THE NEW YORK ISO ANNUAL
GRID & MARKETS REPORT

The Vision for a Greener Grid

Power Trends 2020

New York ISO

New York ISO

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, conducting comprehensive long-term planning for the state's electric power system, and advancing the technological infrastructure of the electric system serving the Empire State.

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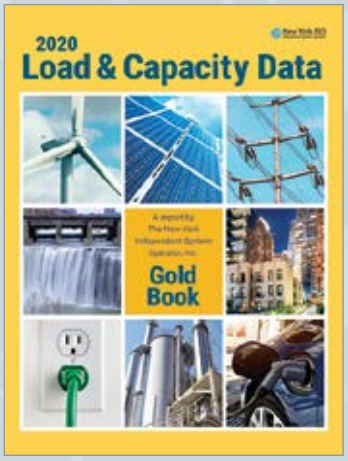
POWER TRENDS 2020 DATA
is from the 2020 Load and Capacity Data Report (also known as the Gold Book), unless otherwise noted.

Published annually by the NYISO, the Gold Book presents New York Control Area system, transmission and generation data and NYISO load forecasts of peak demand, energy requirements, energy efficiency, and emergency demand response; existing and proposed resource capability; and existing and proposed transmission facilities.

The Gold Book and other NYISO publications are available on the NYISO website, visit www.nyiso.com/library



From the CEO

Welcome to *Power Trends 2020: The Vision for a Greener Grid,* the New York Independent System Operator's (NYISO) annual state of the grid and markets report. In these pages we proudly provide critical information and analysis that policymakers and industry leaders need in order to understand the many dynamic factors shaping New York's complex electric system.

Of course, it goes without saying, that the COVID-19 crisis has had a significant impact on all of us. During such an uncertain time, the importance of a reliable electric system has never been more apparent. Through the challenges of the pandemic, just as we have across our 20 year history, the NYISO has fulfilled our mission of maintaining grid reliability, overseeing efficient wholesale markets, and conducting expert grid system planning for New Yorkers. We have fully engaged with policymakers, utilities, generation owners, and our stakeholder community alike to address this crisis together and meet New York's energy needs.

At the time of this writing, the challenges and uncertainties associated with the COVID-19 pandemic still lie before us. Yet I'm inspired by the dedication of the NYISO workforce for their commitment and perseverance. Despite the crisis, the NYISO has continued to advance market design changes, grid operations, and planning initiatives to prepare for the grid of the future.

NYISO system operators made significant sacrifices, volunteering to sequester themselves at our control centers to ensure uninterrupted grid operations knowing hospitals and other front line essential services needed electricity to pull us through. *Power Trends 2020* is dedicated to their service and sacrifice.

Looking forward, chief among our priorities are the steps necessary to prepare for the grid of the future. Led by the Climate Leadership and Community Protection Act, New York State policies set forth the most aggressive clean energy mandates in America. There is no precedent for the level of change needed to meet these objectives. *Power Trends 2020* focuses on the energy and policy landscape being shaped by these policies and highlights both the challenges and the opportunities to align our markets, operations, and planning processes to support the state in achieving these goals.

Power Trends fulfills another critical element of the NYISO's mission: to serve as the authoritative source of information on New York's wholesale electric markets and bulk power system. *Power Trends 2020* provides important information and unbiased analysis that is key to understanding both today's electric system and the steps necessary for meeting the needs of our future. This is a part of our mission we are proud to fulfill. This report offers policymakers, stakeholders and the public the NYISO's perspective on the electric system as public policy initiatives accelerate change and determine the future of our economic, climate and public health goals.

2020 has proven to be a year unlike any other in recent memory. Through these challenges, please know the NYISO remains committed to engaging stakeholders, market participants, policymakers, and the public, to support an electric system that is efficient, affordable, clean, and reliable. We're all in this together.

Sincerely,

Rich Dewey

Richard Dewey
President and CEO

Power Trends
NEW YORK ISO PODCAST

Listen now

Episode 6: a discussion with CEO Rich Dewey on the 'State of the Grid', the NYISO's Initiatives to Meet Climate & Policy Goals.
www.nyiso.com/podcast

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Executive Summary

Perspectives

The New York Independent System Operator (NYISO) is a not-for-profit corporation responsible for operating New York's bulk power system, administering wholesale electricity markets, and conducting system planning. It is subject to the oversight of the Federal Energy Regulatory Commission (FERC) and regulated in certain aspects by the New York State Public Service Commission (NYSPSC). NYISO operations are also overseen by electric system reliability regulators, including the North American Electric Reliability Corporation (NERC), Northeast Power Coordinating Council (NPCC), and the New York State Reliability Council (NYSRC).

The NYISO is dedicated to serving the energy needs of New Yorkers. The NYISO is unaffiliated with any federal or state agency, and independent of any market participant. The NYISO serves the energy industry, policymakers, and the public through skilled and experienced grid operation, innovative market design, and expert system planning. The NYISO also serves as a trusted source of authoritative, independent information on the state power system. Since our inception in 1999, the NYISO's markets have worked to improve system efficiency, supporting a shift toward cleaner sources of generation while upholding the nation's most stringent reliability rules.

2020 began with a focus on New York's energy policy objectives, as exemplified by the New York State Climate Leadership and Community Protection Act (CLCPA). The CLCPA seeks to advance the adoption of clean energy technologies across the economy while promoting the transition to a zero-emissions power grid by 2040.

The COVID-19 outbreak has levied a terrible toll in human life and health, with New York a focal point of the pandemic. As New York acts to address this historic health and economic crisis, we and our colleagues in the electric supply, transmission, and distribution sectors have demonstrated an unwavering commitment to serving the citizens of this state. The NYISO took steps to protect grid reliability and protect the health and safety of employees. The NYISO's proactive steps on pandemic planning poised the organization to seamlessly

A Powerful Purpose

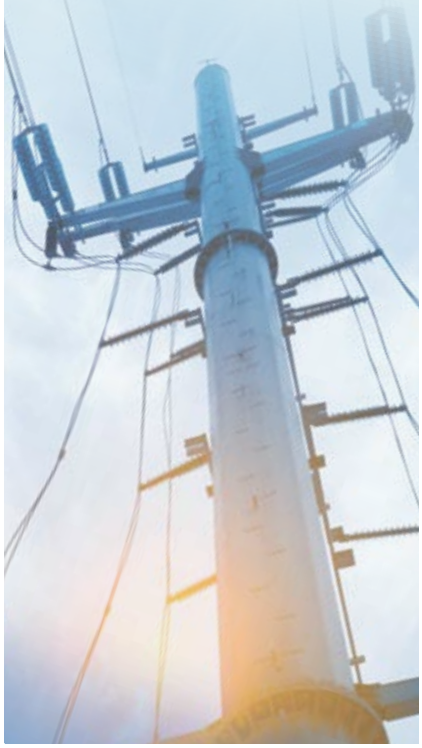
We are dedicated to a reliable, sustainable power grid and competitive markets.

Maintaining and enhancing regional reliability

Operating open and fair wholesale electricity markets

Planning the bulk power system for the future

Providing factual information to policymakers, stakeholders and investors

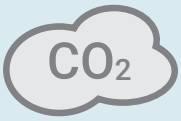


transition to working remotely and continue to fulfill our mission. Further, a 37-person team volunteered to enter a sequestration program, completely isolating themselves from their families to ensure uninterrupted grid operations.

In the midst of this unprecedented pandemic response, the NYISO continues to engage with policymakers and stakeholders to prepare for the grid of the future. In order to achieve the transformation envisioned by the CLCPA, the NYISO and its stakeholders are providing the leadership and expertise to build the grid of the future on the three foundations of reliable operations, economically efficient markets, and forward-looking transmission system planning. To deliver on our mission, the NYISO firmly believes that we must continue to enhance the benefits of our wholesale markets and planning while maintaining grid reliability and delivering economical energy to industry and consumers.

State of the Grid

The NYISO's competitive wholesale electricity markets have delivered economic and environmental benefits for New York. Working in tandem with state environmental and energy policies, the carbon dioxide emissions rate from the power sector has declined by 55% since the inception of NYISO markets 20 years ago. Further, average annual wholesale energy prices in the NYISO's market reached a record low of $32.59/MWh in 2019.



55% ⇩

drop in rate of carbon dioxide emissions from the power sector since the inception of NYISO markets 20 years ago

Forecasting energy consumption trends is a complex task, accounting for historical demand patterns, anticipated economic activity, and increasingly, the effects of energy efficiency programs and the expansion of Distributed Energy Resource (DER) technologies. **Adding further complexity and uncertainty to this year's forecasting efforts are the impacts of the COVID-19 pandemic. The implementation of guidelines under Governor Andrew Cuomo's New York PAUSE executive order to combat the pandemic had an immediate impact on daily energy consumption levels and patterns. To reflect the economic impacts of the pandemic, the NYISO revised its annual overall energy consumption forecasts downward for both 2020 and 2021.**

Integrating renewable resources into grid operations presents new challenges and opportunities for the NYISO's markets to address. For instance, the NYISO's existing market rules seek to optimize the performance of wind generation, while simultaneously seeking to avoid overloading transmission capability in constrained portions of the system. The NYISO continuously monitors and reports publicly on economic curtailment of wind energy production. Curtailment of wind energy production is an important signal for developers to consider in decisions they make about siting resources on the grid. It also signals that transmission system upgrades would maximize the production from existing and planned wind resources.

