuclear as energy resources, resulting in a small gross emissions impact of roughly 1.6 MMT in 2040.

Conversely, an alternate sensitivity that removes new nuclear and thereby relies more heavily on hydrogen for dispatchable zero-carbon firm generation needs substantially increases system costs—by approximately $28 billion NPV through 2040. This outcome is driven by:

- A greater reliance on high-cost hydrogen fuel for balancing in later years, as well as additional investment in combustion capacity to meet resource adequacy needs.
- A need for accelerated deployment of other renewables to serve loads in the absence of nuclear generation. To fill in for the roughly 20 TWh of clean generation that comes from new nuclear in 2040 in the core case, this sensitivity must add ~5.6 GW of additional renewables to serve loads and meet the 2040 target. Much of this must come online by 2035 so as to not violate annual build rate constraints.
- The nuclear capacity in the core case also receives federal tax credits through 2040; in replacing with renewables whose tax credits have been eliminated, this results in a loss of incentives flowing to New York.

Collectively, these factors make the no new nuclear sensitivity far less cost-effective as well as technically difficult given statewide reliance on hydrogen underscoring the benefits that new nuclear investments provide in the core case for meeting reliability and decarbonization goals. System costs relative to the core case are summarized for both Zero-Carbon Firm Resource Sensitivities in Figure 34 below.

Figure 34. Electric System Costs Relative to Additional Action 2.2 GW Variant, NPV through 2040, Zero-Carbon Firm Sensitivities (2024 $B)



Sensitivity: Price Effects of 0x40

Total system costs, consider total investment, fixed, and variable costs necessary to support reliable electricity production and delivery (for more details see Annex 1). Although useful in identifying low-cost resource portfolios, total system costs do not directly reflect generator compensation or consumer-price impacts which occur through markets including energy markets, capacity markets, and market-based policy instruments like renewable energy credits (RECs). Energy markets, or wholesale electricity markets, operate by revealing the marginal cost of meeting an additional unit of load (*e.g.,* +1 MW) in a given location (*e.g.,* Zone A) during a specified period (*e.g.,* hour). These marginal costs are referred to as locational based marginal prices (LBMPs) and reflect the price of energy, losses, and congestion. Between 2023 and 2025,[27] the statewide annual load weighted average LBMPs ranged from $33.80 to $61.83/MWh.[28,29]

To explore the impact of the Energy Plan's *Additional Action* (or *core policy*) resource mix on the LBMPs, we performed additional analyses using RESOLVE's linearized version of a traditional production cost model.[30] For each hour in a year, this tool simulates least-cost electric grid operations given a specified portfolio of generating resources, load, and dispatch constraints. A second case, *Additional Action – No 0x40* (or *No 0x40*), utilizes the same electric sector assumption set as the *No Action* scenario (as described in Table 1), which excludes post-2019 policy actions, such as CES Tier 4 support of CHPE, nuclear license extensions, resource carve outs, and contracted renewable additions with COD post 2025. However, the

No 0x40 case assumes the same annual load as the *Additional Action* scenario, so the scenario's capacity build is distinct from the *No Action* scenario. In continuity with final Plan capacity expansion modeling practices, the *No 0x40* scenario's least cost capacity build was optimized over 2025 to 2050. However, this price effects analysis has focused on 2030 and 2035 due to long-term market and policy uncertainty, and its findings are valid for this time frame - extrapolation beyond 2035 is not recommended without additional analysis.

Under the *core policy* scenario, increased generation from resources such as solar PV and nuclear reduces zonal LBMPs as higher-cost generators are shifted out of the supply stack; this leads to lower clearing prices, resulting in energy market savings for New Yorkers (for similar analysis see the 2012 New York Solar Study[31] and 2021 Tier 4 Petition[32]). Compared to the *No 0x40* case, the *core policy* scenario's zonal energy prices were 16-20% lower in 2030 and 12-18% lower in 2035. These findings are persistent throughout each year and zone, with the *core policy* scenario yielding lower statewide load weighted average LBMPs in all hours, as shown in Figure 35 and Figure 36.

Figure 35. 2030 statewide load weighted locational based marginal prices for the Additional Action - No 0x40 scenario and Additional Action scenario (2024$/MWh)

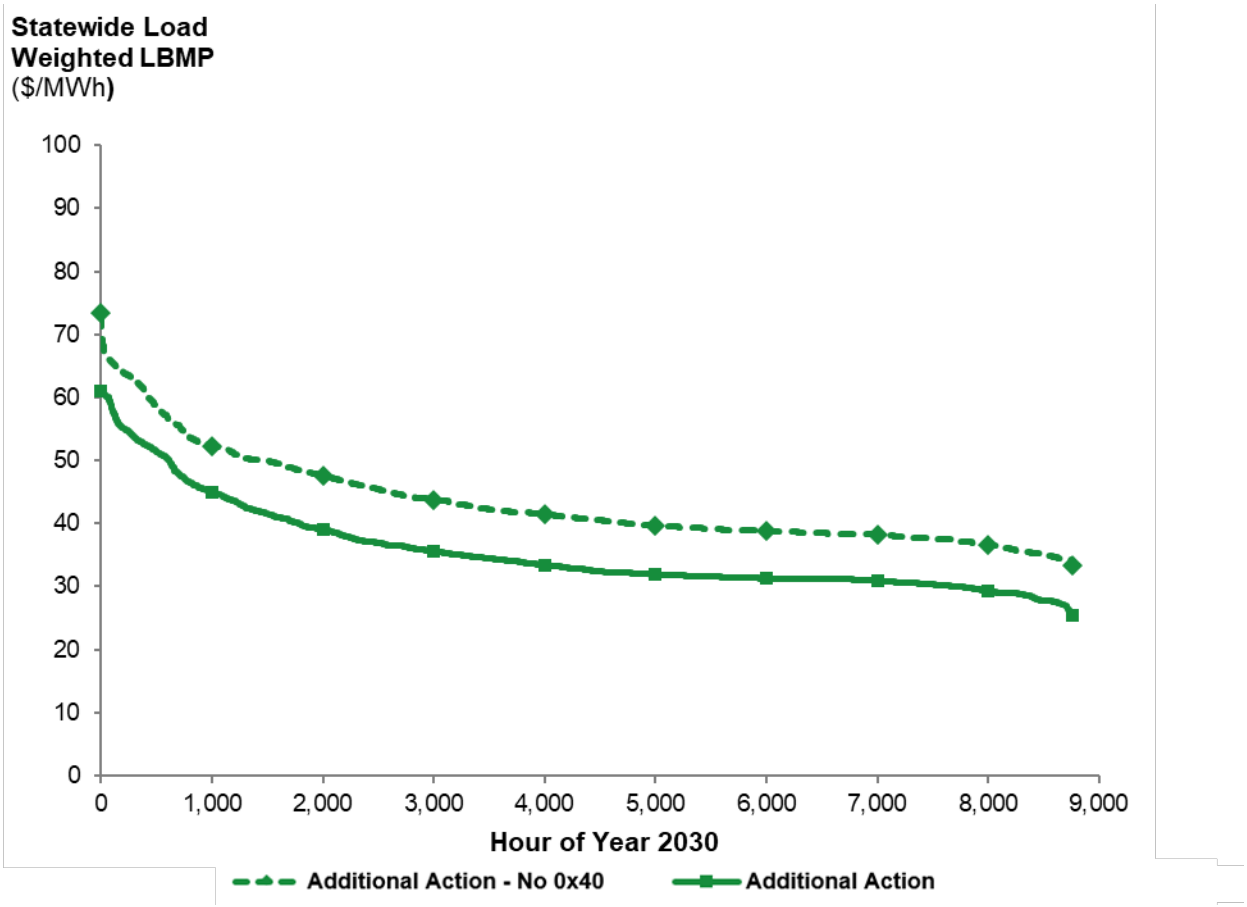
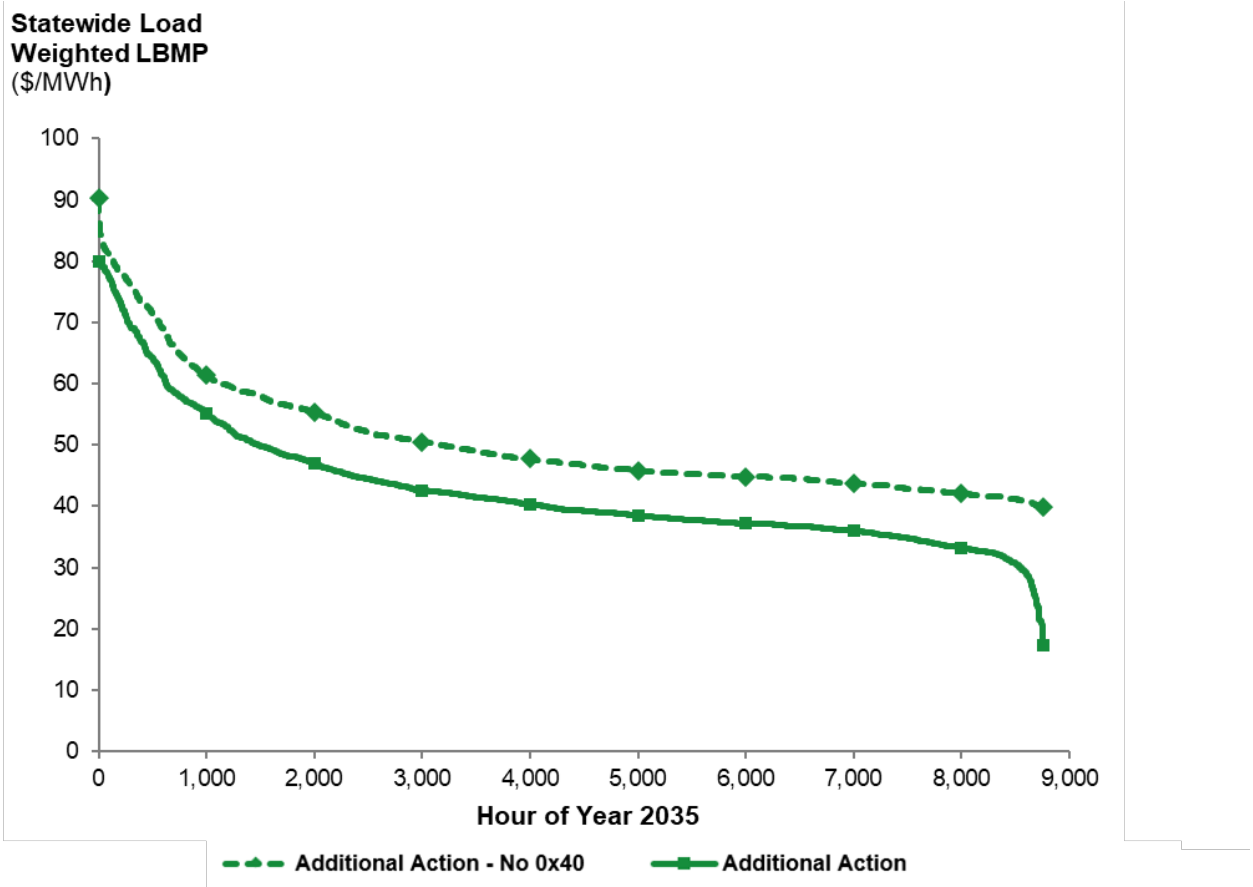


Figure 36. 2035 statewide load weighted locational based marginal prices for the Additional Action - No 0x40 scenario and Additional Action scenario (2024$/MWh)



Compared to the *No 0x40* case, on a statewide annual load weighted average basis, the *core policy* scenario reduces energy prices by 18% in 2030 and 16% in 2035, resulting in a price difference of approximately $7.9/MWh. The price effects of low variable cost resources in the *core policy* scenario are projected to yield annual energy market reductions totaling $804-$938 million dollars (2024$) in 2030 ($921-$1,075 million nominal)[33] and $863-$1,007 million dollars (2024$) in 2035 ($1,109-$1,294 million nominal), after considering bilateral contracts.[34,35,36] Note that capacity market revenues, which is significant source of generator compensation, was not examined in this analysis, which only looked at energy market revenues. Further, programs that support renewable and zero emission resources at the bulk level[37] including those that compensate renewable and zero emission generators (*i.e.,* RECs (Tier 1, Tier 3, Tier 4), South Fork, ORECs) and those that support renewables-supporting infrastructure (Bulk Storage Program, and Transmission (Propel, Smart Path, Phase 2 AOC)) are projected to have gross program costs equal to $2.8 billion (2024$) in 2029 ($3.2 billion nominal).[38] Although the *core policy* case forecasts lower LBMPs and corresponding energy market savings, generator remuneration also occurs through market-based policy instruments, which were not evaluated in this analysis.

Sensitivity: Limited Additional Nuclear

While the core scenarios show substantial value of new nuclear deployment, there are deployment challenges for 2040, as described in the Zero by 40 Technoeconomic Assessment, for example related to project timelines and technology readiness for new reactor types. To understand the implications of these risks, a sensitivity explores the implication of just 1.1 GW of new nuclear by 2040 with continued limited deployment thereafter. By 2040, this sensitivity requires an additional 2.1 GW of offshore wind, 600 MW of solar, and 300 MW of battery storage compared to the core case with 2.2 GW of new nuclear available. Given this wide range of potential resource portfolios to meet New York energy needs, infrastructure planning choices must carefully incorporate and enable these solutions over time. This could mean making adequate investments in transmission assets that allow electricity to flow between upstate and downstate, allow load centers to adequately benefit from offshore wind, and other similar opportunities.

4.3. Fuels Overview

Electrification and efficiency drive significant reductions in the use of petroleum and other fossil fuels across all scenarios over time (Figure 37). Current Policies layers on statewide biofuel blending mandates, while Additional Action includes renewable fuel blending across natural gas, distillate, and jet fuel as a potential decarbonization lever. The supply of low-carbon fuels is approximately 34 TBtu in 2030 and approximately 100 TBtu in 2040 in Additional Action, with further blending in the Net Zero cases (Figure 38). Biofuel feedstock supply was sourced from the 2023 US Department of Energy (DOE) Billion Ton Report and NYSERDA Potential Studies. The Additional Action scenario focused on in-state supply of wastes and residues, while the Net Zero scenarios included a regional supply of wastes, residues, and purpose grown biomass.

Figure 37. Fossil fuel consumption by scenario

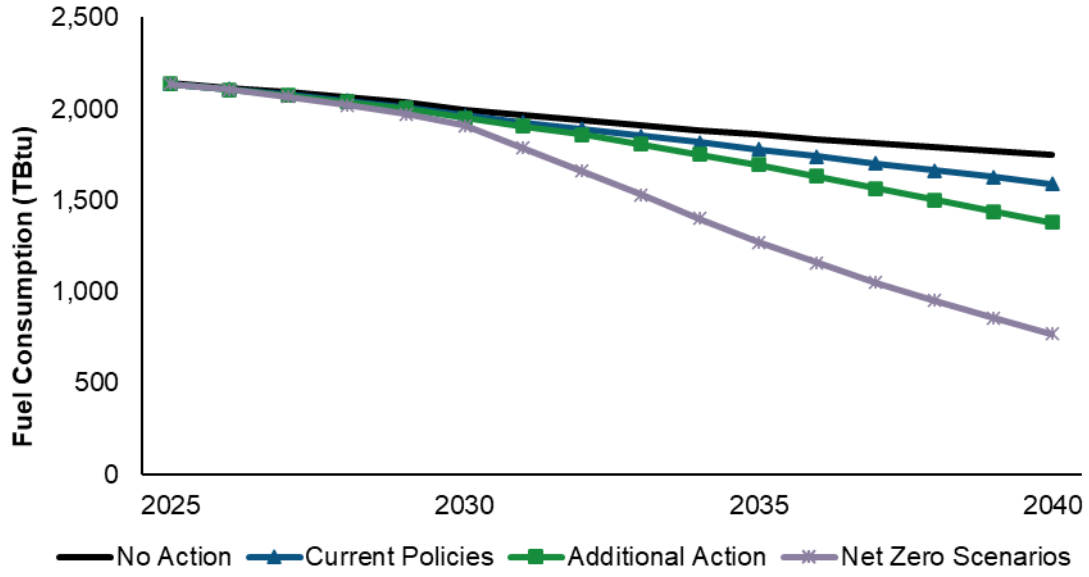
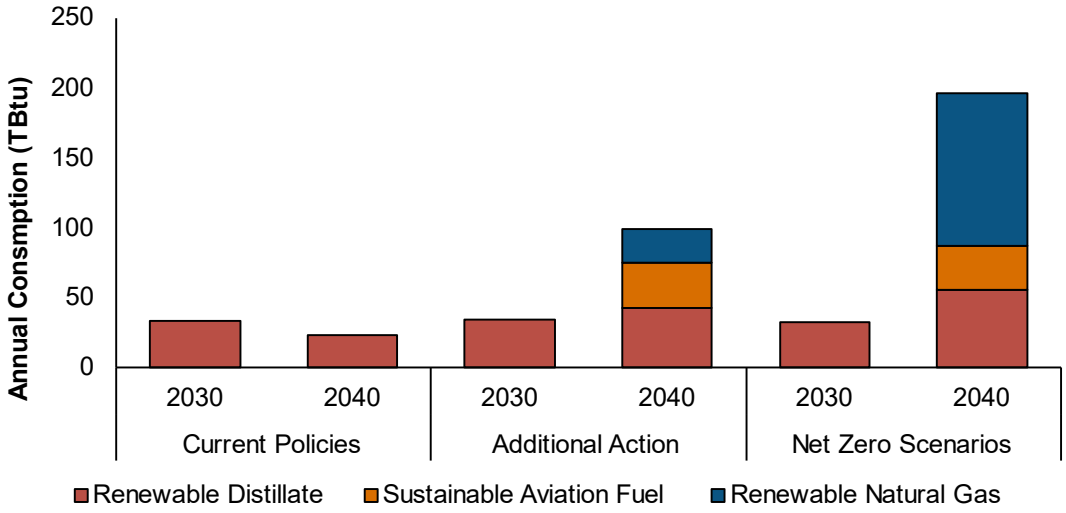


Figure 38. Low-carbon fuel consumption, 2030 and 2040



5. Economy-wide

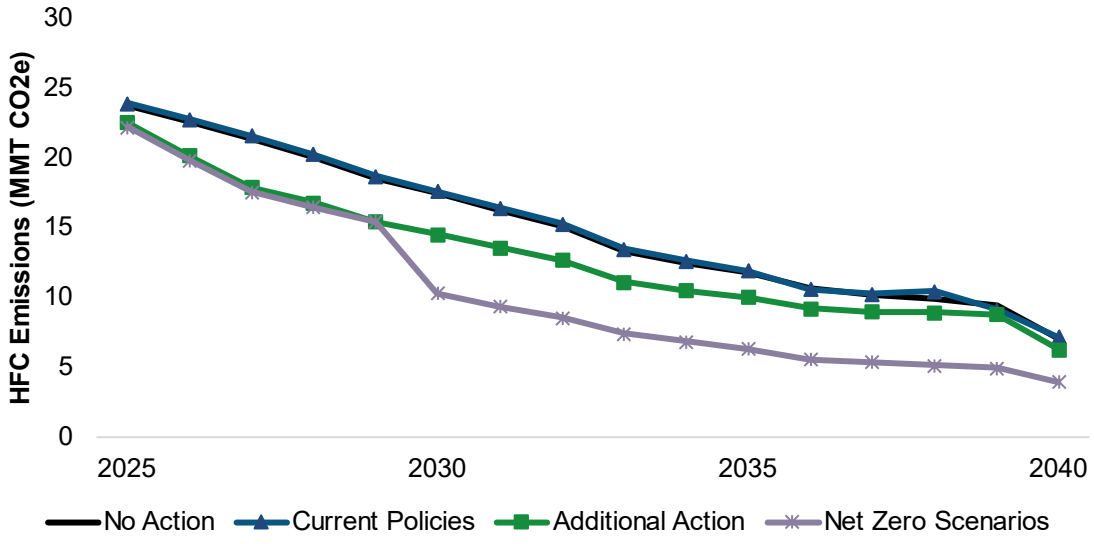
While the Plan is focused on the implications of State policies and actions on energy demand and supply, it is important to consider emissions in the non-energy sectors, especially in tracking progress towards achieving the economy-wide decarbonization goals as outlined in the Climate Act.

5.1. Non-Energy Sectors

Emissions for Agriculture, Waste, and Land Use were provided by DEC using updated forecasts based on the trajectories modeled in the Final Scoping Plan.

Hydrofluorocarbon (HFC) emissions were sourced from an HFC emissions analysis performed by Guidehouse.[39] A key finding is that even the No Action case sees significant declines in HFC emissions through the modeling horizon, driven by EPA rulemaking in 2023-2024. If EPA rules are rolled back, emissions would be expected to increase in the No Action case, in the absence of New York State rules. The Current Policies scenario reflects New York State rules including the HFC regulations in 6 NYCRR Part 494, which support a meaningful reduction in HFC emissions. The Additional Action scenario builds upon the 2024 rules by including more stringent constraints on leakage reduction in HFCs, while the Net Zero cases see further emissions reductions driven by including reclamation of HFCs at end of life (Figure 39). These DEC regulations play and important backstop against any potential future federal rollbacks.

Figure 39: HFC emissions forecast

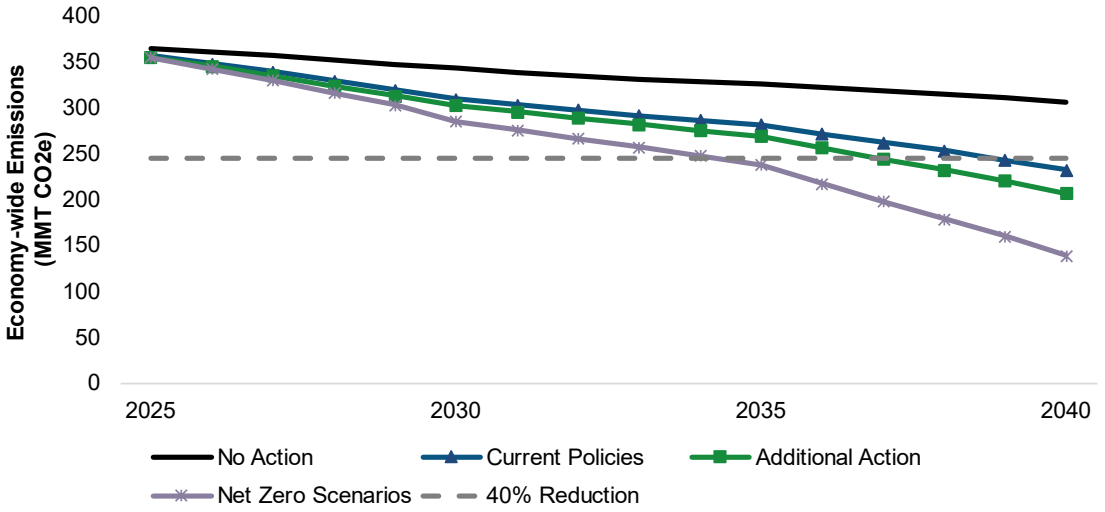


5.2. Total Emissions

According to the 2025 Statewide GHG Emissions Report, under Climate Act accounting, New York has already reduced its GHG emissions by approximately 14% relative to the 1990 Part 496 baseline and 25% relative to GHG emission peaks in 2005.

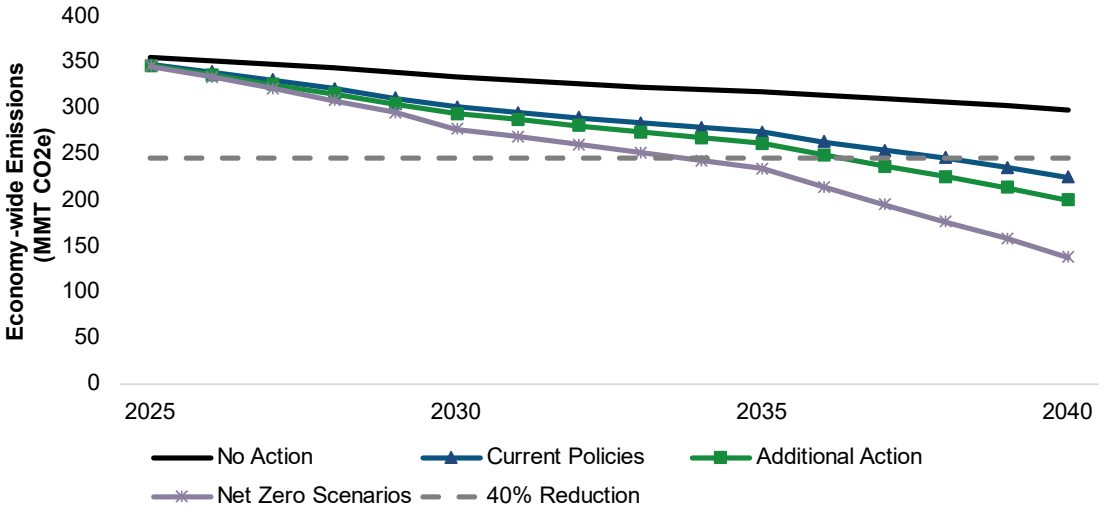
In the No Action scenario, the most significant near-term GHG emissions reductions come from transportation electrification, efficiency gains in end-use devices, and tighter building envelopes. In the Current Policies and Additional Action scenarios, additional savings also flow from faster renewable-electricity buildout, more ambitious electrification of buildings and vehicles, and stronger building codes (Figure 40).

Figure 40. Economy-wide emissions under Climate Act accounting (Draft Plan upstream emission factor)



Climate Act accounting includes a significant component of emissions from upstream emissions from out-of-state fossil fuel production. The 2025 Statewide GHG Emissions Report[40] relies on the National Energy Technology Laboratory's Natural Gas Lifecycle Analysis Model. Recent updates to the model suggest that the current and historic upstream emissions for natural gas are less intensive than the rates used in prior NYS GHG inventories and the Draft Plan, resulting in significant reduction in the State's GHG emissions profile. For more information on the methodology changes, see the 2025 Statewide GHG Emissions Report.[40] Using this latest upstream emissions factor data, combined with further improvements in upstream emissions due to continued projected emissions reductions in the upstream supply chain, across all scenarios, 2030 gross reductions total between 18-32%, compared to 16-30% under prior factors. As a result of modeled reductions and the updated upstream emission factors, Current Policies and Additional Action are projected to achieve the 40% reduction target between 2037 and 2038. Existing rollbacks of federal policies have already increased projected emissions in 2040 by 7 MMT, delaying achievement of the 40% target by at least 1 year. Modeled further rollbacks of federal clean energy policies could push back the achievement of this 40% reduction target to 2039 and increase 2040 emissions by over 9 MMT. In both of these metrics, State policy backstops across the economy mitigate some of the impacts of these federal policy changes; without these policy backstops, emissions increase of federal rollback would be even higher. The Net Zero cases achieve the target in 2034, reflecting the time it would take for any new actions to translate into emission reductions (Figure 41).

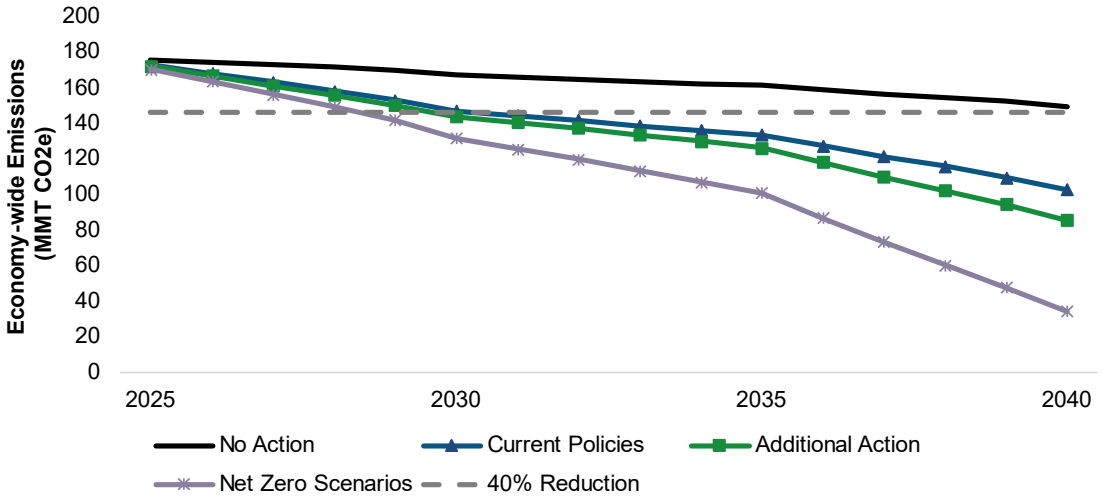
Figure 41. Economy-wide emissions under Climate Act accounting (updated upstream emissions factor)



Emission reductions were also calculated using practices adopted under the United Nations Framework Convention on Climate Change (UNFCCC) and commonly used by the Intergovernmental Panel on Climate Change (IPCC) in its periodic assessments to allow for more direct comparison with other jurisdictions. Calculating emissions consistent with this accounting framework requires excluding out-of-state upstream fossil emissions, treating biofuel combustion as carbon neutral, and applying 100-year (rather than 20-year) global-warming potentials.[41] Using this accounting framework, New York's 2023 net emissions already stand 24% below 1990 levels, and the modeled pathways achieve greater reductions. By 2030, the Additional Action scenario attains 41% net emissions reductions, while the Current Policies scenario misses that mark by under 2 million metric tons. By 2040, both scenarios drive emissions

approximately 58–65% below the 1990 baseline, and the Net Zero scenarios achieve an emissions reduction of 86% (Figure 42).

Figure 42. Economy-wide emissions under UNFCCC accounting



5.3. Benefit and Cost Analysis

Regardless of the scenario, New York State has substantial energy-related investment needs over the course of the planning period. Aging infrastructure across all energy sectors, including electricity and natural gas, will require investment to maintain safety and reliability. While creating new opportunities for workers and communities across New York State, economic development will require substantial expansion of energy infrastructure to ensure abundant, accessible supply. Likewise, replacing aging end use devices in the building and transportation sectors will require space heating and water heating system investments and new vehicle purchases. Furthermore, all of these systems will need to adapt to warmer winters and more extreme heat in the summer. As a result, while the planning scenarios include increases in annual spending, the bulk of energy system investment will be required regardless of the pathway the state ultimately pursues.

Figure 43 and Figure 44 show the annual gross costs across scenarios in 2030 and 2040. The No Action scenario sees relatively flat economy-wide costs of around $150 billion per year; increases in capital expenditures and in electric system costs are offset by reduced fuel purchases due to building and transportation electrification. Note that this analysis does not include changing costs for existing pipeline gas systems or existing electric infrastructure assets whose cost recovery obligations have previously been accrued and added to the rate base, alongside the ongoing maintenance investments for such assets; any such changes in costs would be consistent across scenarios so including those dynamics would impact overall gross costs but not impact the comparison across scenarios. The Current Policies and Additional Action scenarios have slightly increasing costs[42], with a 5% and 7% increase in gross annual costs through 2040, respectively.

Figure 43. Gross annual costs across scenarios in 2030 (2024$)

* "Others" includes oil and gas system costs, operations and maintenance costs, and other direct costs.

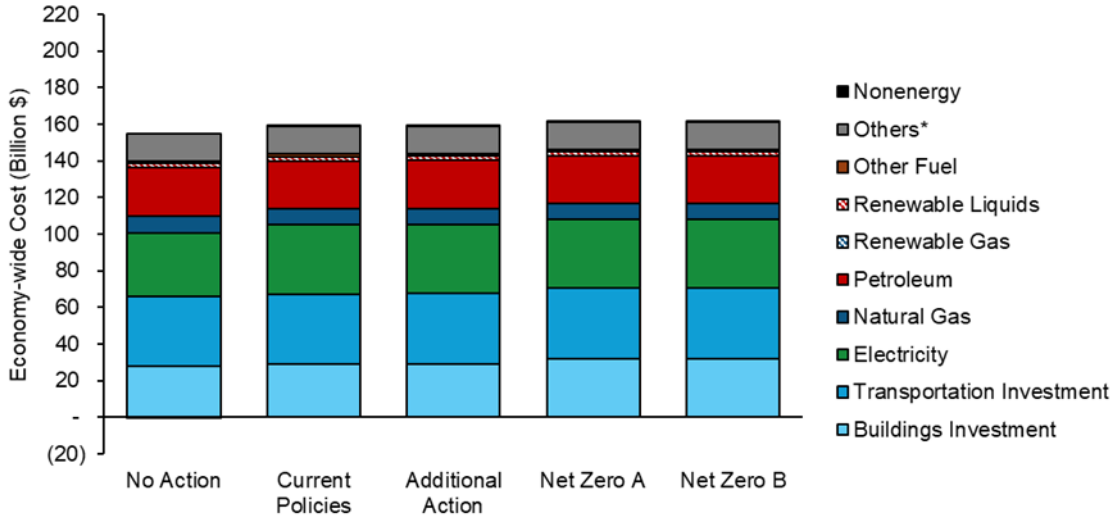
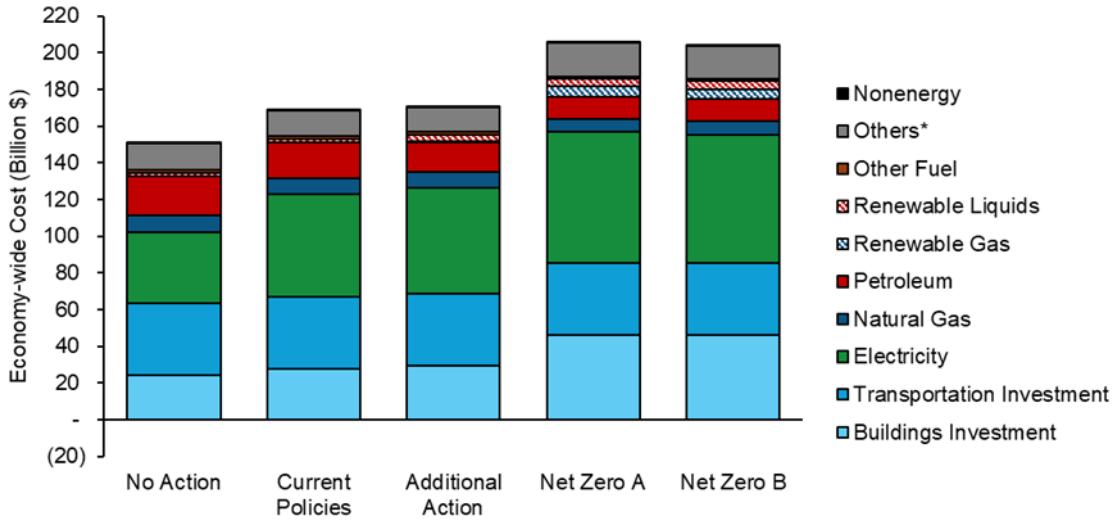


Figure 44. Gross annual costs across scenarios in 2040 (2024$)

* "Others" includes oil and gas system costs, operations and maintenance costs, and other direct costs.



Most added costs when comparing the planning cases to the No Action scenario are from higher capital outlays—chiefly for heat pumps—and incremental power sector costs. These capital costs are partially offset by lower fuel and operations-and-maintenance expenses and by the projected decline in EV and heat-pump prices over time. In 2030 and 2040, incremental costs of the Additional Action scenario relative to the No Action scenario are $4.3 billion and $19.9 billion, which represents a 3% and 13% premium respectively, but is smaller than the cost increases seen in the Net Zero scenarios.

While the costs shown in the figures above show the gross system costs required under each scenario, these values do not include emission reduction benefits, such as the health benefits and the avoided social cost of emissions (SCE) benefits. The policy scenarios will yield substantial health benefits to New Yorkers from improved air quality relative to the No Action case. The Public Health Impacts Analysis chapter of this Plan documents the health benefits associated with air quality improvements in more detail. While health benefits quantify human health improvements from pollution reductions, the SCE measures the economic impact of climate change using a damages-based methodology. For more details, please see the NYSDEC Value of Carbon guidance.[43] The reduction in SCE can be significant for scenarios with increased emissions abatement.

The relative difference between annual costs, benefits, and net benefits under the No Action scenario and the policy scenarios are shown below for 2030 (Figure 45), 2035 (Figure 46) and 2040 (Figure 47). As indicated in figures below, each of the planning scenarios provides a net benefit relative to the No Action scenario. Across scenarios, the net benefit increases in later years. The continuous increase in net benefits results from higher annual GHG reductions in later years, leading to higher SCE savings and health benefits. The annual costs in Net Zero B are slightly lower than in Net Zero A, indicating the potential value of coordinated backup gas heating equipment use.

Figure 45. 2030 annual net costs and benefits by scenario (billion 2024$)

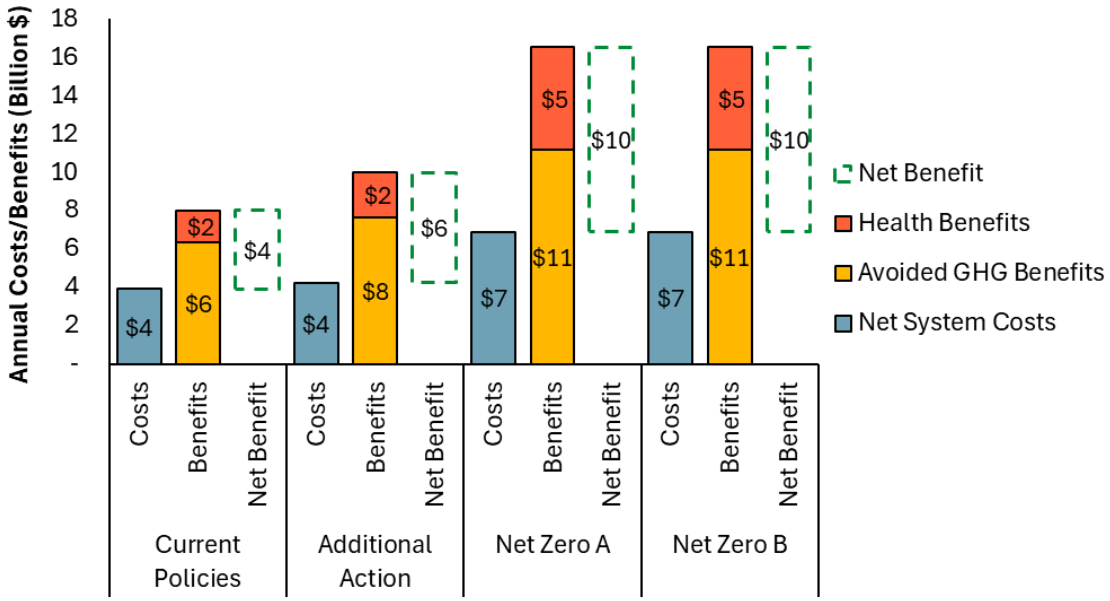


Figure 46. 2035 annual net costs and benefits by scenario (billion 2024$)

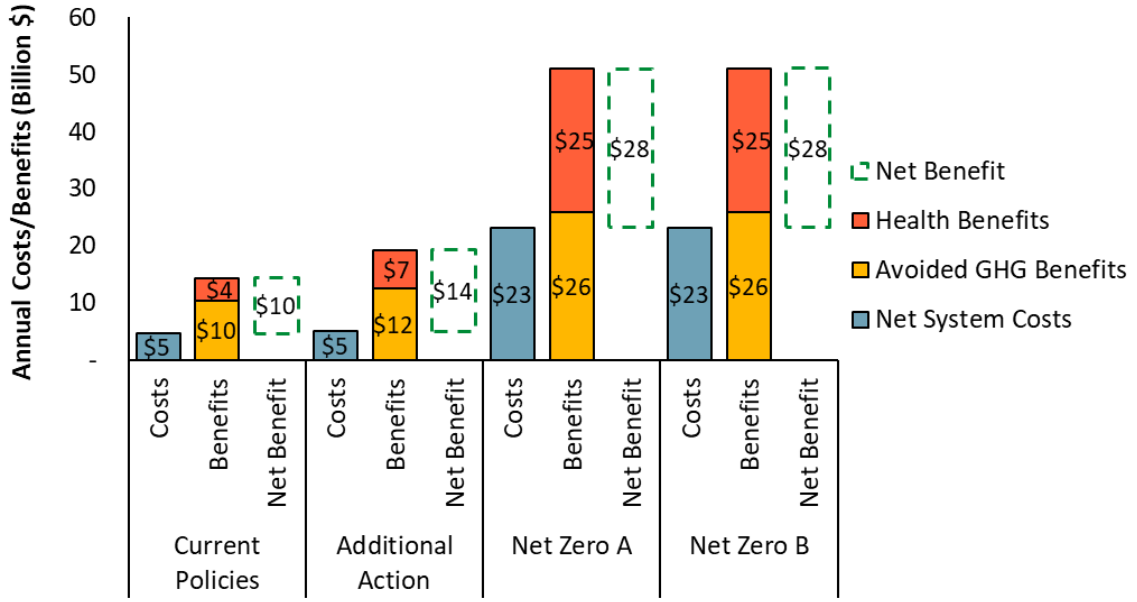
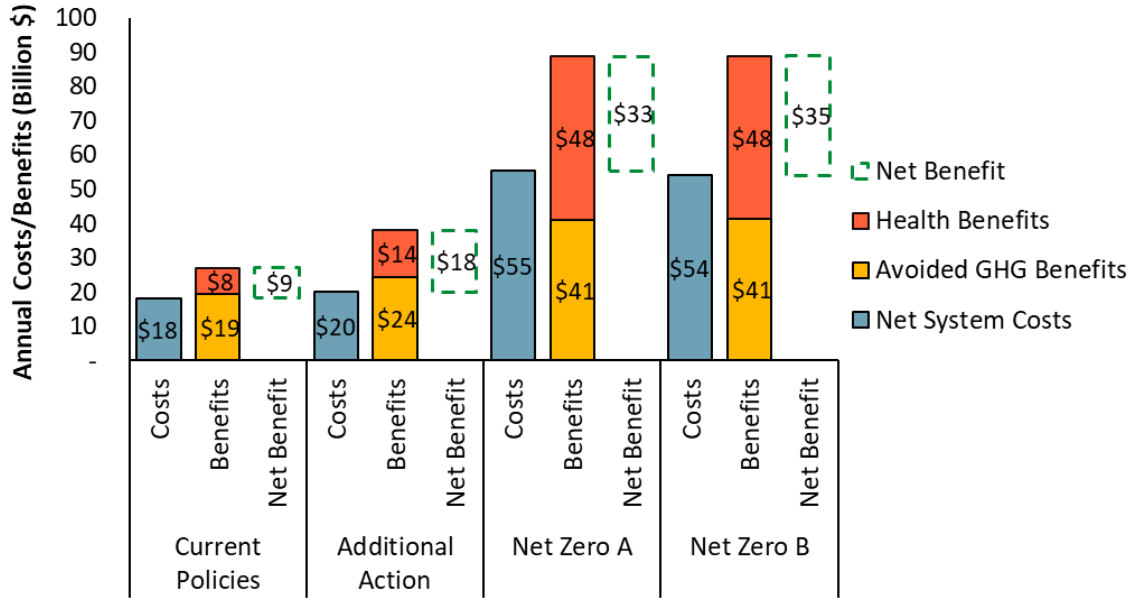


Figure 47. 2040 annual net costs and benefits by scenario (billion 2024$)



The net present value (NPV) of the total net benefits incurred over the planning horizon, 2025-2040, indicate the potential benefits of the policy scenarios. Relative to the No Action case, the Additional Action case shows NPV benefits of $92 billion in 2024 dollars. This reflects population-level estimates, indicating that the combined public health and SCE benefits are expected to outweigh the incremental

costs associated with Additional Action. These estimates do not reflect impacts at the individual level but rather reflect modeled outcomes at the societal level.

Federal policy sensitivity analysis suggests the rollback of federal clean energy tax credits result in a significant cost burden to New Yorkers, with lost support of $31 billion through 2040 ($19 billion on an NPV basis). In addition to these lost tax credits, federal policy changes will also result in increased costs due to tariffs and industry uncertainty impacting learning rates. These additional impacts are not included in the federal policy cost impact estimated here. In addition to impacts to costs, the rollback of these federal programs results in increased emissions and could cause a delay in achieving the State's emissions reduction targets. However, this delay would be much greater if not for various State policy backstops.

6. Summary of Findings

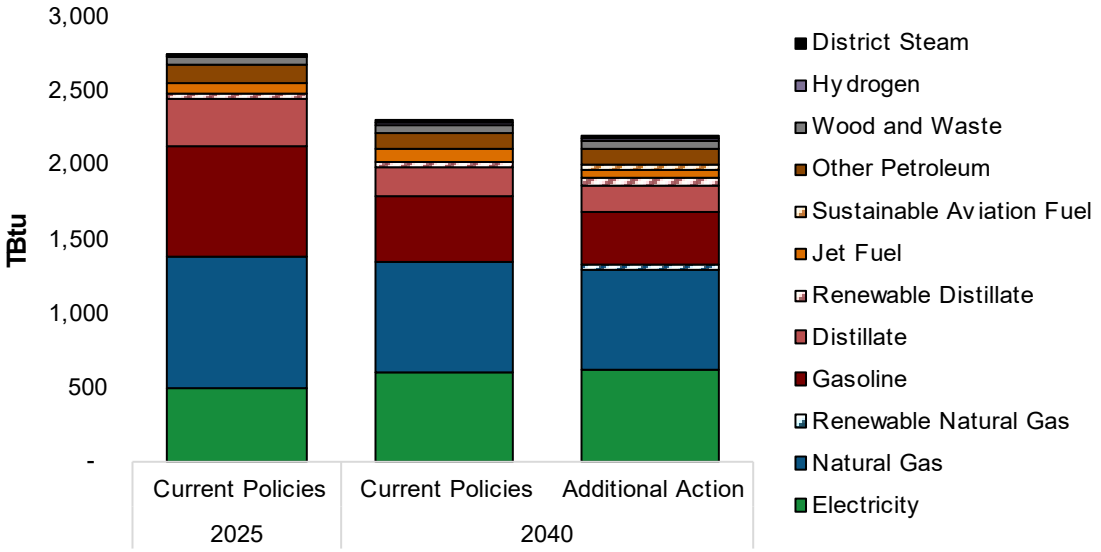
The Plan is underpinned by analysis of possible future energy demand and supply across a range of future scenarios. Through economy-wide modeling of multiple future energy pathways for New York, this analysis simulates possible future energy systems that meet energy needs and advance policy objectives. The analysis completed for the Plan is based on assumptions set in October 2025.

The two planning scenarios modeled include a Current Policies scenario reflecting progress consistent with enacted policies and an Additional Action scenario reflecting further acceleration of adoption of clean energy technologies from some mix of future policies. The planning scenarios include two variants for how much new nuclear and intrastate transmission capacity could be developed through 2040. The core planning scenario for the State Energy Plan is Additional Action, a forward-looking scenario that is consistent with ambitious but achievable progress.

As a reference point, the analysis also includes a No Action scenario that includes federal policies (as of October 2025) and legacy New York State policies but excludes State and local policies from 2019 onward. This scenario represents the energy system absent the Climate Act and other more recent clean energy policies. The net zero scenarios reflect what would be needed for full achievement of the 2050 emission reduction targets for comparison.

As shown in Figure 48 for the planning scenarios, the energy system undergoes a meaningful transformation in final energy demand between 2025 and 2040 even as all resources that contribute to meeting energy needs today continue to be important at the end of the planning period. By 2040, total final energy demand falls by 16–20 percent due to the adoption of energy efficient technologies including building shell (or envelope efficiency) improvements. In the Current Policies and Additional Action scenarios, final energy served by electricity increases from 19 percent in 2025 to 26–29 percent in 2040, and final energy served by direct fossil fuel consumption (across natural gas and petroleum fuels) decreases from 78 percent in 2025 to 63–69 percent in 2040.

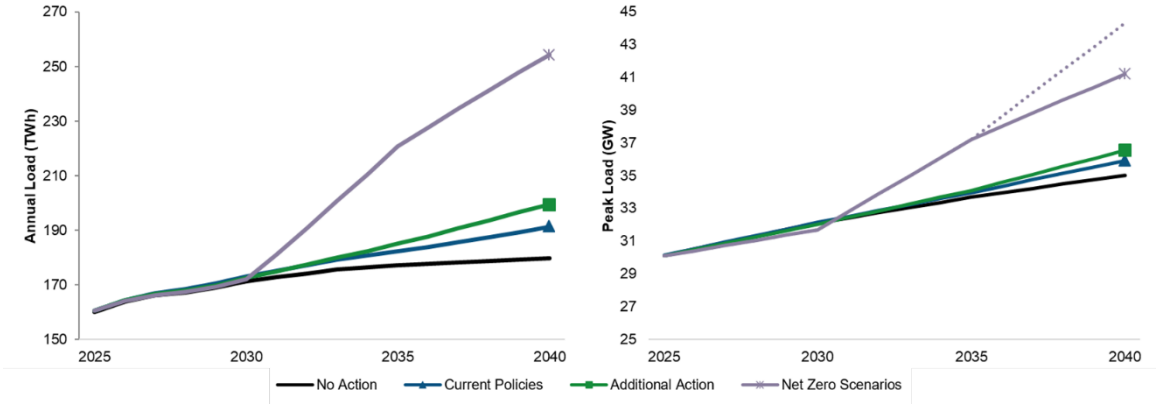
Figure 48. 2025 vs 2040 final energy demand by fuel



6.1. Annual and Peak Electricity Demands

Future electricity demand is projected to grow due to new large loads and electrification of transportation and buildings. In all pathways scenarios, new large loads such as manufacturing and data center projects interconnecting to the system drive growing electricity demand, across both annual loads and peaks (Figure 49). Planning early for abundant supply for these industrial and commercial projects can ensure continued opportunities for economic growth.

Figure 49. Annual electric loads (TWh, left) and NYCA peak loads (GW, right) for each Pathway



Electricity demand is also projected to grow due to electrification of transportation and buildings. Adoption of clean energy technologies, such as electric vehicles (EVs), building energy efficiency, and heat pumps is already underway driven by consumer preferences and federal, State, and local policies and programs. As existing vehicles and heating and colling appliances age out and are replaced, State actions—such as various transportation decarbonization initiatives and investments, heat pump incentive programs, advanced building codes, and all electric new construction —will accelerate

adoption of more efficient and electrified alternatives. By 2040 in the planning scenarios, 38-55 percent of the light-duty vehicle (LDV) stock is a zero-emission vehicle (ZEV) (see Section 3.2), and 19-26 percent of the residential heating stock is heat pumps (see Section 3.1). These shifts lead to further electric system growth.

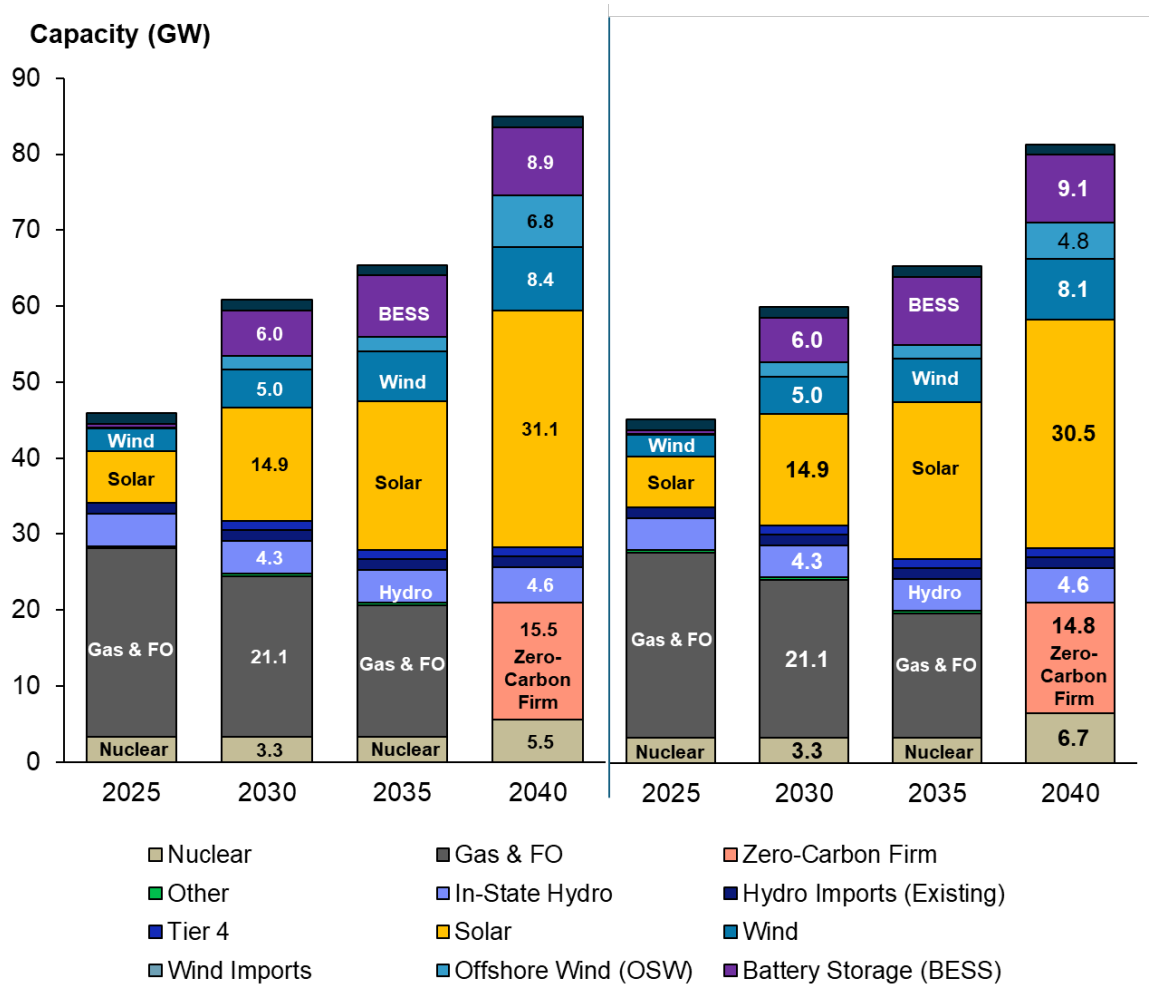
6.2. Electricity Supply

Meeting this growing electricity load, while maintaining system reliability, will require investments in expansion of the electricity system in all pathways. Moreover, progress toward a zero-emission electric grid will necessitate a transformation of the generation mix. This builds upon the deployment of renewables already underway from the Clean Energy Standard (CES) program.

In the core planning scenario, additions of renewable energy, nuclear, transmission, and battery storage are foundational to decarbonizing the state's electricity system. Under two variants of this scenario, by 2040, 28 GW of solar, 6 GW of land-based wind, 5-7 GW of offshore wind, and 2-3 GW of new nuclear would be added to New York's already decarbonizing generation mix, which add to the system's resource diversity (Figure 50, which shows total installed capacity over time). Beyond 2040, and subject to future analysis, the Energy Planning Board anticipates growth opportunities for all technologies considering load growth projections. In light of deployment uncertainty across all resources, planning and investments should rigorously pursue a mix of resources to support multiple energy futures.

Reliably integrating large quantities of variable renewable energy into the electricity system requires flexibility and balancing over multiple timescales, including sub-hourly and hourly balancing as well as ensuring that firm, dispatchable capacity is available to provide adequate amounts of power during multi-day periods of low renewable output.

Figure 50. Additional Action electric sector capacity: 2.2 GW Nuclear Variant (left), 3.3 GW Nuclear Variant (right)



Battery storage and demand-side flexibility provide key contributions to system reliability and support the balancing of renewables with demand. Existing and new nuclear and existing hydroelectric generation, provide large quantities of zero-emissions energy and firm, dispatchable capacity during prolonged periods of low renewable output.

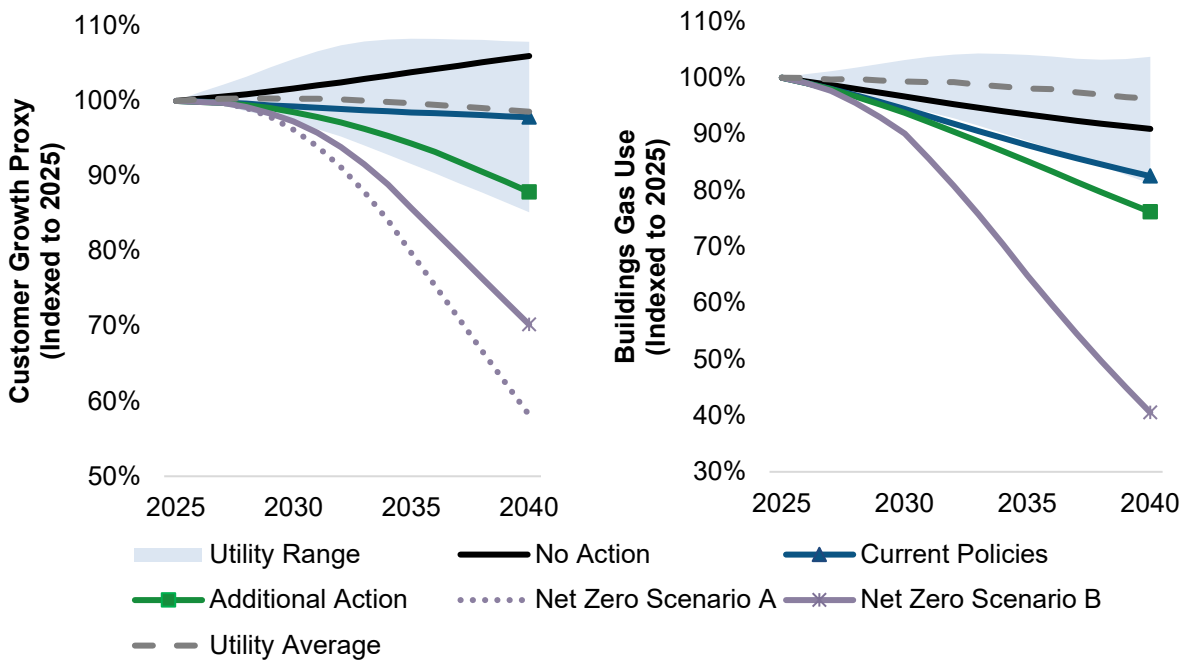
While the State policy process for establishing the definition of zero-emission electricity generation is still underway, the modeling assumes that by 2040 the remainder of multi-day reliability needs are met by generators powered by green hydrogen. Under this assumption, the combustion generation fleet remains critical, with 15 GW of capacity available to run on hydrogen in 2040. This chapter reports on projected combustion unit retirements over the planning period and new or repowered capacity to maintain reliability which includes 3 GW repowered by 2035 in New York City as a result of delayed offshore wind buildout given federal permitting headwinds. The chapter further includes a sensitivity that explores the value of using renewable natural gas (RNG) rather than hydrogen for firm power

generation, finding that the use of RNG lowers system costs and reduces deployment challenges related to infrastructure buildout, generator retrofits, increased load, and higher fuel costs for hydrogen. The size of the overall combustion fleet declines from approximately 25 GW in 2025 to 15 GW in 2040 even as peak demand increases, reflecting the reliability contributions of other new resources like the Champlain Hudson Power Express transmission project, new battery storage, new nuclear generation, and additional renewable capacity.

6.3. Gas Supply and Delivery

While the electricity system is expected to grow in all scenarios; the gas system transformation is pathway dependent. In all scenarios, the gas system remains an important energy delivery system, necessitating investments for reliable ongoing provision of service. Residential and commercial consumption of natural gas declines in all cases with efficiency improvements and customers switching to heat pumps to varying degrees (Figure 51). Natural gas throughput declines even further with progress toward a zero-emission electricity system, although electric generators typically have interruptible service which lowers their impact on overall gas system infrastructure needs. Residential gas customers grow in the No Action scenario absent more recent State action, with new construction and conversions from electric resistance and heating oil driving new connections. Residential gas customers decline over time in the remaining scenarios, reflecting the potential for heat pump programs and other State and local government actions to stem growth. However, regional variability is expected based on the findings of the utility Long Term Plans, and targeted regional investment in system expansion may be needed to increase supply and meet peak demand.

Figure 51. Residential gas customer count change and building gas consumption change for all pathways

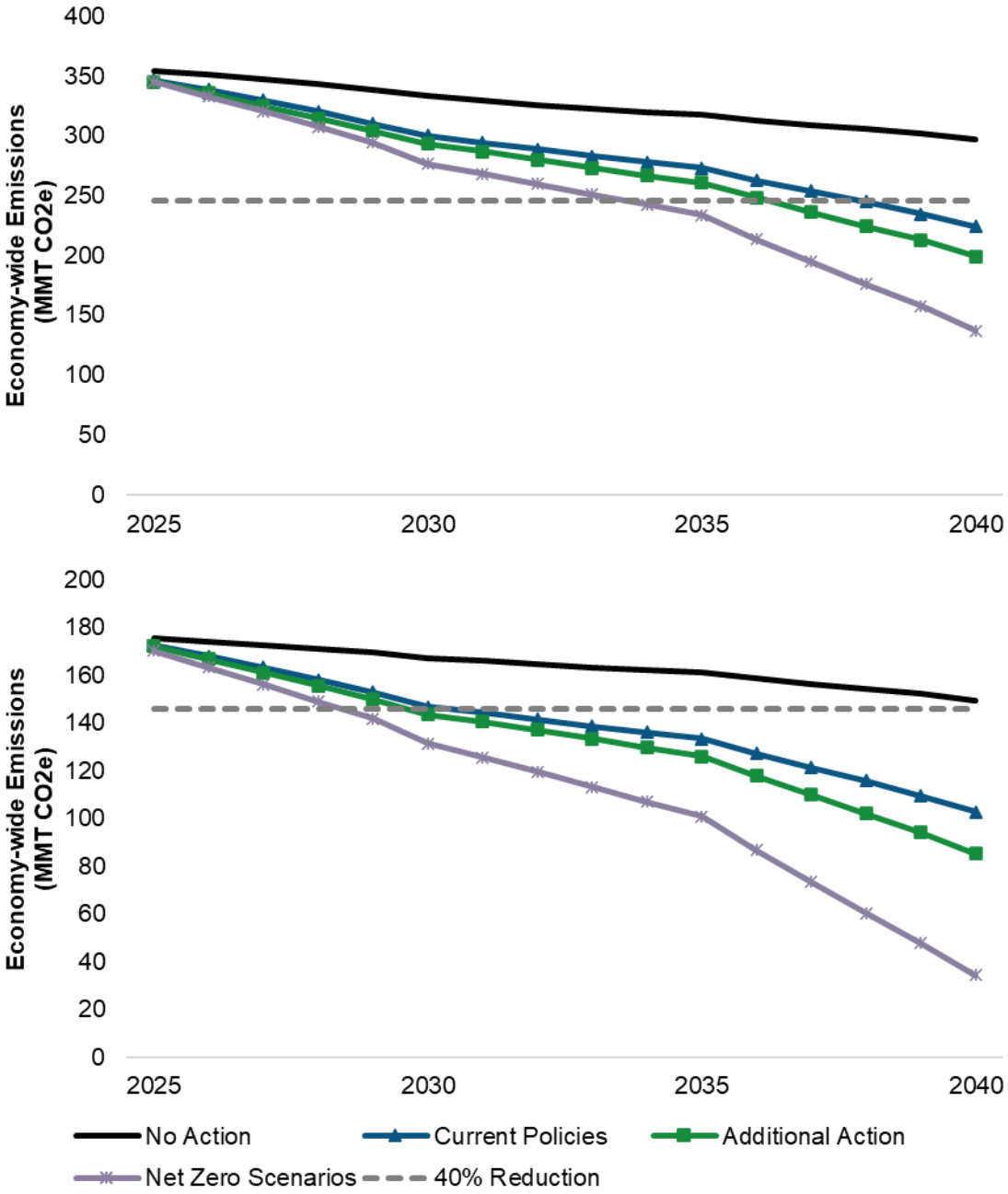


6.4. Greenhouse Gas Emissions

New York's economy-wide emissions today have already declined more than 14 percent from 1990 levels and 25 percent relative to 2005 peak emissions. The modeling finds that existing State policies are laying groundwork for further economy-wide emissions reductions, with significant contributions from power generation, transportation, buildings, and fugitive emissions including methane and hydrofluorocarbons (HFCs; Figure 52). Under the current set of assumptions and the Climate Act GHG accounting methodology, Current Policies will hit 40 percent economywide emissions reduction in 2038, while Additional Action will hit 40 percent reduction in 2037. State policies mitigate some of the impacts of federal policy changes already enacted; without these State actions, emission reductions would be further delayed.

Under conventional UNFCCC accounting, a standard in many other jurisdictions, Additional Action achieves a 40 percent reduction in economy-wide emissions by 2030 and Current Policies is within 2 MMT of the target in that year.

Figure 52. Economy-wide Emissions for all Pathways under Climate Act (top) and UNFCCC (bottom) GHG Emissions Accounting Methodology



Achievement of the net zero economy-wide emissions target will require significant further policy action and technology development, beyond what is currently contemplated, including further electrification and decarbonization in buildings and industry, pursuing electrification and fuel-switching in on-road and non-road transportation sectors, and pursuing ambitious non-energy sector mitigation.

Due to external factors including supply chain disruptions, inflation, recent cuts to federal clean energy tax credits and incentives, and other changes in energy and tariff policy from the federal administration, there is considerable uncertainty in the timeline for progress toward emissions reductions.

6.5. Societal Costs of the Plan

Regardless of the specific future pathway for New York's energy system, continued investment to maintain and modernize existing infrastructure, replace aging equipment, and purchase fuels to meet energy needs will be necessary. The analysis found that the No Action scenario requires annual system-wide spending (including on supply- and demand-side fuel and equipment) of approximately $150 billion (in 2024$) every year through 2040. These funds support replacing end use equipment at end of useful life and constructing new and replacement natural gas generators to meet electricity needs, which are being transformed by new large loads and other needs. Operating fuel expenses trend downwards over time because end use equipment is expected to become more efficient.

By 2030 (Figure 53) and 2040 (Figure 54), the Additional Action scenario raises annual system-wide costs by 3 percent and 13 percent, respectively, relative to the No Action scenario. Additional Action meets over 85 percent of its investment needs in every year by reallocating anticipated spending from legacy energy sources and equipment to energy efficiency and clean alternatives, replacing spending on combustion generators with renewable generation, gas appliances with energy efficient heat pumps, and internal combustion vehicles with battery electric alternatives. In contrast, the cost premium for the Net Zero scenarios reaches over 35 percent by 2040. Recent federal policy changes have shifted cost towards New Yorkers, as tax credits and incentives for clean devices and renewable resources have been repealed. This sums to up to $31 billion through 2040 in lost federal support ($19 billion on a net present value basis). The near-term actions New York is taking to contract projects before credit phase-out are essential for reducing cost to New Yorkers and ensuring ongoing industry progress. In addition to the impact of lost support, federal policy changes will drive increased costs due to tariffs and industry uncertainty impacting learning rates, and those impacts are not included in the federal policy cost shift estimated here.

Figure 53. 2030 gross annual costs by scenario (billion 2024$)

Note: * “Others" includes oil and gas system, operations and maintenance costs, and other direct costs.

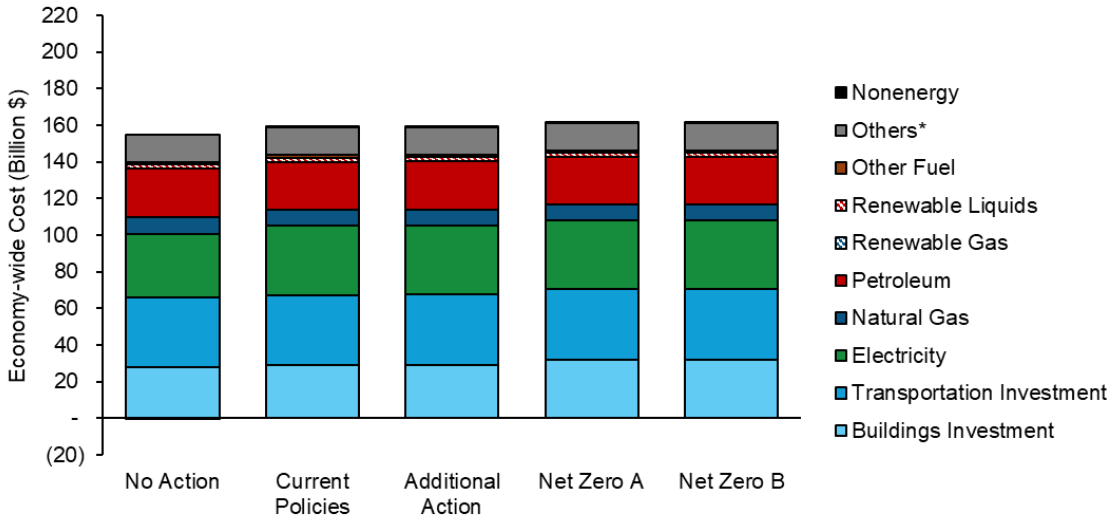
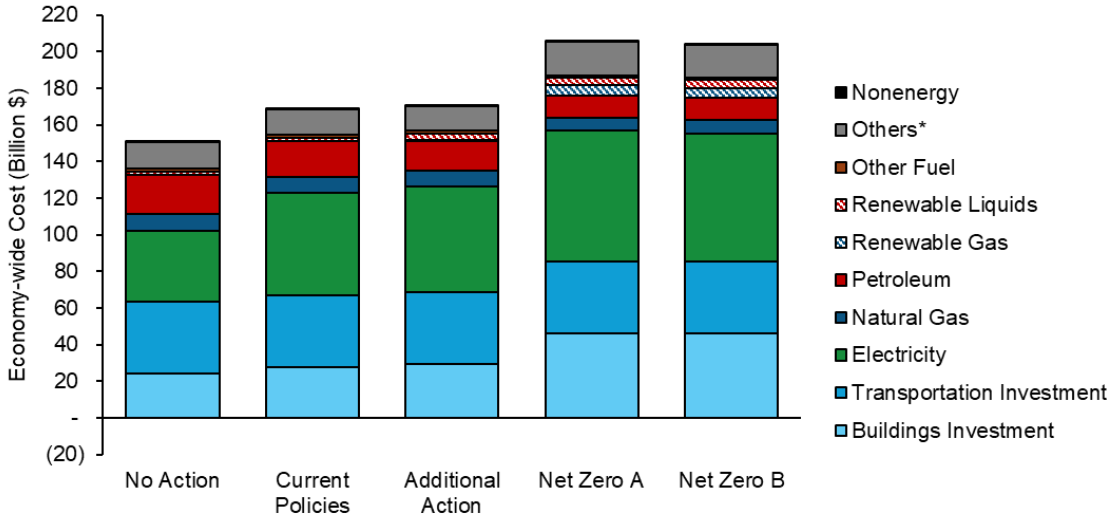


Figure 54. 2040 gross annual costs by scenario (billion 2024$)

Note: * “Others" includes oil and gas system, operations and maintenance costs, and other direct costs.



Across each of the scenarios, the emissions mitigation supported by State actions yields societal benefits that exceed the corresponding incremental costs in each year and in total over the planning period. The core planning case, Additional Action, sees the total net present value of net benefits reach $92 billion by 2040. These benefits grow substantially over the planning period as greater amounts of clean energy substitute for fossil fuel use across the scenarios. As shown in Figure 55, in the Additional Action scenario in 2030, incremental spending of $4 billion secures approximately $10 billion in benefits (or $6 billion in net benefits). By 2040 (Figure 56), incremental spending of $20 billion provides benefits of $38 billion (or net benefits of $18 billion). While greenhouse gas emission reductions provide a meaningful share of the cumulative benefits over the full planning period, significant benefits are also associated

with health improvements. Health improvements include estimated reduction in premature mortality and avoided lost work days, emergency room visits, non-fatal heart attacks and more. For more information on these health benefits see the Public Health Impacts Analysis chapter of this Plan.

Figure 55. 2030 annual net costs and benefits by scenario (billion 2024$)

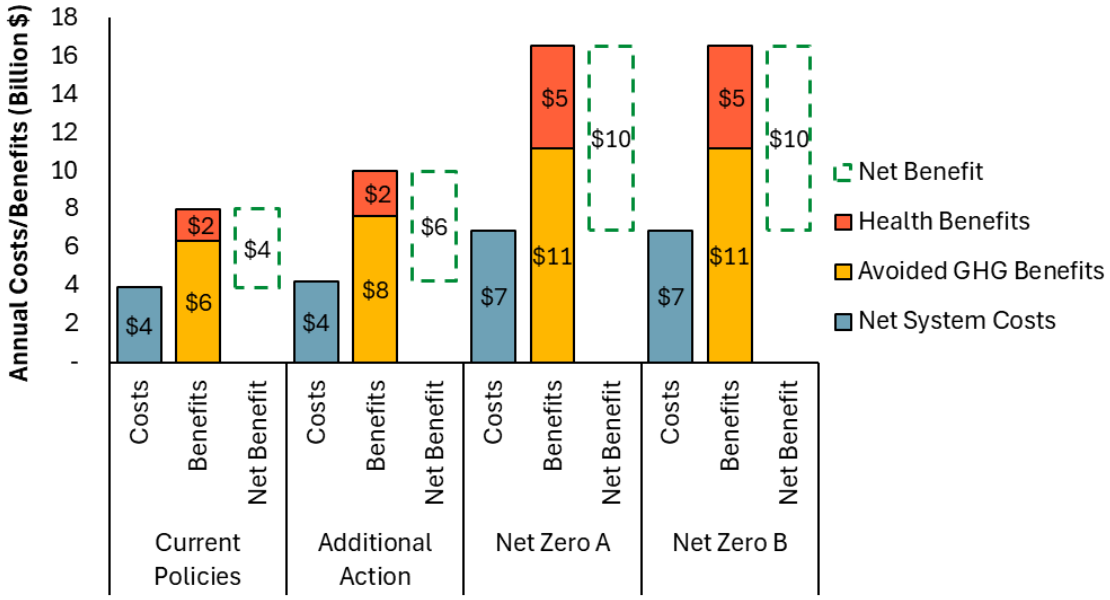
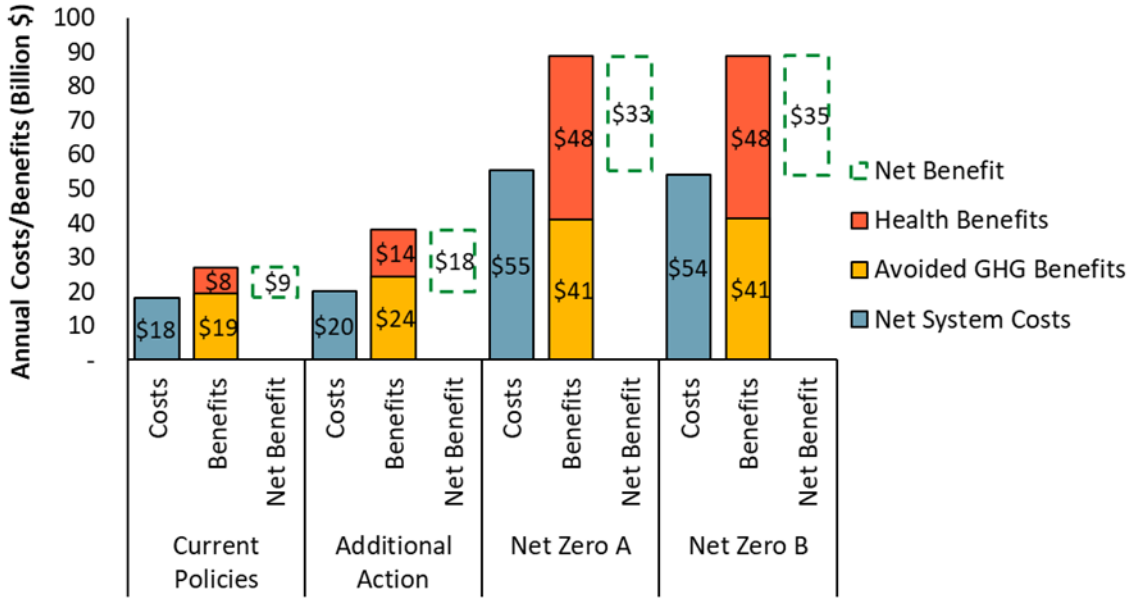


Figure 56. 2040 annual net costs and benefits by scenario (billion 2024$)



6.6. Ability of Energy Systems to Meet Forecast Energy Demand

Across electricity, natural gas, petroleum, and alternative fuels, medium- to long-term demand forecasts are uncertain. Future demand is highly dependent on factors such as economic trends, policy shifts, technology adoption rates, and consumer behavior. To ensure that the state's energy systems are able to reliably meet demand at reasonable cost, New York State policy makers, system operators, and stakeholders will pursue plans and strategies that remain adaptable across a broad set of potential futures.

New York's electricity demand is forecast to grow significantly through 2040 – a marked change from the relatively flat electricity usage over the past decade. New York State is prepared to meet this growing electricity demand while maintaining system reliability and making progress toward a zero-emission grid. New York State likewise will support the reliable provision of natural gas and petroleum fuels, as all major fuels used in the state today are forecast to provide meaningful volumes of energy throughout the planning period.

The core planning scenario developed to inform this Plan projects a 24 percent increase in annual electricity demand and a 21 percent increase in peak demand by 2040 as compared to 2025. This forecast incorporates anticipated new large loads, expanded use of electric vehicles and heat pumps, and energy efficiency upgrades that help manage load growth in buildings. There is uncertainty as to whether the continuous growth in clean energy supply resources will meet growing demand given the federal policy context, broader economic headwinds, and the need for new clean firm technologies to become commercially available. As a result, the State and electricity system operators will continue to pursue careful coordination and planning to adapt as the energy system evolves.

While the State Energy Plan provides statewide and regional forecasts and broad policy direction, multiple ongoing planning processes exist to inform specific decisions such as electricity system investments or whether a given generating unit is needed for system reliability. The NYISO conducts regular reliability planning on both a near-term and long-term basis, including the biennial Reliability Needs Assessment (RNA); if the RNA identifies a reliability need for the bulk system, the NYISO issues competitive solicitations for projects to address it. Importantly, the PSC has initiated changes to the utilities' planning practices in response to clean energy policies and grid modernization needs. For example, the first statewide Coordinated Grid Planning Process (CGPP) is underway.

The scenarios modeled for this Plan suggest declining demand through 2040 for natural gas and petroleum products, though these fuels remain important energy sources. However, notable variability exists across the forecasts that each New York gas utility has developed for natural gas demand in their service area (Figure 49). As directed by the PSC, the gas utilities produced and will regularly update long term plans (LTPs) with gas demand and supply forecasts for multiple scenarios over a 20-year horizon. These LTPs are important to inform gas system investments because they include utility-specific attention to supply sources needed to meet peak day needs during the winter heating months, with consideration of different scenarios that allow for a variety of contingencies to meet energy needs at all times. Electric and gas system planners also need to strengthen coordination measures to ensure fuel adequacy and maintain reliability across both systems.

Appendix

This study models New York's energy system and GHG emissions on an annual basis. Key model outputs include annual energy demand, emissions by fuel, stocks and sales of energy-consuming equipment, and necessary electricity supply infrastructure upgrades. Key inputs include sales forecasts for new technologies (e.g., vehicles, building systems), cost and performance data for supply- and demand-side infrastructure, and fuel price projections.

To perform this analysis, E3 used an integrated suite of modeling tools to analyze the evolution of energy demand, energy supply, and non-energy GHG emissions. A demand-side module calculated direct energy use, associated GHG emissions, and non-combustion emissions and sequestration. This module interacted with models for electricity, low-carbon fuels, and negative emissions technologies. The electricity module used the demand projections to co-optimize investment and operations for the power system, ensuring reliable load service while meeting GHG and renewable energy targets. The low-carbon fuels module assessed the availability of alternative fuels, which the demand-side module could use to reduce emissions by substituting for fossil fuels.

The core analytical tool for energy demand was the New York PATHWAYS model, which projects scenarios to 2050 to align with the Climate Act's targets. The model outputs energy use and GHG emissions for all sectors of the economy, excluding emissions from electricity generation, which were handled by the RESOLVE model. A key feature of PATHWAYS is its characterization of stock rollover, the process of replacing old equipment. By accounting for the long lifetimes of devices like vehicles and heating systems, the model captures the rate of change needed to meet decarbonization goals and highlights the limited window of opportunity to replace fossil-fueled equipment before mid-century. To characterize energy demand, this study used two methods:

1. Stock Rollover Approach: For subsectors with sufficient data, this approach modeled the evolution of infrastructure, energy use, and emissions as new devices are adopted and old ones are retired.

2. Total Energy Approach: For subsectors with less granular data, this approach directly calculated energy consumption based on scenario inputs for energy efficiency, electrification, and fuel switching.

Non-energy sectors were represented by annual emissions by pollutant, informed by parallel modeling efforts which tracked changes in these emissions as driven by policy or infrastructure changes in the scenarios themselves.

1. Buildings

The buildings sector analysis is subdivided into residential and commercial building types, covering energy services such as space conditioning, water heating, lighting, refrigeration, and cooking.

The model calculates building energy demand by first establishing the demand for energy services (e.g., the amount of hot water needed) and then determining the energy demand (e.g., the amount of fuel a

water heater consumes) required to meet that service. Energy demand is calculated by dividing the energy service demand by the efficiency of the device providing the service.

The stock rollover approach tracks the lifetimes and efficiencies of the fleet of devices within each end use device type and calculates the energy demand by summing the energy demand for each constituent end use device. For end uses where the total energy approach was applied, E3 characterized energy demand by fuel type directly based on scenario-specific user inputs characterizing energy efficiency, potential for electrification, and potential for switching from fossil fuel combustion to low-carbon fuel combustion.

The analysis begins with a detailed baseline of the current building stock, segmented by type, vintage, and geography across New York's 11 NYISO load zones for a granular assessment. Because residential space heating is a major component of energy consumption that varies by housing type and location, the analysis uses an enhanced segmentation of households into five categories: single-family detached, single-family attached, 2–4 unit buildings, low- to mid-rise multifamily (1–7 stories), and high-rise multifamily (8+ stories).

To generate the distribution of heating devices and building shells across these housing types and fuel sources, the analysis utilizes National Renewable Energy Laboratories (NREL) ResStock database, with targeted adjustments. For other technologies such as cookstoves and lighting, the analysis leveraged federal data sources such as DOE lighting trends reports, EIA National Energy Modeling System (NEMS), and Residential Energy Consumption Survey (RECS). For commercial buildings, the analysis leveraged the New York State Commercial Baseline Survey and federal data sources including NEMS and the Commercial Building Energy Consumption Survey (CBECS) to characterize the existing commercial building stock and energy consumption.

The model then simulates the evolution of this capital stock over the analysis period using a turnover approach. As existing equipment for end uses like space heating, water heating, cooling, and cooking reaches the end of its useful life, it is retired and replaced with new technologies according to defined scenarios. This same turnover logic is also applied to the building shells. The analysis modeled multiple shell types to account for differences in insulation. The reference shell package represents existing buildings prior to 2005 building codes, while the space heating savings for basic, medium, and deep shell packages are summarized by housing type in the table below. All new construction from 2010 onward is assumed to have energy efficiency savings consistent with a medium shell retrofit, while the policy scenarios from 2028 and beyond assume new construction is consistent with deep shell efficiency savings, in line with advanced building codes.