Public Policy & the Grid

At the federal, state, and local levels, public policy initiatives are shaping the grid of the future. How the grid is operated to maintain reliability and economic efficiency, while achieving the objectives of these policies, requires careful and informed operations, market design, and planning. The NYISO is examining these policy initiatives and is fully engaged with stakeholders

and policymakers to identify the challenges and opportunities these initiatives may present to bulk power system reliability and efficiency.

Competitive Markets for a Grid in Transition

Competitive wholesale electricity markets provide a framework to facilitate change in the power system. The NYISO's wholesale electricity markets will continue to successfully fulfill the mission and goals of reliability and economic efficiency, while also incenting the economic behaviors required to achieve state policy goals. The NYISO is actively engaging stakeholders and policymakers to prepare for the changes on the grid expected from higher levels of renewable energy, energy storage, and DERs.

▸ **More on carbon pricing:** Visit our website, www.nyiso.com/carbonpricing for an informational factsheet, an FAQ blog, a Podcast and more on how the proposal benefits NY's economy & public health

The NYISO's *Carbon Pricing Proposal*, which seeks to reflect a "social cost" of carbon dioxide emissions in our wholesale energy market, is at the forefront of this effort. The NYISO continues to see the implementation of carbon pricing as a more effective means to directly reflect the public policy goals. However, other energy and ancillary services market enhancements to support a grid in transition are also under consideration.

Energy, ancillary service, and capacity market design changes intended to facilitate the growth of DERs and expand utilization of energy storage resources are bringing the grid in transition to reality. Engagement with stakeholders and policymakers on a comprehensive review of market mitigation measures to evaluate future grid conditions is underway, as are efforts to develop new market rules to better align grid operational needs with capacity market incentives. As technologies change and the asset mix evolves, continued assessment and ongoing market improvements will continue to occur.

Planning for a Grid in Transition

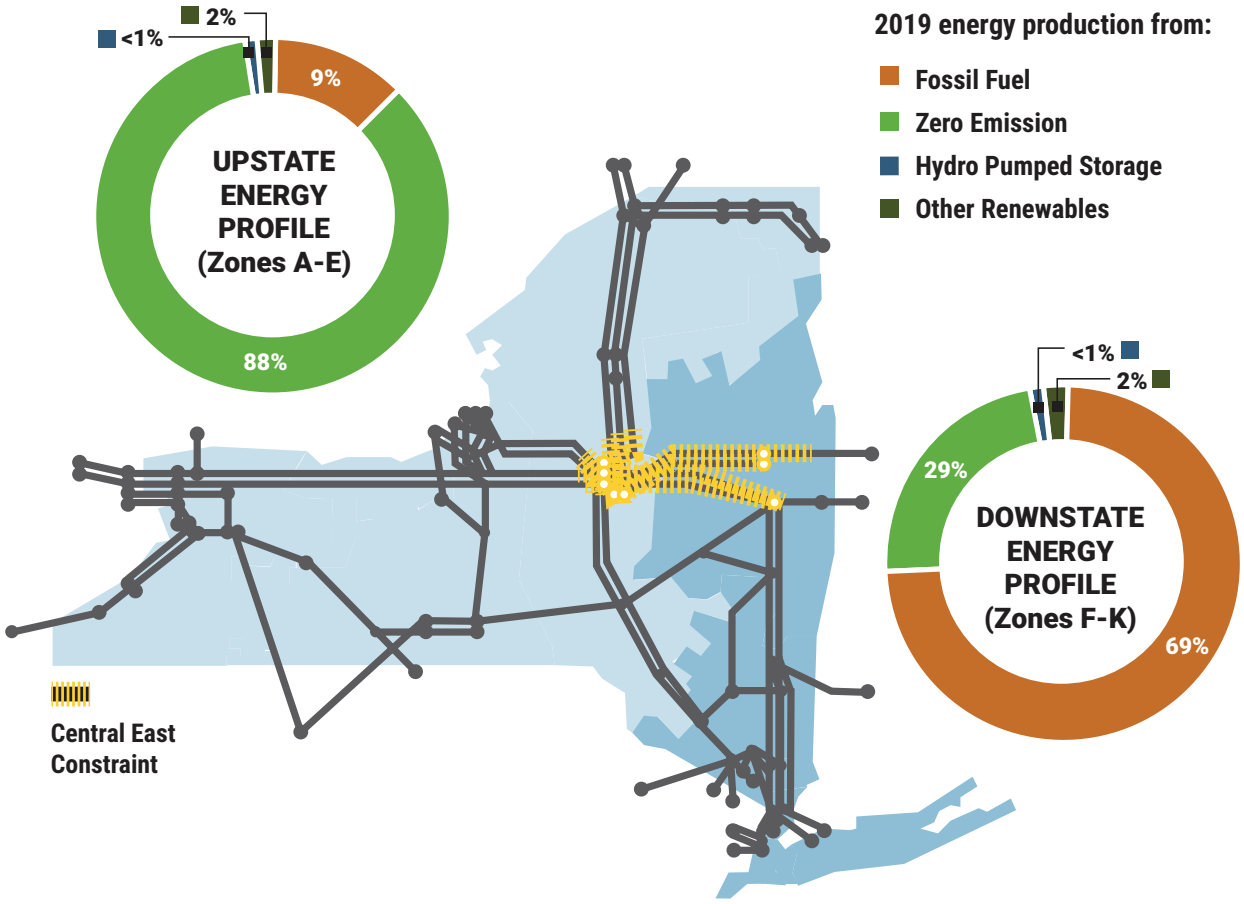
The NYISO's planning processes provide independent and authoritative information to investors, stakeholders, and policymakers. Over the years, the NYISO has evolved these planning processes to align the reliability and efficiency of the electric grid with public policy goals.

Transmission planning is evolving to address infrastructure needs in a rapidly changing power system. As the composition of the power grid changes and the pace of new technology development and investment accelerates, the NYISO interconnection process is evolving to facilitate new entry. Combined with additional reforms, new interconnection processes being put into place will provide developers with more frequent opportunities and flexibility to obtain certainty over their interconnection costs and obligations and subsequently accelerate the interconnection of new resources to the grid.

▸ **Download our many other reports:** Visit www.nyiso.com/library for the CARIS, RNA, CRP, Climate Change Impact & Resilience Study and more.

The NYISO is conducting a number of important studies to inform future market, planning and operational enhancements. Among these studies are the *Congestion Assessment and Resource Integration Study* (CARIS), which includes a scenario analyzing the CLCPA's 70% renewable energy production by 2030 goal, and a *Reliability Needs Assessment* (RNA). The NYISO is also undertaking a multi-phase *Climate Change Impact & Resilience Study* to inform future market, planning and operational enhancements that might be

Tale of Two Grids



necessary to meet system needs and conditions as demands on, and conditions faced by, the grid change over time.

Enhancing Grid Resilience

In 2019, the NYISO's *Fuel & Energy Security Initiative* examined potential reliability challenges associated with the risk of possible fuel disruptions. The assessment did not identify any reliability risks that warrant the development of immediate market rule enhancements. The NYISO will continue to monitor New York's evolving fuel security needs.

The NYISO has a comprehensive program for addressing cyber and physical security risks. This program draws from mandatory and other industry standards and guidelines. The NYISO implements its compliance with mandatory cyber and physical security requirements as part of a layered, defense-in-depth strategy that relies on processes, state-of-the-art technology, and skilled staff to protect its critical infrastructure assets from incursion. The NYISO has also established a comprehensive organizational business continuity and disaster recovery program that safeguards business information systems and provides contingency plans in the event of a significant disruption of NYISO systems or facilities.

Achieving Public Policy Goals Requires a Reliable & Competitive Foundation

In the 20 years since its inception, the NYISO's markets have worked to improve system efficiency and support a shift towards cleaner sources of electric energy supply while upholding the nation's most stringent reliability rules.

Maintaining system reliability is the cornerstone of the NYISO's mission, shaping how we operate, design markets, and conduct system planning. We manage the flow of electricity across more than 11,000 miles of high-voltage transmission lines serving New York, balancing supply and demand throughout the state. The NYISO adheres to the nation's strictest set of reliability standards, which include nearly 1,000 requirements designed to promote reliability for New York consumers.

The NYISO supports reliability primarily through three complementary markets: energy, ancillary services, and capacity. Each market addresses distinct reliability needs. Suppliers compete to provide each of these reliability services through markets that select the lowest cost set of supply resources that meet the needs of the grid. Prices reflect the balance of demand and supply available. Wholesale markets incent suppliers to minimize costs and maximize their ability to provide the various services needed to keep the grid reliable. The transparency and granularity of these prices also serves to inform investment decisions.

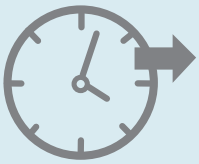
New York State is focused on deploying clean energy resources in support of reducing carbon dioxide emissions from the power sector. The NYISO is actively working on market enhancements to meet these future challenges. A grid characterized by high levels of intermittent renewable resources, energy storage, and distributed generation will require new thinking.

We approach this work with two guiding principles:

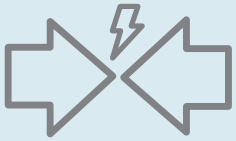
1. All aspects of grid reliability must be maintained; and
2. Competitive markets should continue to maximize economic efficiency and minimize the cost of maintaining reliability while supporting the achievement of New York's climate policy codified in the CLCPA.

Every 5 minutes 24/7, 365

electricity in NY is bought and sold through wholesale energy markets.



Energy Markets: Provide day-ahead and real-time commitments to meet load.



Ancillary Services: Every six seconds resources compete to respond to changing system needs.

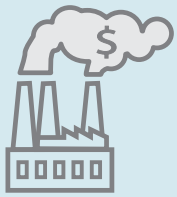
Capacity Markets: Ensure enough generation to meet peak demand and encourage generators to invest in new technology and deactivate outdated resources.

An example of this commitment to leveraging the value of markets is the NYISO's *Carbon Pricing Proposal.* A carbon price in the NYISO's market would build upon the success of wholesale electricity markets to develop the widest possible set of low-cost, innovative carbon dioxide abatement measures. Introducing a "social cost" of carbon dioxide emissions into New York's competitive wholesale electricity markets can help the state meet its clean energy goals faster and more cost-effectively while reducing emissions and maintaining grid reliability. A growing list of organizations supporting the proposal include the American Wind Energy Association, the New York League of Conservation Voters, the Alliance for Clean Energy New York, and the International Brotherhood of Electrical Workers Union (IBEW) Local 97.

How does carbon pricing work?

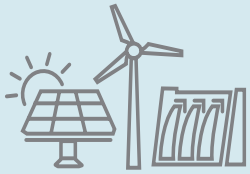
New York State sets a social cost of carbon

as a price per ton of emitted CO_2 based on the impact to the environment



Power plants pay

for the carbon they release into the atmosphere



Generation owners receive economic incentive

to invest in low-carbon or carbon-free resources like wind, solar and hydro

New Yorkers benefit

from reduced costs and lower emissions

"Wholesale energy markets have tremendous, proven power to lower emissions. Adding a carbon price would reduce the state's clean energy costs and provide clear investment signals that promote new development."

— Emilie Nelson, EVP New York ISO

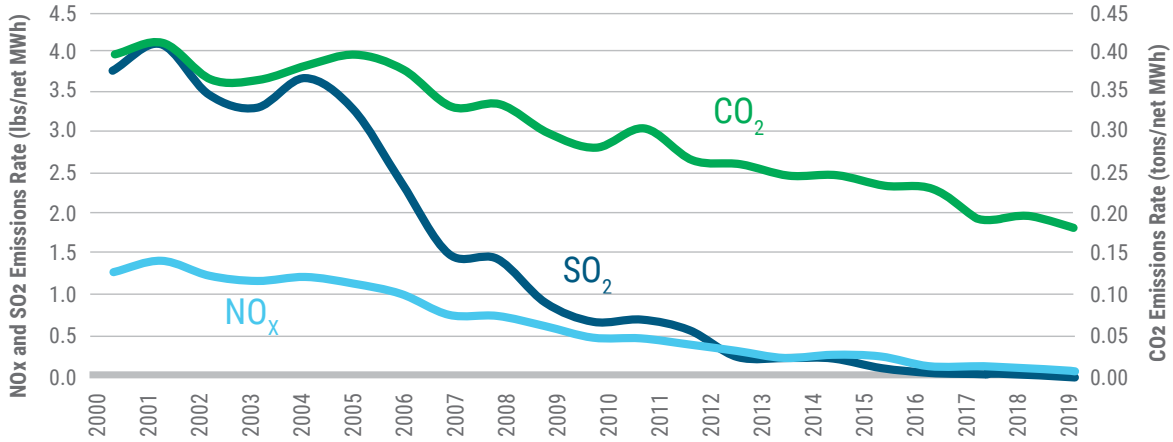
Since the publication of *Power Trends 2019*, NYISO market design and planning enhancements have established new rules for market participation from Distributed Energy Resources (DERs) and energy storage resources, and have developed a sweeping set of new planning rules to reflect how new technologies can reliably interconnect to the grid. Further enhancements are either under regulatory consideration or are the focus of ongoing engagement with stakeholders to further evolve enhance our market design capabilities for the grid in transition.

Power Trends 2020 brings these efforts into perspective by providing views into the status of our grid today, the policies and forces shaping change, and focusing on the market design and planning efforts the NYISO is undertaking to prepare for New York's grid in transition.

State of the Grid

Competitive markets promote operational efficiency that provides economic benefits for consumers and environmental benefits for New York State.

Figure 1: **Emissions Rates from Electric Generation in New York: 2000-2019**



New York power sector emissions rate reductions since the launch of NYISO markets in 1999 according to the US EPA Air Markets Program data

55%
Carbon Dioxide
CO_2

99%
Sulfur Dioxide
SO_2

92%
Nitrogen Oxide
NO_x

Environmental and Price Trends

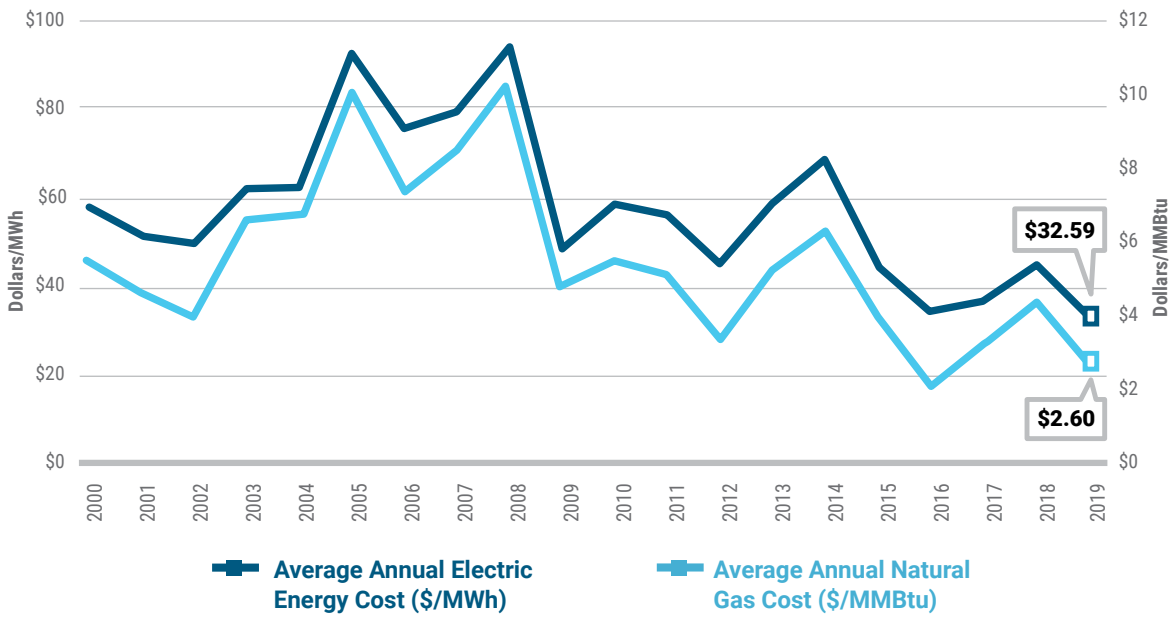
▸ **Competitive Markets:** Provide incentives for generators to improve operational performance and invest in new, more efficient technologies.

Markets encourage suppliers to optimize their efficiency in order to reduce costs and increase the likelihood of being selected to supply the grid in the NYISO's competitive auctions.

Wholesale electricity markets have worked in tandem with air-quality regulations to cut the sulfur dioxide emission rate by 99%, the nitrogen oxide emission rate by 92%, and rate of carbon dioxide emissions from the power sector by roughly 55% over the past 20 years. The CLCPA seeks to eliminate all carbon dioxide emissions associated with power production within the next 20 years. Leveraging the wholesale electricity markets is the most effective means to continue to drive technologies that support the CLCPA goals.

Wholesale electricity prices are directly influenced by the cost of the fuels used to produce electricity. In New York, the cost of natural gas and the price of electricity are closely correlated because, based on the current resource fleet, gas-fired generation often establishes the clearing price for electricity in the NYISO's wholesale electricity market.

Figure 2: **Natural Gas Costs and Electric Energy Prices: 2000-2019**



Load and Demand Trends

Figure 3 presents three load forecast scenarios through 2050. The Baseline Forecast shows the expected statewide loads under expected economic and weather conditions, and accounts for the load-reducing impacts of energy efficiency programs, behind-the-meter (BTM) solar and other distributed generation, building codes, and efficiency standards. As further discussed, the Baseline Forecast has been adjusted to reflect expected economic impacts of the COVID-19 health crisis. The Baseline Forecast also includes the expected impacts of electric vehicle (EV) usage and other electrification measures. The Low-Load Scenario assumes increased adoption of energy efficiency, BTM solar, and fewer purchases of EVs and other electrification measures. The High-Load Scenario assumes reduced adoption of efficiency and solar, but increased electrification measures. These Low and High scenarios provide bounds around the level of uncertainty in forecasting future energy usage.