Table A-1. Shell Retrofit Heating Savings

Shell Type	Home Type	Reduction in heating demand (%)
Basic Shell	Single-Family Attached	14%
	Single-Family Detached	14%
	Single-Family with 2-4 Units	22%
	Multifamily with 5+ units, 1-7 stories	9%
	Multifamily with 5+ units, 8+ stories	9%
Medium Shell	Single-Family Attached	35%
	Single-Family Detached	30%
	Single-Family with 2-4 Units	29%
	Multifamily with 5+ units, 1-7 stories	13%
	Multifamily with 5+ units, 8+ stories	15%
Deep Shell	Single-Family Attached	42%
	Single-Family Detached	43%
	Single-Family with 2-4 Units	33%
	Multifamily with 5+ units, 1-7 stories	50%
	Multifamily with 5+ units, 8+ stories	50%

Future technology performance is a key input to the model. For technologies like electric heat pumps, the analysis assumes that their efficiency, or coefficient of performance (COP), will improve over time due to continued technological advancements. For this analysis, an increase in annual average COP was assumed in line with performance improvement growth rates as seen in the NREL Electrification Future Study Moderate Advancement scenario. By calculating the annual energy consumption for each end use within every building segment and tracking the evolution of equipment stock and efficiency, the model creates an aggregate, bottom-up forecast of total energy demand in the buildings sector through 2050. Costs for building shells and heat pumps were aligned with modeling performed in other State energy analyses (BEEM), while costs for other building technologies were sourced from federal data sources (EIA NEMS).

2. Transportation

The transportation sector analysis is conducted using the PATHWAYS model, which projects energy consumption, costs, and emissions by modeling the evolution of the vehicle and equipment stock over time. The model is divided into distinct sub-models for on-road vehicles and non-road transport modes to capture their unique characteristics.

For the on-road stock subsectors, which include light-duty, medium-duty, and heavy-duty vehicles, the model employs a detailed stock-turnover framework. The analysis begins with a detailed inventory of the current on-road vehicle fleet, disaggregated by vehicle class, size, vintage, and fuel type, leveraging data sources including USDOT Vehicle Inventory and Use Survey, EIA State Energy Data System, and DEC MOVES modeling. The model then projects future vehicle sales and retirements annually, using survival curves to determine when existing vehicles are removed from the stock and replaced with new ones. Total energy consumption is calculated by multiplying the number of vehicles in each category by their projected annual vehicle miles traveled (VMT) and their fuel economy. For this analysis, VMT per vehicle was assumed to hold constant over time, consistent with recent historical experience suggesting economic growth and VMT growth are not causally correlated in New York. Vehicle classes modeled include light-duty autos and trucks, medium and heavy-duty trucks, and buses.

For non-road subsectors such as aviation, rail, and marine transport, a detailed stock-turnover model is not employed. Instead, these "non-stock" subsectors are modeled based on projections of future energy demand. The model accounts for improvements in energy intensity over time and potential fuel switching to alternatives like electricity, hydrogen, or biofuels. By combining the outputs from both the on-road and non-road sub-models, a comprehensive, bottom-up forecast of total energy demand for the entire transportation sector is developed.

3. Industry

Electricity and natural gas use in the starting year are drawn from the NYSERDA statewide Industrial Potential Study performed by DNV, while demand for all other fuels is taken from the EIA SEDS.

The resulting set of modeled subsectors comprises agriculture; primary metals; computer and electronic products; chemicals; construction; food processing; transportation equipment; fabricated metal products; mining and upstream oil and gas; paper; petroleum and coal products; nonmetallic mineral products; and a residual “other” category. An additional large loads category is included to capture new large electricity users, with their projected demand taken directly from NYISO’s annual Gold Book.

4. Electricity

To develop a detailed understanding of future electricity demand, this analysis translates annual energy forecasts into hourly load profiles. This process begins with annual projections for the adoption of new technologies, such as EVs, heat pumps, large loads, and savings from energy efficiency measures. These annual figures are combined with historical hourly usage patterns to create detailed hourly demand profiles. This method captures both the increase in electricity use from new electric technologies and the offsetting savings from efficiency. For the most impactful technologies, namely EVs and electric space heating, a specialized tool called RESHAPE was utilized to generate more granular hourly load profiles by considering factors like local weather patterns, housing characteristics, and driving behavior.

The analysis pairs a least-cost capacity expansion model (RESOLVE) with a resource adequacy model (Renewable Energy Capacity Planning Model, RECAP) to ensure that the selected portfolios maintain system reliability under a wide range of weather conditions. This framework captures the level of temporal detail needed to ensure resource adequacy standards are met under an extensive set of weather conditions, without explicitly modeling all weather conditions within the capacity expansion model. The analytical linkages between the resource adequacy modeling and capacity expansion modeling are described below.

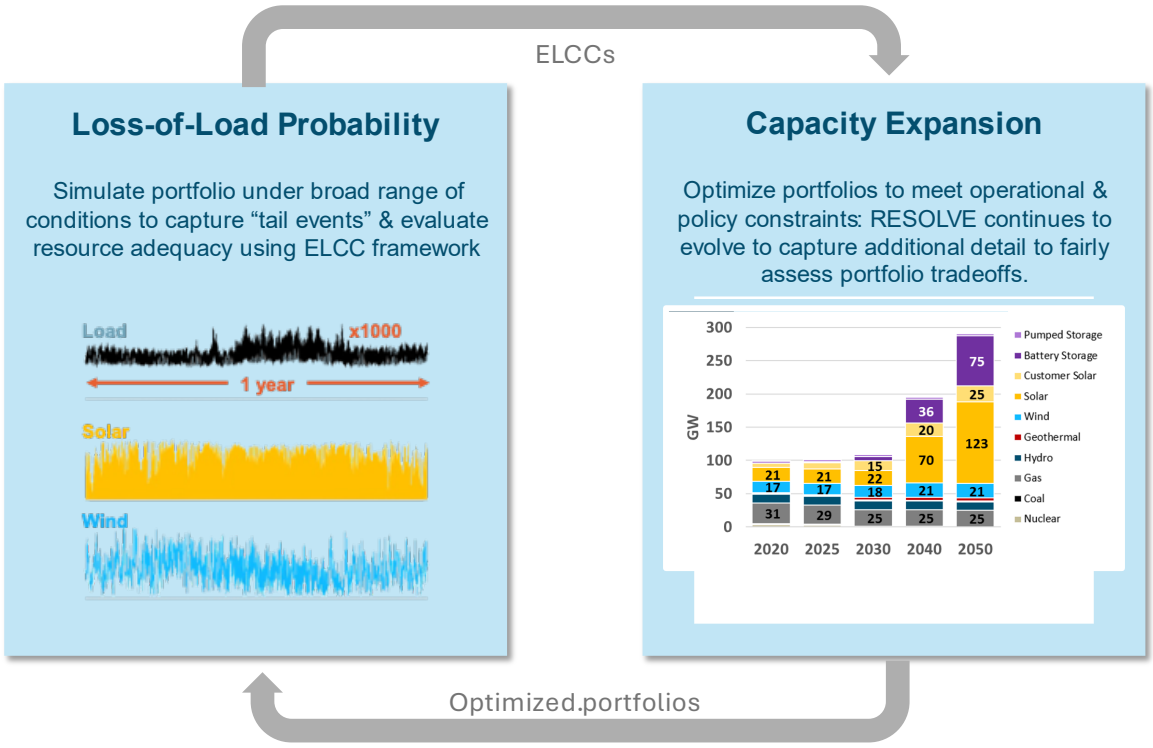
1. **Reliability Modeling (RECAP)**: The first step of the modeling process is conducted in RECAP, which performs Monte Carlo simulations of future loads and renewable outputs under hundreds of years of plausible weather conditions. This modeling is used to identify the reliability contributions of weather-dependent and limited-duration resources, which are measured using an effective load-carrying capability (ELCC) metric. ELCC curves are developed to represent the reliability value of renewable and storage resources as a function of their penetration on the system.

2. **Least-Cost Capacity Expansion (RESOLVE)**: Using annual and hourly load projections from the PATHWAYS analysis coupled with ELCC curves from RECAP, the capacity expansion framework in RESOLVE is then used to identify the least-cost portfolio of investments across New York State to reliably meet projected electricity demands while complying with applicable policy objectives.

3. **Iterative Validation (RECAP)**: The portfolio of generation, storage, and transmission investments selected by RESOLVE is passed back to RECAP to validate that the portfolio meets resource adequacy criteria under the full set of simulated weather conditions. RECAP simulates the reliability performance of the selected portfolio to determine whether the portfolio meets or exceeds the 1-day-in-10-years reliability standard required by the New York State Reliability Council across its thousands of simulations. This step is an iterative step and the portfolio is not finalized until the reliability standard is met.

This integrated process ensures that investment decisions are grounded in a deep, probabilistic understanding of resource reliability, yielding a plan that is both achievable and dependable.

Figure A-1. Interactions between capacity expansion and reliability within electricity modeling



The resource adequacy modeling performed using RECAP leverages a probabilistic Monte Carlo simulation method. RECAP performs hundreds of unique simulations of a full year of grid operations. In each run, it randomly combines historical weather patterns (affecting wind/solar output and electricity demand) with potential unexpected power plant or transmission outages. By analyzing when and how often supply fails to meet demand across these thousands of simulations, RECAP calculates the effective load carrying capacity (ELCC) for variable resources like wind and solar, and for limited-duration resources like batteries.[44] The ELCCs of variable and limited-duration resources serve as inputs into the

capacity expansion modeling. After the least-cost portfolios of resources are identified within the capacity expansion analysis, RECAP is then used to validate that a given portfolio of resources is adequate to meet demand under a comprehensive set of weather conditions, including to ensure the system meets the statewide standard (a loss-of-load expectation of no more than 1 day in 10 years).

The capacity expansion modeling performed in RESOLVE uses optimization methods to identify a least-cost portfolio of generation facilities, energy storage, and/or transmission lines to meet New York's electricity demand. It considers both the upfront capital cost to build new infrastructure and the long-term operational costs (e.g. fuel, operations, and maintenance) of both existing and new facilities. The portfolios must meet the statewide reserve margin as well as local capacity requirements in the Lower Hudson Valley, New York City, and Long Island localities, consistent with the structure of NYISO capacity market requirements. The contributions of the selected portfolio of resources towards resource adequacy constraints are measured using an ELCC framework, leveraging inputs from the RECAP modeling as described above.

Under an ELCC framework, the nameplate capacity of each resource is derated to reflect each resource's availability and limitations during critical reliability periods, as well as its interactive effects with other resources in the portfolio, as reflected in Figure A- 2 and Figure A- 3 below. In all cases, firm resources (gas, nuclear, hydro, and/or hydrogen) provide the majority of system reliability needs, and renewable and storage additions also provide meaningful contributions.

Figure A-2. Reliability Contributions – Additional Action, 2.2 GW Nuclear

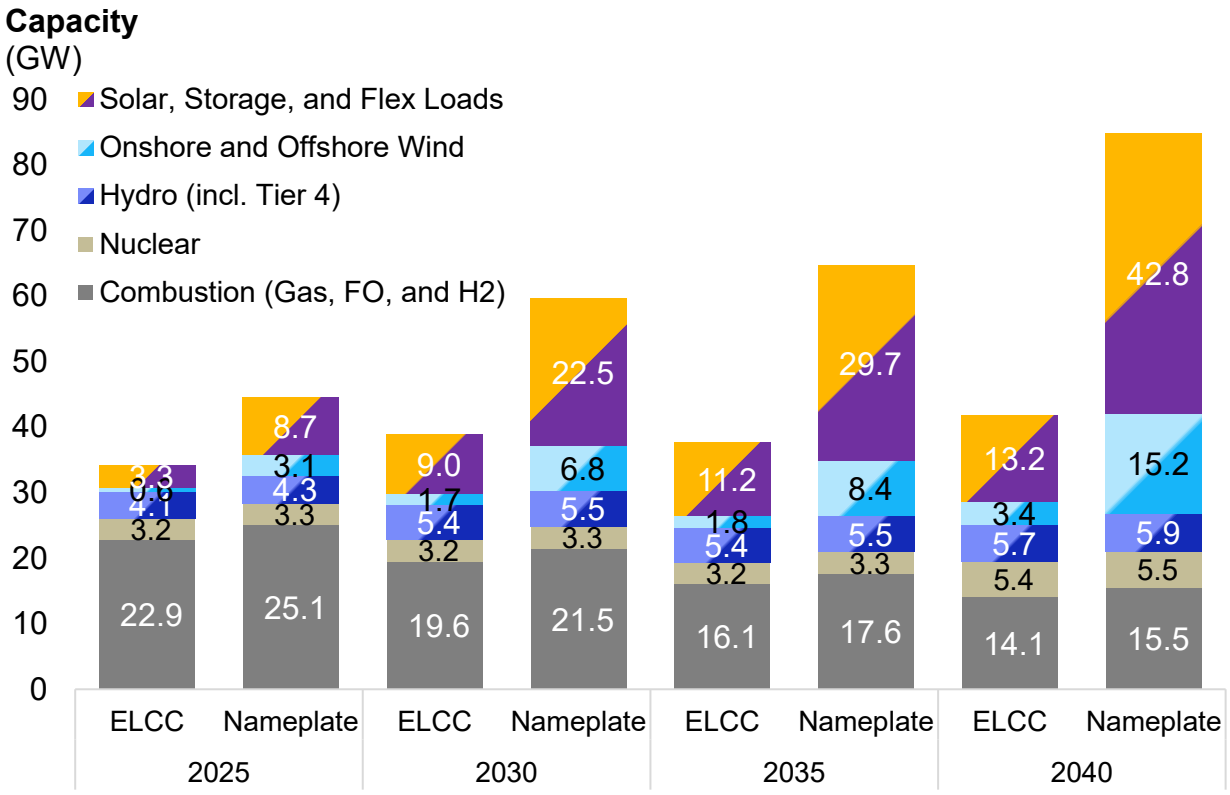
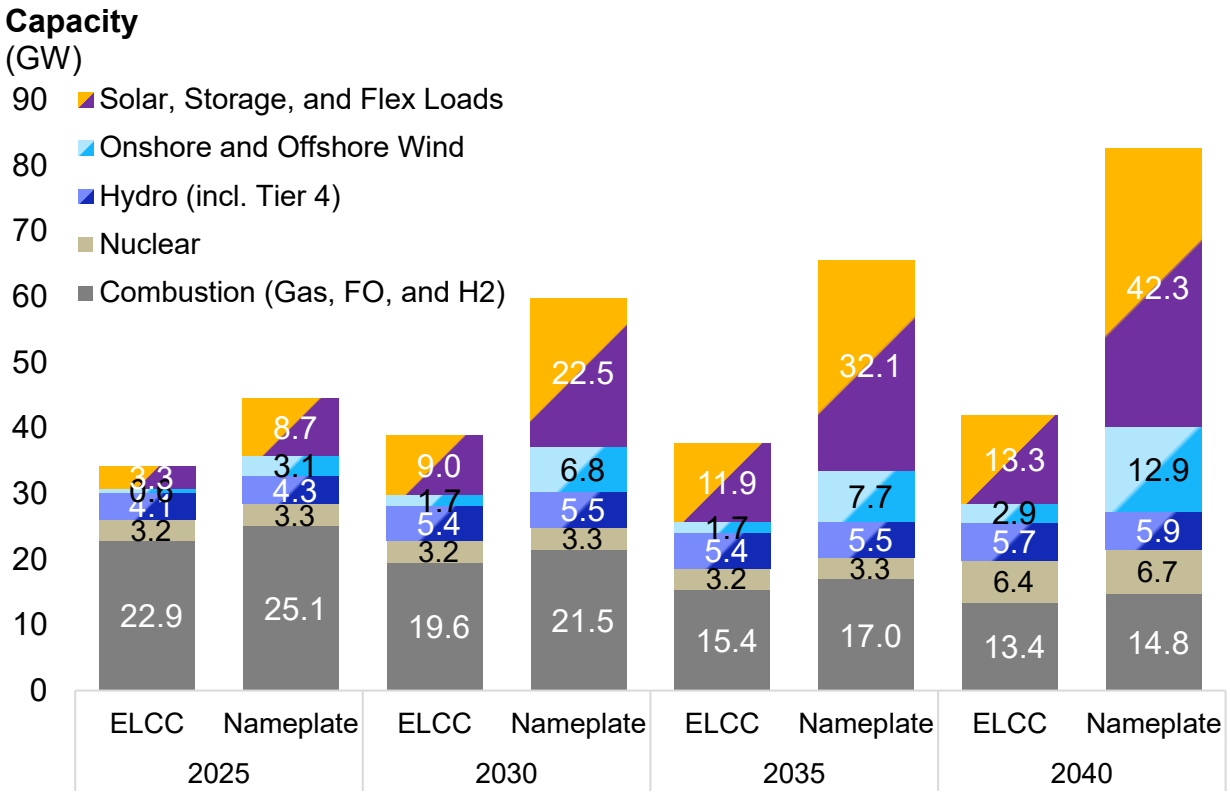
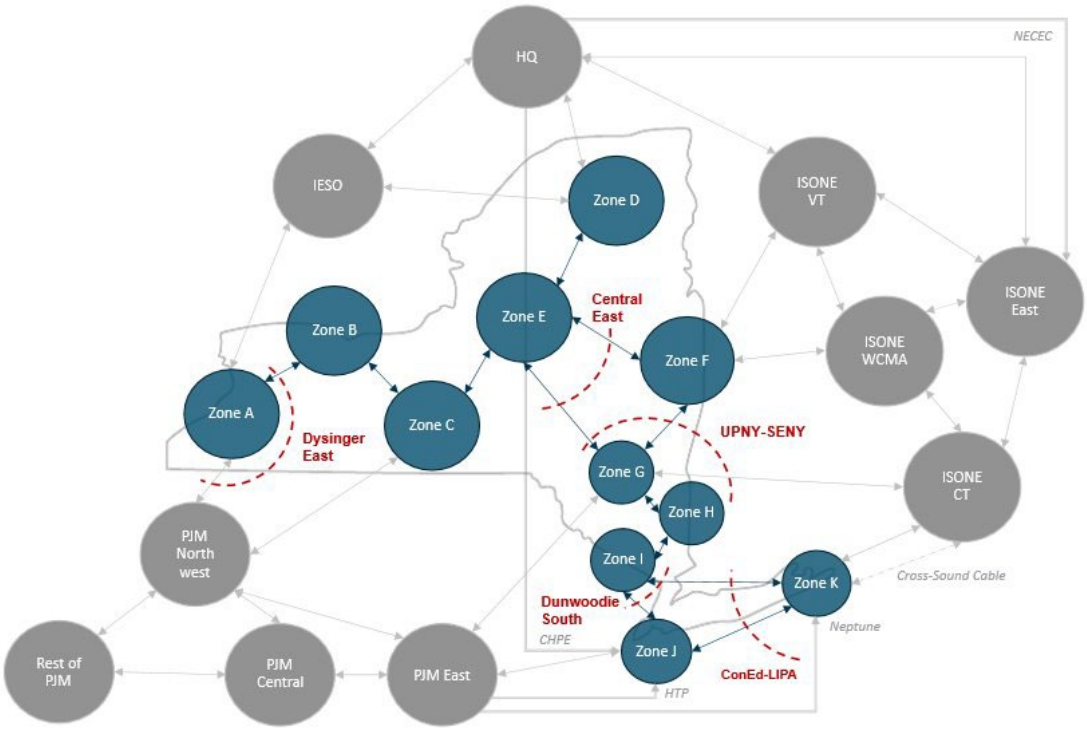


Figure A-3. Reliability Contributions - Additional Action, Additional Nuclear



The model leverages a “pipe-and-bubble” framework to capture the transmission system and account for physical constraints on moving power from where it's generated (e.g., remote wind farms) to where it's consumed (e.g., cities). This framework reflects key transmission constraints both within New York and between New York and neighboring markets. New York is represented as a series of distinct electrical zones or “bubbles” interconnected by transmission “pipes”, aligned with the 11 NYISO load zones (A-K), as shown in Figure A- 4, below. RESOLVE also includes a simplified representation of neighboring power systems—PJM, ISO-New England, Hydro-Quebec, and Ontario—to capture the ability for New York to trade power with those markets.

Figure A-4. Zonal Topology Representation[45]



Combustion units are aggregated into generator blocks in order to simulate their operations while reducing the model size. In each zone, combustion resources are first grouped by their primary fuel—natural gas, residual fuel oil (RFO), or distillate fuel oil (DFO)—and then by technology—combined-cycle gas turbine (CCGT), combustion turbine (CT), or steam turbine (ST). Within every fuel-technology pair, existing units are further stratified into three efficiency tiers defined by heat-rate performance. The representation of combustion resources also reflects units' announced retirement dates and those reaching end-of-life, assuming a 60-year lifetime from commercial-operation date and deferring end-of-life retirements until after 2025. Starting in 2030 upstate and 2035 downstate, the model may choose to retire additional capacity based on their going-forward economics, with the extent of these retirements varying by scenario.

The model chooses from a wide menu of candidate resources to create a portfolio that meets reliability and policy constraints while minimizing total cost. Inputs and assumptions come from a variety of sources including alignment with NYSERDA's Large-Scale Renewables Supply Curve Analysis. Detailed performance and cost data for these resources can be found in Annex 1.

- Land-based and offshore wind
- Imported wind resources with dedicated transmission
- Utility-scale and distributed solar
- Battery storage (between 2–8 hour duration)

- Upgrades to existing hydropower
- New transmission within the state
- CTs and CCGTs (fuel combustion in these units varies with the case, year, and policy definitions)
- New nuclear

In cases subject to the 0x40 emissions constraint, hydrogen consumption in the power sector is supplied in part by in-state electrolyzers. The demand from in-state electrolyzers is dynamically reflected in RESOLVE, and this integration ensures that the electric sector's hydrogen budget is tied to actual consumption patterns. The model takes a comprehensive approach to co-optimizing hydrogen consumption and production in the power sector by considering both the commodity price of hydrogen (aligned with data from the NYSERDA Hydrogen Roadmap) and the marginal cost of energy required for the electrolysis process.

Within the capacity expansion framework, the model simulates the operations of the system over 30 representative days. These days are chosen through rigorous statistical analysis and then weighted such that they span a broad range of historical load and renewable-generation conditions while keeping the computations tractable. The dispatch and operations of the selected portfolios can then also be examined over the entire year, e.g. to better understand the operations of the combustion fleet during challenging periods, especially under achievement of the Zero by 2040 requirements.

5. Low-carbon Fuel Modeling

Mitigation scenarios can incorporate different amounts of advanced biofuels, specifically renewable natural gas (RNG), renewable diesel, and renewable jet fuel, with consumption levels varying significantly between scenarios. Feedstock supply estimates were based on the U.S. Department of Energy's 2023 Billion-Ton Report and the NYSERDA Renewable Natural Gas Potential report, with scenario-specific adjustments to the amount of each feedstock category which is available for use.

The feedstocks considered are classified into three categories:

1. Wastes: Includes animal manure, landfilled or incinerated municipal solid waste (MSW), and byproducts from wastewater treatment. These feedstocks are byproducts of existing economic activities and require no additional land or agronomic inputs.
2. Forest and Agricultural Residues: Consists of logging residues, mill wood waste, and materials from forest management (e.g., thinning and fuel reduction). It also includes agricultural residues like corn stover, cereal straws, and sugarcane bagasse. As byproducts of current forestry and agriculture, these require no new land cultivation.
3. Dedicated Energy Crops: Encompasses cellulosic crops (miscanthus, switchgrass, sorghum) and woody crops (willow, poplar, eucalyptus) grown specifically for energy production. Unlike wastes and residues, these crops require land, which could include marginal agricultural lands or land converted from other uses. These are distinct from conventional biofuel crops like corn (for ethanol) and soybeans (for biodiesel).

An in-house biofuel production model was used to convert biomass feedstocks into one of the three eligible fuels (RNG, renewable diesel, or renewable jet kerosene). The model optimizes this conversion by selecting feedstock-to-fuel pathways that deliver the greatest greenhouse gas emissions mitigation at the lowest cost. Feedstocks from the NYSERDA report, already quantified in energy units of RNG, were not processed through this tool.

Finally, the model generates an average price for each biofuel. This price is determined by the average of the price for feedstock-to-fuel conversion pathways utilized to meet the scenario's demand. These prices serve as key inputs for the broader economy-wide costing analysis and are detailed in Annex 1.

6. Benefit-Cost Approach

This study estimated benefits for two categories: avoided damages from GHG pollution and avoided public health impacts. These benefits were then compared with energy system costs, which include the capital costs of energy-consuming devices and energy supply infrastructure (including electricity generation and electricity imports) in addition to fuel costs. More information on underlying cost assumptions can be found in Annex 1, and more information on the health co-benefits analysis can be found in the Public Health Impacts Analysis chapter.

The value of avoided GHG emissions calculations are based on DEC Value of Carbon guidance, developed under the Climate Act.[46] The DEC Value of Carbon guidance recommends a damages-based approach to valuing avoided GHG emissions, which means that the values are estimates of the monetary impacts on society of GHG pollution. In this study, the total value of avoided GHG emissions is measured in each scenario relative to the No Action Case. The total value of avoided GHG emissions was calculated individually for carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). For other GHGs, avoided emissions were converted to carbon dioxide equivalent (CO_2e) using the AR5-20year GWP values. The avoided GHG emissions time series in each year was multiplied by the annual social cost of GHG based on the DEC Value of Carbon guidance appendix, using the central case estimate for each GHG (2% discount rate for GHG emissions). When calculating NPV of avoided GHG emissions benefits to compare with NPV of costs, NPV calculations apply a discount rate of 5.03% to all annual benefit and costs streams.

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1 The State Energy Planning Board invited New Yorkers to comment on the Draft State Energy Plan from July 23 to October 6. The Board solicited written comments and held three virtual and seven in-person public hearings across the State. The Board received around 15,000 written comments and heard from nearly 450 people at hearings. Over 1,000 people attended hearings overall.

2 Notices of Adoption Rules Amending and Updating the Uniform Code (19 NYCRR Parts 1219 to 1229) and Energy Code (19 NYCRR Part 1240), New York Department of State, October 1, 2025, https://dos.ny.gov/notice-adoption.

3 Cornell Program on Applied Demographics, *New York State Projections, 2022–2050,* distributed by Cornell University, accessed June 2025, https://pad.human.cornell.edu/state_projections/datatools.cfm.

4 New York ISO, *Climate Change Impact Study, Phase 1: Long-Term Load Impact*, (Itron, December 2019), https://www.nyiso.com/documents/20142/10773574/NYISO-Climate-Impact-Study-Phase1-Report.pdf.

[5] *Impacts of Climate Change on the New York Energy System*, (NYSERDA, December 2023), https://www.nyserda.ny.gov/About/Publications/Energy-Analysis-Reports-and-Studies/Greenhouse-Gas-Emissions.

[6] Sales share is defined as the percent (%) of building stock units (commercial square feet or residential housing units) purchasing equipment in a given year that adopt the target technology (e.g., high-efficiency heat pumps as the primary heating system, efficient shell packages).

[7] Cold-climate heat pumps must meet stringent criteria set by the Northeast Energy Efficiency Partnerships, ensuring the unit can operate efficiently and reliably even when outside temperatures drop significantly.

[8] Data available at the U.S. Census website (down as of November 2025 due to federal funding shutdown): https://www.census.gov/quickfacts/fact/table/NY/RHI625224

[9] Note that further rollback of federal methane leakage impacts the upstream out-of-state methane leakage factor, which further increases emissions associated with natural gas consumed in the buildings sector by about 2 MMT, resulting in an overall building related emissions increase of about 4 MMT.

[10] 6 NYCRR Part 218, Emission Standards for Motor Vehicles and Motor Vehicle Engines, New York State Department of Environmental Conservation (DEC), https://extapps.dec.ny.gov/docs/air_pdf/218acc2.pdf

[11] 6 NYCRR Part 218, Emission Standards for Motor Vehicles and Motor Vehicle Engines, DEC, https://dec.ny.gov/sites/default/files/2024-01/218act.pdf

[12] Stephanie Brinley, "California's Advanced Clean Cars II ZEV Rules Under Fire," S&P Global Mobility, May 22, 2025, https://www.spglobal.com/automotive-insights/en/blogs/2025/05/california-advanced-clean-cars-zev-rules#:~:text=Including%20California%2C%2012%20states%20plus,the%20first%20quarter%20of%202025.

[13] "California Will Not Waver in Defending Itself from Federal Overreach: Attorney General Bonta Sues Trump Administration for Attack on California's Clean Vehicles Program," (Press Release, Attorney General Rob Bonta, June 12, 2025), https://oag.ca.gov/news/press-releases/california-will-not-waver-defending-itself-federal-overreach-attorney-general#:~:text=The%20lawsuit%20asks%20the%20court%20to:%20*,*%20Rhode%20Island%20*%20Vermont%20*%20Washington

[14] *2025 Load and Capacity Data (Gold Book)*, (The New York Independent System Operator, Inc. [NYISO], April 2025), https://www.nyiso.com/documents/20142/2226333/2025-Gold-Book-Public.pdf/088438e1-02f1-5316-211b-dbca17c01b4b

[15] *Annual Energy Outlook*, (U.S. Energy Information Administration [EIA], April 15, 2025), https://www.eia.gov/outlooks/aeo/

[16] New York State Profile and Energy Estimates, *State Energy Data System (SEDS): 1960–2023 (complete)*, U.S. EIA, June 27, 2025, http://eia.gov/state/seds/seds-data-complete.php?sid=NY

[17] These flexibility penetrations are in line with the ranges seen in the Grid of the Future study.

[18] Supply curve available on the NYSERDA website: https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Publications/Energy-Analysis/NYSERDA-LSR-Supply-Curve-Results-Table-2025.xlsx.

[19] In reality, new generation needs could be even greater than reported here, as it is assumed that nuclear plants retire at license expiration. In reality, given that this scenario excludes the benefits of the ZEC program, these units may in fact retire much sooner and thus need earlier replacement capacity not represented here

[20] "Governor Hochul Directs New York Power Authority to Develop a Zero-Emission Advanced Nuclear Energy Technology Power Plant," (Press Release, Governor Kathy Hochul, June 23, 2025), https://www.governor.ny.gov/news/governor-hochul-directs-new-york-power-authority-develop-zero-emission-advanced-nuclear-energy.

[21] Across scenarios, deployment of solar and battery energy storage includes both distributed and utility-scale projects.

[22] The color of hydrogen refers to its production method. Green hydrogen is produced through electrolysis powered by renewable energy, making it a zero-carbon fuel.

[23] New York State Department of Public Service (DPS), NYSERDA, The Brattle Group, Pterra Consulting, *New York Power Grid Study*, (New York State Public Service Commission [PSC], January 19, 2021),

https://www.nyserda.ny.gov/About/Publications/Energy-Analysis-Reports-and-Studies/Electric-Power-Transmission-and-Distribution-Reports/Electric-Power-Transmission-and-Distribution-Reports---Archive/New-York-Power-Grid-Study.

[24] GE Vernova, *Grid Performance Gaps Study*, April 2025, https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Publications/Research/Electic-Power-Delivery/25-23-Grid-Performance-Gaps-Study.pdf.

[25] Brattle, Pterra Consulting, DPS, and NYSERDA, *New York Power Grid Study*, January 2021, https://www.nyserda.ny.gov/About/Publications/Energy-Analysis-Reports-and-Studies/Electric-Power-Transmission-and-Distribution-Reports/Electric-Power-Transmission-and-Distribution-Reports---Archive/New-York-Power-Grid-Study.

[26] GE Vernova, *Grid Performance Gaps Study*, April 2025, https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Publications/Research/Electic-Power-Delivery/25-23-Grid-Performance-Gaps-Study.pdf.

[27] The 2025 annual load-weighted average LBMP is averaged over January through November 2025, the data available at time of publishing.

[28] Energy Market & Operational Data, NYISO, https://www.nyiso.com/energy-market-operational-data.

[29] *Integrated Real-Time Actual Load Data,* NYISO, https://www.nyiso.com/load-data.

[30] RESOLVE's operational simulation module optimizes electric grid services for all hours of the year under a simplified set of operational constraints and generator aggregation. In RESOLVE's operational simulation module, unit commitment variables are represented as continuous variables rather than integer variables. For more information, refer to the Integration Analysis Technical Supplement to the New York State Climate Action Council Scoping Plan, Appendix G, published December 2022.

[31] *New York Solar Study: An Analysis of the Benefits and Costs of Increasing Generation from Photovoltaic Devices in New York*, (NYSERDA, January 2012), https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Publications/Energy-Analysis/NY-Solar-Study-Report.pdf.

[32] NYSERDA and Department of Public Service petition Regarding Agreements for Procurement of Tier 4 Renewable Energy Certificates in the Proceeding on Motion of the Commission to Implement a Large-Scale Renewable Program and a Clean Energy Standard, Case 15-E-0302. November 30, 2021.

[33] Assuming a long-term inflation rate of 2.3% according to the 2023 LSR Supply Curve. *LSR Supply Curve Output Data,* distributed by NYSERDA, December 9, 2023, https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Programs/LSR/NYSERDA-LSR-Supply-Curve-Results-Table-2023-12-09.xlsx

[34] Between January 2022 and July 2025, LBMP transactions made up 60-70% of total NYISO energy market transactions. Internal bilaterals, import bilaterals, export bilaterals, and wheel through transactions represent the remaining 30-40% of transactions. For this analysis, we assume that the historical range of LBMP energy market transactions continues through 2035.

[35] Rana Mukerji, *Market Operations Report*, (NYISO, January 17, 2024).

[36] Shaun Johnson, *Market Operations Report*, (NYISO, August 13, 2025).

[37] Climate Act programs include the following: Clean Energy Fund, RECs (Tier 1, Tier 3, Tier 4), South Fork, ORECs, VDER RECs, Residential and Retail Energy Storage, the Bulk Storage Program, H Value, Utility EE, NYSERDA EE, IEDR (Phase 1 & 2), EV Make Ready, and Transmission (Propel, Smart Path, Phase 2 AOC). In 2029, costs to support all Climate Act programs amount to $4.2 billion in 2024 real dollars.

[38] *New York State Department of Public Service Second CLCPA Informational Report on Overall Implementation of the Climate Leadership and Community Protection Act, with Corrections*, (DPS, September 23, 2025).

[39] Guidehouse, *Hydrofluorocarbon Emissions Inventory and Mitigation Potential in New York State*, (NYSERDA, June 2021, https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Publications/Energy-Analysis/21-28-HFC-Emissions-Inventory-and-Mitigation-Potential-in-New-York-State.pdf.

[40] *2025 Statewide GHG Emissions Report*. (DEC, accessed December 2025) https://dec.ny.gov/environmental-protection/climate-change/greenhouse-gas-emissions-report.

[41] For additional detail and example practice, see: https://www.ipcc.ch/report/ar6/wg3/ and https://www.ipcc.ch/2019/05/13/ipcc-2019-refinement/.

[42] The benefit cost analysis for Current Policies and Additional Action scenarios leverage power sector costs from the 2.2 GW Nuclear variant which is expected to be a conservative assumption.

[43] *Establishing a Value of Carbon*: *Guidelines for Use by State Agencies*, (New York State DEC, April 2025), https://dec.ny.gov/sites/default/files/2025-04/vocguide2025.pdf.

[44] ELCC represents the capacity contribution as an equivalent amount of "perfect" capacity (capacity that is always available); for example, if solar has an ELCC of 50%, then 100 MW of solar provides the same reliability contributions as 50 MW of perfect capacity. The ELCC of a resource is not fixed; it changes based on a number of factors including the penetration of that resource on the system, its interactive effects with other resources, and the timing of system reliability needs (e.g. as loads change over time).

[45] *2024 Reliability Needs Assessment (RNA)*, (NYISO, November 19, 2024), https://www.nyiso.com/documents/20142/2248793/2024-RNA-Report.pdf; Energy Exemplar, https://www.energyexemplar.com/; *Clean Energy and Climate Plan for* 2050, (Massachusetts Executive Office of Energy and Environmental Affairs, December 2022), https://www.mass.gov/doc/2050-clean-energy-and-climate-plan/download.

[46] DEC, *Establishing a Value of Carbon*.

New York State Energy Plan

VOLUME II | Plan Analyses and Impacts

Energy Affordability Impacts Analysis

17

2025 NEW YORK STATE ENERGY PLAN

Key Terms Used in This Chapter

FOR THE COMPLETE GLOSSARY ➜

Household and Transportation Energy Expenditures: The total amount households spend on both household energy (such as electricity and heating fuel) and transportation energy (such as gasoline and electricity). This metric is a useful indicator of a household's overall energy spending.

Energy Insecurity: The inability to meet basic energy needs. It may mean having to choose between energy and other expenses, keeping your house at an unsafe or unhealthy temperature to save expenses, or being unable to pay energy bills.

Energy Burden: Percentage of gross income that a household spends on energy. It is calculated by dividing the average housing energy cost by the average annual household income. When a household is described as energy burdened, that generally means that it spends more than six percent of household income on energy.[1]

Transportation Energy Burden: Percentage of gross income that a household spends on energy for transportation. It is calculated by dividing the average transportation energy cost by the average annual household income.

Disadvantaged Communities (DACs): The Climate Act defines disadvantaged communities as communities that bear burdens of negative public health effects, environmental pollution, impacts of climate change, and possess certain socioeconomic criteria, or comprise of high-concentrations of low- and moderate-income households. DACs are identified using criteria as established by the Climate Justice Working Group.[2] On March 27, 2023, the CJWG voted to approve the DAC criteria.[3] Indigenous Nations and Indigenous Peoples are included in the DAC criteria as individual members of census tracts as counted by the U.S. Census Bureau in counts of American Indian and Alaska Native population (a selected indicator) and as citizens

1 U.S. Department of Energy, Low-Income Energy Affordability Data (LEAD) Tool, https://www.energy.gov/scep/low-income-energy-affordability-data-lead-tool.
2 New York State, Environmental Conservation Law § 75-0101(5) (2019).
3 New York State Climate Act, Disadvantaged Communities Criteria, https://climate.ny.gov/Resources/Disadvantaged-Communities-Criteria.

of sovereign Nations or residents of Nation-owned territory if the Nation-owned territory (either sovereign territory or owned) exceeds five percent of the area of a census tract.

Household Income Strata:

- **Low-income** includes households with incomes at or below 60 percent of State Median Income.
- **Moderate-income** includes households with incomes above 60 percent but below 80 percent of State Median income or Area Median Income, whichever is higher.
- **Average income** uses the average income of a household in an analysis region to represent households with incomes that fall above the low- or moderate-income range.

Key Findings → Energy Affordability Impacts Analysis

Affordable, clean energy is foundational to ensuring that New Yorkers have access to safe, healthy homes and neighborhoods, clean air, and economic opportunity, and delivering it will require upgrades across the energy system. This analysis provides context on energy affordability challenges across New York State and then explores the cost impacts of three household energy upgrade journeys across a range of household profiles from 2026 to 2031. These journeys illustrate potential representative technology adoption pathways: the replacement of conventional equipment, moderate efficient electrification, and high efficient electrification.

- **Across the U.S. and New York, households face affordability challenges. There are many drivers of household affordability, and expenditures in areas such as housing, transportation, food, and healthcare are significant.** Energy is an important affordability challenge for many households, as a component of housing and transportation costs. For many low- and moderate-income households, meeting energy needs can impose substantial cost burdens. The accelerated pace of recent bill increases highlights the importance of taking steps to keep energy costs manageable for New York State households. To understand how energy costs impact people, it is important to look comprehensively at both household and transportation energy spending. On average, total energy spending in New York, accounting for household and transportation energy costs, is lower than the national average, as well as the top outmigration states from New York.

- **Low- and moderate-income households are more likely to experience energy affordability challenges.** Across the U.S. and New York, although low- and moderate-income households on average use less energy and spend less on energy than higher-income households, their household energy and transportation energy burdens are still often many times greater. In addition, lower-income and vulnerable populations experience energy insecurity at above average rates. These dynamics further exacerbate disparities in health and quality of life. Existing programs that promote energy efficiency and offer bill assistance play a key role, but more action is needed to make energy services more affordable, in particular for low-income households, vulnerable populations, and disadvantaged communities.

- **Energy-saving measures, such as building envelope efficiency, efficient appliances and equipment, fuel-efficient and electric vehicles, and public transit use, can lower overall household energy costs.** Many households pursuing these measures are likely to see net reductions in operating costs on a real dollar basis due to the combined impacts of a variety of efficiency measures, including efficient electrification, on household and transportation energy spending. However, the actual savings and energy costs will vary depending on the unique circumstances of the household when pursuing energy efficiency and electrification projects. These factors include energy prices, building envelope and insulation, home size and occupancy, type of home (e.g., single-family vs. multi-family), efficiency of existing and new equipment, extent of equipment replacement, usage of equipment, transportation mode, vehicle type, and driving patterns. For some low- and moderate-income households, such as transit-dependent households and those that do not currently pay a heating bill, continued attention will be needed so there are no negative affordability impacts for households pursuing efficient electrification. New York should continue to investigate and develop affordability programming and electric rate designs that enhance low- and moderate-income households' ability to manage electricity costs.

- **Policy and market solutions that focus on lowering upfront costs and other barriers to adoption for a range of energy efficiency measures have the potential to enable households to realize more affordable operating costs.** This can in turn help to alleviate energy insecurity and energy burdens.

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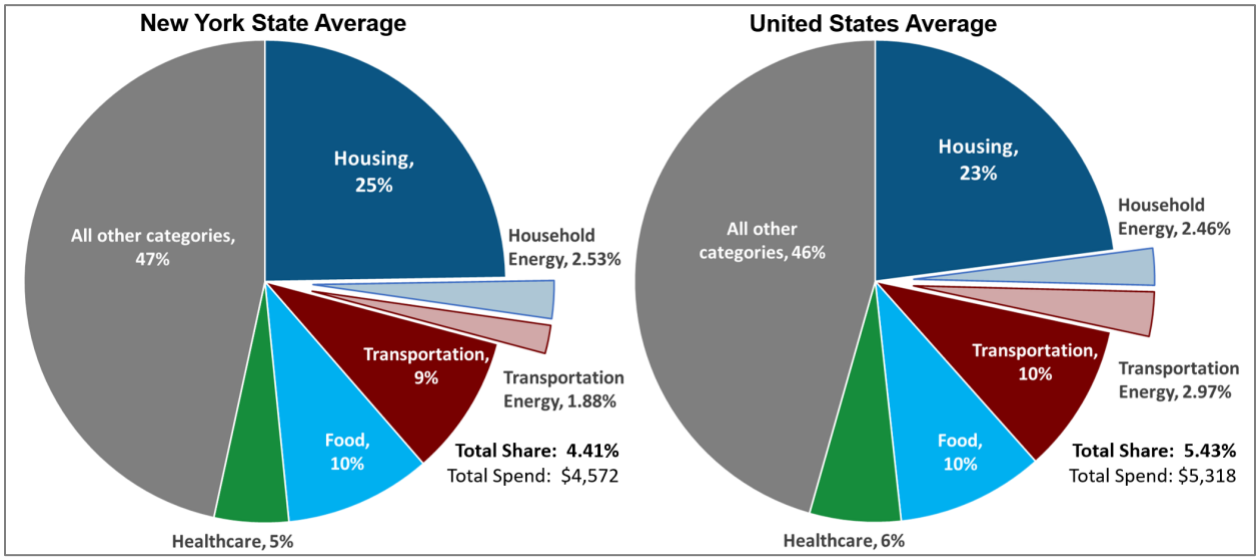
1. Overview

Affordable, clean energy is foundational to ensuring that New Yorkers have access to safe, healthy homes and neighborhoods, clean air, and economic opportunity. Delivering affordable, clean energy will involve necessary upgrades across the energy system to ensure that it is resilient to disruption and that modern, reliable energy services are accessible to households and industries across the state.

Household energy costs are a subset of housing and transportation costs, which in addition to other categories like food and healthcare contribute to overall cost of living. Figure 1 below illustrates household spending by category as a share of income in New York State and in the United States on average.

Figure 1. Household spending as share of income, New York State and United States[1]

Source: U.S. Bureau of Labor Statistics. Consumer Expenditure Surveys. New York and U.S.: 2022 & 2023. Accessed 10/30/25, https://www.bls.gov/cex/tables.htm#geo.



Although there are broad similarities between average household spending in New York State (NYS) and the United States (U.S.) as a whole, there are some small but notable differences. The share spent on housing is slightly higher in New York State while the transportation share is slightly lower as compared to the U.S. Total household energy and transportation energy expenditures are a relatively small share of household income relative to other categories, and energy spending in New York State is slightly lower than the U.S. average.

Within the State, household energy consumption patterns differ by region due to factors such as climate, dwelling size and differences in the built environment, and access to public transit. These characteristics contribute to differences in energy expenditures and energy affordability in different regions of the state.

For many low- and moderate-income households, energy affordability remains a challenge. Two concepts used to assess the nature and extent of energy affordability challenges are **energy insecurity**, or the inability to meet basic energy needs, and **energy burden**, the proportion of household income

that a household spends on energy. Low- and moderate-income (LMI) households and disadvantaged communities (DAC) experience energy insecurity and energy burden at higher-than-average rates. LMI households and DACs are also more likely to face barriers that limit access to affordable clean energy services.

2. State of energy affordability in New York

2.1. Overall affordability

New York State strives to provide affordable clean energy to families across the state. The Climate Act sets NYS on a path to decarbonize its energy system by midcentury, while ensuring that 35–40% of investments flow to DACs. The State has adopted a target of limiting energy burden for low-income households, so that energy costs do not exceed 6% of household income, and affordability is the Governor's top priority in the development of key policies. New York provides support for programs that save energy and save families money, such as efficiency in buildings and vehicle electrification.

Across the U.S. and across New York, households face affordability challenges, driven primarily by expenditures in areas such as housing, transportation, food, and healthcare. Energy affordability can be understood as a focus on the energy cost components of the overall cost of living. Energy is an important affordability challenge for many households, as a component of housing and transportation costs. However, as discussed below, for many low- and moderate-income households, meeting energy needs can impose substantial cost burdens.

Many households have experienced increasing utility bills in recent years, alongside growing inflation across the economy. Recent research has documented and examined price increases and their underlying drivers.[2,3] Although clean energy policy costs are one component of energy prices, aging infrastructure and the impacts of extreme weather have been found to be core drivers. The accelerated pace of recent bill increases highlights the importance of taking steps to keep energy costs manageable for NYS households.

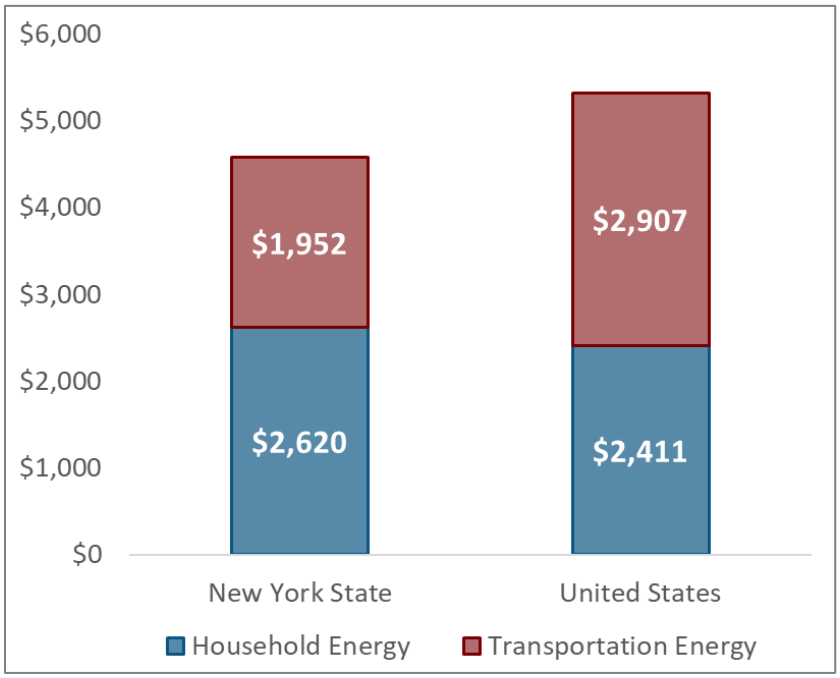
To understand how energy costs impact people, it is important to look holistically at both household energy expenditures and transportation energy expenditures. On average, 2.5 percent of income goes toward household energy spending in both NYS and the U.S., while the share of income devoted to transportation energy spending is 1.9 percent in NYS and 3.0 percent in the U.S. In total, the combined average household and transportation energy expenditures as a percent of income are 4.4 percent in NYS and 5.4 percent in the U.S. Together, household and transportation energy expenditures provide a comprehensive perspective on the ways energy policy impacts household spending to meet energy needs and provides an opportunity to evaluate tradeoffs between different consumer choices households may make.

As illustrated in Figure 2 below, on a combined basis, New York compares favorably to the national average in terms of total energy spending. At $4,572 annually (comprised of $2,620 for household energy and $1,952 for transportation energy), New York households on average spend less annually on energy expenses than the national average of $5,318 (comprised of $2,411 for household energy and

$2,907 for transportation energy), according to the Consumer Expenditure Survey, a longstanding measure of consumer spending across common categories of goods and services.[4]

Figure 2. Average household and transportation energy expenditures, New York State and United States[5]

Source: U.S. Bureau of Labor Statistics. Consumer Expenditure Surveys. New York and U.S.: 2022 & 2023. Accessed 10/30/25, https://www.bls.gov/cex/tables.htm#geo.



Energy prices can be higher in parts of NYS than the U.S. average, but energy consumption is lower, leading to lower total household and transportation energy expenditures than the national average. Lower transportation spending offsets slightly higher household energy spending on a statewide basis in NYS. On average, NYS has the lowest average household Vehicle Miles of Travel (VMT) and transportation energy expenditures as a percentage of income in the nation.[6] Within the State, these dynamics vary: average transportation energy expenditures as a percentage of income downstate is 50 percent lower than upstate, where it is comparable to the national average. This variation reflects the greater access to transit and less reliance on personal vehicles downstate relative to upstate.

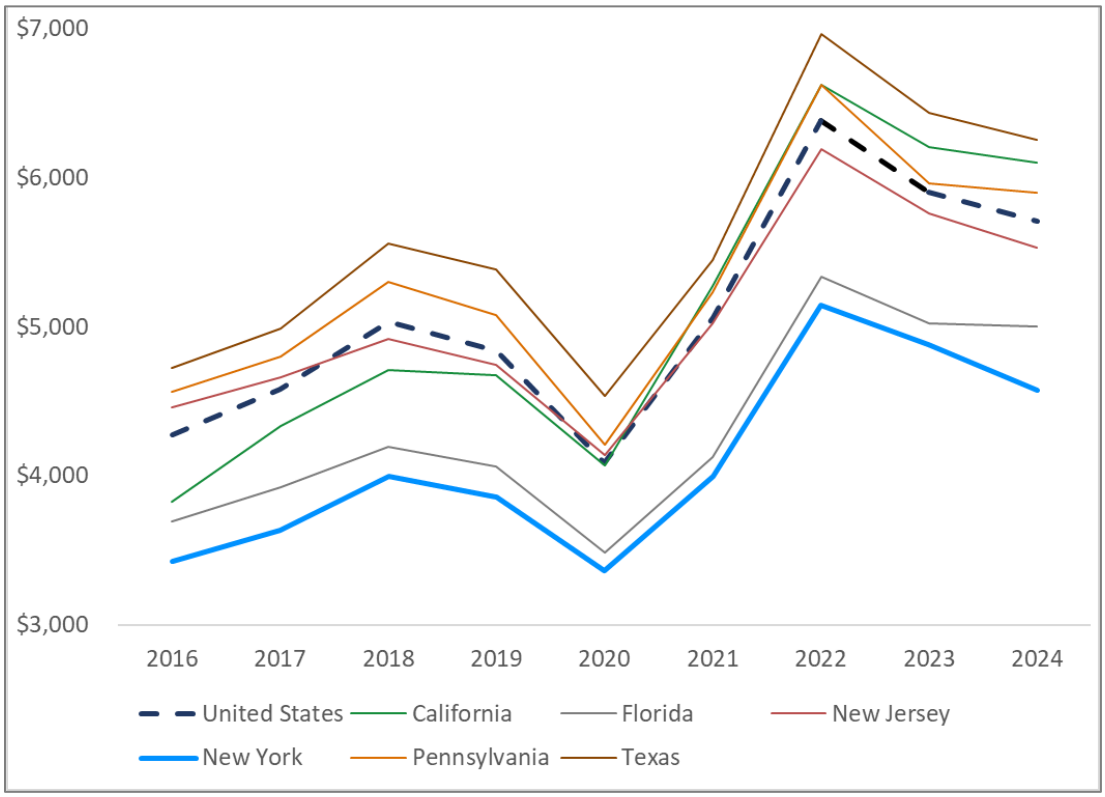
As noted in Figure 3, New York households also spend less on energy compared to states that are the predominant targets of outmigration from the state. That is, households migrating to these other states would expect to spend more on energy after their move. These dynamics are similar to the comparison between average New York and U.S. households above: substantially lower household transportation energy offsets higher household energy spending.

Although these State-level data serve as key indicators on an average and aggregate basis, they are not able to capture regional variation within New York State. Developing an internally consistent energy

affordability dataset that can disaggregate by intra-state region is an important area for further research and analysis.

Figure 3. Total household energy and transportation energy spending per household, US, NYS, and top outmigration states from NYS[7]

Source: U.S. Bureau of Economic Analysis.[8]

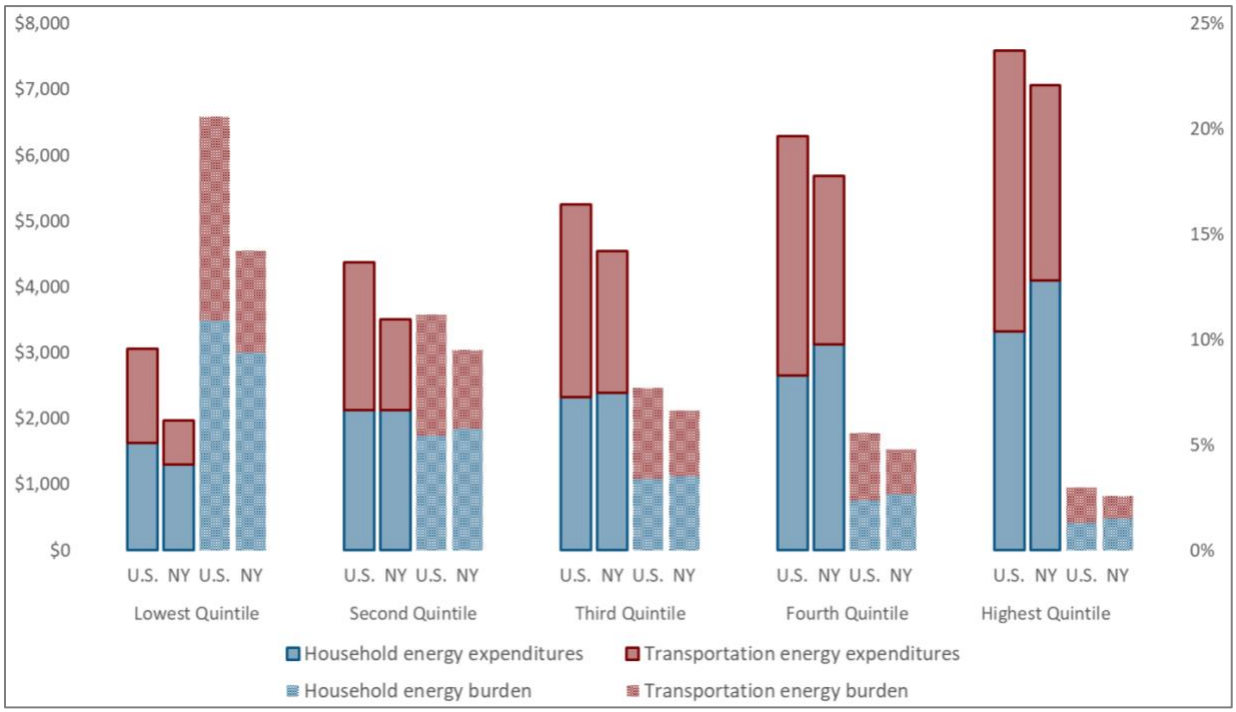


2.2. Energy burden and energy insecurity

Across the U.S. and across New York, low- and moderate-income households are more likely to experience energy affordability challenges. As shown in Figure 4 below, energy expenditures and burdens follow a pattern of lower expenditures but disproportionate burdens at lower incomes. While on average and across all income levels, total household and transportation energy expenditures are lower in NYS than the U.S., the energy affordability needs of all New Yorkers are not always being met. In NYS, energy burdens experienced by households in the lowest income quintile are approximately 10 percent, or four times higher than average, and transportation energy burdens experienced by the lowest income quintile are approximately 6 percent, or three times higher than average. At nearly 16 percent, the total household energy and transportation energy burden experienced by the lowest income households is nearly four times higher than average. Notably, on average, households in the second lowest income quintile experience energy burdens close to six percent.[9] [10]

Figure 4. Energy and transportation expenditures and associated burdens by income quintile, United States and New York State [11]

Source: US Bureau of Labor Statistics.[12]



In addition to energy burden, lower income and more vulnerable households experience energy insecurity—for example, foregoing other expenses to pay for energy, keeping one's home at an unsafe temperature, or getting behind on an energy bill—at above average rates.[13] Indeed, at the end of 2024, nearly 1.4 million NYS households were in arrears with outstanding balances on their utility bills greater than 60 days overdue, representing a total amount owed of nearly $1.9 billion. These dynamics further exacerbate disparities in health and quality of life for vulnerable populations.

The rate of change in energy bills, driven by factors such as recent price trends, fossil fuel price volatility, seasonality, and the rollout of new rates, can strain household budgets and exacerbate affordability challenges.

It is important to note that the energy expenditures and burdens presented above represent average, population-scale data as opposed to individual household experience. For example, in addition to households that pay for all of their utilities and drive daily, this data will necessarily include households who rent, don't pay a heating bill, and primarily use transit instead of driving. In addition, there is some time lag between the current moment and the most recently available data. For these reasons, these metrics are not directly comparable to any one individual household or segment of households, including those household profiles analyzed as part of the outlook in this chapter.

2.3. Mitigating barriers impacting access to affordable clean energy services

A variety of programs are available to advance energy affordability, either through bill assistance, or by advancing efficiency and electrification of buildings and transportation. Existing programs focused on low-income households include the Weatherization Assistance Program, Empower+, Low-Income Home Energy Assistance Program, Energy Affordability Program, and the Energy Affordability Guarantee Pilot. Even more programs provide support for moderate-income households or households in general, such as Inflation Reduction Act rebates and tax credits, as well as a host of NYS-specific programs. NYSERDA maintains a list of programs here (https://www.nyserda.ny.gov/All-Programs) and a set of dashboards that track clean energy programs and investments here (https://www.nyserda.ny.gov/ny/dashboards).

However, low- and moderate-income households experience a range of barriers that inhibit access to affordable clean energy services.[14] These barriers can be linked by common themes: **Physical and Economic Structures and Conditions** (e.g., split incentives,[15] limited access to public transit or electric vehicle charging), **Financial and Knowledge Resources and Capacity** (e.g., lack of time, expertise, access to credit), **Perspectives and Information** (e.g., lack of trust[16]), and **Programmatic Design and Implementation** (e.g., program complexity, awareness gaps).[17] More action is needed to overcome barriers to affordable clean energy. More information on barriers to access and adoption can be found throughout the plan, and in the transportation, buildings, and environmental and climate justice chapters in particular.

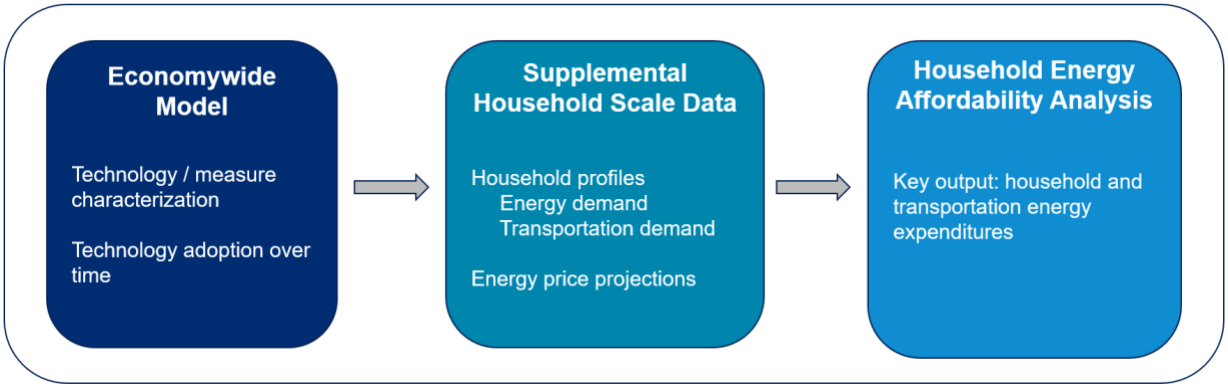
3. Outlook

3.1. Analytic approach

The outlook is informed by a household energy affordability analysis, which assesses household and transportation energy expenditures for a set of household profiles and journeys that are representative of scenarios from the economywide pathways analysis.

As illustrated in Figure 5, The analytic approach starts with technology and measure characterization data and considers technology adoption over time from the economywide model, supplements this with household scale data, such as household energy and transportation energy demand, and energy price projections, and calculates household and transportation energy demand and expenditures.

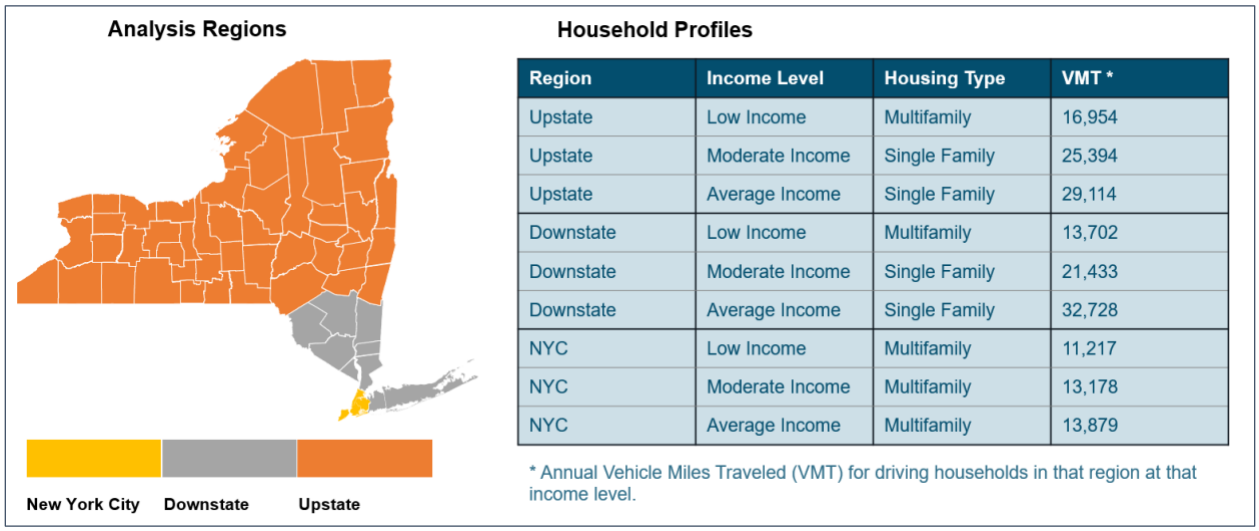
Figure 5. Household energy affordability analysis approach



In this way, the analysis represents household journeys that are consistent with the range of household technology adoption within the economywide scenarios.

The analysis includes household profiles for three income levels, low-, moderate-, and average income, across three regions of the State, Upstate, Downstate, and New York City, for a total of nine profiles. Figure 6 below illustrates the factors that represent and differentiate these household profiles.[18]

Figure 6. Analysis regions and household profiles

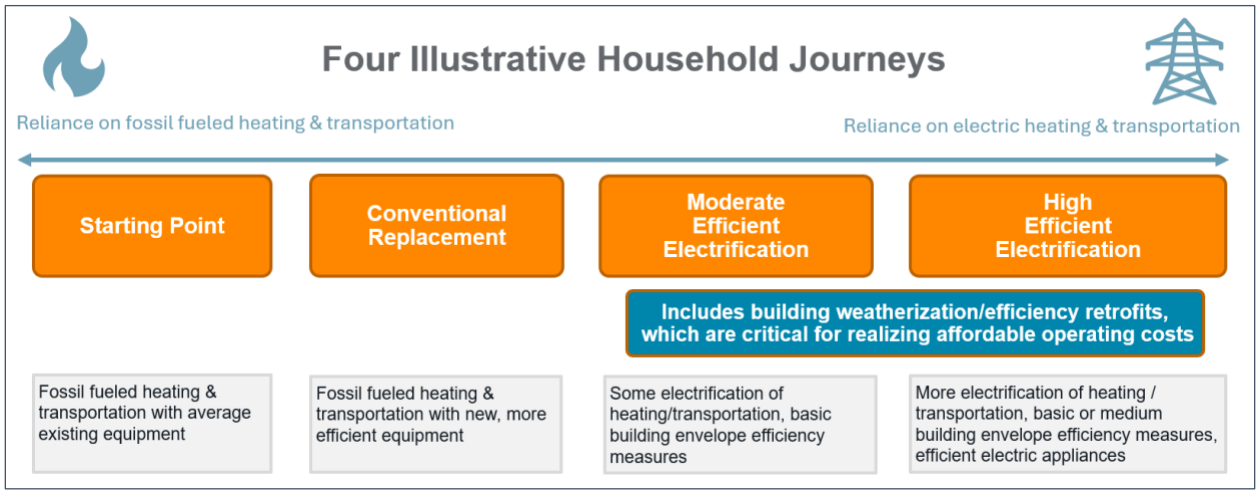


Region	Income Level	Housing Type	VMT *
Upstate	Low Income	Multifamily	16,954
Upstate	Moderate Income	Single Family	25,394
Upstate	Average Income	Single Family	29,114
Downstate	Low Income	Multifamily	13,702
Downstate	Moderate Income	Single Family	21,433
Downstate	Average Income	Single Family	32,728
NYC	Low Income	Multifamily	11,217
NYC	Moderate Income	Multifamily	13,178
NYC	Average Income	Multifamily	13,879

* Annual Vehicle Miles Traveled (VMT) for driving households in that region at that income level.

For each household profile, future household and transportation energy expenditures are calculated for four illustrative journeys involving different technology mixes and fuel types.

Figure 7. Household journeys



As Figure 7 shows, these journeys range from more reliant on fossil fueled heating and transportation to more reliant on efficient electric heating and transportation, with the critical role of building weatherization and efficiency retrofits reflected in each efficient electrification journey.

- Household journeys
    - **Starting Point:** Fossil fueled heating and transportation with average existing equipment
    - **Conventional Replacement:** Fossil fueled heating and transportation with new, more efficient equipment
    - **Moderate Efficient Electrification:** Some electrification of heating and transportation, with basic building envelope efficiency measures
    - **High Efficient Electrification:** More electrification of heating and transportation, with basic or medium building envelope efficiency measures, and efficient electric appliances

The analysis explores the cost impacts of these journeys across household profiles in a starting point year of 2026 and a five-year time step of 2031. These journeys illustrate potential representative technology adoption pathways; continued action to address barriers will be required to enable widespread access to affordable clean energy services. More details about the analysis methodology and assumptions underlying these household profiles and journeys can be found in the appendix and the energy affordability data annex.

3.2. Summary of findings

Energy saving measures, such as weatherization and building envelope efficiency, efficient appliances and equipment, fuel efficient and electric vehicles, and transit use, can lower overall household and transportation energy costs. Households pursuing these measures are likely to see gradually declining levels of energy consumption and operating costs in real dollar terms over time due to the combined impacts of adopting more efficient equipment. The nature and extent of these cost savings differs by profile, with dynamics that vary across regions, building types, and income levels. In addition, it is important to note that the actual savings and energy costs will vary depending on the unique circumstances of the household when pursuing energy efficiency and electrification projects. These factors include building envelope and insulation, home size and occupancy, type of home (e.g., single-family vs. multi-family), efficiency of existing and new equipment, extent of equipment replacement, and usage of equipment.

Table 1 shows changes in both total expenditures, and expenditures disaggregated by household energy and transportation energy, across household profiles and journeys. These include variations that examine heating with oil as opposed to natural gas. Note that additional sensitivities can be found in the appendix to this chapter and detailed results can be found in the energy affordability data annex.

The analysis shows significant opportunities for households to lower transportation energy expenditures. For driving households, both conventional replacement of gasoline vehicles with a more fuel-efficient option and vehicle electrification can lower transportation energy spending relative to the average starting point, and vehicle electrification can further reduce transportation energy spending relative to conventional replacement outside of NYC. In addition, households well-served by public transit, including in NYC, can keep overall energy costs lower than average by minimizing or avoiding transportation energy expenditures.

Household energy expenditures vary across profiles and journeys. Households that heat with a delivered fuel, such as heating oil, can realize substantial savings from efficient electrification. For some households that use natural gas heating, household energy costs could increase with heat pump adoption alone; however, the combined impacts of heat pump adoption, building envelope efficiency, and more efficient lighting and appliances can potentially lower household energy expenditures.

Although all household profiles see savings in combined total household and transportation energy spending relative to the 2026 Starting Point in the Conventional Replacement, Moderate Electrification, and High Electrification journeys, there are some instances where household energy spending increases. These are the upstate Moderate Efficient Electrification journey across income levels and the upstate High Efficient Electrification journey for low-income and average income households, with a slight increase for moderate income households. In these cases, cost savings in transportation energy offset household energy spending increases. The expenditure values from which the changes in Table 1 are derived can be found in Table 2, which also includes disaggregated household and transportation energy expenditures. Detailed results may be found in the energy affordability data annex.

Table 1. Changes in monthly household energy and transportation energy expenditures by profile and journey (real 2025 $)

House-hold Profile	Expenditure Type	2026	2031			
		Starting Point	Starting Point	Conventional Replacement	Moderate Efficient Electrification	High Efficient Electrification
			Change Relative to 2026	Change Relative to 2031 Starting Point		
Upstate, Moderate Income with Oil	Household	*$361*	*$25*	*-$50*	*-$96*	*-$176*
	Transportation	*$283*	*$2*	*-$113*	*-$126*	*-$160*
	Total	***$644***	***$27***	***-$163***	***-$222***	***-$335***
Upstate, Low Income	Household	*$139*	*$10*	*-$25*	*$8*	*$12*
	Transportation	*$189*	*$1*	*-$75*	*-$93*	*-$120*
	Total	***$328***	***$12***	***-$100***	***-$85***	***-$108***
Upstate, Moderate Income	Household	*$206*	*$16*	*-$33*	*$24*	*-$11*
	Transportation	*$283*	*$2*	*-$113*	*-$126*	*-$160*
	Total	***$488***	***$18***	***-$146***	***-$102***	***-$171***
Upstate, Average Income	Household	*$206*	*$16*	*-$33*	*$24*	*$9*
	Transportation	*$324*	*$2*	*-$130*	*-$145*	*-$183*
	Total	***$530***	***$18***	***-$162***	***-$121***	***-$174***
Downstate, Moderate Income with Oil	Household	*$402*	*$26*	*-$56*	*-$77*	*-$150*
	Transportation	*$239*	*$2*	*-$95*	*-$90*	*-$103*
	Total	***$641***	***$28***	***-$152***	***-$168***	***-$253***
Downstate, Low Income	Household	*$235*	*$26*	*-$44*	*-$30*	*-$43*
	Transportation	*$153*	*$1*	*-$61*	*-$55*	*-$78*
	Total	***$387***	***$27***	***-$105***	***-$85***	***-$121***
Downstate, Moderate Income	Household	*$349*	*$39*	*-$59*	*-$47*	*-$109*
	Transportation	*$239*	*$2*	*-$95*	*-$90*	*-$103*
	Total	***$588***	***$40***	***-$155***	***-$137***	***-$213***
Downstate, Average Income	Household	*$349*	*$39*	*-$59*	*-$47*	*-$86*
	Transportation	*$365*	*$3*	*-$146*	*-$138*	*-$158*
	Total	***$714***	***$41***	***-$205***	***-$185***	***-$244***
NYC, Low Income	Household	*$333*	*$34*	*-$61*	*-$50*	*-$67*
	Transportation	*$125*	*$1*	*-$50*	*-$15*	*-$35*
	Total	***$458***	***$35***	***-$111***	***-$65***	***-$102***
NYC, Moderate Income	Household	*$333*	*$34*	*-$61*	*-$50*	*-$67*
	Transportation	*$147*	*$1*	*-$59*	*-$17*	*-$41*
	Total	***$480***	***$35***	***-$120***	***-$67***	***-$108***
NYC, Average Income	Household	*$333*	*$34*	*-$61*	*-$50*	*-$54*
	Transportation	*$155*	*$1*	*-$62*	*-$18*	*-$44*
	Total	***$488***	***$35***	***-$123***	***-$68***	***-$98***

3.3. Results and discussion

3.3.1. Monthly energy demand and expenditures

Figure 8, Figure 9, and Figure 10 below illustrate the monthly energy expenditures in detail for a selection of profiles and journeys.[19] Although the analysis considers nine total household profiles and two additional variations with oil heat,[20] these selected profiles illustrate some key overall dynamics. Each figure displays average monthly expenditures for all relevant fuels and categorizes them as household energy and transportation energy. Detailed tables and figures for all profiles and journeys are available in the energy affordability data annex.

Relative to the Starting Point, energy efficiency drives sequentially greater reductions in energy consumption in the Conventional Replacement, Moderate Efficient Electrification, and High Efficient Electrification journeys. In the Conventional Replacement journey, energy consumption is reduced due to the replacement of existing equipment, such as lighting, heating systems, and vehicles, with new, more efficient versions. In the Moderate Efficient Electrification journey, energy consumption is further reduced by basic building envelope efficiency and including efficient electric equipment replacement to meet a portion of heating and transportation demand. The High Efficient Electrification journey results in the lowest energy consumption of the journeys, driven by a more efficient building envelope retrofit[21] and more fully electrifying heating, transportation, and other end-uses with efficient electric appliances.

Reductions in household and transportation energy expenditures generally follow these reductions in energy consumption relative to the Starting Point. However, there are some exceptions due to differences in energy prices by fuel and region. For example, as shown in Figure 8, household energy costs increasingly decline with the level of efficient electrification for households that heat with oil. However, for households that use natural gas in the starting point, cost dynamics vary by profile and journey. As illustrated in Figure 9, for an upstate household that heats with gas, Conventional Replacement results in lower household energy costs, followed by High Efficient Electrification, which includes a more efficient building envelope retrofit than the Moderate Efficient Electrification profile. This highlights the importance of building envelope efficiency as a key factor in whether conversions to heat pumps from natural gas see operating cost savings. In this household profile, savings from transportation electrification offset an increase in household energy costs in the Moderate Efficient Electrification journey.

Figure 8. Total monthly household energy and transportation energy expenditures, Upstate, Moderate Income, Oil Heat, 2031 (real 2025 $)

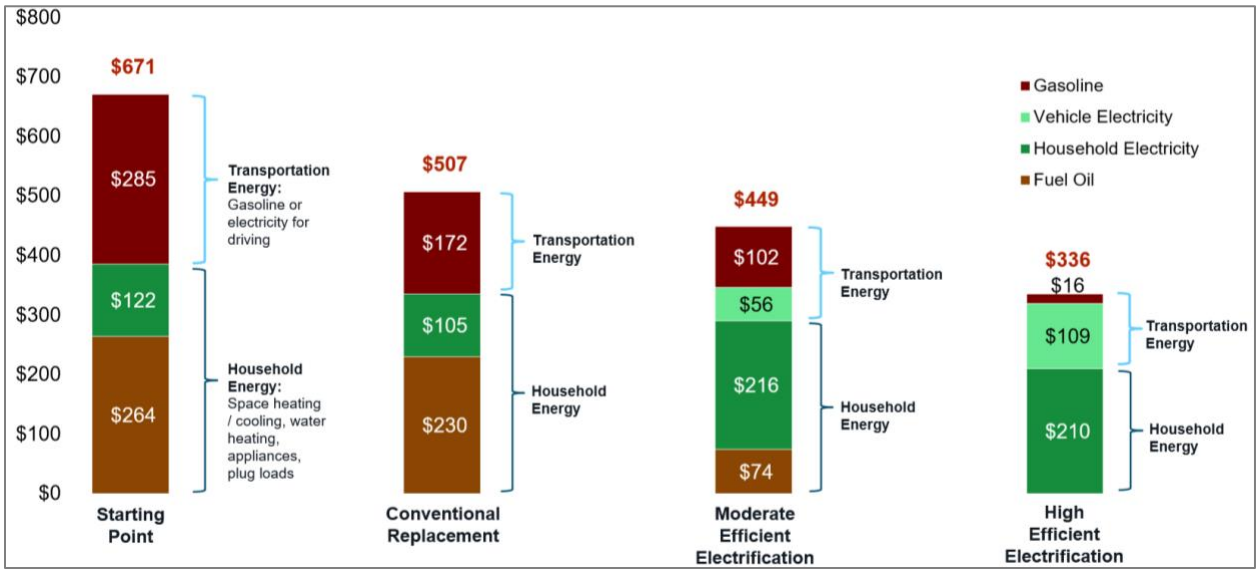
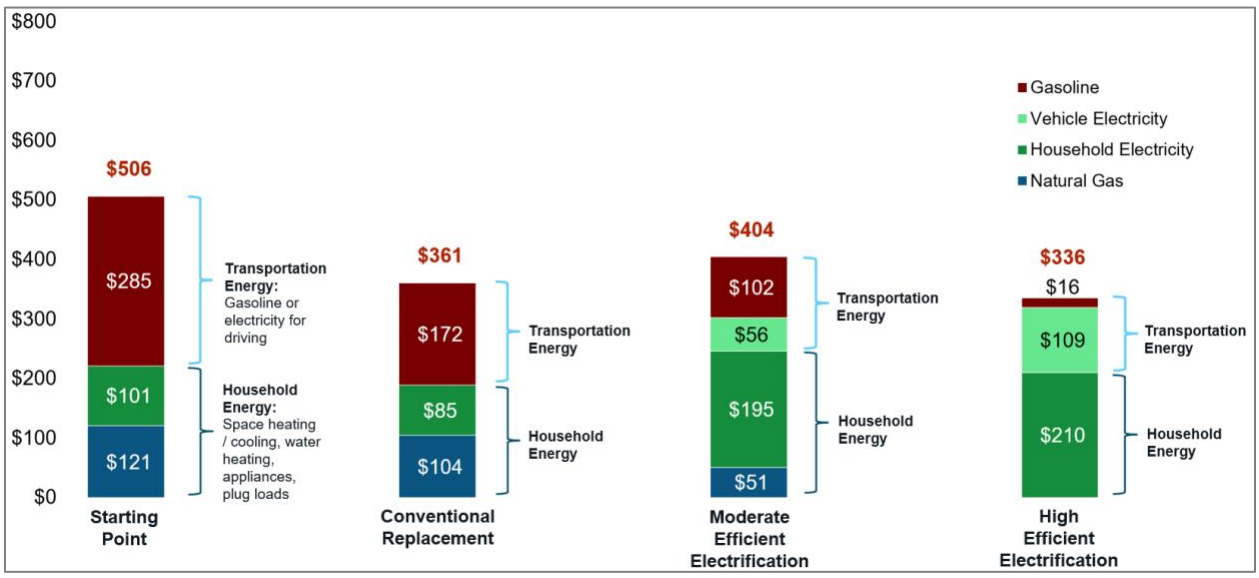


Figure 9. Total monthly household energy and transportation energy expenditures, Upstate, Moderate Income, Natural Gas, 2031 (real 2025 $)



The New York City profile shown in Figure 10 presents a special case for a few reasons. First, although the profiles assume a driving household, a high share of households already manage their transportation energy costs by using public transit. In addition, for driving households, the efficiency of electric vehicles results in lower transportation energy expenditures relative to the Starting Point, even in NYC where electricity prices are higher than in other regions. However, in NYC, the transportation energy expenditures in the Conventional Replacement journey are lower than in either of the efficient electrification journeys, due in part to the impact of federal fuel economy standards on vehicle efficiency

over time. However, even non-driving households in NYC would see reductions in household energy expenditures in all journeys beyond the Starting Point.

Figure 10. Total monthly household energy and transportation energy expenditures, NYC, Moderate Income, Natural Gas, 2031 (real 2025 $)

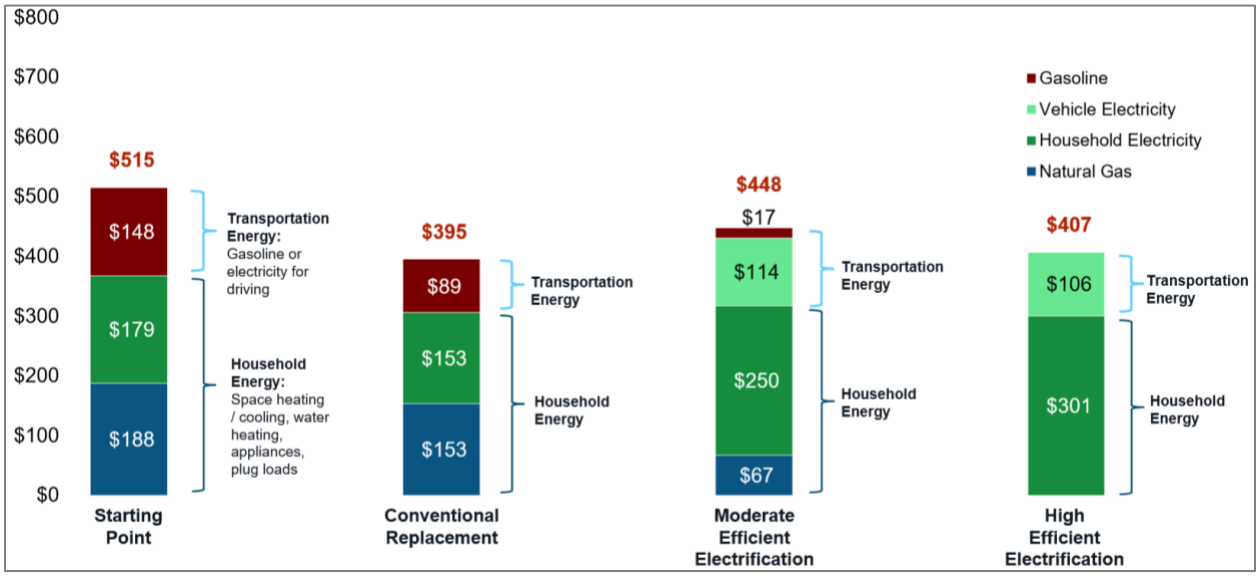


Table 2 shows both the total expenditures and expenditures disaggregated by household energy and transportation energy, across household profiles and journeys. Notably, although upstate low-income households in multifamily buildings that drive see operating cost declines in all journeys relative to the Starting Point, household energy expenditures in the Moderate and High Efficient Electrification journeys increase for this profile, due in part to the relatively lower energy savings levels realized by the medium level building shell package in multifamily relative to single family homes.