$32.59/MWh

the NYISO's market record low average annual wholesale energy price in 2019

Figure 3: **Electric Energy Usage Trends and Forecast: 2019-2050**

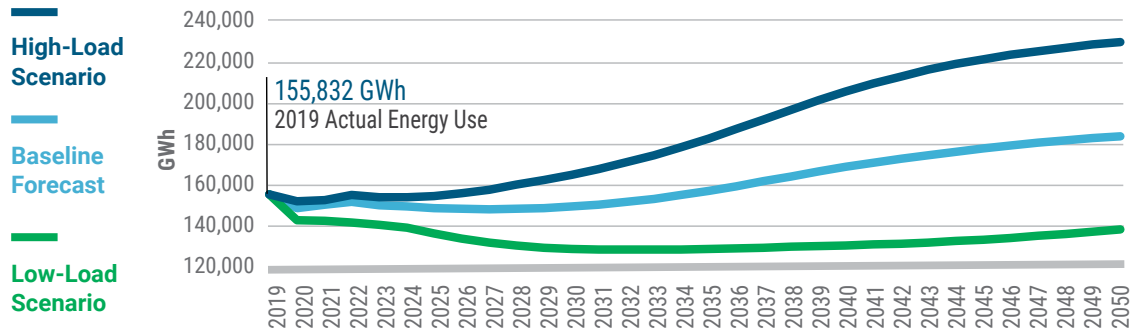


Figure 4: **Electric Summer Peak Demand – Actual & Forecast: 2019-2050**

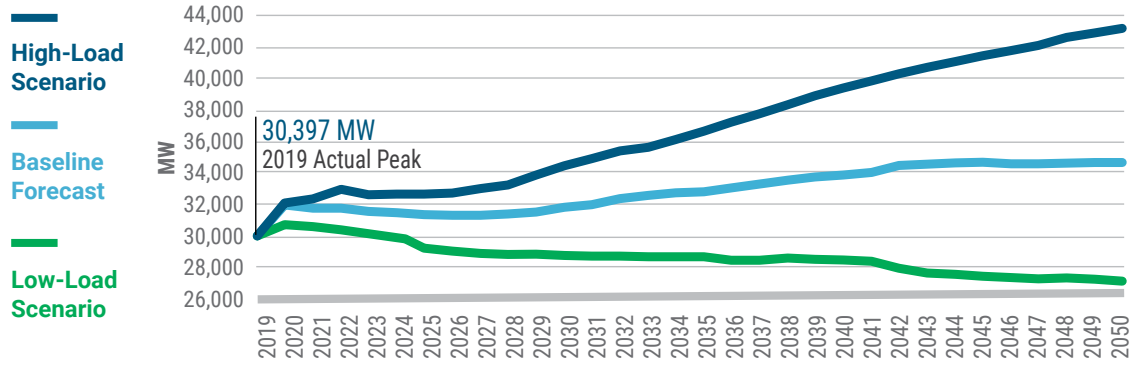


Figure 4 provides summer peak-demand scenarios through 2050. The Baseline Forecast anticipates a long-term, gradual growth in summer peak demand as EV adoption begins to expand. The Low-Load Scenario assumes greater adoption of BTM solar, fewer EV purchases with more adoption of smart charging to reduce peak impacts, and reduced adoption of electrification measures. The High-Load Scenario assumes greater levels of EV purchases with no adoption of smart charging, increased adoption of electrification, and stronger economic growth.

COVID-19 Impacts on Demand

The coronavirus outbreak has had a significant impact on New York's economy due to reductions in commercial and industrial activity as New Yorkers adjust their lives by working from home and limiting social interaction. Earlier iterations of the NYISO's load forecasts anticipated load levels reflective of economic forecasts at the time. Throughout the month of March and into April 2020, the changing patterns of behavior acted to reduce New York electricity consumption. To reflect the potential continuing economic impacts associated with the COVID-19 pandemic, the NYISO revised its baseline annual energy usage forecast downward for 2020 and 2021.

Due to the rapidly evolving nature of the outbreak, the energy usage forecast reflects our perspective as of April 2020. The sudden departure from historical behavioral patterns caused by New York's response to COVID-19 is unprecedented and creates unique challenges to forecasting the state's energy needs. As the situation evolves and more data becomes available, the NYISO will continue to monitor these forecasts.

Electrification Trends

The concept of "beneficial electrification" is growing as state energy and climate policies seek to reduce economy-wide carbon dioxide emissions and refers to adopting technologies that support the transition of fossil-fuel-intensive sectors of the economy to electricity.

Near-term efforts are focused on transportation and building sectors to replace fossil-fueled vehicles, furnaces and appliances and are expected to create long-term upward pressure on electric load growth. The NYISO is continuing to study the impacts of electrification on future electric system demands.

Figure 5: **Electric Vehicle Energy & Peak Impacts – Baseline Forecast**

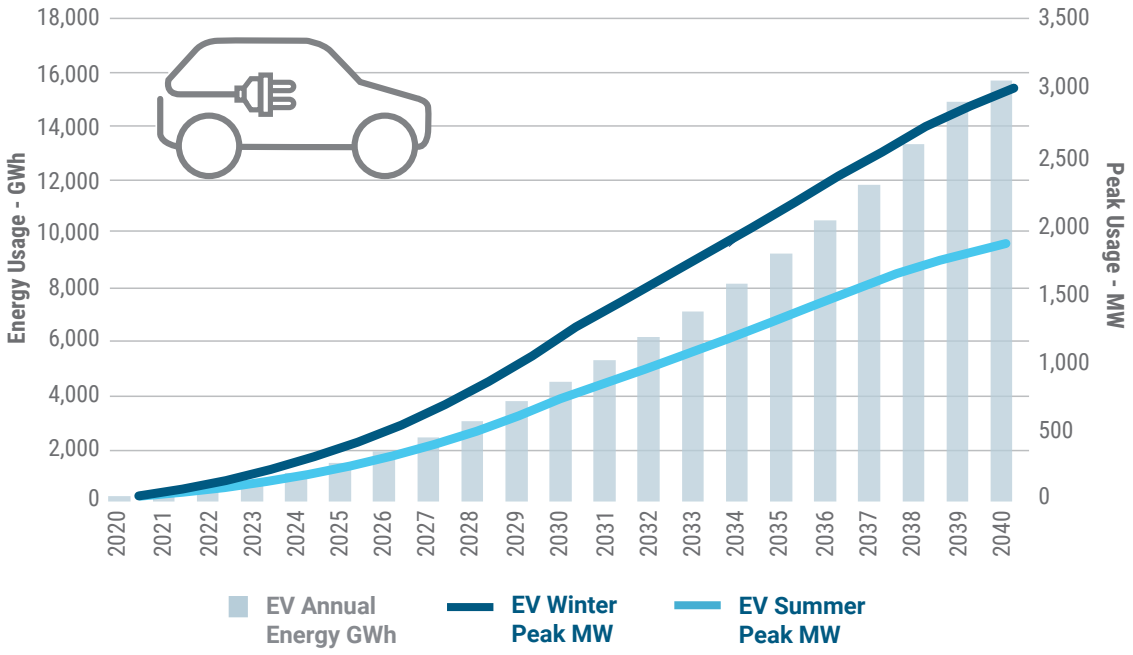
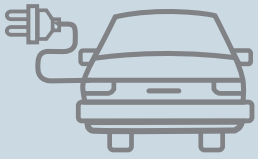


Figure 5 shows the forecast of EV impacts on summer and winter coincident peak demand, as well as energy usage. These forecasts assume over 4.5 million total EV purchases in New York State by 2040, including passenger vehicles, trucks, and buses. The impacts on peak demand periods are highly dependent on customer adoption, technologies, incentives, and retail rate structures which can enable EV owners to more efficiently manage vehicle charging cycles.

Load forecasts presented in previous charts reflect varying degrees of EV adoption and managed charging to offer upper and lower boundaries for the expected impacts of higher EV usage. Policies that incent managed EV charging cycles would help reduce EV coincident peak demand on the grid.



4.5 Million

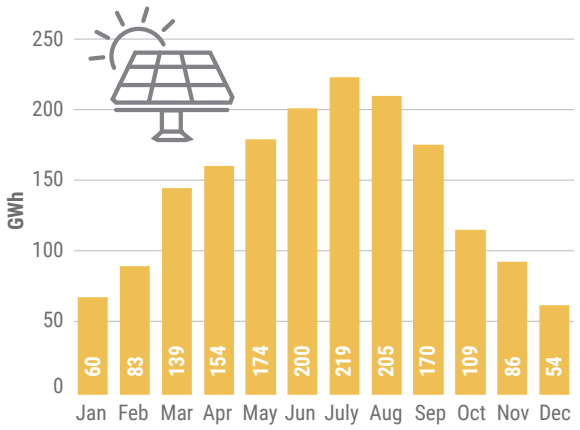
total projected EV purchases in New York State by 2040

Renewable and Clean Energy Resource Trends

Intermittent supply resources, like wind and solar, are expected to be a larger contributor to serving load in the future. Coordinating the supply with demand will become increasingly complex because the supply produced by intermittent resources relies on weather conditions.

The proliferation of BTM solar resources, if unaccounted for, creates more uncertainty over load forecasts as these resources intermittently serve a portion of load historically served by central-station generating resources. To reduce this uncertainty and leverage the pioneering approach taken to forecasting energy production from wind resources, the NYISO implemented solar forecasting tools to anticipate the contribution of solar as well as provide real-time estimates of BTM solar production. By serving load on the distribution system, BTM solar resources reduce demand and lower the amount of energy delivered by the bulk power system. However, the sun shines brightest around noon while demand for electricity peaks later in the afternoon. During winter months, for example, peak demand occurs after sunset when solar production is unavailable to directly support the system's peak demand needs.

Figure 6: **2019 Behind-the-Meter Solar Energy Production**



"Behind-the-meter" (BTM):
A generation unit that supplies electric energy to an end user on-site without connecting to the bulk power system or local electric distribution facilities.

On January 11, 2020, the NYISO experienced a record-setting level of wind energy production. At that time, wind resources were contributing 1,748 MW, or about 11% of the statewide load. However, the level of energy production from wind resources is constantly changing, and while early 2020 brought a new record for peak hourly wind energy production, in 2019 there were 64 instances when wind resources supplied less than 100 MW to the grid for periods of more than 8 consecutive hours. 100 MW represented about 5% of the installed wind capacity in 2019.

Figure 7: **Wind Generation and Curtailment in New York – Energy Produced: 2003-2019**

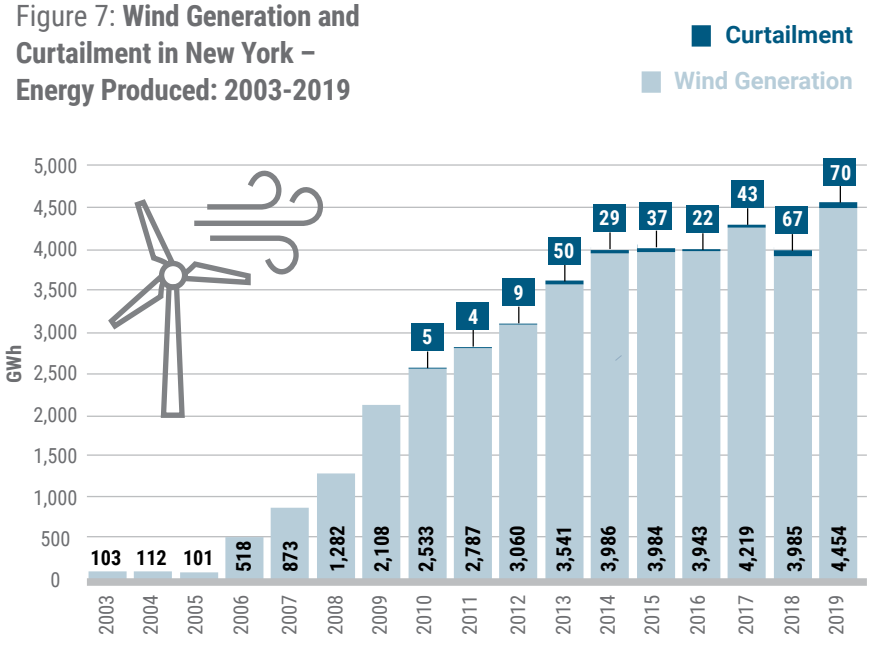


Figure 7 indicates that additional wind energy could have been supplied to the grid, but at times transmission constraints resulted in a need to curtail production in order to maintain reliable operations. Additional transmission capability is necessary to alleviate constraints and maximize the potential contribution of the renewable resources to meeting electric demand and to achieving public policy goals. This issue is further discussed in Power Trends in the context of the NYISO's *Congestion Assessment and Resource Integration Study* (CARIS) "70x30" scenario analysis.

To balance lower capacity factor, intermittent resources, and shorter-duration resources like energy storage, bulk power system operators will require a full portfolio of resources that can be dispatched in response to any change in real-time operating conditions to maintain bulk power system reliability. The ability to dispatch resources to reliably meet ever-changing grid conditions and serve New York's electric consumers will always be paramount.

▸ Download the CARIS Report:
Visit www.nyiso.com/library

These issues highlight the need for properly designed competitive electricity markets, system planning, and operational processes to incent investment in both the transmission capability needed to connect intermittent supply from constrained regions of New York to load centers, and the dispatchable supply resources needed to balance intermittent supply with demand.

Figure 8: **Energy Storage Nameplate Capacity and Energy Usage Forecast**

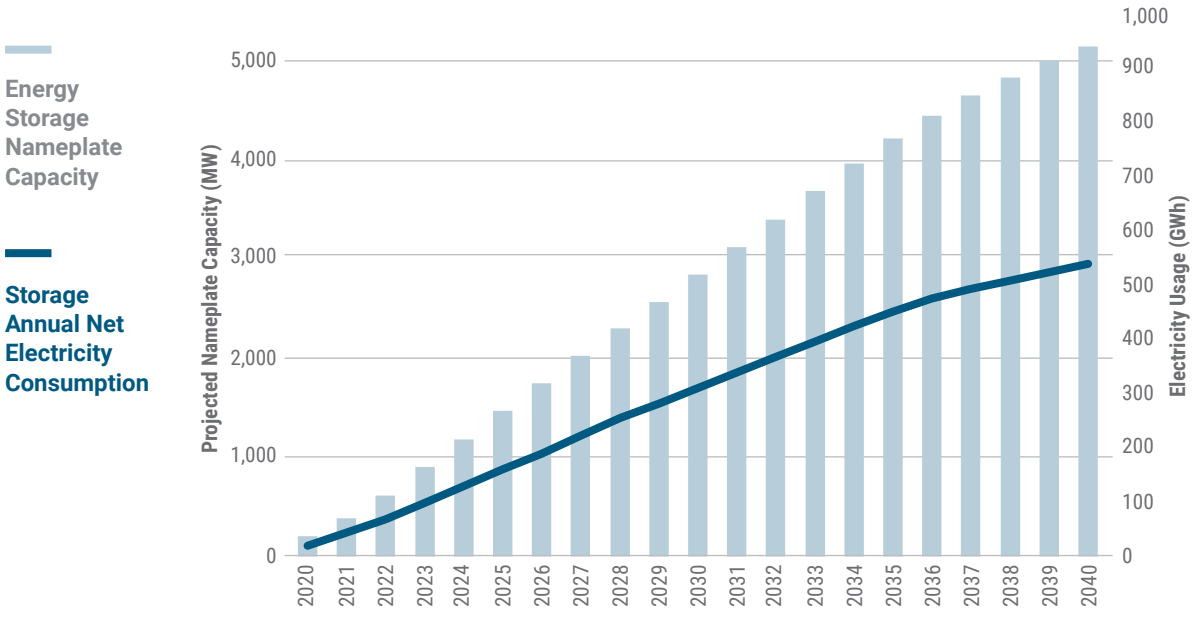
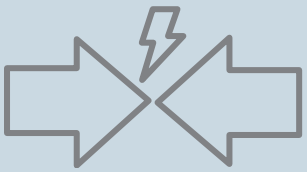


Figure 8 shows the expected growth of energy storage capacity in New York State through 2040 as well as the projected increase in energy usage attributable to these resources. Storage resources increase net annual electricity consumption due to energy losses that arise from charging and discharging cycles.



▸ Capacity and Energy

There are differences between a generator's ability to produce power (capacity) and the amount of electricity it actually produces (energy).

Capacity: is the maximum electric output that a generator can produce. It is measured in MW.

Energy: is the amount of electricity a generator produces over a specific period of time. It is measured in megawatt-hours (MWh). (A generating unit with a 1 MW capacity operating at full capacity for one hour will produce 1 MWh of electricity.)

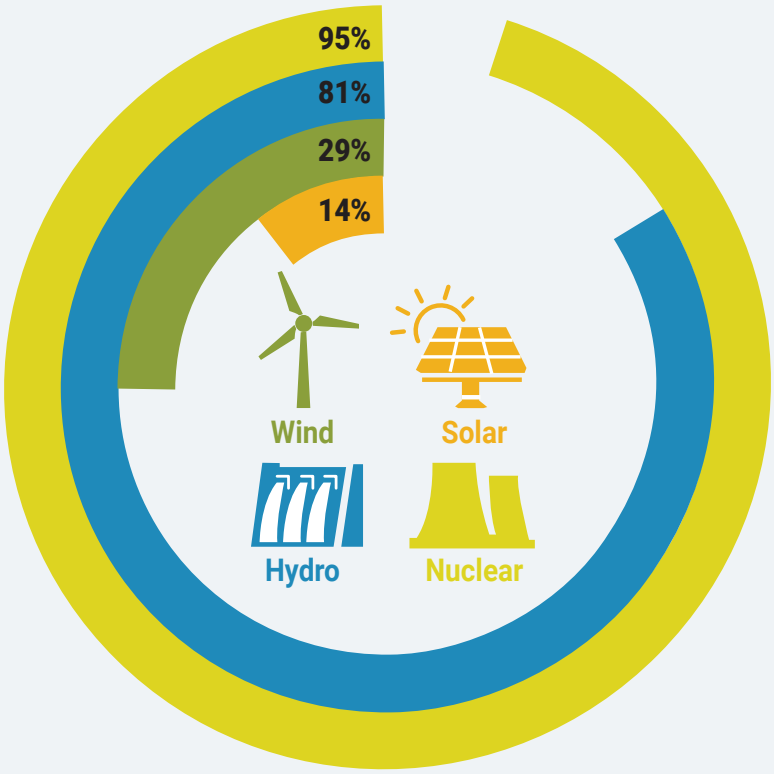
Capacity Factor: measures actual generation as a percentage of potential maximum generation. (A generator with a 1 MW capacity operating at full capacity for full year, or 8,760 hours, would produce 8,760 MWh of electricity and have an annual capacity factor of 100%.)