Results such as these underscore the need to pay special attention to transit-using households and potentially households that drive less than average to ensure that these households experience overall operating cost reductions alongside efficient electrification. Similarly, households that do not currently pay a heating fuel bill (e.g., renters for whom heating is included in the rent), could see an increase in energy expenditures as more end uses are included in their electricity bill if heating fuel savings are not commensurately reflected in rents. In addition, there are limitations to any analysis of household energy spending due to the wide variation in household characteristics and uncertainty in energy prices over time, in particular prices of one fuel relative to another.

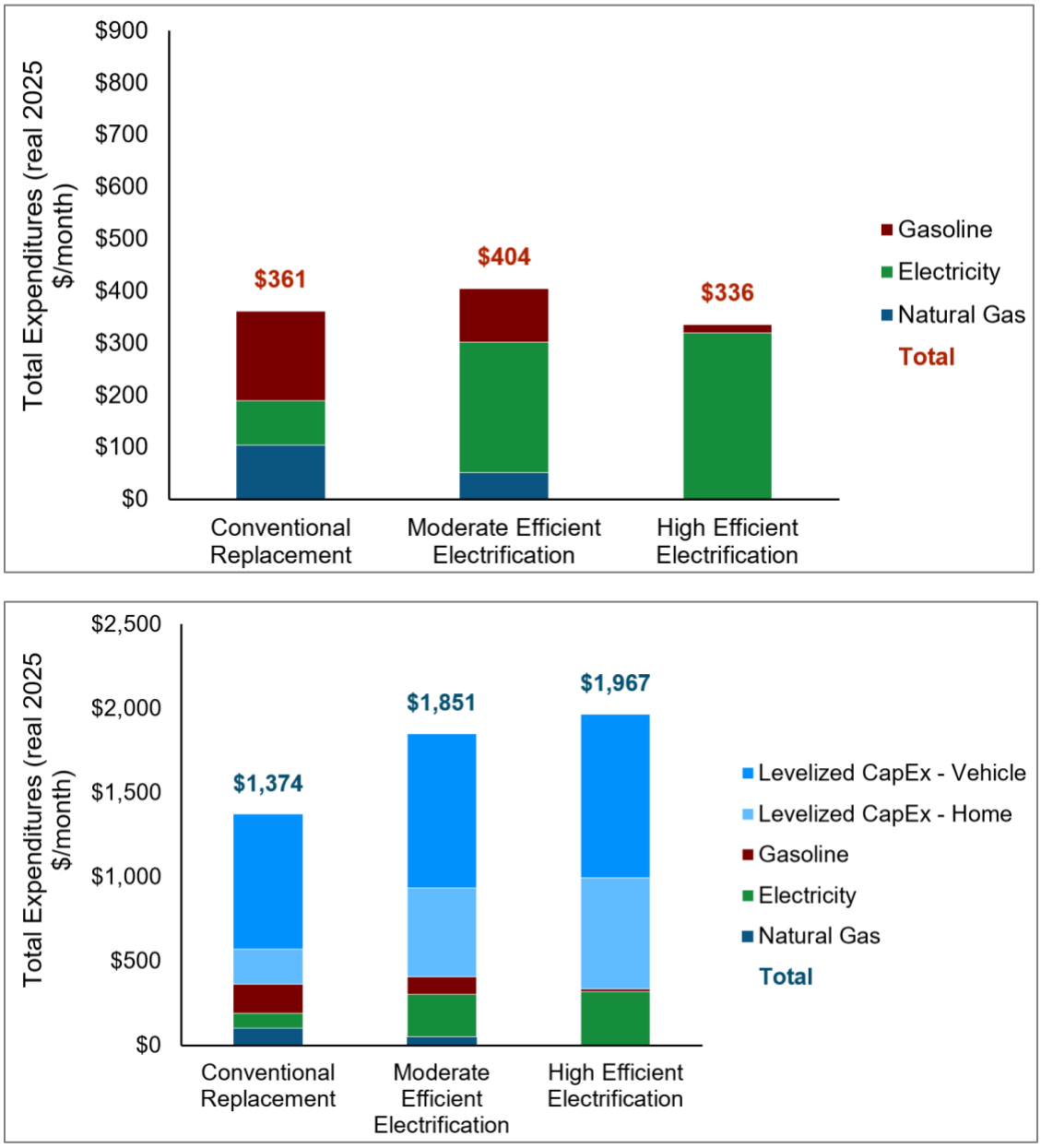
Table 2. Summary of expenditures by type and household profile (real 2025 $)

		2026	2031			
House-hold Profile	**Expenditure Type**	**Starting Point**	**Starting Point**	**Conventional Replacement**	**Moderate Efficient Electrification**	**High Efficient Electrification**
Upstate, Moderate Income with Oil	Household	*$361*	*$386*	*$336*	*$290*	*$210*
	Transportation	*$283*	*$285*	*$172*	*$158*	*$125*
	Total	***$644***	***$671***	***$507***	***$449***	***$336***
Upstate, Low Income	Household	*$139*	*$150*	*$125*	*$157*	*$162*
	Transportation	*$189*	*$190*	*$115*	*$97*	*$70*
	Total	***$328***	***$340***	***$239***	***$254***	***$232***
Upstate, Moderate Income	Household	*$206*	*$222*	*$189*	*$246*	*$210*
	Transportation	*$283*	*$285*	*$172*	*$158*	*$125*
	Total	***$488***	***$506***	***$361***	***$404***	***$336***
Upstate, Average Income	Household	*$206*	*$222*	*$189*	*$246*	*$231*
	Transportation	*$324*	*$327*	*$197*	*$182*	*$144*
	Total	***$530***	***$548***	***$386***	***$428***	***$374***
Downstate, Moderate Income with Oil	Household	*$402*	*$428*	*$372*	*$351*	*$278*
	Transportation	*$239*	*$240*	*$145*	*$150*	*$137*
	Total	***$641***	***$669***	***$517***	***$501***	***$416***
Downstate, Low Income	Household	*$235*	*$260*	*$216*	*$230*	*$217*
	Transportation	*$153*	*$154*	*$93*	*$99*	*$76*
	Total	***$387***	***$414***	***$309***	***$329***	***$293***
Downstate, Moderate Income	Household	*$349*	*$388*	*$329*	*$341*	*$278*
	Transportation	*$239*	*$240*	*$145*	*$150*	*$137*
	Total	***$588***	***$628***	***$474***	***$491***	***$416***
Downstate, Average Income	Household	*$349*	*$388*	*$329*	*$341*	*$301*
	Transportation	*$365*	*$367*	*$221*	*$229*	*$209*
	Total	***$714***	***$755***	***$550***	***$570***	***$511***
NYC, Low Income	Household	*$333*	*$367*	*$306*	*$317*	*$301*
	Transportation	*$125*	*$126*	*$76*	*$111*	*$91*
	Total	***$458***	***$493***	***$382***	***$428***	***$391***
NYC, Moderate Income	Household	*$333*	*$367*	*$306*	*$317*	*$301*
	Transportation	*$147*	*$148*	*$89*	*$131*	*$106*
	Total	***$480***	***$515***	***$395***	***$448***	***$407***
NYC, Average Income	Household	*$333*	*$367*	*$306*	*$317*	*$313*
	Transportation	*$155*	*$156*	*$94*	*$138*	*$112*
	Total	***$488***	***$523***	***$400***	***$455***	***$425***

3.3.2. Outlook including equipment cost

Figure 11 illustrates the impact of a sensitivity analysis that assesses the impact of up-front capital costs on monthly expenditures. Although households pursuing Efficient Electrification may experience lower total operating costs, the analysis shows these households would see a net cost increase of 35-40 percent relative to a Conventional Replacement journey when including the combined up-front costs for vehicles, heating systems, efficient appliances, and building envelope measures.

Figure 11. Total monthly household energy and transportation fuel expenditures, without and with levelized capital expenditures in 2031 for an illustrative upstate, moderate-income household (real 2025 $)



4. Energy affordability conclusions

Across the U.S. and New York, households face affordability challenges. Energy is an important affordability challenge for many households, as a component of housing and transportation costs. However, for many low- and moderate-income households, meeting energy needs can impose substantial cost burdens. The accelerated pace of recent bill increases highlights the importance of taking steps to keep energy costs manageable for New York State households. To understand how energy costs impact people, it is important to look comprehensively at total household and transportation energy spending, which is lower in New York than the national average, as well as lower than the top outmigration states from New York.

Low- and moderate-income households are more likely to experience energy affordability challenges. Across the U.S. and New York, although low- and moderate-income households on average use less energy and spend less on energy than higher income households, their combined energy burdens are still often many times greater. In addition, lower income households and vulnerable populations experience energy insecurity at above average rates. These dynamics further exacerbate disparities in health and quality of life.

Energy saving measures, such as building envelope efficiency, efficient appliances and equipment, fuel efficient and electric vehicles, and transit use, can lower overall household energy costs. Many households pursuing these measures are likely to see net reductions in operating costs due to the combined impacts of a variety of efficiency measures, including efficient electrification, on household and transportation energy spending. However, the actual savings and energy costs will vary depending on the unique circumstances of the household when pursuing energy efficiency and electrification projects. These factors include energy prices, building envelope and insulation, home size and occupancy, type of home (e.g., single-family vs. multi-family), efficiency of existing and new equipment, extent of equipment replacement, usage of equipment, transportation mode, vehicle type, and driving patterns. For some low- and moderate-income households, such as transit -dependent households and those that do not currently pay a heating bill, continued attention will be needed to ensure there are no negative affordability impacts for households pursuing efficient electrification. New York should continue to investigate and develop affordability programming and electric rate designs that enhance low- and moderate-income households' ability to manage electricity costs.

Policy and market solutions that focus on lowering up-front costs and other barriers to adoption for a range of energy efficiency and efficient electrification measures have the potential to enable households to realize more affordable operating costs. This can in turn help to alleviate energy insecurity and energy burdens.

5. Themes and recommended actions

1. **Understanding energy affordability**

    - Although Federal data provides some insights on energy affordability, energy insecurity, and energy burden, these data have limitations in resolution and their continued availability is not guaranteed.

- New interdisciplinary pilot research efforts are underway to develop capacity for New York State to better understand energy affordability.
- However, sustained research to better understand the dynamics of energy affordability and household experiences over time is needed to ensure that New York State has access to timely and relevant information and policy-relevant insights.

2. **Advancing household energy affordability**
    - Weatherizing homes and buildings is a cornerstone of energy affordability and will lead to long term energy burden reduction by decreasing energy consumption and associated costs.
    - Pursuing efficient electrification across household energy and transportation can drive reductions in overall operating costs for households.
    - Continued attention will be needed to ensure there are no negative impacts on total energy costs for households pursuing efficient electrification that don't currently pay heating bills or are transit dependent, and thus would not experience cost savings from vehicle electrification.
    - Continued investigation and development of affordability programming and electric rate designs can enhance low- and moderate-income households' ability to manage electricity costs.
3. **Opportunities to improve access to affordable clean energy services.**
    - Low- and moderate-income households experience a range of barriers that inhibit access to affordable clean energy services. More action is needed to overcome these barriers.
    - Inclusive program planning with representatives of disadvantaged communities will be key to pursuing opportunities to overcome barriers.
    - Interagency coordination will also be key to reducing program complexity and ensuring streamlined access to resources for LMI households and DACs.

Further recommendations for advancing energy affordability via household and transportation energy savings can be found in the Buildings, Transportation, and Environmental and Climate Justice chapters of this Plan.

Appendix

The household energy affordability analysis assesses household and transportation energy expenditures for a set of household profiles and journeys that are representative of scenarios from the economywide pathways analysis. The household profiles include representative housing types, income levels, and geographies across the state of New York, while the household journeys are scenarios with different technology mixes, fuel types, and levels of electrification and efficiency.

This appendix provides results for additional sensitivity analyses and describes the methodology for the analysis. Results for all household profiles are provided in the energy affordability data annex, along with inputs, assumptions, and sources.

6. Additional sensitivity analysis

6.1. Low-income single family household profile

Energy consumption is stratified by income, which this analysis reflects in the base case by modeling a multi-family dwelling as part of the low-income household profile. This sensitivity analysis examines energy affordability for low-income single-family households. Table A1 shows changes in both total expenditures, and expenditures disaggregated by household energy and transportation energy, across household profiles and journeys. These profiles include variations that examine heating with fuel oil as opposed to natural gas.

Although all household profiles see savings in combined total household and transportation energy spending relative to the 2026 Starting Point in the Conventional Replacement, Moderate Efficient Electrification, and High Efficient Electrification journeys, household energy spending increases in the upstate single family natural gas profile in the Moderate Efficient Electrification journey. In this case, cost savings in transportation energy offset household energy spending increases. These results differ slightly from the primary analysis due to the energy savings levels realized by the medium level building shell package in single family relative to multifamily buildings.

The expenditure values from which the percentage changes in Table A1 are derived can be found in Table A2, which also includes disaggregated household and transportation energy expenditures.

Detailed results may be found in the energy affordability data annex.

Table A1. Change in monthly household energy and transportation energy expenditure by profile and journey, low-income single family household sensitivity (real 2025 $)

House-hold Profile	Expenditure Type	2026	2031			
		Starting Point	Starting Point	Conventional Replacement	Moderate Efficient Electrification	High Efficient Electrification
			Change Relative to 2026	Change Relative to 2031 Starting Point		
Upstate, Low Income, Fuel Oil	Household	*$361*	*$25*	*-$50*	*-$96*	*-$176*
	Transportation	*$189*	*$1*	*-$75*	*-$93*	*-$120*
	Total	***$550***	*$26*	*-$126*	*-$189*	*-$296*
Upstate, Low Income, Natural Gas	Household	*$206*	*$16*	*-$33*	*$24*	*-$11*
	Transportation	*$189*	*$1*	*-$75*	*-$93*	*-$120*
	Total	***$394***	*$17*	*-$108*	*-$69*	*-$131*
Downstate, Low Income, Fuel Oil	Household	*$402*	*$26*	*-$56*	*-$77*	*-$150*
	Transportation	*$153*	*$1*	*-$61*	*-$55*	*-$78*
	Total	***$554***	*$28*	*-$117*	*-$132*	*-$227*
Downstate, Low Income, Natural Gas	Household	*$349*	*$39*	*-$59*	*-$47*	*-$109*
	Transportation	*$153*	*$1*	*-$61*	*-$55*	*-$78*
	Total	***$502***	*$40*	*-$120*	*-$101*	*-$187*

Table A2. Summary of expenditure by type and household profile, low-income single family household sensitivity (real 2025 $)

		2026	2031			
House-hold Profile	**Expenditure Type**	**Starting Point**	**Starting Point**	**Conventional Replacement**	**Moderate Efficient Electrification**	**High Efficient Electrification**
Upstate, Low Income, Fuel Oil	Household	*$361*	*$386*	*$336*	*$290*	*$210*
	Transportation	*$189*	*$190*	*$115*	*$97*	*$70*
	Total	***$550***	***$576***	***$450***	***$387***	***$281***
Upstate, Low Income, Natural Gas	Household	*$206*	*$222*	*$189*	*$246*	*$210*
	Transportation	*$189*	*$190*	*$115*	*$97*	*$70*
	Total	***$394***	***$412***	***$304***	***$343***	***$281***
Downstate, Low Income, Fuel Oil	Household	*$402*	*$428*	*$372*	*$351*	*$278*
	Transportation	*$153*	*$154*	*$93*	*$99*	*$76*
	Total	***$554***	***$582***	***$465***	***$450***	***$355***
Downstate, Low Income, Natural Gas	Household	*$349*	*$388*	*$329*	*$341*	*$278*
	Transportation	*$153*	*$154*	*$93*	*$99*	*$76*
	Total	***$502***	***$542***	***$421***	***$440***	***$355***

6.2. Higher Energy Price Growth

This sensitivity analysis examines total household energy and household transportation energy expenditures under higher energy price growth than in the Base Case.

Table A3 shows changes in household spending associated with the suite of household profiles and journeys, and Table A4 shows the expenditure values from which these percentage changes were derived.

The five-year increase in total household spending ranges from 14-19 percent in the Higher Price Growth Sensitivity compared to 3-8 percent in the Base Case when there is no equipment replacement. Conventional, like-for-like, replacement with new, more efficient equipment yields savings across profiles, with higher 2031 savings in a higher price environment. Although the relative prices of fuels determine specific expenditures for efficient electrification journeys, energy spending follows similar dynamics to the base case when compared to the 2031 Starting Point.

- Households using heating oil experience the most significant savings from efficient electrification
- Vehicle electrification offers substantial savings relative to the Starting Point in all regions and greater savings than Conventional Replacement outside of NYC
- Households using natural gas upstate see modest to moderate household operating cost increases, which are offset by cost savings associated with vehicle electrification.

Table A3. Changes in monthly household energy and transportation energy expenditure by profile and journey, Higher Energy Price Growth Sensitivity (real 2025 $)

House-hold Profile	Expenditure Type	2026	2031			
		Starting Point	Starting Point	Conventional Replacement	Moderate Efficient Electrification	High Efficient Electrification
			Change Relative to 2026	Change Relative to 2031 Starting Point		
Upstate, Moderate Income with Oil	Household	*$370*	*$69*	*-$57*	*-$78*	*-$164*
	Transportation	*$283*	*$34*	*-$126*	*-$130*	*-$157*
	Total	***$653***	***$103***	***-$183***	***-$208***	***-$321***
Upstate, Low Income	Household	*$148*	*$36*	*-$31*	*$18*	*$27*
	Transportation	*$189*	*$23*	*-$84*	*-$89*	*-$120*
	Total	***$337***	***$59***	***-$115***	***-$72***	***-$93***
Upstate, Moderate Income	Household	*$217*	*$52*	*-$40*	*$43*	*$5*
	Transportation	*$283*	*$34*	*-$126*	*-$130*	*-$157*
	Total	***$500***	***$87***	***-$166***	***-$87***	***-$152***
Upstate, Average Income	Household	*$217*	*$52*	*-$40*	*$43*	*$31*
	Transportation	*$324*	*$40*	*-$144*	*-$149*	*-$180*
	Total	***$542***	***$92***	***-$184***	***-$106***	***-$148***
Downstate, Moderate Income with Oil	Household	*$409*	*$61*	*-$62*	*-$74*	*-$151*
	Transportation	*$239*	*$29*	*-$106*	*-$99*	*-$111*
	Total	***$648***	***$90***	***-$168***	***-$173***	***-$262***
Downstate, Low Income	Household	*$244*	*$54*	*-$51*	*-$34*	*-$49*
	Transportation	*$153*	*$19*	*-$68*	*-$58*	*-$84*
	Total	***$397***	***$72***	***-$119***	***-$93***	***-$133***
Downstate, Moderate Income	Household	*$363*	*$80*	*-$68*	*-$53*	*-$124*
	Transportation	*$239*	*$29*	*-$106*	*-$99*	*-$111*
	Total	***$602***	***$109***	***-$174***	***-$152***	***-$236***
Downstate, Average Income	Household	*$363*	*$80*	*-$68*	*-$53*	*-$98*
	Transportation	*$365*	*$44*	*-$162*	*-$151*	*-$170*
	Total	***$727***	***$125***	***-$230***	***-$204***	***-$268***
NYC, Low Income	Household	*$346*	*$73*	*-$70*	*-$57*	*-$76*
	Transportation	*$125*	*$15*	*-$56*	*-$13*	*-$37*
	Total	***$471***	***$89***	***-$126***	***-$70***	***-$112***
NYC, Moderate Income	Household	*$346*	*$73*	*-$70*	*-$57*	*-$76*
	Transportation	*$147*	*$18*	*-$65*	*-$16*	*-$43*
	Total	***$493***	***$91***	***-$135***	***-$73***	***-$119***
NYC, Average Income	Household	*$346*	*$73*	*-$70*	*-$57*	*-$61*
	Transportation	*$155*	*$19*	*-$69*	*-$16*	*-$45*
	Total	***$501***	***$92***	***-$139***	***-$73***	***-$107***

Table A4. Summary of expenditures by type and household profile, Higher Energy Price Growth Sensitivity (real 2025 $)

		2026	2031			
House-hold Profile	Expenditure Type	Starting Point	Starting Point	Conventional Replacement	Moderate Efficient Electrification	High Efficient Electrification
Upstate, Moderate Income with Oil	Household	*$370*	*$439*	*$381*	*$360*	*$275*
	Transportation	*$283*	*$317*	*$191*	*$187*	*$160*
	Total	***$653***	***$756***	***$573***	***$548***	***$435***
Upstate, Low Income	Household	*$148*	*$184*	*$154*	*$202*	*$211*
	Transportation	*$189*	*$212*	*$128*	*$122*	*$92*
	Total	***$337***	***$396***	***$281***	***$324***	***$303***
Upstate, Moderate Income	Household	*$217*	*$270*	*$230*	*$313*	*$275*
	Transportation	*$283*	*$317*	*$191*	*$187*	*$160*
	Total	***$500***	***$587***	***$421***	***$500***	***$435***
Upstate, Average Income	Household	*$217*	*$270*	*$230*	*$313*	*$301*
	Transportation	*$324*	*$364*	*$219*	*$215*	*$184*
	Total	***$542***	***$633***	***$449***	***$528***	***$485***
Downstate, Moderate Income with Oil	Household	*$409*	*$469*	*$408*	*$396*	*$319*
	Transportation	*$239*	*$268*	*$162*	*$169*	*$156*
	Total	***$648***	***$737***	***$569***	***$565***	***$475***
Downstate, Low Income	Household	*$244*	*$298*	*$247*	*$263*	*$248*
	Transportation	*$153*	*$171*	*$103*	*$113*	*$87*
	Total	***$397***	***$469***	***$350***	***$376***	***$336***
Downstate, Moderate Income	Household	*$363*	*$443*	*$375*	*$390*	*$319*
	Transportation	*$239*	*$268*	*$162*	*$169*	*$156*
	Total	***$602***	***$711***	***$537***	***$559***	***$475***
Downstate, Average Income	Household	*$363*	*$443*	*$375*	*$390*	*$345*
	Transportation	*$365*	*$409*	*$247*	*$258*	*$239*
	Total	***$727***	***$852***	***$622***	***$648***	***$584***
NYC, Low Income	Household	*$346*	*$420*	*$350*	*$363*	*$344*
	Transportation	*$125*	*$140*	*$85*	*$127*	*$104*
	Total	***$471***	***$560***	***$434***	***$489***	***$448***
NYC, Moderate Income	Household	*$346*	*$420*	*$350*	*$363*	*$344*
	Transportation	*$147*	*$165*	*$99*	*$149*	*$122*
	Total	***$493***	***$584***	***$449***	***$512***	***$466***
NYC, Average Income	Household	*$346*	*$420*	*$350*	*$363*	*$358*
	Transportation	*$155*	*$173*	*$105*	*$157*	*$128*
	Total	***$501***	***$593***	***$454***	***$520***	***$486***

7. Methodology

This section summarizes the methods and data for the household energy affordability analysis. The following sections describe key inputs and assumptions, with additional details provided in the energy affordability data annex. The analytic approach incorporates technology and measure characterization data from the New York Pathways model. It also considers technology adoption over time from the economywide pathways analysis. The analysis then supplements this information with household scale data including household energy demand, transportation energy demand, and energy price projections, and then calculates household and transportation energy demand and expenditures.

7.1. Household profiles

Because energy spending varies by region and income, the analysis includes household profiles across three regions of the State and three income levels: Upstate, Downstate, and NYC; and low-income, moderate-income, and average income. Key assumptions were developed to align with region- and income-specific demand profiles for household energy and transportation energy. For household energy, energy demand profiles for each region for single-family and multifamily housing were reviewed and selected for alignment with energy demand benchmarks that reflect average demand patterns and typical housing types for each region and income level. For transportation energy, region- and income-specific household vehicle miles traveled (VMT) were developed that reflect average demand patterns for each region and income level. Table A5 summarizes key attributes of the nine core household profiles.

Table A4. Household profile matrix

Region	Income Level	Housing Type	Vehicle Miles Traveled
Upstate	Low Income	Multifamily	16,954
Upstate	Moderate Income	Single Family	25,394
Upstate	Average Income	Single Family	29,114
Downstate	Low Income	Multifamily	13,702
Downstate	Moderate Income	Single Family	21,433
Downstate	Average Income	Single Family	32,728
NYC	Low Income	Multifamily	11,217
NYC	Moderate Income	Multifamily	13,178
NYC	Average Income	Multifamily	13,879

The three income level definitions are:

- **Low-income** includes households with incomes at or below 60 percent of State Median Income.
- **Moderate-income** includes households with incomes above 60 percent but below 80 percent of State Median Income or Area Median Income, whichever is higher
- **Average income** uses the average income of a household in an analysis region to represent households with incomes that fall above the low- or moderate-income range.

Buildings

This analysis draws on a variety of sources to represent the components of total household energy expenditures, energy demand, and technology and measure characteristics from buildings. These include the NYSERDA Building Efficiency and Electrification Model (BEEM), which provides data based on empirical research and building simulations on energy demand by end use for different building types and regions in New York, and the New York Pathways model. The household scale BEEM data was used as a starting point and adjusted using assumptions from the New York Pathways model, including equipment efficiencies and costs. This approach represents specific household types while also aligning with building sector assumptions from the pathways analysis.

In this analysis, calculations were normalized to a per-housing unit basis for ease of comparison across household types. For master metered multifamily buildings, this means allocating building-wide bills equally across all building units. In addition, this analysis assumes that the resident pays for electricity and heating fuels, such as natural gas or oil, even though in reality some energy costs may be built into rent. In some real-world situations where heating fuel bills are included in rent, there may be a cost shift from owners to renters after electrification. For example, this could occur in multifamily units where the owner pays the gas bill, but the tenant pays the electricity bill.

The initial primary heating fuel for each profile is assumed to be natural gas. However, versions of the Upstate and Downstate moderate-income profiles with heating oil as the primary heating fuel are also included. In addition, a sensitivity analysis is included in this Appendix for Upstate and Downstate low-income households with a single-family housing energy demand profile.

Energy demand, equipment efficiency assumptions, and building shell measure savings are included in the energy affordability data annex.

Transportation

This analysis uses a variety of sources to represent the components of total energy expenditures, energy demand, and technology characteristics from transportation. These include the National Household Transportation Survey (NHTS) and the New York Pathways Model. The NHTS provides data on household transportation behavior, including household transportation demand, expressed as VMT, and number of vehicles per household, including for regions within New York State at different levels of household income. The VMT are multiplied by vehicle efficiencies drawn directly from the economywide pathways analysis to calculate energy demand, and subsequently, transportation energy expenditures. This approach represents regional- and income-differentiated transportation demand from different household types while also aligning with the light-duty vehicle assumptions from the pathways analysis.

Households were assumed to have either one or two vehicles based on region- and income-specific data.

Energy demand, vehicle efficiency assumptions, and VMT values are included in the energy affordability data annex.

7.2. Household journeys

For each household profile, household and transportation energy expenditures were calculated for four illustrative journeys with different technology mixes, fuel types, and levels of electrification and efficiency:

- ***Starting Point:*** a scenario with existing equipment in which natural gas or fuel oil and gasoline are the predominant energy sources for home heating and transportation, respectively.
- ***Conventional Replacement:*** a scenario with new equipment in which natural gas or fuel oil and gasoline are the predominant energy sources for home heating and transportation, respectively.
- ***Moderate Efficient Electrification:*** a scenario with basic building envelope and appliance efficiency measures where heat pumps meet most of the annual heating load and natural gas or fuel oil is used for heating in the coldest hours of the year. Transportation is partially decarbonized with a plug-in hybrid electric vehicle.
- ***High Efficient Electrification:*** a scenario with basic or medium building envelope efficiency measures and efficient electric appliances where heat pumps meet all heating and cooling loads, heat pump water heaters meet all water heating loads, and transportation is decarbonized with battery electric vehicles and plug-in hybrid electric vehicles.

Although the economywide pathways model includes a simulation of stock rollover at the sector, subsector, and end-use level, it does not explicitly model households. Therefore, the household energy affordability analysis cannot directly incorporate specific technology adoption profiles from the New York Pathways model. Instead, the analysis represents potential household journeys that are consistent with the range of household technology adoption within the economywide scenarios. Table A6 summarizes the equipment, vehicle, and shell measure assumptions by household profile and journey in greater detail.

While many variables determine household energy bills, a primary driver of home energy costs is heating and cooling. In the Starting Point journey, the home was assumed to have existing equipment, heated using natural gas or fuel oil and cooled with a central air conditioner (AC) for single-family homes and a window AC for multifamily homes. In the Conventional Replacement journey, the home was assumed to have new equipment including a boiler or furnace fueled with natural gas or fuel oil as well as a central or window AC. In the Moderate Efficient Electrification journey, the home was assumed to have a ducted air source heat pump (ASHP) for single-family homes and a ductless ASHP for multifamily homes, where the heat pump provides 80% of space heating requirements and a natural gas or fuel oil furnace or boiler provides backup for the remaining 20%. In the High Efficient Electrification scenario, the home was assumed to have a ducted ASHP for single-family homes and a ductless ASHP for multifamily homes, without any fossil fuel backup.

In the Starting Point and Conventional Replacement journeys, the home was assumed to have an existing building shell without any efficiency improvements. In the Moderate Efficient Electrification journey, single-family homes were assumed to have a shell improvement consisting of air sealing, ceiling/attic

insulation, and rim joist insulation. Multifamily homes were assumed to have a shell improvement consisting of air sealing and roof insulation. In the High Efficient Electrification journey, single-family low- and moderate-income homes were assumed to have a shell improvement consisting of air sealing, ceiling/attic insulation, rim joist insulation, and wall insulation. Multifamily low- and moderate-income homes were assumed to have a shell improvement consisting of air sealing, roof insulation, and double-pane windows. Average income homes were assumed to have the same shell improvements as the Moderate Efficient Electrification scenario. This distinction reflects the priority to pair heating electrification with weatherization and efficiency retrofits for low- and moderate-income households to ensure that operating costs remain reasonable.

For transportation, energy bills were calculated for the number of vehicles that are typical for each area. In New York City, expenditures include transportation costs for one vehicle per household. For the Downstate and Upstate regions, expenditures include transportation costs for one vehicle per household for low-income households and two vehicles per household for moderate- and average-income households. In the Starting Point journey, the home was assumed to have existing internal combustion engine (ICE) vehicles. In the Conventional Replacement journey, the home was assumed to have new ICE vehicles with higher efficiency. In the Moderate Efficient Electrification journey, the home was assumed to have either one plug-in hybrid electric vehicle (PHEV) or one ICE vehicle and one PHEV, depending on whether the home has one or two vehicles. In the High Efficient Electrification scenario, the home was assumed to have either one battery electric vehicle (BEV) or one PHEV and one BEV, depending on whether the home has one or two vehicles.

In addition to space heating, space cooling, and transportation, this analysis also included appliances and plug loads. In the Starting Point journey, the home was assumed to have an existing gas or electric stove and a mixture of incandescent, CFL, and LED lighting. Additionally, single family homes were assumed to have a gas or electric clothes dryer. In the Conventional Replacement and Moderate Efficient Electrification journeys, the home was assumed to have a new gas or electric stove and LED lighting. Single family homes were assumed to have a new gas or electric clothes dryer. In the High Efficient Electrification scenario, the home was assumed to have an efficient electric clothes dryer, an induction stove, and LED lighting.

Table A6. Equipment, vehicle, and building shell assumptions by household profile and journey

Household Profile	Starting Point	Conventional Replacement	Moderate Efficient Electrification	High Efficient Electrification
Upstate, Moderate Income with Oil	* Oil space heating with central AC * Oil water heating * Two fleet average gasoline vehicles * Electric clothes dryer and stove, incandescent/CFL/LED lighting	* Efficient oil space heating and central AC * Efficient oil water heating * Two new gasoline vehicles * Efficient electric clothes dryer and stove, LED lighting	* Basic shell + ducted ASHP, 20% fuel backup * Efficient oil water heating * One new gasoline vehicle, one PHEV * Efficient electric clothes dryer and stove, LED lighting	* Medium shell + ducted ASHP * Heat pump water heating * One PHEV, one BEV * Efficient electric clothes dryer, induction stove, LED lighting
Upstate, Low Income	* Gas space heating with window AC * Gas water heating * One fleet average gasoline vehicle * Gas stove, incandescent/CFL/LED lighting	* Efficient gas space heating and window AC * Efficient gas water heating * One new gasoline vehicle * Efficient gas stove, LED lighting	* Basic shell + ductless heat pump, 20% fuel backup * Efficient gas water heating * One PHEV * Efficient gas stove, LED lighting	* Medium shell + ductless heat pump * Heat pump water heating * One BEV * Induction stove, LED lighting
Upstate, Moderate Income	* Gas space heating with central AC * Gas water heating * Two fleet average gasoline vehicles * Gas clothes dryer and stove, incandescent/CFL/LED lighting	* Efficient gas space heating and central AC * Efficient gas water heating * Two new gasoline vehicles * Efficient gas clothes dryer and stove, LED lighting	* Basic shell + ducted ASHP, 20% fuel backup * Efficient gas water heating * One new gasoline vehicle, one PHEV * Efficient gas clothes dryer and stove, LED lighting	* Medium shell (moderate income), basic shell (average income) * Ducted ASHP * Heat pump water heating * One PHEV, one BEV * Efficient electric clothes dryer, induction stove, LED lighting
Upstate, Average Income				
Downstate, Moderate Income with Oil	* Oil space heating with central AC * Oil water heating * Two fleet average gasoline vehicles * Electric clothes dryer and stove, incandescent/CFL/LED lighting	* Efficient oil space heating and central AC * Efficient oil water heating * Two new gasoline vehicles * Efficient electric clothes dryer and stove, LED lighting	* Basic shell + ducted ASHP, 20% fuel backup * Efficient oil water heating * One new gasoline vehicle, one PHEV * Efficient electric clothes dryer and stove, LED lighting	* Medium shell + ducted ASHP * Heat pump water heating * One PHEV, one BEV * Efficient electric clothes dryer, induction stove, LED lighting
Downstate, Low Income	* Gas space heating with window AC * Gas water heating * One fleet average gasoline vehicle * Gas stove, incandescent/CFL/LED lighting	* Efficient gas space heating and window AC * Efficient gas water heating * One new gasoline vehicle * Efficient gas stove, LED lighting	* Basic shell + ductless heat pump, 20% fuel backup * Efficient gas water heating * One PHEV * Efficient gas stove, LED lighting	* Medium shell + ductless heat pump * Heat pump water heating * One BEV * Induction stove, LED lighting
Downstate, Moderate Income	* Gas space heating with central AC * Gas water heating * Two fleet average gasoline vehicles * Gas clothes dryer and stove, incandescent/CFL/LED lighting	* Efficient gas space heating and central AC * Efficient gas water heating * Two new gasoline vehicles * Efficient gas clothes dryer and stove, LED lighting	* Basic shell + ducted ASHP, 20% fuel backup * Efficient gas water heating * One new gasoline vehicle, one PHEV * Efficient gas clothes dryer and stove, LED lighting	* Medium shell (moderate income), basic shell (average income) * Ducted ASHP * Heat pump water heating * One PHEV, one BEV * Efficient electric clothes dryer, induction stove, LED lighting
Downstate, Average Income				
NYC, Low Income	* Gas space heating with window AC * Gas water heating * One fleet average gasoline vehicle * Gas stove, incandescent/CFL/LED lighting	* Efficient gas space heating and window AC * Efficient gas water heating * One new gasoline vehicle * Efficient gas stove, LED lighting	* Basic shell + ductless heat pump, 20% fuel backup * Efficient gas water heating * One PHEV * Efficient gas stove, LED lighting	* Medium shell (low- and moderate-income), basic shell (average income) * Ductless heat pump * Heat pump water heating * One BEV * Induction stove, LED lighting
NYC, Moderate Income				
NYC, Average Income				

7.3. Electricity and fuel prices

Economy-wide trends are expected to impact the rates charged for energy services, with important implications for customer affordability. While recognizing that there are significant unknowns, this analysis drew on the best available data to provide informed projections of future customer rates.

The electric rates in this analysis are utility-specific average residential rates based on 2024 utility residential revenue and sales as reported by the U.S. Energy Information Agency (EIA) in Form EIA-861. These initial electric rates were adjusted using escalators based on a 10-year trend (2015-2024) of the New York State Department of Public Service (DPS) utility total electric bill estimates, which differ by customer class and utility. Between 2024 and 2031, the escalators result in an annual average nominal compound annual growth rate (CAGR) of approximately 3% downstate and 3% upstate. Similarly, utility-specific residential volumetric rates[22] and monthly charges for natural gas customers were adjusted using escalators based on a 10-year trend (2015-2024) of the DPS utility total gas bill estimates, which differ by customer class and utility. Between 2024 and 2031, this results in an annual average nominal CAGR of approximately 5% downstate and 4% upstate. The analysis used the projected costs of residential fuel oil and vehicle gasoline from the economywide pathways analysis, using the Central fuel price scenario, which is derived from the 2025 Energy Information Administration Annual Energy Outlook Reference Case.

For the higher energy price growth sensitivity, the same starting point electric and gas rates were adjusted using escalators based on a blend of the 5-year trend (2019-2024) of the DPS utility total electric and gas bill estimates and the second DPS CLCPA report and gas utility long-term plans, respectively. Between 2024 and 2031, the escalators result in an annual average nominal compound annual growth rate (CAGR) of approximately 5% downstate and 7% upstate for electricity and 7% downstate and 6% upstate for natural gas. The analysis used the projected costs of residential fuel oil and vehicle gasoline from the economywide pathways analysis, using the High fuel price scenario, which is derived from the 2025 Energy Information Administration Annual Energy Outlook Low Oil and Gas Supply Case.

The electricity, natural gas, fuel oil, and gasoline prices are included in the energy affordability data annex.

7.4. Equipment costs

In addition to the cost of energy, the analysis assessed the upfront capital costs of equipment and the associated annual maintenance costs. The analysis used capital and maintenance costs from the pathways analysis for building shell upgrades; space heating, space cooling, water heating, clothes drying, and cooking equipment; and vehicles. To make a meaningful comparison with other cost categories, capital costs were levelized assuming a 7% financing rate over a ten year period.

The equipment cost assumptions are included in the energy affordability data annex.

[1] U.S. Bureau of Labor Statistics, "Consumer Expenditure Surveys. New York and U.S.: 2022 & 2023," accessed October 30, 2025, https://www.bls.gov/cex/tables.htm#geo. For consistency between State-level and U.S. data, values reported are an average of 2022 and 2023.

[2] Ryan H. Wiser, Eric O'Shaughnessy, Galen L. Barbose, Peter Cappers, and Will Gorman, "Factors influencing recent trends in retail electricity prices in the United States," *Lawrence Berkeley National Laboratory*, accessed October 30, 2025, https://emp.lbl.gov/publications/factors-influencing-recent-trends.

[3] New York State Department of Public Service, "Second Climate Leadership and Community Protection Act Report," accessed October 30, 2025, https://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7b40075E99-0000-C639-832F-142B5C387BBD%7d.

[4] We use Consumer Expenditure Survey (CE) data throughout this chapter to characterize combined household and transportation energy expenditures, as well as associated energy burden, transportation energy burden and combined household energy and transportation energy burdens. The CE data has a number of key features that make it useful for this analysis: It is an internally consistent data set that situates energy expenditures within household spending more broadly and includes both household energy and transportation fuel spending. Although not identical, energy burden calculated using CE data is broadly in line with other approaches to calculate energy burden, such as the approach based on Census data used in the Low-Income Energy Affordability Data tool, a commonly used Federal Government resource for understanding energy burden that as of the time of this writing was removed from publication by the current administration.

[5] U.S. Bureau of Labor Statistics, "Consumer Expenditure Surveys. New York and U.S.: 2022 & 2023," accessed October 30, 2025, https://www.bls.gov/cex/tables.htm#geo. For consistency between State-level and U.S. data, values reported are an average of 2022 and 2023.

[6] Yan Zhou, Spencer Aeschliman, and David Gohlke, 2020, "Affordability of household transportation fuel costs by region and socioeconomic factors," *Argonne National Laboratory,* accessed April 16, 2025, https://publications.anl.gov/anlpubs/2021/01/165141.pdf.

[7] U.S. Bureau of Economic Analysis, "Regional data, GDP and personal income," accessed October 30, 2025, https://www.bea.gov/itable/regional-gdp-and-personal-income.

[8] U.S. Bureau of Economic Analysis, "Regional data, GDP and personal income," accessed October 30, 2025, https://www.bea.gov/itable/regional-gdp-and-personal-income.

[9] In the CE data, incomes in the lowest and second lowest quintile, together representing 40 percent of New York State households, were $13,857 and $36,908, respectively. The comparable U.S. incomes in the lowest and second quintiles were slightly higher at $14,894 and $39,096. The average income for CE households in New York State was $103,568 versus $97,904 for the U.S.

[10] Researchers are increasingly considering the total combined household energy and transportation energy burden to be a useful complement to the energy burden that represents a comprehensive perspective on household energy spending. See, for example, Aimee Bell-Pasht, ACEEE, 2024, "Combined energy burdens: Estimating total home and transportation energy burdens," https://www.aceee.org/topic-brief/2024/05/combined-energy-burdens-estimating-total-home-and-transportation-energy-burdens. See also, NREL, 2025, "SLOPE: State and local planning for energy. Energy affordability – household energy and transportation burden," https://maps.nrel.gov/slope/data-viewer?layer=eej.household-energy-burden.

[11] U.S. Bureau of Labor Statistics. "Consumer Expenditure Surveys. New York: Quintiles of income before taxes, 2022–2023" and "US: Quintiles of income before taxes, 2022 & 2023," accessed October 30, 2025, https://www.bls.gov/cex/tables.htm#geo.

[12] U.S. Bureau of Labor Statistics. "Consumer Expenditure Surveys. New York: Quintiles of income before taxes, 2022–2023" and "US: Quintiles of income before taxes, 2022 & 2023," accessed October 30, 2025, https://www.bls.gov/cex/tables.htm#geo.

[13] U.S. Census Bureau, "Household Pulse Survey: Measuring Emergent Social and Economic Matters Facing U.S. Households," accessed April 16, 2025, https://www.census.gov/data/experimental-data-products/household-pulse-survey.html; U.S. Energy Information Administration, "Residential Energy Consumption Survey," accessed April 16, 2025. https://www.eia.gov/consumption/residential/data/2020. Households experiencing higher-

than-average rates of energy insecurity from this data include minorities, people with disabilities, women, larger households, and households with children.

[14] For households in disadvantaged communities, these barriers can result from historical patterns of exclusion, segregation, and disinvestment in communities.

[15] Split incentives occur when the benefits do not accrue to the party that makes an investment.

[16] Households may not always experience a high level of trust in clean energy programs, installers, and contractors to deliver promised performance.

[17] *New York State Disadvantaged Communities Barriers and Opportunities Report*, 2021, https://climate.ny.gov/-/media/Project/Climate/Files/21-35-NY-Disadvantaged-Communities-Barriers-and-Opportunities-Report.pdf.

[18] All profiles assume natural gas heating. The upstate and downstate moderate-income profiles also include a version that assumes oil heating.

[19] Because of substantial differences in living situations and energy use patterns across real-world households, as well as uncertainty in future energy prices, not all households will experience the level of savings modeled.

[20] Note that additional sensitivities, such as low-income households in single-family homes, can be found in the appendix and energy affordability data annex.

[21] In the High Efficient Electrification Journey, the low- and moderate-income household profiles include a medium level of building envelope efficiency, while the average income household profiles include a basic level of building envelope efficiency. This distinction reflects the priority to pair heating electrification with weatherization and efficiency retrofits for low- and moderate-income households to ensure that operating costs remain reasonable.

[22] Many utilities incorporate a declining block structure for volumetric natural gas rates, which this analysis does not model directly. Rather, the impact of the declining block is included in the average price we assume. The significance of this declining block structure as a disincentive for natural gas usage reduction is an important area for future research.

New York State Energy Plan

VOLUME II | Plan Analyses and Impacts

Health Impacts Analysis

18

Key Terms Used in This Chapter

FOR THE COMPLETE GLOSSARY ➜

Fine particulate matter ($PM_{2.5}$): Airborne particles less than 2.5 micrometers in diameter can travel into the lungs, infiltrate the bloodstream, and cause cardiovascular and respiratory health effects. $PM_{2.5}$ is directly emitted from combustion sources (primary $PM_{2.5}$) and also forms in the atmosphere through reactions of precursor pollutants, including nitrogen oxides (NO_X), sulfur dioxide (SO_2), ammonia (NH_3), and volatile organic compounds (VOCs).

Ozone: A respiratory irritant when it reaches elevated concentrations in surface air. Ozone is not emitted directly into the air, rather it is produced by chemical reactions between NO_X and VOCs in the presence of sunlight. Ozone is most efficiently formed on hot sunny days in areas with high concentrations of emission sources.

Key Findings → Health Impacts Analysis

Exposure to air pollution from fuel combustion is harmful to human health and can increase risks of cardiovascular and respiratory symptoms and diseases including heart attacks, asthma exacerbation, and premature mortality. New York State's economy-wide energy policies that increase energy efficiency and shift vehicles, buildings, electricity generation, and other sources to clean energy are lowering air pollutant emissions—and will continue to do so. This analysis estimates how recent, ongoing, and future State energy policies could impact air pollutant concentrations and public health outcomes in communities throughout New York State.

- All communities in New York State would experience public health benefits as a result of implementing State energy policies that would substantially reduce air pollutant emissions relative to the No Action scenario, lowering pollutant concentrations. As a result of policies in the Plan's core planning scenario, Additional Action, population-level health risks associated with exposure to air pollutants would be lower, including cumulatively from 2025–2040 avoiding approximately 6,500 cases of premature mortality, 2,700 nonfatal heart attacks, and nearly 8,700 emergency room visits for asthma, and leading to further improvements in other metrics. Under all planning scenarios, health benefits are expected to increase over time from 2025 to 2040 and continue beyond 2040. These projections represent statistical estimates of health benefits based on modeled changes in air pollution exposure, reflecting risk reductions across populations rather than definitive outcomes for specific individuals.

- The health analysis estimates the benefits from reduced exposure to fine particulate matter ($PM_{2.5}$) concentrations at the community scale and ozone concentration reductions at the county scale for three scenarios of the Plan: Current Policies, Additional Action, and Net Zero B. In general, the cumulative projected air pollution concentration reductions and ensuing health benefits from the Additional Action scenario are 60 percent greater than those from the Current Policies scenario, and the estimated potential benefits from the Net Zero B scenario are approximately triple the Additional Action scenario's benefits.

- While roughly 37 percent of the statewide population is projected to live in geographic areas designated as disadvantaged communities (DACs) in analysis years, DAC areas would accrue approximately 50 percent of the physical health benefits under all scenarios because DAC areas would often experience greater improvements in air quality and also have higher baseline incidence rates for the health conditions analyzed compared to non-DAC areas. Higher benefits within DAC areas are expected in all areas of the state. Accounting for differences in population, DAC areas would experience approximately 70 percent higher benefits than non-DAC areas under all scenarios.

- The greatest benefits would occur in urban areas where air pollutant emission reductions and population are greatest. Approximately 80-90 percent of the health benefits would come from emission reductions in the transportation and buildings sectors. The Additional Action and Net Zero B scenarios include additional policies that reduce emissions from the industrial, aircraft, and non-road (Net Zero B only) sectors. Benefits in DAC areas from the use of sustainable aviation fuel are more than double the benefits compared to non-DAC areas per capita.

- The combined societal value of the public health benefits from reductions in $PM_{2.5}$ and ozone concentrations from 2025 to 2040 is estimated to be nearly $52 billion for Additional Action (net present value 2024$).

- Public health benefits would have been approximately 47 percent higher in 2040, relative to the Current Policies scenario, if federal energy policy rollbacks as of October 2025 had not occurred. Further federal policy rollbacks could potentially decrease 2040 health benefits by approximately 27 percent relative to the Current Policies scenario. These differences amount to thousands of cases of premature mortality, nonfatal heart attacks, and other public health impacts. Overall, current federal policies may have set back public health benefits that may have been achieved by 2040 by 4 years, and further federal rollbacks could result in the same level of benefits being set back beyond 2050.

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1. Overview of Public Health Analysis Approach

This public health analysis evaluates the benefits associated with the future energy scenarios developed in the Pathways Analysis, described in greater detail in the Pathways Analysis chapter of this State Energy Plan (Plan). The health analysis estimates the potential impact of changes in fuel combustion from economywide energy policies on air pollutant emissions and ensuing public health outcomes. This public health analysis followed the same general approach used previously in the New York Scoping Plan,[1] while applying an improved analysis modeling framework aimed at providing more detailed community-scale effects.

The basic framework of the health analysis is as follows:

- Estimate reductions of air pollutant emissions based on changes in fuel consumption from the Pathways Analysis (see Pathways Analysis chapter of this Plan).
- Model changes in air quality resulting from reductions in air pollutant emissions.
- Model changes in public health effects resulting from changes in air quality.
- Calculate the value of the change in health effects using standard economic values.

NYSERDA used a newly developed air quality and health impacts modeling framework—the New York Community-Scale Health and Air Pollution Policy Analysis (NY-CHAPPA) model[2]—to conduct the health analysis. The NY-CHAPPA modeling framework estimates benefits at a community scale, which enables evaluation of potential health benefits within geographic disadvantaged communities (DACs) as defined under the Climate Leadership and Community Protection Act (Climate Act).[3] Emissions were estimated based on regional changes in fuel consumption from the Pathways Analysis for each scenario and downscaled to the census tract level.

The health analysis in the Plan uses NY-CHAPPA v2.0, which uses 2020 census tract definitions and emissions sources, receptors, and updated geographic DAC definitions. The model is an update from NY-CHAPPA v1.0, which used 2010 census tracts and was used for the health analysis in the Draft Plan.

To calculate changes in health effects for the Plan scenarios, NY-CHAPPA projects the change in fine particulate matter ($PM_{2.5}$) concentration resulting from changes in air pollutant emissions. The air quality model accounts for primary (directly emitted) $PM_{2.5}$ and precursor pollutants, including nitrogen oxides (NO_X), sulfur dioxide (SO_2), volatile organic compounds (VOCs), and ammonia (NH_3) that react in the atmosphere to form secondary $PM_{2.5}$. Dispersion of local emissions sources, transport of pollutants between New York State regions, the influx of pollutants from outside New York State, and chemical transformation are combined in the modeling framework to estimate the change in $PM_{2.5}$ concentrations in each census tract.

NY-CHAPPA then applies functions that correlate the change in $PM_{2.5}$ concentrations to changes in health effects in each census tract. The health impact functions included in NY-CHAPPA are those from the U.S. Environmental Protection Agency's (EPA) CO-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA), as well as some New York City-specific functions for respiratory-related

emergency room visits and hospitalizations for cardiovascular events (see the appendix to this chapter for additional information on the health impact functions used in this analysis).[4,5] These individual physical health effects are also evaluated as a societal value, which enables combining the various health effects into a single metric that can also be used for the benefit-cost analysis of the Plan. NY-CHAPPA calculates both a low and high value, based on different approaches for estimating avoided mortality and nonfatal heart attacks.

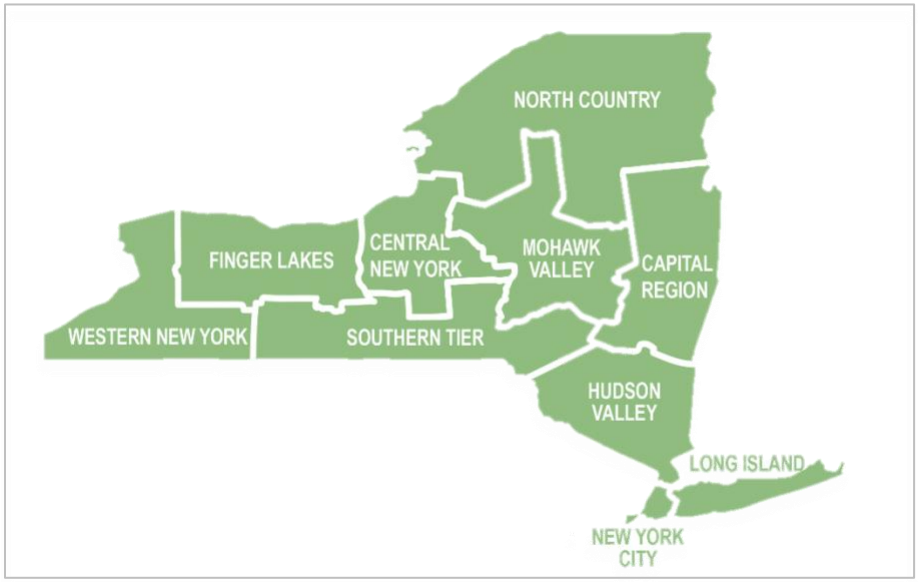
The methodology used to estimate public health impacts and their societal value is based on current scientific understanding of the relationship between $PM_{2.5}$ or ozone and human health and the economic valuation of these health effects drawn from the U.S. EPA's Integrated Science Assessment for Particulate Matter,[6] Integrated Science Assessment for Ozone and Related Photochemical Oxidants,[7] and methodology that has been extensively reviewed by independent scientific bodies. Additional information on the health impact functions and monetary values is in the appendix to this chapter.

NY-CHAPPA examines the change in health effects due only to changes in $PM_{2.5}$ concentrations. The emission reductions under the Plan scenarios will have additional air quality benefits not captured by NY-CHAPPA, including reductions in ozone concentrations. To provide an estimate of the benefits from reduced ozone concentrations, COBRA was used.[8] Ozone benefits from COBRA are limited to the county-level spatial resolution, which is not sufficient to estimate DAC benefits because DAC areas are defined at the census tract scale. Because NY-CHAPPA has a higher geographic resolution than COBRA in terms of both emissions inputs and health outputs, most of the results discussed below are focused on the $PM_{2.5}$ results from NY-CHAPPA. The ozone benefits, which tend to be relatively smaller than the $PM_{2.5}$ benefits under the scenarios examined in this analysis (see Section 3.4), are included in the results for physical benefits and their societal value, and the results are clearly marked to indicate whether the results are from $PM_{2.5}$, ozone, or both.

COBRA was also used to quantify the benefits of the Plan's policy scenarios on out-of-state regions. Emissions differences under the policy scenarios relative to the No Action scenario within New York State were modeled in COBRA to estimate the value of societal benefits of lower $PM_{2.5}$ and ozone concentrations downwind in the continental U.S. outside of the state. The physical health benefits shown in Sections 3.1, 3.2, and 3.3 are for New York State only and out-of-state results are shown for societal values in Sections 3.4 and 3.5.

In many cases, results are presented at the regional level to show the geographic distribution of the benefits. Figure 1 shows the regions used in this health analysis. Results are aggregated to the regional and community-type level because of uncertainties in the local details of the policies scenarios. For more information on the health analysis methodology and uncertainties see the appendix to this chapter.

Figure 1. New York State Regions for Health Analysis Results



The health analysis evaluated the change in health effects in five-year increments between 2025 and 2050 and interpolated results in between years to estimate the cumulative benefits. The results presented below are for 2025–2040. More information on benefits for 2040–2050, as well as more detailed geographic results at the county level are available in the appendix to this chapter and public health impacts analysis data annex.

Estimates of public health benefits in this health analysis only include benefits from reduced concentrations of $PM_{2.5}$ and ozone in outdoor air and do not include other potential benefits of reduced air pollutant emissions from State energy policies, including reductions in concentrations of nitrogen dioxide (NO_2) and other hazardous air pollutants or improvements to indoor air quality. In addition to health benefits from reductions in fuel consumption, policies in the Plan may result in additional health benefits not quantified here, including benefits from increased physical activity due to increased active transportation modes and energy efficiency interventions in residential buildings, which were both shown to contribute additional health benefits in analysis done for the Scoping Plan.[1] To the extent that programs resulting from the Plan invest in improving energy security, there may also be additional public health benefits. Climate-related public health impacts avoided are accounted for separately as the total value of avoided damages from greenhouse gas pollution within the benefit-cost analysis (see Pathways Analysis chapter). Overall, the public health benefits quantified in this analysis should be considered a conservatively low estimate of health benefits from the State's energy policies.

2. Overview of the Public Health Analysis Scenarios

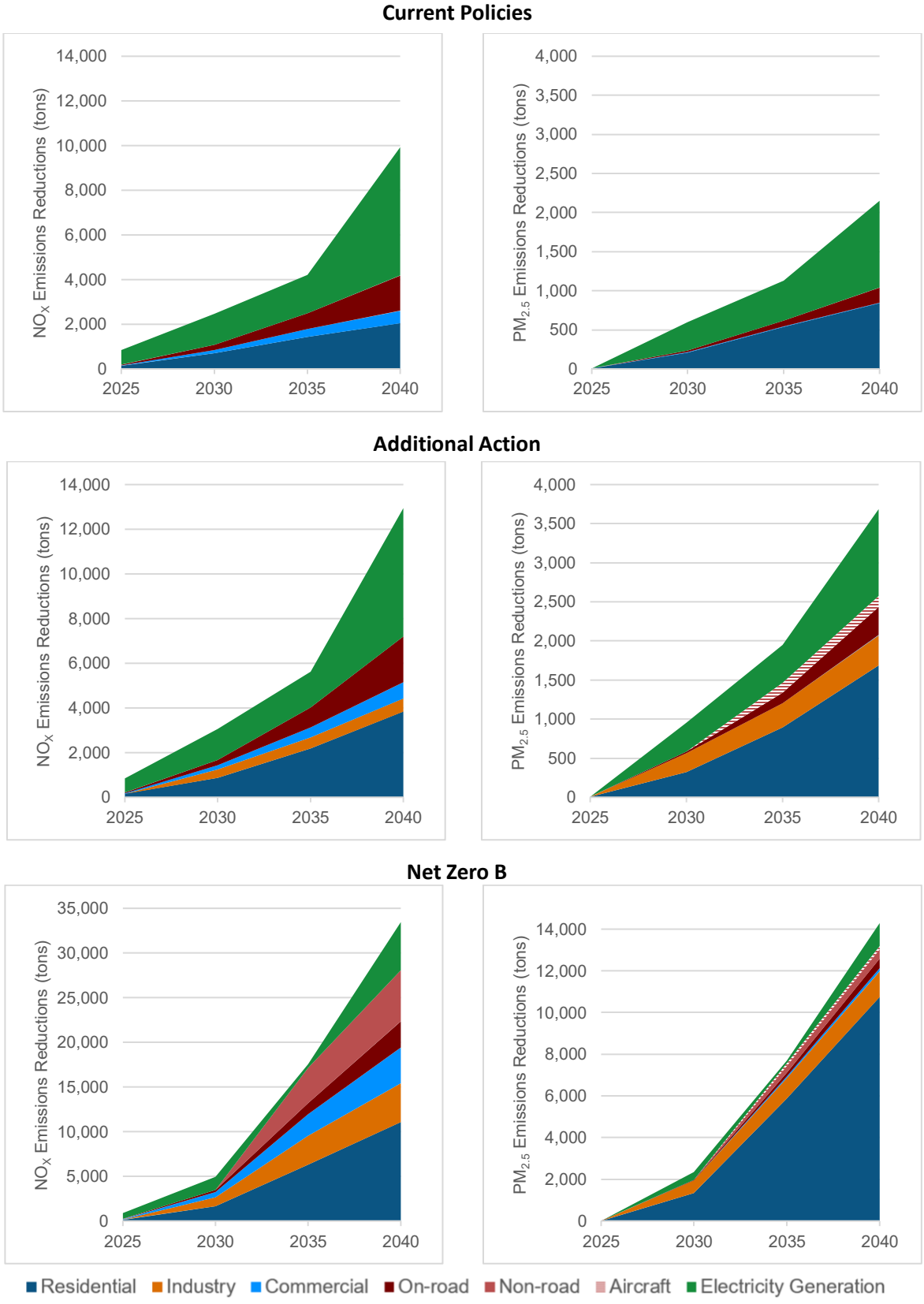
The health analysis focused on three scenarios of the Plan, described in detail in the Pathways Analysis chapter of this Plan and briefly summarized in Table 1.[9] For all policy scenarios, the change in health effects is estimated relative to the No Action scenario, which excludes recent State and local policies. The core planning scenario for the Plan is represented by the Additional Action scenario. Additional sensitivity cases exploring the impacts of federal policies are presented in Section 3.5.

Table 1. Scenarios Considered in the Health Analysis

Scenario	Description
No Action	Includes federal incentives (as of October 2025) and legacy New York State policies but excludes the Climate Act and more recent additional State and local policies.
Current Policies	Current progress toward achievement of enacted State and local policies (e.g., Clean Energy Standard progress, building code updates, Advanced Clean Cars/Trucks).
Additional Action	All actions included under Current Policies scenario plus additional progress toward adoption of clean technologies through a mix of future programs and investments aligned with recommendations in the Plan.
Net Zero B	Accelerates adoption of clean energy technologies in all sectors toward achievement of economywide net zero by 2050.

Statewide annual air pollutant emissions were estimated based on projected fuel consumption from the scenarios in Table 1 and emission factors for each sector and fuel (see the appendix to this chapter for a full description of emissions inputs). Figure 2 shows the change in NO_x and $PM_{2.5}$ emissions by sector for each policy scenario relative to the No Action scenario emissions. In 2040, annual NO_x emissions would be nearly 10,000 tons, 12,950 tons, and 33,500 tons lower under the Current Policies, Additional Action, and Net Zero B scenarios, respectively, than in the No Action scenario. Annual $PM_{2.5}$ emissions in 2040 would be nearly 2,200 tons, 3,700 tons, and 14,300 tons lower under the Current Policies, Additional Action, and Net Zero B scenarios, respectively, than in the No Action scenario. Changes in sectoral emissions over 2025-2040 are driven by the policies described in the Pathways chapter and Section 3.3 includes additional discussion of health benefits by sector. These lower air pollutant emissions drive lower $PM_{2.5}$ and ozone concentrations and result in health benefits discussed in the results sections below.

Figure 2. Statewide Annual NO_x and $PM_{2.5}$ Emission Reductions by Sector and Scenario Relative to the No Action Scenario Emissions in the Same Year



3. Public Health Impact Analysis Results and Discussion

The results in this section show the estimated air quality and public health benefits of the Current Policies, Additional Action, and Net Zero B scenarios relative to the No Action scenario absent recent State and local policies. This section provides an overview of the results of this analysis for 2025–2040, including estimated public health effects and the societal value of those benefits, along with breakdowns of benefits by region and sector. The results are also presented in terms of the share of benefits expected in geographic DAC areas.

NY-CHAPPA provides both low and high estimates of health benefits as described above.[10] Where only one value is shown, the high estimate is used—generally, the difference between the high and low estimates is in magnitude only, and the estimates' distribution will otherwise be the same temporally and geographically.

Estimates of health cases refers to the avoided number of new cases of a health outcome over a specified time period due to reduced exposure to $PM_{2.5}$ or ozone. A change in cases reflects changes in statistical risk that are aggregated over an entire population. For example, a reduction in premature mortality risk for a certain population and its associated monetary value represents the sum of many small risk reductions and does not correspond to the loss or value of an individual life.

The results presented below are for 2025–2040. More information on benefits for 2040–2050, as well as more detailed geographic results at the county level are available in the appendix to this chapter and data annex. The section begins with an overview of the statewide results followed by regional results and results by sector. The section concludes with a discussion and analysis of the findings and their implications for the core policy scenarios as well as additional results from a sensitivity analysis of the impacts of federal policies.

3.1. Statewide Health Benefits

Under all scenarios in the Plan, lower air pollutant emissions relative to the No Action scenario are projected to lower $PM_{2.5}$ and ozone concentrations and result in public health benefits.

Figure 3 shows the avoided annual cases of premature mortality (from $PM_{2.5}$ and ozone), nonfatal heart attacks (from $PM_{2.5}$ only),[11] and emergency room visits for asthma (from $PM_{2.5}$ and ozone) for the three scenarios in 2030, 2035, and 2040. The health benefits from all scenarios would increase over time and the cumulative benefits from Net Zero B are expected to be more than triple those of Additional Action, which in turn are approximately 60 percent greater than the health benefits expected for Current Policies. Figure 4 shows the cumulative number of avoided health effects from 2025–2040 for these three health endpoints.

Figure 3. Statewide Annual Avoided Cases from Lower $PM_{2.5}$ and Ozone Concentrations by Scenario Relative to the No Action Scenario (2030, 2035, 2040)

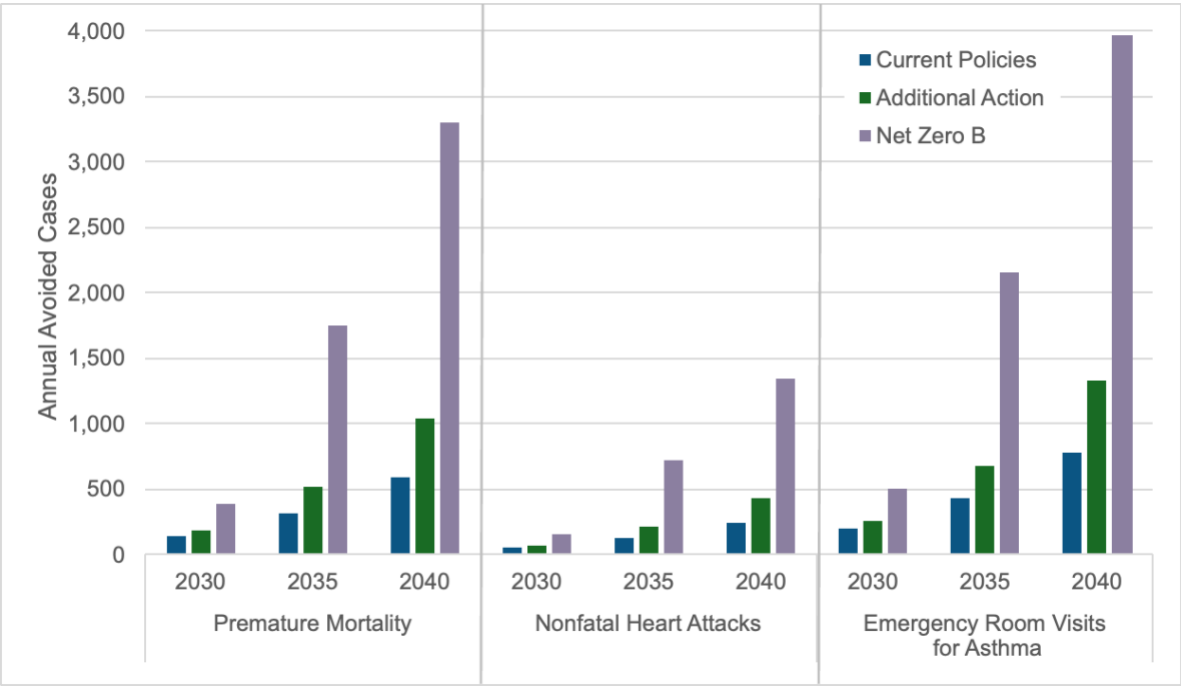


Figure 4. Statewide Cumulative Avoided Cases from Lower $PM_{2.5}$ and Ozone Concentrations by Scenario Relative to the No Action Scenario (2025–2040)

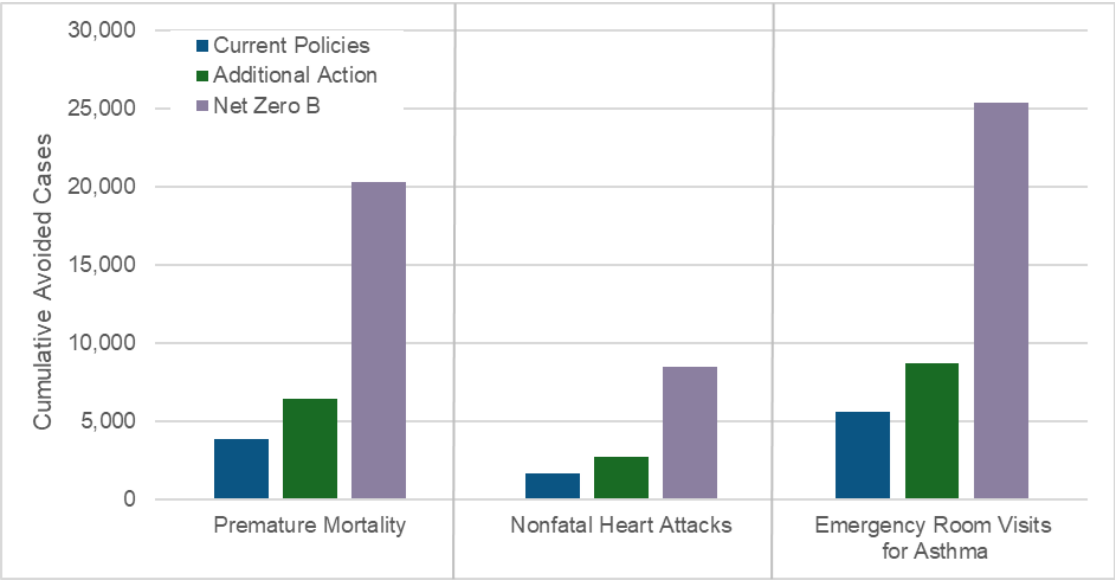
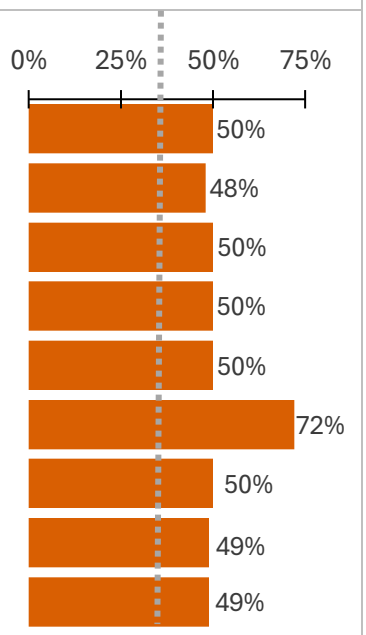


Table 2 shows annual avoided health effects from lower $PM_{2.5}$ and ozone concentrations for all three scenarios in 2040 including additional health endpoints. Note that the fraction of benefits in DAC areas is only due to benefits from lower $PM_{2.5}$ concentrations because the results for ozone are only available at

the county level. All scenarios are projected to result in health benefits across the range of endpoints, and the magnitude of benefits increases from Current Policies to Additional Action to Net Zero B as the reductions in economywide fuel combustion increase. In 2040, for example, Net Zero B is expected to result in approximately 3,200 avoided premature mortality cases, and the Current Policies and Additional Action scenarios have estimated avoided mortality of approximately 570 cases and 1,000 cases per year, respectively. See the data annex for county level avoided health cases for all model years.

Table 2. Statewide Annual Avoided Public Health Effects from Lower $PM_{2.5}$ and Ozone Concentrations by Scenario Relative to the No Action Scenario (2040)

Health Effect	Avoided Cases in 2040			Fraction in DAC Areas (from $PM_{2.5}$)
Geographic Population of Disadvantaged Communities in New York:				37%
Scenario:	**Current Policies**	**Additional Action**	**Net Zero B**	
Premature Mortality	570	1,000	3,200	50%
Nonfatal Heart Attacks	240	430	1,300	48%
Hospitalizations	160	280	880	50%
Acute Bronchitis	260	450	1,400	50%
Respiratory Symptoms	8,000	14,100	44,000	50%
Emergency Room Visits, Asthma	780	1,300	4,000	72%
Asthma Exacerbation	4,900	8,600	27,000	50%
Minor Restricted Activity Days	160,000	280,000	870,000	49%
Work Loss Days	27,000	48,000	150,000	49%



Under all scenarios, geographic DAC areas would experience greater avoided health effects than their share of the state's population (37 percent) because DACs have higher baseline incidence for the health endpoints analyzed. For example, DAC areas would experience 72 percent of the benefits from avoided emergency room visits for asthma because DACs have a particularly high baseline incidence of emergency room visits for asthma (Table 2). The fraction of health benefits accruing to DAC areas shown in Table 2 would be similar across all scenarios. This higher fraction of benefits within DAC areas relative to population fraction is also evident at the regional and county level. For more details see Section 3.2 and the appendix to this chapter.

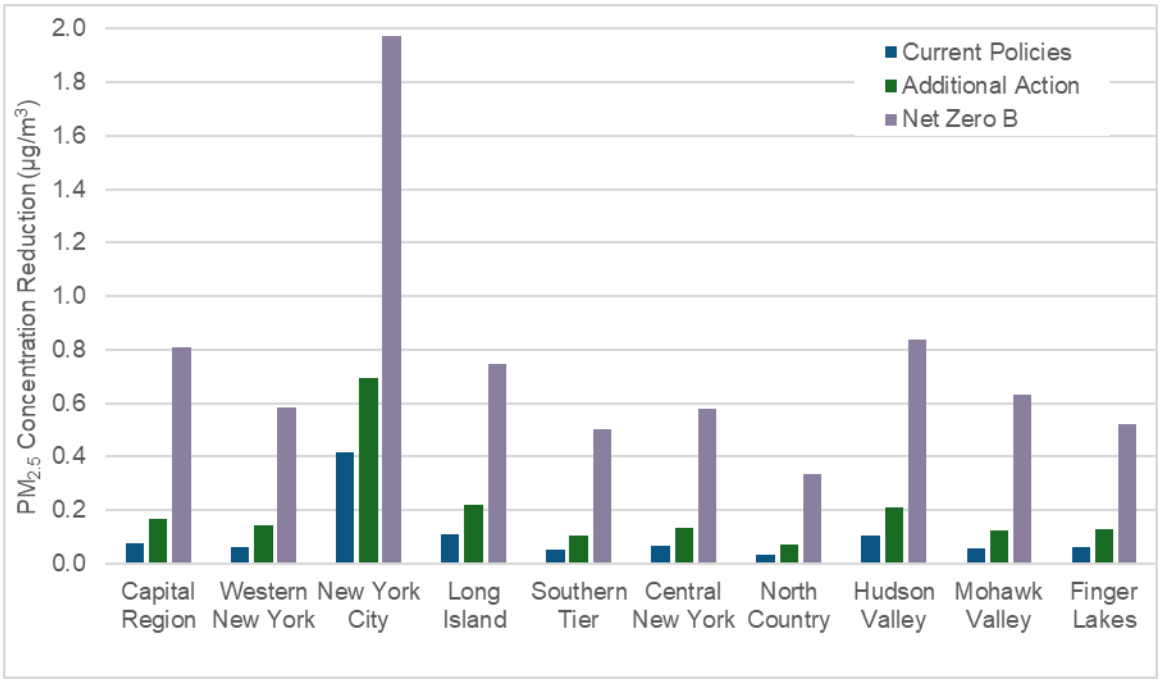
The physical benefits shown in this section are for New York State only and there would be additional out-of-state health benefits not included here.

3.2. Public Health Benefits by Region

Every region of the state would experience air quality improvements in all scenarios relative to the No Action scenario. Figure 5 shows the population-weighted distribution of lower annual average $PM_{2.5}$ concentrations relative to the No Action scenario across each state region in 2040 for all three scenarios.

Within regions, $PM_{2.5}$ concentration reductions would be largest in urban areas, including but not limited to New York City, where both population and air pollutant concentrations are greatest. Under the Additional Action scenario, for example, New York City would experience a 0.7 µg/m^3 lower annual average $PM_{2.5}$ concentrations, whereas the other regions are expected to experience approximately 0.1-0.2 µg/m^3 lower annual average $PM_{2.5}$ concentrations in 2040 relative to the No Action scenario. This is because the New York City region is a dense urban area with higher air pollutant concentrations relative to other regions of the state under the No Action scenario, so New York City is more sensitive to lower emissions under the policy scenarios. While other regions of the state would experience lower magnitudes of annual average $PM_{2.5}$ concentration reductions compared to New York City, within these regions, air quality improvements would be greater in urban counties where air pollutant concentrations are higher compared to non-urban counties. Additional data at the county level can be found in the appendix to this chapter and data annex.

Figure 5. Population-Weighted Average $PM_{2.5}$ Concentration Reductions by Region and Scenario Relative to the No Action Scenario (2040)



Due to lower $PM_{2.5}$ concentrations in the policy scenarios relative to the No Action scenario, each region would also experience population-level public health benefits (Figure 6). While all the regions would experience net positive health benefits, most of the benefits for all health endpoints in all scenarios would accrue in the New York City region because it has the highest population density and would experience the greatest change in air pollution emissions relative to the No Action Scenario, followed by

the Long Island and Hudson Valley regions. On a per capita basis, the benefits gap across regions is somewhat smaller than in absolute terms (Figure 6). While the New York City region is expected to experience higher benefits than other regions in all scenarios analyzed, that discrepancy is somewhat less pronounced under the Additional Action scenario relative to the Current Policies, and substantially less pronounced under the Net Zero B scenario. For example, in the Net Zero B scenario, DAC areas in Mohawk Valley experience the greatest per capital benefits compared to all other regions. In general, closing the gap in benefits between regions is more pronounced for DAC areas where benefits outside the New York City region increase proportionally more than in New York City in the Additional Action and Net Zero B scenarios.

Across regions, air quality improvements are generally greater in geographic DAC areas in all three scenarios. In the New York City region, while there are differences in local exposure, on average, DAC and non-DAC areas would experience similar annual average $PM_{2.5}$ concentration reductions.

DAC areas in general benefit from larger reductions in $PM_{2.5}$ concentrations because in most regions, those communities tend to be clustered in urban counties where air pollutant concentrations and population density are higher.

Figure 6. Per Capita Annual Health Benefits for Disadvantaged Community and Non-Disadvantaged Communities Areas from Lower $PM_{2.5}$ Concentrations by Region and Scenario Relative to the No Action Scenario (2040)

Using the Additional Action scenario as a representative example, Figure 7 shows that in each region, geographic DAC areas receive a larger share of 2025–2040 cumulative monetary value from lower $PM_{2.5}$

concentrations relative to their share of the population. In regions outside of New York City, Long Island, and Hudson Valley, the fraction of cumulative benefits accruing to DAC areas is 14 percent or greater than the geographic DAC share of the population. Statewide, 50 percent of cumulative benefits accrue to DAC areas compared to 37 percent of the statewide population projected to live in geographic DAC areas. Similar relationships are observed for the Current Policies and Net Zero B scenarios (see the appendix to this chapter).

Figure 7. Fraction of Cumulative Benefits from Lower $PM_{2.5}$ Concentrations Accruing in DAC Areas Compared to Fraction of Population in DAC Areas by Region and Statewide (Additional Action Scenario Relative to the No Action Scenario, 2025–2040)

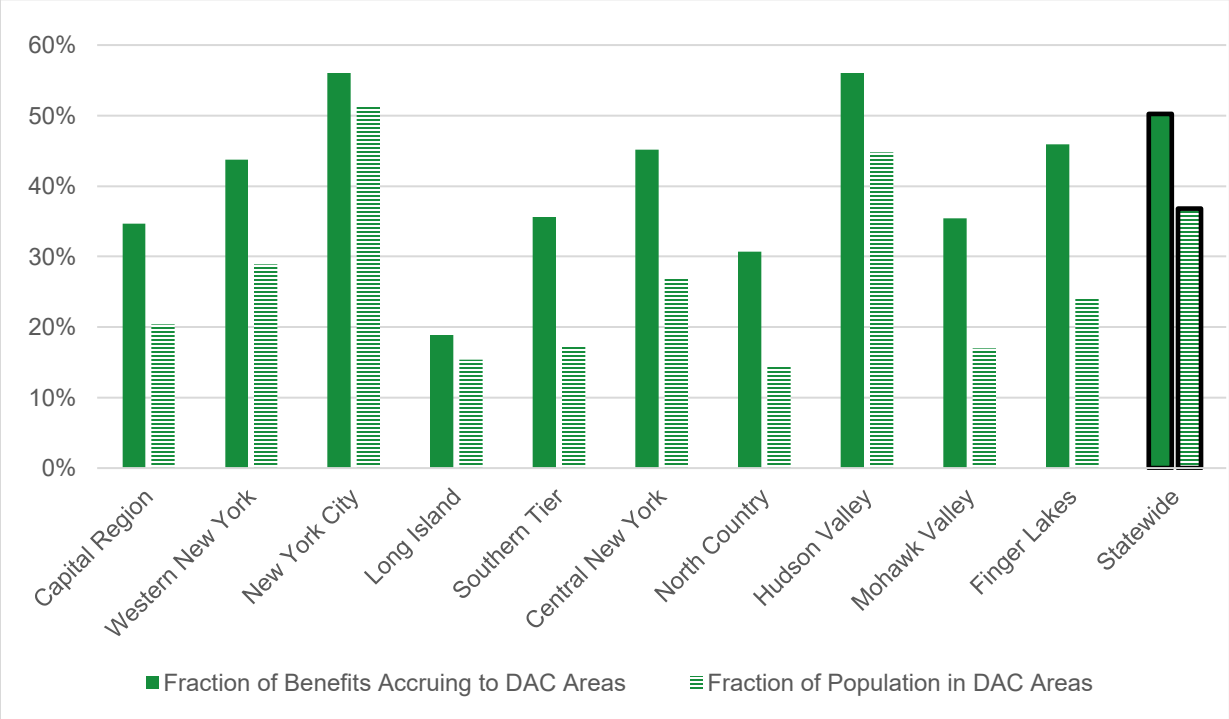
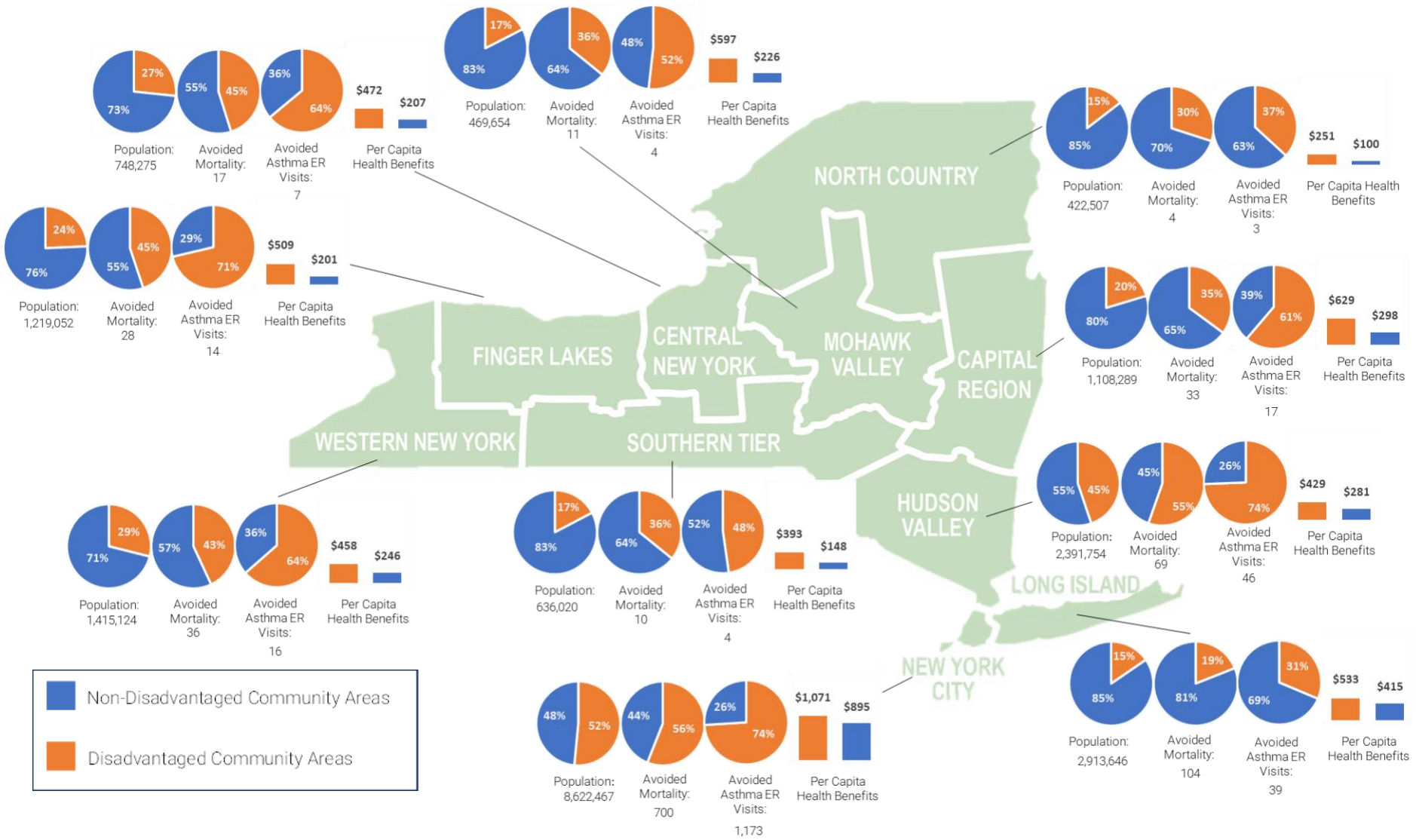


Figure 8 summarizes the physical benefits from lower $PM_{2.5}$ concentration experienced by geographic DACs in the 10 regions across the state from the Additional Action scenario relative to the No Action scenario in 2040. The pie charts show DAC and non-DAC area fractions of regional population, avoided premature mortality cases, and avoided asthma emergency room (ER) visits, with regional totals beneath each pie chart. The bar charts show annual per capita monetary values for DAC and non-DAC areas for each region, representing the combined value of all avoided health effect types. The fraction of health benefits experienced within DAC areas are expected to be greater than their fraction of the population and per-capita benefits would be higher in DAC areas relative to non-DAC areas in every region of the state. While the per-capita values vary in magnitude by scenario, DAC areas are estimated to receive greater per capita benefits compared to non-DAC areas in all scenarios. See the appendix to this chapter for additional details for other scenarios. Figure 8 shows annual benefits for 2040 only, but DAC and non-DAC area fractional benefits are similar in other years.