Generators: do not operate at their full capacity all the time. A unit's output may vary according to weather, operating conditions, fuel costs, market prices, and/or scheduling instructions from the grid operator. The ability of generators to operate at full capacity also varies by the type of facility, the fuel used to produce power, and the unit's technology.

Capacity Factors, Demand Patterns, and Resource Adequacy Needs

The relative capacity factors of different types of generation[1] are important considerations in reliably operating the grid. For example, based on 2019 operating performance for wind and hydro, it would require nearly 2.8 MW of wind capacity to produce the same amount of energy as 1 MW of hydro capacity over the course of a year.

Figure 9: **Annual Capacity Factors for Non-Emitting Resources**

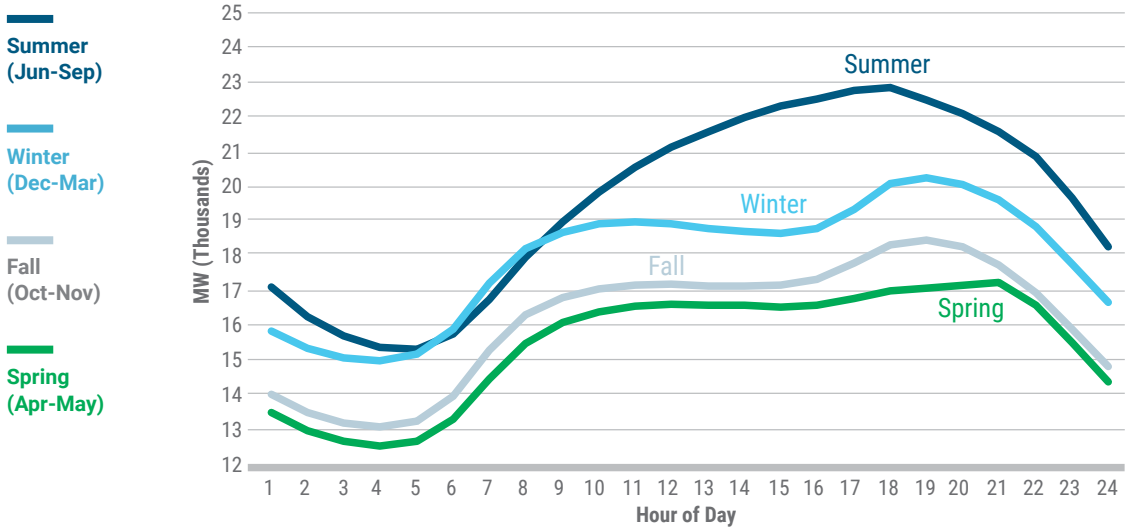


The demand for electricity fluctuates throughout the day and varies by season, influenced largely by factors such as time of day and weather. In New York, peak demand currently occurs during the summer when heat waves prompt greater use of air conditioning.

Resource intermittency means system operators cannot rely upon them to produce additional energy on demand in the same manner as non-intermittent supply resources. Even if sufficient intermittent renewable capacity is developed to produce the equivalent amount of energy as higher-capacity factor resources, energy from those resources will not always be available when consumers need it.

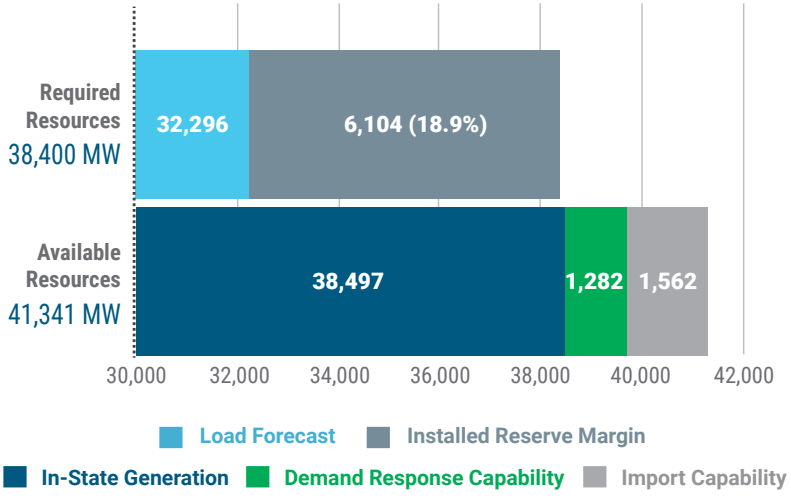
Understanding demand patterns is critical to establishing resource adequacy and ensuring sufficient supply resources are available to meet anticipated peaks.

Figure 10: **Seasonal Hourly Demand Patterns: 2019**



Each year, the New York State Reliability Council (NYSRC) establishes an Installed Reserve Margin (IRM) identifying the amount of capacity that must be available above the forecasted peak demand to maintain reliable system operations. Resources eligible to satisfy this requirement may include generation, demand response, or imported resources from other regions. For the current year, the NYSRC adopted an IRM of 18.9% based on a projected peak demand of 32,296 MW. In proposing the increased IRM for the current year, the NYSRC noted seven parameters that influenced the 2020-2021 IRM, with load forecast uncertainty tied to weather conditions, as a "principal driver" for the increase.

Figure 11: **Statewide Resource Availability: Summer 2020**



▸ New York's Installed Reserve Margin (IRM): The not-for-profit New York State Reliability Council develops and monitors compliance with reliability rules specifically established for New York State's electric system. Those rules include an Installed Reserve Margin, established annually with approval from Federal Energy Regulatory Commission (FERC) and the New York State Public Service Commission (PSC).

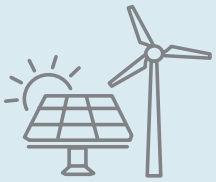
Public Policy & the Grid

While groundbreaking in its own right, the Climate Leadership and Community Protection Act (CLCPA) is not the only public policy initiative shaping how energy will be supplied, transmitted, and consumed in New York State. More than a decade ago, the state developed programs such as the Renewable Portfolio Standard (RPS) and, in collaboration with neighboring states, the Regional Greenhouse Gas Initiative (RGGI), to achieve power sector emissions reductions. More recently, the state's Reforming the Energy Vision (REV) and Clean Energy Standard (CES) policies established new programs for reducing the environmental impacts of energy production and integrating renewable and other clean energy resources into New York's bulk power system.

> **"By exercising a global leadership role on greenhouse gas mitigation and climate change adaptation, New York will position its economy, technology centers, financial institutions, and businesses to benefit from national and international efforts to address climate change."**
>
> — CLCPA

26.8%

of the state's electric load was served by renewable resources in 2018



70% by 2030

CLCPA requirement for load served by renewable resources and a zero-emissions grid by 2040

To support the development of clean energy in this competitive environment, contracts for Renewable Energy Credits (RECs) between the state and developers were established. According to the New York State Energy Research and Development Authority (NYSERDA), 26.8% of the state's electric load was served by renewable resources in 2018.[2] The CLCPA calls for growing the portion of load served by renewable resources to 70% by 2030. Looking beyond 2030, the CLCPA requires a zero-emission grid by 2040.

At the federal, state, and local levels, public policy initiatives are shaping the grid of the future. How the grid is operated to maintain reliability and economic efficiency while achieving these policies requires careful and informed operations, market design, and planning. From this perspective, the NYISO is examining a number of public policy initiatives, and engaging stakeholders and policymakers to identify the challenges and opportunities these initiatives may present to bulk power system reliability and efficiency.

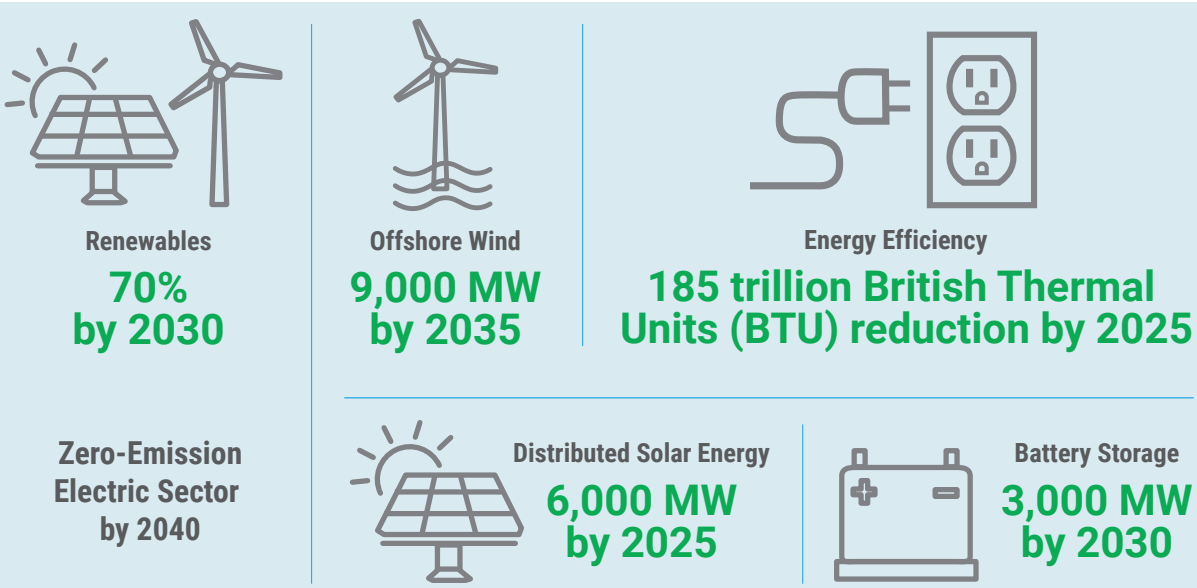
Summary Table of Key Environmental Regulations and Energy Policies