Figure 8. Summary of Annual Public Health Benefits from Lower $PM_{2.5}$ Concentrations (Additional Action Scenario Relative to the No Action Scenario, 2040)



3.3. Health Benefits by Sector

For the three policy scenarios, the building and transportation sectors together account for most of the statewide public health benefits from lower $PM_{2.5}$ concentrations relative to the No Action scenario by 2040 (Figure 9), with increasing benefits from other sectors in the Additional Action and Net Zero B scenarios, respectively. The 2025–2040 cumulative statewide benefits from buildings account for 72 percent of the benefits from Current Policies, 59 percent of the benefits from Additional Action and 71 percent of the benefits from Net Zero B. The cumulative statewide benefits from transportation account for 21 percent, 30 percent, and 17 percent for Current Policies, Additional Action, and Net Zero B, respectively. As energy policies are implemented from 2025 to 2040, the magnitude of health benefits associated with emission reductions from all sectors increases over time under all three scenarios (Figure 11) (note the fractions of benefits from a given sector are affected both by the overall increase and by the relative increase in the sector). The contribution of different sectors as a fraction of the total benefits is shown by community type (Figure 9), as well as how it differs by region (Figure 10) and over time (Figure 11). These variations are described for each sector below. See the appendix to this chapter for additional information on all scenarios.

3.3.1. *Buildings*

The buildings sector accounts for 72 percent of the total statewide value associated with health benefits from $PM_{2.5}$ from 2025 to 2040 under Current Policies, 59 percent under Additional Action, and 71 percent of the total value under Net Zero B. The health benefits associated with the buildings sector is dominated by lower emissions in the residential subsector relative to the No Action scenario, and commercial buildings represent a small contributor to benefits in the overall buildings sector. Residential benefits are mostly from less fossil fuel heating relative to the No Action scenario, with a substantial contribution from less residential wood combustion, which has outsized emissions relative to its energy use, and is more prevalent in upstate regions. While mitigation characterized by the Pathways Analysis is not focused on reducing wood combustion, benefits are associated with energy efficiency improvements along with reduction in the use of wood when cleaner heating systems are installed, and wood may continue to be used in a more limited way for supplemental heating. Despite the wood benefits representing a very small fraction of shift in energy use, the high emission factors associated with wood combustion result in outsized benefits relative to residential fossil fuels. Note, health benefits associated with buildings represent benefits from pollutant emissions reductions in outdoor air; additional health benefits from lower pollutant emissions in indoor air are not included in this analysis and would be expected to provide additional benefits.

Figure 11 shows the benefits associated with the buildings sector increase from 2025 to 2040. Under all policy scenarios, the fractional benefits from the residential subsector, including from both lower fossil fuel and wood combustion emissions, would increase over time as buildings decarbonize and increase energy efficiency (see Figure 2). The fractional benefits from buildings relative to other scenarios would be greatest under Current Policies and Net Zero B. Under Net Zero B, residential and commercial heat pumps would reach 100 percent sales share by 2035, whereas in Current Policies, absolute benefits from all sectors are lower and buildings account for a larger relative fraction (Figure 11). However, even under the Additional Action scenario, while emission reductions from buildings are slightly lower in magnitude

compared to Net Zero B, reductions in fossil fuel heating account for a large fraction of benefits (53 percent) in New York City (Figure 10).

Figure 9. Cumulative Societal Value from Lower In-State $PM_{2.5}$ Concentrations by Sector and Scenario Relative to the No Action Scenario, and Additional Breakdown for DAC Areas vs. Non-DAC Areas for Additional Action (2025–2040)

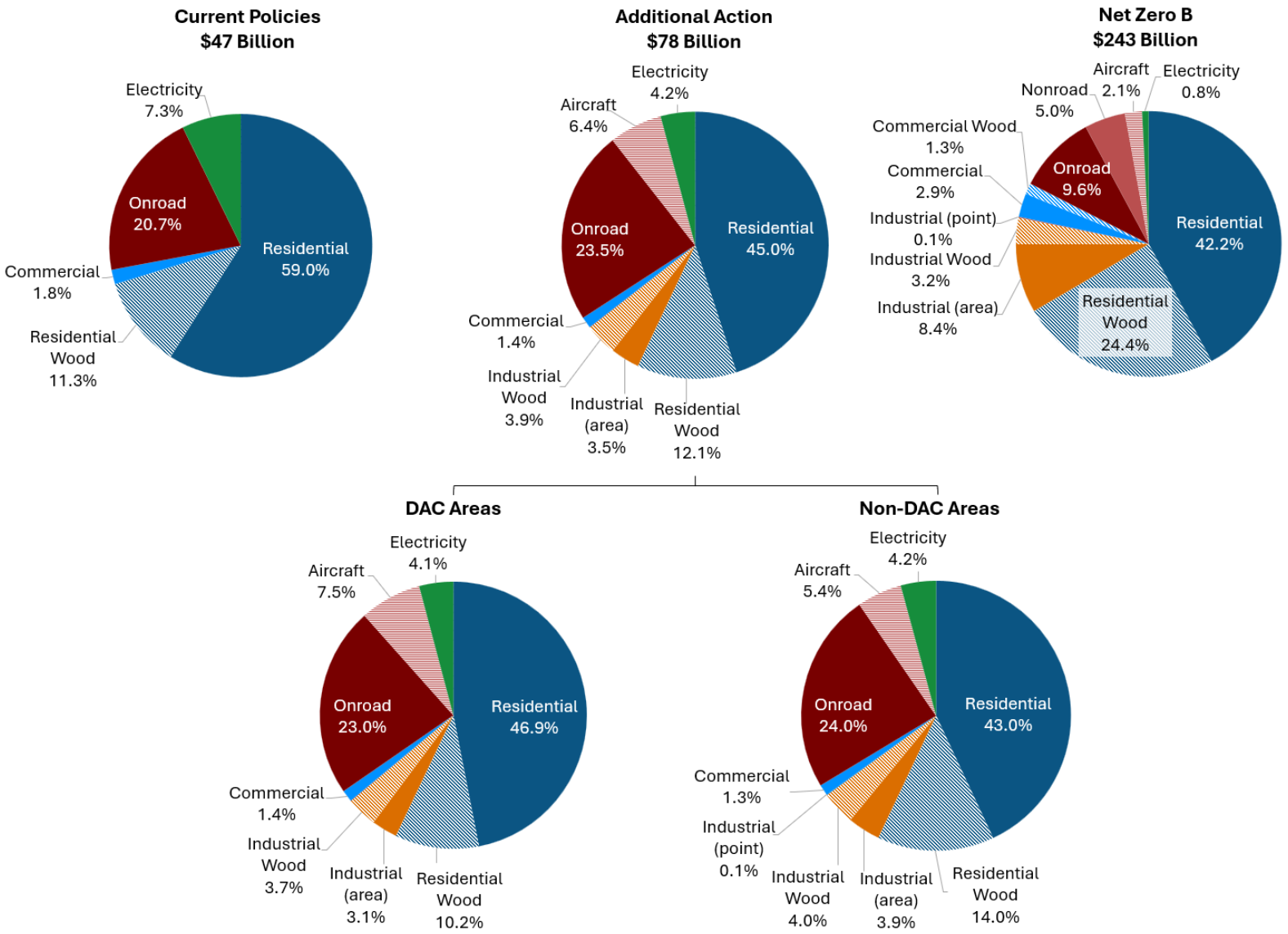


Figure 10. Distribution of the Cumulative Value of Benefits from Lower In-State $PM_{2.5}$ Concentrations by Region and Sector (Additional Action Scenario Relative to the No Action Scenario, 2025–2040)

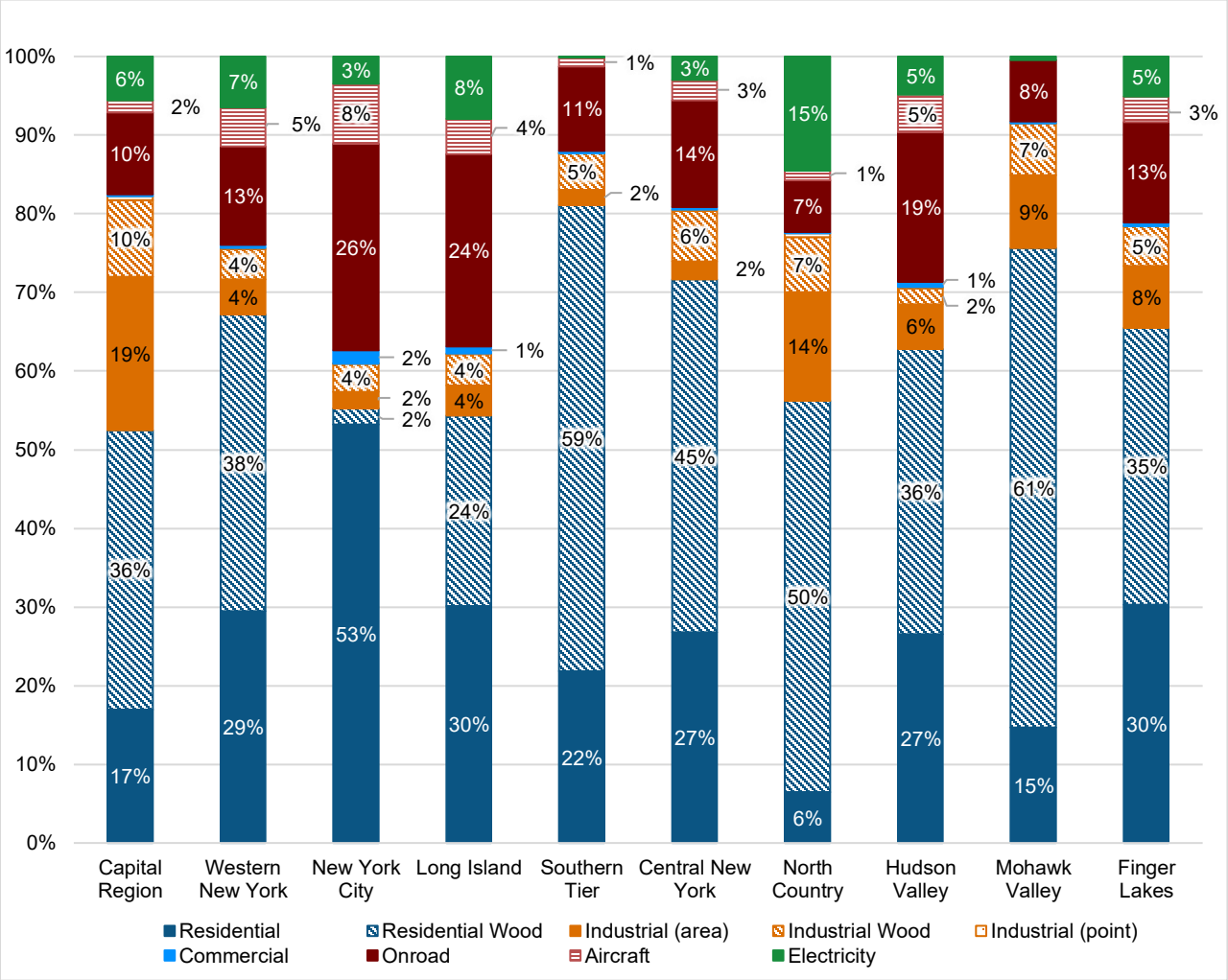
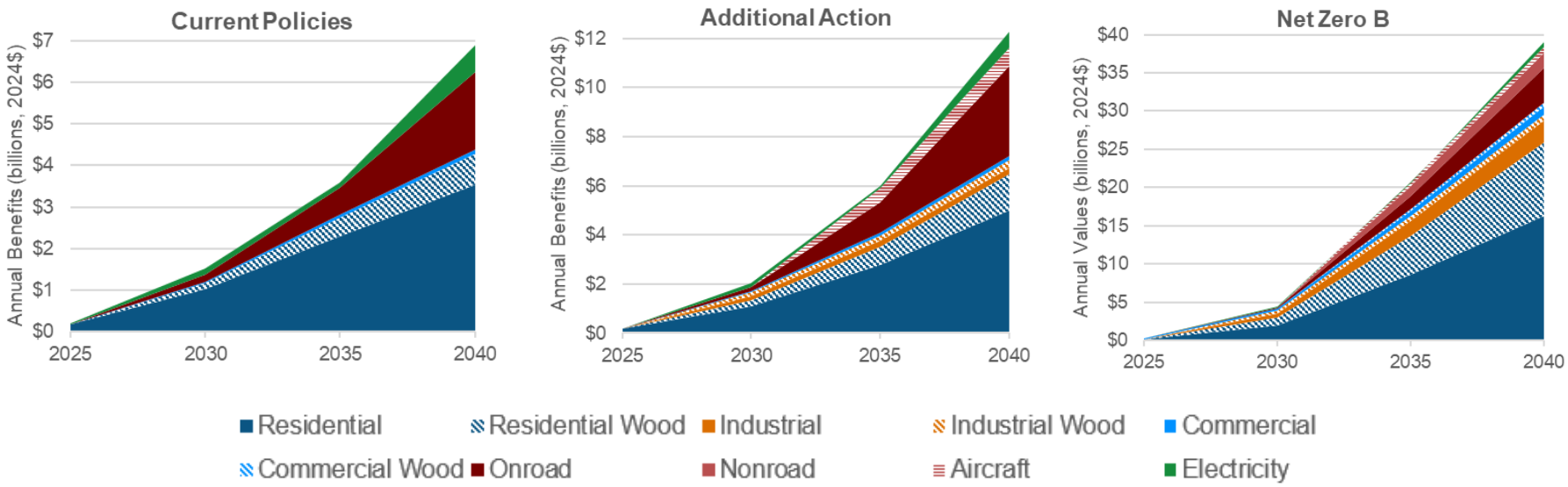


Figure 11. Distribution of Annual Value of Benefits from Lower In-State $PM_{2.5}$ Concentrations by Sector and Scenario Relative to the No Action Scenario (2025-2040)



Regionally, lower emissions from residential wood relative to the No Action scenario account for most residential buildings benefits in some upstate regions including Southern Tier, Central New York, North Country, and Mohawk Valley under Current Policies and Additional Action (Figure 10). Emissions from commercial wood combustion under Current Policies and Additional Action are the same as in the No Action scenario. Under Net Zero B, lower emissions from commercial wood relative to the No Action scenario account for approximately 1 percent of the benefits starting in 2035.

DAC and non-DAC areas would experience a similar fraction of benefits from lower emissions from buildings overall; however, under all scenarios, more of the benefits accruing in DAC areas would be from less fossil fuel heating than from less residential wood heating relative to the No Action scenario, which is more prevalent in non-urban areas with lower geographic DAC populations.

3.3.2. *Transportation*

On-road vehicles account for 21 percent, 24 percent, and 12 percent of the total statewide value associated with health benefits from $PM_{2.5}$ from 2025 to 2040 under Current Policies, Additional Action, and Net Zero B, respectively. The transportation sector will undergo varying degrees of transformation under the policy scenarios as zero emission vehicle stock shares grow over time from 2030 to 2040 and benefits from on-road vehicles increase over time in all scenarios (Figure 11). The impact of the loss of federal EV tax credits is explored in Section 3.5. Regionally, relative benefits from lower emissions from on-road vehicles relative to the No Action scenario are larger in urban regions where denser road networks are geographically closer to populations compared to rural regions.

The use of sustainable aviation fuel (SAF) is expected to lower air pollutant emissions near airports, and the impacts from the use of SAF were modeled in NY-CHAPPA (see the appendix to this chapter). SAF accounted for 15.1 TBtu and 14.9 TBtu of the total projected fuel for domestic flights in 2035 under Additional Action and Net Zero B, respectively, and 32.2 TBtu and 31.4 TBtu of the total jet fuel for domestic flights in 2040 under Additional Action and Net Zero B, respectively. Lower emissions from the use of SAF relative to the No Action scenario account for approximately 6 percent and 2 percent of total 2025–2040 projected benefits under Additional Action and Net Zero B, respectively. A small portion of the projected aircraft benefits from Net Zero B are due to decreases in total jet fuel use in addition to the use of SAF. Health benefits from SAF would likely be pronounced in areas surrounding large airports and have a notably larger benefit within DACs in areas like New York City.

In addition to aircraft, other emissions from the non-road sector include marine, rail, and non-road engines used in construction, agriculture, and mining. The non-road sector accounts for approximately 5 percent of the total value associated with health benefits from $PM_{2.5}$ from 2025 to 2040 under the Net Zero B scenario only and does not contribute benefits under the other scenarios where non-road emissions are the same as the No Action scenario. As described in the appendix to this chapter, data on non-road sources are limited, particularly for non-road equipment, so the estimates of exposure to and potential for emission reductions from this sector are likely conservative. Furthermore, given the uncertainty regarding location of non-road engines over the years (e.g., construction) and model limitations regarding emission reduction projections for specific facilities, there are likely more benefits

from this sector and varying distribution of those benefits by community that cannot be represented in this analysis.

DAC and non-DAC areas would experience a similar fraction of benefits from lower emissions in the transportation sector overall under all scenarios (Figure 9). Note that benefits from lower emissions from on-road vehicles were not differentiated by vehicle type (i.e., light duty versus medium and heavy duty) in this analysis. Benefits in DAC areas from SAF are more than double the benefits compared to non-DAC areas per capita under both the Additional Action and Net Zero B scenarios in which SAF is included.

3.3.3. *Electricity*

The electricity sector accounts for 7 percent, 4 percent, and 2 percent of the cumulative health benefits from 2025 to 2040 under Current Policies, Additional Action, and Net Zero B, respectively. Under all three scenarios, the electric sector will undergo changes in annual loads and resource mix. For example, electricity accounts for approximately 8 percent of benefits in 2030 and 5 percent in 2040 under the Additional Action scenario (Figure 11). This temporal pattern reflects the varying timelines in which different sectors decarbonize and changes in annual loads (see the Pathways Analysis chapter of this Plan). Under all policy scenarios, there are lower emissions from the electricity sector relative to the No Action scenario, but in the earlier model years before 2040, these reductions are tempered by increased load from other sectors, which are expected to increasingly electrify.

Furthermore, while there are substantial emission reductions relative to the No Action scenario in the electricity sector, as shown in Figure 2, above, the resulting air quality and public health benefits from this sector are smaller compared to other sectors. This is due in part to the fact that emissions from the electricity sector tend to be released from taller smokestacks, which disperse the emissions more broadly than other sectors, such as residential buildings or on-road vehicles, which release their emissions at or near the ground level. In addition, emissions from the electricity sector are, in some cases, released in less densely populated areas, while the emissions from the residential and on-road sectors tend to be released in more densely populated areas.

The cumulative benefits from reduced emissions from electricity are similar in DAC areas and non-DAC areas statewide (Figure 9). Regionally, benefits from the electric sector are a larger fraction of relative benefits in the North Country, Long Island, and Western New York regions, compared to relative benefits from electricity in other regions (Figure 10). However, in absolute terms, the New York City, Long Island, and Hudson Valley regions have the highest benefits from lower emissions in the electricity sector.

A subset of the benefits from lower electricity sector emissions in the policy scenarios relative to the No Action scenario are from lower emissions from combustion turbines (CTs) and steam turbines (STs),[12] that typically operate to provide electricity during times of highest electricity demand. Lower emissions from these plants account for approximately 35 percent, 37 percent, and 45 percent of the projected cumulative (2025-2040) benefits from the electricity sector, for the Current Policies, Additional Action, and Net Zero B scenarios, respectively. Lower emissions from facilities that generate baseload power account for the remainder of the benefits in the electricity sector. Note that the share of the benefits from lower emissions from CTs and STs changes over time relative to facilities that generate baseload power. For example, in the Additional Action scenario, lower emissions from CTs and STs account for 56

percent of the benefits from the electricity sector in 2030, decreasing to 20 percent by 2040. This is due in part to the fact that many of these plants are retired over time in the No Action scenario, which reduces the impact of lower emissions from the policy scenarios relative to the No Action scenario in the later years.

Note that the scenarios considered here assume hydrogen combustion starting in 2040 for the remaining thermal generation needs. The analysis conservatively assumed that emission rates of NO_x from those sources (emissions per unit of energy) would be double those from similar natural gas units, though indications are that hydrogen-specific combustion turbines, control technology, and other approaches can mitigate the bulk of this impact. NO_x is a precursor contributing to the formation of $PM_{2.5}$ and ozone, and therefore the assumption of higher NO_x emissions conservatively results in higher $PM_{2.5}$ and ozone concentrations. However, given the elimination of direct $PM_{2.5}$ emissions from hydrogen combustion, this change still has a net positive effect on air pollutant formation and health outcomes.

In addition, due to some differences in electric sector model representation in the later years of the Pathways Analysis, the benefits from the electric sector in 2040 may be somewhat conservatively low (see the appendix).

3.3.4. *Industry*

Both No Action and Current Policies include the same energy efficiency and fuel switching policies in the industrial sector, so only Additional Action and Net Zero B show the value associated with benefits from industry relative to No Action from 2025-2040 (Figure 9). Additional Action includes modest energy efficiency improvements for industry over Current Policies, resulting in approximately 7 percent of total benefits from 2025–2040. Net Zero B includes additional electrification, conversion to hydrogen, and efficiency improvements for industry, resulting in approximately 12 percent of total benefits from 2025 to 2040. Of the industrial sources, industrial point sources account for a small fraction of benefits relative to other sources at a statewide level. Industrial area and wood sources account for similar fractional benefits under Additional Action, and industrial area sources account for increasing fractional benefits by 2040 compared to industrial wood under Net Zero B (Figure 11). Industrial sources account for larger fractional benefits in some upstate regions, including the Capital Region, Mohawk Valley, and North Country (Figure 10), and additional benefits to local communities may be larger than those aggregated to the regional level shown here. Additional benefits from potential reductions in emissions of toxic air pollutants from industrial sources where not modeled as part of this analysis.

3.4. Societal Value of Total Public Health Benefits

The public health benefits from lower air pollutant concentrations described above are also evaluated as a societal value that can be combined into a single metric to evaluate and compare total public health benefits. Figure 12 shows the estimated public health benefits for 2025–2040 (net present value 2024$) from lower $PM_{2.5}$ and ozone concentrations under each scenario relative to the No Action scenario.[13] Geographic DAC areas receive 49–51 percent of the in-state net present value benefits from reduced $PM_{2.5}$ concentrations, depending on the scenario, which is a larger share of the benefits relative to their share of the population (37 percent). This is because most DAC areas benefit from greater emission reductions and these communities have higher baseline incidence rates for the health outcomes

analyzed, meaning air quality improvements in DAC areas will have a relatively larger effect in those areas compared to similar effects in non-DAC areas.

In addition to the benefits from lower in-state $PM_{2.5}$ concentrations estimated by NY-CHAPPA, the health analysis also applied EPA's COBRA tool to estimate additional benefits from lower ozone concentrations, both for New York State and other continental U.S. states, as well as the benefits to other states from lower $PM_{2.5}$ concentrations from state policies. Due to atmospheric transport of air pollutants, lower pollutant emissions in New York under the policy scenarios relative to the No Action scenario will result in lower pollutant concentrations and public health benefits downwind and outside of New York State in addition to the in-state benefits shown above. The air quality and public health benefits in other states from the policy scenarios relative to the No Action scenario tend to be concentrated in mid-Atlantic and Northeastern states, with the highest benefits in New Jersey, Connecticut, and Pennsylvania.

Figure 12 shows that most of the benefits from lower $PM_{2.5}$ and ozone concentrations would be experienced in New York State, accounting for 90 percent, 88 percent, and 84 percent of the total net present value (high value) of the benefits for the Current Policies, Additional Action, and Net Zero B scenarios, respectively. The combined in- and out-of-state ozone benefits tend to be relatively small compared to the $PM_{2.5}$ benefits, accounting for approximately 6 percent – 10 percent of the total net present value (low value) and approximately 3 percent – 5 percent of the total net present value (high value) of all benefits.

Figure 12. Net Present Value of Health Benefits from $PM_{2.5}$ and Ozone by Scenario Relative to the No Action Scenario and by In-State and Out-of-State Benefits (2025–2040)

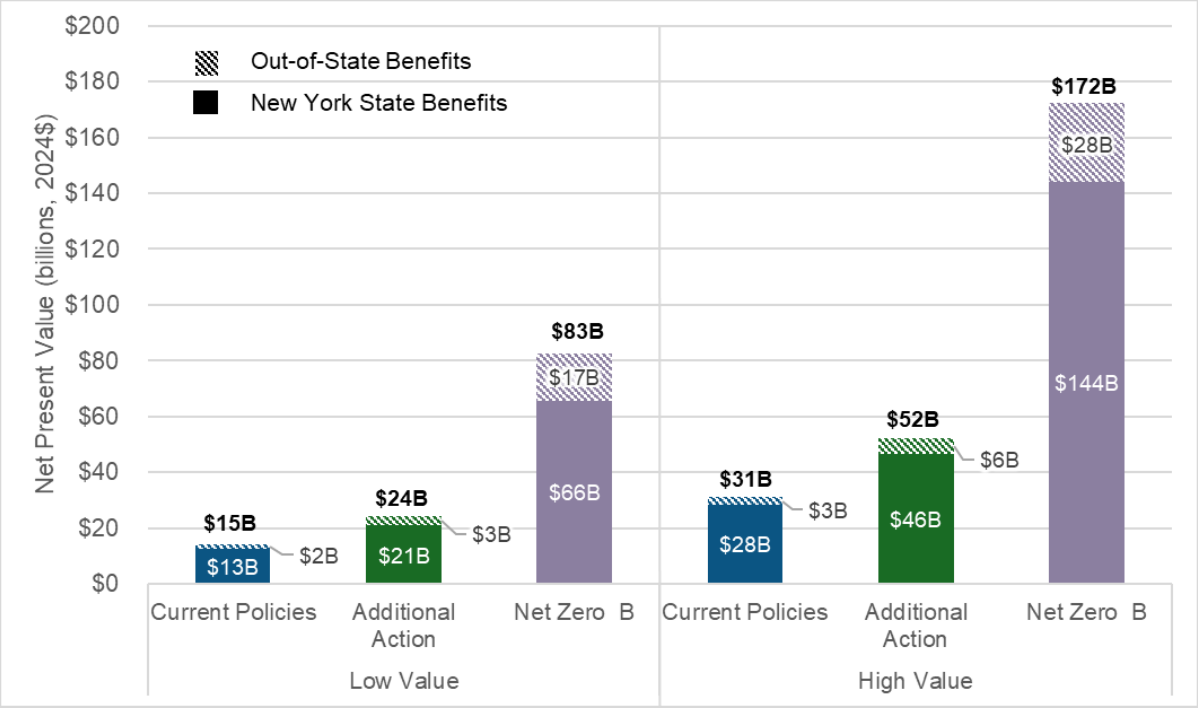
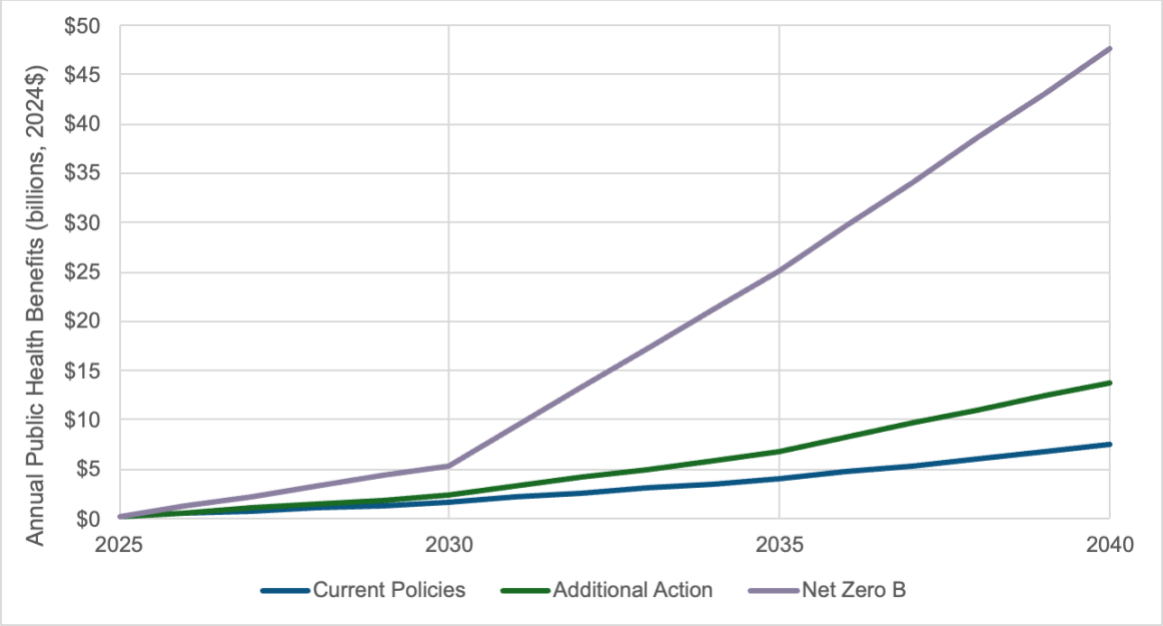


Figure 13 shows the total annual monetary value associated with lower $PM_{2.5}$ and ozone concentrations for each scenario between 2025 and 2040, including both in-state and out-of-state benefits. The modeling indicates that benefits will accrue at faster rates beginning in 2030 under the Net Zero B scenario and beginning in 2035 under Current Policies and Additional Action with the implementation of additional energy policies. By 2040, the total annual public health benefits associated with the Current Policies scenario are valued at more than $7.6 billion. For the same year, the Additional Action scenario projected benefits are valued at nearly $14 billion for the State—80 percent more than Current Policies. At over $47 billion, Net Zero B would provide the greatest amount of annual public health benefits for the State by 2040.

Figure 13. Annual Health Benefits Value from In- and Out-of-State $PM_{2.5}$ (High Value) and Ozone by Scenario Relative to the No Action Scenario (2025–2040)



3.5. Health Impacts of Federal Policies

In addition to the core scenarios, the health analysis also considered two sensitivities built off the Current Policies scenario, one that assesses the impact of federal policies already enacted and a second that evaluates potential impacts of future federal policy uncertainty (see Table 3 and the Pathways Analysis chapter for complete scenario descriptions). In general, there are fewer state policy backstops included in the Current Policies scenario compared to the other core policy scenarios (see Pathways Analysis chapter), so Current Policies is expected to be relatively more sensitive to changes in federal policies than the other policy scenarios.

Table 3. Sensitivity Scenario Descriptions

Sensitivity Scenario	Description
Current Policies **Pre-Federal Rollback**	Federal policies such as the Inflation Reduction Act are re-instated to illustrate what a Current Policies world would look like if federal policies were consistent with those in January 2025.
Current Policies with **Further Federal Rollback**	Explores the potential for future federal policy rollbacks that could negatively impact State energy and climate objectives, including the repeal of the Advanced Clean Cars/Trucks waiver and appliance standards.

3.5.1. *Impacts of Federal Policies on Public Health Benefits*

Figure 14 shows the 2025–2040 cumulative avoided cases of premature mortality (from $PM_{2.5}$ and ozone), nonfatal heart attacks (from $PM_{2.5}$ only), and emergency room visits for asthma (from $PM_{2.5}$ and

ozone) for Current Policies and the two sensitivity scenarios, all relative to the No Action scenario. Physical health benefits under the Pre-Federal Rollback scenario would have been approximately 50 percent greater than under the Current Policies scenario, and under the Further Federal Rollback scenario, physical health benefits would be approximately 30 percent lower than under the Current Policies scenario.

While the magnitude of changes in fuel consumption under the federal sensitivity cases are modest relative to the total fuel consumption in the Current Policies scenario (see Pathways Analysis chapter), the relationships between air pollution exposure and health impacts, accounting for population and baseline health incidence, mean that small changes in fuel consumption are magnified when translated to health impacts (see appendix to this chapter for additional information on health impact functions).

Figure 14. Statewide Cumulative Avoided Cases from Lower $PM_{2.5}$ and Ozone Concentrations by Scenario Relative to the No Action Scenario (2025–2040)

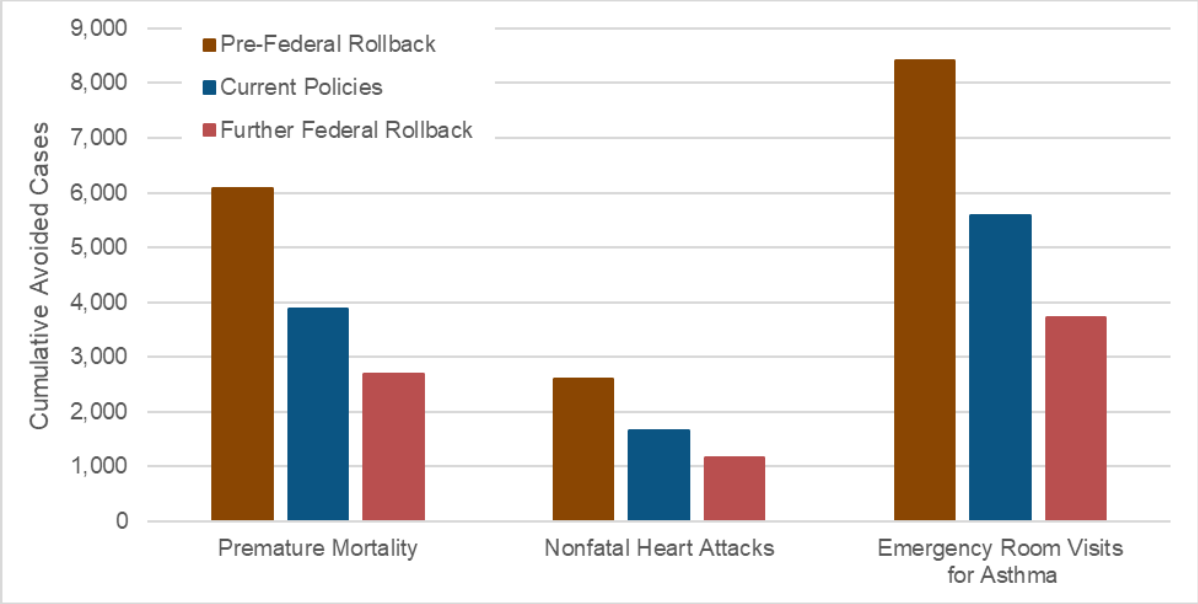
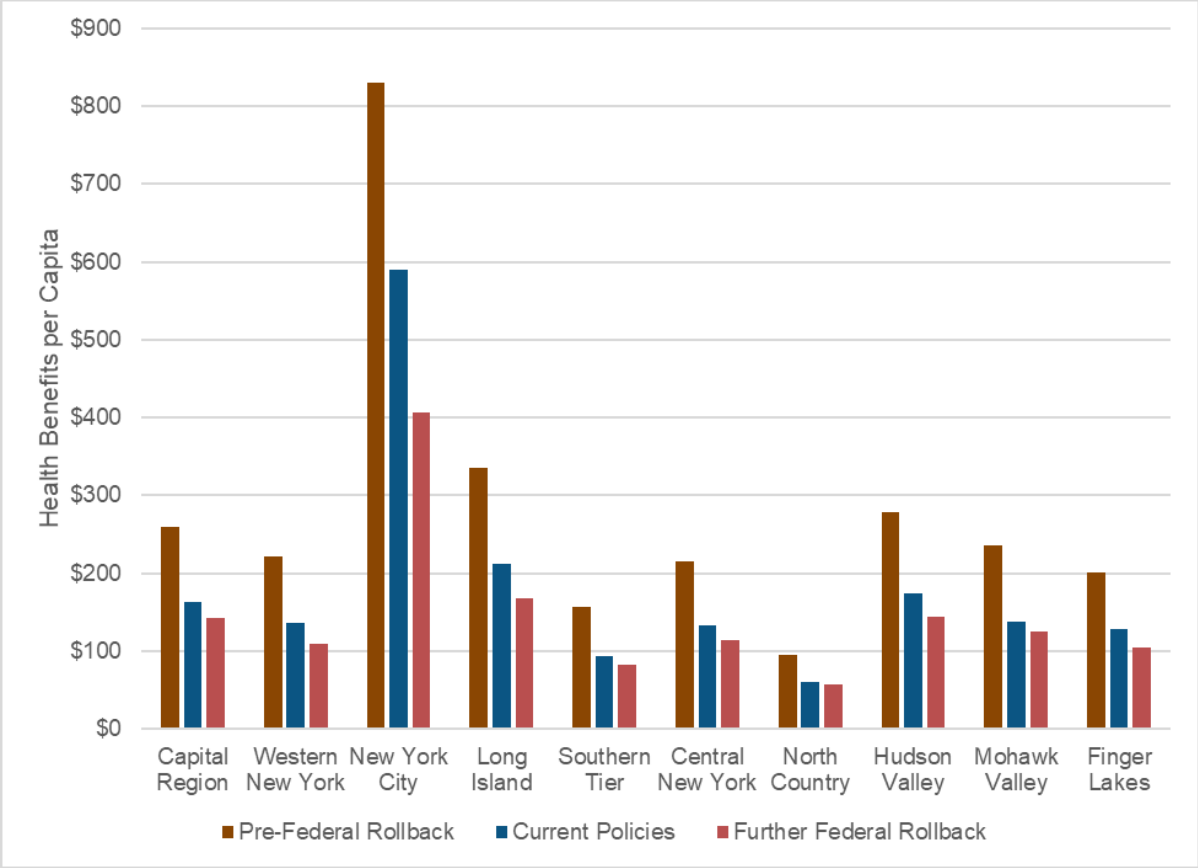


Figure 15 shows federal policies impact public health benefits in all regions of the state. The distribution of physical health benefits accruing within DAC and non-DAC areas under the two sensitivity cases is expected to be similar to the distribution under the Current Policies scenario. While the geographic distribution of benefits under the federal sensitivity cases is similar to Current Policies, there are some regional differences. Under the Current Policies scenario, 74 percent of the physical health benefits in 2040 accrue in New York City. Under the Pre-Federal Rollback scenario, 66 percent of the additional benefits would accrue within New York City and 34 percent in the rest of the state. Lower benefits under a potential Further Federal Rollback scenario would have a greater impact on New York City, which would see 83 percent of the disbenefits (see the appendix to this chapter and data annex for additional information by region and county).

Figure 15. Per Capita Annual Health Benefits from Lower $PM_{2.5}$ Concentrations by Region and Scenario Relative to the No Action Scenario (2040)



3.5.2. *Impacts of Federal Policies by Sector*

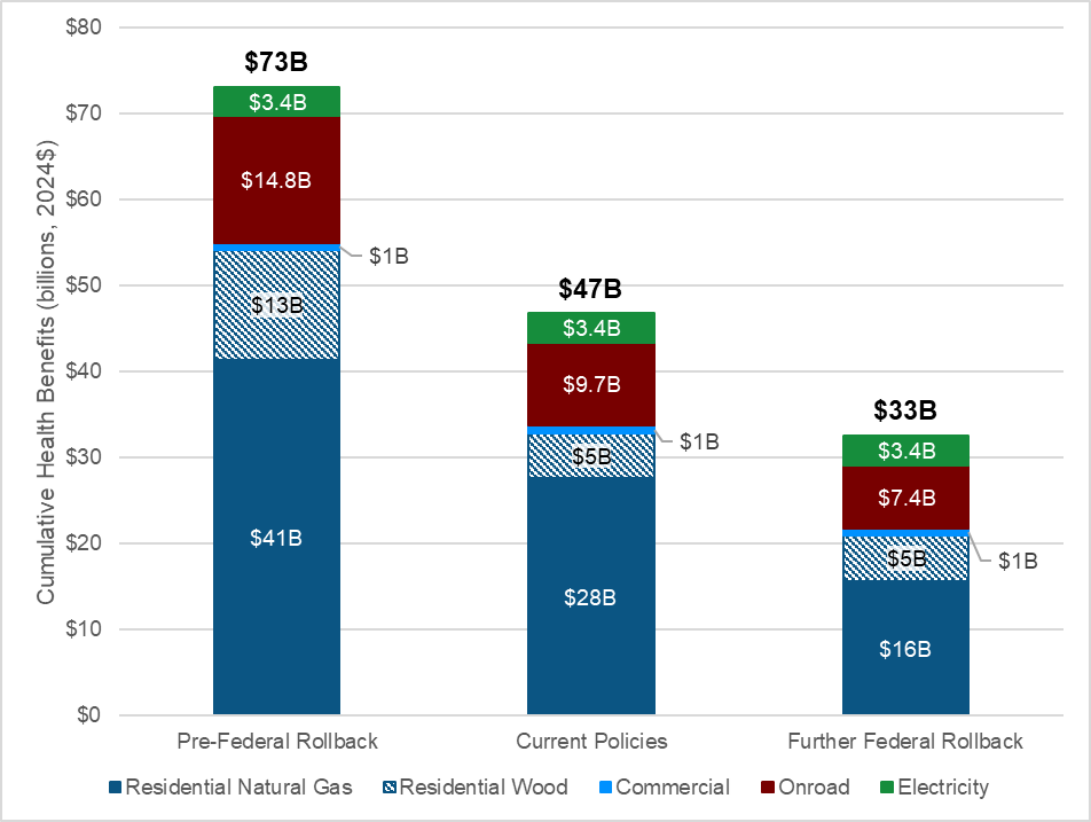
The federal sensitivity cases explored the impacts of federal policies on the electricity, on-road transportation, and building sectors (see Pathways Analysis chapter). The impact of federal policies on health benefits from the electricity sector is expected to be small, given the 0x40 State backstop, so the health analysis uses the same electric sector emissions for the sensitivity scenarios as in the core Current Policies scenario and does not attribute additional health impacts to the electric sector.

The residential buildings and on-road transportation sectors account for 91 percent of statewide health benefits from $PM_{2.5}$ under the Current Policies scenario (see Section 3.3). In the Pre-Federal Rollback scenario, federal support for EVs, heat pumps, and energy efficiency as of January 2025 are included, as compared to the Current Policies scenario that includes State and local policies including ACCII/ACT, building regulations, and state incentives for EVs, heat pumps, and energy efficiency. The Further Federal Rollback scenario explores the impacts of repealing the ACCII/ACT waiver and Department of Energy appliance standards.

Figure 16 illustrates how sensitive each sector's public health benefits are to the federal policies described above. Benefits from both the on-road transportation and residential sector are highly

sensitive to the federal policy changes explored here, particularly benefits from changes in natural gas heating compared to Current Policies. Health benefits from the commercial sector are minimally affected by the federal policy changes explored in these scenarios.

Figure 16. Cumulative Societal Value from Lower In-State $PM_{2.5}$ by Sector and by Scenario Relative to the No Action Scenario (2025-2040)



The Pre-Federal Rollback scenario would add $26.4B in additional cumulative statewide health benefits from $PM_{2.5}$ from 2025-2040. The residential sector accounts for 80 percent of those additional benefits, with lower natural gas fuel combustion accounting for 52 percent ($13.8B) and lower wood fuel combustion accounting for 28 percent ($7.4B). Inclusion of federal support for electrification and weatherization of residential buildings would result in the Pre-Federal Rollback scenario achieving the 2040 residential sector health benefits for Current Policies ($32.9B) in 2034, 6 years earlier. The on-road transportation sector accounts for the remainder of the additional benefits achieved by the Pre-Federal Rollback scenario, $5.1B or 19 percent. Inclusion of federal EV tax credits would accelerate the achievement of ACCII ZEV goals to 2039, 4 years earlier than Current Policies (2043). As a result, the Pre-Federal Rollback scenario achieves the 2040 on-road transportation health benefits for Current Policies ($9.7B) in 2037, 3 years earlier.

Compared to the State and local backstops of the Current Policies, the Further Federal Rollback scenario would decrease cumulative statewide health benefits from $PM_{2.5}$ from 2025-2040 by $14.2B, a 30 percent decrease from Current Policies. The residential sector accounts for 83 percent of the decrease in benefits, mostly from higher natural gas fuel consumption ($12B). The Further Federal Rollback scenario

would achieve the 2040 residential sector health benefits for Current Policies ($32.9B) in 2044, delaying achievement by 4 years. The on-road transportation sector accounts for the remainder of the reduction in benefits in the Further Federal Rollback scenario, amounting to $2.3B or 16 percent. The Further Federal Rollback scenario would achieve the 2040 on-road transportation health benefits for Current Policies ($9.7B) in 2044, delaying achievement by 4 years.

3.5.3. *Impacts of Federal Policies on the Societal Value of Health Benefits*

Figure 17 shows the impact of federal policies on the value of public health benefits in 2040, including in- and out-of-state benefits from $PM_{2.5}$ and ozone, as described above. Under the Current Policies scenario, the annual value of benefits would reach $7.6 billion in 2040. The inclusion of federal policies under the Pre-Federal Rollback scenario would increase 2040 health benefits by $3.6 billion compared to Current Policies for a total of $11.2 billion, a 47 percent increase. If federal policies were further rolled back as illustrated under the Further Federal Rollback scenario, 2040 health benefits would decrease by $2.0 billion compared to Current Policies for a total of $5.6 billion, a 27 percent decrease.

Figure 17. Annual Health Benefits Value from In- and Out-of-State $PM_{2.5}$ and Ozone by Scenario Relative to the No Action Scenario (2040)

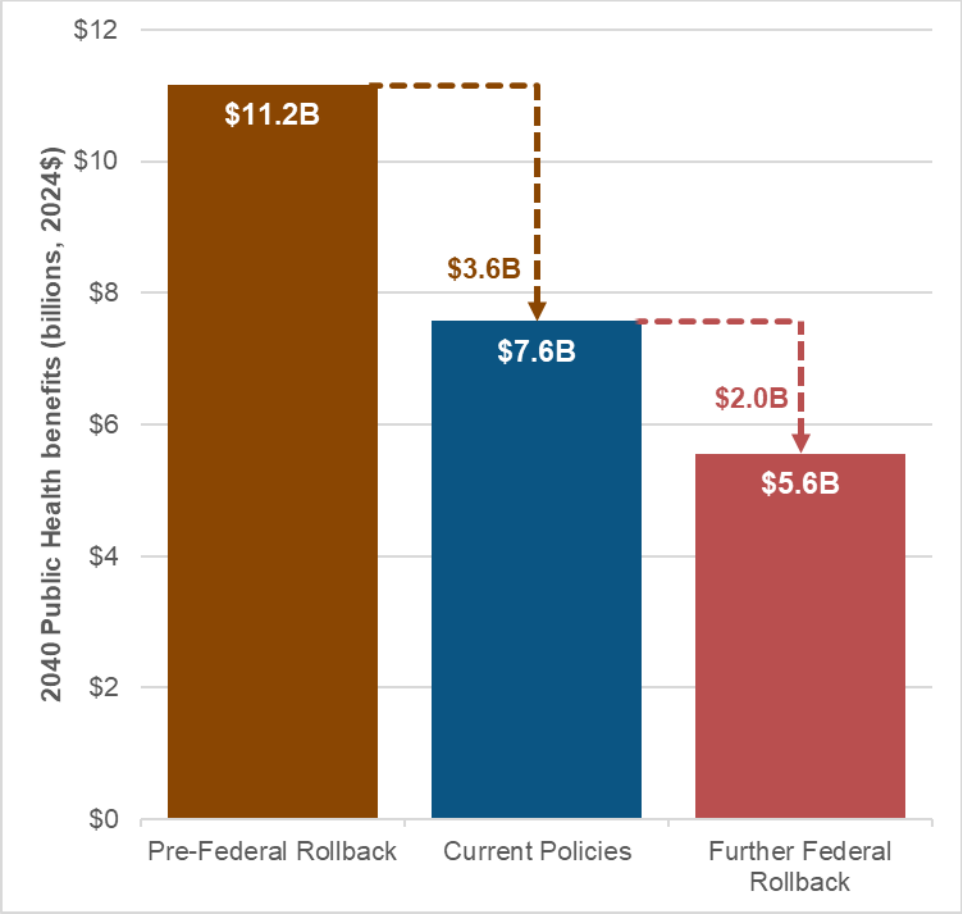


Figure 18 shows the estimated public health benefits for 2025–2040 (net present value 2024$) from lower $PM_{2.5}$ and ozone concentrations under each scenario relative to the No Action scenario. The 2025–

2040 cumulative societal value of the health benefits from reductions in $PM_{2.5}$ and ozone under Current Policies is $31 billion (net present value, 2024$). The Pre-Federal Rollback scenario would add $19 billion in 2025-2040 total benefits, while the Further Federal Rollback would reduce total benefits by $9.5 billion. The distribution of health benefits accruing in-state versus out-of-state under the two sensitivity cases is expected to be similar to the distribution under the Current Policies scenario (approximately 90 percent of benefits accrue in-state and 10 percent accrue out-of-state).

Figure 18. Net Present Value of Health Benefits from $PM_{2.5}$ and Ozone by Scenario Relative to the No Action Scenario and by In-State and Out-of-State Benefits (2025–2040)

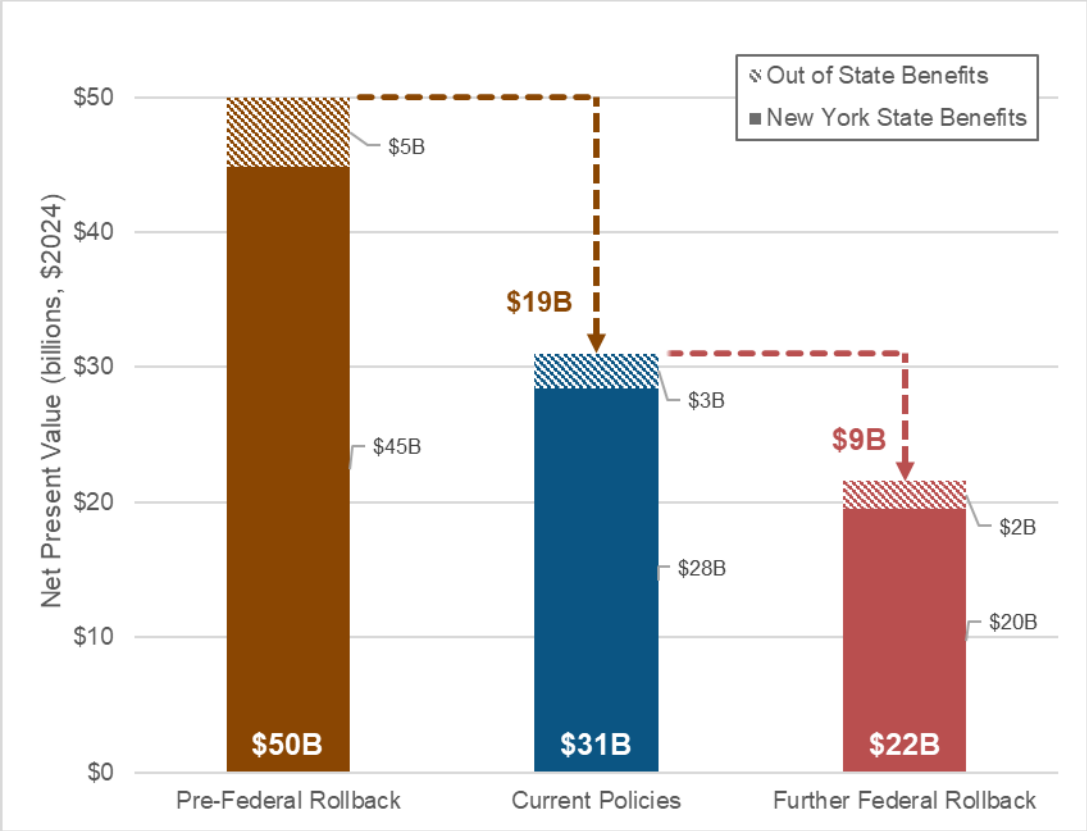
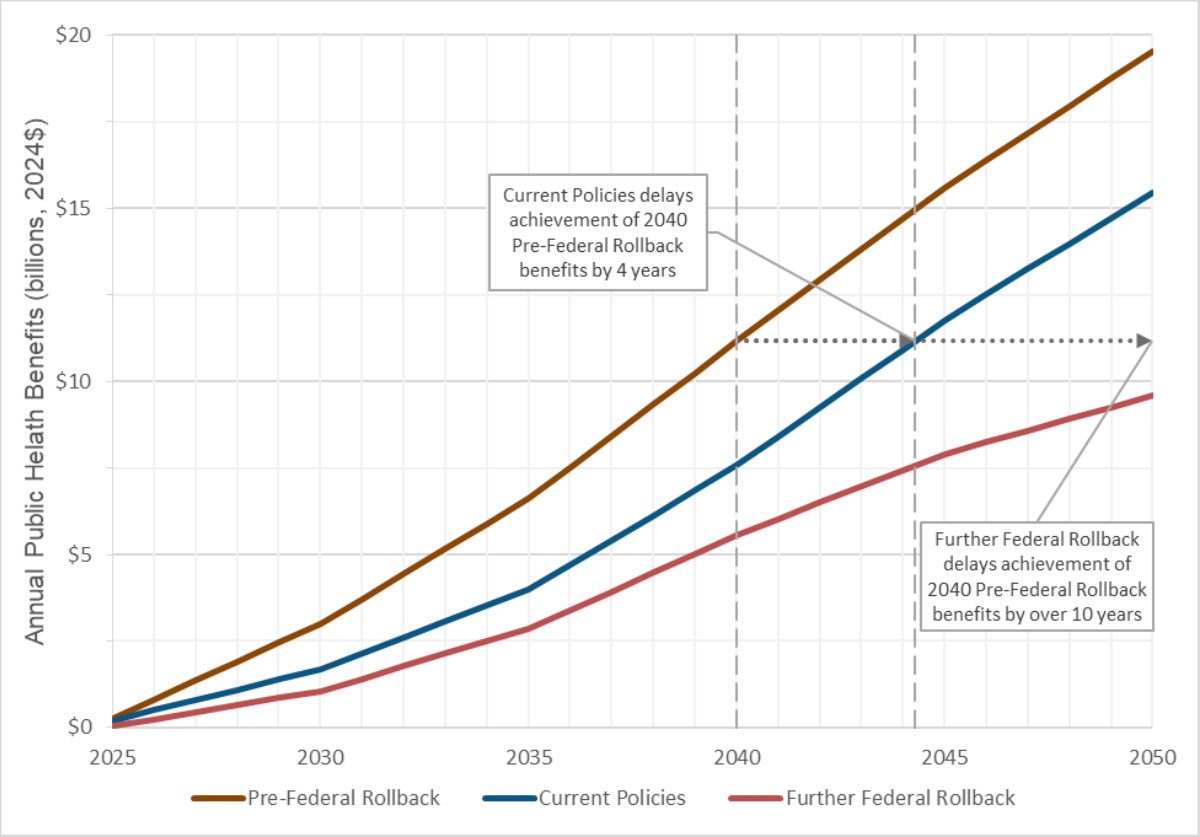


Figure 19 shows the total annual value associated with lower $PM_{2.5}$ and ozone concentrations for each scenario from 2025 to 2050, including both in-state and out-of-state benefits. Compared to the health benefits that would have been achieved under the Pre-Federal Rollback scenario in 2040 ($11 billion), the federal rollbacks in the Current Policies scenario delay achievement of the same level of benefits by 4 years and the Further Federal Rollback scenario would further delay achievement of the same level of benefits beyond 2050.

Figure 19. Annual Health Benefits Value from In- and Out-of-State $PM_{2.5}$ (High Value) and Ozone by Scenario Relative to the No Action Scenario (2025–2050)



4. Summary of Public Health Analysis Results

All three scenarios of the Plan considered in this health analysis (Current Policies, Additional Action, and Net Zero B) are projected to result in air quality improvements and public health benefits in all regions of the state relative to the No Action scenario absent New York State policies under the Climate Act.

4.1. Statewide Health Benefits

Economywide reductions in fuel combustion would lead to lower $PM_{2.5}$ and ozone concentrations throughout the state, benefiting public health across a range of outcomes including reducing premature mortality, hospitalizations, emergency department visits, and cases of various respiratory conditions. From 2025 to 2040, health benefits increase over time under all scenarios. For example, under Additional Action, avoided premature mortality increases from less than 200 cases annually in 2030 to over 1,000 cases annually in 2040.

Cumulative physical health benefits under the Additional Action scenario would be 60 percent higher than the benefits from the Current Policies scenario, and physical benefits under the Net Zero B scenario would be approximately triple those from the Additional Action scenario. The differences in the magnitude of health benefits between scenarios reflects the differences in each scenario's energy policies.

4.2. Benefits in DAC Areas

In all scenarios, a larger share of physical health benefits accrues to the state's geographic DAC areas compared to their share of the population (statewide and in every region). DAC areas generally benefit from greater improvements in air quality, and DACs have higher baseline incidence rates for the health outcomes analyzed, meaning DAC areas receive a larger proportion of health benefits. As an example, DAC areas would experience approximately 72 percent of avoided emergency room visits for asthma under all scenarios, which is significantly higher than their fraction of the statewide population (37 percent).

Air quality improvements are generally greater in DAC areas in all three scenarios. In the New York City region, while there are differences in local exposure, DAC and non-DAC areas would experience similar annual average $PM_{2.5}$ concentration reductions. DAC areas in general benefit from larger reductions in $PM_{2.5}$ concentrations because in most regions, those communities tend to be clustered in urban areas that would experience larger emissions changes and have higher population density.

4.3. Benefits by Region

There would be air quality improvements in every region of the state under all scenarios relative to the No Action scenario. Urban areas of the state would experience the largest air quality improvements because those areas have higher air pollutant emissions. Larger reductions in pollutant concentrations combined with higher populations in urban areas mean these areas would experience greater physical health benefits. For these reasons, the New York City region would experience the largest physical health benefits across all three scenarios.

4.4. Benefits by Sector

Emission reductions from buildings and transportation account for most statewide benefits under all scenarios, with a larger fraction associated with building emissions in the Net Zero B scenario. From 2025–2040, cumulative benefits from lower emissions from residential fossil fuel heating account for 43-59 percent of benefits across all scenarios, and benefits from lower emissions from on-road vehicles account for approximately 21-24 percent of benefits under Current Policies and Additional Action.

In urban areas where total air pollutant emissions under the No Action reference scenario are higher, there are larger reductions in air pollutant concentrations. In these areas, lower emissions from on-road vehicles and residential fossil fuel heating account for most of the benefits. In upstate regions, lower emissions from buildings account for the largest fractional share of benefits, and in these regions most of these benefits are from lower emissions from residential wood heating. While air pollutant concentrations are generally lower in these regions, less residential wood combustion has an outsized impact on air quality and ensuing public health benefits because of their larger emissions of $PM_{2.5}$ relative to other local sources, despite not representing a focus of mitigation policies and a small part of the energy transition.

While DAC and non-DAC areas have similar fractional benefits from buildings overall across scenarios, more of the benefits accruing to DAC areas are from residential fossil fuel heating than from residential wood. DAC and non-DAC areas have similar fractional benefits from transportation overall across

scenarios. Benefits in DAC areas from the use of sustainable aviation fuel are more than double the benefits compared to non-DAC areas per capita.

4.5. Societal Monetary Value of Health Benefits

The population-level physical public health benefits from all three policy scenarios of the Plan also translate to societal values. The 2025–2040 cumulative societal value of the health benefits from reductions in $PM_{2.5}$ and ozone is over $31 billion for Current Policies, over $52 billion for Additional Action, and over $172 billion for Net Zero B (net present value 2024$). The value of benefits is greatest for Net Zero B due to the higher level of ambition needed across all sectors to achieve the net zero by 2050 target under the Climate Act. The value of benefits increase from 2025–2040 but they do not accrue at a steady rate; rather, value associated with public health benefits accrues more rapidly after 2030 for Net Zero B, and after 2035 for Current Policies and Additional Action, reflecting the temporal pattern of lower emissions in the building and transportation sectors from the energy policies in the underlying scenarios (Figure 13). Most of the 2025-2040 cumulative benefits would be experienced in New York State, accounting for 84-90 percent of the total net present value of the benefits across scenarios.

Approximately 50 percent of the value of public health benefits would accrue to DAC areas under all scenarios, which is a larger share of the benefits relative to their 37 percent share of the geographic population. In each region of the state, the fraction of benefits accruing to DAC areas is also larger than their fraction of the region's population. All regions of the state would receive per capita benefits, and in all regions, higher per capita benefits accrue to DAC areas compared to non-DAC areas.

While these health benefits represent a substantial societal value, it is important to recognize that achieving some of these outcomes may require significant investment in the energy system. Ensuring that these costs are managed equitably – especially for low-income and energy-burdened households – will be critical. This analysis focuses on quantifying potential benefits to inform those broader cost-benefit and policy tradeoff discussions.

4.6. Impacts of Federal Policy

Federal energy policies are projected to impact the public health benefits experienced by New York State. Compared to the Current Policies scenario, if federal policies consistent with those in January 2025 were re-instated, 2025-2040 cumulative public health benefits would have been approximately 50 percent greater. If some federal policies were further rolled back, 2025-2040 cumulative public health benefits could be up to 30 percent lower compared to Current Policies. Under the federal sensitivity scenarios explored in the Plan, differences in statewide health benefits from $PM_{2.5}$ are due to differences in emissions from residential buildings and on-road vehicles. The inclusion of pre-rollback federal policies would increase the value of public health benefits in 2040, including in- and out-of-state benefits from $PM_{2.5}$ and ozone, by $3.6 billion compared to Current Policies ($7.6 billion), while further rollback of federal policies would decrease health benefits by $2.0 billion compared to Current Policies.

Appendix

1. Introduction

The public health analysis evaluated the potential for lower air pollutant emissions under three scenarios developed in the Pathways Analysis (Current Policies, Additional Action, and Net Zero B relative to the baseline No Action scenario) to affect changes in public health outcomes. The public health analysis followed the same basic approach used in the New York Scoping Plan,[14] while applying an improved analysis modeling framework.

The basic framework of the analysis is:

- Estimate reductions of air pollutant emissions based on changes in fuel consumption from the Pathways Analysis (see Pathways Analysis chapter of this Plan).
- Model changes in air quality resulting from reductions in air pollutant emissions.
- Model changes in public health effects resulting from changes in air quality.
- Calculate the value of the change in health effects using standard economic values.

A key difference from the approach used for the Scoping Plan is that this analysis was conducted using a newly developed air quality and health impacts modeling framework—the NY Community-Scale Health and Air Pollution Policy Analysis (NY-CHAPPA) model[15]—rather than using the Environmental Protection Agency's (EPA's) CO-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA)[16] to analyze health outcomes from changes in fine particulate matter ($PM_{2.5}$) concentrations. In addition, COBRA was used to evaluate the impact from changes in ozone concentrations at a county level (this is a new capability now available from COBRA but is limited to the county scale).

The NY-CHAPPA modeling framework estimates benefits at a sub-county scale, which enables evaluation of potential health benefits by community type, allowing evaluation of health effects within geographic disadvantaged community (DAC) areas as defined under the Climate Act.[17]

The health analysis modeled the change in air quality and ensuing health effects in five-year increments between 2025 and 2050, and the impact of the Plan focused on the Plan years (2025 to 2040).

This appendix describes the methodology used in the NY-CHAPPA modeling framework (Section 2), and detailed results of the health analysis (Section 3). The accompanying data annex provides additional data beyond those shown in Section 3.

2. Methodology

This section outlines the health analysis methodology. Section 2.1 describes the overall modeling framework, Section 2.2 describes the specific data inputs and scenarios used for the Plan health analyses, and Section 2.3 notes limitations and uncertainties of the health analysis methodology.

2.1. Modeling Framework

The modeling framework, NY-CHAPPA, was developed for NYSERDA by Abt Global and the University of North Carolina (UNC) to quantify how changes in $PM_{2.5}$ associated with lower air pollutant emissions such as those expected from decarbonization policies could impact health outcomes at the community scale.

The NY-CHAPPA modeling framework is based on the framework used by the Zip-code Air Pollution Policy Analysis tool (ZAPPA), also developed by UNC and Abt Global for NYSERDA and New York City.[18] The ZAPPA framework combines two existing models: Community Tools (C-TOOLS)[19] developed by UNC in collaboration with the EPA, and EPA's COBRA tool (v5.2). These existing models have been previously evaluated and have been used in dozens of peer-reviewed studies.[4,5,20] The sections below provide an overview of the statewide modeling framework developed for NY-CHAPPA.

The health analysis uses NY-CHAPPA v2.0, which updated the modeling framework as compared to the analysis in the Draft Plan, which used NY-CHAPPA v1.0. NY-CHAPPA v1.0 used 2010 census tracts whereas NY-CHAPPA v2.0 uses 2020 census tracts. NY-CHAPPA v2.0 includes revised source and receptor representation and geographic DAC areas consistent with the updated census tracts. In addition, NY-CHAPPA v2.0 uses an updated version of COBRA (v5.1) to model the transport of pollutants from outside of the modeled region, discussed in more detail below, whereas NY-CHAPPA v1.0 used COBRA v4.1. However, testing done using the two methods for transported pollutants show minimal impact on modeled changes in projected $PM_{2.5}$ concentrations.

2.1.1. *Underlying Models and Model Framework Design*

In the NY-CHAPPA modeling framework, New York State was divided into eight regions (Figure A-1).[21] To calculate the annual average $PM_{2.5}$ concentration in each census tract in each scenario, C-TOOLS was used to model dispersion of primary $PM_{2.5}$ and secondary $PM_{2.5}$ precursor pollutants nitrogen oxides (NO_x), sulfur dioxide (SO_2), volatile organic compounds (VOCs), and ammonia (NH_3) within each region. C-TOOLS models dispersion of pollutants from sources and calculates the effect on concentrations of $PM_{2.5}$ and precursors at receptor census tracts from emissions in each source census tract in New York State (see following sections).

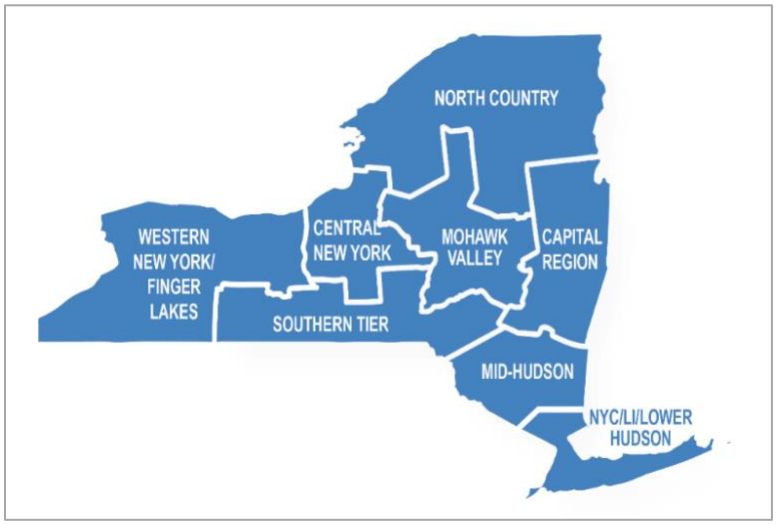
After census tract concentrations are calculated for local sources within a region, transported concentrations by county are added to account for emissions from outside the region and/or outside of the state. These concentrations are calculated using COBRA (v5.1) for each model year and policy scenario. The calculations involved running COBRA with zero emissions within each region across all sectors (effectively eliminating local dispersion within the region being analyzed). The resulting concentrations of $PM_{2.5}$ in each county represent the concentrations transported into the region from outside of the region (either from another region or outside of New York State).

The total $PM_{2.5}$ concentration for a census tract is calculated as the sum of the concentrations of total $PM_{2.5}$ from local dispersion from C-TOOLs and total $PM_{2.5}$ from transported sources from the COBRA model. Note that although the COBRA tool currently provides results at the county level, the underlying

total $PM_{2.5}$ concentration calculations can be done with the tool at any resolution; therefore, this approach is used to calculate total $PM_{2.5}$ concentrations at the census tract scale.

The above process is used to calculate total $PM_{2.5}$ concentrations for each census tract within a region for the baseline scenario and the policy scenarios for each model year. The change in total $PM_{2.5}$ is calculated by subtracting the total $PM_{2.5}$ concentration for the scenario and year from the baseline concentration for that year for each census tract.

Figure A-1. NY-CHAPPA Modeling Framework Regions



NY-CHAPPA then multiplies the change in $PM_{2.5}$ concentrations in each census tract by the health impact functions in COBRA and some NYC-specific functions for respiratory-related emergency room visits[22] and hospitalizations for cardiovascular events,[23] and by the population and incidence data described in Section 2.2, to calculate the change in health effects within each census tract. The health impact functions from COBRA are standard functions used by EPA in regulatory analysis, and include functions for premature mortality, respiratory and cardiovascular hospitalizations, emergency room visits for asthma, asthma exacerbation, nonfatal heart attacks, acute bronchitis, minor restricted activity days, and work loss days. COBRA includes more than one health impact function for calculating avoided mortality and nonfatal heart attacks. Rather than average the values of those functions together, this analysis reports them separately, as the high and low values.

Lastly, NY-CHAPPA estimates the monetary value of the avoided health effects by multiplying them by standard economic values for each health effect from EPA's COBRA tool. These economic values were developed from economic studies of the cost of medical care and/or the public's willingness to pay to avoid certain health outcomes. See Section 2.2 for more information about the health impact functions and economic values used in this analysis.

While NY-CHAPPA estimates benefits due to reductions in $PM_{2.5}$ concentrations in policy scenarios, there are additional potential benefits from reduced air pollution, including reductions in ozone concentrations. To develop a high-level estimate of these benefits, COBRA is used to model ozone concentration reductions and associated public health benefits. This approach used the same emissions

inputs as those used in NY-CHAPPA, but aggregated to the county scale, which is the scale used in COBRA. Because COBRA currently provides the outputs at the county scale, the distribution of these benefits to DAC areas could not be determined. Nevertheless, these results provide additional information on the total health benefits from improved air quality under policy scenarios. Health benefits from reduced ozone concentrations modeled by COBRA include avoided premature mortality, respiratory hospital admissions, emergency room visits for asthma, asthma symptoms, new diagnoses of asthma, and school loss days. The data annex (described in more detail below) includes regional data on the modeled number of avoided cases of each health outcome for both $PM_{2.5}$ and ozone in each model year.

COBRA was also used to estimate benefits outside of NYS. Emissions changes from the policy scenarios within NYS were modeled in COBRA to estimate the value of societal benefits of reductions in $PM_{2.5}$ and ozone concentrations to the continental U.S. outside of NYS.

Additional benefits such as benefits associated with reductions in NO_2 or toxic pollutant concentrations are excluded; therefore, the results provided using this framework are conservative and do not account for additional potential benefits.

2.1.2. *Source Representation*

NY-CHAPPA's dispersion model calculates pollutant concentrations based on emissions from sources (see Section 2.2.3) represented as point sources, line sources, and area sources using different algorithms for each source type.

Point Sources: NY-CHAPPA used the point source location, stack parameters, and emission estimates for all emissions from fuel combustion associated with electricity generation and industrial operations that reported stack parameters to New York State Department of Environmental Conservation (DEC) (see Section 2.2.3).

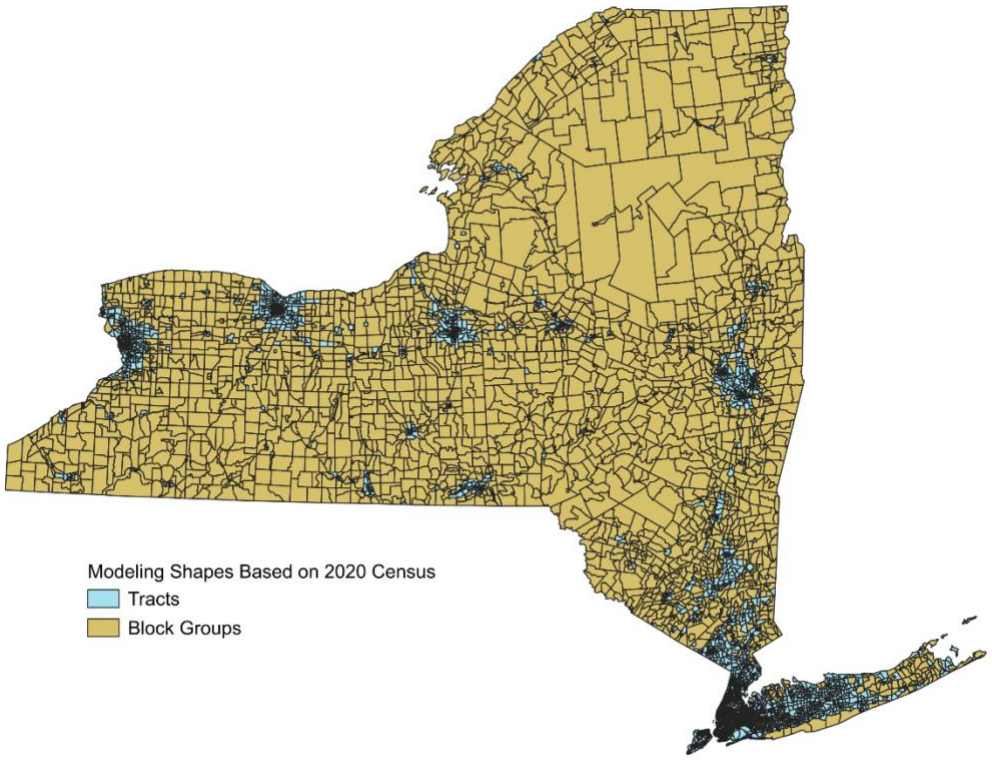
Line Sources: On-road emissions from major and secondary road categories (interstates, arterials, and major collectors) were modeled as line sources. Line segment data from the Federal Highway Administration's Highway Performance Monitoring System (HPMS) for the state of New York was post-processed to split any polyline representations of roads into segments with a single start and end point, since NY-CHAPPA's line source algorithm is designed for simple line sources. Road segments were mapped to an individual county based on the midpoint of the road segment, and then to the census tract scale as described in Section 2.2.3.

Area Sources: Sectors for which point or line source data were not available were modeled as area sources. This includes the residential, commercial, and non-road sectors, as well as non-point industrial sources. In addition, on-road emissions from minor collector and local roads were also modeled as area sources. Cartographic boundary files representing census tracts and census block groups were downloaded from the U.S. Census Bureau to serve as the basis for area source geometries. New York State has a total of 5,411 census tracts and approximately 15,800 block groups in the 2020 census. Due to a modeling constraint in NY-CHAPPA, multi-polygon representations in the dataset were split apart into separate polygon shapes (e.g., census tracts with multiple islands). In addition, some census tract polygon geometries were simplified further by using the outer ring geometry to avoid instances where

the polygon shape included an inner ring (like a donut), since shapes with inner rings can yield unexpected modeling results. NY-CHAPPA modeling then attributed census tract-level emissions to the outer ring geometries of the census tracts (in effect this combines the emissions sources of the inner and outer rings into a single source). For larger census tracts (with an area greater than 20 square kilometers), block group geometries were used instead of tract geometries to ensure high resolution modeling. Block group geometries were also simplified to avoid multi-polygon representations and inner rings. Figure A-2 shows the larger census tracts with an area greater than 20 square kilometers (which are modeled at the block group level) in brown and smaller tracts (which are modeled at the census tract level) in blue.

Figure A-2. NY-CHAPPA Modeling Shapes Based on 2020 Census Tracts and Block Groups in New York State

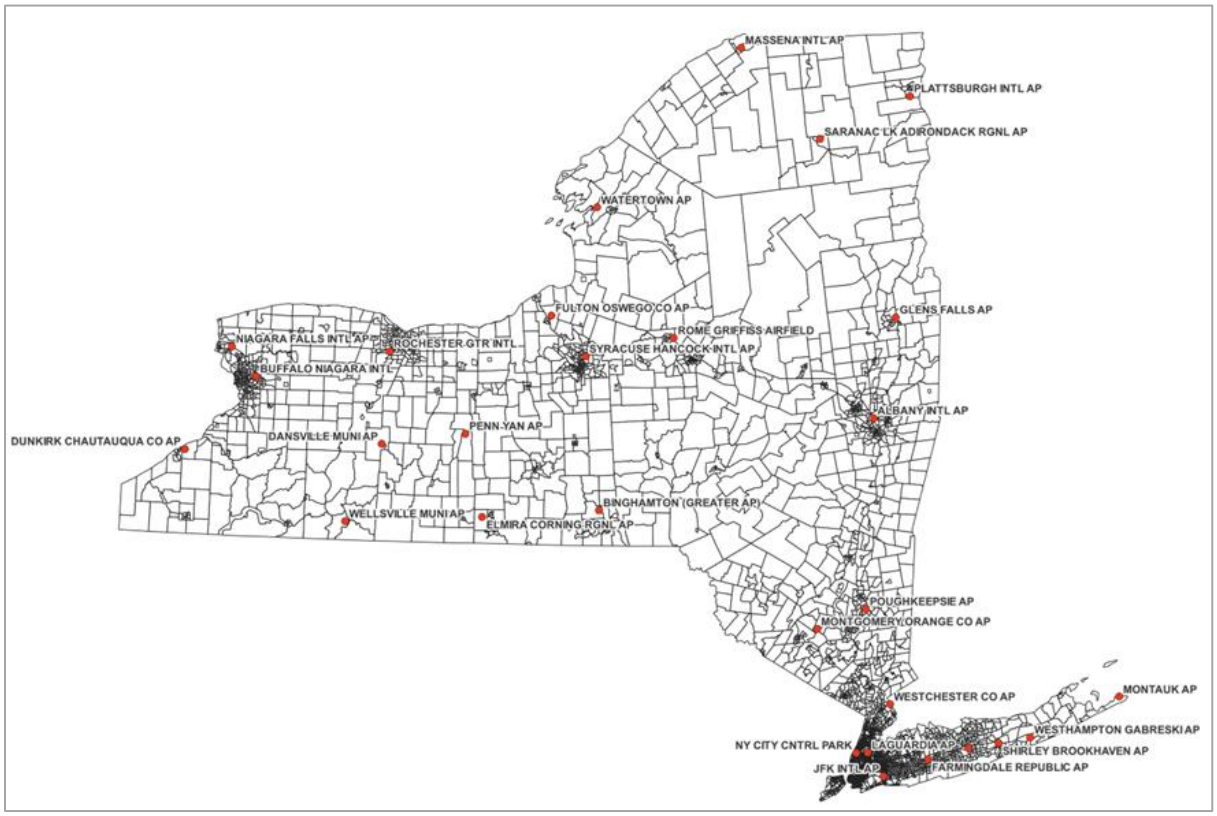
Note: Blue shows the census tracts of area less than or equal to 20 km^2, while brown shows census tracts with area greater than 20 km^2. Areas in brown were modeled at census block group resolution.



Area sources were modeled at varying heights depending on the source of the emissions. County-wide average heights were calculated based on county-level data from the EPA's National Emissions Inventory (NEI) for each sector (e.g., residential, commercial, industrial). Emissions for a census tract within a given county used this county average height. Emissions without average height data (e.g., the transportation sector) were modeled at ground level.

Each source was matched with its nearest meteorological station (see Figure A-3), and METeorologically-weighted Averaging for Risk and Exposure (METARE)-processed annual meteorology data (see Section 2.1.4) from that station was used to disperse emissions from each source.

Figure A-3. Location of the 29 Meteorological Stations in New York State



2.1.3. *Receptor Network*

NY-CHAPPA calculates pollutant concentrations at discrete point locations called receptors. In this modeling framework, census tract centroid locations (using the 2020 census tract definitions) were used when that tract's area was less than or equal to 20 square kilometers and block group centroid locations were used when the census tract's area was greater than 20 square kilometers. This approach ensured a dense receptor network even in larger census tracts. Using this hybrid approach, the modeling receptor network consisted of approximately 7,200 receptor points. Census tract concentrations, as calculated by NY-CHAPPA, represent the average of all receptors within that census tract.

Receptors were modeled at a height of 1.8 meters, a common receptor height for air quality modeling to represent the average height of a person.[24] For census tracts containing multiple receptors, the concentrations from all receptors were averaged to calculate the census tract concentration. Note that averaging to the census tract levels creates population-homogenized results which can then be appropriately analyzed and averaged since census tracts are designed to be roughly equal in population.

2.1.4. *Meteorology*

To develop the meteorological inputs needed to model the dispersion of pollution from sources to receptors, first, hourly meteorological data was generated through AERMET using data from the National Weather Service (NWS) from 29 airports. The list of stations and their locations are shown in Figure A-3 and Table A-1, below. Data from 2017-2021 was analyzed to determine the interannual variability in the meteorological data, as discussed in the following section, "Meteorological Sensitivities." Based on the results of this analysis, a single year of meteorological data (2016) was selected for use in NY-CHAPPA.