PUBLIC POLICY INITIATIVE	POLICYMAKING ENTITIES	PUBLIC POLICY GOALS	PUBLIC POLICY IMPLICATIONS
Climate Leadership and Community Protection Act	New York State Public Service Commission, New York State Energy Research and Development Authority, New York State Department of Environmental Conservation, Climate Action Council	**6,000 MW** of distributed solar installed by 2025, **185 trillion** BTU reduction in total energy consumption, including electrification to reduce fossil fuel use in buildings by 2025, **3,000 MW** of storage installed by 2030, **70%** of load supplied by renewable resources by 2030, **9,000 MW** of Offshore Wind Installed by 2035, **100%** of load supplied by zero-emissions resources by 2040	**Transformation of the power grid,** necessitating examination of market structures, planning processes, flexible load, and investment in bulk power system infrastructure
Indian Point Deactivation	Agreement between New York State and Entergy	Deactivate Indian Point units 2 and 3 by **2020** and **2021**, respectively	The NYISO issued a deactivation assessment finding no reliability need associated with loss of Indian Point's **2,311 MW** assuming the addition of certain expected resources. Subsequently, unit 2 deactivated on April 30, 2020. Unit 3 is scheduled to deactivate in **April 2021**
New York City Residual Oil Elimination	City of New York	Eliminate combustion of fuel oil numbers 6 and 4 in New York City by **2020** and **2025,** respectively	**2,946 MW** of installed capacity affected by rule
CO_2 Performance Standards **for Major Electric Generating Facilities**	New York State Department of Environmental Conservation (DEC)	Establish restrictions on carbon dioxide emissions for fossil fuel-fired facilities in New York by **2020**	As of **April 2020,** all coal-fired generation facilities supplying the bulk power system deactivated. NYISO generator deactivation assessments found no reliability needs associated with these deactivations
Regional Greenhouse Gas Initiative (RGGI)	New York and other RGGI states	Reduce carbon dioxide emissions cap by 30% from 2020 to 2030 and expand applicability to currently exempt "peaking units" below current 25 MW threshold	The NYS DEC proposed to expand applicability in NYS to generators of **15 MW** or greater, whereas currently rules do not apply to generators **less than 25 MW**
"Peaker Rule" **Ozone Season Oxides of Nitrogen (NOx) Emissions Limits for simple cycle and regenerative combustion turbines**	New York State Department of Environmental Conservation (DEC)	Reduce ozone-contributing pollutants associated with New York State-based peaking unit generation. Compliance obligations phased in between **2023** and **2025**	DEC rule impacts approximately **3,300 MWs** of peaking unit capacity in New York State. The NYISO is analyzing compliance plans through its Reliability Needs Assessment (RNA) to determine whether they trigger reliability needs
NYS Accelerated Renewable Energy Growth and Community Benefit Act	Office of Renewable Energy Siting (ORES) within the NYS Department of State, New York State Public Service Commission, New York State Energy Research and Development Authority (NYSERDA)	Provides for an accelerated path for the permitting and construction of renewable energy projects other than the Article 10 power plant siting law, calls for a comprehensive study to identify cost-effective distribution, local and bulk electric system upgrades to support the state's climate goals, and to file the study with the New York State Public Service Commission	Intended to help **accelerate siting of eligible renewable resources** in support of state policy goals. Intended to establish new transmission investment priorities to facilitate the achievement of state policies

Discussion of Key Environmental Regulations & Energy Policies

Climate Leadership and Community Protection Act (CLCPA)

On July 18, 2019, Governor Cuomo signed the Climate Leadership and Community Protection Act (CLCPA), codifying into law the following measures:



The CLCPA created a 22-member Climate Action Council (CAC) to establish a roadmap for how the state will work towards these goals. That council is co-chaired by the President of NYSERDA and the Commissioner of the Department of Environmental Conservation (DEC) and consists of relevant state agencies and legislative appointees. The CAC will develop many of the implementation details of the CLCPA, including a roadmap of policies needed to achieve the law's mandates. The CLCPA establishes that the CAC should develop a draft scoping plan by the end of 2022 and deliver a final plan to the Governor and the Legislature by the end of 2023.

Indian Point Deactivation

On January 9, 2017, Entergy and New York State announced an agreement to close Indian Point units 2 and 3 in 2020 and 2021, respectively. Following receipt of a deactivation notice from Entergy on November 13, 2017, the NYISO evaluated the proposed deactivation as part of the required generator deactivation assessments it performs for proposed generator retirements. In its analysis, the NYISO assumed that certain power plants then under construction would enter into service. Based on the study's assumptions, the NYISO concluded that the proposed Indian Point deactivation did not result in a reliability need. Subsequent reliability planning studies have not altered this outlook. Additional resources identified in the assessment have entered into service and, on April 30, 2020, Indian Point unit 2 deactivated. The NYISO anticipates that Indian Point unit 3 will deactivate by April 30, 2021 without causing a reliability need.

New York City Residual Oil Elimination

New York City passed legislation in December 2017 that will prohibit the combustion of fuel oil Numbers 6 and 4 within utility boilers in New York City by 2020 and 2025, respectively. The rule is expected to impact 2,946 MW of generation in New York City. Many generators in New York City that are connected to the local gas distribution network are required to maintain alternative fuel combustion capabilities. In addition, the New York State Reliability Council (NYSRC) has a minimum oil-burn requirement rule that is intended to ensure that electric system reliability will be maintained in the event of gas supply interruptions.

2,946 MW

of New York City generation may be affected by the residual oil elimination legislation.

Generators have taken steps to convert their facilities to comply with the law. While oil accounts for a relatively small percentage of the total energy production in New York State, it is often called upon to fuel generation during critical periods, such as when severe cold weather limits access to natural gas. **Dual-fuel capability serves as both an important tool in meeting reliability and an effective economic hedge against high natural gas prices during periods of high demand for natural gas.**

Carbon Dioxide Performance Standards for Major Electric Generating Facilities

The DEC adopted regulations that limit carbon dioxide emissions from existing fossil fuel-fired generators. As a result, approximately 860 MW of coal-fired generation exited the market by April 2020, eliminating coal-fired generation as a supply resource on the bulk power system in the state. New York's coal-fired generation accounted for less than 1% of the total energy produced in the state in 2019. The NYISO assessed these deactivations and concluded that they would not result in reliability needs.

Regional Greenhouse Gas Initiative (RGGI)

RGGI is a multi-state carbon dioxide emissions cap-and-trade initiative requiring affected fossil fuel generators to procure carbon dioxide emissions allowances. The costs for these allowances are factored into the costs of operating fossil fuel-fired generators. Suppliers seek to recover these costs through competitive offers in the wholesale electricity markets. Through this initiative, each participating state determines a set number of allowances, the majority of which are collectively auctioned to generators or other stakeholders. For the initiative to be successful at reducing carbon dioxide emissions, the level of available allowances is established in advance and lowered over time to encourage generators to invest in emissions reduction strategies or prepare for increasing costs associated with procurement of the allowances.

The New York State DEC issued proposed RGGI regulations that would cap New York's carbon dioxide emissions at approximately 21 million tons by 2030. In 2019, New York generators emitted approximately 24.6 million tons of carbon dioxide. The proposed rule seeks to expand applicability to generators of 15 MW or greater, whereas currently RGGI rules do not apply to generators less than 25 MW. New Jersey re-joined the initiative in 2020. Other regional states, such as Virginia and Pennsylvania, are considering joining RGGI in the future. The expansion of the RGGI region and anticipated changes to program design features may affect the dynamics of allowance cost and availability going forward. Tighter requirements through RGGI, however, are not likely to trigger reliability concerns.

Peaker Rule: Ozone Season Oxides of Nitrogen (NOx) Emission Limits for Simple Cycle and Regenerative Combustion Turbines

In December 2019, the DEC issued requirements to reduce emissions of smog-forming pollutants from peaking generation units.

Combustion turbines known as "peakers" typically operate to maintain bulk power system reliability during the most stressful operating conditions, such as periods of peak electricity demand. Many of these units also maintain transmission security by supplying energy within certain areas of New York City and Long Island — known as load pockets. Load pockets represent transmission-constrained geographic areas where electrical demand can only be served by local generators due to transmission limitations during certain operational conditions.

The Peaker Rule, which phases in compliance obligations between 2023 and 2025, will affect approximately 3,300 MW of simple-cycle turbines located mainly in the lower Hudson Valley, New York City and Long Island. The rule required peaking unit owners to submit compliance plans to the DEC in March 2020. These generator compliance plans will inform the NYISO's longer-term *2020 Reliability Needs Assessment* (RNA).