Table A-1. List of the 29 Meteorological Stations with Coordinates

WBAN	Name	State	County	Latitude	Longitude
14735	Albany International Airport	NY	Albany	42.7472	-73.7991
04725	Binghamton (Greater Airport)	NY	Broome	42.2068	-75.9799
14733	Buffalo Niagara International	NY	Erie	42.9300	-78.7361
94704	Dansville Municipal Airport	NY	Livingston	42.5699	-77.7143
14747	Dunkirk Chautauqua Co Airport	NY	Chautauqua	42.4932	-79.2762
14748	Elmira Corning Regional Airport	NY	Chemung	42.1566	-76.9029
54787	Farmingdale Republic Airport	NY	Suffolk	40.7344	-73.4164
54773	Fulton Oswego Co Airport	NY	Oswego	43.3504	-76.3832
14750	Glens Falls Airport	NY	Warren	43.3385	-73.6102
04781	Islip-LI Macarthur Airport	NY	Suffolk	40.7939	-73.1018
94789	JFK International Airport	NY	Queens	40.6392	-73.7639
14732	LaGuardia Airport	NY	Queens	40.7795	-73.8803
94725	Massena International Airport	NY	St. Lawrence	44.9334	-74.8484
54780	Montauk Airport	NY	Suffolk	41.0731	-71.9235
04789	Montgomery Orange Co Airport	NY	Orange	41.5091	-74.2646
04724	Niagara Falls International Airport	NY	Niagara	43.1083	-78.9382
94728	NY City Central Park	NY	New York	40.7790	-73.9693
54778	Penn Yan Airport	NY	Yates	42.6441	-77.0529
64776	Plattsburgh International Airport	NY	Clinton	44.6392	-73.4631
14757	Poughkeepsie Airport	NY	Dutchess	41.6257	-73.8816
14768	Greater Rochester International Airport	NY	Monroe	43.1172	-77.6754
64775	Rome Griffiss Airfield	NY	Oneida	43.2242	-75.3956
94740	Saranac Lake Adirondack Regional Airport	NY	Franklin	44.3928	-74.2029
54790	Shirley Brookhaven Airport	NY	Suffolk	40.8212	-72.8674
14771	Syracuse Hancock International Airport	NY	Onondaga	43.1111	-76.1038
94790	Watertown Airport	NY	Jefferson	43.9887	-76.0261
54757	Wellsville Municipal Airport	NY	Allegany	42.1078	-77.9842
94745	Westchester Co Airport	NY	Westchester	41.0624	-73.7045
14719	Westhampton Gabreski Airport	NY	Suffolk	40.8506	-72.6193

The meteorological outputs for 2016 from AERMET were then processed using the METARE method previously developed and published in Chang et al.[25] to obtain 100 representative hours throughout the year.

The METARE approach defines 5 bins for wind speed, 4 bins for wind direction, and 5 bins for Monin-Obukhov length, resulting in 5 x 4 x 5 = 100 representative conditions (Table A-2). These conditions represent a series of representative meteorological inputs with similar wind speed, wind direction, and

Monin-Obukhov length. Initial screening of the AERMET output file identifies how often the 100 representative conditions occur in the NWS hourly meteorology data in 2016 at each meteorological station. If any of the 100 representative conditions do not occur in the station data, that representative condition is eliminated for that meteorological station, meaning there are less than 100 representative conditions for some meteorological stations. The METARE approach weights the 100 representative conditions by how many hours in the year the median Monin-Obukhov length occurs in the station data (# of hours falling into that condition / # of all the valid hours of the years). If for a given condition no data is available due to data missing, no representative hour will be selected, and the weight will be 0. Chang et al. showed the METARE approach performs well when compared to a model simulation that uses all 8,760 meteorological hours for the year, and this approach was used previously in the initial development of ZAPPA, the precursor model for NY-CHAPPA.

Table A-2. Meteorological Bins Used in METARE Approach

Parameter	Bin
Wind Speed (m/s)	0–1
	1–2
	2–4
	4–7
	>7
Wind Direction (degree)	0–90
	90–180
	180–270
	270–360
Monin-Obukhov length	0–100 (stable)
	100–500 (slightly stable)
	>500 or < (-500) (neutral)
	(-500) – (-100) (slightly unstable)
	(-100) – 0 (unstable)

Meteorological Sensitivities

While NY-CHAPPA uses a single year of meteorology, a sensitivity analysis was conducted to analyze the variability in meteorology data over time. The analysis examined differences in wind speed and direction at different meteorological stations in New York State from 2017-2021. Figure A-4 shows wind rose plots for LaGuardia Airport for 2017–2021. These plots show that the annual distribution of wind speed and direction did not change substantially from 2017 to 2021. Similar plots were developed for all other meteorological stations in New York State, and they show a similar lack of variability in wind speed and direction.

We also compared the number of hours with Monin-Obukhov length values in different stability ranges for the years 2016–2021 and shown in Figure A-5, below. Monin-Obukhov length is an indication of stability in the atmosphere and the dispersion model relies on this value to compute the extent of dispersion. Similar to the wind rose plots shown, above, the Monin-Obukhov plots also do not show

significant year-to-year change at individual stations. The New York City Central Park station has the most interannual variability in Monin-Obukhov lengths of all of the stations, but it does not have as much variation in wind speed or direction, and it is therefore not expected to have a large impact on the dispersion modeling in NY-CHAPPA.

Figure A-4. Annual Distribution of Hourly Wind Speed by Direction, LaGuardia Airport, 2017–2021

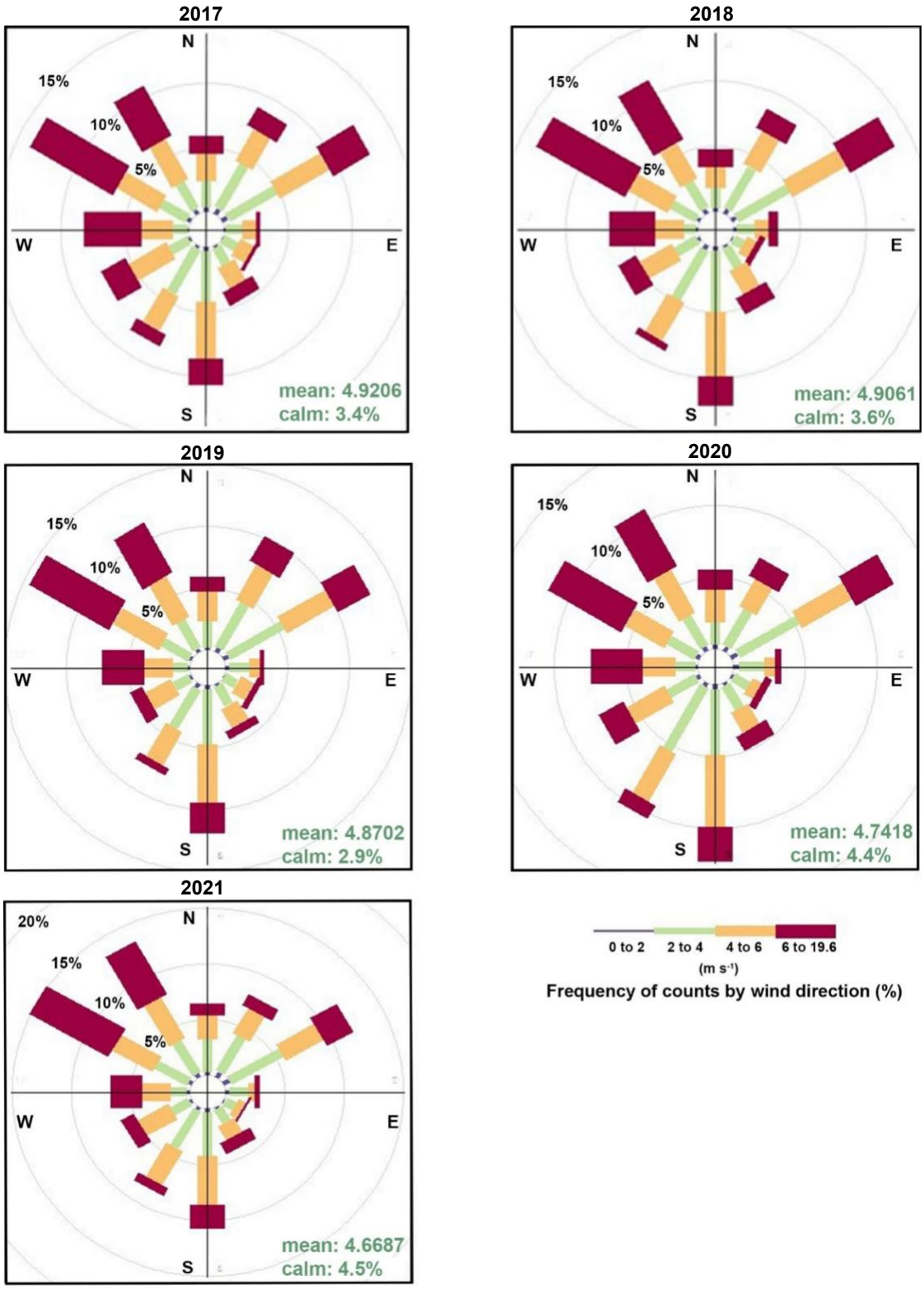
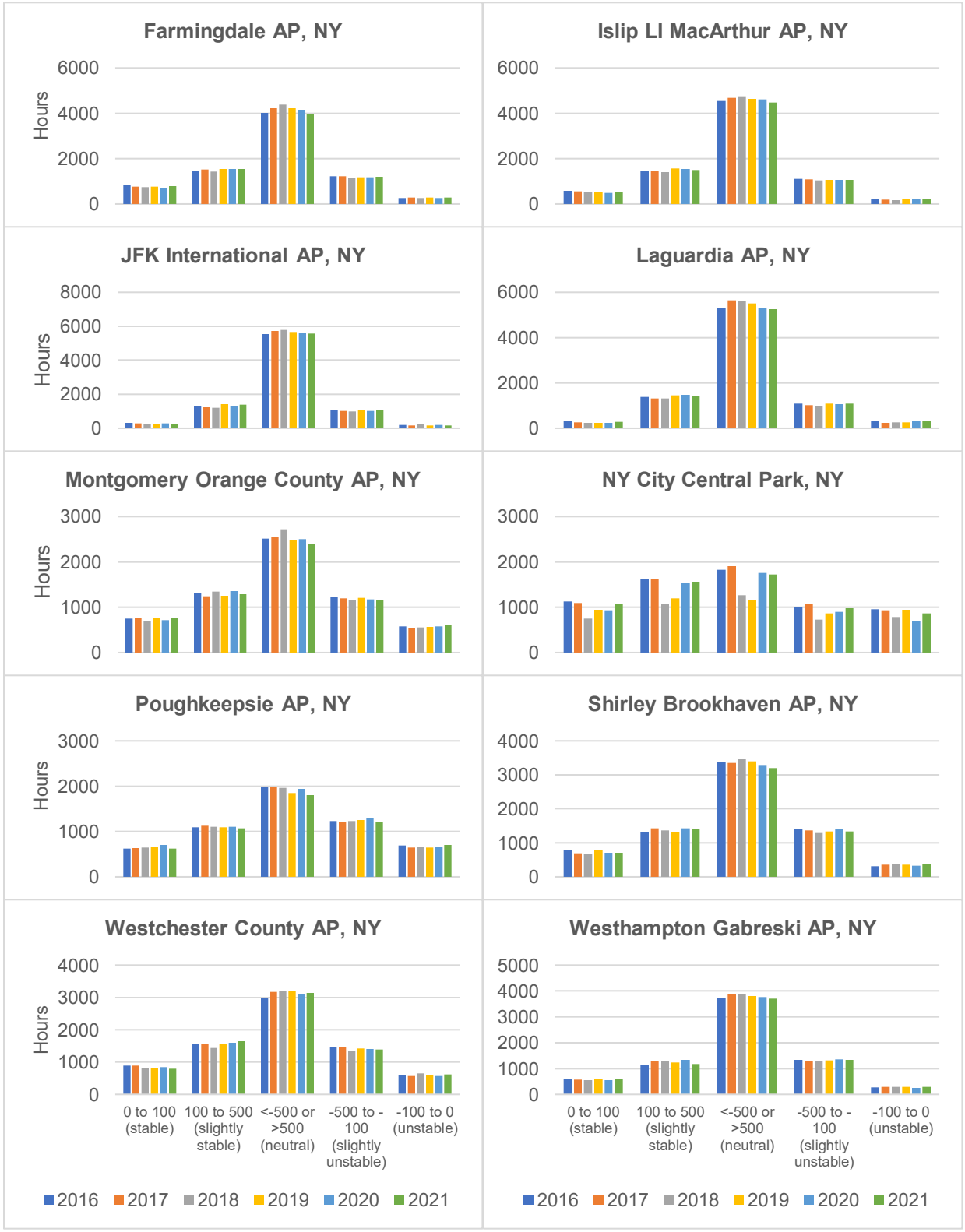


Figure A-5. Distribution of the Number of Hours per Year with Monin-Obukhov Length Values in Different Stability Ranges (Subset of Meteorological Stations in NYS, 2016-2021)



Given the lack of substantial interannual variability in wind speed, wind direction, and Monin-Obukhov length, which are key input parameters that drive dispersion in the model, the health analysis was conducted with NY-CHAPPA using a single year of meteorology, 2016.

2.1.5. *Model Validation*

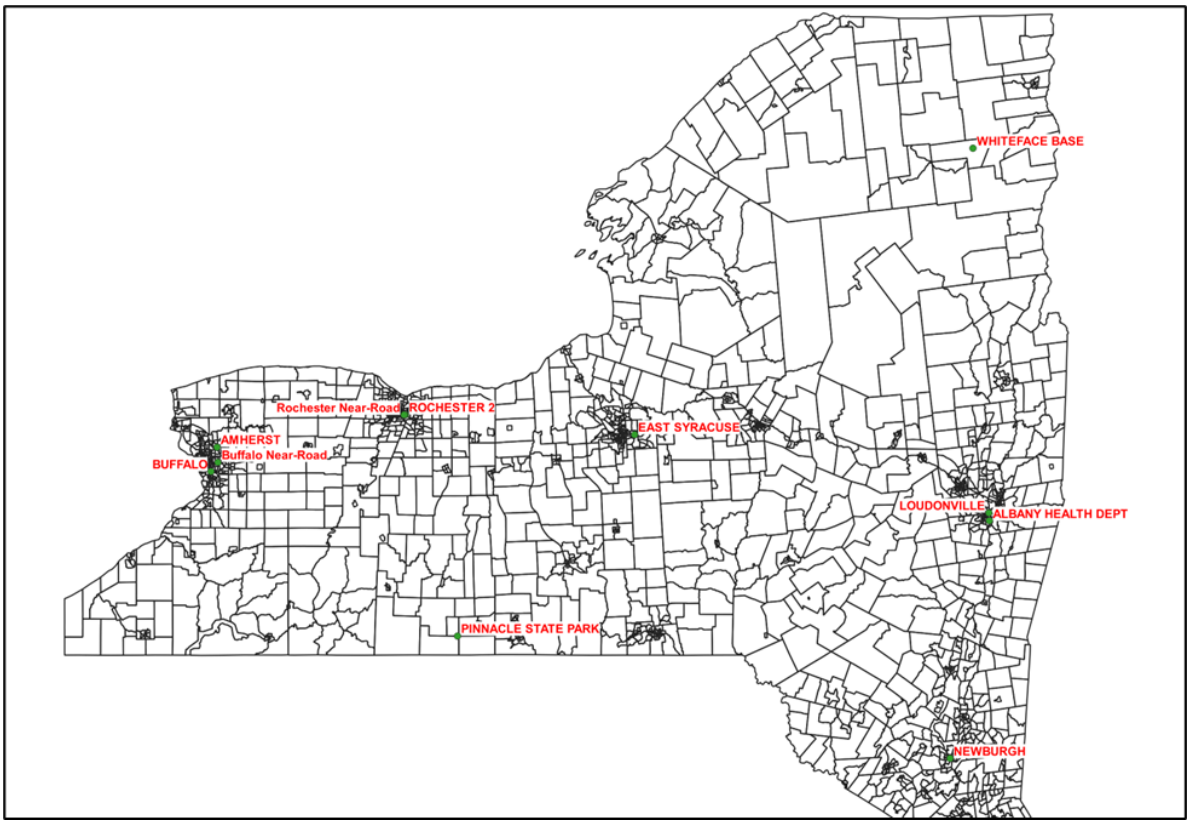
To evaluate the performance of NY-CHAPPA, the projected $PM_{2.5}$ concentrations using emissions from the No Action scenario in 2025 from the Plan were compared to $PM_{2.5}$ observations from 2020-2024 from 19 $PM_{2.5}$ monitoring sites throughout New York State,[26] shown in Table A-3 and Figure A-6. The model validation shown here is for NY-CHAPPA v2.0 with 2020 census tracts. The projected and observed $PM_{2.5}$ concentrations were compared using five standard model performance evaluation metrics routinely used for air quality model validation: (1) fractional bias, (2) geometric mean bias, (3) normalized mean square error, (4) geometric variance, and (5) fraction of modeled data within a factor of 2 of the observations.[27] Each of these metrics is a measure of the distribution of the difference in $PM_{2.5}$ concentrations estimated by the model and observed $PM_{2.5}$ concentrations from air quality monitor(s) in the same census tract.

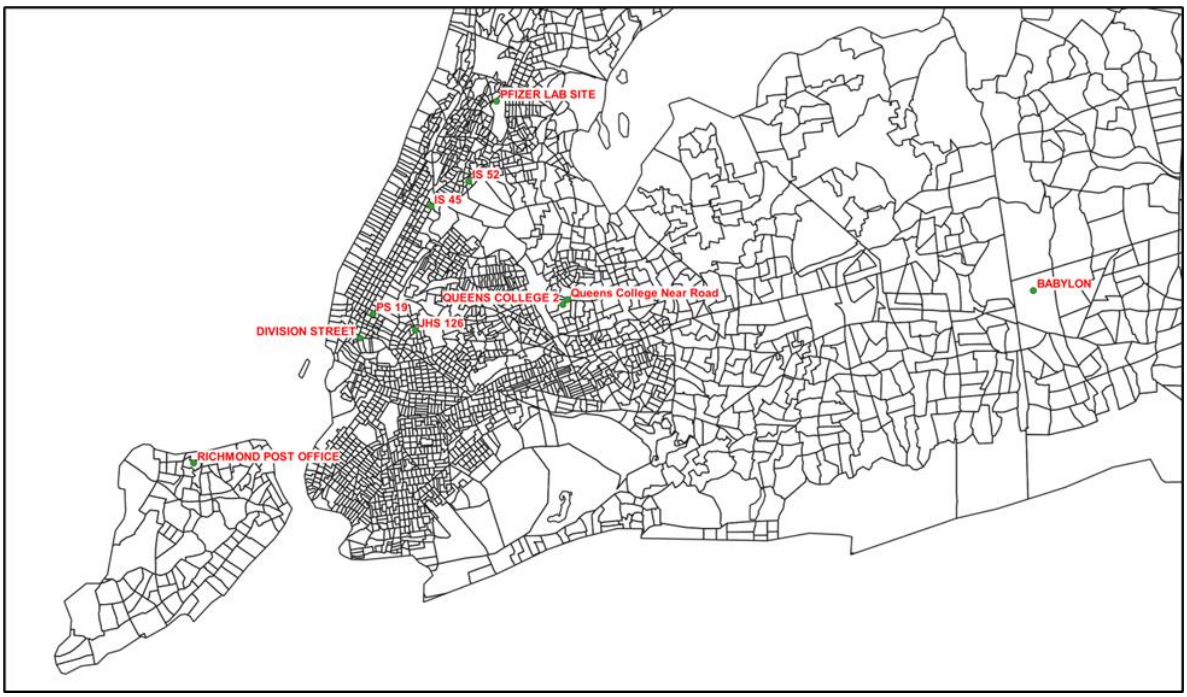
Table A-3. Observed (2020–2024) and Modeled (2025) $PM_{2.5}$ Concentrations (µg/m³) in New York State

Note: Near-road monitoring sites, indicated with stars (*), are included in this table for completeness but are excluded from summary statistics of the model validation in Table A-4 because they are not intended to capture average ambient concentrations.

Air Quality Monitoring Site	Observed $PM_{2.5}$ Concentrations					NY-CHAPPA v2.0 Modeled $PM_{2.5}$ Concentrations (2025)
	2020	2021	2022	2023	2024	
IS 45	6.98	7.43	6.94	9.07	6.67	16.95
JHS 126	7.34	7.62	7.29	9.23	6.85	14.54
IS 52	6.65	7.74	6.89	8.99	7.12	12.84
Newburgh	6.45	6.30	5.83	7.57	5.70	10.16
Pfizer Lab Site	6.96	7.14	6.90	9.04	6.43	9.95
Richmond Post Office	7.72	8.38	6.90	9.49	6.91	9.71
Queens College Near Road*	7.37	7.72	7.05	8.92	7.17	9.02
Queens College 2	6.86	7.50	7.31	9.36	7.62	8.83
Albany County Health Dept	6.11	6.70	5.96	7.88	6.51	7.65
Rochester Near-Road*	5.94	7.15	6.07	8.37	6.53	6.05
Buffalo Near-Road*	6.83	7.70	6.65	8.89	6.36	5.39
Loudonville	4.97	5.48	5.64	7.44	5.43	5.33
Rochester 2	5.62	6.25	5.54	7.75	5.39	5.30
Buffalo	6.48	7.43	6.53	8.16	6.62	5.20
Babylon	6.38	6.91	5.99	8.00	5.91	5.00
Amherst	6.04	6.79	5.74	8.97	5.81	4.28
East Syracuse	5.07	5.87	5.07	7.51	5.10	3.42
Pinnacle State Park	4.37	5.66	4.80	7.33	4.67	3.21
Whiteface Base	3.21	3.66	3.51	4.89	3.87	1.94

Figure A-6. $PM_{2.5}$ Monitoring Sites in New York State





Each metric has thresholds against which model performance is evaluated. For example, it is generally accepted that air quality models should have a fractional bias with ±0.3.[28] Because model projections

were only available starting with year 2025, these results were compared against multiple years of observational data, starting with the year 2020. EPA's standard approach for evaluating the performance of dispersion models is to compare the distributions of the highest hourly observed and modeled concentrations (unpaired in time).[29] NY-CHAPPA was evaluated here with a paired comparison of annual average observed and modeled $PM_{2.5}$ concentrations. Table A-3 shows the comparisons of observed and projected $PM_{2.5}$ concentrations for the years 2020–2024, and Table A-4 shows the average of the model performance evaluation metrics calculated for each year.

Table A-4. Summary of Metrics for Evaluating Model Performance in Comparison to Observed Air Quality Data

Note: Near-road monitors were excluded from the data to develop these summary metrics.

Comparison Measure	Value from Model Validation	Threshold	Does Model Satisfy Threshold?
Fractional bias	-0.25	within ± 0.3	Yes
Geometric mean bias	0.92	closer to ±1	Yes
Normalized mean square error	0.26	closer to 0	Yes
Geometric variance	1.24	ranges between ± 1	Yes
Fraction of data within a factor of 2 of observations	0.9	closer to 1	Yes

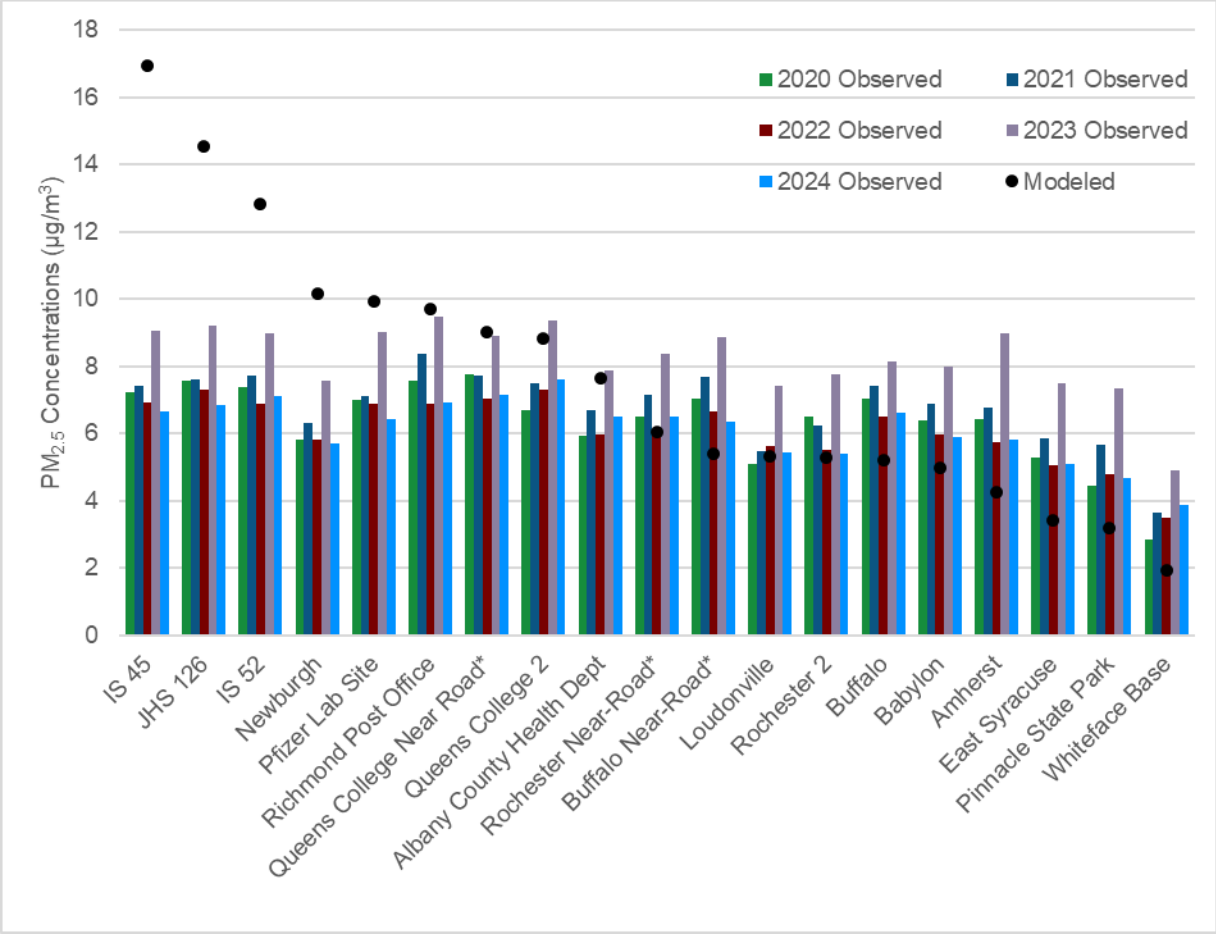
Figure A-7 shows the $PM_{2.5}$ concentrations observed at each monitoring station for 2020–2024 and the modeled 2025 concentration for the corresponding census tract. Figure A-7 demonstrates that for most locations, modeled $PM_{2.5}$ concentrations are generally aligned with the observed data. As shown in Table A-4, the summary statistics across all monitoring stations in the network meet the standard thresholds for performance of an air quality model in each year, 2020–2024.

Note that some of the air quality monitors shown in Figure A-7 are source-oriented monitors, which are situated close to roadways specifically to measure near-road concentrations close to highways and not to measure average ambient concentrations from all sources. These near-road monitors were included in Figure A-7, but were not included in the summary statistics displayed in Table A-4 because the source-oriented monitors have different siting procedures and would not necessarily be comparable to randomly placed receptors not specifically placed near a line source.

The model also has similar performance metrics to the Community Multiscale Air Quality model (CMAQ), a state-of-the-science comprehensive multi-scale and multi-pollutant photochemical model, developed by the EPA and used for both scientific and regulatory applications in the U.S. and elsewhere. According to an evaluation of CMAQ for multiple years and for different studies, that model had a median fractional bias of -12 percent and a median normalized mean error of 41.2 percent.[30] This is compared to the baseline case values used for NY-CHAPPA v2.0 of -25 percent and 26 percent, respectively, suggesting that NY-CHAPPA performs comparably or better in this use case, despite its reliance on reduced form dispersion modeling approaches.

Figure A-7. Comparison of Observed (2020-2024) and Modeled (2025) Annual Average $PM_{2.5}$ Concentrations in New York State

Note: Near-road monitoring sites, indicated with stars (*), are included in this figure for completeness but are excluded from summary statistics of the model validation in Table A-4 because they are not intended to capture average ambient concentrations.



2.2. Inputs and Scenario Design

To model changes in $PM_{2.5}$ concentrations and ensuing public health effects, NY-CHAPPA requires four sets of input data:

- Population;
- Baseline health incidence;
- Baseline case (No Action scenario) emissions of primary $PM_{2.5}$ and secondary $PM_{2.5}$ precursors NO_x, SO_2, VOCs, and NH_3; and
- Scenario emission of those pollutants.

The following subsections discuss the approach for developing each of these data inputs used in this health analysis.

2.2.1. *Population*

Population estimates by age group were developed for each of the analysis years for all counties in New York State. County-level population data for 2021 was from the U.S. Census Bureau.[31] The Pathways Analysis assumes total statewide population in 2040 remained flat at 2021 levels, but estimates population changes within the state based on the most recent available county level projection data from Cornell University's County Projects Explorer.[32] An annual growth rate by county was derived based on the change between the 2021 population data and the 2040 population projections and used to estimate the county level population for each health analysis year. Population projections from NY-CHAPPA v1.0, which used 2010 census tract definitions, were converted to 2020 census tract definitions for use in NY-CHAPPA v2.0.

2.2.2. *Baseline Health Incidence*

Baseline health incidence is required for each health endpoint to determine the change in public health impacts from changes in $PM_{2.5}$ concentrations. Baseline health data was obtained at a sub-county level from New York State Department of Health (DOH) for mortality, asthma emergency room visits, asthma hospitalizations, and chronic lung disease hospitalizations. For all other health outcomes, sub-county-level data was not available, and the county-level baseline health incidence data from COBRA was used. Most of the sub-county-level data was not at the census tract level, but rather at aggregations of census tracts developed by DOH to protect patient confidentiality.[33] In cases where the sub-county-level data had between 1 and 4 cases, the exact number was not provided, and a value of 2.5 (the midpoint of the range) was used instead. Table A-5 lists the sources of incidence data and the associated years for each health endpoint included in NY-CHAPPA v2.0. Table A-6 lists the sources of the health impact functions used in NY-CHAPPA, along with the monetary value of each avoided health outcome. As shown in Tables A-5 and A-6, the incidence and health impact functions for avoided mortality are for all-cause mortality. In some contexts, the term "premature mortality" refers specifically to deaths occurring before the age of 75; however, in the Plan, that term is used to indicate reductions in mortality risk due to reduced air pollution exposure for populations up to age 99. The monetary values come from COBRA v5, inflated to 2024$. Note that this is a difference from NY-CHAPPA v1.0, which used monetary values from COBRA v4.

The economic value of health impacts is estimated by multiplying changes in the number of cases of each health endpoint by its monetary value listed in Table A-6. The benefits of avoiding premature mortality are valued using the Value of a Statistical Life, an estimate that represent how much people are willing to pay for small reductions in their risks of dying from harmful health conditions that may be caused by environmental pollution. Monetary values for other health endpoints are based on economic valuation studies that estimate cost of illness (e.g., hospitalizations, emergency department visits) or estimate people's willingness to pay for reducing mortality risk or avoiding other adverse health effects (e.g., asthma exacerbation, respiratory symptoms). Some health endpoints (adult mortality and non-fatal heart attacks) are assumed to occur over a 20-year period and a discount rate of 5.03% is used for consistency with the discount rate used to express total value of health benefits as net present value.

Table A-5. Sources of Incidence Data used in NY-CHAPPA

Health Endpoint	Pollutant	Source of Incidence Data	Years of Incidence Data
Mortality, all cause	$PM_{2.5}$, O_3	NY Department of Health	2008-2012
Nonfatal Heart Attacks	$PM_{2.5}$	EPA COBRAv5	2014
Hospital Admits, Respiratory (except for asthma and chronic lunch disease) and Cardiovascular (except for heart attacks)	$PM_{2.5}$, O_3	EPA COBRAv5	2011-2014
Hospital Admits, Asthma	$PM_{2.5}$	NY Department of Health	2008-2012
Hospital Admits, Chronic Lung Disease	$PM_{2.5}$	NY Department of Health	2008-2012
Acute Bronchitis	$PM_{2.5}$	EPA COBRAv5	2014
Upper and Lower Respiratory Symptoms	$PM_{2.5}$	EPA COBRAv5	1991
Emergency Room Visits, Asthma	$PM_{2.5}$, O_3	NY Department of Health	2008-2012
Minor Restricted Activity Days	$PM_{2.5}$	EPA COBRAv5	1989
Work Loss Days	$PM_{2.5}$	EPA COBRAv5	1996
School Loss Days	O_3	EPA COBRAv5	1996
Asthma Exacerbation	$PM_{2.5}$, O_3	EPA COBRAv5	2006-2013
Asthma Onset	O_3	EPA COBRAv5	2016
Hay Fever/Rhinitis Incidence	O_3	EPA COBRAv5	2009

Table A-6. Health Impact Functions used in NY-CHAPPA v2.0 for $PM_{2.5}$ and COBRAv5 for Ozone

Note: The monetary values for nonfatal heart attacks depend on age.

Health Endpoint	Pollutant	Source of Health Impact Function	Age Ranges	Monetary Value (2024$)
Mortality, all cause (low)	$PM_{2.5}$	Krewski et al. (2009).[34]	30-99	$11,995,364
Mortality, all cause (high)	$PM_{2.5}$	Lepeule et al. (2012).[35]	25-99	$11,995,364
Nonfatal Heart Attacks	$PM_{2.5}$	Peters et al. (2001).[36]	18-99	$53,290-$421,473
Nonfatal Heart Attacks	$PM_{2.5}$	Pope et al. (2006).[37]	18-99	$53,290-$421,473
Nonfatal Heart Attacks	$PM_{2.5}$	Sullivan et al. (2005).[38]	18-99	$53,290-$421,473
Nonfatal Heart Attacks	$PM_{2.5}$	Zanobetti and Schwartz (2006).[39]	18-99	$53,290-$421,473
Nonfatal Heart Attacks	$PM_{2.5}$	Zanobetti et al. (2009).[40]	18-99	$53,290-$421,473
Nonfatal Heart Attacks	$PM_{2.5}$	Peters et al. (2001)[36]	18-99	$53,290-$421,473
Hospital Admissions, All Cardiovascular (except heart attacks)	$PM_{2.5}$	Moolgavkar (2000).[41]	18-64	$64,609
Hospital Admissions, All Cardiovascular (except heart attacks)	$PM_{2.5}$	Bell et al. (2008).[42]	65-99	$60,591
Hospital Admissions, All Cardiovascular (except heart attacks)	$PM_{2.5}$	Peng et al. (2008).[43]	65-99	$60,591
Hospital Admissions, All Cardiovascular (except heart attacks)	$PM_{2.5}$	Peng et al. (2009).[44]	65-99	$60,591

Health Endpoint	Pollutant	Source of Health Impact Function	Age Ranges	Monetary Value (2024$)
Hospital Admissions, All Cardiovascular (except heart attacks)	$PM_{2.5}$	Zanobetti et al. (2009)[40]	65-99	$60,591
Hospital Admissions, All Respiratory	$PM_{2.5}$	Zanobetti et al. (2009)[40]	65-99	$50,791
Hospital Admissions, All Respiratory	$PM_{2.5}$	Kloog et al. (2012).[45]	65-99	$50,791
Hospital Admissions, Asthma	$PM_{2.5}$	Babin et al. (2007).[46]	0-17	$23,931
Hospital Admissions, Asthma	$PM_{2.5}$	Sheppard (2003).[47]	0-17	$23,931
Hospital Admissions, Chronic Lung Disease	$PM_{2.5}$	Moolgavkar (2000).[48]	18-64	$31,578
Emergency Room Visits, Asthma	$PM_{2.5}$	Mar et al. (2010).[49]	0-99	$683
Emergency Room Visits, Asthma	$PM_{2.5}$	Slaughter et al. (2005).[50]	0-99	$683
Emergency Room Visits, Asthma	$PM_{2.5}$	Glad et al. (2012).[51]	0-99	$683
Acute Bronchitis	$PM_{2.5}$	Dockery et al. (1996).[52]	8-12	$740
Asthma Exacerbation, Cough	$PM_{2.5}$	Mar et al. (2004).[53]	6-18	$89
Asthma Exacerbation, Cough	$PM_{2.5}$	Ostro et al. (2001).[54]	6-18	$89
Asthma Exacerbation, Shortness of Breath	$PM_{2.5}$	Mar et al. (2004)[53]	6-18	$89
Asthma Exacerbation, Shortness of Breath	$PM_{2.5}$	Ostro et al. (2001)[54]	6-18	$89
Asthma Exacerbation, Wheeze	$PM_{2.5}$	Ostro et al. (2001)[54]	6-18	$89
Minor Restricted Activity Days	$PM_{2.5}$	Ostro and Rothschild (1989).[55]	18-64	$105
Lower Respiratory Symptoms	$PM_{2.5}$	Schwartz and Neas (2000).[56]	7-14	$32
Upper Respiratory Symptoms	$PM_{2.5}$	Pope et al. (1991).[57]	9-11	$51
Work Loss Days	$PM_{2.5}$	Ostro (1987).[58]	18-64	$243
Mortality, Long-term exposure	O_3	Turner et al. (2016).[59]		$11,995,364
Mortality, Short-term exposure	O_3	Katsouyanni et al. (2009).[60]	30-99	$11,995,364
Mortality, Short-term exposure	O_3	Zanobetti and Schwartz (2008).[61]	0-99	$11,995,364
Hospital Admissions, All Respiratory	O_3	Katsouyanni et al. (2009)[60]	65-99	$50,791
Emergency Room Visits, Asthma	O_3	Barry et al. (2018).[62]	0-99	$683
Asthma Exacerbation	O_3	Lewis et al. (2013).[63]	5-12	$89
Asthma Onset	O_3	Tetreault et al. (2016).[64]	0-17	$73,225
Asthma Onset	O_3	Garcia et al. (2019).[65]	9-18	$73,225
Hay Fever/Rhinitis Incidence	O_3	Parker et al. (2009).[66]	3-17	$992.61

2.2.3. *Baseline and Policy Scenario Emissions*

NY-CHAPPA estimates the changes in $PM_{2.5}$ concentrations and ensuing health effects based on changes in emissions of primary $PM_{2.5}$ and precursors to secondary $PM_{2.5}$ formation, including NO_x, SO_2, NH_3, and VOCs. Statewide annual emissions were estimated based on projected fuel consumption modeled in the

Plan scenarios (see Pathways Analysis chapter) and emission factors for each fuel and source type (described below). The emissions were downscaled to the census tract scale, as described in more detail below. The change in emissions for each analysis year is the difference between a given policy scenario and the baseline—in this analysis the No Action scenario.

The approach for estimating emissions and downscaling the emissions to the census tract level, differed by sector as follows:

Electricity generation sector emissions inputs were calculated based on outputs from the PLEXOS electricity sector model. PLEXOS is an additional production/cost model that uses the electric sector capacity builds identified in the Pathways analysis using the RESOLVE model (see Pathways Analysis chapter) to estimate unit-level dispatch needed for the spatial resolution of the health analysis. PLEXOS modeling done for the Plan was calibrated to RESOLVE inputs to project generally similar dispatch findings from the two models. Some differences were observed between PLEXOS and RESOLVE results for in-state hydrogen generation in 2040 and later years because of different model representations. These differences led to higher in-state hydrogen generation in the policy cases observed in 2040 and later in PLEXOS, which means that benefits from emission reductions in the electric sector may be conservatively low. The relatively small contribution of hydrogen emissions to health impacts and the fact that these generation differences are projected in later years of the analysis are expected to reduce the significance of this difference in terms of the overall projected benefits.

All generation sources in NYS were simulated as point sources with explicit emissions data for each source, and, therefore, downscaling was not necessary for this sector. The emissions point sources were placed based on latitude and longitude coordinates for each power plant analyzed, applying the specific heights of the exhaust stacks from NEI or the Energy Information Administration (EIA).[67, 68] Emissions were calculated based on the fuel consumption projections and emission rates derived from sources including the latest EPA Emissions & Generation Resource Integrated Database (eGRID) for NO_x and SO_2.[69] Generator-level $PM_{2.5}$ emission rates were developed from eGRID's latest $PM_{2.5}$ data for 2021.[70] Emission rate data was supplemented with the latest data from EPA's National Electric Energy Data System[71] and cross-referenced and verified with the 2020 NEI[72] and historical data derived from EPA's Clean Air Markets Data.[73]

The Pathways scenarios assume hydrogen combustion for remaining thermal generation needs starting in 2040 (see the Pathways Analysis chapter of this Plan). Hydrogen combustion may increase emissions of NO_x compared to natural gas due to the higher flame temperatures. The health analysis conservatively assumes that emission rates of NO_x (emissions per unit of energy) would be double those from similar natural gas units. We expect that dedicated units combusting hydrogen would be designed for hydrogen and would have appropriate emissions controls as required, resulting in NO_x emissions that are similar to those from the same electricity generation using natural gas. A sensitivity analysis of NO_x emissions from hydrogen combustion in the Draft Plan found that if NO_x emission rates from hydrogen combustion were similar to natural gas units, health benefits associated with the electric sector would increase by three percent in 2040, yielding an overall health benefits increase of less than half a percent, indicating that health benefits in general would not be sensitive to the NO_x emission rate assumption. Furthermore, the

sensitivity analysis demonstrates that overall health benefits are not very sensitivity to hydrogen combustion because NO_x is the only pollutant emitted and the magnitude of NO_x emissions is low.

Industrial sector emissions were downscaled using two separate approaches for point sources and area sources. Larger industrial facilities report their emissions and fuel consumption by fuel type as point sources to DEC. These sources are modeled in NY-CHAPPA using their reported locations and stack heights, similar to the electricity generation sector, and their reported emissions. The modeled emission reductions under the Plan scenarios are assigned to specific point sources based on the fraction of fuel consumed by each facility. For example, if a facility consumed 0.1 percent of the industrial natural gas in NYS, it was assigned 0.1 percent of the emission reductions from industrial natural gas associated with the scenario (relative to the facility's reported emissions). The remaining industrial emissions from non-point sources were modeled as area sources, in which emissions were calculated using emission factors from the 2020 NEI for each of the industrial fuel types (coal, natural gas, distillate oil, and wood).[72] The resulting emissions were downscaled from state to county scale based on proportion of employment in the industrial sector in each county. Emissions were then downscaled from the county scale to the census tract scale based on the proportion of land area in each county designated as industrial, according to the NYS Department of Taxation and Finance (DTF).[74]

Commercial sector emissions were calculated using emissions factors from the 2020 NEI for wood combustion and for emissions of NH_3 and SO_2 from all fuel types,[72] and emission factors developed by Brookhaven National Laboratory (BNL) for emissions of primary $PM_{2.5}$, NO_X, and VOCs from natural gas and fuel oil combustion.[75] This is a difference from the Draft Plan, which used emission factors from the 2020 NEI for all commercial fuel types. The BNL emission factors for $PM_{2.5}$, NO_x, and VOCs from distillate and natural gas are lower than the NEI emission factors by 50% or greater on an energy content basis. The resulting emissions were downscaled from the regional scale to the county scale based on the proportion of employment in the commercial sector in each county. Emissions were then downscaled from the county scale to the census tract scale based on the proportion of land area in each county designated as commercial, according to the DTF.

Residential sector emissions were calculated using emissions factors from BNL for emissions of primary $PM_{2.5}$, NO_X, and VOCs from fuel oil and natural gas combustion,[75] and the 2020 NEI for liquid petroleum gas, as well as for emissions of NH_3 and SO_2 from all fuel types.[72] The emission factors for fuel oil and natural gas combustion have been updated since the Draft Plan. The BNL emissions factors for NO_x and VOCs from distillate and natural gas and for $PM_{2.5}$ from distillate are lower than the NEI emission factors whereas the emission factor for $PM_{2.5}$ from natural gas is higher than the NEI emission factor. For wood, the analysis used emission factors provided to NYSERDA from the Northeast States for Coordinated Air Use Management (NESCAUM), based on equipment testing supported by NYSERDA. Residential sector emissions were downscaled from the regional scale to the census tract scale using data from the U.S. Census Bureau's American Community Survey,[76] which provides data on the number of occupied homes in each block group. The regional-scale emissions were downscaled to the census tract scale based on the proportion of occupied homes in each census tract relative to the regional total. One exception to this approach is for residential wood consumption, which was first downscaled from the state to the county scale based on data from a survey conducted by the Commission for Environmental Cooperation

and NESCAUM.[77] The county scale emissions were then downscaled to the census tract scale based on the proportion of occupied homes in each census tract relative to the county total.

On-road sector county scale emissions were estimated using EPA's Motor Vehicle Emissions Simulator (MOVES) to develop emission factors by vehicle type, road type, and speed bin. These emission factors were multiplied by county scale projections of vehicle miles traveled (VMT) from the Pathways Analysis to estimate county scale emissions. The county scale emissions were downscaled to the census tract scale using two separate approaches:

- For most road types (except local and minor collector roads), emissions were downscaled using VMT data from the Federal Highway Administration's Highway Performance Monitoring System (HPMS) by road link for more than 400,000 road links in New York State. The county scale emissions were assigned to specific road links based on the proportion of VMT on that road link to the total VMT for that road type. For example, for a specific segment of an interstate in a given county, a portion of the emissions from interstates in that county estimated from MOVES were assigned to that segment based on the proportion of VMT for that segment to the total VMT for interstates in all segments in that county.
- HPMS data is not available for local and minor collector roads. Emissions from these road types were downscaled to the census tract scale using the following multi-step process which sought to ensure that emissions from these road types were properly distributed to urban and rural areas within each county.
    1. The census tracts that are considered urban were identified based on data from the U.S. Census Bureau.
    2. The total 2025 population by census tract was summed up to the county level based on urban and rural designations in step 1.
    3. The total urban county population and total rural county population from step 2 was divided by the total county population to get urban and rural population ratios.
    4. The ratios from step 3 were then multiplied by the county scale emissions (described above) to estimate the county scale emissions in the urban and rural areas in each county.
    5. The area of each census tract was then used to sum the urban census tracts and the rural census tracts (based on the designations from step 1) to get the total urban and rural areas for each county. The urban and rural areas for each county were then divided by the total area for each county to get the ratio of the urban and rural land area.
    6. Lastly, these land area ratios from step 5 were multiplied by the county scale urban and county scale rural emissions from step 4 to distribute the urban and rural emissions to each census tract based on their proportion of land area.

Aircraft emissions for domestic flights in NYS were downscaled using Federal Aviation Administration (FAA) data on landings and takeoffs at airports. Emissions were distributed into three altitude bins:

surface level; up to 500 feet; and 500 to 2,000 feet based on emissions profile data from the FAA's Aviation Environmental Design Tool (AEDT).[78] Emissions were modeled as area sources occurring within the census tract where each airport is located, with the exception of the 2,000-foot altitude bin for LaGuardia and JFK airports. Those emissions were uniformly distributed within a 5.5 land mile radius around each airport to account for landing and takeoff emissions within these airports' airspace. This analysis does not include emissions from cruising altitudes above 2,000 feet, as those emissions are more broadly dispersed and are expected to have little impact on local concentrations.

Reductions in emissions from sustainable aviation fuel (SAF) blends were based on a literature review summarized in the memorandum, *Co-Pollutant Impacts of Low-Carbon Fuels and Technologies—2025 Update*.[79] Based on data reported in relevant studies, this analysis estimates an average 66 percent reduction in $PM_{2.5}$ emissions during idling and a 59 percent reduction in $PM_{2.5}$ from landing and takeoff operations for 50 percent SAF blends relative to 100 percent fossil jet fuel. Reductions in aircraft SO_2 emissions from SAF are expected to be directly proportional to the reduced sulfur content of the SAF-fossil jet fuel blend and be consistent across all operating modes. This analysis estimates aircraft SO_2 emissions reductions of approximately 36 percent for 50 percent SAF blends. No emission reductions were included for NO_x because SAF is not expected to significantly impact NO_x emissions. These emission reductions were applied to the SAF consumption projections from the Pathways Analysis.

Marine and rail emissions were calculated using emissions factors from the 2020 NEI.[72] The emissions for each scenario were downscaled to the census tract scale based on census tract area. Emissions were distributed only to census tracts with marine shipping lines or rail lines, respectively.

Emissions inputs for *other non-road sectors*, including non-road engines used in construction, agriculture, and mining, were calculated using emissions factors for non-road distillate fuel from the 2020 NEI.[72] The regional scale fuel consumption was downscaled to the county scale using data derived from the NONROAD module of EPA's MOVES model. The county scale emissions were downscaled to the census tract scale based on proportion of population, as data on non-road equipment populations were not available.

2.3. Limitations and Uncertainty

This analysis involves modeling changes in air quality and health effects under different future scenarios of energy consumption and air pollutant emissions. Each of the steps in the analysis has some uncertainty and limitations.

The changes in air pollutant emissions are estimated using modeled changes in fuel consumption from the Pathways Analysis. However, there are some simplifying assumptions made to translate the Pathways Analysis fuel combustion data to census tract scale emissions inputs for NY-CHAPPA that represent sources of uncertainty. The details of how the policies embedded in the scenarios will play out locally are unknown; thus, as described in the section above, fuel consumption data was downscaled to the census tract scale following simplifying assumptions that differ by sector as appropriate. As an example, in the industrial sector, emissions from smaller facilities that do not report their emissions to DEC are represented as area sources in which changes in statewide fuel consumption are downscaled

based on employment and land area designations. As another example, non-road emissions from construction, agriculture, and mining are downscaled by population because the distribution of equipment and its turnover time due to state policies is unknown. Results in the health analysis are aggregated by state, region, and community-type because of uncertainties in local results.

In addition, the health analysis assumes no change in emissions from alternative fuels, such as renewable diesel, compared to fossil fuels. This may be a conservative assumption as some research has suggested that renewable diesel may have lower emissions when used in uncontrolled non-road engines.[79] (Note that one exception to this approach is for sustainable aviation fuels, as discussed in the previous section.)

There are also limitations in the modeling of emissions from the electricity sector. In particular, the modeling approach was able to estimate emission reductions in $PM_{2.5}$, NO_x, and SO_2, but not VOC and NH_3. The electricity sector modeling conservatively assumes emission rates of NO_x would be double those from similar natural gas units. As described above, a sensitivity analysis conducted for the Draft Plan indicated that if NO_x emissions rates from hydrogen combustion plants were similar to natural gas units, the total benefits would increase only slightly; for example, relaxing this assumption would increase electric sector-related health benefits by three percent and total health benefits by less than half a percent in 2040. In addition, NY-CHAPPA only accounts for changes in emissions in New York State. For this reason, the analysis does not account for any emissions changes in the electricity sector outside of the state, including, for example, changes in electric sector imports into New York State over time.

While care was taken to downscale the estimated air pollutant emissions to the census tract scale, the approach described above does not necessarily fully represent all emissions sources or account for all variation in emissions within census tracts. In particular, this analysis focused on changes in energy-related emissions that would be impacted by the policy scenarios. There may be other changes to emissions in other sectors; however, these emissions changes are outside the scope of this analysis.

Similarly, the air quality model used in NY-CHAPPA estimates how changes in air pollutant emissions result in changes in ambient $PM_{2.5}$ concentrations. Although the model performs well in estimating current air quality against observations and other models (described in Section 2.1.5), no model will perfectly predict air quality concentrations. In particular, NY-CHAPPA appears to somewhat overpredict baseline $PM_{2.5}$ concentrations in the NYC area and underpredict concentrations in some of the upstate areas. Furthermore, the future changes in $PM_{2.5}$ concentrations under the policy scenarios will be impacted by multiple factors, including changes in meteorology, which are difficult to predict, especially for future years. The health analysis does not account for future changes in meteorology given large uncertainties and instead uses a single meteorological year.

Furthermore, NY-CHAPPA and COBRA were used to estimate the benefits of reduced $PM_{2.5}$ and ozone concentrations, respectively, but neither of these tools account for other potential benefits of reduced air pollutant emissions, including reductions in NO_2 concentrations and other hazardous air pollutants (also referred to as “air toxics”) nor does it account for potential benefits from improvements in indoor air quality.

The approach to estimating changes in health effects also includes uncertainty. The health impact functions used in NY-CHAPPA are taken from EPA's COBRA tool and/or the published epidemiological literature, based on studies that determine the effect of changes in air quality on changes in health effects. The health impact functions derived from these studies are useful, but the actual observed health impact of changes in air quality can be affected by multiple other factors, such as individual risk factors within populations and the implementation of other public health programs. Additionally, the baseline health incidence data used from COBRA and DOH does not reflect incidence data from more recent years (Table A-5).

Therefore, results of NY-CHAPPA and COBRA are best represented at aggregated spatial scales and by community type and should not be interpreted at the individual census tract scale, to minimize false precision of results.

Lastly, the approach used to estimate the monetary value of the health benefits relies on standard economic values developed by the EPA for the COBRA tool. These economic values are based on studies of the cost of medical care and/or the public's willingness to pay to avoid certain health effects. These economic values are averages, and they may not represent the actual costs of each health effect in all cases.

Beyond the air quality benefits modeled by NY-CHAPPA, policies in the Plan may result in additional health benefits—for example, from active transportation, energy efficiency interventions in residential buildings, and energy security—are not quantified here. Future work could assess health benefits beyond those captured in this analysis. In addition, while this analysis focused on aggregated benefits, future work may also consider more localized impacts from sectoral policies.

3. Additional Results of the Public Health Impacts Analysis

In addition to the results of the public health analysis discussed in the chapter above, the sections below provide additional results for all policy scenarios considered in the health analysis: Current Policies, Additional Action, and Net Zero B (Sections 3.1, 3.2, and 3.3), and the two federal sensitivity scenarios (Section 3.4). All results are shown relative to the No Action scenario. The associated data annex includes additional results at the county level and for additional model years for all scenarios.

3.1. Statewide Health Benefits

Table A-7 provides a summary of the annual avoided public health effects due to reduced $PM_{2.5}$ and ozone concentrations for each scenario in 2040, as well as the fraction of benefits accruing in DAC areas for each health effect under each scenario. Note that the fraction of benefits in DAC areas is only due to benefits from lower $PM_{2.5}$ concentrations because the results for ozone are only available at the county level. These results are presented in Table 2 in this chapter, but includes the DAC area fraction for each scenario, which can be considered relative to the 37 percent geographic population of DACs statewide. Table A-8 provides the same information for 2050.

Table A-7. Summary of Annual Statewide Avoided Public Health Effects due to Lower $PM_{2.5}$ and Ozone Concentrations by Scenario Relative to the No Action Scenario (2040)

Note: The DAC area fraction represents the fraction of avoided cases due to lower $PM_{2.5}$ concentrations within those areas and can be compared with the statewide fraction of population within DAC areas, approximately 37 percent.

Health Effect	Current Policies		Additional Action		Net Zero B	
	Avoided Cases Per Year	DAC Area Fraction	Avoided Cases Per Year	DAC Area Fraction	Avoided Cases Per Year	DAC Area Fraction
Premature Mortality	570	51%	1,000	50%	3,200	49%
Nonfatal Heart Attacks	240	49%	430	48%	1,300	47%
Hospitalizations	160	50%	280	50%	880	49%
Acute Bronchitis	260	50%	450	50%	1,400	49%
Respiratory Symptoms	8,000	50%	14,100	50%	44,000	49%
Emergency Room Visits, Asthma	780	72%	1,300	72%	4,000	72%
Asthma Exacerbation	4,900	50%	8,600	50%	27,000	49%
Minor Restricted Activity Days	160,000	49%	280,000	49%	870,000	48%
Work Loss Days	27,000	49%	48,000	49%	150,000	48%

Table A-8. Summary of Annual Statewide Avoided Public Health Effects due to Lower $PM_{2.5}$ and Ozone Concentrations by Scenario Relative to the No Action Scenario (2050)

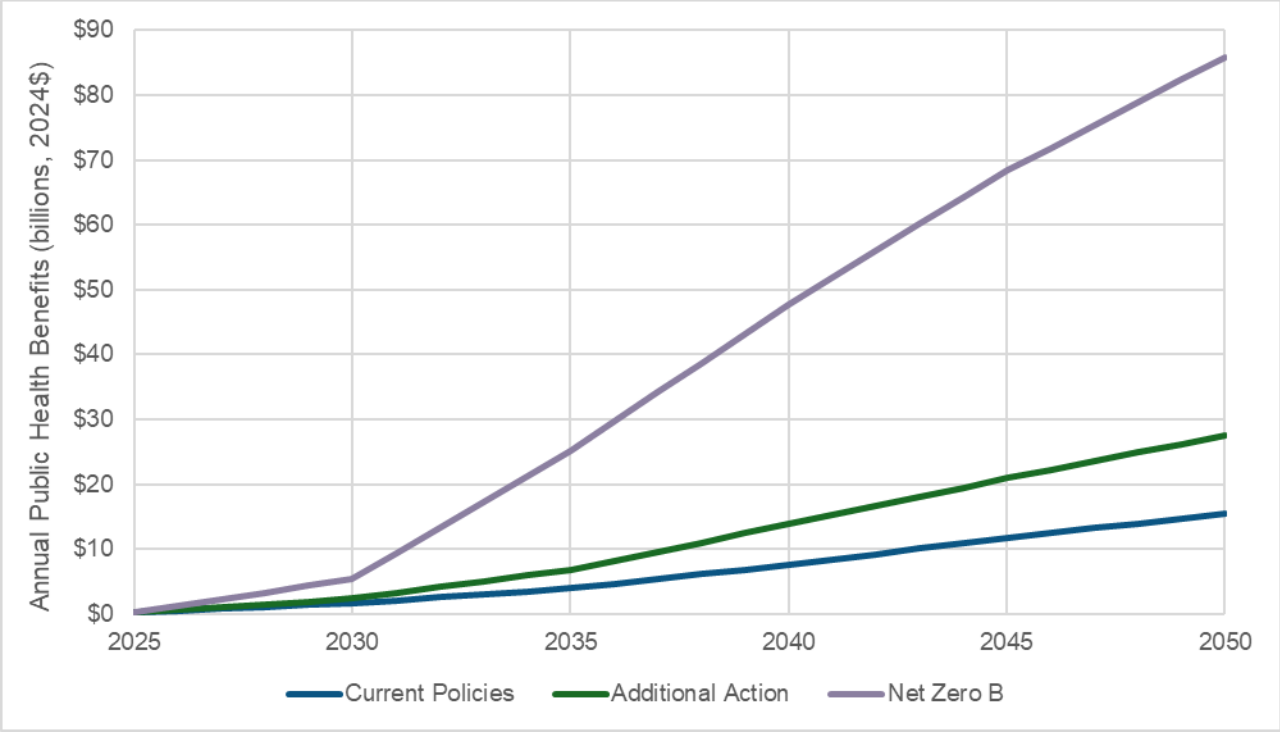
Note: The DAC area fraction represents the fraction of avoided cases due to lower $PM_{2.5}$ concentrations within those areas and can be compared with the statewide fraction of population within DAC areas, approximately 37 percent.

Health Effect	Current Policies		Additional Action		Net Zero B	
	Avoided Cases Per Year	DAC Area Fraction	Avoided Cases Per Year	DAC Area Fraction	Avoided Cases Per Year	DAC Area Fraction
Premature Mortality	1,200	50%	2,000	50%	5,900	49%
Nonfatal Heart Attacks	490	49%	820	48%	2,400	47%
Hospitalizations	320	50%	540	50%	1,600	49%
Acute Bronchitis	470	50%	790	50%	2,200	49%
Respiratory Symptoms	15,000	50%	25,000	50%	71,000	49%

Health Effect	Current Policies		Additional Action		Net Zero B	
	Avoided Cases Per Year	DAC Area Fraction	Avoided Cases Per Year	DAC Area Fraction	Avoided Cases Per Year	DAC Area Fraction
Emergency Room Visits, Asthma	1,400	72%	2,300	72%	6,400	72%
Asthma Exacerbation	9,000	50%	15,000	50%	44,000	49%
Minor Restricted Activity Days	290,000	49%	480,000	49%	1,300,000	48%
Work Loss Days	49,000	49%	81,000	50%	230,000	48%

Figure A-8 shows the total annual benefits values associated with lower $PM_{2.5}$ and ozone concentrations for each scenario relative to the No Action scenario between 2025 and 2050, including both in-state and out-of-state benefits. The chapter shows a similar figure, covering the period 2025 to 2040. The data annex provides annual benefits values by scenario for in-state, out-of-state, and total benefits associated with projected reduced exposure to $PM_{2.5}$ and ozone.

Figure A-8. Projected Annual Health Benefits Value from $PM_{2.5}$ (High Value) and Ozone by Scenario Relative to the No Action Scenario (2025–2050)



3.2. Benefits by Region and Community

Figure A-9 shows the annual average $PM_{2.5}$ concentration reductions by region and community from each scenario in 2040 relative to the No Action scenario. The data annex provides this information for all scenarios at the county level. The magnitude of $PM_{2.5}$ concentration reductions increases from Current Policies to Additional Action to Net Zero B, illustrated in the different y-axis scales. These figures show that in all regions DAC areas tend to receive a higher reduction in $PM_{2.5}$ concentrations relative to non-DAC areas. While there are differences in local exposure, the New York City region has similar $PM_{2.5}$ concentration reductions between DAC and non-DAC areas.

Figure A-10, Figure A-11, and Figure A-12 show maps of the county scale average reduction in $PM_{2.5}$ concentrations in 2040 in each scenario. While each county would experience a reduction in average ambient $PM_{2.5}$ concentrations in each scenario, urban areas would experience the largest reductions, with the highest reductions in New York City. These areas also tend to have the highest baseline emissions and therefore would see the largest emissions reductions in each scenario.

Figure A-13 shows the total annual value of health benefits in 2040 for each region under each scenario relative to the No Action scenario. The data annex provides this information for all scenarios at the county level. The charts on the left in each figure show the annual benefits for all regions except New York City, and the charts on the right show the annual benefits for the New York City region on a different scale. The value of benefits under Additional Action are at least 60 percent higher than under Current Policies across all regions, and the value of benefits under Net Zero B are approximately triple compared to those under Additional Action.

Figure A-9. Population-Weighted Average $PM_{2.5}$ Concentration Reductions by Community, Region, and Scenario Relative to the No Action Scenario (2040)

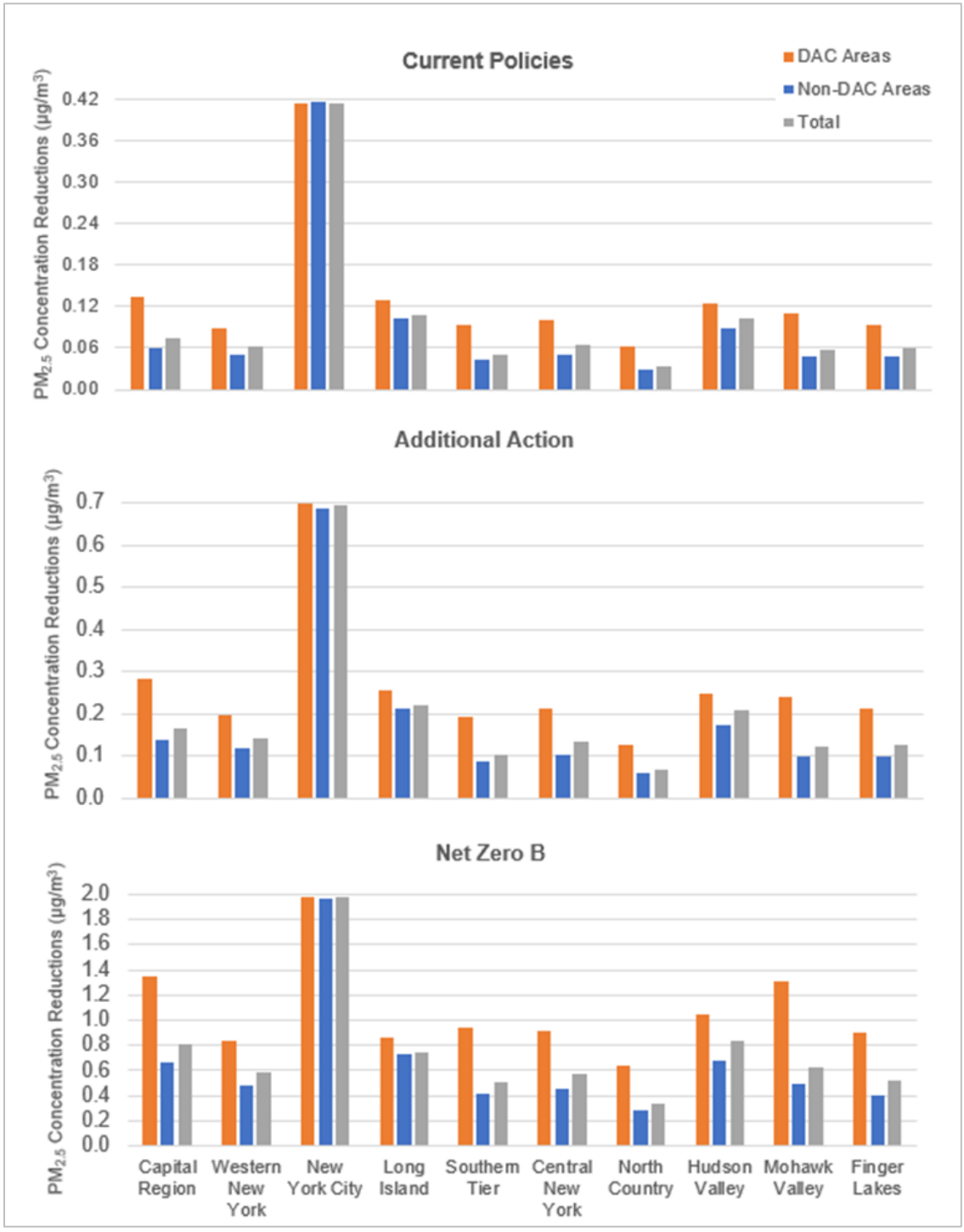


Figure A-10. Population-Weighted $PM_{2.5}$ Concentration Reductions (µg/m³) by County (Current Policies Scenario Relative to the No Action Scenario, 2040)

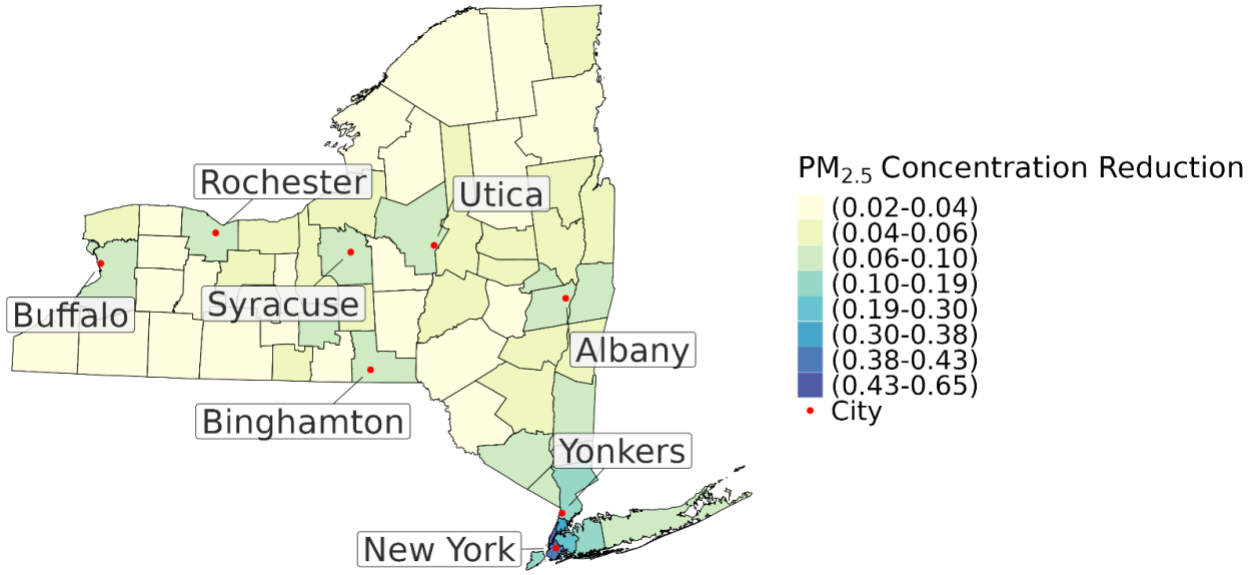


Figure A-11. Population-Weighted $PM_{2.5}$ Concentration Reductions (µg/m³) by County (Additional Action Scenario Relative to the No Action Scenario, 2040)

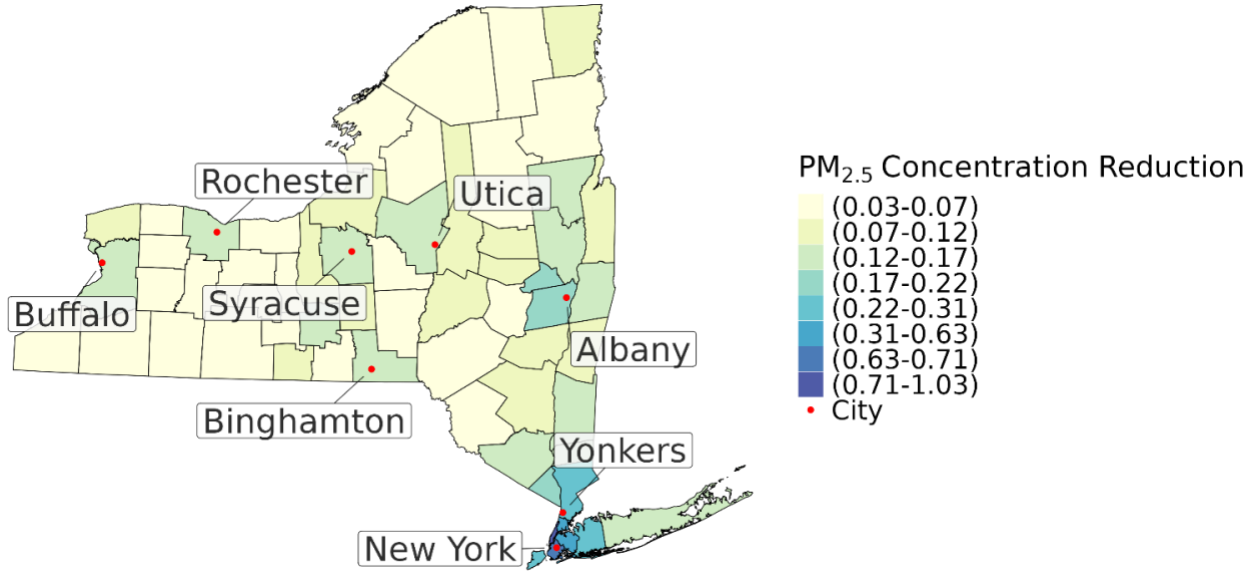


Figure A-12. Population-Weighted $PM_{2.5}$ Concentration Reductions (µg/m³) by County (Net Zero B Scenario Relative to the No Action Scenario, 2040)

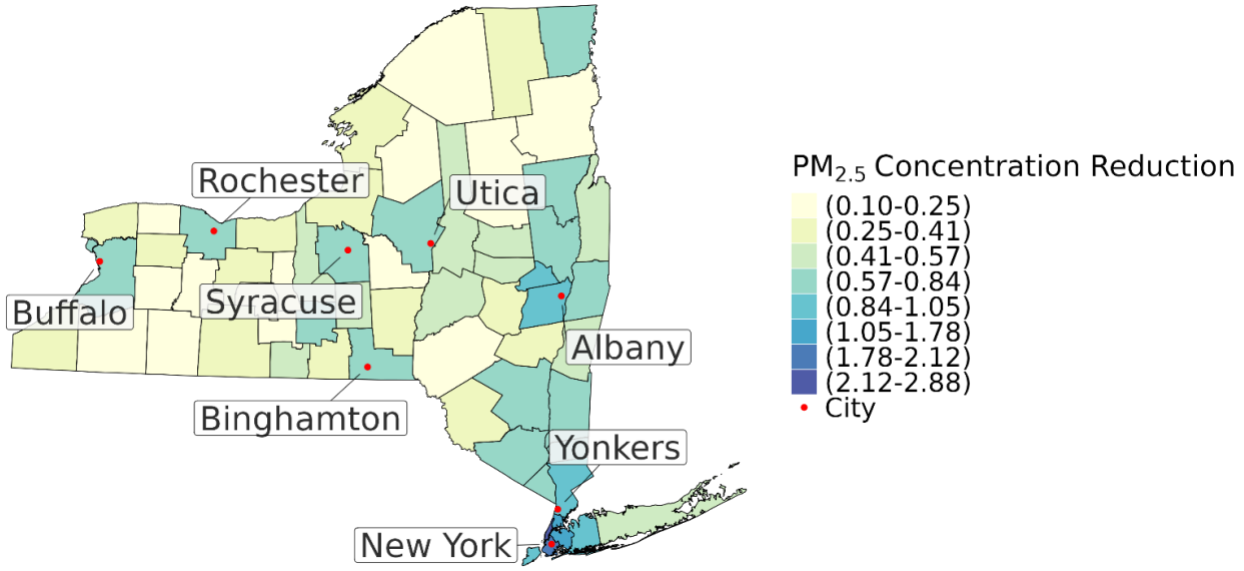


Figure A-13. Annual Value of Health Benefits from Lower $PM_{2.5}$ Concentrations by Region and by Scenario Relative to the No Action Scenario (2040)

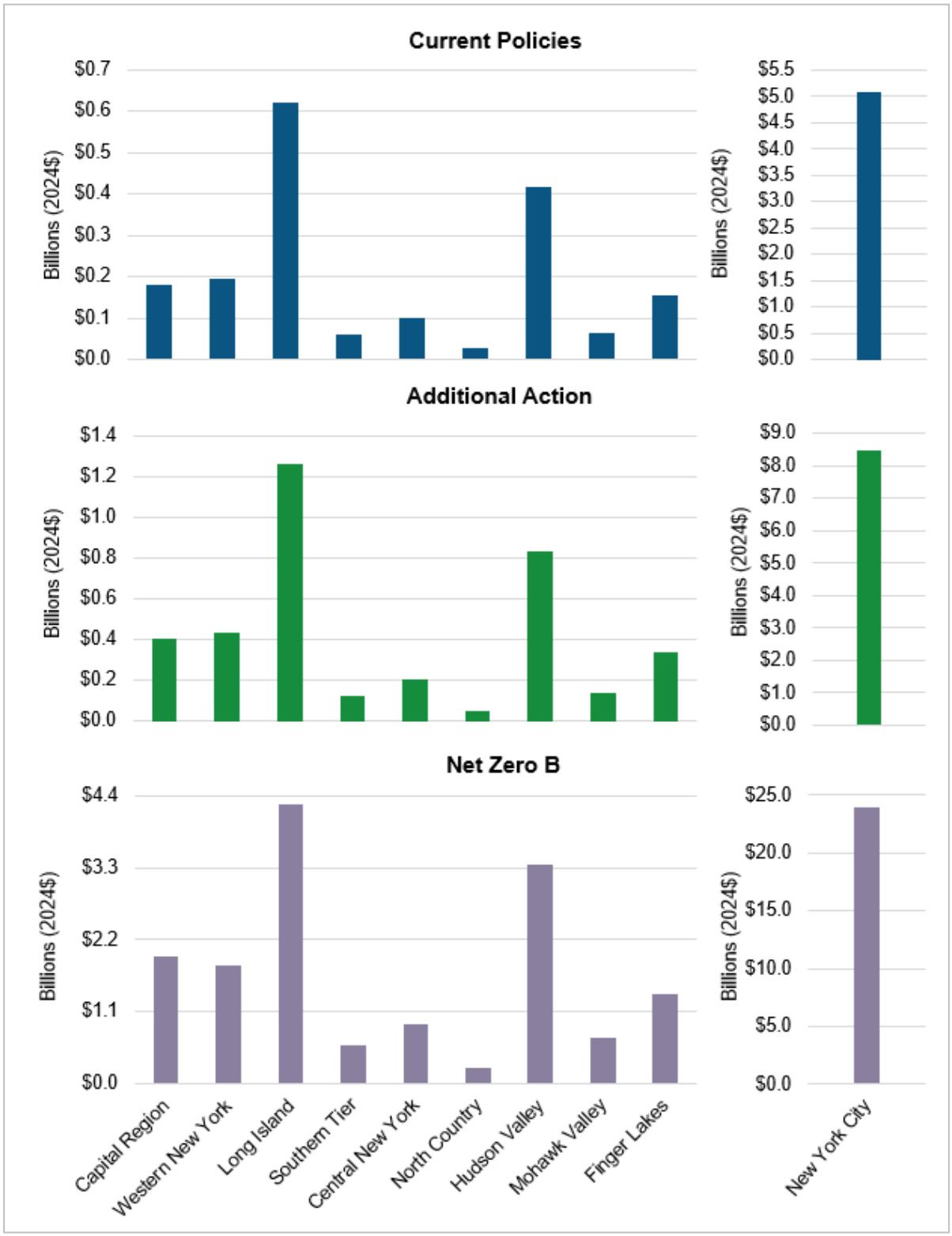


Figure A-14, Figure A-15 and Figure A-16 show maps of the county scale per-capita value of public benefits of each scenario in 2040. Similar to the distribution of $PM_{2.5}$ reductions shown in Figure A-10, Figure A-11, and Figure A-12, each county would see positive per-capita health benefits in each scenario. However, the urban areas tend to see higher per-capita benefits, due to the greater reductions in $PM_{2.5}$ concentrations in these areas.

Figure A-14. Per Capita Health Benefits Value ($) by County (Current Policies Scenario Relative to the No Action Scenario, 2040)

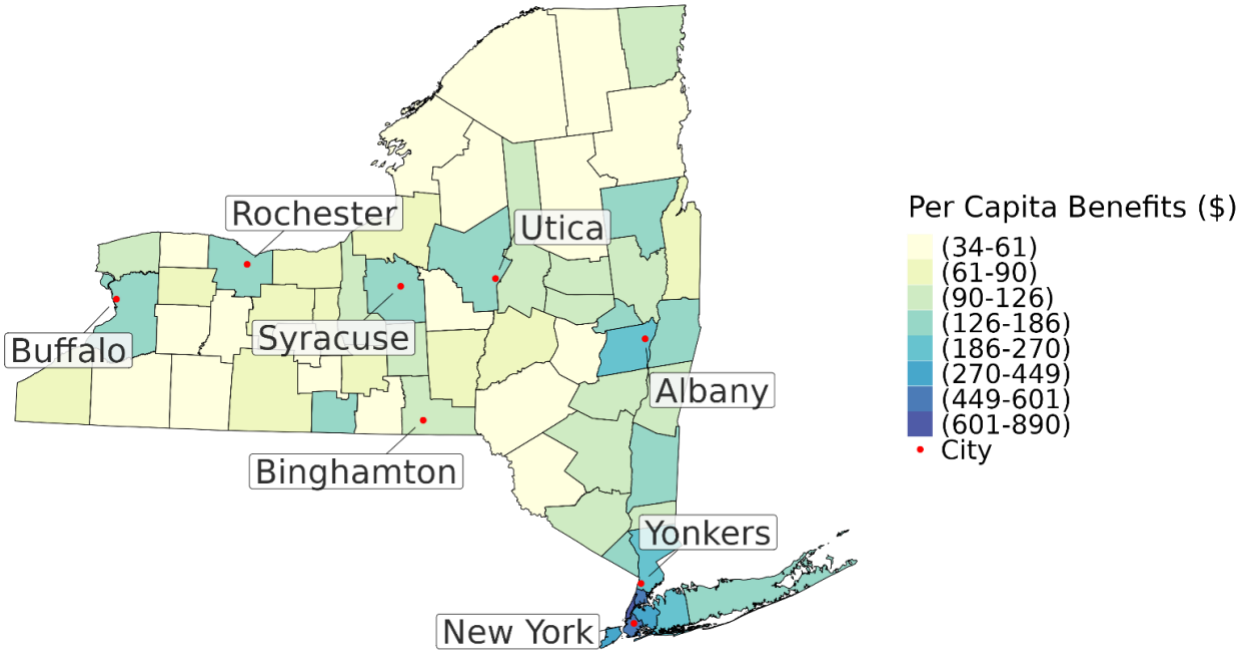


Figure A-15. Per Capita Health Benefits Value ($) by County (Additional Action Scenario Relative to the No Action Scenario, 2040)

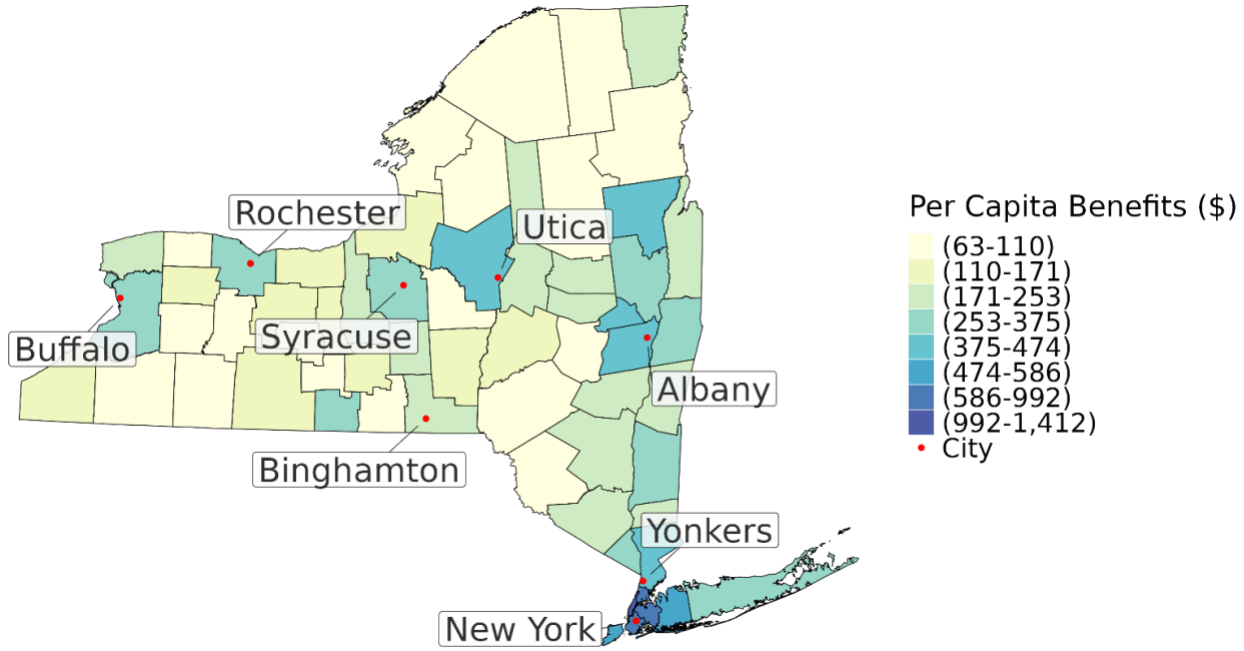


Figure A-16. Per Capita Health Benefits Value ($) by County (Net Zero B Scenario Relative to the No Action Scenario, 2040)

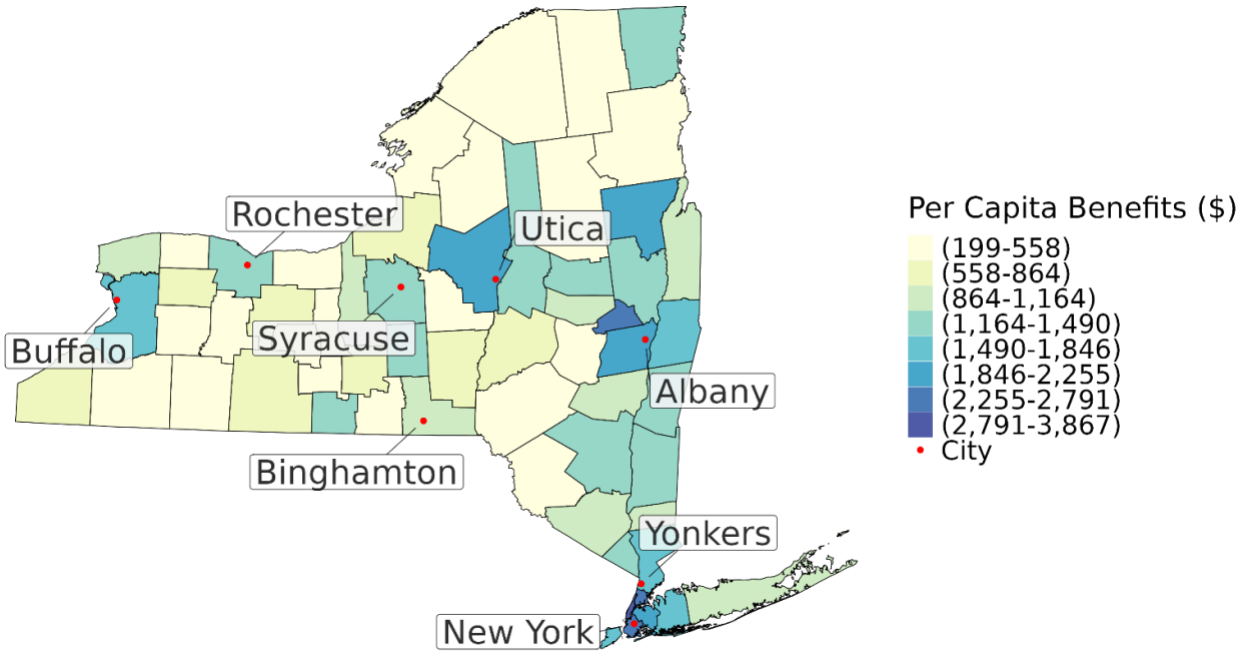


Figure A-17 shows the fraction of the value of benefits from lower $PM_{2.5}$ concentrations accruing to DAC areas compared to their fraction of the population in each region under all scenarios. The data annex provides this information for all scenarios at the county level. These figures show that for all regions, DAC areas receive a larger share of benefits relative to their share of the population. The distribution of fractional benefits accruing to DAC areas is similar across all scenarios.

Figure A-17. Fraction of Cumulative Benefits due to Lower $PM_{2.5}$ Concentrations Accruing to DAC Areas by Scenario Relative to the No Action Scenario Compared to the Fraction of Population in DAC Areas (2025–2040)

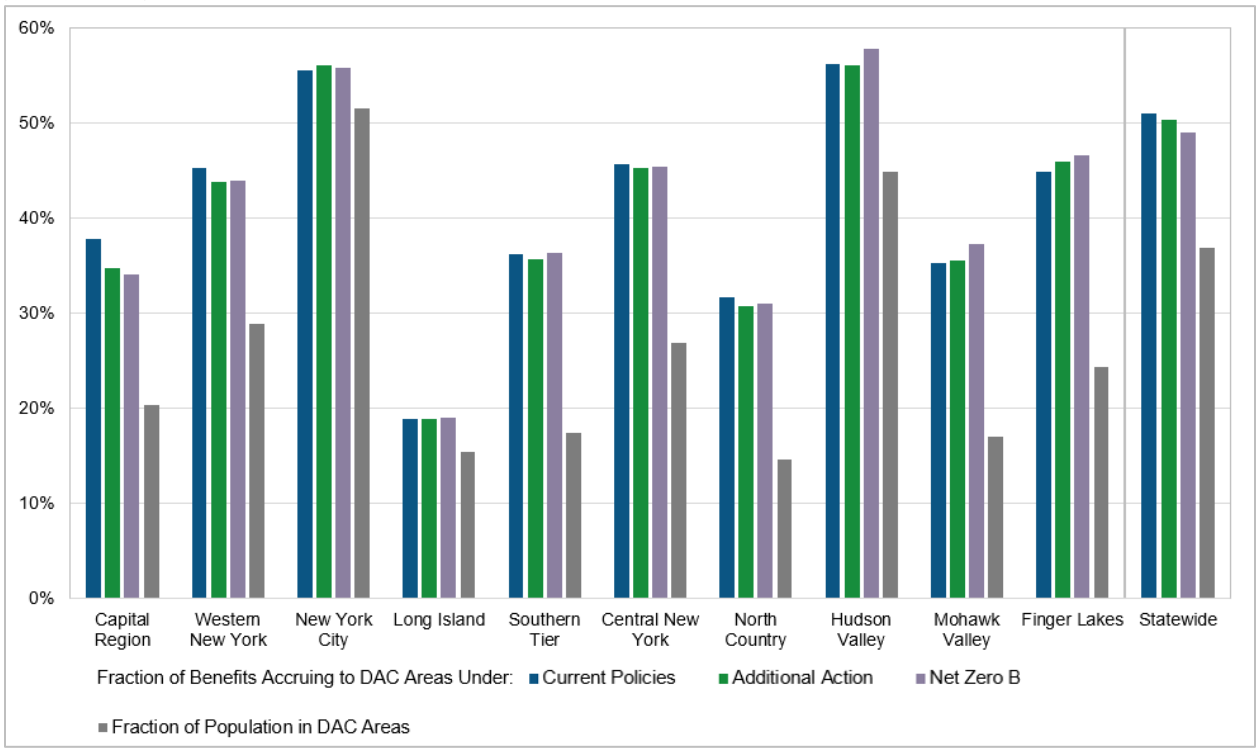


Figure A-18 and Figure A-19 summarize the regional-level distribution of public health outcomes to geographic DACs and non-DACs in 2040 under the Current Policies and Net Zero B scenarios (the chapter shows a similar figure for the Additional Action). The pie charts show DAC and non-DAC area fractions of regional population, avoided premature mortality cases, and avoided emergency room visits for asthma, with regional totals beneath each pie chart. The bar charts show annual per capita monetary values for DAC and non-DAC areas for each region, representing the combined value of all avoided health effect types. DAC areas receive higher per capita benefits than non-DAC areas under all scenarios; under Net Zero B, the difference in per capita benefits for DAC areas compared to non-DAC areas is even larger than under Current Policies and Additional Action.

Figure A-18. Summary of Annual Public Health Benefits from Lower $PM_{2.5}$ Concentrations (Current Policies Scenario Relative to the No Action Scenario, 2040)

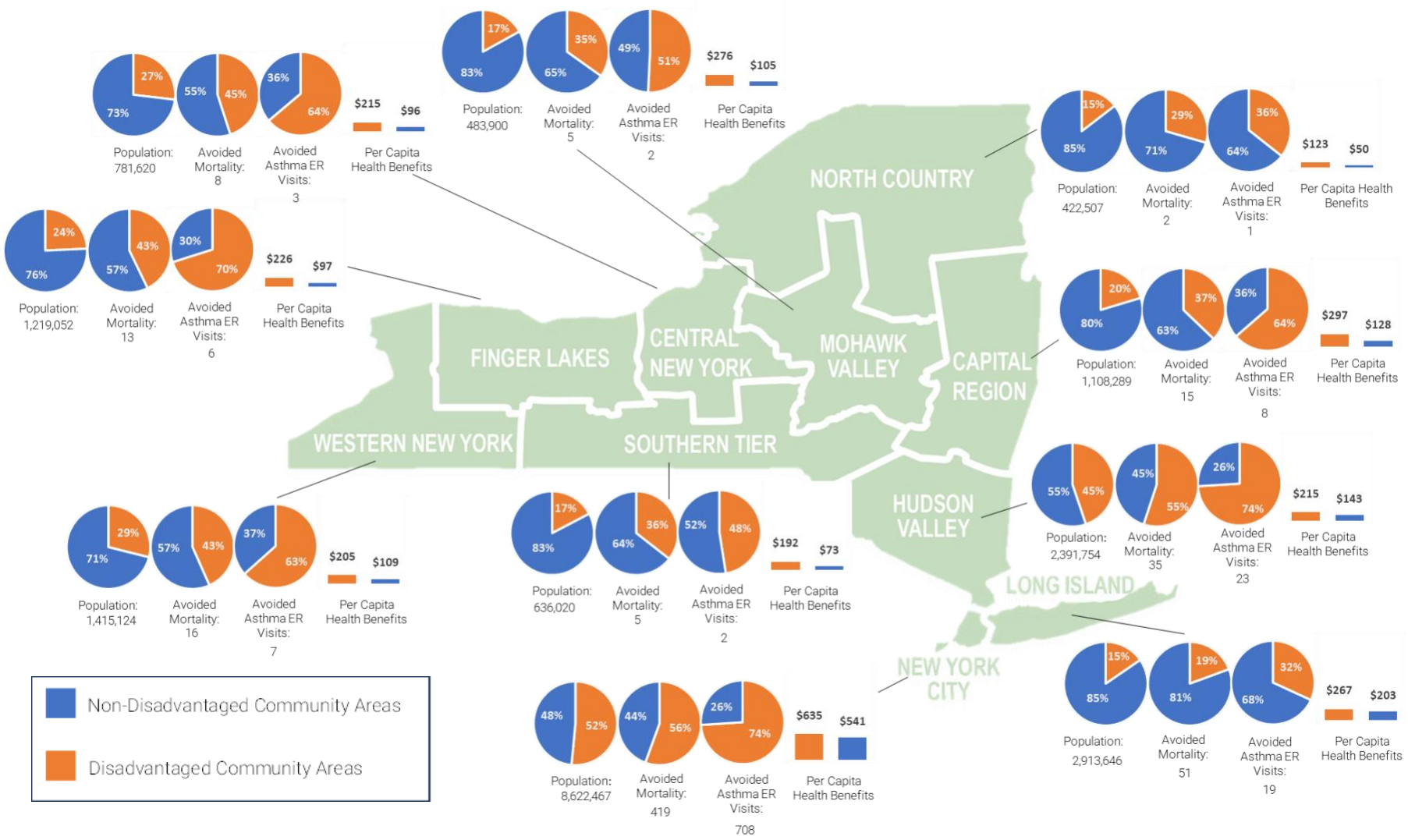
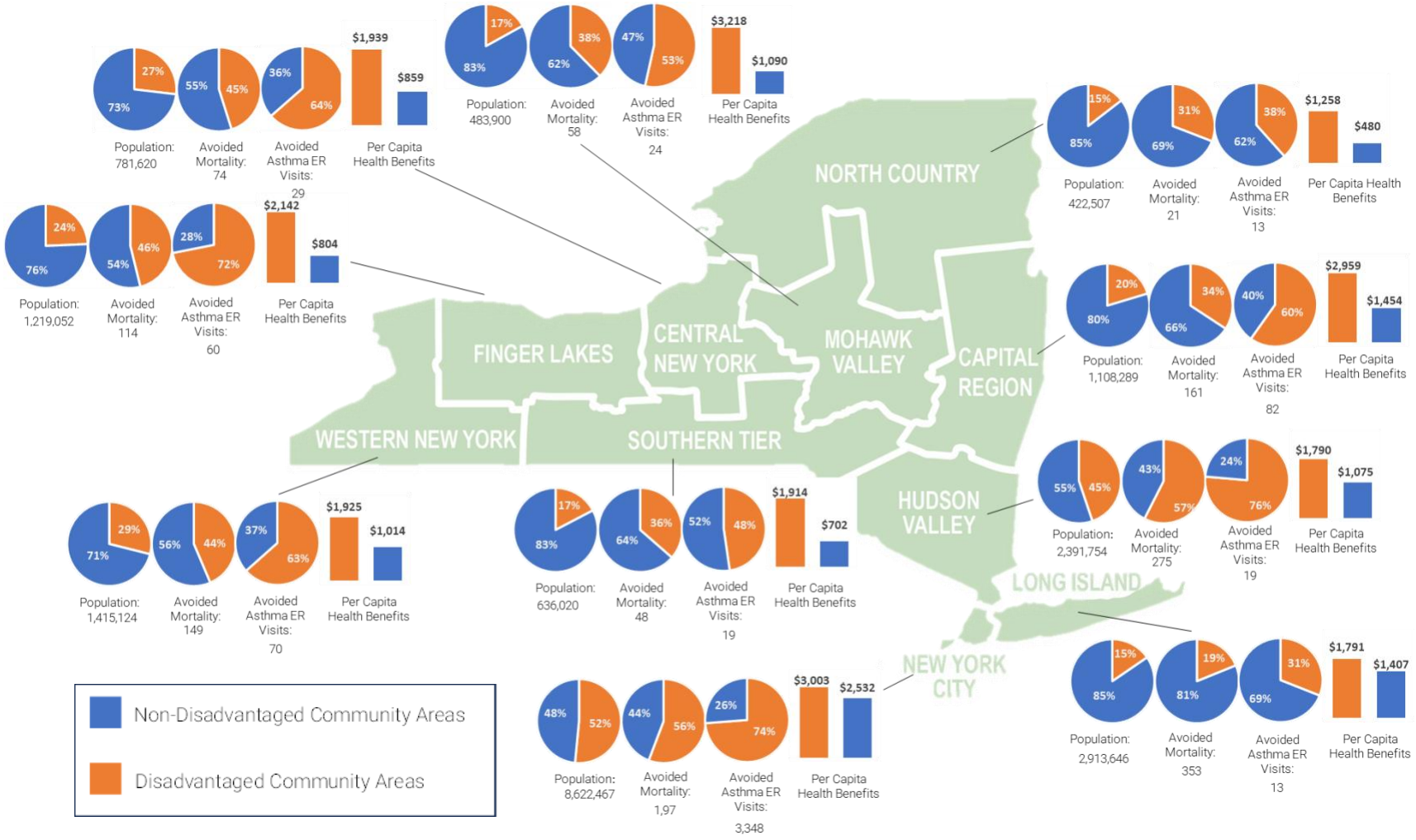


Figure A-19. Summary of Annual Public Health Benefits from Lower $PM_{2.5}$ Concentrations (Net Zero B Scenario Relative to the No Action Scenario, 2040)



3.3. Benefits by Sector

Table A-9 and Figure A-20 through Figure A-25 present the distribution of the public health benefits for each scenario by sector. Table A-9 shows the cumulative 2025-2040 value of benefits by sector and scenario. Figure A-20 though Figure A-22 show the proportion of cumulative benefits by sector and community, both with and without the benefits of reduced wood combustion.

Table A-9. Cumulative Societal Public Health Benefits Value (million $) from Lower In-State $PM_{2.5}$ Concentrations by Sector and Scenario Relative to the No Action Scenario (2025–2040)

Sector	Current Policies	Additional Action	Net Zero B
Buildings			
Commercial Fossil Fuels	$836	$1,057	$7,009
Commercial Wood	$0	$0	$3,215
Residential Fossil Fuels	$27,581	$34,935	$102,496
Residential Wood	$5,282	$9,371	$59,388
Buildings Total	**$33,670**	**$45,363**	**$172,109**
Transportation			
On-road	$9,675	$18,268	$23,408
Non-road	$0	$0	$12,131
Aircraft	$0	$4,997	$5,050
Transportation Total	**$9,675**	**$23,265**	**$40,588**
Industry			
Industrial (area)	$0	$2,733	$20,399
Industrial (point)	$0	$36	$268
Industrial Wood	$0	$3,010	$7,811
Industry Total	**$0**	**$5,779**	**$28,477**
Electricity	**$3,399**	**$3,240**	**$1,937**
Total	**$46,774**	**$77,647**	**$243,113**

Generally, the buildings and transportation sectors account for the highest share of the benefits in all scenarios, and the sectoral results are described in more detail in the chapter. The Net Zero B scenario has significantly higher total benefits than the other scenarios, and as shown in Table A-9, the largest fraction of those benefits are from reductions in emissions in the buildings sector, most of which are from the residential sector, both from fossil fuels and wood. Net Zero B also has much larger benefits from industry compared to the other scenarios.

Although reducing wood combustion is not a focus of mitigation characterized by the Pathways Analysis, the reductions in emissions from wood combustion are a co-benefit of improved energy efficiency and the reduction in wood use when cleaner heating systems are installed. Despite the wood benefits representing a very small fraction of shift in energy use, the high emission factors associated with wood combustion result in outsized benefits relative to residential fossil fuels. The figures below show that when the benefits from reductions in wood combustion are excluded, the other sectors account for a relatively higher share of the total non-wood benefits.

Figure A-23 through Figure A-25 show the regional and sectoral distributions of the public health benefits with and without the benefits of reduced wood combustion.

Figure A-20. Cumulative Societal Value from Lower In-State $PM_{2.5}$ Concentrations Relative to the No Action Scenario by Sector and Community, with (top) and without (bottom) the Benefits from Lower Wood Combustion (Current Policies Scenario, 2025–2040)

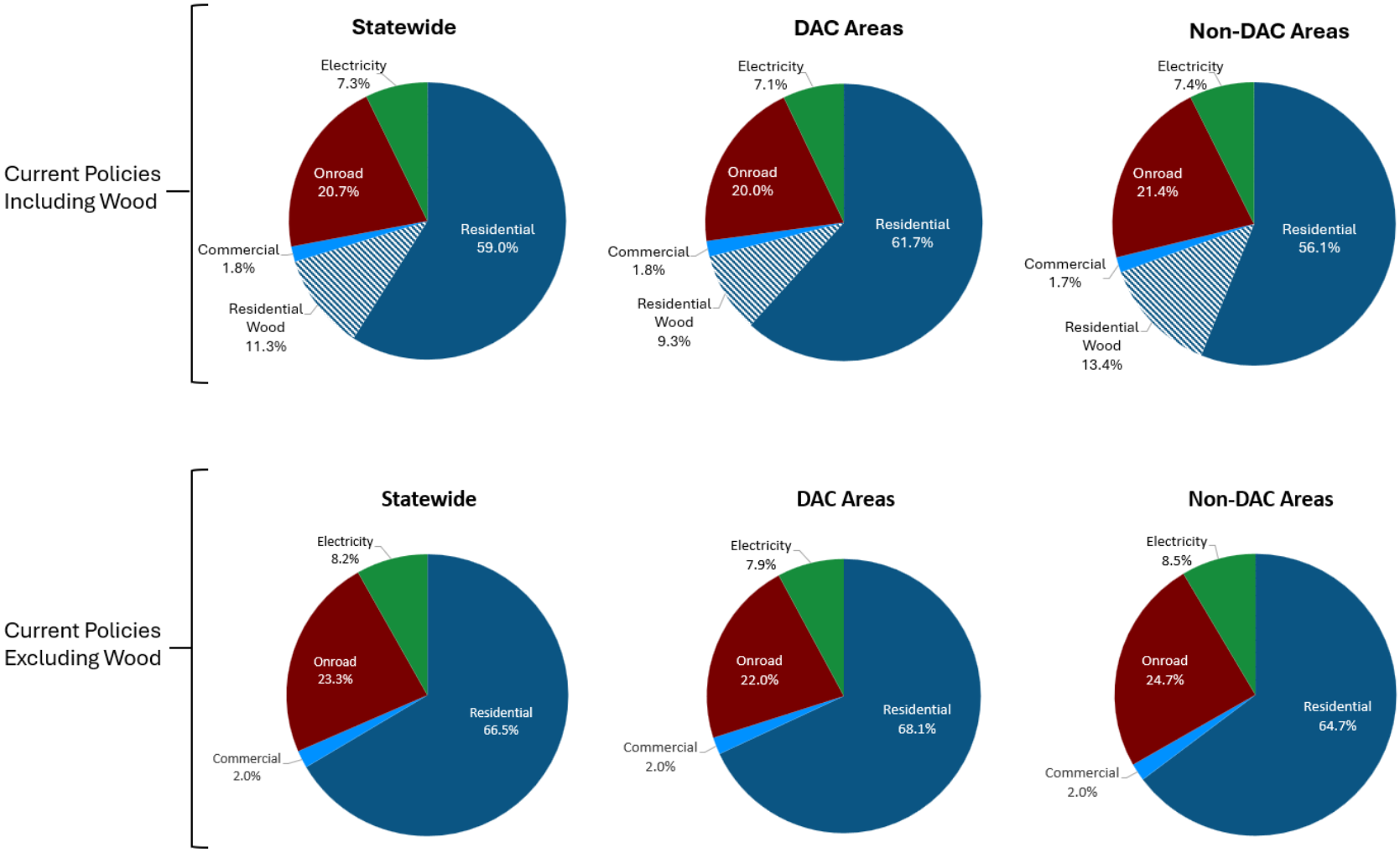


Figure A-21. Cumulative Societal Value from Lower In-State $PM_{2.5}$ Concentrations Relative to the No Action Scenario by Sector and Community, with (top) and without (bottom) the Benefits from Lower Wood Combustion (Additional Action Scenario, 2025–2040)

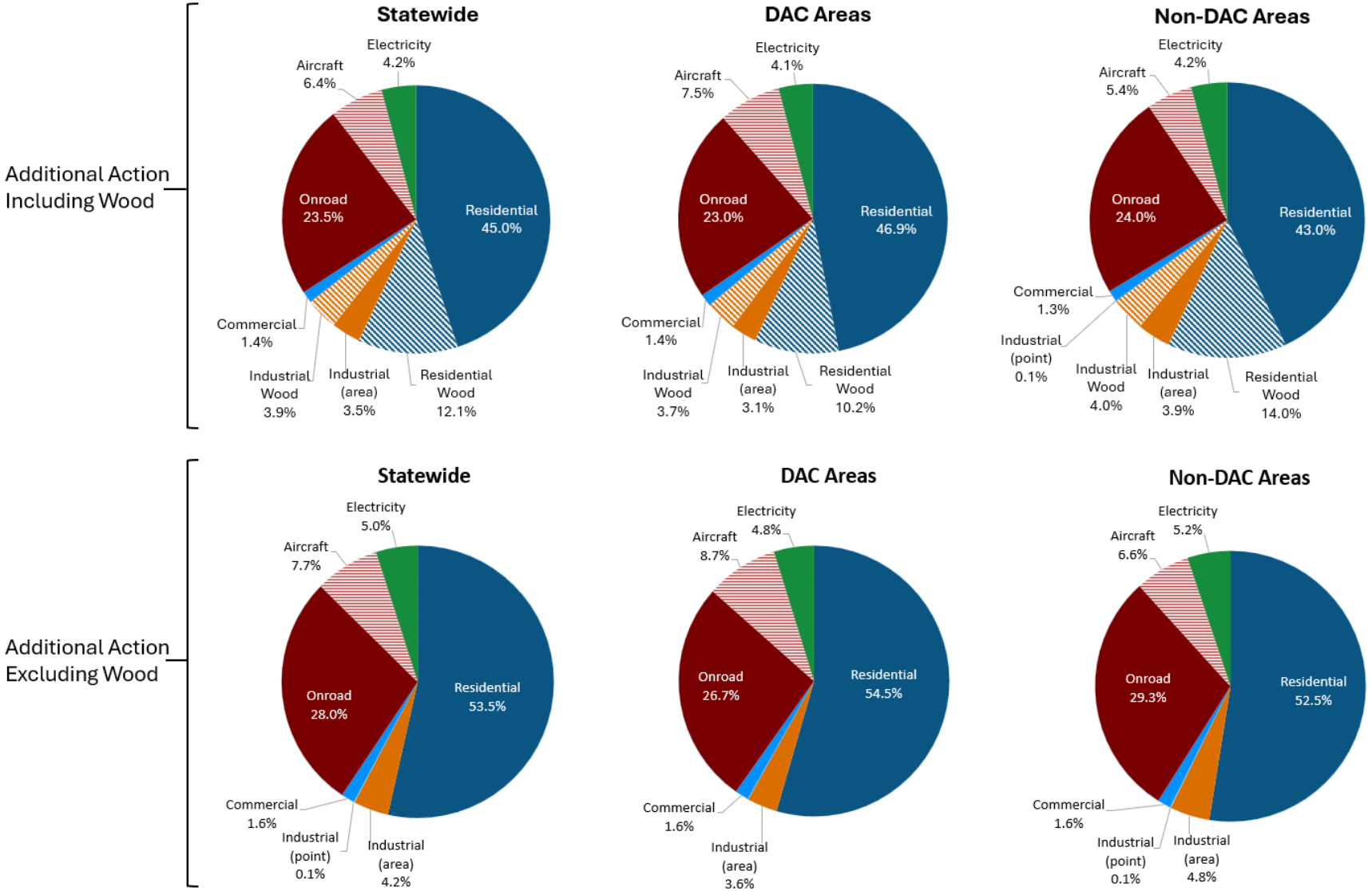


Figure A-22. Cumulative Societal Value from Lower In-State $PM_{2.5}$ Concentrations Relative to the No Action Scenario by Sector and Community, with (top) and without (bottom) the Benefits from Lower Wood Combustion (Net Zero B Scenario, 2025–2040)

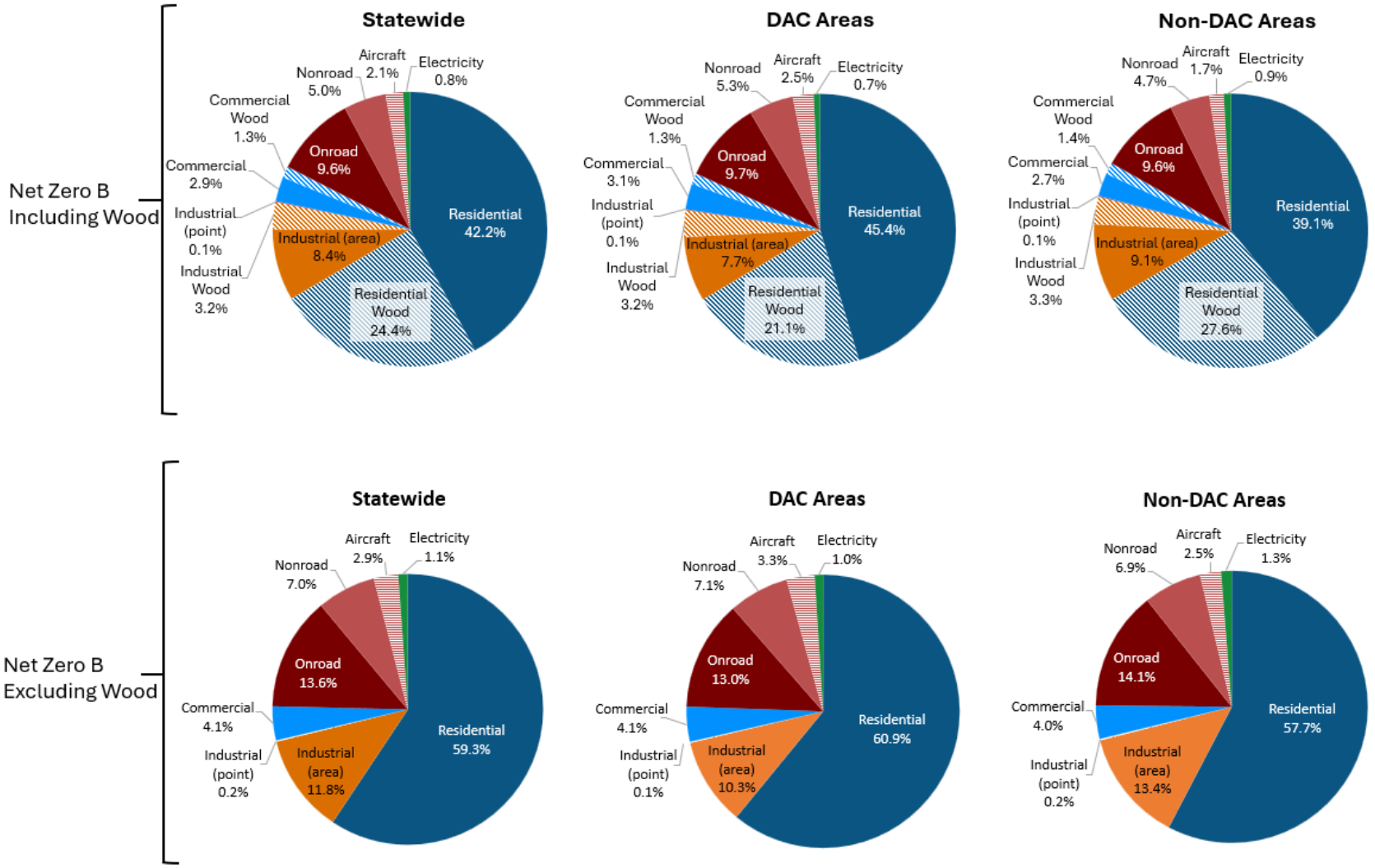
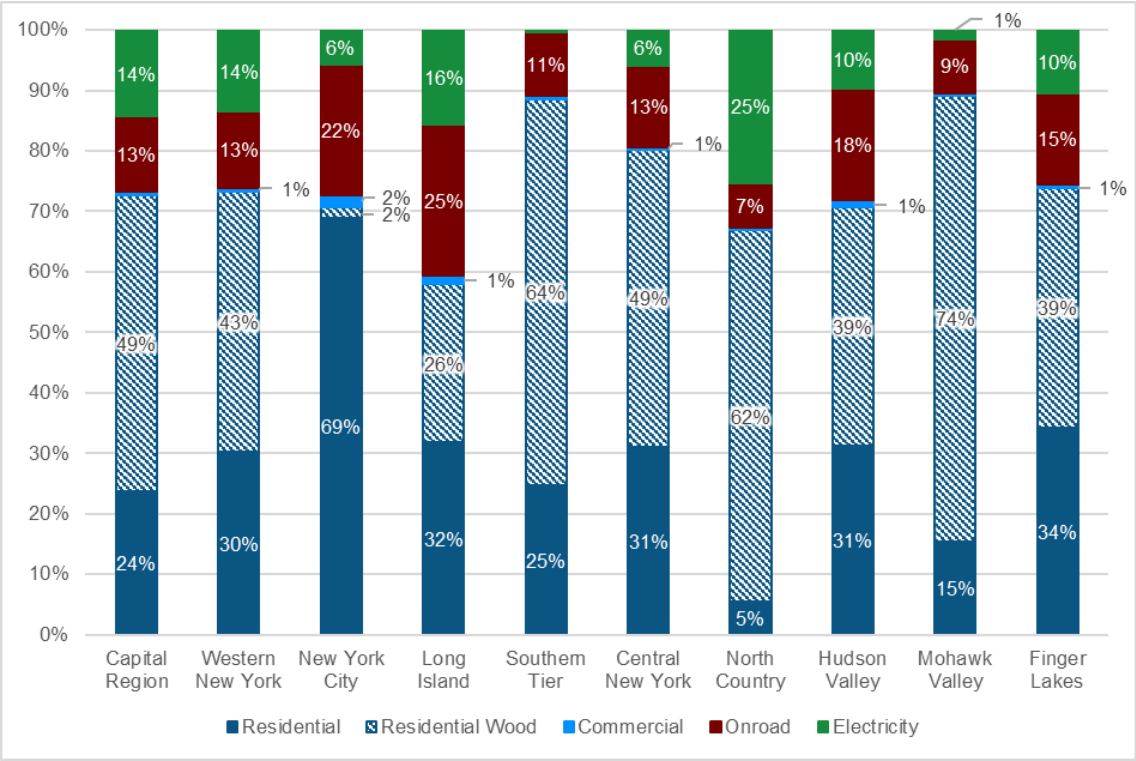


Figure A-23. Regional Distribution of Cumulative Value of Benefits from Lower In-State $PM_{2.5}$ Concentrations Relative to the No Action Scenario by Sector with (top) and without (bottom) the Benefits of Lower Wood Combustion (Current Policies Scenario, 2025–2040)



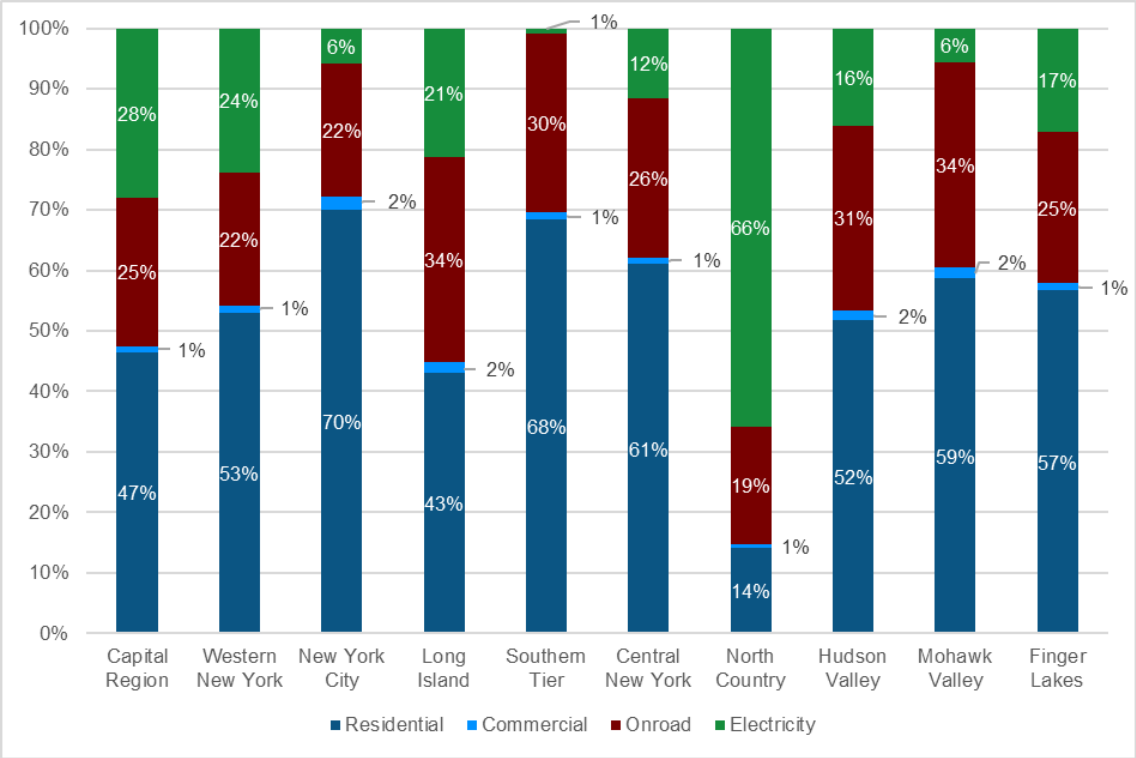
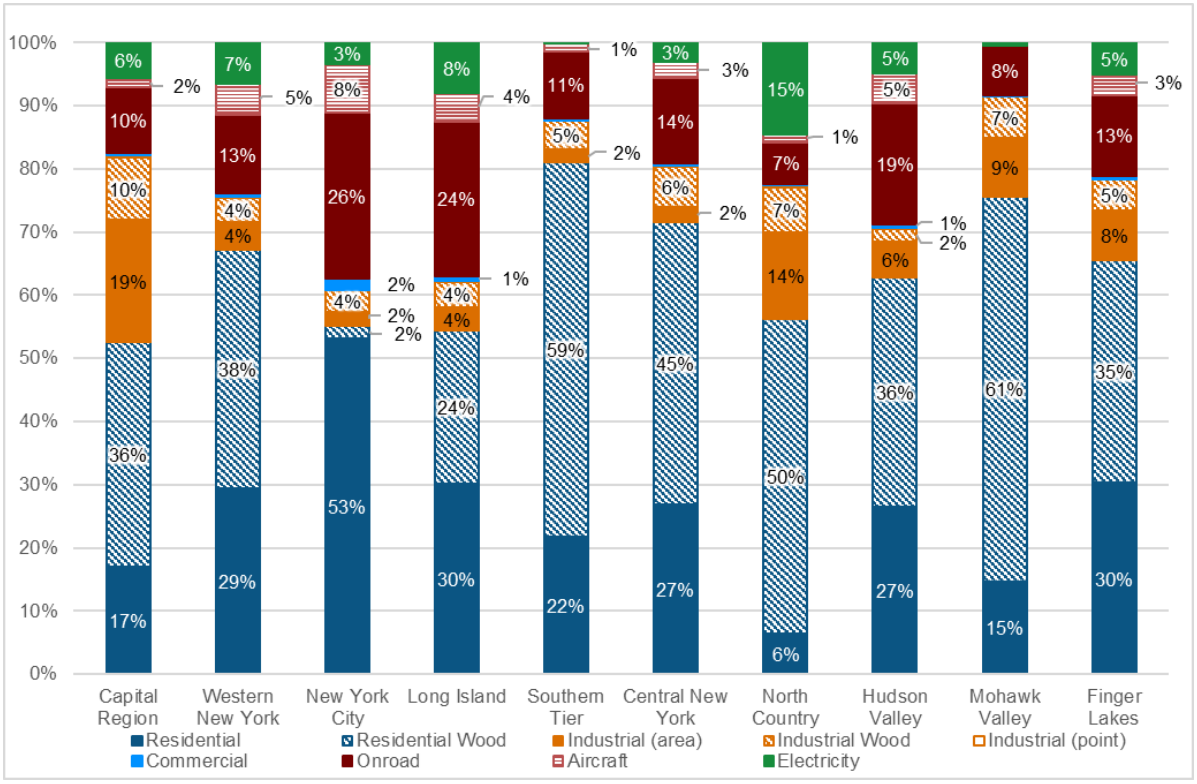


Figure A-24. Regional Distribution of Cumulative Value of Benefits from Lower In-State $PM_{2.5}$ Concentrations Relative to the No Action Scenario by Sector with (top) and without (bottom) the Benefits of Lower Wood Combustion (Additional Action Scenario, 2025–2040)



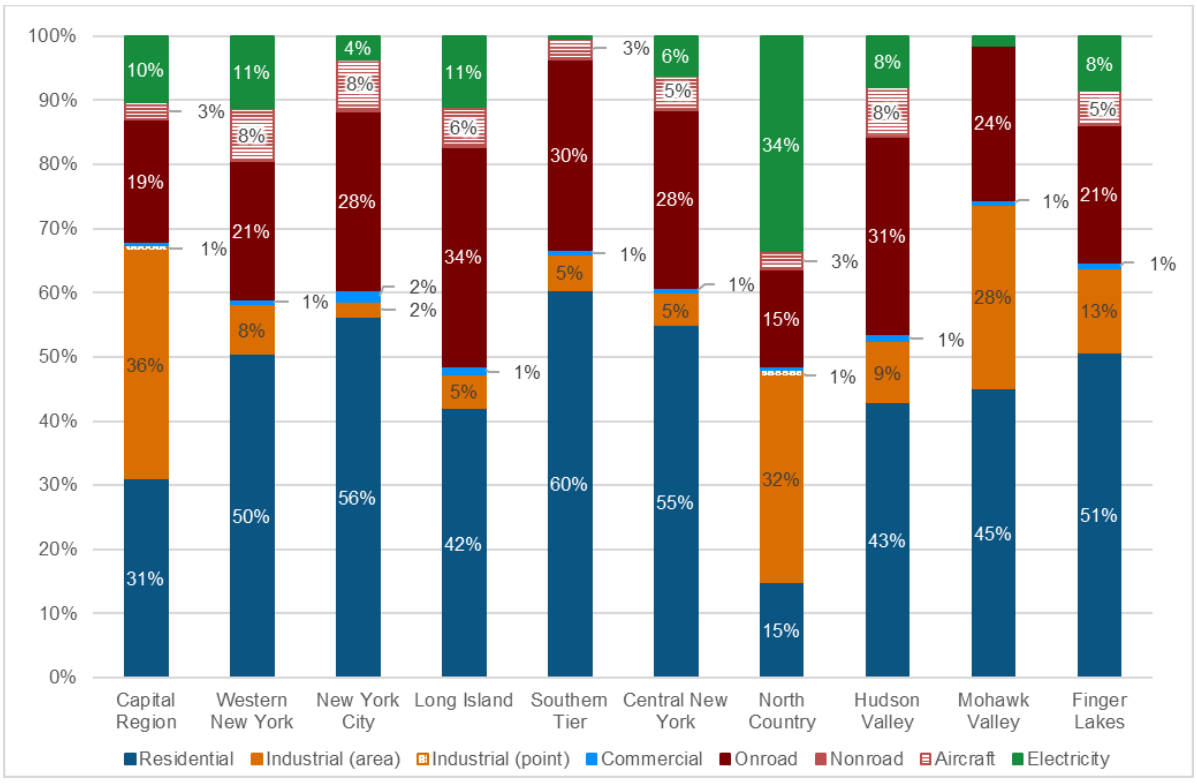
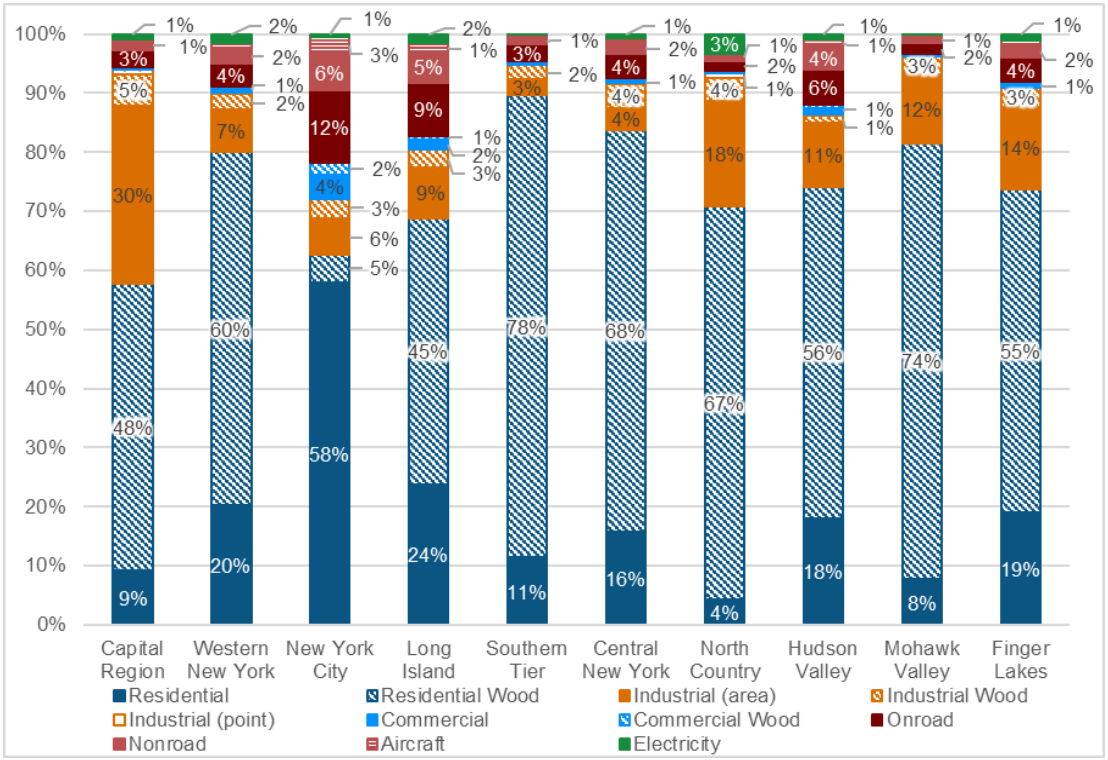
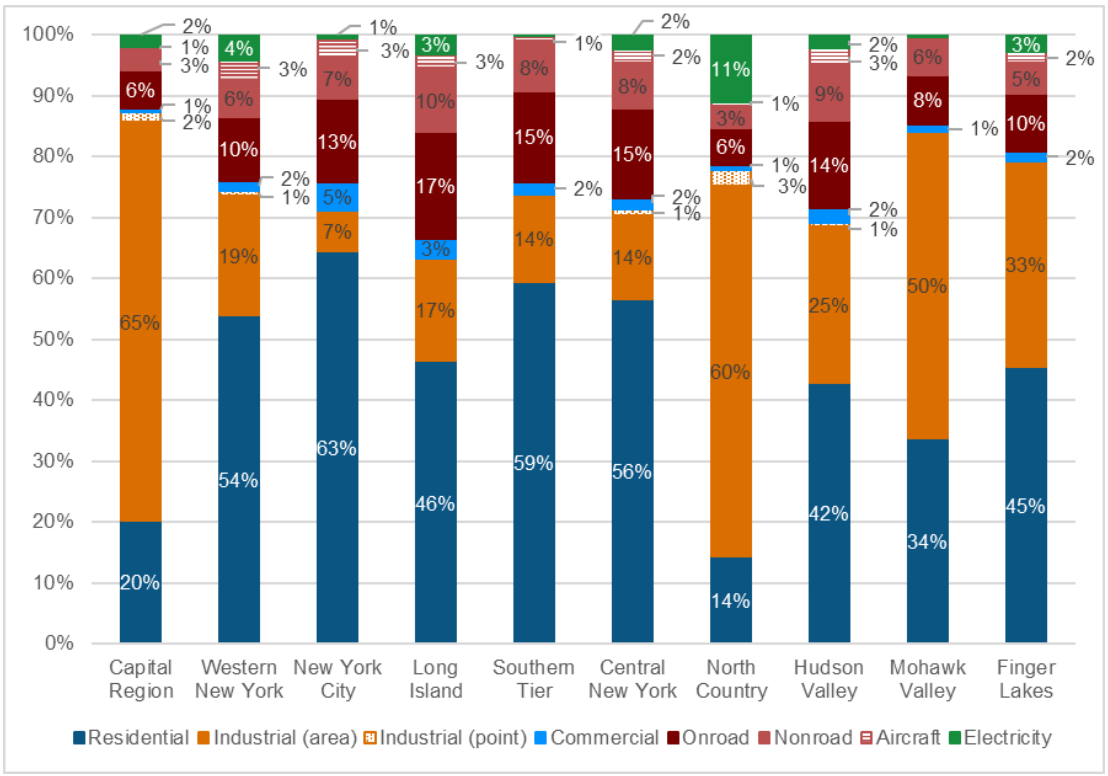


Figure A-25. Regional Distribution of Cumulative Value of Benefits from Lower In-State $PM_{2.5}$ Concentrations Relative to the No Action Scenario by Sector with (top) and without (bottom) the Benefits of Lower Wood Combustion (Net Zero B Scenario, 2025–2040)





3.4. Health Impacts of Federal Policies

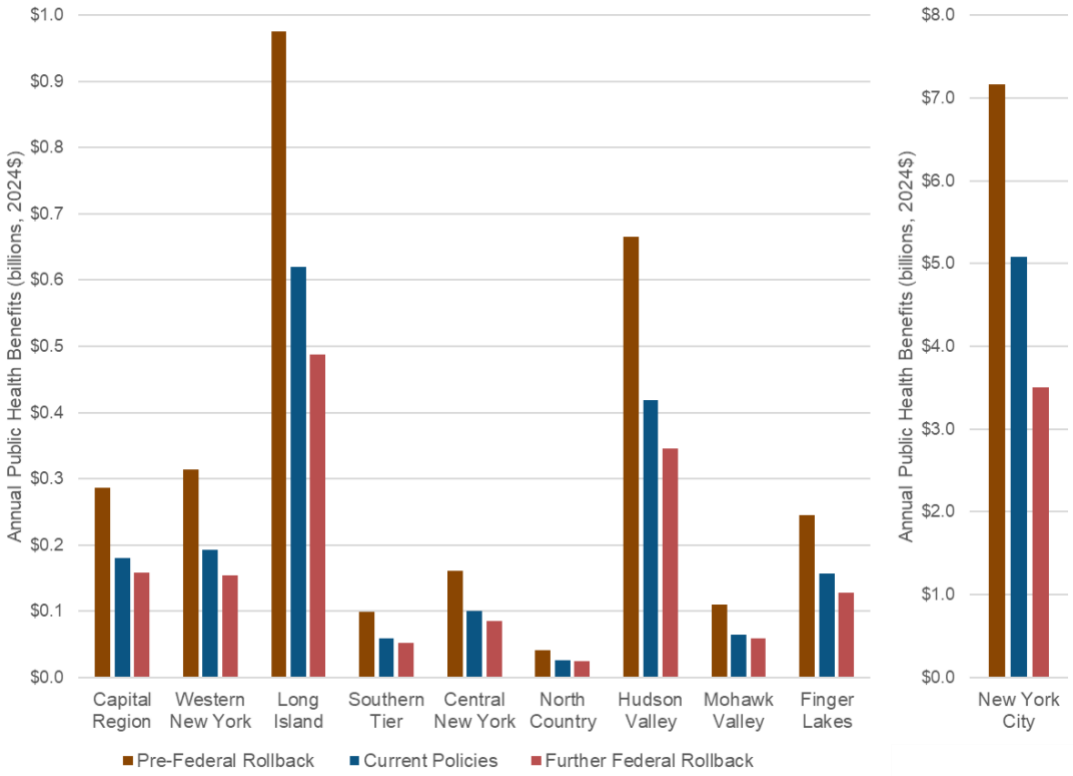
Table A-10 summarizes the annual public health effects avoided due to reduced $PM_{2.5}$ and ozone concentrations for the Current Policies scenario, as well as the differences in avoided cases under each federal sensitivity scenario from Current Policies in 2040, the end of the Plan's assessment period. The data annex provides the physical benefits for all scenarios at the county level. Both federal sensitivity scenarios diverge from Current Policies in 2025, the beginning of the Plan's assessment period, with differences growing annually through 2040. Table A-10 also reports the fraction of $PM_{2.5}$-attributable benefits accruing in DAC areas in 2040. The fractional benefits accruing to DAC areas under both federal sensitivity cases is similar to those under Current Policies. Results for ozone are only available at the county level and not suitable for calculating impacts in DAC areas.

Table A-10. Annual Statewide Avoided Public Health Effects due to Lower $PM_{2.5}$ and Ozone Concentrations for Current Policies Relative to the No Action Scenario and Differences in Avoided Cases by Sensitivity Scenario from Current Policies (2040)

Health Effect	Pre-Federal Rollback		Current Policies		Further Federal Rollback	
	Difference in Avoided Cases Per Year	DAC Area Fraction	Avoided Cases Per Year	DAC Area Fraction	Difference in Avoided Cases Per Year	DAC Area Fraction
Premature Mortality	+260	50%	570	51%	-160	50%
Nonfatal Heart Attacks	+110	48%	240	49%	-70	48%
Hospitalizations	+70	50%	240	50%	-50	50%
Acute Bronchitis	+110	50%	260	50%	-70	50%
Respiratory Symptoms	+3,600	50%	8,000	50%	-2,300	50%
Emergency Room Visits, Asthma	+330	72%	780	72%	-230	72%
Asthma Exacerbation	+2,200	50%	4,900	50%	-1,400	50%
Minor Restricted Activity Days	+72,000	48%	160,000	49%	-47,000	49%
Work Loss Days	+12,000	48%	27,000	49%	-8,000	48%

Figure A-26 shows the annual value of health benefits in 2040 for each region under the Current Policies scenario and each federal sensitivity case relative to the No Action scenario. The data annex provides this information for all scenarios at the county level. The charts on the left show the annual benefits for all regions except New York City, and the chart on the right shows the annual benefits for New York City (on a different scale). Similar to the results for the core scenarios shown above, the largest annual health benefits would occur in New York City under both federal sensitivity scenarios.

Figure A-26. Annual Value of Health Benefits from Lower $PM_{2.5}$ Concentrations by Region and Scenario Relative to the No Action Scenario (2040)



Statewide in 2040, the value of benefits under the Pre-Federal Rollback scenario would be 47 percent larger than under Current Policies and the value under the Further Federal Rollback scenario would be 27 percent smaller than under Current Policies. Figure A-27 shows differences in the value of benefits under the federal sensitivity scenarios by region. In 2040, the value of benefits under the Pre-Federal Rollback scenario ranges from 41 to 70 percent larger than under Current Policies, depending on the region, and the value of benefits under the Further Federal Rollback scenario ranges from 7 to 31 percent smaller than under Current Policies. As discussed in the chapter, the Further Federal Rollback scenario would have a greater relative impact on health benefits in New York City compared to other regions, whereas the Pre-Federal Rollback scenario would have a greater relative impact on health benefits in regions outside New York City.

Figure A-27. Loss of Health Benefits due to Federal Policy Changes as the Percent Difference in Annual Value of Health Benefits from In-State $PM_{2.5}$ Concentrations from Current Policies by Region and by Scenario (2040)

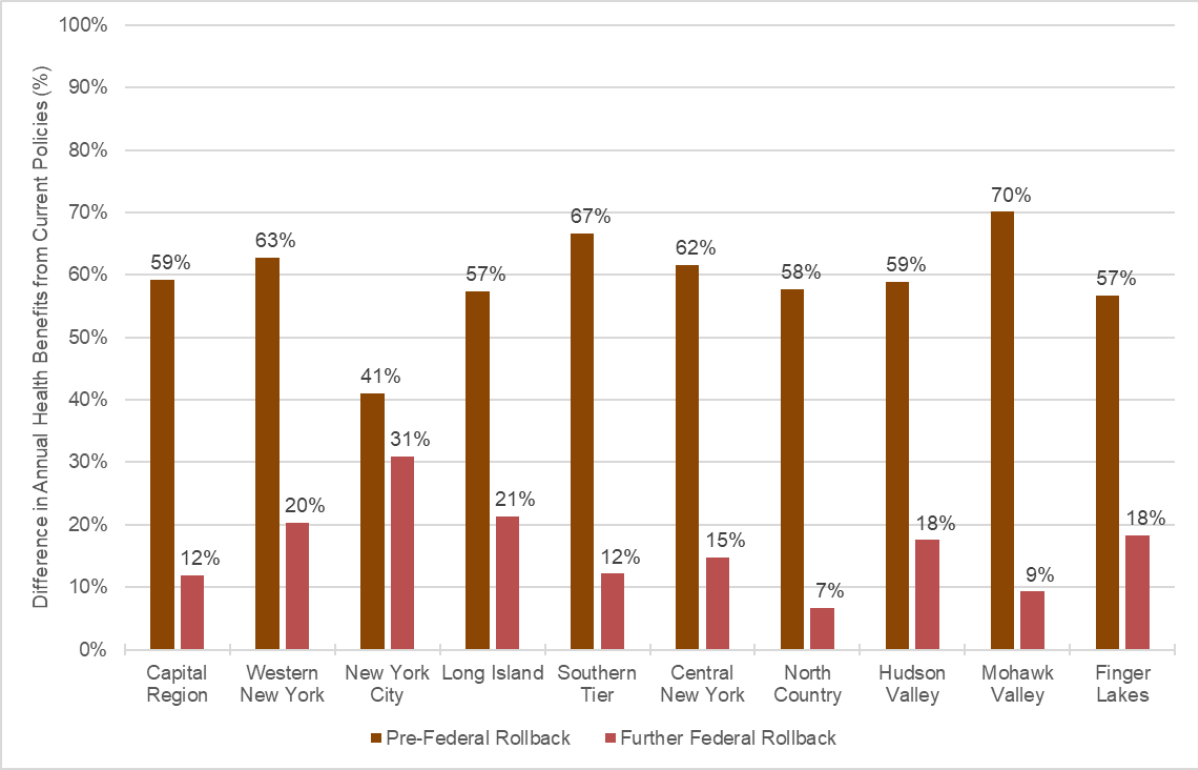


Table A-11 and Figure A-28 and Figure A-29 present the distribution of the public health benefits for the Current Policies scenario and each federal sensitivity case by sector. Table A-11 stratifies the cumulative 2025-2040 value of benefits by sector and scenario.

As shown in the chapter, on-road transportation and residential buildings accounting for the majority of the change,in benefits under the two federal sensitivity scenarios. The regional distribution of relative benefits by sector under the federal sensitivity scenarios is simiular to the results of the Current Policies scenario shown in the section above.

Table A-11. Cumulative Value of Societal Public Health Benefits (million $) from Lower In-State $PM_{2.5}$ Concentrations by Sector and Scenario Relative to the No Action Scenario (2025–2040)

Sector	Pre-Federal Rollback	Current Policies	Further Federal Rollback
Buildings			
Commercial Fossil Fuels	$835	$836	$732
Residential Fossil Fuels	$41,427	$27,581	$15,600
Residential Wood	$12,708	$5,286	$5,391
Buildings Total	**$54,970**	**$33,703**	**$21,722**
Transportation	**$14,756**	**$9,675**	**$7,384**
Electricity	**$3,409**	**$3,399**	**$3,438**
Total	**$73,136**	**$46,777**	**$32,545**

Figure A-28 and Figure A-29 show the annual value of health benefits from 2025 to 2050 for the on-road transportation and residential sectors for the Current Policies scenario and each federal sensitivity case. The chapter shows combined annual health benefits from lower in-state $PM_{2.5}$ from all sectors from 2025-2050. The federal rollbacks in the Current Policies scenario delay achievement of the health benefits that would have been achieved under the Pre-Federal Rollback scenario in 2040 for the on-road transportation sector ($3.0 billion) and residential buildings sector ($6.3 billion) by 2 years and 8 years, respectively. For both sectors, the Further Federal Rollback scenario would further delay achievement of the same level of benefits beyond 2050.

Figure A-28. Annual Health Benefits from Lower In-State $PM_{2.5}$ from On-road Transportation by Scenario Relative to the No Action Scenario (2025–2050)

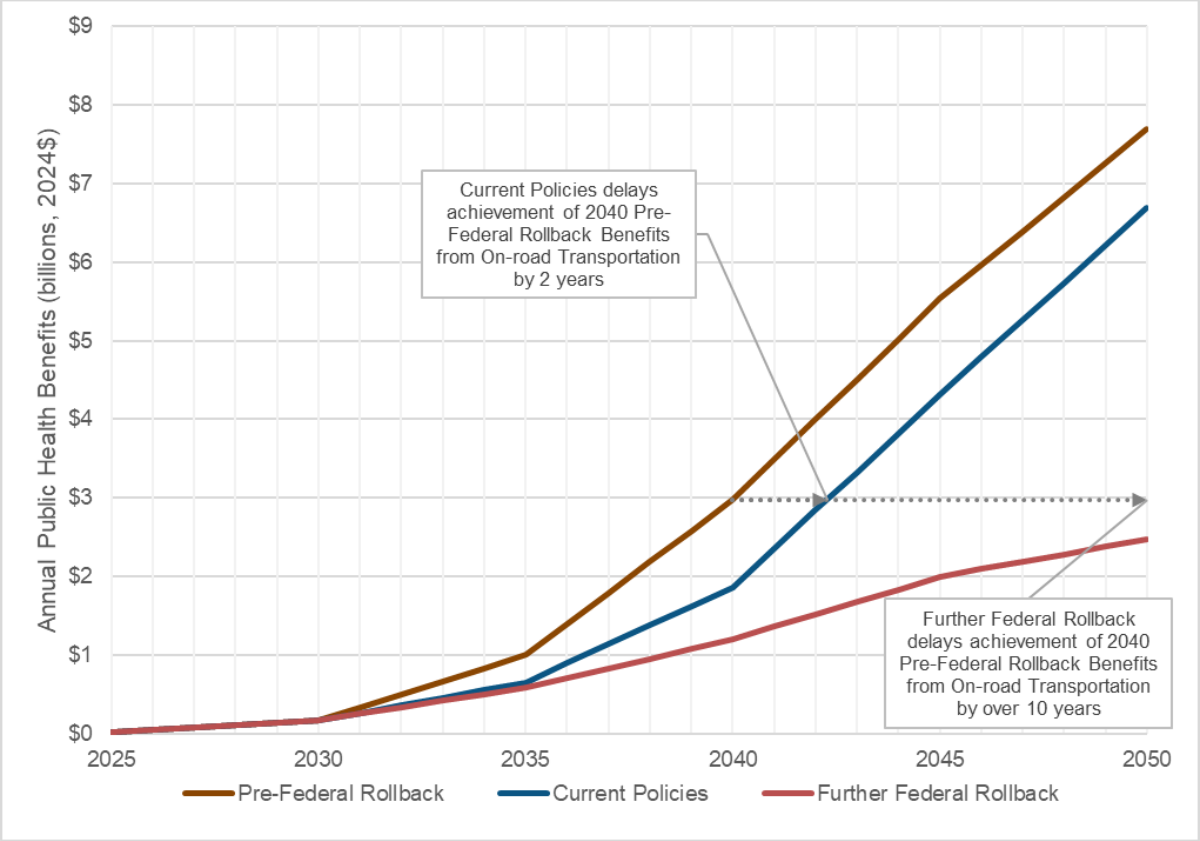
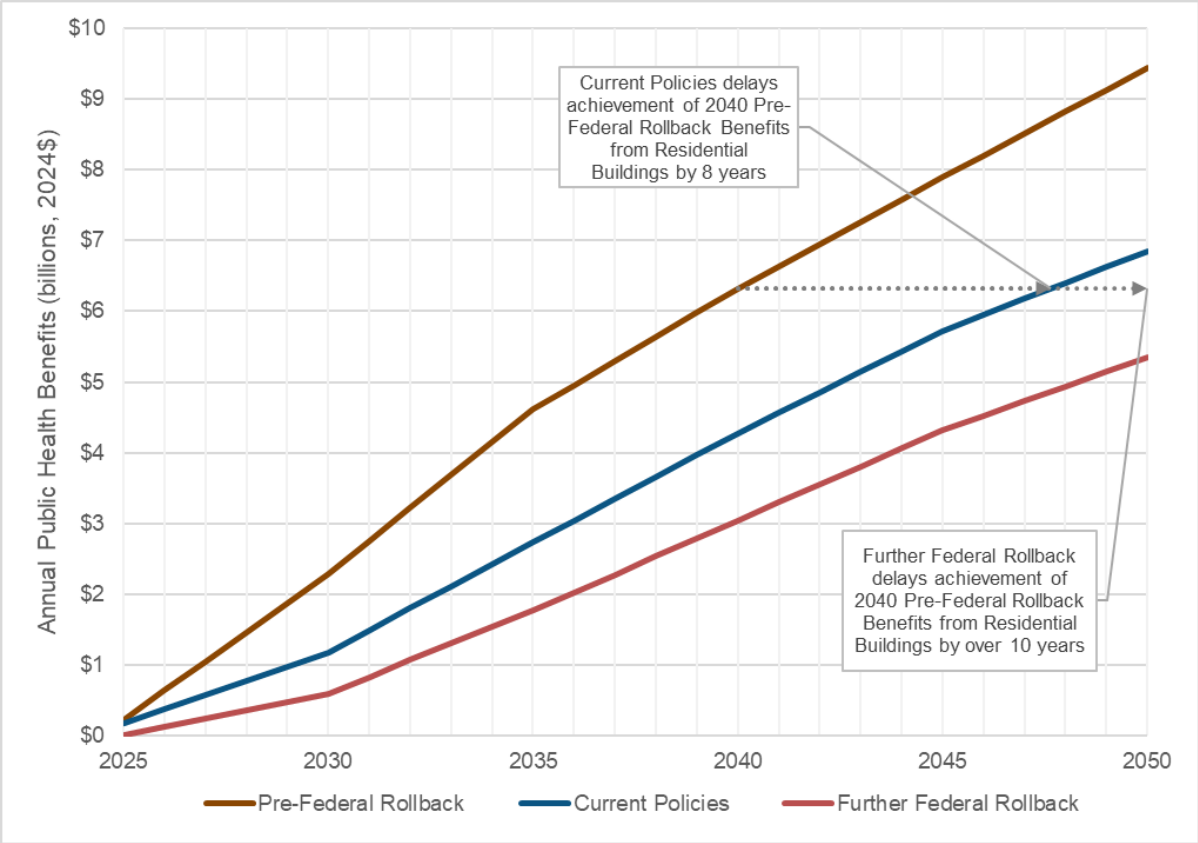


Figure A-29. Annual Health Benefits from Lower In-State $PM_{2.5}$ from Residential Buildings by Scenario Relative to the No Action Scenario (2025–2050)



1 *Scoping Plan, Appendix G: Integration Analysis Technical Supplement* (New York Climate Action Council, 2022), https://climate.ny.gov/resources/scoping-plan/.

2 S. Arunachalam et al. "A Census Tract-Level Modeling Framework for Estimation of Health Co-Benefits of Decarbonization in New York State." ChemRxiv. Preprint. doi:10.26434/chemrxiv-2025-8sbv82025; https://treehug-app.its.unc.edu/chappa/.

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[9] The Pathways Analysis, described in the Pathways Analysis chapter of this Plan, considers two net zero scenarios (A and B) that differ primarily in the extent of hybrid heat pump use. Because of the similarities in energy consumption between Net Zero A and B, Net Zero A was excluded from the analysis and its health benefits are expected to be similar to those of Net Zero B.

[10] NY-CHAPPA calculates both a low and high value based on different approaches for estimating avoided mortality and nonfatal heart attacks.

[11] Avoided cases of nonfatal heart attacks shown in Figures 2 and 3 are only due to reductions in $PM_{2.5}$ concentrations. There is not a concentration response function available that describes the impacts of reductions in ozone concentrations on nonfatal heart attacks.

[12] Generator technologies such as internal combustion engines are also included with combustion turbines and steam turbines due to similar operating characteristics and marginal contribution to overall capacity.

[13] The net present value of future monetized physical health benefits was estimated using a real discount rate of 5.03 percent, consistent with the present value cost and benefits estimates calculated elsewhere in the Plan. Use of alternative discount rates reflecting other perspectives on the social rate of time preference for health benefits would result in different net present values.

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[16] U.S. Environmental Protection Agency. *CO-Benefits Risk Assessment Health Impacts Screening and Mapping Tool*. 2014. Model updated 2024.

[17] CJWG, *Disadvantaged Communities Criteria*. NY-CHAPPA developed geographic DAC areas based on the criteria developed by the NY CJWG and the 2020 census tract definitions from the U.S. Census. Throughout this chapter, estimates of potential impacts in DACs refers to impacts that accrue in designated geographic DAC areas. For purposes of clean energy and energy efficiency investments, the CJWG additionally included in the DAC criteria low-income households located anywhere in the state; however, this spatial health impacts analysis uses only the geographic criteria for analyzing DAC areas.

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New York State Energy Plan

VOLUME II | Plan Analyses and Impacts

Jobs Impacts Analysis

19

Key Findings → Jobs Impacts Analysis

New York's transition to cleaner energy will create jobs and drive meaningful economic benefits. The State Energy Plan recognizes employment as one of the primary economic impacts of New York's energy investments. The jobs analysis evaluates the employment impacts associated with two policy scenarios. Notable overall job growth is projected in both scenarios.

- Under the Plan's core planning scenario, employment across New York's energy economy—including the electricity, buildings, transportation, and fuels sectors—is expected to increase by over 80,000 jobs by 2040. This is a 17 percent increase in statewide energy jobs compared to 2025.
- The electricity and buildings sectors are projected to grow, jointly adding more than 98,000 net jobs, driven by sizeable investments into clean electricity generation, electrification, and building decarbonization. The expansion of these sectors is more than five times the size of projected declines in vehicle maintenance, fueling stations, and other fossil fuel-related subsectors.
- New jobs are largely concentrated in the construction industry, which is expected to grow by roughly 72 percent (over 56,000 net jobs). Manufacturing will also experience meaningful growth of 25 percent (over 7,000 jobs).
- When accounting for ongoing utility system maintenance and operations needs, as well as worker retirements, the natural gas distribution sector will need to hire workers for more than 2,000 jobs, roughly 15 percent of the existing workforce.
- Clean energy investments will also stimulate job growth across New York's economy, inducing nearly 18,000 net new jobs in other sectors as a result of increased economic activity.

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1. Overview

The State Energy Plan recognizes employment outcomes as one of the primary economic impacts from New York's energy investments. This analysis evaluates the employment impacts associated with the Additional Action scenario, the core planning scenario, and Net Zero B scenario, which assumes full achievement of the Climate Act targets.[1,2] Over the planning period (2025–2040), the analysis finds that the Additional Action Scenario would add over 80,000 net new jobs across New York's energy economy, pointing to meaningful economic benefits. The Net Zero B scenario projects that jobs could grow by nearly 230,000.

The Additional Action scenario includes job growth related to the continuation of existing State, local, and federal policies as of September 2025 as well as additional policies and programs to drive further market adoption of clean energy technologies, such as increased investments into transportation and building efficiency and electrification. The Net Zero B scenario includes job growth related to accelerated adoption of clean energy technologies in all sectors toward achievement of a net zero economy by 2050. For a full description of scenario assumptions, see the Pathways Analysis chapter of this Plan.[3]

Using New York energy employment data for 2023 as a baseline year, employment impacts are projected for 2025, 2030, 2035, and 2040.[4] These impacts include direct, indirect, and induced jobs across the electricity, fuels, buildings, and transportation sectors.[5]

2. Methodology

2.1. Modeling and Output Structure

This analysis organizes New York's energy economy by four major sectors and their relevant subsectors, shown in Table 1. This structure allows for focus on the four sectors of the economy most directly impacted by State energy policies.[6]

This modeling effort estimates the employment impacts associated with in-state capital and operational expenditures across the subsectors listed in Table 1. The modeling framework also includes negative employment impacts in New York from those subsectors seeing reduced investments and expenditures in these scenarios.

Table 1. Primary Energy Sectors and Subsectors

Category	Sector	Subsector
Energy Supply	**Electricity**	Solar Generation Offshore Wind Generation Onshore Wind Generation Hydropower Hydrogen Generation Biomass Generation Distribution Transmission Storage Natural Gas Generation Other Fossil Generation Nuclear Generation
	Fuels	Hydrogen Bioenergy Natural Gas Natural Gas Distribution Petroleum Fuels
Energy Demand	**Buildings**	Commercial HVAC Commercial Shell Commercial Other Residential Shell Residential HVAC Residential Other
	Transportation	Vehicle Manufacturing Wholesale Trade Parts Charging & Hydrogen Fuel Stations Vehicle Maintenance Conventional Fueling Stations

The methodology follows six steps:

1. Determine the unit inputs for the model. Unit inputs typically come from the Pathways Analysis data and take the form of device stocks and sales, megawatts (MW) of electric capacity, and fuel demand.
2. Determine the unit and total investments. Investment inputs come from the Pathways Analysis data where provided, and any additional investments assumed from secondary sources have been noted.
3. Process the investments to reduce inter-annual variation as needed.

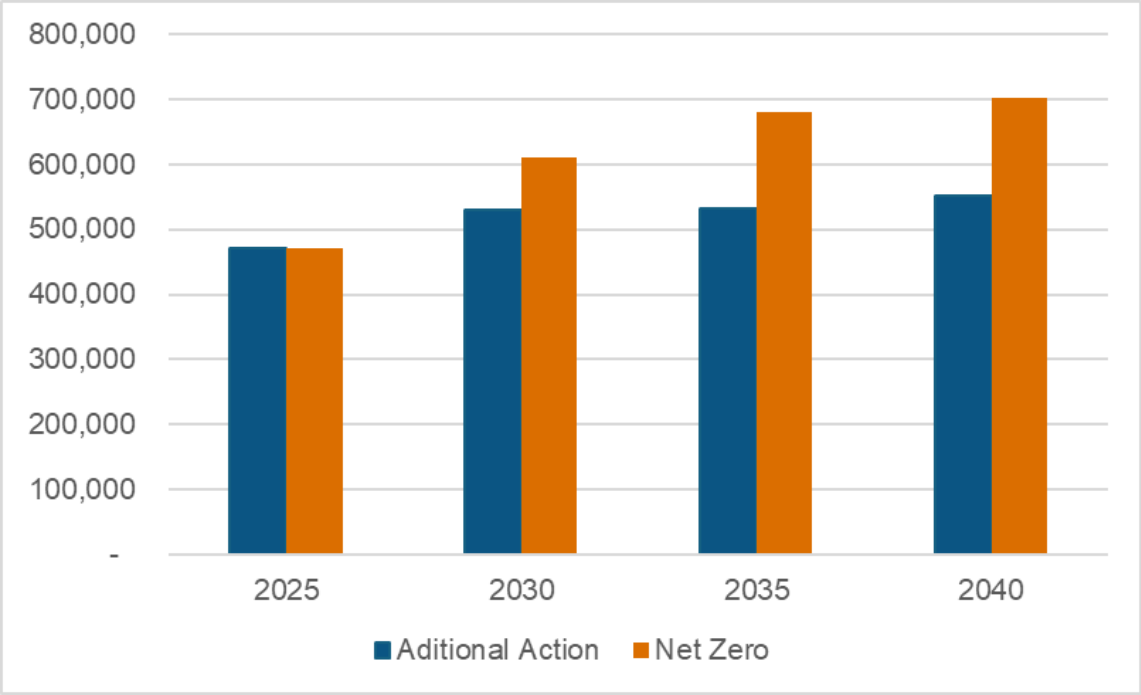
4. Use technical cost data from secondary sources to allocate the processed investment data into the relevant industry categories based on the activities associated with the investments, such as relevant construction, manufacturing, and professional services activity.
5. Apply IMPLAN/JEDI industry employment multipliers based on the allocation described in step 4 to calculate employment outputs.
6. Report employment outputs by sector, subsector, and by industry category (construction, professional services, manufacturing, other supply chain, and induced).

3. Employment Impacts

3.1. Overall Energy Sector Impacts

Over the full horizon of this Plan (2025 to 2040), net jobs are expected to grow by 17 percent under the Additional Action scenario and 49 percent under the Net Zero B scenario, adding over 80,000 and 230,000 net new jobs, respectively (see Figure 1). Under the Additional Action scenario, overall energy sector jobs in New York increase by 13 percent between 2025 and 2030, remain flat between 2030 and 2035, and increase by 4 percent between 2035 and 2040. The Net Zero B scenario projects faster growth in the medium-term, with an increase of 13 percent between 2025 and 2030, 11 percent between 2030 and 2035, and increase by 3 percent between 2035 and 2040.

Figure 1. Projected Energy Jobs, 2025-2040



Job growth in both scenarios is driven by sizeable investments into clean electricity, building efficiency and electrification, and clean transportation, offset somewhat by comparatively smaller decreases in the transportation and fuels sector. In the Additional Action scenario, the largest number of new net jobs is

projected in the electricity sector, which sees roughly 59,300 new jobs, or a 44 percent increase, and maintains the second-largest share of energy workers throughout the horizon of the Plan. The buildings sector makes up the largest sector of the energy workforce and is projected to add roughly 38,900 net jobs over the course of the Plan. Net jobs in the transportation and fuels sector are expected to decrease between 2025 and 2040—by 11 percent and 9 percent, respectively—consistent with decreased investments in fossil fuels.

Table 2. Statewide Energy Jobs, by Sector (Additional Action)

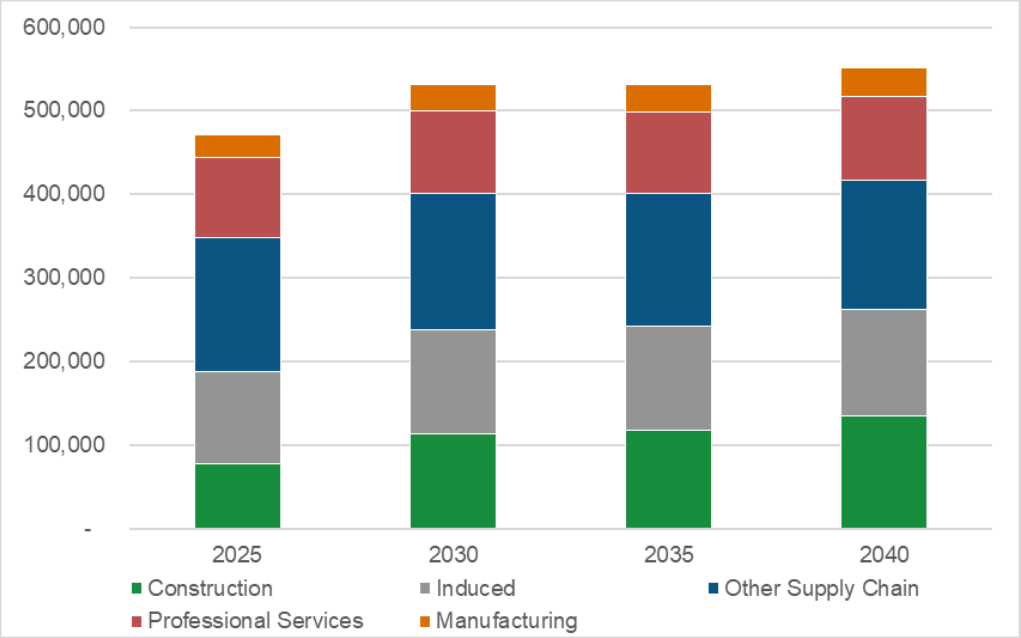
Sector	2025	2030	2035	2040	Change 2025 to 2040	
Electricity	133,618	173,353	173,050	192,963	59,345	44 %
Buildings	170,700	194,415	200,360	209,565	38,866	23%
Transportation	136,671	133,248	128,992	121,500	(15,171)	-11 %
Fuels	30,603	29,815	28,917	27,878	(2,726)	-9%
Total	**471,592**	**530,831**	**531,319**	**551,905**	**80,314**	**17 %**

Table 3. Statewide Energy Jobs, by Sector (Net Zero B)

Sector	2025	2030	2035	2040	Change 2025 to 2040	
Electricity	133,663	173,850	195,806	242,174	108,511	81%
Buildings	170,254	274,572	320,621	306,507	136,253	80%
Transportation	136,671	133,248	130,729	122,788	(13,883)	-10%
Fuels	30,598	29,459	32,355	30,620	22	0%
Total	**471,187**	**611,129**	**679,511**	**702,089**	**230,903**	**49%**

Much of the net increase in jobs in the Additional Action scenario can be attributed to increased demand for construction work, which is expected to add roughly 57,000 new net jobs (see Figure 2). Other net growth industries include manufacturing (7,100 added jobs), professional services (5,200 added jobs), and induced jobs across the economy (17,900 added jobs). Jobs in other parts of the supply chain, which include some operations jobs (for example plant operators, maintenance work, wholesalers, or other on-site work outside of the construction phase), are expected to decrease by 6,800 net jobs. Other supply chain jobs may increase beyond the time horizon of the Plan as new construction forecasted in the later years of the Additional Action scenario becomes operational.

Figure 2. Statewide Energy Jobs, by Industry



Within the two net growth sectors, the electricity sector and the buildings sector, roughly half of the added jobs (or 53,300 jobs) are in the construction industry. About one-fifth (21 percent) of the net added jobs are induced across other industries, and 13 percent in other supply chain work (12,400), which includes operations and related work, 6 percent in manufacturing (5,800), and the balance are in professional services.

3.2. Electricity Sector

In the Additional Action scenario, investments into the electric sector are projected to generate 59,300 jobs between 2025 and 2040. Despite overall growth at the sector level, projected growth is not uniform across the subsectors. The electric distribution system and solar generation subsectors are projected to add the largest number of jobs, adding more than 17,000 new jobs, each (see Table 4). The fastest growth rates are projected in the nuclear and wind generation subsectors, which are expected to grow threefold by 2040, adding over 11,00 and 14,000 jobs, respectively. Overall, growth in these subsectors meaningfully outpaces the projected displacements in fossil generation.

On a net basis, the fossil fuel generation subsectors see the most substantial decrease in employment, declining by approximately 5,100 jobs between 2025 and 2040. This decline is offset in part by converting plants near retirement to clean, dispatchable energy sources such as hydrogen.

Table 4. Electricity Sector Jobs, by Subsector (Additional Action)

	2025	2030	2035	2040
Distribution	71,840	77,277	82,880	89,333
Solar	21,535	41,253	35,380	39,398
Fossil Fuel and Hydrogen	13,207	11,636	9,517	8,078
Hydropower	7,855	7,855	7,855	10,029
Wind	6,962	15,205	15,818	21,351
Nuclear	5,888	5,903	9,244	17,597
Storage	3,164	11,044	9,348	6,811
Biomass	2,943	2,943	2,936	-
Transmission	223	235	72	366

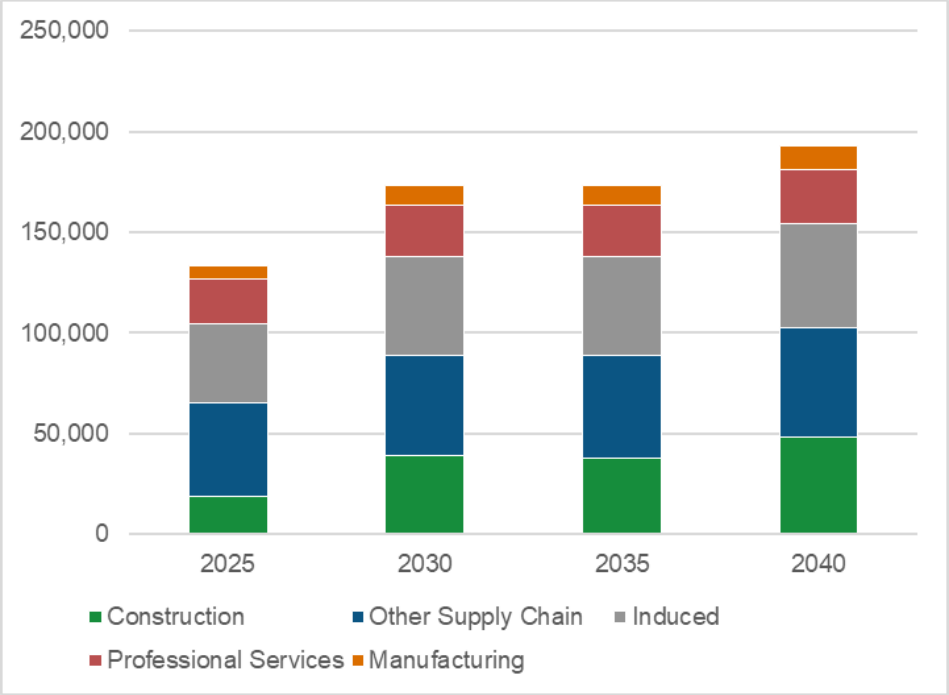
The Net Zero B scenario is projected to add nearly twice the number of jobs as the Additional Action scenario, with roughly 108,500 jobs added between 2025 and 2040 (see Table 5). Growth across zero emission generation increases in this scenario, consistent with increased demand for clean electricity.

Table 5. Electricity Sector Jobs, by Subsector (Net Zero B)

	2025	2030	2035	2040
Distribution	71,884	77,077	98,900	113,873
Solar	21,535	42,654	33,656	45,019
Fossil Fuel and Hydrogen	13,207	11,631	10,369	11,161
Hydropower	7,855	7,855	8,686	9,268
Wind	6,962	15,259	19,231	27,208
Nuclear	5,888	5,903	12,586	29,294
Storage	3,164	10,276	9,086	5,615
Biomass	2,945	2,944	2,945	-
Transmission	223	251	346	737

In the Additional Action scenario, the electricity sector is expected to add roughly 29,000 net construction jobs and 5,100 net manufacturing jobs between 2025 and 2040. The remainder of the net jobs are found in other supply chain categories, in professional services, as well as induced jobs across other sectors (see Figure 3).

Figure 3. Electricity Sector Jobs, by Industry (Additional Action)



3.2.1. Electric Distribution

The electric distribution subsector refers to the delivery of electrical grid services to end users, including homes, businesses, and institutions. In the Additional Action scenario, the distribution subsector is projected to add 17,493 jobs (24 percent) from 2025 to 2040 (see Table 4). Growth is relatively evenly distributed across industries. By 2040, other supply chain categories (39,009 jobs) and induced employment (23,685 jobs) make up most of the employment in the subsector.

3.2.2. Solar Generation

Solar generation, including utility scale and distributed solar, is expected to generate more than 17,800 net jobs (an 83 percent increase) between 2025 and 2040. Solar jobs roughly double between 2025 and 2030 to support new investments and remain relatively steady through 2040. Most of the growth in the solar subsector is concentrated in construction, which grows by 11,700 jobs (65 percent). In 2040, construction (17,700 jobs) and other supply chain jobs (3,900 jobs) make up roughly two thirds of the employment in the subsector, while 23 percent of jobs in 2040 are induced across other sectors. .

3.2.3. Fossil Fuel and Hydrogen Generation

The fossil fuel generation subsectors—including natural gas and other petroleum-based fuels—are projected to experience a displacement of 13,200 jobs by 2040 as the electric grid transitions to exclusively zero emissions sources. These displacements are offset by continuing the operation of some existing plants with a new fuel source. Overall, roughly 8,000 jobs are projected to support the conversion to hydrogen generation by 2040. On net, this would lead to roughly 5,100 fossil generation jobs being displaced (see Table 6).

Table 6. Jobs, Fossil Fuel and Hydrogen Electric Generation[7]

	2025	2030	2035	2040
Natural Gas Generation	9,786	8,215	5,468	-
Other Fossil Generation	3,421	3,421	3,375	-
Hydrogen Generation	-	-	673	8,078
Total Fossil Fuel and Hydrogen	**13,207**	**11,636**	**9,517**	**8,078**

3.2.1. Hydropower

The hydropower subsector experiences a net increase of 2,174 jobs (30 percent) between 2025 to 2040, with this increase occurring between 2035 and 2040. More than half of these added jobs are in construction (2,137 jobs).

3.2.2. Wind Generation

Offshore and onshore wind are jointly projected to add roughly 14,400 net jobs between 2025 and 2040. The onshore wind subsector is projected to add 2,000 net jobs (32 percent) from 2025 to 2040. In 2040, jobs are relatively evenly split across industries: construction, professional services, and induced employment account for roughly a quarter of jobs each, followed by manufacturing (16 percent) and other supply chain (14 percent).

Net jobs in the offshore wind subsector are projected to expand significantly between 2025 and 2040, growing from roughly 650 to 13,000 jobs in that period. Construction (2,600 new net jobs) and manufacturing (4,100 new net jobs) make up roughly 50 percent of that growth. In 2040, induced employment accounts for 29 percent of the projected jobs in the subsector, followed by manufacturing with 32 percent and construction with 21 percent.

3.2.3. Nuclear

The nuclear subsector experiences a substantial increase of 11,700 jobs (199 percent) from 2025 to 2040 with most of that growth happening from 2035-2040.[8] Nuclear jobs are largely concentrated in construction, induced jobs, and other supply chain, which includes operations work, and jointly make up 82 percent of the total jobs.

3.2.1. Storage

The storage subsector encompasses batteries, pumped hydro storage, and thermal storage. Storage jobs are expected to increase by 7,900 in the 2025 to 2030 period, largely driven by new construction work, which adds 5,500 jobs. In 2040, construction jobs make up 46 percent of jobs in this subsector, followed by induced jobs (21 percent) and professional services (19 percent).

3.2.2. Biomass

The biomass subsector involves generating power by burning organic materials such as wood, agricultural residues, or waste into electricity, often using direct combustion, gasification, or anaerobic digestion. The biomass subsector experiences a decline from 2,943 jobs in 2025 to no employment in 2040 jobs, with this decline projected to occur in the last five years of the Plan. While the Additional

Action scenario excludes biomass electric generation as a qualifying source of clean electricity, jobs in biomass facilities are not necessarily displaced altogether. Many of these facilities, such as pulp and paper mills would likely continue to generate onsite power from biomass sources. However, these jobs would no longer be considered part of the State's electricity sector.

While not included in this analysis, a Renewable Natural Gas (RNG) sensitivity was evaluated in the Pathways Analysis. If RNG is deemed an eligible zero-emissions firm resource by the Public Service Commission, it is likely that the biomass subsector would experience an increase in employment demand.

3.2.1. Transmission

Transmission subsector jobs are expected to experience small employment growth over the horizon of the plan, with an increase from 220 in 2025 to 370 in 2040.

3.3. Buildings Sector

The buildings sector includes activities related to residential and commercial buildings. Overall, the Additional Action scenario projects a total net employment increases by 38,900 jobs (23 percent) in the buildings sector between 2025 and 2040.

Despite meaningful growth at the sector-level, growth is not uniform across the subsectors. The residential shell subsector is projected to experience the highest rate of growth (275 percent) and largest absolute growth in employment (see Table 7). The residential heating, ventilation, and air conditioning (HVAC) subsector also sees a substantial increase in jobs, growing by 26 percent, while the residential other subsector—which includes efficiency appliances, lighting, and other energy-related equipment—sees a decrease of 10 percent. Jointly, the residential sector will add 30,600 jobs, an increase of 31 percent. In the Net Zero B scenario, the growth rate of the residential sector climbs to 73 percent (see Table 8).

The commercial subsectors are projected to see more modest, but consistent, growth. Commercial shell work is projected to increase by 22 percent, commercial HVAC by 10 percent, and commercial other by 13 percent. Jointly, the commercial subsector will add 8,200 jobs over the planning period, an increase of 12 percent. In the Net Zero B scenario, this growth rate climbs to 90 percent.

Table 7. Building Sector Jobs, by Subsector (Additional Action)

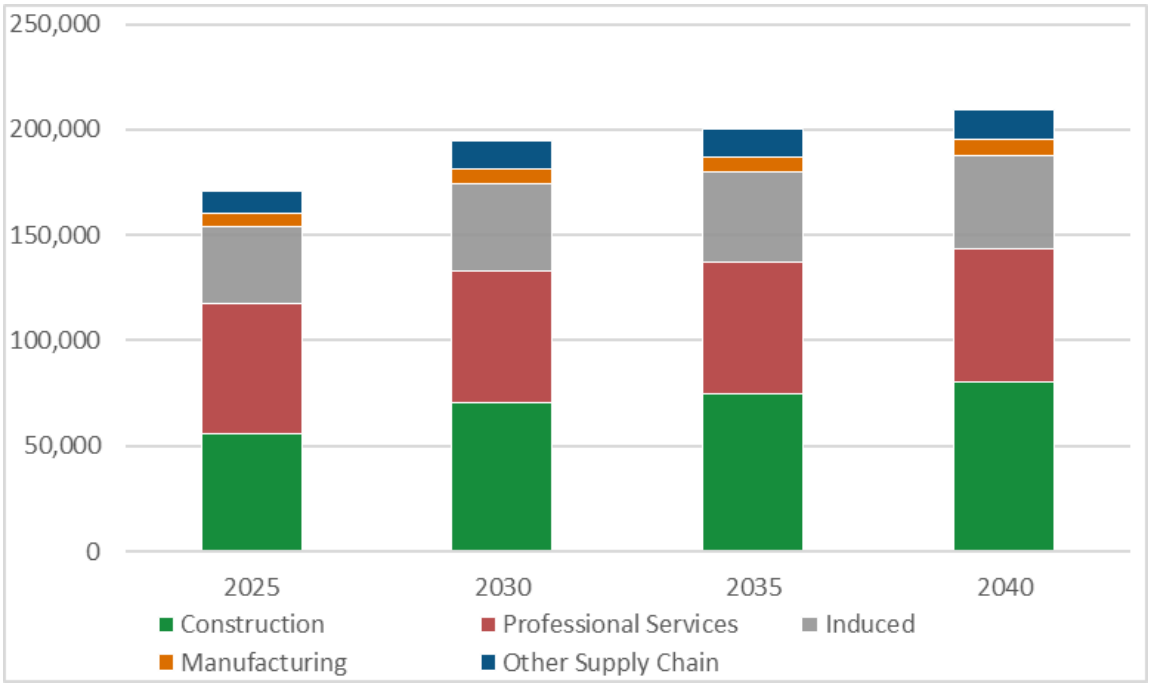
	2025	2030	2035	2040
Residential HVAC	56,924	62,442	68,140	71,479
Residential Shell	7,193	21,204	20,552	26,956
Residential Other	35,815	34,679	33,394	32,116
Commercial HVAC	39,551	42,069	42,856	43,332
Commercial Shell	4,772	6,108	6,123	5,829
Commercial Other	26,445	27,914	29,295	29,853

Table 8. Building Sector Jobs, by Subsector (Net Zero B)

	2025	2030	2035	2040
Residential HVAC	56,178	69,361	92,530	91,814
Residential Shell	7,193	50,086	48,159	46,279
Residential Other	35,815	35,664	35,412	33,648
Commercial HVAC	39,852	44,338	52,640	53,154
Commercial Shell	4,772	36,105	32,523	21,935
Commercial Other	26,445	39,018	59,357	59,677

In the Additional Action scenario, the buildings sector is expected to add 24,000 net construction jobs and nearly 700 net manufacturing jobs between 2025 and 2040. The remainder of the job growth is expected to be added in other supply chain (4,000), and in professional services (1,600). The increased activity in the buildings sector is projected to induce 8,200 jobs across other sectors (see Figure 4).

Figure 4. Building Sector Jobs, by Industry (Additional Action)



3.3.1. Residential HVAC

The residential HVAC subsector covers the installation, maintenance, and repair of space heating, ventilation, and air conditioning systems. This subsector is projected to experience growth of 14,500 jobs (26 percent) from 2025 to 2040. Most of the growth in residential HVAC jobs is in construction, which grew by roughly 10,000 jobs, or 49 percent. This growth in construction is driven primarily by increased investments in single-family space heating. Manufacturing and other supply chain industries represent a small share of the overall growth, but grow by 14 percent and 23 percent, respectively.

In 2040, construction (31,000 jobs) and professional services (19,600 jobs) make up most of the total employment in the subsector, while induced employment accounts for 14,900 jobs.

3.3.2. Residential Shell

The residential shell sector includes the construction, upgrade, and maintenance of the building envelope in various types of housing, such as detached and attached single-family homes and multifamily buildings. The residential shell subsector is projected to experience substantial growth, adding roughly 14,000 jobs in the 2025 to 2030 period and adding nearly 6,000 jobs in the 2030 to 2040 period. Over the timeline of the Plan, this subsector is projected to add 19,800 net jobs, a more than twofold increase from 2025. Increased investments in single-family building shell upgrades drive long-term growth in the subsector. Looking at industries in the subsector, construction has the highest share of jobs, accounting for 51 percent of employment in 2040. Construction jobs have the most substantial increase in the subsector by employment, gaining 11,000 jobs (426 percent increase) by 2040, while other supply chain jobs see the biggest percentage increase, growing by 542 percent, or 3,000 jobs.

3.3.1. Residential Other

The residential other subsector includes residential appliances, lighting, and other equipment that falls outside of core HVAC and building envelope work. This subsector includes clothes washers and dryers, dishwashers, refrigerators, cooking equipment, general and specialty lighting, and refrigeration and water heating systems. The other residential subsector is projected to decline by 3,700 jobs (10 percent) from 2025 to 2040, with steady decreases across each period. This decline in employment in the subsector is driven primarily by decreased investments in residential lighting and water heating. Professional services has the highest share of jobs, accounting for 45 percent of employment in 2040. Construction has the most substantial decline in the subsector, losing 2,600 jobs (26 percent) from 2025 to 2040

3.3.1. Commercial HVAC

The commercial HVAC sector involves the installation, operation, and maintenance of heating, ventilation, and air conditioning systems in commercial buildings. Employment in commercial HVAC is projected to grow by 3,800 jobs, or 10 percent from 2025 to 2040. Increased investments in commercial space heating drove greater employment in this subsector. Most of this job growth is concentrated in construction, which added 2,600 net jobs (19 percent) in that same period. Construction also makes up the highest share of jobs, accounting for 37 percent of employment in 2040, followed by professional services (32 percent).

3.3.2. Commercial Shell

The commercial shell sector includes the construction, upgrade, and maintenance of the building envelope in commercial spaces. The commercial shell subsector is projected to add nearly 1,100 jobs between 2025 and 2040. Much of this increase is expected to occur during the 2025 to 2030 period, where jobs climb from approximately 4,700 to 6,100 and remain at that level until 2040, when jobs decrease to 5,800. In 2040, just under 40 percent of the jobs in this subsector are in construction,

followed by professional service (25 percent) and induced (22 percent). Only a small share of this work is in manufacturing and other supply chain work (jointly 14 percent).

3.3.3. *Commercial Other*

The commercial other subsector includes a diverse range of energy-using equipment and end-uses in commercial spaces that fall outside of core HVAC and building envelope work. The subsector includes efficient commercial cooking equipment, refrigeration units, water heating systems, and various types of lighting, such as general service, High Intensity Discharge, and linear fluorescent lighting. The commercial other subsector saw significant investment in commercial cooking equipment, while commercial lighting investments declined heavily.

The commercial other subsector experiences an increase of 3,400 jobs (13 percent) from 2025 to 2040, with growth relatively evenly spread across all periods. In this subsector, professional services and construction industries have the highest share of jobs across the industries, accounting for two-thirds of employment in 2040. Construction jobs also experience the most substantial increase in the subsector, gaining 2,400 jobs, or 32 percent between 2025 and 2040.

3.4. Fuels Sector

Overall, fuels jobs in the Additional Action scenario are projected to decrease by about 9 percent, or roughly 2,700 jobs between 2025 and 2040 (see Table 9). This displacement is driven largely in jobs associated directly with natural gas fuels (separate from natural gas distribution and natural gas generation) and petroleum fuels, while projected growth in the hydrogen and biofuels subsectors offset this displacement somewhat. The Net Zero B scenario projects virtually no overall change in the fuels sectors, as growth in hydrogen and biofuels offsets increased displacement in petroleum and natural gas fuels (see Table 10). Under both scenarios, new workers will be needed to maintain natural gas distribution infrastructure despite decreasing throughput.

Table 9. Fuel Sector Jobs, by Subsector (Additional Action)

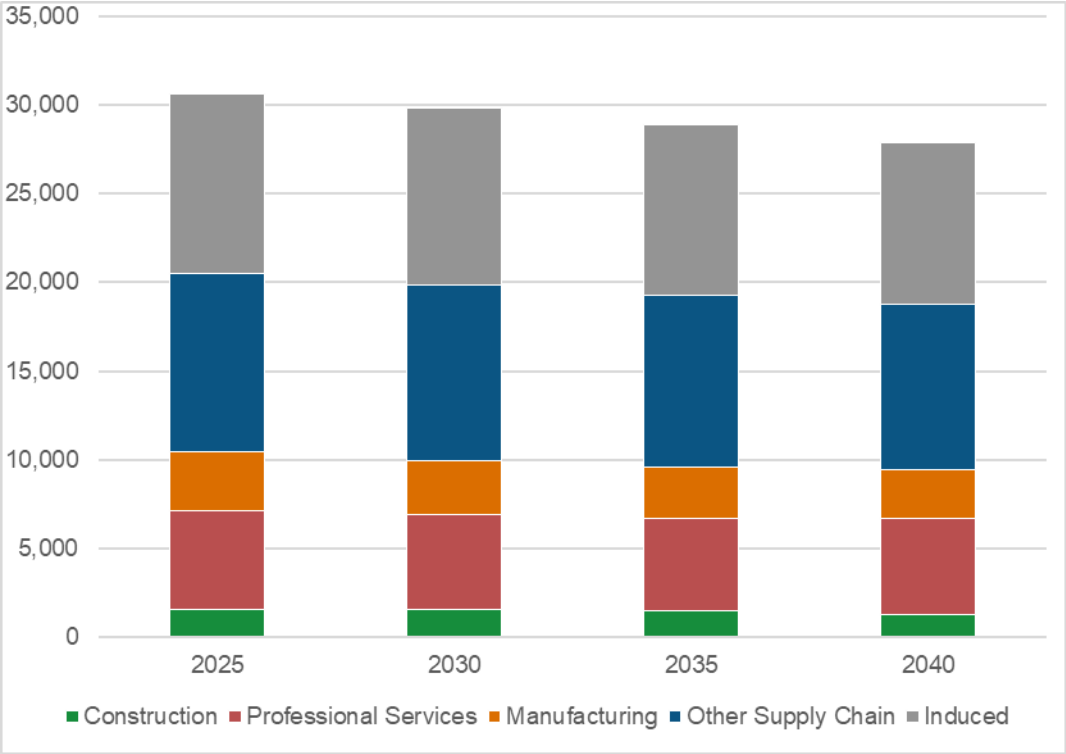
	2025	2030	2035	2040
Natural Gas Distribution	12,579	13,244	13,345	12,459
Petroleum Fuels	8,712	7,803	6,485	4,934
Biofuels	4,925	4,595	5,002	6,408
Natural Gas Fuels	4,387	4,134	3,811	3,356
Hydrogen Fuels	-	38	273	720

Table 10. Fuel Sector Jobs, by Subsector (Net Zero B)

	2025	2030	2035	2040
Natural Gas Distribution	12,579	13,234	13,241	12,341
Petroleum Fuels	8,705	7,742	5,705	3,803
Biofuels	4,925	4,483	8,602	9,442
Natural Gas Fuels	4,388	3,961	2,232	1,111
Hydrogen Fuels	-	38	2,574	3,924

The fuels sector jobs displacement is concentrated in other supply chain work, where the subsector is expected to lose roughly 700 net jobs over the course of the Plan (see Figure 5).

Figure 5. Fuels Sector Jobs, by Industry



3.4.1. Natural Gas Distribution

The natural gas distribution subsector includes activities related to the natural gas distribution system or relevant support services. Recognizing the high degree of attention and dearth of existing research around worker displacement in the natural gas distribution system, this analysis considers utility investments and worker retirements to better understand employment impacts.

Over the course of the Plan, the Additional Action scenario assumes a roughly 20 percent decrease of throughput in the natural gas distribution system. However, the reduction in system investments will not decrease on a one-to-one basis due to the networked nature of the system, where larger, non-terminal pipelines, compressor stations, and other equipment must remain online if they continue to serve some customers, even if the as utilization declines. This analysis assumes that investments decrease stepwise, only as substantial segments of users leave the system and the relevant segments can be decommissioned safely.[9]

As a result, jobs in this subsector remain relatively flat, decreasing by only 1 percent over the planning period (see Table 9). The Net Zero B scenario—which also anticipates a significant remaining gas network as many heat pump customers retain supplementary gas backup—is projected to see nearly identical impacts, but with a total decrease of 2 percent over the planning period (see Table 10).

Roughly 20 percent, or 2,500, of New York's existing natural gas distribution workforce is aged 55 or older.[10] By 2040, these workers will be 70 or older and will likely be retired. When assuming that these positions will need to be backfilled in order to maintain the safety of the distribution of the system, both scenarios see demand for over 2,300 new workers (see Table 11). However, the exact timing and type of such growth will require additional analysis.

Table 11. Net Change in Natural Gas Distribution Jobs, Net of Retirement

	Additional Action	Net Zero B
Total natural gas distribution jobs in 2025	12,579	12,579
Total natural gas distribution jobs in 2040	12,459	12,341
Net jobs projected between 2025 and 2040	-120	-238
Assumed worker retirement between 2025 and 2040	2,554	2,554
Net change including worker retirement	**+2,433**	**+2,315**

By 2040, other supply chain jobs—which include relevant wholesale and retail trade, transportation, and operations—makes up 38 percent of the jobs of the Additional Action natural gas distribution subsector. Roughly 39 percent of jobs are induced across other sectors because of activities in this subsector. The balance of jobs is spread between construction and professional service, with about 300 manufacturing jobs and more than 600 construction jobs in the subsector throughout the time horizon of the Plan.

3.4.1. Natural Gas Fuels

The natural gas fuels subsector includes jobs in production, trade, and support services in natural gas, outside the natural gas distribution and natural gas generation subsectors. In natural gas fuels, net employment is expected to decrease by 1,000 jobs, or by 23 percent between 2025 and 2040. Employment is projected to slow somewhat between 2025 and 2030 and again between 2035 and 2040. In 2040, 29 percent of natural gas employment falls into the other supply chain industry group, followed by 18 percent in professional services and 12 percent in manufacturing. Induced employment impacts contribute to 41 percent of the subsector's employment.

3.4.1. Petroleum Fuels

Employment within the petroleum fuels subsector—which consists of services related to the production trade, transportation, and support of oil, gas tanker trucks, and other delivered fuels—declines steadily from 2025 to 2040, seeing a decrease of just under 3,800 jobs (43 percent) across this period. At the industry level, petroleum fuels is split fairly evenly between professional services (18 percent of jobs),

manufacturing (23 percent of jobs), and other supply chain (27 percent of jobs). The remaining 28 percent of jobs are supported by induced impacts.

3.4.2. *Biofuels*

Employment within the biofuels subsector increases by nearly 1,500 net jobs (an increase of 30 percent) between 2025 and 2040. Employment declines between 2025 and 2030 as ethanol expenditures decline. While ethanol spending continues to decline through 2040, employment begins to rise again after 2030 as renewable jet kerosene and renewable natural gas expenditures rise.

At the industry level, most biofuels employment is concentrated in professional services and other supply chain, which comprise 36 percent and 33 percent of subsector employment in 2040, respectively. Induced impacts contribute to 20 percent of biofuels employment in 2040, while manufacturing makes up 10 percent of employment.

3.4.1. *Hydrogen Fuels*

Consistent with new hydrogen generation assumptions made in the Additional Action scenario, employment in the hydrogen fuels subsector grows from one in 2025 to 720 jobs in 2040. About 36 percent of employment in 2040 is in manufacturing, 28 percent in induced employment, 19 percent in professional services, and 16 percent in other supply chain.

3.5. Transportation Sector

In both the Additional Action and Net Zero B scenarios, the transportation sector is projected to see overall job displacement, offset by meaningful growth in employment related to electric vehicle charging stations, where jobs are projected to increase roughly threefold between 2025 and 2040 due to increased investments into clean transportation (see Table 12 and Table 13).

The Additional Action scenarios projects overall job displacement of roughly 15,200 jobs, (11 percent decrease). In contrast to the strong growth in the electric vehicle (EV) charging station subsector, which grows threefold by adding 9,300 jobs, and relatively steady employment numbers in the vehicle manufacturing and wholesale trade parts subsectors across the study years, job displacement is projected in the conventional fueling stations and vehicle maintenance subsectors. Conventional fueling stations and vehicle maintenance subsectors decrease by 13,700 (32 percent) and 10,400 (18 percent), respectively. Overall employment in the transportation sector remains fairly flat through 2030, but net displacement occurs from 2030 to 2040 as alternative transportation stock increases more rapidly and internal combustion engine vehicle stock decreases more rapidly.

Table 12. Transportation Jobs, by Subsector (Additional Action)

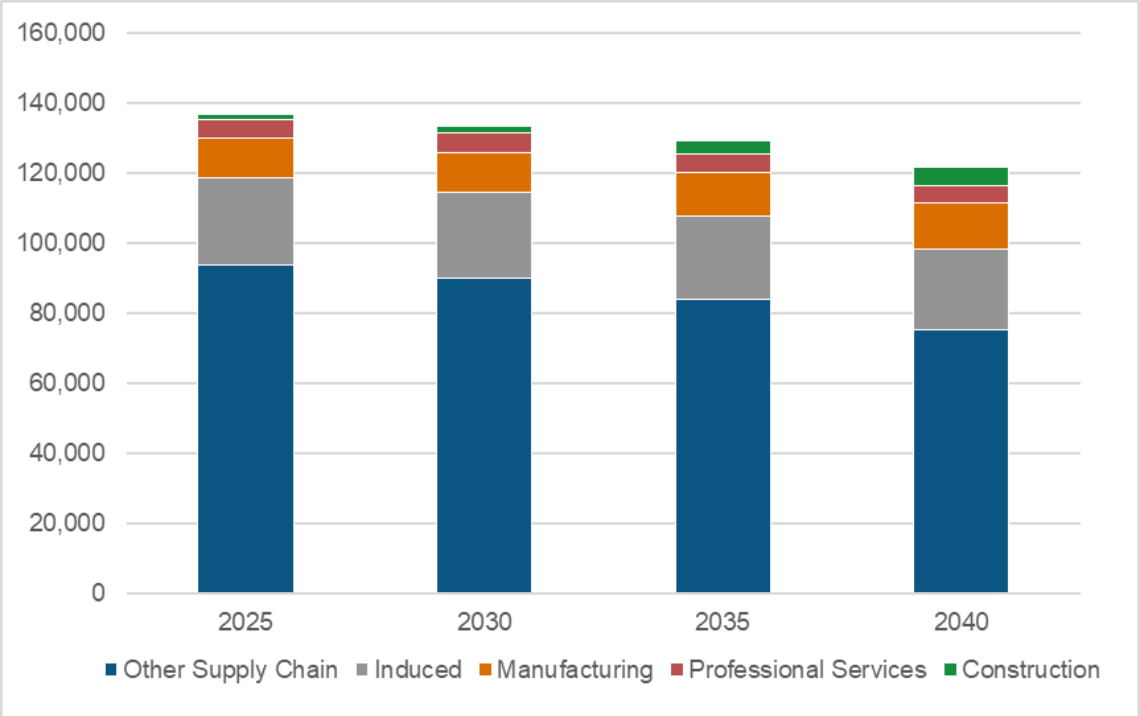
	2025	2030	2035	2040
Vehicle Maintenance	58,917	57,495	53,997	48,543
Conventional Fueling Stations	42,163	38,797	34,061	28,462
Wholesale Trade Parts	18,387	18,298	18,210	18,124
Vehicle Manufacturing	14,202	14,186	14,142	14,132
Charging Stations	3,002	4,473	8,582	12,239

Table 13. Transportation Jobs, by Subsector (Net Zero B)

	2025	2030	2035	2040
Vehicle Maintenance	58,917	57,495	53,208	47,507
Conventional Fueling Stations	42,163	38,797	33,412	27,486
Wholesale Trade Parts	18,387	18,298	18,210	18,125
Vehicle Manufacturing	14,202	14,186	14,142	14,132
Charging Stations	3,002	4,473	11,757	15,539

The transportation sector is expected to displace roughly 18,500 net jobs within the other supply chain category—such as fuel station operators, maintenance, and repair workers—and another 2,000 jobs that would otherwise be induced. However, this sector will add a net 4,000 construction jobs and 2,000 manufacturing jobs to support the build out of new EV charging infrastructure (see Figure 6).

Figure 6. Transportation Sector Jobs, by Industry



3.5.1. Vehicle Maintenance

The vehicle maintenance subsector declines by 18 percent, or 10,400, from 2025 to 2040. This decrease in employment is primarily caused by the difference in maintenance expenditures between alternative vehicles and internal combustion engine vehicles. Alternative vehicles have fewer moving parts compared to internal combustion vehicles, meaning fewer parts that will potentially need replacement as well as a decrease in regularly scheduled maintenance, such as oil changes or changes in transmission fluid, resulting in lower maintenance expenditures.[11] As the composition of vehicle stock in the state

shifts to include more alternative transportation and the number of miles traveled in alternative vehicles increases, overall maintenance costs decrease and lead to a decrease in employment.[12]

Vehicle maintenance employment is concentrated in the other supply chain industry group, which comprises roughly 80 percent of employment in the subsector across the study years and decreases by 18 percent over that period.

3.5.1. Conventional Fueling Stations

The conventional fueling station subsector experiences a decline of 13,700 jobs (a decrease of 32 percent) from 2025 to 2040. This decline in employment is driven by decreased fuel demand due to declining internal combustion engine vehicle stocks. Employment within this subsector is concentrated in the other supply chain, which encompasses 77 percent of jobs.

3.5.1. Wholesale Trade Parts

While the composition of vehicle stocks changes significantly during this time—with alternative vehicles comprising just 6 percent of total vehicle stocks in 2023 to 57 percent of stocks in 2040—the total number of vehicle stocks in the state remains largely unchanged throughout the study period, resulting in stable employment numbers. Employment in wholesale trade parts remains relatively stable from 2025 through 2040, seeing a decrease of just 1 percent across this period. Employment in wholesale trade parts is concentrated in the other supply chain and professional service industries, which make up 76 percent and 2 percent of employment, respectively, across the study years.

3.5.2. Vehicle Manufacturing

Employment within the vehicle manufacturing subsector remains steady from 2025 through 2040, seeing a decrease of only 0.5 percent. Employment in this subsector is based primarily on vehicle sales. While the composition of the types of vehicles sold in this period changes dramatically—with alternative vehicles comprising just 16 percent of vehicle sales in 2025 and 98 percent of vehicles sold in 2040—the total number of vehicles sold remains largely stable across the study years.

Most of the employment (73 percent) is concentrated in manufacturing across the study years, with the remainder of jobs falling into induced employment (25 percent) and some in the professional services industry (2 percent).

3.5.1. Charging Stations

The EV charging station subsector experiences growth of 9,237 jobs (+308 percent) from 2025 to 2040, with employment gains increasing more rapidly from 2030 to 2040 as charger manufacturing, installation, and maintenance expenditures rise to accommodate the growth in the State's alternative vehicle stocks. About 42 percent of employment in the subsector is concentrated in construction and 22 percent is concentrated in manufacturing across the study years. Professional services and other supply chain make up 7 percent and 6 percent of employment, respectively, while the remaining 23 percent falls into the induced employment category. Construction sees the largest absolute employment growth between 2025 and 2040 (3,906 jobs), followed by manufacturing (2,000 jobs). Employment growth is relatively uniform across these industry groups, each increasing by 306 percent to 311 percent relative to their 2025 employment levels.

4. Appendix – Detailed Methodology

4.1. Summary of Input-Output Models

Input-output (I/O) modeling is used to generate employment estimates based on different investments over time. The research team used two different I/O models, **IMPLAN** and the National Renewable Energy Laboratory's (NREL) **JEDI** (Jobs and Economic Development Impact) model software for this purpose. Input-output models illustrate the interdependent relationships between different sectors of a region's economy. Investments or activities in a given sector are used as inputs into the model to estimate the multiplier effect on business, household, and government expenditures and industry employment.

Figure 7. Direct, Indirect, and Induced Effects

IMPLAN is not an energy-specific industry analysis, but instead is focused on the overall employment impacts that would be felt across a given economic region, in this case the State of New York. JEDI estimates the local economic impacts of the construction and operation of power generation and biofuel plants. NREL provides JEDI models for various energy sub-sectors, including onshore and offshore wind, biomass, and hydropower. JEDI estimates job creation by running user input of project location facility size, and year of construction, in combination with the built-in model defaults and economic multipliers. JEDI is used in the electricity and fuels sectors as a technical data source to split

investments into industries and to generate initial employment outputs for both onshore and offshore wind electricity sub-sectors.

4.1.1. Initial Employment Output (IEO) Methodology

The initial employment outputs (IEO) generated for the jobs analysis follow the same general methodological approach across the four primary sectors, with the most relevant tools and data sources based on what is appropriate for each sub-sector. Assumptions made within specific sub-sectors vary due to the nature of the different activities, however the general structure remains consistent.

The IEO's are meant to produce the quantity of jobs that change over time for each of the sectors and sub-sectors. The IEO's were generated for 2023 (the baseline year) and for both the scenarios for 2025, 2030, 2035, and 2040.

The IEO methodology follows 6 steps.

1. Initially, the research team determines the unit inputs for the model. Unit inputs typically come from the State Energy Plan's Pathways Analysis data and take the form of device stocks and sales, MW of electric capacity, and fuel demand.
2. Next, the research team determines the unit and total investments. Investment inputs come from the State Energy Plan's Pathways Analysis data where provided, and any additional investments are assumed from secondary sources that have been noted.
3. Next, the research team processes the investment data to levelized inputs that reduce inter-annual variation as needed.
4. Next, the research team allocates the processed investment data into the relevant industry categories based on the activities associated with the investments by using technical cost data from secondary sources.
5. Next, the research team applies IMPLAN/JEDI industry employment multipliers based on the allocation described in step 4 to calculate employment outputs.
6. Finally, employment outputs were reported by industry category (Construction, Professional Services, Manufacturing, Other Supply Chain, and Induced). The 2023 baseline employment was derived from the 2024 New York Clean Energy Industry Report (NYCIER) and the 2024 United States Energy and Employment Report (USEER) unless otherwise stated.

4.2. Sector Specific Assumptions & Sources

The following assumptions and data sources were used in the modeling of each of the primary sectors, electricity, fuels, buildings, and transportation. Table 14 summarizes the data used to estimate baseline employment for each sub-sector.

Table 14. Baseline Employment Data Source, by Subsector.

SECTOR	SUB-SECTOR	BASELINE DATA SOURCE
Electricity	Solar	2024 New York Clean Energy Industry Report (NYCEIR)
	Offshore Wind	2024 New York Clean Energy Industry Report (NYCEIR)
	Onshore Wind	2024 New York Clean Energy Industry Report (NYCEIR)
	Hydropower	2024 New York Clean Energy Industry Report (NYCEIR)
	Hydrogen	None
	Biomass	2024 New York Clean Energy Industry Report (NYCEIR)

	Distribution	2024 U.S Energy Employment Report (USEER) and BLS
	Transmission	2024 U.S Energy Employment Report (USEER) and BLS
	Storage	2024 New York Clean Energy Industry Report (NYCEIR)
	Natural Gas Generation	2024 U.S Energy Employment Report (USEER)
	Other Fossil Generation	2024 U.S Energy Employment Report (USEER)
	Nuclear	2024 U.S Energy Employment Report (USEER)
Fuels	Hydrogen	None
	Bioenergy	2024 U.S Energy Employment Report (USEER)
	Natural gas	2024 U.S Energy Employment Report (USEER)
	Natural gas distribution	2024 U.S Energy Employment Report (USEER) and BLS
	Petroleum Fuels	2024 U.S Energy Employment Report (USEER)
Buildings	Commercial HVAC	2024 U.S Energy Employment Report (USEER)and BLS
	Commercial Shell	2024 U.S Energy Employment Report (USEER)and BLS
	Commercial Other	2024 U.S Energy Employment Report (USEER)and BLS
	Residential Shell	2024 U.S Energy Employment Report (USEER)and BLS
	Residential HVAC	2024 U.S Energy Employment Report (USEER)and BLS
	Residential Other	2024 U.S Energy Employment Report (USEER) and BLS
Transportation	Vehicle Manufacturing	2024 U.S Energy Employment Report (USEER)
	Wholesale Trade Parts	2024 U.S Energy Employment Report (USEER)
	Charging & Hydrogen Fuel Stations	2024 New York Clean Energy Industry Report (NYCEIR)
	Vehicle Maintenance	2024 U.S Energy Employment Report (USEER)
	Conventional Fueling Stations	Bureau of Labor Statistics

4.3. Electricity

For the electricity sub-sector models, E3 provided outputs on the electric system investment into new generating capacity, retirement of existing capacity, as well as fixed and operating costs of the projected capacity and generation mix. E3 outputs include the following information.

Capacity Data:

- Planned, economic and total capacity additions by technology (MW)
- Planned, economic and total retirements by technology (MW)
- Total installed capacity (MW)
- Total installed capacity by region (MW)
- Local capacity requirement capacity (MW)
- Installed storage capacity by region and duration (MW)
- Fuel mix capacity (MW) and energy (GWh)
- New transmission additions (MW)

Investment Data:

- Total capital expenditure (capex) by technology ($)
- Fixed and variable operational expenditures by technology ($)
- Fuel expenditure by technology ($)
- Distribution system investment ($)
- Transmission system investment ($)

- In-state renewable transmission ($)
- Interregional transmission ($)
- Tier 4 Transmission, CHPE ($)

4.3.1. Solar & Storage

For the solar and storage sub-sectors, technical cost data obtained from NREL's Solar and Storage Cost Benchmarks was used to allocate investment data into inputs for each value chain.[13] We used the 60MW, 2-hour standalone Li-ion model cost data in the 2021 NREL report as the basis of the storage sub-sector model inputs by value chain.[14]

For the distributed solar CAPEX investments, we used a weighted average of the project costs for the 8kW mixed residential model from the 2023 NREL report and the 0.2-MW commercial ground mount model from the 2021 NREL report to determine model inputs by value chain. For O&M investments, we used a weighted average of the residential and commercial ground mount O&M costs to determine model inputs by value chain.

For the utility solar CAPEX investments, we used project costs for the single-axis tracker 100-MW model from the 2023 NREL report to determine model inputs by value chain. For the O&M investments, we used O&M cost data to determine model inputs by value chain.

4.3.2. Hydrogen

Hydrogen investments included hydrogen fuel cell investments, hydrogen combustion investments, and investments in hydrogen-compatible combustion systems originally running on natural gas from the Pathways Analysis data. Employment associated with operating natural gas facilities that convert to hydrogen combustion was assumed to remain unchanged and was simply reclassified from natural gas to hydrogen. Investments for transitioning natural gas facilities to hydrogen and constructing new hydrogen generating facilities were allocated to construction of new power structures.

4.3.3. Hydropower

The Hydropower electricity sub-sector uses Hydropower generation cost data and capacity data from the forecasts developed in the Pathways Analysis.

4.3.4. Transmission & Distribution

The electric transmission and distribution sub-sectors leveraged baseline employment from the US Energy and Employment Report (USEER), splitting distribution and transmission using employment in NAICS 221121 – Electric Bulk Power Transmission and Control and NAICS 221122 – Electric Power Distribution. Transmission and distribution investments were allocated to construction of new power structures and electric power transmission and distribution value chain categories.

4.3.5. Offshore & Land-based Wind

Offshore wind outputs are generated using NREL's JEDI Offshore Wind Model Rel. 2021-3, using installed capacity from the Pathways Analysis as input. Land-based wind outputs are generated using NREL's JEDI Land Based Wind Model Beta rel. W10.30.20, using installed capacity from the Pathways Analysis as input.

4.3.6. Nuclear

The Nuclear electricity sub-sector uses Nuclear generation cost data and capacity data from the forecasts developed in the Pathways Analysis. 2023 baseline employment is derived from the 2024 USEER.

4.3.7. Electricity Displacement

The electricity displacement sub-sectors—natural gas generation, other fossil fuel generation, and biomass generation —used baseline utilities employment as input into IMPLAN multipliers to derive induced employment impacts. Baseline 2023 employment was adjusted over time by capacity retirements and operational expenditures as detailed in the Pathways Analysis data. Decommissioning impacts for other fossil plants were not included due to a lack of data on the scale and timing of these impacts.

4.4. Fuels

4.4.1. Fuels Growth

For the fuels sub-sectors that were projected to grow under the transition scenarios – hydrogen and biofuels – the research team used investment data derived from the Pathways Analysis. Value chain allocation of investments for biofuels was derived from the NREL JEDI Biorefinery Sugars to Hydrocarbon model.

4.4.2. Fuels Displacement

For the fuels displacement sub-sectors, natural gas and petroleum fuels, the research team adjusted 2023 baseline USEER data based on declining fuel investments over time from the Pathways Analysis.

4.4.3. Natural Gas Distribution

For the natural gas distribution sub-sector, the research team leveraged natural gas distribution capital and operational expenditures derived from the Pathways Analysis. These outputs serve as a proxy for customer loss, which is then used to adjust baseline employment over time. The research team incorporated an employment elasticity metric calculated using data from Davis and Hausman, 2022, that details the average operational expenditures at a natural gas distribution company by activity (e.g., administrative, repair and maintenance) and the portion of those expenditures that leave with the customer when they disconnect from gas service. The research team calculated ~41 percent of total operational expenditures leave with the customer, meaning 41 percent of every decrease in natural gas distribution investments results in natural gas distribution employment displacement, the other 59 percent remains unchanged. The research team derived baseline 2023 employment in natural gas distribution from the 2024 USEER.

4.5. Buildings

The buildings sub-sectors use investment data derived from the Pathways Analysis. Buildings sector data was also calibrated by an analysis of data on New York State's building electrification activities.

4.5.1. Commercial & Residential HVAC

Commercial and residential HVAC sub-sector industry spending patterns are adjusted based on BEEM and Pathways Analysis data, allocating supply chain expenditures to the following commodities:

- air conditioning, refrigeration, and warm air heating equipment,
- sheet metal,
- fabricated pipes and pipe fittings, and
- power boilers and heat exchangers.

4.5.2. Commercial & Residential Shell

Commercial and residential shell sub-sector industry spending patterns are adjusted based on BEEM and Pathways Analysis data, allocating supply chain expenditures to the following commodities:

- paints and coatings,
- mineral wool (insulation),
- metal windows and doors, and
- wood windows and doors.

4.5.3. Commercial & Residential Other

Commercial and residential other sub-sector industry spending patterns are adjusted based on BEEM and Pathways Analysis data for, allocating supply chain expenditures to the following commodities:

- household laundry equipment,
- household refrigerators and home freezers,
- lighting fixtures,
- heating equipment (except warm air furnaces),
- other major household appliances,
- household cooking appliances, and
- air conditioning, refrigeration, and warm air heating equipment.

4.6. Transportation

4.6.1. Vehicle Manufacturing

To estimate employment for the vehicle manufacturing subsector, the research team scales baseline 2023 employment by projected vehicle sales data provided by the Pathways Analysis. This approach assumes that vehicle manufacturing employment grows or declines proportionally with sales of the vehicle types served by each manufacturing sector. In applying this approach, the research team distinguishes between vehicle manufacturing related to conventional vehicles, manufacturing related to alternative vehicles, and vehicle manufacturing that is “dual-technology” (i.e., serving both conventional and alternative vehicles). In addition, the research team distinguishes between employment related to vehicles sold in the New York market and employment related to vehicles sold outside the New York market. The research team assumes that the former scales with New York vehicles sales and that the latter remains constant over time.

4.6.2. Vehicle Maintenance

The research team’s assessment of employment related to vehicle maintenance reflected differences between the maintenance requirements of alternative vehicles and the maintenance requirements for conventional vehicles. Information on maintenance costs per mile by vehicle type and component category (e.g., engine, braking system, transmission, etc.) were from CARB and research published at the International Battery, Hybrid and Fuel Cell Electric Vehicle Symposium. Based on this information and projected changes in the size and composition of the vehicle stock over time as obtained from the Pathways Analysis, the research team adjusted 2023 baseline employment to reflect changing needs for maintenance labor over time.

4.6.3. Wholesale Trade Parts

The research team estimates changes in employment related wholesale trade for vehicle parts based on projected changes in the vehicle stock over time. As a starting point for the analysis, the research team obtained baseline employment data from the 2024 USEER, distinguishing between wholesale employment related to conventional vehicles and employment related to alternative vehicles. The research team also distinguishes between wholesale employment serving the New York market and employment serving other markets. To project changes in employment over time, the research team scales wholesale employment serving the New York market based on projected changes in New York's conventional vehicle stock and alternative vehicle stock over time, as obtained from the Pathways Analysis. The research team assumes no change in employment serving non-NY market and assumes the same employment requirements across vehicle technologies.

4.6.4. Fueling Stations

The research team estimates changes in fueling station employment based on projected changes in fossil fuel and biofuel consumption over time. As an initial step, the research team estimates 2023 baseline employment at fueling stations using U.S. Census Bureau data. These data report employment separately for fueling stations with and without convenience stores. For fueling stations with convenience stores, the research team estimates that 61 percent of revenues are related to fuel sales, based on research from the National Association of Convenience Stores. For this segment of the fueling station market, the research team assumes that 61% of baseline employment scales proportionately with projected changes in fossil fuel and biofuel consumption over time, based on fuel consumption projections from the Pathways Analysis. The other 39 percent of employment for these fueling stations is assumed to remain unchanged over time. For fueling stations without gas stations, the research team scales the full 100 percent of baseline employment with projected changes in fossil fuel and biofuel consumption over time. The research team assumes no gas stations transition to charging stations, providing a high-end estimate of potential job reductions.

4.6.5. Charging Stations

For the charging stations sub-sector, the research team projects growth in employment to meet increased demand for chargers by type. This includes manufacturing, installation labor, and materials. Total charger investments across alternative fuel types are derived from the Pathways Analysis and are broken out into hardware, installation materials, and installation labor investments following data collected by the International Council on Clean Transportation. Expected maintenance hours per year per charger were derived from the US Department of Energy (DOE) Alternative Fuels Data Center (AFDC). The research team assumes MD/HD vehicles exclusively use DC Fast chargers, the share of LD vehicles using DC Fast chargers remains constant (17 percent DC Fast, 83 percent Level 2), 100 percent of maintenance and installation labor is in-state, and ~10 percent of charger materials and hardware manufacturing is in-state. The research team assumes hydrogen refueling stations follow the same installation and maintenance investments as EV chargers, due to a lack of available data and low share of total investment.

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1 This analysis was conducted by BW Research.

2 See the Pathways Analysis chapter for additional detail on modeling assumptions. This analysis uses the 2.2 GW Nuclear Variant of the Additional Action scenario.

3 The Pathways Analysis and this employment impacts analysis were completed in November 2025 based on assumptions set in September 2025; they do not reflect more recent State or federal policy updates.

[4] Baseline employment data is sourced from the 2024 New York Clean Energy Industry Report and the 2024 United States Energy and Employment Report unless otherwise stated. The analysis models projected employment for the future years based on the Pathways scenario data.

[5] **Direct** employment is associated with the initial economic activity of a given investment or activity (e.g., changes in wages, production, or jobs). **Indirect** employment is associated with the supply chain connected to the initial economic activity of the original investment or activity (e.g., purchases of goods and services or business tax impacts). **Induced** employment is based on the additional household spending resulting from the additional direct and indirect employment that is generated from the initial economic activity of the original investment or activity (e.g., wages paid, household purchases, or household tax impacts).

[6] The employment modeling approach is developed based on the methods used in the New York Just Transition Working Group's 2023 Jobs Study.

[7] Columns may not sum due to rounding.

[8] The Additional Action scenario assumes that all nuclear facilities retire at the end of their 60-year licenses and was conducted before the Governor's June 2025 announcement directing NYPA to pursue a new nuclear plant.

[9] Scenario-specific estimates of annual capital investment and operating expenses for the gas system were developed by using local distribution company investment forecasts as a baseline, then adjusting the investment forecast to reflect scenario-specific decreases in gas system utilization (e.g., customer count, peak demand). The analysis did not assume a one-to-one relationship between system utilization variables and investment. Rather, elasticities were developed for capital expense categories to reflect more realistic estimates of the relationship between system use and investment. Additional detail can be found in the Pathways Analysis chapter.

[10] JobsEq Software. Data for NAICS 2212, average of 2023Q1 to 2024Q1, for New York, accessed October 2025.

[11] For more information on maintenance costs used for each vehicle type, see Bernd Propfe et al., "Cost analysis of plug-in hybrid electric vehicles including maintenance and repair costs and resale values." *World Electric Vehicle Journal* 5, no.4 (2012): 866–895, https://doi.org/10.3390/wevj5040886.

[12] While vehicle miles traveled (VMT) increases substantially for alternative vehicles from 2023-2040, the overall VMT in 2040 is 4 percent lower than VMT in 2023, potentially contributing to employment decline.

[13] Ramasamy et al., U.S. Solar Photovoltaic System and Energy Storage Cost Benchmarks, with Minimum Sustainable Price Analysis: Q1 2023 (National Renewable Energy Laboratory (NREL), September 2023), https://docs.nrel.gov/docs/fy23osti/87303.pdf.

[14] Feldman et al., U.S. Solar Photovoltaic System and Energy Storage Cost Benchmark: Q1 2020 (NREL, January 2021), https://docs.nrel.gov/docs/fy21osti/77324.pdf.

New York State Energy Plan

VOLUME II | Plan Analyses and Impacts

Environmental Impacts Analysis

20

2025 NEW YORK STATE ENERGY PLAN

Key Terms Used in This Chapter

FOR THE COMPLETE GLOSSARY ➜

Agrivoltaics: The simultaneous use of land for solar photovoltaic power generation and agricultural production of "crops, livestock, and livestock products".

Ecosystem: A dynamic complex of plant, animal [including human], and microorganism communities interacting with each other and the nonliving environment as a functional unit.

Endangered: Under the Endangered Species Act, plant and animal species that may be in danger of extinction throughout all or a significant portion of its range.

Ecosystem Services: Benefits people obtain from an ecosystem.

Threatened: Under the Endangered Species Act, plant and animal species that are likely to become endangered within the foreseeable future.

Wetlands: An area that is saturated or inundated by water, either surface or ground, at a frequency and duration sufficient to support vegetation adapted to saturated soil conditions.

Key Findings → Environmental Impacts Analysis

New York State contains a diversity of terrestrial and aquatic ecosystems, which provide critical ecosystem services, including food, water, forest products, air and water purification, flood prevention, carbon storage, climate moderation, recreational opportunities, and cultural services. However, ecosystems statewide face significant challenges due to climate change and land use patterns. This chapter describes New York's ecosystems and natural resources, environmental impacts of its energy systems, and potential impacts of the energy transition. It outlines policies and programs and recommends continued and additional actions to inform an environmentally responsible energy transition.

- **New York State's emissions control and clean energy programs are contributing to improving air quality and environmental benefits for communities and ecosystems across the state.** Energy market forces and energy-related air quality policies have resulted in substantially reduced emissions and ambient concentrations of criteria air pollutants over the past 20 years, significantly reducing ecosystem stressors such as acid (rain) deposition. These trends in emission reductions and associated benefits are projected to continue under each of the State Energy Pathway scenarios modeled in this Plan.

- **New York State has a robust regulatory framework for identifying and mitigating environmental impacts associated with energy development, generation, transmission, and use.** New York State's regulations and programs are implemented to protect and maintain our air quality, water resources, sensitive ecosystems and land resources, and wildlife from any adverse impacts associated with energy. These regulations and programs seek to address any adverse impacts from the full life cycle of an energy project—from construction to operation, decommissioning, and waste.

- **New York State's strategies for procuring and siting energy resources can reduce energy project risks and minimize land use conflicts.** For example, the Smart Solar Siting Scorecard is used to evaluate large solar project applications for their avoidance and mitigation of agricultural and forest lands. The New York State Offshore Wind Master Plan was based on extensive environmental and fisheries data collection to inform our understanding of environmental sensitivities and user conflicts associated with potential offshore wind (OSW) areas. These types of early investments in siting optimization can reduce environmental and project risks, help to inform construction windows and permit conditions, and accelerate project timelines.

- **Opportunities to inform an environmentally responsible energy system transition should be leveraged through** continued research into new and emerging technologies and fuels, best practices, and dual use of energy sites. For example, New York State is funding research to produce data on crop and grazing potential inside large solar projects. To balance the growth of the OSW industry with existing marine industries, such as commercial fishing, the State has supported research to maintain and grow the region's sustainable fisheries. Environmental monitoring enables policymakers to evaluate the effectiveness of energy-related regulations, policies, and strategies.

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1. Overview

1.1. New York's Ecosystems and Natural Resources

New York State contains a diversity of terrestrial and aquatic ecosystems, which provide critical ecosystem services, including food, water, forest products, air and water purification, flood prevention, carbon storage, climate moderation, recreational opportunities, and cultural services.[1] However, ecosystems statewide face significant challenges due to climate change and land use patterns.

1.1.1. Land Use and Development

New York State is predominantly rural, with forest and agriculture making up 75 percent of land use. Agricultural and forest land is present throughout the state but is highly variable among the regions. For example, the Central/Finger Lakes region includes approximately 41 percent agricultural land and 42 percent forested land, and the Mohawk River Valley, Southern Tier, Great Lakes, and St. Lawrence Valley each have more than 20 percent agricultural land and are 55 percent to 65 percent forested. New York's diverse ecosystems support a variety of agricultural and forestry goods, and the State is one of the top producers of dairy and fruit. Forests also provide an abundance of ecosystem services including air and water filtration, wildlife habitat, recreational opportunities, and carbon mitigation. About 11 percent of land is developed, mostly in New York City and Long Island.[2] Disadvantaged communities (DACs) are distributed across both urban and rural areas.

1.1.2. Waterways and Coastal Ecosystems

A total of 13.6 percent of New York State is covered by water, including inland waters, the Great Lakes, and coastal waters.[3] The State has more than 16,000 freshwater lakes, ponds, and reservoirs greater than 0.1 acre, as well as nearly 70,000 miles of rivers and streams. Water resources support biodiversity and provide a variety of critical ecosystem services to society, including drinking water and hydropower, and support regional economies through recreational opportunities, aesthetics, and cultural qualities.

Climate change is increasing lake surface water temperatures, decreasing ice cover, and increasing the length and strength of thermal stratification. Climate-induced changes in temperature, ice cover, and stratification are primary contributors to the deoxygenation of lakes. Ongoing and projected future deep-water deoxygenation represents a major challenge to coldwater fisheries.[4]

New York State has approximately 117 miles of shoreline stretching along the coast of the Atlantic Ocean as well as 577 miles of shoreline within the Great Lakes Basin, the St. Lawrence River, and the Niagara River. New York's marine habitats support abundant natural resources that are both ecologically and economically important. The New York Bight is an area of high primary productivity, supporting regional fisheries, threatened and endangered species, and part of migratory pathway along the Atlantic coast. Climate change is contributing to sea level rise, as well as species range shifts.

1.1.3. Wetlands

Wetlands in the state include 2.4 million acres of freshwater wetlands and 25,000 acres of tidal wetlands. Often located at the transition between upland and aquatic habitats, wetlands support a diverse assemblage of plant and animal species including invertebrates, fish, amphibians, reptiles, birds,

and semi-aquatic mammals. Many of these species are rare, threatened, or endangered in New York. Wetlands also provide a number of other critical ecosystem services, many of which contribute to climate resilience in watersheds. These ecosystem services include soil retention, groundwater recharge, nutrient and toxin filtration, carbon sequestration, floodwater storage, shoreline protection, and aesthetics. Wetlands have an important impact on water quality, as they intercept, filter, and absorb sediments and pollutants in surface runoff before it enters aquifers, streams, rivers, lakes, and the ocean.

1.1.4. Wildlife and Biodiversity

New York's habitats support a wide variety of species of animals and plants, including threatened and endangered species.[5] The State has 53 endangered species and 41 threatened species.[6] Biodiversity, including the conservation of ecosystems, rare species, and genetic diversity, is necessary to maintain valuable ecosystem services and function. More than 600 species of plants and nearly 500 species of animals are at risk of extirpation from New York due to habitat loss and fragmentation, pollution, overharvesting, invasive species, and other factors.[7] Marine wildlife exist within a highly dynamic and human-influenced ecosystem. Natural variations in oceanographic factors, such as sea surface temperature, oceanic currents, and broad scale climate patterns, create substantial seasonal, annual, and long-term changes in wildlife abundance and distributions in marine ecosystems, which can be further influenced by human activities like fishing, shipping, and gravel/sand mining.[8]

1.1.5. Threats to Ecosystems

Climate change and climate hazards, such as sea level rise, temperature change, changes in precipitation amount and intensity, and extreme events present a threat to New York State's ecosystems, as do other pressures—including invasive species that altering New York State's ecosystems.[9] Human activities that result in habitat loss and fragmentation, erosion, sedimentation, and pollution also continue to impact State ecosystems and can account for significant ecosystem impacts.[10] Habitat loss, fragmentation, and degradation are identified as major drivers of biodiversity loss across the globe. Habitat connectivity is another key consideration as large, intact, proximate, and well-distributed conserved natural areas are necessary to ensure populations of flora and fauna have reliable and healthy habitats into the future. As such, strategic conservation of lands and waters are identified as a key mechanism to secure biodiversity, abundance of life, and ecosystem services.

1.2. Environmental Effects from the Energy System Transition

There are environmental impacts associated with energy development, generation, transmission, and use. Decisionmakers address environmental impacts from the energy sector through regulatory and permitting measures and other strategies that seek to avoid, minimize, and mitigate any adverse effects.

Energy generation technologies and infrastructure that are in operation today and that this Plan projects will continue to operate and/or expand in the future include solar energy, hydroelectric facilities, and onshore and offshore wind; these have been the subject of environmental review in prior State proceedings.[11] The potential environmental issues associated with less mature energy generation technologies or fuels evaluated in this Plan—such as alternative fuels and next generation nuclear energy—are discussed in the Low-Carbon Alternative Fuels and Nuclear chapters of this plan, respectively.

This chapter discusses the environmental impacts and benefits associated with the projected trajectory of New York State's energy system transition and highlight past and current efforts underway to monitor progress and inform responsible energy development.

2. Areas of Potential Environmental Effects

2.1. Air Quality

2.1.1. State Goals

New York State regulates air emissions from facilities in the energy sector and other sectors to ensure air quality meets National Ambient Air Quality Standards (NAAQS) as required by the federal Clean Air Act.[12] State regulators also participate in interstate bodies, such as the Ozone Transport Commission, to engage and shape regional and federal efforts to address interstate air pollutants. State regulations and initiatives aimed at reducing greenhouse gas (GHG) emissions from the transportation sector can also reduce other air pollutants, such as fine particulate matter and nitrogen oxides (NO_x).

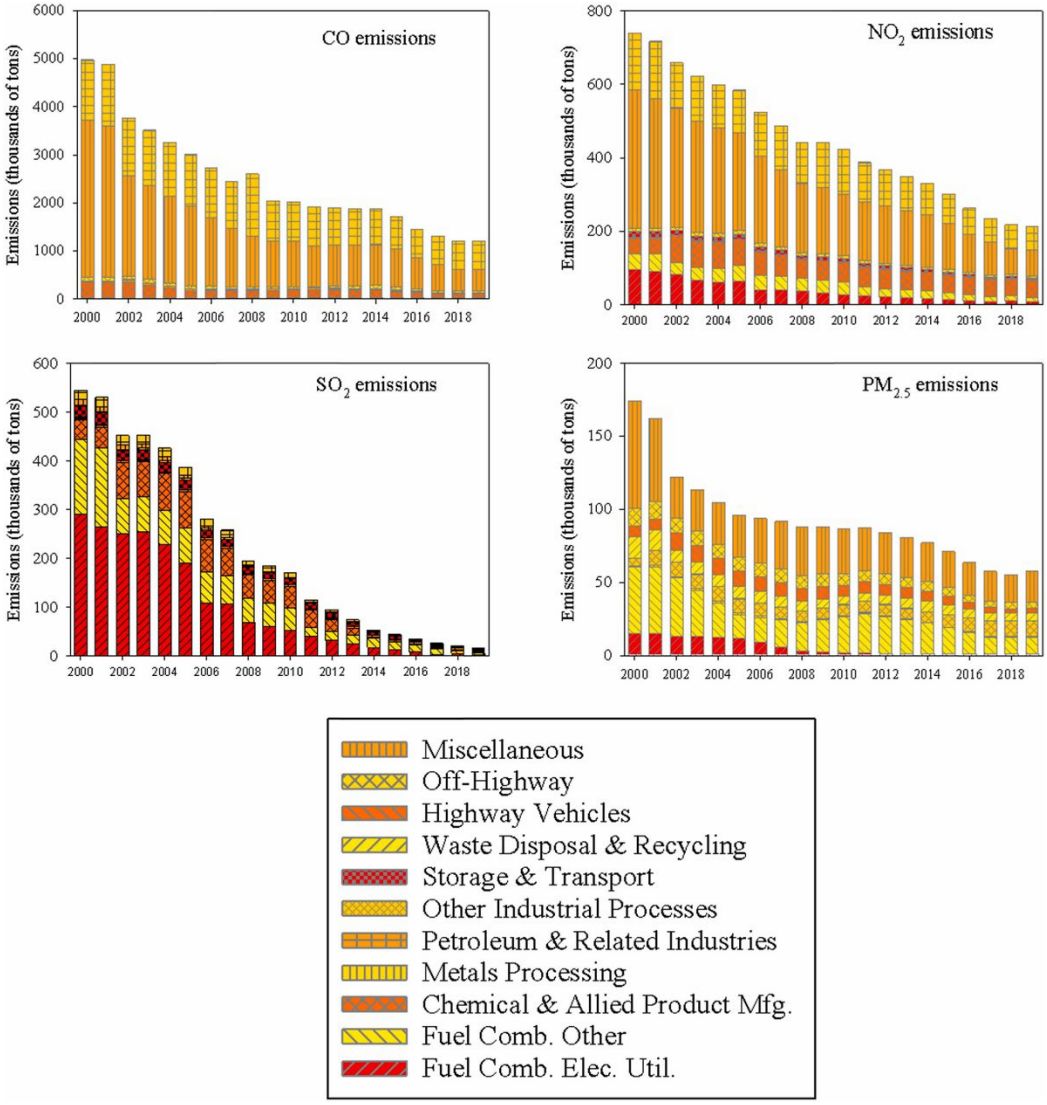
2.1.2. Air Quality Impacts

Fossil-fuel combustion: Exposure to air pollutants, such as fine particulate matter or ozone, can pose significant health risks—especially to vulnerable populations and those with preexisting conditions. Emissions from electric generation, heating, and transportation sources can contribute to air quality impacts statewide and in nearby communities, including in DACs. These sources of air pollution include oil and natural gas fired power plants, industrial processes and building heating systems, and mobile sources from on-road and non-road vehicle emissions.[13] Importantly, these emissions and associated impacts can originate from sources within New York State and from sources located in "upwind" states.

Over the past twenty years, market forces, economic drivers and the implementation of federal, State, and local energy-related air quality regulations have resulted in substantially reduced energy-related emissions and decreases in concentrations of ambient air quality pollutants such as fine particulate matter.[14] A recent research study published the results of a trends analysis for Carbon Monoxide (CO), Nitrogen Dioxide (NO_2), Sulfur Dioxide (SO_2), Ozone (O_3), and fine particulate matter ($PM_{2.5}$) at fifty-four State DEC monitoring sites that are part of the U.S. Environmental Protection Agency's (EPA) Air Quality System for the period 2005–2019. During this time there were substantial reductions in source emissions and in resultant ambient concentrations of all ambient pollutants except O_3.

Figure 1. Annual Emissions of CO, NO_2, SO_2, and primary $PM_{2.5}$ in New York State[15]

Source: Yunle Chen, David Q. Rich, Mauro Masiol, Philip K. Hopke, Changes in ambient air pollutants in New York State from 2005 to 2019: Effects of policy implementations and economic and technological changes, Atmospheric Environment, Volume 311, 2023, 119996, ISSN 1352-2310, https://doi.org/10.1016/j.atmosenv.2023.119996.



2.1.3. Programs and Policies

Federal regulations that have driven these trends include those generally focused on emissions controls and improved fuel quality from mobile sources, and the enactment of new rules to reduce emissions from older, uncontrolled electricity generation units—such as the federal Clean Air Interstate Rule. At the State level, New York has enacted regulations to phase out coal-fired power production and require ultra-low sulfur content in heating oil, as well as initiated the Renewable Portfolio Standard, Reforming the Energy Vision, and Clean Energy Fund during this time. The New York City (NYC) Clean Heat Program phased out #6 heating oil by 2015 and will phase out #4 heating oil by 2030.

In addition, in 2019 DEC adopted a regulation (6 NYCRR Subpart 227-3) to reduce NO_x emissions from Simple Cycle Combustion and Regenerative Combustion Turbines. These turbines are often referred as "peaking units" because they are electricity generating units that tend to operate during periods of high electricity demand to maintain grid stability. As of May 1, 2025, 37 "peaking" units have retired. The retired peaking units represent one gigawatt of older fossil fuel-fired generation and a significant reduction of pollution. In addition to shutdowns, additional emission controls were installed on 43 units totaling 1,267 megawatts (MW).

2.1.4. State Energy Pathways Will Continue to Reduce Energy-Related Emissions and Deliver Air Quality Benefits to Communities and Ecosystems

Air Quality Co-Benefits from State Energy Policies: The core planning scenario of the Draft Plan illustrates the potential for improvements in statewide air quality from decarbonization policies leading to substantial health benefits. The air quality improvements described above are largely the result of policies that were designed to directly reduce air pollutant emissions; for example, the use of cleaner fuels and post-combustion emission controls on vehicles and power plants. The Draft Plan's analysis of public health impacts shows that statewide energy policies focused on electrification would result in additional co-benefits for air quality, broadening the emission reductions by introducing zero emission alternatives, increased efficiency, and expanding beyond the reach of traditional emission control strategies. The majority of statewide air pollutant emission reductions would result from electrification and efficiency improvements in buildings and electrification of on-road vehicles. These improvements in air quality across all regions of the state would also lead to substantial public health benefits across a range of outcomes including reducing premature mortality, hospitalizations, emergency department visits, and incidence of various respiratory conditions, with larger health benefits expected in geographic DACs. A full analysis of the air quality and health modeling framework and results can be found in the Public Health Impacts Analysis chapter of this Plan.

Alternative Fuels Combustion: As discussed in chapters focusing on Electricity, Petroleum and Transportation, State Pathways Analysis scenarios project a decline in fossil fuel consumption between 2025 and 2040. Some of this fossil fuel consumption will be offset by the integration of alternative fuels, such as renewable natural gas (RNG), biodiesel and renewable diesel, sustainable aviation fuel (SAF) and hydrogen. As discussed further in the Low-Carbon Alternative Fuels chapters of this Plan, there are important climate, air quality, and environmental considerations associated with the production and uses of alternative fuels. In general, integration of alternative fuels for specific applications has the potential to reduce GHG emissions and in some cases reduce co-pollutants. In addition to GHG and co-pollutant emissions, the broader environmental impacts of alternative fuels, including effects on water use, water quality, land use, biodiversity, and waste management, should be considered in New York State's energy planning, policy development, and project evaluation. These impacts vary significantly by fuel type and production pathway and should be evaluated alongside climate and health outcomes to support sustainable decision-making.

Battery Energy Storage Systems: Energy storage technologies, such as battery energy storage systems (BESS), can improve the reliability and stability of the grid, especially when paired with intermittent

renewable generation. Battery storage paired with renewables can avoid reliance on peaker plants, contributing to lower levels of both local (i.e., criteria pollutants) and global (i.e., GHG) emissions.[16]

Battery storage systems emit GHGs during all stages of their life cycle (materials production, manufacturing, operation, end-of-life) and during transportation. A life cycle assessment of utility-scale energy storage systems found lithium-ion storage systems, which represent the majority of all stationary and mobile storage deployments in the State, have the lowest GHG emissions of five electro-chemical energy storage systems assessed (sodium-sulfur, lithium-ion, valve-regulated lead-acid, nickel-cadmium, and vanadium redox flow).[17]

As discussed in the Electricity chapter of this Plan, New York created the nation-leading Inter-Agency Fire Safety Working Group in response to fire incidents at energy storage facilities. Lithium is highly flammable when it contacts water, and if handled improperly can flow into surface water or leach into groundwater and cause combustion. Fires involving BESS can emit CO, CO_2, and volatile organic compounds (VOCs), and may emit other trace gases such as HF, HCN, or others depending on the battery chemistry and overall materials of construction of the BESS unit. Air sampling from past incidents at BESS have found that contaminant concentrations beyond the immediate fire scene do not pose a public health risk due to the rapid dispersion of gases limiting the potential for toxic exposure.[18]

2.2. Water and Wetlands

2.2.1. State Goals

The State prioritizes ensuring safe and clean drinking water, protecting diverse water resources, and supporting ecological well-being. Water quality is protected through permitting, compliance, enforcement, and monitoring efforts. Waters are classified for their best uses (fishing, source of drinking water, etc.) and standards are set to protect those uses. The State also seeks to protect, maintain, enhance, and restore freshwater and tidal wetlands ecosystems so they can continue to provide a broad array of ecological functions and benefits to communities and the environment, including carbon sequestration.[19,20]

2.2.2. Potential Environmental Effects

Deposition of Acid and Mercury Compounds from Fossil Fuel Combustion

Acid rain (and other types of acid deposition) forms when SO_2 and nitrogen oxides (NO_x) combine with moisture in the atmosphere to produce sulfuric acid and nitric acid. Historically, the source of SO_2 and NO_x emissions that contributed to acid rain was from fossil fuel combustion, in particular uncontrolled coal fired power plants, including those in states upwind of New York. By the 1960s, it became clear to scientists that acid deposition was significantly impacting natural resources across New York, especially in the Catskill and Adirondack Mountains where soils were becoming too acidic to maintain healthy forests, and many waterbodies were unable to support healthy populations of fish. Decreases in emissions have significantly reduced acid rain in New York, and ecosystems are slowly recovering, and many are now able to support more diverse and abundant wildlife and associated recreational opportunities.[21]

Mercury is a naturally occurring metal that is also emitted as an air pollutant from coal combustion. Mercury has been identified as being one of the most important of the persistent, bio-accumulative, toxic contaminants of concern for New York State. Mercury concentrations exceed human and ecological risk thresholds in many areas of New York State, particularly the Adirondacks, Catskills, and parts of Long Island. Mercury concentrations in the environment of New York State have declined over the last four decades, concurrent with decreased air emissions from regional and U.S. sources, and further controls on mercury emission sources are expected to continue to lower mercury concentrations in the food web, yielding multiple benefits to fish, wildlife, and people of New York State. However, scientists are also observing that fish and wildlife remain highly impacted by legacy Mercury deposition, as evidenced by stable and increasing trends of Mercury concentrations found in certain species and in some regions of the state.[22,23]

Atmospheric carbon dioxide (CO_2), caused by combustion of fossil fuels, is the primary driver of ocean acidification (OA). Localized acidification occurs periodically in some coastal areas, including Western Long Island Sound and the New York-New Jersey Harbor.[24] This addition of carbon dioxide alters the oceans' carbon chemistry. Reductions in pH, a process referred to as ocean acidification, make it harder for organisms to create shells and affect other physiological processes. Evidence suggests that increased carbon dioxide concentrations in marine waters have contributed to reductions in the quantity and quality of shellfish and the development and growth of finfish.[25,26] This presents ecological and socioeconomic risks, as the State has a commercial fishing industry with a value added of about $1.6 billion and a recreational industry with a value added of $770 million.[27] In 2016, the New York State Legislature established the Ocean Acidification Task Force to identify contributing factors to ocean acidification and evaluate ways to apply the best available science to address its impacts.[28] The 2024 Task Force report to the Legislature describes potential ways to mitigate the impact of OA, including addressing water quality standards, discharges, and enhancing blue carbon sequestration by seagrasses, kelp beds, and marshes.

Cooling Water Intake and Thermal Discharge

Steam-electric facilities such as those fueled by fossil fuels or nuclear energy, use water to create steam in the power generation process. The steam is cooled through the non-contact cooling system, and the cooling water is returned at an elevated temperature to the source waterbody. Steam-electric generating facilities may also require water for heating service water needs and cooling the thermal discharge effluent. These power plants are significant users of water, withdrawing more than half the of the total water withdrawn from lakes, rivers, and coastal waters.[29] Throughout the State, power-generating facilities can withdraw over 4.8 billion gallons of water per day. [30]

Adverse environmental impacts of a cooling water intake structure include the impingement of fish and other aquatic organisms on the facility's intake screens, and entrainment of smaller fish through the cooling system. Adult fish and some shellfish can experience abrasions and suffocation from being trapped on the intake screens. Juvenile fish and eggs that have been entrained are subject to physical, thermal, and chemical impacts as they move through the cooling system. The heated discharged water can impact local ecosystems by raising the water temperature, which can lead to reduced oxygen levels. The thermal discharge plume may also block migration routes for fish and, if warm enough, could be

lethal to some species that directly encounter the plume. Larval fish and eggs are particularly susceptible to impacts of the plume, due to their generally fragile life stage and inability to escape the thermal discharge.

Offshore wind converter stations also require cooling systems to manage heat generated during the alternative current (AC) to direct current (DC) power conversion process.[31] The most common method of heat exchange is the use of a non-contact once-through cooling water, with flow ranging from 2 to 15 million gallons per day.[32] These facilities can have similar impingement and entrainment impacts as on-shore once-through cooling systems, as well as similar thermal discharge impacts.

Land-Based Energy Generation and Infrastructure

Energy projects can also have hydrologic and ecological consequences if not carefully sited and managed. During construction, activities such as land clearing, grading, and infrastructure installation can alter habitats and compact soils as well as increase sedimentation in nearby wetlands and waterbodies. Energy infrastructure such as electric transmission lines and fuel pipelines often bisect wetlands, grasslands, forests, and waterbodies during construction, which can further fragment these ecosystems; and routine management after construction is complete can lead to further impacts, such as by increasing the risk of chemical runoff from herbicides. New York State regulators, energy companies and utilities seek to avoid, minimize, and mitigate associated impacts through permitting and best practices.

Hydroelectric Dams and Operation

Hydroelectric dams impound water to create a reservoir and divert water to hydropower plants. The dam and reservoir can change water temperatures, water chemistry, aquatic communities, river flow, and sediment loads. In New York State, there are limits on where new hydropower facilities can be sited in order to protect the Adirondack and Catskill Forest Preserves, and State Forests, including Reforestation Areas, and Wildlife Management Areas, and State Nature and Historical Preserves, as well as designated rivers that possess important scenic, ecological, recreational, historical, or scientific values.[33,34] As retired hydroelectric dams are removed, natural hydrology and river functions can be restored; water quality may improve, aquatic connectivity of habitat may be restored, and flood risks may be reduced.[35]

Oil, Gas, and Geothermal Wells

DEC regulates the drilling, plugging, and abandonment of oil, natural gas wells, underground gas storage and solution salt mining wells, in addition to brine disposal, stratigraphic, and geothermal wells drilled deeper than 500 feet to prevent pollution to ground and surface waters. DEC administers regulations and a permitting program to mitigate, to the greatest extent possible, any potential environmental impact of well drilling and well production, as summarized in DEC's 1992 Generic Environmental Impact Statement (GEIS) on the Oil, Gas and Solution Mining Regulatory Program.[36] DEC requires well plugging permits for all regulated wells once a well reaches the end of its useful life. Financial security provided by a well owner is required and held by the DEC for the life of the regulated well. The security is released only after DEC staff verify that the well was properly plugged and the surface remediated in accordance with State regulations.

Additionally, DEC is currently undertaking a rule making and the development of a GEIS specific to closed loop geothermal boreholes drilled deeper than 500 feet. The rule making and GEIS are intended to cover the drilling and installation of closed loop geothermal boreholes to ensure the protection of the environment and public health and safety during the development of geothermal energy resources statewide.

Solar

Photovoltaic (PV) cells, commonly called solar cells convert the sun's radiant energy directly into electricity. The solar panels contain multiple PV cells made of semiconductor devices. The PV cells are connected and sealed in a protective case to guard against weather conditions, forming a solar module. The solar modules are wired together to form the solar panel. Most solar panels used in commercial applications are monocrystalline silicon or polycrystalline silicon varieties.[37]

The bulk of solar panels are made of glass and aluminum; however, the internal components of solar panels may contain various metals such as lead (in solder) that if released into the environment (through breakage or improper disposal) could cause environmental contamination. Under normal operations, the U.S. Department of Energy found that "leaching of trace metals from the PV panels is unlikely to present a significant risk due to the sealed nature of the installed cells."[38]

Concerns have also been raised that solar panels could contain per- and polyfluoroalkyl substances (PFAS) which are a large group of man-made chemicals, some of which have been shown to lead to adverse human health risks. According to a Michigan State University literature review, PFAS are not customarily used in solar panels because alternatives have already been developed and commercialized. Further, this review found that no studies have shown the presence or leaching of PFAS from PV panels.[39] However, due to the limited research conducted to date, further inquiry may be appropriate.

The proper installation, use and decommissioning of solar energy systems has not been conclusively shown to introduce significant levels of hazardous or toxic materials into the environment.

Offshore Wind

The development of offshore wind (OSW) energy will result in new structures in the water, including foundations, scour protection, and hard protection for export and array cables. The introduction of foundations may result in alteration of local water currents, leading to increased movement, suspension, and deposition of sediments. Structures may also reduce wind-forced mixing of surface waters and waters flowing around foundations may increase vertical mixing. OSW may also impact atmospheric and oceanographic processes through the presence of structures in the water and the extraction of energy from the wind. There are few studies that have characterized potential hydrodynamic wakes and the interaction of atmospheric wakes with the sea surface. There is also a lack of research on the impact of wakes on regional scale oceanographic processes, such as the Mid-Atlantic Cold Pool, or secondary changes to primary production and ecosystems.[40]

Impacts to water quality from offshore wind activities are expected to be minor, resulting from accidental releases, sediment suspension, the presence of structures, port utilization, and land disturbances.[41] OSW activities are required to comply with regulatory requirements related to the

prevention and control of accidental spills and Construction Spill Prevention Control and Countermeasures (SPCCs) are required for every project to provide rapid spill response, clean up, and other measures to minimize potential impacts.[42] Any accidental release would be localized and result in no degradation of water quality in exceedance of water quality standards.

2.2.3. Programs and Policies

Regulations and voluntary programs at all levels of government combine to protect New York's water resources. DEC is the lead state agency for monitoring surface and groundwater quality, administering permits to regulate sources of pollution and water withdrawals. New York's water quality standards serve as foundation for how the state manages programs, enforces regulations, and issues permits to protect surface water and groundwater resources. New York State enforces numerous environmental regulations, such as the Freshwater Wetlands Act, Tidal Wetlands Act, and the Coastal Management Program to minimize and mitigate impacts by ensuring careful environmental review, responsible planning and restoration efforts, all to balance our increasing energy needs with environmental preservation.

In 2022, the State's Freshwater Wetlands Act[43] was amended, increasing the number of regulated freshwater wetlands. The Office of Renewable Energy Siting and Electric Transmission (ORES) have updated Article VIII regulations to align with the changes and expanded the options available for mitigation. In ORES' draft Article VIII regulations, mitigation banking, in lieu fee, and other mitigation fee programs are permissible for unavoidable wetland impacts.

DEC administers the Tidal Wetlands Regulatory Program, which is designed to prevent the despoliation and destruction of tidal wetlands by requiring permits for regulated activities in regulated tidal wetlands and tidal wetland adjacent areas.

The Coastal Management Program is implemented to preserve natural protective features, including beaches, and dunes and bluffs, which are especially effective at protecting storm-induced high water. DEC implements this program through its Coastal Erosion Management regulations, which require a permit to ensure that development, or other actions in erosion hazard areas, is undertaken in a manner that minimizes damage to property and natural protective features, prevents the exacerbation of erosion hazards, and protects human life.

The State Pollutant Discharge Elimination System (SPDES) program[44] regulates wastewater and stormwater discharges to prevent pollution that could degrade water quality. SPDES permits are required for industrial and municipal wastewater, as well as stormwater discharges to protect waters of the state. SPDES permits contain conditions that will require the permittee to monitor and minimize adverse environmental impact at facilities that have a once-through cooling water intake and thermal discharge. These conditions may include biological monitoring, including for water quality, impingement, and entrainment. These conditions also direct such facilities to utilize the Best Technology Available (BTA) for minimizing impingement and entrainment of fish and other aquatic life. Those BTA permit conditions will require the facility to measure through-screen intake velocity, perform studies of fish communities near the intake, provide an assessment of technologies or operational measures to reduce impingement and entrainment, and conduct thermal monitoring. After BTA technologies are installed, the facilities must

conduct additional studies to verify that the performance of the technologies and operational measures minimizes adverse environmental impacts.

Under Section 401 of the Clean Water Act (CWA), a federal agency may not issue a permit or license to conduct any activity that may result in any discharge into waters of the United States unless a Section 401 Water Quality Certification (WQC) is issued, verifying compliance with state water quality requirements. In New York State, applicants for a federal license or permit for activities that may result in a discharge into waters of the United States are required to apply for and obtain a WQC indicating that the proposed activity will comply with New York State water quality standards. The WQC process evaluates whether a project will prevent water pollution, protect aquatic habitats, and maintain water quality standards for designated uses (e.g., drinking water, recreation, and fish and wildlife habitats). A WQC is most commonly required when a project also requires a permit from the U.S. Army Corps of Engineers under Section 404 of the CWA for the placement of fill in waters of the United States. Examples of projects may include energy infrastructure projects, dredging operations, pipeline installations, and large-scale construction developments. To obtain certification, applicants must demonstrate that their project will comply with New York's state water quality requirements and standards. This often involves implementing best management practices (BMPs), sediment control measures, and various mitigation strategies to reduce environmental harm.

2.3. Land Use

2.3.1. State Goals

As discussed further in the Smart Growth chapter of this Plan, there are myriad environmental and health benefits associated with smart growth development, which can further complement State goals to conserve open space, protect watersheds, preserve biodiversity and wildlife migration, increase climate resiliency, and sequester atmospheric carbon. Specific State policy goals include supporting a national goal to preserve 30 percent of lands and waters by 2030, plant 25 million trees by 2033, and coordinate efforts to maintain and restore grasslands to address concerns about declines in grassland breeding and wintering birds.[45] The State has also prioritized the protection, restoration and monitoring of working agricultural and forest lands and wildlife management areas.[46] This has included the investment of hundreds of millions of dollars toward protecting agricultural land through the State Farmland Protection Program, and grass and forestland through real property acquisitions by the State.

2.3.2. Potential Environmental Effects

Energy Infrastructure

The State's energy system includes electric transmission lines and natural gas pipelines and refined petroleum product pipelines. Construction and operation of energy transmission facilities can result in direct disturbance to State lands and other terrestrial habitats, e.g., forest fragmentation. In addition to clearing and loss of habitat, construction may result in storm water runoff, siltation of streams and destruction of wetland vegetation. Maintenance of rights-of-way involves periodic clearing of vegetation, use of herbicides and installation of permanent infrastructure and access roads, sometimes in sensitive environments. As discussed further in the Electricity chapter of this Plan, State Pathways Analysis scenarios anticipate the need for additional investments in electric transmission infrastructure to meet

electric demand growth and integrate increasing amounts of renewable energy. Decisions on where to upgrade existing transmission lines or build new transmission lines will likely have land use implications if associated with renewable energy interconnection. Energy storage intended to reduce the intermittency of electricity supply from renewable energy sources is typically co-sited with the renewable energy facility, in some cases expanding the footprint of the overall facility.[47]

Solar

State Pathways Analysis scenarios project that increasing amounts of solar energy will be needed to meet state climate goals. Agricultural land generally provides flat clear terrain with minimal contamination that is ideally suited for all types of development, including suburban sprawl and more recently solar energy projects. Studies have documented that agricultural communities are more likely to host solar projects.[48] State stakeholders have expressed concerns about the visual effects of solar development on rural character, and on potential future land use conflicts between solar development and the sustaining of agricultural operations and services, as well as goals to restore and maintain breeding and wintering habitat for threatened and endangered grassland bird species and species of special concern.

The ultimate new capacity of solar (and other electric generation sources) that may be constructed between now and 2040 is unknown. However, for the purposes of estimating potential statewide land use impacts associated with solar energy, assumptions can be made based on past solar development and potential future energy scenarios. The Pathways Analysis identifies the potential for new solar capacity (distributed and utility-scale) of approximately 24 GW. A review of solar constructed in NYS between the years 2019-2024 identifies that approximately two-thirds (67%) of capacity additions were either community solar projects or utility-scale solar projects[49] – both of which are ordinarily ground-mounted on the landscape (i.e. not distributed commercial or residential rooftop projects). Applying the 67% historical rate to a potential future total solar capacity of 24 GW results in an estimated 16 GW of new community and utility-scale solar through 2040.

Producing an estimate on the amount of land area required for this new 16 GW of community and utility-scale solar capacity requires additional assumptions. Lawrence Berkeley National Lab researchers estimated that 2.9 acres are needed per MW for fixed-tilt solar and 4.4 acres per MW for single-axis tracking solar.[50] Assuming that 5 acres of land are needed for each MW of solar capacity, multiplying the 16 GW (16,000 MW) of potential community and utility-scale solar by the assumed 5 acres per MW provides an estimated 80,000 acres of land required to host new solar capacity, which is the equivalent of 1.2% of the state's 6.5 million acres of land in farms, respectively. [51]

Stakeholders have recognized that agricultural impacts from solar energy development might potentially be more regional in nature. In response to those concerns, NYSERDA commissioned a report to characterize the regional land use and economic implications of solar energy development on New York State's agricultural industry.[52] The focus and contents of this effort are being informed by engagement with a Regional Agronomic Impacts from Solar Energy (RAISE) specialist committee comprised of farmers, solar developers, academic advisors, State agency representatives, and other key stakeholders. The charge of this committee is to better understand the drivers of agricultural land conversion across

the state and in different regions, the tradeoffs of solar development relative to New York's agricultural industry, and study approaches for assessing solar development impacts on regional agricultural productivity and economies.

New York State has steadily adopted procurement and permitting policies intended to avoid or mitigate impacts to sensitive agricultural and forest lands. State procurement of renewable generation from utility scale renewable energy projects ("Tier 1 renewables") require applicants to include plans to minimize potential agricultural and Mineral Soils Groups (MSG) 1-4 impacts, forest impacts, and consider strategies for dual use with agriculture. Key milestones related to the State's solar siting policy as it pertains to agricultural considerations include:

2019 – New York State Department of Agriculture and Markets (NYSAGM) Guidelines for Solar Projects - Construction Mitigation for Agricultural Lands were established and which then became mandatory in 2020; requires a solar development to have an Environmental Monitor with expertise in agricultural practices. For projects above 50 acres in size, additional inspections and approvals from the Environmental Monitor are required.

2020 – The Agricultural Mitigation Payment was implemented for solar projects proposed in a certified agricultural district with the intent to disincentivize solar proposals in agricultural districts.

2021 – The Smart Solar Siting Scorecard was established (first as voluntary but since 2022 has become mandatory) and is used to evaluate applications for utility scale solar projects for their avoidance and mitigation of agricultural and forest lands.

2022 – The Agricultural Mitigation Payment Deferral Option was introduced to encourage "agrivoltaics" otherwise referred to as "dual use" or "agricultural co-utilization" of solar energy installations.

2023 – NYSERDA, in collaboration with the Agricultural-Technical Working Group (A-TWG), commissioned the report *Growing Agrivoltaics in New York State* to explore opportunities and barriers for more widespread adoption of agrivoltaics.

To help local governments and communities consider and address solar development proposals, the New York State Solar Guidebook contains a chapter on Solar Installations on Agricultural Lands, which identifies strategies that communities can adopt to protect farmland and prioritize development away from sensitive or high-quality farmland. The Guidebook also contains strategies for agrivoltaic (dual-use) project siting, to pair solar arrays with agricultural practices that would benefit from their presence. These benefits can be captured with appropriate site planning and mitigating environmental impacts. Some common dual-usage strategies being studied and piloted include animal grazing under solar arrays, growing crops that require shade provided by solar arrays, and pollinator friendly plants combined with solar arrays.

The state also has strategies to support solar deployment away from farmlands. AGM funds the development of Farmland Protection Plans conducted by local communities. The State Environmental Quality Review also has stricter standards for farmland impacts, triggering a review once 2.5 acres of farmland are impacted, compared to 10 acres for other land use types. Lastly, the Department of State's

Brownfield Opportunity Area Program encourages development of previously used sites, some of which may be appropriate for solar deployment.

In addition, as documented in prior regulatory proceedings, the flat, open landscapes preferred for solar project development are also some the best remaining habitat for grassland nesting and wintering birds in New York State. To minimize impact on critical grassland bird habitat, ORES has adopted pre-application procedures and developed standard uniform conditions to help identify when impacts to grassland birds occur and to reduce and mitigate for impacts that cannot be avoided.

Onshore Wind

A survey by the National Renewable Energy Laboratory of large wind facilities in the United States found that they use between 30 and 141 acres per megawatt of power output capacity. However, less than 1 acre per megawatt is disturbed permanently and less than 3.5 acres per megawatt are disturbed temporarily during construction.[53] Subsequent studies identify that wind power infrastructure such as the turbines and roads typically occupy only 5 percent of a wind power site, with the rest often used for other purposes, such as agriculture.[54]

Biofuels

To reduce ozone formation, the New York City metropolitan area and Long Island require the use of reformulated motor gasoline blended with ethanol. According to the U.S. Energy Information Administration (EIA), the State consumes about 534 million gallons of fuel ethanol annually, the fourth-largest amount of any state.[55] New York's only fuel ethanol production plant has a capacity of about 62 million gallons per year.[56] New York thus imports about 470 million gallons of fuel ethanol annually. Using rough industry estimates that one acre of corn produces 500 gallons of ethanol,[57] the total land area (within and outside the state) associated with growing corn for ethanol to support New York State consumption could be approximately 1 million acres (assuming all the fuel ethanol is produced from corn grain). According to EIA, New York does not have any biodiesel production, but the State is the nation's sixth-largest biodiesel consumer.[58,59]

2.4. Wildlife

2.4.1. State Goals

New York State seeks to protect and conserve biodiversity, manage wildlife populations, and preserve critical habitats. Conservation of wildlife supports ecosystem services, including food and other goods, pollination of crops, and waste decomposition. The State also prioritizes preventing the disappearance of endangered native species by protecting these species and their habitats.

2.4.2. Potential Environmental Effects

Energy Infrastructure

Land development, including for energy and utility infrastructure, can result in habitat loss, degradation, and fragmentation. If poorly timed, the clearing or modification of habitat can result in the direct loss of individual animals or a decline in productivity. Loss of habitat and vegetation, or fragmentation of habitat, can occur during the construction of infrastructure and operation of energy systems as the result

of increased human presence, noise, motion, and alteration of the terrain for roads, buildings, foundations, or other permanent site infrastructure.

Fossil Fuels

Fossil fuel extraction, transportation, processing, and combustion can have negative effects on plants and animals. Transportation and storage of oil and gas can result in spills and leakages, which contribute to water and air pollution.

Vis-à-vis offshore oil and natural gas development, there are no active oil and gas projects or leases in the Atlantic Outer Continental Shelf (OCS) Region. New York State responded to the Bureau of Ocean Energy Management's (BOEM) Request for Information on the development of the 2024–2029 National OCS Oil and Gas Leasing Program petitioning for the removal of the North and Mid-Atlantic Planning Areas from consideration,[60] due to the high risk of adverse impacts to New York's coastal and marine resources and ocean economy, specifically the commercial fishing industry. Seismic surveys during oil and gas exploration produce intense noise that could lead to widespread adverse impacts to marine life, including endangered and threatened species. Oil spills or well blowouts during extraction could also have significant effects on New York's coastline, ocean economy, and protected species.

Combustion of fossil fuels produces air pollutants, which can result in acid deposition or thermal changes in the atmosphere—causing climate change.

Acid rain (and other types of acid deposition) forms when SO_2 and NO_x combine with moisture in the atmosphere to produce sulfuric acid and nitric acid. Historically, the source of SO_2 and NO_x emissions that contributed to acid rain was from fossil fuel combustion, in particular uncontrolled coal-fired power plants, including those in states upwind of New York. By the 1960s, it became clear to scientists that acid deposition was significantly impacting natural resources across New York, especially in the Catskill and Adirondack Mountains where soils were becoming too acidic to maintain healthy forests, and many waterbodies were unable to support healthy populations of fish. Elevated concentrations of inorganic aluminum (Al_i), mobilized by acidic conditions, led to many water bodies becoming seasonally toxic to biota.[61] Decreases in emissions have significantly reduced acid rain in New York, and waterbodies are slowly recovering, and many are now able to support more diverse and abundant wildlife and associated recreational opportunities.[62]

Mercury is a naturally occurring metal that is also emitted as an air pollutant from coal combustion. Mercury has been identified as being one of the most important of the persistent, bio-accumulative, toxic contaminants of concern for New York State. Mercury concentrations exceed human and ecological risk thresholds in many areas of New York State, particularly the Adirondacks, Catskills, and parts of Long Island. Mercury concentrations in the environment of New York State have declined over the last four decades, concurrent with decreased air emissions from regional and U.S. sources, and further controls on mercury emission sources are expected to continue to lower mercury concentrations in the food web, yielding multiple benefits to fish, wildlife, and people of New York State. However, scientists are also observing that fish and wildlife remain highly impacted by legacy mercury deposition, as evidenced by stable and increasing trends of mercury concentrations found in certain species and in some regions of the state.[63,64]

Hydroelectric

Hydroelectric facilities may impact fish and wildlife resources due to the creation of dams and reservoirs and due, in part, to the way the facility is operated. Hydroelectric dams fragment river and stream systems, preventing upstream and downstream movement of fish and aquatic organisms. Dams can also fragment riparian habitat for semi-aquatic organisms. Anadromous species, fish that live in the ocean and come upriver to spawn, have declined dramatically in the last 150 years due to pollution, overfishing, and habitat destruction. Other effects of the loss of aquatic connectivity through dam creation can include the loss of other aquatic species dependent on the presence of certain fish. Many freshwater mussel species require specific fish species to serve as hosts to complete their life cycle. Dams that block fish passage can result in the loss of freshwater mussel populations that are dependent upon the presence of fish species.

All hydroelectric projects in New York State require intake protection and downstream passage sites for fish species to maintain aquatic habitats. Some weaker-swimming aquatic organisms can be restricted from passage, leading to changes in community structure. Most projects already have steel trash racks to prevent debris from entering the turbine, which may protect species of resident and migratory fish from entering intakes.[65]

Solar

Solar development in New York State can have both direct and indirect impacts on wildlife, particularly if large-scale projects significantly alter natural landscapes. One of the primary concerns is habitat loss and fragmentation. Clearing undisturbed land for solar farms can displace native species especially those that are less mobile, including pollinators, amphibians, and small mammals. Grassland birds can be adversely affected because the large, open habitat they require may be segmented by the placement of solar panels. Solar projects built on open fields or shrublands may force species into less suitable habitats, increasing competition for resources and potentially leading to population declines. Birds that nest on grasslands or open fields may be displaced when land is converted into a solar facility. If clearing or grading occurs during the nesting season, individual animals may be killed and productivity for the season may be lost. Even if some vegetation remains or is replaced, panel arrays can reduce habitat suitability and, alter nesting conditions potentially requiring compensatory mitigation. However, emerging research also indicates that some common bird species can quickly adapt to utilizing solar energy facilities for nesting or foraging, and that opportunities exist for biodiversity enhancement through vegetation planning and management.

Onshore Wind

Onshore wind turbines present direct and indirect threats to birds and bats. The main risk is collision with turbines when passing through the rotor swept zone or other parts of the tower structure. The risk of collision can increase when turbines are developed on ridges and upwind slopes or when they are built close to migration routes or concentration areas. Based on monitoring conducted at wind energy projects in New York through 2021, the average fatality rates across all bat and bird species are 7.2 bats per MW per year, and 2.2 birds per MW per year. Additionally, as of April 2025, 15 bald eagle fatalities have been documented at wind energy facilities in New York since 2015. Bat mortality due to turbine

collision may have a negative impact on some bat populations, particularly migratory tree-roosting bats. Bat mortality is a concern because many bat populations have experienced steep declines over the past two decades due to white-nose syndrome. While wind turbines are one of the primary causes of mortality for several bat species, research consistently shows that wind turbines are less harmful to songbirds than other human-made structures or predators.[66, 67]

Construction can also result in habitat loss; tree removal does occur at most project sites for construction needs and road access. This can reduce access to breeding sites and foraging areas. Disturbance caused by rotor movement, noise, vibration, flickering lights, and increased human presence may lead to behavioral changes such as avoidance and changes in flight paths, particularly for species living in open environments such as grasslands.[68]

There have been improvements in wind turbine design, project siting, and operation which have reduced the impact of wind turbines on birds and bats.[69] However, estimates of bird and bat mortality can vary in accuracy due to non-standardized survey methods and limits to accessing data.[70] DEC released an updated Guide for Conducting Bird and Bat Studies at Commercial Wind Energy Projects in 2016.[71]

Energy storage may enable impact reduction strategies for protection of vulnerable species (e.g., bats and birds) that are susceptible to operational impacts. For example, energy storage can enable the curtailment of wind turbine operation to avoid periods of peak wildlife activity in close proximity to wind turbines (e.g., feeding or migratory passage).[72]

Offshore Wind

Offshore wind (OSW) has the potential to impact marine ecosystems and wildlife at different stages of construction and operation. Noise from site characterization, construction, operation, and decommissioning activities can harm marine mammals, sea turtles, and fish by causing behavioral changes, masking communication, or causing physical injuries. Vessel traffic at all stages of OSW can pose a collision risk for marine mammals and sea turtles, especially large whales. However, the observed and projected increase in vessel traffic from OSW activities is small. Benthic habitats may be lost of degraded during construction, displacing organisms and affecting demersal habitats. Species may also be displaced by OSW structures, disrupting migration, feeding, or breeding; conversely, other species may be attracted to the area due to increased habitat complexity or foraging opportunities. Birds and bats are at risk of collision with turbines during operation, which can cause injury or death. Collision impacts are very difficult to assess, as traditional methods to study post-construction fatalities are not practically applied in open water environments. Additionally, subsea power cables generating electromagnetic fields may affect the behavior of electrosensitive species, such as sharks, rays, sturgeon, and some invertebrates. The presence of OSW structures may also lead to displacement of fishing efforts, although fishing is not restricted within OSW areas.

Offshore wind structures are known to act like artificial reef-like habitats, increasing local primary productivity and food availability on and near the structures.[73] Structure-oriented fishes may also be attracted to these locations. Benthic species dependent on hardbottom habitat may benefit from hard surfaces, resulting in increases in benthic diversity. Benthic monitoring at US offshore wind turbines has

found that new habitat and availability of food resources has attracted recreationally, commercially, and ecologically important species to the structures.[74]

Potential impacts to wildlife are first avoided during siting and then reduced through mitigation measures applied under State and federal permit approval processes. Wind Energy Areas (WEAs) are identified by BOEM using a suitability analysis that accounts for both environmental sensitivities and coexistence with other ocean users. Areas of highest conflict are removed from consideration and then further refined in consultation with other government agencies, states, stakeholders, and public comments. Prior to development, OSW projects must receive BOEM approval for their Construction and Operations Plan (COP), which is subject to terms and conditions to mitigate potential impacts to protected species, habitats, and fisheries.

2.4.3. Policies and Programs

The New York State Endangered and Threatened Species Act provides legal protection for species that are at risk of extinction or significant population decline within New York State.[75] It designates species as endangered, threatened, special concern, or extirpated, depending on their risk level. Once listed, these species receive protections that prohibit harming, harassing, capturing, or killing them, as well as destroying or significantly altering their habitats. Additionally, federally listed rare and threatened species also receive protection through coordination with federal laws, such as the U.S. Endangered Species Act (ESA) and the Migratory Bird Treaty Act (MBTA).

The New York State Wildlife Action Plan (SWAP) serves as a comprehensive strategy for conserving the state's diverse wildlife and their habitats, focusing on species of greatest conservation need (SGCN).[76] The plan identifies key threats to wildlife, such as habitat loss, climate change, pollution, and invasive species, while outlining conservation actions to address these challenges. The SWAP emphasizes habitat restoration, species monitoring, public education, and partnerships with conservation organizations to enhance biodiversity protection. By providing a framework to proactively manage wildlife populations and ecosystems, the plan supports long-term ecological health, reduces the need for future regulatory interventions, and aligns with broader federal conservation goals.

The New York Natural Heritage Program, funded by DEC and managed by the State University of New York College Environmental Science and Forestry, facilitates the conservation of New York State biodiversity by providing scientific expertise on rare species and natural ecosystems to resource managers.

In addition, proposed energy facilities must comply with state and federal wildlife permitting requirements. The State Environmental Quality Review Act (SEQRA) mandates an environmental impact assessment that is reviewed at the local level for projects that do not meet the size threshold to fall under ORES jurisdiction. Large scale renewable energy projects—projects with a nameplate capacity of at least 25 MW—are reviewed by ORES to ensure that such projects avoid and minimize impacts to ecological resources and wildlife. To compensate for impacts to threatened and endangered species that cannot be avoided, ORES requires mitigation that will provide a net conservation benefit for the affected species. If federal wildlife laws apply (such as under the MBTA or ESA or the Bald and Golden Eagle Protection Act), coordination with U.S. Fish and Wildlife Service may be required.

Offshore wind energy projects are being developed in federal waters (more than three nautical miles from shore) with transmission infrastructure in State waters, necessitating both State and federal permitting.[77] The Coastal Zone Management Act allows the State to review activities in federal waters and projects with coastal effects to New York to ensure consistency with the federally enforceable policies of New York State Coastal Management Program administered by the Department of State. DEC reviews potential impacts on threatened and endangered species and fisheries conservation and management from offshore wind development under the Environmental Conservation Act. BOEM leases submerged lands and approves Site Assessment Plans and Construction and Operation Plans. The National Oceanic and Atmospheric Administration and U.S. Fish and Wildlife Service manage consultations pertaining to the Magnuson-Stevens Fisheries Conservation and Management Act, Marine Mammal Protection Act, and Endangered Species Act.

2.5. Legacy Sites and Waste from Energy Sectors

2.5.1. State Goals

The development, use, and decommissioning of energy facilities results in waste products that need to be managed. As part of the transition to clean energy, the State initiated the development of a blueprint to guide the retirement and redevelopment of New York City's oldest fossil fuel facilities by 2030. The Climate Action Council Scoping Plan made recommendations for a circular economy approach to materials management and an increase in recycling capacity. One strategy in the Plan calls for the State to support domestic recycling facilities and markets for recovered resources and incentivize public-private partnerships for recycling facility development. NYSERDA's Blueprint for Advanced Nuclear Energy Technologies recommends that the State address challenges around waste management and storage to enable the adoption of advanced nuclear.

2.5.2. Potential Environmental Effects

Fossil Fuel Plant Retirement and Legacy Pollution

The decommissioning of fossil fuel power plants may necessitate environmental remediation, which involves the investigation and cleanup of hazardous materials to meet federal and state requirements. Coal ash has contributed to groundwater contamination and can spill into adjacent waterways, where it can also harm multiple physiological systems in exposed animals.[78] Remediation of natural gas and petroleum-fired plants involves the dismantling, cleaning, and disposal of fuel storage equipment such as tanks and transportation lines.[79] Leaking fuel storage tanks may require additional remediation to remove and properly dispose of contaminated soil. Some level of asbestos remediation may also be necessary.

Subsurface Energy Development

The State of New York has a rich history of oil and natural gas production, dating back to the nineteenth century. DEC currently maintains records for approximately 20,000 plugged wells and 23,000 unplugged wells; about 12,000 of the unplugged wells are actively producing, and new drilling continues. Most oil and gas wells in New York are located in the western part of the state, with the majority located in Allegany, Cattaraugus, Chautauqua, and Erie counties.[80]

It is estimated that a total of 75,000 wells may have been drilled in New York, with potentially tens of thousands of legacy orphaned and abandoned wells without proper well plugging prior to the existence of DEC or a regulatory framework in the state. If left unplugged, orphaned and abandoned wells can provide unimpeded conduits for oil, gas, and other fluids to migrate between different geologic formations, into aquifers, and potential to impact the land surface and waterways.[81] Unplugged orphaned and abandoned wells can also provide a potential route for subsurface methane and hydrogen sulfide to escape into the atmosphere, potentially contributing to increased levels of GHGs.

As the locations of many orphaned and abandoned wells are unknown, in 2020, DEC and NYSERDA collaborated to implement new tools and techniques for locating orphaned and abandoned wells drilled prior to existing regulation, including flying drones equipped with magnetometers.[82] With property owner cooperation, DEC has begun using this unmanned aerial systems technology across seven counties to successfully locate orphaned and abandoned wells which could not be located through routine DEC inspections. Once the wells are located, DEC has used State and federal funding to plug more than 500 orphaned and abandoned wells to mitigate the associated potential threats to the environment public health, and public safety.

Nuclear Waste

As discussed in the Pathways Analysis chapter of this Plan, planning scenarios project the continued operation of existing state nuclear plants through 2040. Nuclear power creates radioactive waste that remains in the environment for thousands of years and requires active stewardship to contain and mitigate risk for environmental exposure. By volume, the majority of radiological waste is made up of lightly contaminated items, primarily associated with electric power generation but also includes activities at hospitals, universities, research laboratories and others, and is classified as low-level radioactive waste. The New York State Low-Level Radioactive Waste Management Act requires low-level waste generators in the State to submit annual reports to NYSERDA that provide detailed information on how low-level radioactive waste is generated, stored, and disposed. Spent nuclear fuel from power generation is classified as high-level waste. Spent nuclear fuel generated by nuclear power plants is managed on-site in the form of solid spent fuel rods stored in deep pools of water for approximately 10 years after generation and then stored in steel-lined concrete casks, a practice known as dry cask storage. Dry cask storage has been successful at preventing leaks or exposure, but there is a risk of storage failure from materials degradation as dry casks age. Cask aging management is an important element of long-term storage, until such time as the federal government implements its responsibility to take possession of the high-level waste for permanent disposal options, which currently remain limited. Each of the nuclear power plant locations in New York manages an Independent Spent Fuel Storage Installation for high-level waste generated on the site.

Renewable Energy Waste

The transition to renewable energies and green transportation will produce waste that includes batteries, solar panels, and wind turbine blades. Waste from end-of-life renewable energy infrastructure is expected to increase significantly in the coming decades. More than 85% of a solar photovoltaic module is made of recyclable materials; however, recycling is not currently cost effective or widely

adopted.[83] Some solar panels are considered hazardous waste due to high levels of metals present.[84] Despite this, most solar waste currently goes to landfills.[85] In the U.S., 90% of the mass of decommissioned wind turbines could be recycled.[86] However, the U.S. Department of Energy found that existing U.S. recycling facilities find it difficult to process the materials in wind turbine blades and generators.

Battery-based energy storage could cause environmental impacts during end-of life disposal. Improper disposal at the end of a battery's life may cause land and groundwater pollution.[87] Recycling batteries can limit the environmental impacts, but there are barriers to recycling utility-scale lithium-ion batteries, including the high cost of spent battery transportation.[88] Globally, only five percent of lithium-ion batteries were recycled as of 2019, though that number could be rising more recently as lithium-ion batteries become more popular, particularly with individual consumers.[89]

2.5.3. Policies and Programs

NYSERDA's Just Transition Site Reuse Planning Program supports communities with planning services to inform future decision making at the local level to mitigate negative impacts of pending or future fossil fuel power plant closures.[90] Funds may be used to evaluate a site's environmental conditions (Phase I Environmental Site Assessment) or conduct pre-development activities, such as evaluating the presence or environmental contamination.

DEC is considering adding solar panels to the Universal Waste (UW) rule. The UW rule was established by the EPA in 1995 and is a set of requirements for commonly generated hazardous waste. DEC believes that hazardous waste solar panels are often misidentified and diverted to non-hazardous waste management streams and require an improved set of regulations for end-of-life management.[91] Niagara County became the first local government in the nation to pass a local law requiring producers to finance solar panel recycling.[92] DEC also recommends the passage of extended producer responsibility requirements that should include waste from renewable and green technologies.[93]

3. Opportunities to Inform an Environmentally Responsible Energy Transition

Assessing environmental uncertainties associated with energy development and use is key to avoiding, minimizing, and mitigating potential impacts as well as identifying opportunities for co-utilization or ecosystem enhancements. The State currently undertakes research into new energy technologies, as well as conducts data and monitoring studies to address information gaps and optimize siting, which can in turn reduce project impacts, risks and costs.

3.1. Environmental Research and Pre-Development Data Collection

As the State's energy generation mix continues to evolve to meet its energy needs, it will be important to continuously evaluate the potential impacts and benefits of new energy technologies and seek ways to optimize energy siting and use. For example, the State conducted more than 20 studies to inform the **New York State Offshore Wind Master Plan** in 2018.[94] These included an assessment of wildlife, fisheries, and habitats, which were used to refine the BOEM's Wind Energy Areas and identify areas of research to further improve siting. New York continues to invest in research studies to improve understanding of environmental sensitivities and user conflicts associated with offshore wind.[95]

New York has also proactively undertaken pre-development data collection ahead of offshore wind development, such as collecting metocean data, including wind speed and direction and wave height; mapping seabed sediments and sub-seabed conditions; conducting digital aerial surveys to identify wildlife; and deploying acoustic sensors to detect birds, bats, and marine mammals.[96] Pre-development data collection can reduce project costs by providing critical information to developers, regulators, and stakeholders early to improve understanding of the marine environment, reducing project risk; help to inform construction windows and permits; and accelerate project timelines.

3.1.1. Co-Utilization or Dual-Use of Energy Facilities

New energy development is being deployed in dynamic environments with existing users. To characterize the potential for energy facilities to support multiple uses, the State is funding research in collaboration with agricultural and commercial fisheries users.

For example, the co-utilization of solar energy facilities with active agriculture—referred to as "agrivoltaics"—represents a possible pathway to help achieve New York's solar energy goals while preserving production in agricultural lands. Examples of agrivoltaics can include, but are not limited to, growing livestock grazers, such as sheep and cattle, to produce livestock products and maintain vegetation in solar panel arrays while panels provide shading and protection from the weather; and growing crops that can thrive under and around solar panels to help sustain soils and farming activity. New York State is funding research projects to produce data on crop and grazing potential, environmental and species use, enhancement and mitigation opportunities, and optimal siting design considerations for large solar PV projects.

To balance the growth of the offshore wind industry with existing marine industries, such as commercial fishing, the State has supported research to maintain and grow the region's sustainable fisheries. This has included collaboratively developing technical strategies and tools to minimize commercial fisheries disruption within offshore wind areas, gear modification to enhance access to fishing within wind areas, and projects that have improved fisheries stock enhancement.

3.2. Environmental Monitoring

The State conducts environmental monitoring to evaluate compliance and document long-term trends associated with the environmental impacts of energy use. The data collected assists policymakers in evaluating the effectiveness of energy-related environmental regulations and policies.

For example, air quality monitoring can identify how transitions in the electric generation and transportation sector are affecting air quality. DEC operates more than 50 air quality monitoring sites statewide that measure both criteria and non-criteria pollutants, including ozone, SO_2, NO_x, carbon monoxide (CO), $PM_{2.5}$ (fine particulate with diameter less than 2.5 microns), and meteorological data. Air quality monitoring networks such as this not only provides real-time data on dangerous conditions to help people decide when to curtail outdoor activity but can be instrumental to observing trends and measuring the projected air quality benefits associated with this Plan.

Another environmental monitoring network that has proven instrumental to informing energy-related air quality regulations has been the Adirondack Long Term Monitoring (ALTM) program. The ALTM was

initiated in 1982 with the goal of evaluating the chemistry of Adirondack lakes and measuring the impacts that electricity generation sources—mainly those in the midwestern states—were having on otherwise pristine Adirondack waterbodies. ALTM data on the effects of acid rain proved instrumental in the passage of federal Clean Air Act Amendments and has continued to measure their effectiveness. As the watersheds in the Adirondacks have been recovering from acid rain and its effects, impacts from climate change and interacting stressors are emerging.

3.3. Stakeholder Collaboration to Inform Responsible Energy Development

New York State convenes multiple stakeholder groups to inform and advise on issues associated with renewable energy development. These stakeholder groups have proven successful in identifying areas to advance research to inform responsible energy development policies.

For example, following a series of fires at three BESS locations across New York State in the summer of 2023, Governor Hochul convened an Inter-Agency Fire Safety Working Group to address safety concerns around lithium-ion BESS. The Working Group includes State agency officials from the New York State Division of Homeland Security and Emergency Services, New York State Office of Fire Prevention and Control, NYSERDA, DEC, the New York State Department of Public Service and the New York State Department of State, as well as nation-leading BESS safety industry experts. In February 2024, the working group released initial recommendations for enhanced safety standards.

The State Agricultural Technical Working Group (A-TWG) has brought together State agencies; agricultural land and farmer advocates; nongovernmental organizations that focus on clean energy, climate, and environmental protection; local government officials; solar developers and operators; and academic experts to steer efforts in advancing renewable energy development across scales in a responsible way that supports the State's agricultural operations, lands, farmers, and communities. Committees of this group have advised on state solar energy procurement strategies to avoid and minimize agricultural impacts, opportunities to advance agrivoltaics policy, and characterizing agronomic impacts and opportunities of solar energy.

New York State also established Offshore Wind Technical Working Groups (TWGs) concerning the key subjects of fishing, maritime commerce, the environment, jobs, the supply chain, and environmental justice. The offshore wind TWGs are designed to foster ongoing collaboration with individuals and entities who have "technical knowledge, practical experience, and professional interest" in topics related to the OSW industry. The Environmental and Fisheries TWGs have supported information sharing, developed guidance on best practices, and informed research investments.[97] NYSERDA is also an active member of the Responsible Offshore Science Alliance and the Regional Wildlife Science Collaborative, which support regional research on fisheries and wildlife potentially impacted by offshore wind development.

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Acronyms

AC	alternating current
ACC	Advanced Clean Cars
ACET	Agricultural and Clean Energy Technology
ACT	Advanced Clean Trucks
AEDT	Aviation Environmental Design Tool
AEO	Annual Energy Outlook
AGM	New York State Agriculture and Markets
AI	artificial intelligence
AMEEP	Affordable Multifamily Energy Efficiency Program
AMI	advanced metering infrastructure
ANSC	Advanced State Nuclear Collaborative
ARL	adoption readiness level
ASHP	air source heat pump
ATSP	Active Transportation Strategic Plan
ATT	advanced transmission technology
Bcf	billion cubic feet
BEEM	Building Efficiency and Electrification Model
BESS	battery energy storage system
BEV	battery-electric vehicles
BIL	Bipartisan Infrastructure Law
BILD	Building Information and Land Use Database
BOA	Brownfield Opportunity Area
BOCES	Boards of Cooperative Education Services
BOEM	Bureau of Ocean Management
BRACE	Building Resilience Against Climate Effects
BRT	bus rapid transit
BTM	behind-the-meter
Btu	British thermal unit
CAC	Community Advisory Committees
CAIDI	Customer Average-Interruption Duration Index
CAM	Community Air Monitoring
CARIS	Congestion Assessment and Resource Integration Study

CBECS	Commercial Building Energy Consumption Survey
CBA	Community Benefit Agreement
CBO	Community Based Organization
ccASHP	cold climate air source heat pump
ccf	hundred cubic feet
CCGT	combined cycle combustion turbines
CCRP	Climate Change Resilience Plan
CCS/CCUS	Carbon Capture and Storage or Carbon Capture Utilization and Storage
CCVS	Climate Change Vulnerability Study
CDG	community distributed generation
CDTA	Capital District Transportation Authority
CEF	Clean Energy Fund
CEMP	Comprehensive Emergency Management Plan
CEPA	County Emergency Preparedness Assessments
CES	Clean Energy Standard
CESER	Cybersecurity, Energy Security, and Emergency Response
CEZ	clean energy zone
cf	cubic feet
CGPP	Coordinated Grid Planning Process
CHGE	Central Hudson Gas and Electric
CHIPS	Consolidated Local Street and Highway Improvement Program
CHP	combined heat and power
CHPE	Champlain Hudson Power Express
CISA	U.S. Department of Homeland Security Cybersecurity and Infrastructure Security Agency
CISBOT	cast iron sealing robot
CJWG	Climate Justice Working Group
Climate Act	Climate Leadership and Community Protection Act (2019)
CMAQ	Community Multiscale Air Quality Model
CNG	compressed natural gas
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COBRA	Co-Benefits Risk Assessment Health Impacts and Mapping Tool
COP	coefficient of performance
CPCN	Certificate of Public Convenience and Necessity
CRF	Climate Resilient Farming
CRIS	Capacity Resource Interconnection Service
CRL	Commercial Readiness Level
CRP	Comprehensive Reliability Plan

CSAPR	Cross-State Air Pollution Rule
CSC	Climate Smart Communities
CSRP	Commercial System Relief Program
CT	Combustion Turbines
CTOOLS	Community Tools
CUNY	City University of New York
DACs	disadvantaged communities
DADRP	Day-Ahead Demand Response Program
DAM	Day-Ahead Market
DC	direct current
DCFC	Direct Current Fast Charging
DEC	New York State Department of Environmental Conservation
DER	distributed energy resource
DG	distributed generation
DHSES	Division of Homeland Security and Emergency Services
DLM	dynamic load management
DLRP	Distribution Load Relief Program
DOB	Decommissioning Oversight Board
DOE	U.S. Department of Energy
DOH	New York State Department of Health
DOL	New York State Department of Labor
DOS	New York State Department of State
DOT	New York State Department of Transportation
DPS	New York State Department of Public Service
DR	demand response
DRV	Demand Reduction Value
DSASP	Demand-Side Ancillary Services Program
DSIP	Distributed System Implementation Plan
DSM	Demand-Side Management
Dth	decatherms
EAP	Energy Affordability Program
EEAP	Enhanced Energy Affordability Program
EBC	Empire Building Challenge
EDA	U.S. Economic Development Administration
EDRP	Emergency Demand Response Program
EE	energy efficiency
EEAC	Energy Emergency Assurance Coordinators Program
EE-BE	energy efficiency and building electrification
EEC	Energy Equity Collaborative

EEPS	Energy Efficiency Portfolio Standard
EHAP	Extreme Heat Action Plan
EIA	U.S. Department of Energy, Energy Information Administration
EITE	Energy-Intensive and Trade-Exposed
ELCC	Effective Load-Carrying Capability
EMAC	Emergency Management Assistance Compact
EMP	electromagnetic pulse
EPA	U.S. Environmental Protection Agency
EPD	Environmental Protection Declarations
EPF	Environmental Protection Fund
EPPAC	Energy Policy Planning Advisory Council
ERP	Emergency Response Plan
ESA	Endangered Species Act
ESB	electric school buses
ESCO	Energy Service Company
ESD	Empire State Development
ETP	Empire Tech Prize
EUE	expected unserved energy
EUI	energy use intensity
EV	electric vehicle
EVSE	Electric Vehicle Supply Equipment
FCEV	fuel cell electric vehicle
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FHWA	Federal Highway Administration
FY	fiscal year
GCEW	Growing the Clean Energy Workforce
GCM	Global Climate Model
GEIS	General Environmental Impact Statement
GET	grid-enhancing technology
GHG	greenhouse gas
GJGNY	Green Jobs-Green New York
GOTF	Grid of the Future
GPS	global positioning system
GSHP	ground source heat pump
GW	gigawatt
GWh	gigawatt-hour
GWP	global warming potential
H_2S	hydrogen sulfide

HALEU	High-Assay Low Enriched Uranium
HCR	Homes and Community Renewal
HEAP	Home Energy Assistance Program
HFC	hydrofluorocarbon
HPD	New York City Department of Housing Preservation and Development
HPMS	Highway Performance Monitoring System
HVAC	heating, ventilation, and air conditioning
HVDC	high-voltage direct current
ICAP	installed capacity
ICE	internal combustion engine
ICS	New York State Reliability Council Installed Capacity Subcommittee
IDA	Industrial Development Agency
IEDR	Integrated Energy Data Resource
IIJA	Infrastructure Investment and Jobs Act
IOU	investor-owned utility
IPCC	Intergovernmental Panel on Climate Change
IRA	Inflation Reduction Act
IRM	installed reserve margin
IRR	installed reserve requirement
ITC	independent transmission company
JEDI	Jobs and Economic Development Impact
JU	Joint Utilities
KEDLI	National Grid Long Island
KEDNY	National Grid New York
kV	kilovolt
kWh	kilowatt-hour
LBMP	locational-based marginal prices
LBW	land-based wind
LCA	life cycle analysis
LCOE	levelized cost of energy
LDC	local distribution company
LDES	Long Duration Energy Storage
LDV	light-duty vehicle
LECCLA	Low-Embodied Carbon Concrete Leadership Act
LEED	Leadership in Energy and Environmental Design
LIETF	New York State Low-Income Energy Task Force
LIHEAP	Low-Income Home Energy Assistance Program
LIPA	Long Island Power Authority
LIRR	Long Island Rail Road

LMI	low- and moderate-income
LNG	liquified natural gas
LOEE	loss of energy expectation
LOLE	loss of load expectation
LPA	labor peace agreement
LPP	leak-prone pipe
LSE	load serving entity
LSR	large-scale renewables
LSRV	local system relieve value
LTO	landing and takeoff cycle
LTP	local transmission plan
LTP	long-term plan
LTPP	local transmission planning process
LWR	light water reactors
MBtu	thousand British thermal units
METARE	MET-eorologically-weighted Averaging for Risk and Exposure
MHDV	Medium- and Heavy-Duty Vehicles
MISO	Midcontinent Independent System Operator
MMBtu	million British thermal units
MMBtu/h	million British thermal units per hour
MMRV	International Measuring, Monitoring, Reporting, and Verification
MMT CO_2e	million metric tons of carbon dioxide equivalent
MOVES	U.S. EPA Motor Vehicle Emissions Simulator
MPO	Metropolitan Planning Organizations
MTA	Metropolitan Transportation Authority
MW	megawatt
Mwac	Megawatt Alternating Current
MWdc	Megawatt direct current
MWh	megawatt-hour
MWBE	Minority/Women-owned Business Enterprises
Mwe	Megawatt Electrical
NAAQS	National Ambient Air Quality Standards
NARUC	National Association of Regulatory Utility Commissioners
NASEO	National Association of State Energy Officials
NEI	National Emissions Inventory
NEMA	National Emergency Management Association
NEMS	National Energy Modeling System
NERC	North American Electric Reliability Corporation
NERC-CIP	North American Electric Reliability Corporation Critical Infrastructure Protection

NESCAUM	Northeast States for Coordinated Air Use Management
NFG	National Fuel Gas Distribution Corporation
NFTA	Niagara Frontier Transportation Authority
NGA	National Governors Association
NH_3	ammonia
NHTS	National Household Transportation Survey
NIETC	National Interest Electric Transmission Corridor
NIST	National Institute of Standards
NMPC	National Grid Upstate
NOAA	National Oceanic and Atmospheric Administration
NO_X	nitrogen oxide
NPA	non-pipeline alternative
NPCC	Northeast Power Coordinating Council
NRC	Nuclear Regulatory Commission
NREL	National Renewable Energy Laboratories
NSF	National Science Foundation
NSPS	new source performance standards
NWA	non-wires alternative
NYCA	New York Control Area
NYCEDC	New York City Economic Development Corporation
NYCHA	New York City Housing Authority
NY-CHAPPA	New York Community-Scale Health and Air Pollution Policy Analysis
NYCRR	New York Codes, Rules and Regulations
NYCRRA	New York Community Risk and Resiliency Act
NYGATS	New York Generation Attributes Tracking System
NYISO	New York Independent System Operator
NYPA	New York Power Authority
NYSARP	New York Statewide Adaptation and Resilience Plan
NYSCH	New York State Clean Heat
NYSCIA	New York State Climate Impacts Assessment
NYSEEP	New York State Energy Emergency Plan
NYSEG	New York State Electric and Gas
NYSERDA	New York State Energy Research and Development Authority
NYSESP	New York State Energy Security Plan
NYSRC	New York State Reliability Council
NYSTAR	New York State Division of Science, Technology and Innovation
NYTVIP	New York Truck Voucher Incentive Program
O&R	Orange & Rockland Utilities, Inc.
OCT	New York State Office of Counter Terrorism

OEM	New York State Office of Emergency Management
OEM	original equipment manufacturer
OGS	New York State Office of General Services
OJET	Office of Just Energy Transition
OREC	Offshore Wind Renewable Energy Credit
OREP	Office of Resilience and Emergency Preparedness
OREP USS	OREP Utility Security Section
ORES	Office of Renewable Energy Siting and Electric Transmission
OSW	Offshore Wind
OSWD	Office of Strategic Workforce Development
OTDA	New York State Office of Temporary and Disability Assistance
OWTI	Offshore Wind Training Institute
PAD	Program on Applied Demographics at the Cornell Jeb E. Brooks School of Public Policy
PEM	Performance Engineered Mixture
PEV	plug-in electric vehicles
PFC	perfluorocarbons
PHEV	plug-in hybrid EVs
PHMSA	U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration
PII	personally identifiable information
PLA	project labor agreement
$PM_{2.5}$	Particulate Matter less than 2.5 micrometers
PON	Program Opportunity Notice
PPTN	public policy transmission need
PPTPP	public policy transmission planning process
PSC	New York State Public Service Commission
PSL	Public Service Law
PTC	Production Tax Credit
PV	photovoltaic
RABA	Regional Assessment and Barriers Analyses
RAPID	Renewable Action through Project Interconnection and Deployment
RD&D	research, development, and demonstration
REC	renewable energy certificates
RECAP	Renewable Energy Capacity Planning Model
RECS	Renewable Energy Consumption Survey
RED	resource efficient decarbonization
REDC	Regional Economic Development Council
REP	Radiological Emergency Preparedness

RES	Renewable Energy Standard
RETI	renewable energy training initiatives
REV	Reforming the Energy Vision
RFI	request for information
RFP	request for proposals
RFS	Renewable Fuel Standard
RGE	Rochester Gas and Electric Corporation
RGGI	Regional Greenhouse Gas Initiative
RGRTA	Rochester-Genesee Regional Transportation Authority
RMD	Residential Methane Detector
RNA	reliability needs assessment
RNG	renewable natural gas
ROP	Reactor Oversight Process
RPM	reliability performance mechanisms
RPP	reliability planning process
RPS	renewable portfolio standard
RRAP	Regional Resiliency Assessment Program
RTM	real-time market
RTO	Regional Transmission Organization
SAF	Sustainable Aviation Fuel
SAIFI	System Average-Interruption Frequency Index
SCADA	Supervisory Control and Data Acquisition
SCR	special case resource
SDVOB	Service-Disabled Veteran-Owned Businesses
SEPA	State Emergency Preparedness Assessment
SEPB	State Energy Planning Board
SEQRA	State Environmental Quality Review Act
SGIPA	Smart Growth Infrastructure Policy Act
SHMP	State Hazard Mitigation Plan
SIR	Standardized Interconnection Requirements
SMR	Small Modular Reactors
SMS	Statewide Mobility Services
SNAP	Supplemental Nutrition Assistance Program
SNF	spent nuclear fuel
SO_2	sulfur dioxide
SOV	single-occupant vehicles
SPR	State Preparedness Report
SSP	Shared Socioeconomic Pathway
STARS	Short-Term Assessment of Reliability

SUNY	State University of New York
SWAP	State Wildlife Action Plan
SWC	Soil and Water Conservation
TANF	Temporary Assistance for Needy Families
TBtu	trillion British thermal units
TCL	Transportation Corporations Law
TCO	Total Cost of Ownership
TEDO	Tribal Energy Development Organization
TEN	thermal energy network
th	therms
THIRA	Threat and Hazard Identification and Risk Assessment
TIM	Traffic incident management
TMA	Transportation Management Area
TO	transmission owner
TOD	transit-oriented development
TOP	transmission operator
TOU	time of use
TRL	technology readiness level
TSMO	Transportation System Management and Operations
TW	terawatt
TWG	Technical Working Group
TWh	terawatt-hour
UAS	unmanned aircraft systems (aka drones)
ULSD	ultra-low sulfur diesel
UNC	University of North Carolina
UNFCCC	United Nations Framework Convention on Climate Change
UPV	Utility-Scale Solar Photovoltaics
USACE	U.S. Army Corps of Engineers
USCA	United States Climate Alliance
USDA	United States Department of Agriculture
USGBC	U.S. Green Building Council
USGCRP	U.S. Global Change Research Program
USS	utility security section
UTEN	United Thermal Energy Network
UTENJA	Utility Thermal Energy Network and Jobs Act
V2B	Vehicle to building
V2G	vehicle to grid
VDER	value of distributed energy resource
VGI	vehicle grid integration

VMT	vehicle miles traveled
VOC	volatile organic compound
VPP	virtual power plant
WAP	Weatherization Assistance Program
WARN	Worker Adjustment and Retraining Notification
WQC	water quality certification
ZAPPA	Zip-Code Air Pollution Policy Analysis Tool
ZEC	zero-emissions credit
ZEV	zero-emission vehicle

Glossary of Key Terms

Active Transportation
Active Transportation includes human-powered modes of transportation—walking, bicycling, and operating a wheelchair—along with small-scale electric vehicles such as e-bikes and e-scooters (also known as “micromobility”).

Adaptation
In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; the process by which a system moves toward resilience.

Advanced Clean Cars II (ACC II)
A regulation adopted by New York State that will require all new passenger cars and trucks sold in New York State to be zero-emissions by 2035.

Advanced Clean Trucks (ACT)
A regulation adopted by New York State that requires manufacturers of vehicles greater than 8,500 pounds to sell an increasing number of zero-emission vehicles (ZEVs) in New York State.

Agricultural Sector
Grows crops, raises livestock, and harvests plants and animals from their natural habitats.

Agrivoltaics
The simultaneous use of land for solar photovoltaic power generation and agricultural production of crops, livestock, and livestock products.

Alternative Fuels
Alternative Fuels: Liquid or gaseous fuel derived from biomass or clean energy such as biodiesel, renewable natural gas (RNG), renewable diesel, hydrogen, sustainable aviation fuel (SAF), and synthetic fuels.

Apprenticeship Utilization
A requirement that a certain percentage of labor hours for a given project be performed by Registered Apprentices.

Biogas
Biogas is gas resulting from the decomposition of organic matter, most commonly under anaerobic conditions (such as in a landfill, manure storage, or wastewater recovery facility). The principal constituents are methane and carbon dioxide. Some end-uses can use biogas directly as a fuel source with minimal processing, though its lower energy density and purity compared to conventional natural gas or renewable natural gas precludes it from most end-uses.

Biofuel
Fuels produced from biomass such as plants or organic wastes.

Biodiesel
Biodiesel is produced from vegetable oils, animal fat, and recycled cooking oil. It is a liquid fuel that can be blended with conventional diesel but cannot entirely replace it. Biodiesel can be blended in most applications that use diesel.

Brownfield Opportunity Area Program
Created to support community planning for the reuse and redevelopment of known or suspected contaminated areas.

Brownfield
A former industrial or commercial site where future use is affected by real or suspected environmental contamination.

Building Shell Upgrades
Upgrades to a building protecting the interior from outside temperatures and moisture to cut energy use and enhance indoor comfort through measures such as air sealing, insulation, and window upgrades. Also called building envelope upgrades.

Bulk Power System
Operated by the New York State Independent System Operator (NYISO), which generally consists of transmission lines operating at 230 kilovolt (kV) and above and certain lower voltage facilities, which the NYISO manages to ensure system reliability. The bulk power system in New York State consists of approximately 4,100 miles of high-voltage transmission lines.

Bulk Terminal
Petroleum facility designed for the storage and distribution of refined petroleum fuels such as heating oil, motor gasoline, diesel and other products.

Capacity Factor (in the context of power generation)
Measures the ratio of a power plant's actual generation relative to the maximum amount it could generate annually if producing at full capacity without any interruption.

Carbon Capture Utilization and/or Storage (CCUS/CSS)
Technologies capture carbon dioxide (CO_2) emissions from large sources, like power plants and industrial facilities, or directly from the atmosphere, which is then either repurposed or stored. Also called carbon capture and sequestration.

City Gate
The point at which gas utilities or local distribution companies take operational responsibility for safely and reliably transporting gas to customers.

Clean Energy Worker (Job)
Any energy worker (job) that is directly involved with work related to the following clean energy sectors: renewable electric power generation; grid modernization and energy storage; building decarbonization and energy efficiency; renewable fuels; and clean and alternative fuels transportation.

Climate Act
New York's Climate Leadership and Community Protection Act (Climate Act) was signed into law in July 2019.

Climate Justice
Justice that links development and human rights to achieve a human-centered approach to addressing climate change, safeguarding the rights of the most vulnerable people and sharing the burdens and benefits of climate action and its impacts equitably and fairly.[1]

Climate Justice Working Group (CJWG)
This body was created by the Climate Act and is composed of representatives from environmental justice communities across the state, including three from New York City, three from rural areas, and three from urban communities in upstate New York. It also includes

1 "Principles of Climate Justice," Mary Robinson Foundation – Climate Justice, https://www.mrfcj.org/principles-of-climate-justice/, accessed December 8, 2025.

representatives from the New York State Departments of Environmental Conservation (DEC)—which chairs the CJWG—Health (DOH), Labor (DOL), and the New York State Energy Research and Development Authority (NYSERDA).[2] The Climate Act requires the CJWG to establish criteria to identify disadvantaged communities for the purposes of: (1) emissions reductions (greenhouse gases and co-pollutants), (2) regulatory impact statements, and (3) the allocation of investments related to the Climate Act.[3]

Climate Mitigation
A human intervention to reduce emissions or enhance the sinks of greenhouse gases. (See also "Greenhouse Gas Mitigation").

Climate Resilience
A system's ability to anticipate, prepare for, respond to, recover from, and adapt to a disruption, such as an extreme climate hazard, with minimum damage to social well-being, public health, the economy, and the environment.

Combustion (in the context of power generation)
Generators that burn fuel, often gaseous or liquid, to produce electricity. Within the State Energy Plan, potential combustion fuels include natural gas, renewable natural gas, fuel oil, and hydrogen.

Commercialization
Commercialization programs help bring beneficial energy technologies and services to market through technical assistance, financing, customer discovery, and further product development.

Community Air Monitoring (CAM) Initiative
The Climate Act required DEC to develop a CAM program to identify and measure air pollution in priority DAC locations that have the highest potential exposure burdens to air pollutants.[4] DEC used mobile air monitoring to conduct street-by-street assessments in ten disadvantaged communities. Using these results, community input, and other data, DEC is identifying air pollution sources and prioritizing areas of concern near sensitive sites such as schools and nursing homes. To guide this process, DEC established Community Advisory Committees (CACs) in each of the ten disadvantaged communities. These CACs will collaborate with DEC, the CJWG, and other state agencies to develop strategies aimed at reducing air pollution in disadvantaged communities.

2 N.Y. ECL § 75-0115 (2019).
3 N.Y. ECL § 75-0111(1)(b).
4 N.Y. ECL § 75-0115 (2019)

Community Lifelines
The most fundamental services in the community that, when stabilized, enable all other aspects of society to function. They include Safety and Security; Health and Medical; Energy; Communications; Transportation; Food, Hydration, Shelter; Hazardous Materials and Water Systems.

Consequence
The effect of the loss or degradation of an energy infrastructure asset on energy supply or service, and the associated indirect impacts of those losses on society.

Conventional Fuels
The fossil fuel that is typically used today, such as conventional diesel, conventional jet fuel, conventional natural gas.

Co-Pollutant Emissions
Air pollutants that are a byproduct from combustion of fossil fuels and most alternative fuels. These include fine particulate matter ($PM_{2.5}$), nitrogen oxides (NO_X), volatile organic compounds (VOC), sulfur dioxide (SO_2), and various toxic compounds. These pollutants contribute to a range of health issues, including respiratory conditions, asthma, heart attacks, and other serious illness.

Cross-Sector Interdependency
One energy sector (electricity, gas or liquid fuel) relying on another energy sector; for example, the electric sector has a cross-sector interdependency with the natural gas sector.

Decommissioning
The final process of safely closing and dismantling a facility or equipment after its operational life such as a power plant, nuclear facility, or natural gas infrastructure.

Demand Response
Programs that encourage customers to reduce consumption during periods of high demand, sometimes by shifting demand from high load periods to periods of lower demand. These programs are typically administered by utilities.

Design Day Demand
The expected consumption of natural gas by a gas utility's firm service customers on a design day.

Direct Entry Program
New-York-State-approved apprenticeship preparation programs that can help workers get the skills they need to meet the minimum requirements of a New York State Registered Apprenticeship program. Successful participants have a direct opportunity to interview with a sponsor of a New York State Registered Apprenticeship Program. Direct Entry providers are required to have agreements with New York State Registered Apprenticeship program sponsors to ensure the availability of jobs with those sponsors. Direct Entry Programs cannot charge tuition.[5]

Disadvantaged Communities
The Climate Act defines disadvantaged communities as communities that bear burdens of negative public health effects, environmental pollution, impacts of climate change, and possess certain socioeconomic criteria, or comprise of high-concentrations of low- and moderate-income households. Disadvantaged communities are identified using criteria as established by the Climate Justice Working Group.[6] On March 27, 2023, the Climate Justice Working Group voted to approve the disadvantaged community criteria.[7] Indigenous Nations and Indigenous Peoples are included in the disadvantaged community criteria as individual members of census tracts as counted by the U.S. Census Bureau in counts of American Indian and Alaska Native population (a selected indicator) and as citizens of sovereign Nations or residents of Nation-owned territory if the Nation-owned territory (either sovereign territory or owned) exceeds five percent of the area of a census tract.

Dispatchable Emissions-Free Resources (DEFRs)
Firm electric generation resources that can be rapidly turned on or off, or adjusted as needed, to meet electricity demand with low to no emissions. Note a formal definition of eligibility is still being developed in the Public Service Commission (PSC) Zero by 40 Proceeding. These may be needed to provide electricity during extended periods of high demand and/or low renewable generation, such as winter weeks with increased heating loads from heat pumps coupled with lower renewable output, when short-duration storage would be insufficient to meet demand. Some DEFRs can also provide zero-emission energy outside of challenging days and weeks.

Distributional Equity
Refers to the fair distribution of the benefits and burdens of energy policies and programs.

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5 "Apprenticeship Direct Entry," DOL, accessed July 1, 2025, https://dol.ny.gov/direct-entry.
6 N.Y. ECL § 75-0101(5) (2019).
7 "Disadvantaged Communities Criteria," New York State Climate Act, https://climate.ny.gov/Resources/Disadvantaged-Communities-Criteria, accessed December 5, 2025.

In an equitable energy system, all communities receive a fair share of clean energy investments, job opportunities, cost savings, and pollution reductions.[8]

Ecosystem
A dynamic complex of plant, animal (including human), and microorganism communities interacting with each other and the nonliving environment as a functional unit.

Ecosystem Services
Benefits people obtain from an ecosystem.

Efficient Electric Heat Pumps
Include ground source heat pumps and heat pump water heater systems that meet or exceed the U.S. Environmental Protection Agency's ENERGY STAR specification, as well as cold climate air-source heat pumps, packaged terminal heat pumps, and variable refrigerant flow products that meet or exceed standard specifications for heat pumps that are best suited to heat efficiently in cold climates.

Efficient Electrification
Electrification of a building with an adequately efficient thermal envelope to conserve energy use, keep occupants comfortable, and enable an efficient electric heat pump system to operate effectively.

Electric Peak Demand
The highest actual average hourly load that occurred during a calendar year. Given that the electric transmission and distribution systems are designed and built to serve peak load, reducing peak demand is important for improving system efficiency, reducing wholesale electricity prices, and delaying the need for additional infrastructure.

Electric Vehicles (EVs)
Vehicles powered by electricity from an external source stored onboard in a battery, including both battery-electric vehicles (BEVs), which run exclusively on electricity, and plug-in hybrid electric vehicles (PHEVs), which run exclusively on electricity for a limited range and then are powered by an internal combustion engine.

Embodied Emissions
The total greenhouse gas emissions generated throughout the entire life cycle of a product,

8 American Council for an Energy-Efficient Economy, Energy Equity: Conceptual Framework, January 2021, https://www.aceee.org/research-report/e2101.

particularly emphasizing the stages before its operational use. This includes the extraction of raw materials, manufacturing, transportation, construction, and disposal at the end of its life.

Emergency
A serious, unexpected, and often dangerous situation requiring immediate action.

Endangered
Under the Endangered Species Act (ESA), plant and animal species that may be in danger of extinction throughout all or a significant portion of their range.

Energy Burden
Percentage of gross income that a household spends on energy. It is calculated by dividing the average housing energy cost by the average annual household income. When a household is described as energy burdened, that generally means it spends more than six percent of household income on energy.[9]

Energy Insecurity
The inability to meet basic energy needs. It may mean having to choose between energy and other expenses, keeping your house at an unsafe or unhealthy temperature to save expenses, or being unable to pay energy bills.

Energy Justice
The goal of achieving equity in both the social and economic participation in the energy system, while also remediating social, economic, and health burdens on those communities historically disadvantaged by the energy system. Energy justice in New York centers the concerns of disadvantaged communities and aims to make energy more accessible, affordable, clean, and democratically managed for all communities. The practitioner and academic approaches to energy justice emphasize these process-related and distributive justice concerns.[10]

Environmental Justice
The fair treatment and meaningful involvement of all people regardless of race, color, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including a racial, ethnic, or socioeconomic group, should bear a disproportionate share of the negative

9 "Low-Income Energy Affordability Data (LEAD) Tool" U.S. Department of Energy, https://www.energy.gov/scep/low-income-energy-affordability-data-lead-tool, accessed December 8, 2025.
10 "Section 1 – Defining Energy Justice: Connections to Environmental Justice, Climate Justice, and the Just Transition," Initiative for Energy Justice, n.d., https://iejusa.org/section-1-defining-energy-justice/.

environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies.[11]

Energy Security Planning and Emergency Preparedness
Plans and actions that ensure a reliable and resilient supply of energy that protects public health, safety, and welfare while minimizing economic disruption. Energy Security Planning identifies, assesses, and mitigates risks to energy infrastructure and plans for, responds to, and recovers from events that disrupt energy supply. New York State Energy Emergency Preparedness includes energy emergency planning and response as well as energy security risk and mitigation planning through the New York State Energy Emergency Plan and the New York State Energy Security Plan.

Energy Worker (Job)
Any worker (job) that is directly involved with the research, development, production, manufacture, distribution, sales, implementation, installation, maintenance, or repair of components, goods, or services related to the energy system. These workers also include supporting services including but not limited to consulting, finance, tax, and legal services related to energy.

Fine Particulate Matter ($PM_{2.5}$)
Airborne particles less than 2.5 micrometers in diameter, can travel into the lungs, infiltrate the bloodstream, and cause cardiovascular and respiratory health effects. $PM_{2.5}$ is directly emitted from combustion sources (primary $PM_{2.5}$) and also forms in the atmosphere through reactions of precursor pollutants, including nitrogen oxides (NO_X), sulfur dioxide (SO_2), ammonia (NH_3), and volatile organic compounds (VOCs).

Firm Service
Service for natural gas customers who lack alternatives to natural gas consumption and require uninterrupted delivery of gas. Residential and small commercial customers typically receive firm gas service.

Fossil Fuel Workers (Jobs)
Any energy worker (job) that is directly involved with work related to energy derived from fossil fuels, including electric generation, delivered fuels, internal combustion vehicles, and natural gas distribution.

11 Commissioner Erin M. Crotty "Commissioner Policy 29, Environmental Justice and Permitting," (NYSDEC, last updated March 19, 2003), https://dec.ny.gov/regulatory/guidance-and-policy-documents/commissioner-policy-29-environmental-justice-and-permitting.

Fossil Fuels
Fuels produced from the decay of prehistoric organic materials. These fuels can be liquid (example: petroleum) or gaseous (example: natural gas).

Green Infrastructure
Measures that strategically utilize plantings, soils, and other media to capture and treat stormwater by relying on the natural processes of filtration, infiltration, and evapotranspiration.[12] Green Infrastructure can also help cool communities and mitigate the urban heat island effect.[13]

Greenhouse Gas Mitigation
A human intervention to reduce emissions or enhance the sinks of greenhouse gases. (See also "Climate Mitigation").

Greenhouse Gas
Gases that trap some of the Earth's outgoing energy, thus retaining heat in the atmosphere. This heat trapping, known as the greenhouse gas effect, alters climate and weather patterns at global and regional scales. Greenhouse gases include carbon dioxide, methane, nitrous oxide, and certain synthetic chemicals, such as fluorocarbons and sulfur hexafluoride.

Hazard Mitigation
Any sustained action taken to reduce or eliminate long-term risk to life and property from hazard events. It is an on-going process that occurs before, during, and after disasters and serves to break the cycle of damage and repair in hazardous areas. More generally, mitigation is the action of reducing the severity, seriousness, or painfulness of a risk.

Home Rule
The Home Rule form of government exercised by local governments (counties, cities, towns, and villages) is authorized by Article IX of the New York State Constitution.[14] as implemented through the enactment of statutes like the Statute of Local Governments and the Municipal Home Rule Law. Statutes like these outline and otherwise grant a range of powers and the procedures for their exercise, including the ability of cities, towns, and villages to regulate land use and zoning and the ability of all local governments to enact local laws, undertake comprehensive planning, own and maintain municipal property and roadways, and levy local

12 "About Green Infrastructure," U.S. Environmental Protection Agency, (EPA), February 13, 2025, https://www.epa.gov/green-infrastructure/about-green-infrastructure.
13 "Reduce Heat Islands," U.S. EPA, April 22, 2025, https://www.epa.gov/green-infrastructure/reduce-heat-islands.
14 N.Y. Const. art. IX, § 2, https://dos.ny.gov/system/files/documents/2025/01/constitution-january-1-2025.pdf.

taxes. Because cities, towns, and villages control most zoning and land use decisions, the State typically assumes an advisory and funding role with land use planning.

Household Income Strata

- **Low-income** includes households with incomes at or below 60 percent of State Median Income.
- **Moderate-income** includes households with incomes above 60 percent but below 80 percent of State Median income or Area Median Income, whichever is higher.
- **Average income** uses the average income of a household in an analysis region to represent households with incomes that fall above the low- or moderate-income range.

Hybrid Heat Pump

A heat pump system installed that is not sized to meet the full heating load of the building, requiring the use of a supplemental heating system during the coldest hours of the year.

Hydrogen

Hydrogen is an energy carrier that is typically produced via thermal processes, using high temperatures, or electrolytic processes, using water and electricity. Hydrogen can be used for many end-uses and is either combusted or used in fuel cells to provide electricity. Hydrogen can also be converted to synthetic fuels (see below) Hydrogen is only considered a zero-emission fuel if its production does not include the use of fossil fuels (e.g., electrolysis powered by renewable energy).

Indigenous Knowledge

A body of observations, oral and written knowledge, innovations, practices, and beliefs developed by Indigenous peoples through interaction and experience with the environment. It is applied to phenomena across biological, physical, social, cultural, and spiritual systems. Indigenous knowledge can be developed over millennia, continues to develop, and includes understanding based on evidence acquired through direct contact with the environment and long-term experiences, as well as extensive observations, lessons, and skills passed from generation to generation.[15] Coordination with Indigenous Nations, and the respectful incorporation of Indigenous knowledge should honor Indigenous Nation sovereignty.

Indigenous Nations

Refers to any State- or federally-recognized Indigenous Nations (as indicated on the New York State Office of Parks, Recreation & Historic Preservation “Indigenous Nation Areas of

15 “Overview—Indigenous Knowledge and Traditional Ecological Knowledge,” U.S. National Park Service, last modified June 26, 2024, https://www.nps.gov/subjects/tek/description.htm

Interest in New York State" map[16]), Nation-owned parcels, current reservation boundaries, or lands held in trust by the federal government for that Indigenous Nation. Nine Indigenous Nations reside within, or have common geographic borders with, New York State: Cayuga Nation, Oneida Indian Nation, Onondaga Nation, Saint Regis Mohawk Tribe, Seneca Nation of Indians, Shinnecock Indian Nation, Tonawanda Seneca Nation, Tuscarora Nation, and Unkechaug Indian Nation. The United States formally recognizes all but the Unkechaug Nation. The State of New York recognizes all nine Nations.[17]

Industrial Sector
Businesses focused on the mass production of goods, often involving machinery, technology, and a significant workforce.

Innovation Ecosystem
Innovation ecosystems are communities of interacting stakeholders engaged in producing, enhancing, and creating novel methods, products, and processes.

Installed Capacity
The amount of electric power that can be generated in the state.

Installed Reserve Margin
The amount of generation capacity that must be in place to ensure an acceptable level of reliability. The IRM is measured by the amount of generation and other capacity resources above 100% of forecasted peak load that must be available to serve all customers without interruption.

Interruptible Service
Service for natural gas customers who can employ an alternative fuel or cease consumption of natural gas entirely when requested to do so by the gas utility (often at a particular cold temperature threshold). Customers receiving interruptible service pay reduced distribution rates.

Intra-Sector Interdependency
One part of an energy sector (electricity, gas or liquid fuel) relying on or controlled by another part of the energy system within the same sector; for example, the liquid fuel inventory in

16 "Indigenous Nation Areas of Interest in New York State" New York State Office of Parks, Recreation & Historic Preservation , last updated August 2024, https://www.arcgis.com/home/item.html?id=59341d9537b54e439e2581e5ef468ad2.

17 New York State Climate Justice Working Group (CJWG) and New York State Department of Environmental Conservation (NYSDEC), 2023 Disadvantaged Communities Criteria Final Report, (New York State Climate Action Council, January 14, 2025), https://climate.ny.gov/-/media/Project/Climate/Files/Disadvantaged-Communities-Criteria/Technical-Documentation-on-the-Disadvantaged-Communities-Criteria---Final-Version.pdf.

New York has an intra-dependency with refinery production and pipeline operations in the Gulf states.

Investment/Production Tax Credit (ITC/PTC)
U.S. federal tax credits designed to promote clean energy development. The ITC provides a tax credit based on a percentage of the upfront investment cost to build eligible renewable energy projects. The PTC offers a tax credit based on the amount of electricity a qualifying renewable facility generates over time. Credits deployed and extended under the Inflation Reduction Act have since been significantly changed as a result of H.R. 1.

Joint Utilities (JU)
The Joint Utilities are comprised of Central Hudson Gas and Electric Corporation, Consolidated Edison Company of New York, Inc. ("Con Edison"), New York State Electric & Gas Corporation, Niagara Mohawk Power Corporation d/b/a National Grid ("National Grid"), Orange and Rockland Utilities, Inc. and Rochester Gas and Electric Corporation. Together, the Joint Utilities provide electric service to over 13 million households, businesses, and government facilities across New York State.

Labor Peace Agreement
Agreements between employers and a union limiting certain actions from both sides for a specified period of time. Labor peace agreements may require management to remain neutral and not interfere in any union organizing, and the union to avoid strikes or other activities that could seriously interrupt workplace operations.[18]

Life Cycle Analysis (LCA)
Evaluates the potential environmental impacts associated with a product, process, or service throughout its entire life cycle.

Light Water Reactors (LWRs)
A term used to describe reactors using ordinary water as a moderated coolant.[19]

Light-Duty Vehicles
On-road vehicles under 8,500 lbs. gross vehicle weight rating (GVWR), Class 1 and 2a, per the U.S. Environmental Protection Agency (US EPA) classification system.

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18 "Climate Jobs Institute," School of Industrial and Labor Relations at Cornell University, accessed July 20, 2025, https://www.ilr.cornell.edu/climate-jobs-institute.

19 U.S. Nuclear Regulatory Commission (NRC). Glossary. https://www.nrc.gov/reading-rm/basic-ref/glossary.html#S

Liquid Fuels
Another name for delivered fuels. A group of fuels that, at surface temperatures, are in the liquid phase with little or no pressurization, as a result, these fuels can be transported by a variety of modes.

Load Factor
Load factor is a measure of the degree of uniformity of demand over a period of time, usually one year, and equivalent to the ratio of average demand to peak demand expressed as a percentage. It is calculated by dividing the total energy provided by a system during a period by the product of peak demand during the period and the number of hours in the period.[20]

Load Serving Entity
A retail electric service provider (e.g., a utility) that is obligated to procure or purchase wholesale electricity to serve its end-use customers.

Local distribution company
A gas utility. LDCs are responsible for building and maintaining a local pipeline system that delivers natural gas to end use customers, such as businesses and homes, after receiving gas from a transmission pipeline at the city gate or another source.

Location-efficient Areas
Compact and resilient neighborhoods that offer walkability, a mix of uses, proximity to daily destinations, and reduced reliance on automobiles.

Low-carbon Fuels and Energy Sources
Produce significantly fewer greenhouse gas emissions during their lifecycle compared to traditional fossil fuels.

Managed Charging
The practice of controlling the speed and/or time at which an EV is charged for the purpose of minimizing charging during times of peak electricity usage and minimizing charging costs for the EV driver.

Manufacturing Sector
Encompasses firms that transform raw materials into finished goods.

20 North American Energy Standards Board Wholesale Electric Industry Glossary.

Medium- and Heavy-Duty Vehicles
On-road vehicles over 8,500 lbs. gross vehicle weight rating (GVWR), Class 2b through 8, per the U.S. Environmental Protection Agency (US EPA) classification system.

Megawatt Electrical
The electric output capability of a power plant.

Microcredentials
Flexible and compact academic credentials created to meet specific workforce needs that are taught by faculty. Often credit bearing, these empower individuals with essential skills, knowledge and practical experience in high-demand fields and are designed to be stackable and build into degrees.

Micromobility
Any low-speed, human or electric-powered transportation device, including bicycles, scooters, electric-assist bicycles (e-bikes), electric scooters (e-scooters), and other small, lightweight, wheeled conveyances.

New York Control Area
The New York Control Area (NYCA) is comprised of eleven geographic zones (also referred to as "load zones") from western New York (Zone A) through Long Island (Zone K).[21]

New York State Energy Emergency Plan
An emergency response plan outlining State activities and responsibilities in response to an energy emergency. The scope includes emergency response planning and coordination with federal and industry partners; it does not identify the major risks to the current energy system or include longer-term resilience or mitigation activities. It is an annex to the State's Comprehensive Emergency Management Plan.

New York State Energy Security Plan
A plan focused on identifying and protecting the state energy systems by providing a detailed, comprehensive risk assessment of critical energy infrastructure and cross-sector interdependencies and providing a framework for evaluating risk mitigation approaches to enhance reliability and end-use resilience.

Nuclear Generations
Nuclear technology discussions often refer to "generations" of nuclear designs, with current

21 New York Independent System Operator (NYISO) Comprehensive Reliability Plan. 2023. https://www.nyiso.com/documents/20142/2248481/2023-2032-Comprehensive-Reliability-Plan.pdf

operating large LWRs referred to as “Gen II” or “Gen III.” Newer advanced technologies are categorized as either “Gen III+,” defined as large or small modular light water reactors that offer improved economics and safety over conventional large light water reactors, or “Gen IV,” defined as small modular reactors (SMRs) or microreactors that offer improved sustainability, economics, safety, and proliferation and use non-water coolants. Gen IV technologies include high temperature gas reactors, liquid sodium metal reactors, and molten salt reactors.

Operational Flow Order
A mechanism used in the natural gas industry to manage and maintain the operational integrity of a pipeline system. It requires shippers to balance their gas supply with their customers’ usage on a daily basis, within a specified tolerance band, to prevent system imbalances and potential operational issues.

Ozone
A respiratory irritant when it reaches elevated concentrations in surface air. Ozone is not emitted directly into the air, rather it is produced by chemical reactions between NO_X and VOCs in the presence of sunlight. Ozone is most efficiently formed on hot sunny days in areas with high concentrations of emission sources.

Pathways Model
An economy-wide stock rollover model that calculates stocks, sales, energy use, and greenhouse gas emissions from transportation, buildings, industry, and other sectors, and captures interactions among measures to create a detailed picture of the energy system through 2050.

Petroleum Fuels
Another name for crude oil. This liquid extracted from wells is a mixture of organic molecules that can be separated into specific fuels through a refining process. Petroleum fuels include fuels such as diesel, gasoline, kerosene, and propane.

Phased Electrification
Projects wherein the building electrification process is carried out over time. This staged approach aims to electrify most or all a building’s energy systems while minimizing disruptions to building operations and occupant experience. This may be a multifamily or commercial building where certain units of the building are converted to electric heat pumps for space heating (e.g., at the time of tenant turnover), or as part of a phased more comprehensive renovation project. This may also result in instances where full electrification of the building may not be possible due to available electric capacity or limitations related to customers’ capital cycles.

Pre-apprenticeship Program
Programs or a set of services designed to prepare individuals to enter and succeed in an apprenticeship program. By definition, a pre-apprenticeship program has a documented partnership with at least one apprenticeship program. Pre-apprenticeships help individuals meet the entry requirements for apprenticeship programs and ensure they are prepared to be successful in their apprenticeship.[22]

Prevailing Wage
A wage standard required by federal and State law for publicly funded or publicly assisted projects. Prevailing wages define the hourly wages, benefits, and overtime rates for a particular geographic area, for a particular trade, as determined by the United States Department of Labor or the New York State Department of Labor (DOL). In New York State, the DOL's Bureau of Public Work and Prevailing Wage Enforcement is responsible for enforcement of state prevailing wage requirements.[23]

Priority Populations
These include veterans; individuals with disabilities; low-income individuals, whose household's total income is below or at 60 percent of the State Median Income or whose household has been determined eligible for or is receiving assistance through the Home Energy Assistance Program, Temporary Assistance for Needy Families, Supplemental Nutrition Assistance Program, or other human service benefit programs; incumbent or unemployed fossil fuel workers; previously incarcerated individuals; 16- to 24-year-olds who are enrolled in or have completed a comprehensive work preparedness training program such as those offered by Boards of Cooperative Education Services, technical high schools, Conservation Corps, YouthBuild, and AmeriCorps; homeless individuals; and single parents.[24]

Procedural Equity
Fair and transparent processes used for decision-making, resource allocation, and policy development. Decision makers create inclusive and accessible processes for developing and implementing clean energy programs such that all stakeholders have equitable access to participate.[25]

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22 "Workforce Development and Training Definitions," New York State Energy Research and Development Authority (NYSERDA), 2025, https://www.nyserda.ny.gov/All-Programs/Clean-Energy-Workforce-Development-and-Training/Resources/Definitions.
23 "Bureau of Public Work and Prevailing Wage Enforcement," New York State Department of Labor (DOL), accessed July 20, 2025, https://dol.ny.gov/bureau-public-work-and-prevailing-wage-enforcement.
24 Workforce Development and Training Definitions," NYSERDA, 2025.
25 American Council for an Energy-Efficient Economy, Energy Equity: Conceptual Framework, January 2021, https://www.aceee.org/research-report/e2101.

Project Labor Agreement
Labor Law §222(1) provides that a project labor agreement (PLA) is a pre-hire collective bargaining agreement between a contractor and a bona fide building and construction trade labor organization establishing the labor organization as the collective bargaining representative for all persons who will perform work on a public work project, and which provides that only contractors and subcontractor who sign a pre-negotiated agreement with the labor organization can perform work.

RECAP Model (Resource Adequacy)
A loss-of-load-probability model designed to evaluate the resource adequacy of electric power systems, including systems with high penetrations of renewable energy and other dispatch-limited resources such as hydropower, energy storage, and demand response.

Regional Planning Commission
(Also referred to as a committee, board, or council) is a quasi-governmental body that supports municipalities within a defined region by providing planning, coordination, and technical assistance. These organizations help local governments, often facing capacity constraints, address issues that cross jurisdictional boundaries, including transportation, land use, environmental sustainability, economic development, and regional infrastructure.[26]

Registered Apprenticeship Program
Programs that offer standardized training for workers to learn the skills and abilities they will need to be a fully functioning journey worker in a specific trade/occupation. They utilize an "earn-while-you-learn" model, including a minimum of 2,000 hours of paid on-the-job training combined with related instruction, often provided in a classroom and/or lab setting. They can be operated by a single employer or a group of employers, and with or without the participation of a labor union. In New York State, programs must be registered with the New York State Department of Labor.[27]

Reliability
The energy system's ability to function consistently during normal conditions. In many cases, adaptation strategies that improve resilience also have the benefit of improving reliability.

Renewable Diesel
Renewable diesel is interchangeable with conventional diesel. It is typically produced by

26 A list of regional planning commissions within New York State can be found at https://dos.ny.gov/planning-organizations
27 "Registered Apprenticeship: A Different Kind of Higher Ed.," DOL, accessed July 2, 2025, https://dol.ny.gov/apprenticeship/overview.

hydrotreating, combining fats and hydrogen at high temperatures. Renewable diesel can be used as a drop-in replacement for any application that uses diesel.

Renewable Natural Gas
Renewable natural gas (RNG) is biogas that has been processed and upgraded to a higher methane content with less impurities and can be used as a drop-in replacement of natural gas in end-uses such as the power sector, industrial processes, buildings, and transportation.

Research, Development, and Demonstration (RD&D)
RD&D includes basic and applied research, development of new products or services (including modification to existing products, services), and demonstration of benefits and risks in a real-world setting.

Resilience
The capacity to withstand or to recover quickly from negative events such as natural disasters, climate change, and other threats/hazards.

RESOLVE Model (Capacity Expansion)
An electricity resource planning model that identifies optimal long-term electric generation and transmission investments subject to reliability, policy, and technical constraints.

Resource Efficient Decarbonization
A phased approach to eliminating greenhouse gas emissions from large buildings in cold climates that creates a path toward cost-effective decarbonization.

Risk
The potential for the loss or degradation of energy supply or services, and the associated indirect impacts of those losses on society, resulting from the exposure of energy infrastructure to a threat.

Risk Mitigation Strategy
A proactive approach to enhance the State's energy reliability and end-use resilience through which Risk Mitigation Measures are identified, evaluated, and potentially prioritized for implementation.

Sales Share (in the context of the Pathways model)
The percent (%) of building or transportation stock units purchasing equipment in a given year that adopt the target technology (e.g., residential housing units purchasing equipment in a given year that adopt the target technology such as high-efficiency heat pumps as the primary heating system or efficient shell packages).

Sensitivity (in the context of the Pathways model)
A modeling case built off an existing scenario with a targeted variable(s) changed to explore specific questions on the future of the energy system. Examples of sensitivities run for the Final State Energy Plan include "Zero Carbon Firm" and "Federal Policies" sensitivities. These differ from the scenarios within the model that change multiple variables to reflect potential energy futures of these updated variables acting at the same time.

Small Modular Reactors (SMRs)
Smaller, more advanced nuclear reactors that offer improved sustainability, economics, safety, and proliferation and use non-water coolants.

Smart Growth
An approach to planning and development that supports and integrates equity, economic vitality, environmental sustainability, energy, public health, healthy aging, and climate resilience to create livable, sustainable communities for people of all ages, incomes, backgrounds, and abilities.[28, 29]

Spot Market / Spot Price
A market where assets are traded for immediate delivery and payment. (As contrasted with futures markets, where transactions are settled at a future date).

Sprawl
The development of low-density, automobile-dependent development that spreads beyond urbanized areas into rural and natural landscapes. It often results in inefficient land use and loss of agricultural and open lands while also stretching and straining water, transportation, and energy infrastructure, as well as other municipal services.

Stock Share (in the context of the Pathways model)
The percent (%) of building or transportation stock units that are present in the economy in a given year, as a percentage of the total building or transportation stock units of a given category (e.g., the number of light-duty battery electric vehicles on the roads as a share of total light-duty vehicles on the road).

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28 These Smart Growth principles guide the New York State Department of State's Smart Growth Community Planning Program and are informed by the original principles developed by the Smart Growth America Network and the criteria outline in the State Smart Growth Public Infrastructure Policy Act

29 Smart Growth Network and U.S. Environmental Protection Agency, This Is Smart Growth, April 2014, https://www.epa.gov/sites/default/files/2014-04/documents/this-is-smart-growth.pdf; State Smart Growth Public Infrastructure Criteria, New York State Senate, Environmental Conservation, Chapter 43-B, § 6-0107 (2015), https://www.nysenate.gov/legislation/laws/ENV/6-0107.

Strike Price
A predetermined fixed price at which the owner of an option can buy or sell an underlying asset.

Subsidized Affordable Housing
Housing that is affordable because of government subsidy. This can include, but is not limited to, housing units receiving support under the U.S. Department of Housing and Urban Development programs (e.g., Section 8 Housing Choice Voucher, tenant-based vouchers, project-based vouchers, and HOME), including units owned or overseen by Public Housing Authorities.

Supplemental Heat
A heating system that is installed or left in place to complement a heat pump heating system that is not sized to meet the full heating load of the building, providing heat to supplement the main heating system during the coldest hours of the year.

Sustainable Aviation Fuel (SAF)
Sustainable Aviation Fuel is typically produced from biomass waste and fats/greases/oils. It is a newer alternative fuel that can be blended with conventional jet fuel.

Synthetic Fuel
Synthetic fuels are produced by combining hydrogen and carbon dioxide using renewable energy. Synthetic natural gas and other liquid synthetic fuels such as renewable diesel and SAF can be produced.

Thermal Energy Network
A network of equipment and pipes that connects multiple buildings together to thermal energy sources such as geothermal, surface water, waste heat, and the air, to provide space heating, cooling, and domestic hot water. This technology can be an effective way to reduce energy costs and greenhouse gas emissions from a set or groups of buildings at scale.

Threat
Anything that can damage, destroy, or disrupt energy systems, including natural, technological, human/physical, and cybersecurity events.

Threatened
Under the Endangered Species Act, plant and animal species that are likely to become endangered within the foreseeable future.

Transit-Oriented Development (TOD)
Dense, pedestrian-oriented, mixed-use development located near (usually within a quarter- or half-mile radius) of direct transit access. Transit-oriented development integrates multiple mobility modes, including walking, biking, micromobility, and various forms of public transit, to provide residents with convenient and efficient transportation options beyond personal vehicles.

Transportation Demand Management (TDM)
Managing demand is about providing travelers, regardless of whether they drive alone, with travel choices, such as work location, route, time of travel and mode. In the broadest sense, demand management is defined as providing travelers with effective choices to improve travel reliability.

Transportation Energy Burden
Percentage of gross income that a household spends on energy for transportation. It is calculated by dividing the average transportation energy cost by the average annual household income.

Transportation Systems Management and Operations (TSMO)
Focuses on operational improvements that can maintain and even restore the performance of the existing transportation system before extra capacity is needed.

Upstream Emissions (in the context of fossil fuel production)
Out-of-state greenhouse gas emissions associated with the extraction, transmission, and use of fossil fuels imported into the State.

Vehicle Miles Traveled (VMT)
The amount of travel for all vehicles in a geographic region; calculated by adding up all miles driven by all motorized vehicles.

Vehicle-Grid Integration
Vehicle-to-Grid (V2G) technology allows EVs to both draw electricity from the electric grid to charge the EV's battery and also discharge the EV's battery to sell power back to the electric grid.

Vulnerability
The susceptibility of an energy infrastructure system to damage, loss, or degradation caused by a threat due to weaknesses within the system or due to the system's dependence on critical supporting systems or material, technical, or workforce resources affected by the threat.

Weatherization
Protecting a building's interior from outside temperatures and moisture to cut energy use and enhance indoor comfort through measures such as air sealing, insulation, and window upgrades.

Wetlands
An area that is saturated or inundated by water, either surface or ground, at a frequency and duration sufficient to support vegetations adapted to saturated soil condition.[30]

Zero by 40 (or 0x40)
New York State Climate Act target for zero-emission electricity.

Zero-Emissions Vehicles (ZEVs)
Vehicles powered by energy sources that result in no tailpipe emissions, such as battery-electric vehicles (BEVs) and hydrogen fuel cell electric vehicles (FCEVs). Plug-in hybrid electric vehicles (PHEVs), which run exclusively on electricity for a limited range and then are powered by an internal combustion engine, are also considered ZEVs under certain regulations.

30 New York State Department of Environmental Conservation (DEC), Wetlands, accessed July 11, 2025, https://dec.ny.gov/nature/waterbodies/wetlands#:~:text=Wetlands%20(swamps%2C%20marshes%2C%20bogs,life%20in%20saturated%20soil%20conditions.