The *2019-2028 Comprehensive Reliability Plan* (CRP) included a scenario analysis that identified resource deficiencies in New York City and Long Island resulting from the deactivation of all of the affected peakers. The 2020 RNA will determine if reliability needs arise on the system from 2021-2030 including consideration of generators filed compliance plans. If so, the NYISO will solicit long-term market-based solutions, including new resources, and regulated solutions, such as new transmission, to address the expected shortfalls. If a peaker intends to deactivate, the NYISO will also address the reliability implications of these deactivations through its short-term reliability planning process. The regulations include a provision to allow an affected generator to continue to operate up to two years, with a possible further two-year extension, after the compliance deadline if the generator is designated by the NYISO or the local transmission owner as needed to resolve a reliability need until a permanent solution is in place.

NYS Accelerated Renewable Energy Growth and Community Benefit Act

In an effort to speed up the siting and construction of large-scale clean energy projects, Governor Cuomo and the state Legislature passed the Accelerated Renewable Energy Growth and Community Benefit Act in April 2020. The act provides an accelerated path for permitting and constructing renewable energy projects by establishing a new Office of Renewable Energy Siting (ORES) within the New York State Department of State to oversee siting for renewable generators larger than 25 MW. Renewable generators between 20 and 25 MW, usually subject to a local environmental review, can opt into this state-administered process, as can eligible renewable projects currently in the Article 10 process. The act directs ORES to:

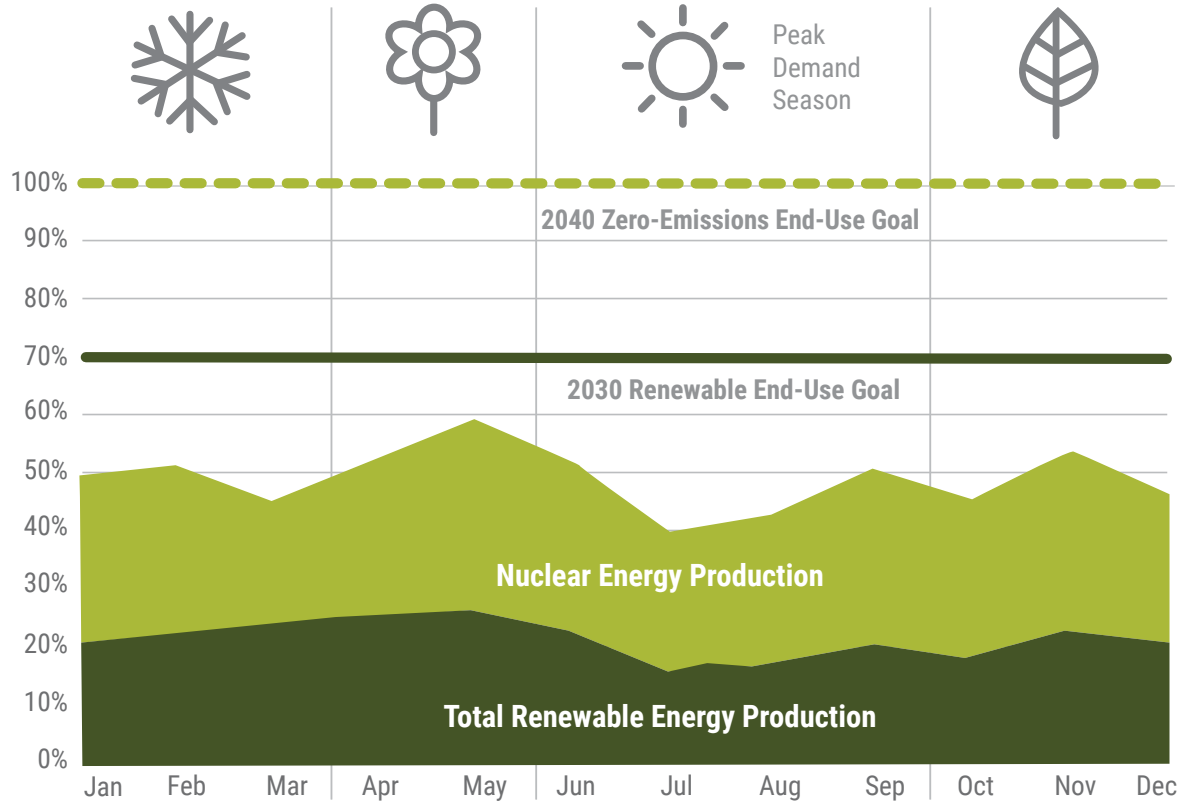
- Establish uniform regulations and standards encompassing the environmental impacts common to large, renewable energy projects, and identify mitigation measures to address those impacts within 1 year.
- Ensure that applications are acted upon within one year, or 6 months in the case of projects seeking to locate at former commercial and industrial sites.

The act also directs the New York State Department of Public Service, in consultation with NYSERDA, the New York Power Authority, the Long Island Power Authority, the investor-owned utilities, and the NYISO, to conduct a comprehensive study to identify cost-effective distribution, local and bulk electric system upgrades to support the state's climate and clean energy policies. This study is to be completed by December 29, 2020 and filed with the PSC. The PSC will commence a proceeding leading to a transmission investment plan utilizing the NYISO's Public Policy Process to select projects, while enabling the PSC to designate NYPA, either on its own or with others, to carry out projects needed expeditiously to achieve CLCPA goals.

Markets & Reliability Processes Must Evolve to Enable New York's Energy Goals

While energy markets in New York have produced efficiency gains, supported investment in cleaner technologies, and delivered emissions reductions, the requirements and timelines associated with the CLCPA seek greater gains in renewable energy production in the next 10 years than have been realized in the past 20 years.

Figure 12: **Production of In-State Renewables and Zero-Emission Resources Relative to 2019 Load**



This chart illustrates the monthly production of in-state renewable and nuclear generation in 2019 and highlights the magnitude of the effort necessary to meet the state's goals. It also illustrates the seasonal nature of this challenge. The relative contribution from wind resources tends to wane in the summer months, when load typically increases. Solar production is generally lower in the winter months. Furthermore, the goals for 2030 and 2040 are with respect to the end-use energy consumed, and New York renewable and emission-free energy production may not all be consumed within New York.

56%

of New York's zero-emission generation in 2019 was from nuclear resources

Nuclear resources currently contribute significantly to zero-emission generation levels in New York State. Nuclear resources accounted for roughly 56% of all zero-emission generation in 2019. Looking forward, this level of contribution will be impacted by the deactivation of the Indian Point nuclear power plant units in 2020 and 2021. The loss of output from these units will create potential challenges to achieving carbon dioxide emissions reduction goals.

Properly designed competitive markets and flexible reliability processes will be important to realize the state's energy goals while minimizing costs and risks to ratepayers. To the extent that the CLCPA leads to the elimination of all fossil fuel-based resources supplying the grid, the carbon-free resources supplying the grid will need to offer comparable dispatchable capabilities to meet electricity demand currently provided by the fossil fuel resources. Fossil fuel plants can typically be dispatched to a rated output level for extended periods while also offering a level of flexibility to ramp up or down as needed to continuously balance load and supply. Outside of hydro generation, renewable resources tend to be intermittent and, by definition, unable to follow dispatch signals from the grid operator to increase production in the same manner as fossil fuel resources. Battery storage offers the flexibility needed to follow dispatch signals, but is limited in duration. For example, in the 2019-2028 CRP, the NYISO determined that the deactivation of peaker units led to resource gaps of up to 14 hours in New York City and 15 hours on Long Island. Storage resources are currently limited in their ability to supply the grid for such durations on a daily basis due, in part, to the time needed for recharging. The elimination of fossil fuel resources will necessarily require replacement with a portfolio of zero-emitting resources and energy storage resources that can match, individually or collectively, the capabilities of fossil fuels.

The potential operational limitations of zero-emissions resources will have implications for system reliability. Today, the primary measure of reliability is resource adequacy, meaning that sufficient supply, demand response, and import capabilities exist to meet the expected peak demand plus any reserve margin requirements. On a system that is more heavily dependent upon wind, solar, and battery storage, reliability concerns may arise over energy shortfalls if intermittent supplies are unavailable and storage capabilities are limited in duration.

Moreover, the outage risk of individual fossil fuel-based generators is generally independent of the outage risk of any other resources supplying the grid. On the contrary, individual wind and solar generators may be simultaneously affected by regional weather conditions, such as extended periods of low wind. These differences pose a challenge to maintaining resource adequacy and transmission security requirements that will be addressed in the NYISO's evolving markets and planning processes. In collaboration with stakeholders and policymakers, the NYISO is pursuing such changes.

The NYISO is currently conducting the 2019 CARIS Phase 1 Study. As part of this study, the NYISO is analyzing the CLCPA requirement that renewable energy resources supply a minimum of 70% of the electricity delivered in the state in 2030. This "70 x 30" scenario will help identify opportunities for transmission investment that could assist in un-bottling renewable energy to facilitate achievement of the state's renewable energy production goals.

In developing approaches to the grid in transition, the NYISO conducted a reliability gap analysis to identify ways in which the transition towards intermittent resources could lead to operational circumstances that may violate system reliability requirements.

The analysis included potential areas that the NYISO must be prepared to address in order to continue to meet mandatory reliability standards, such as:

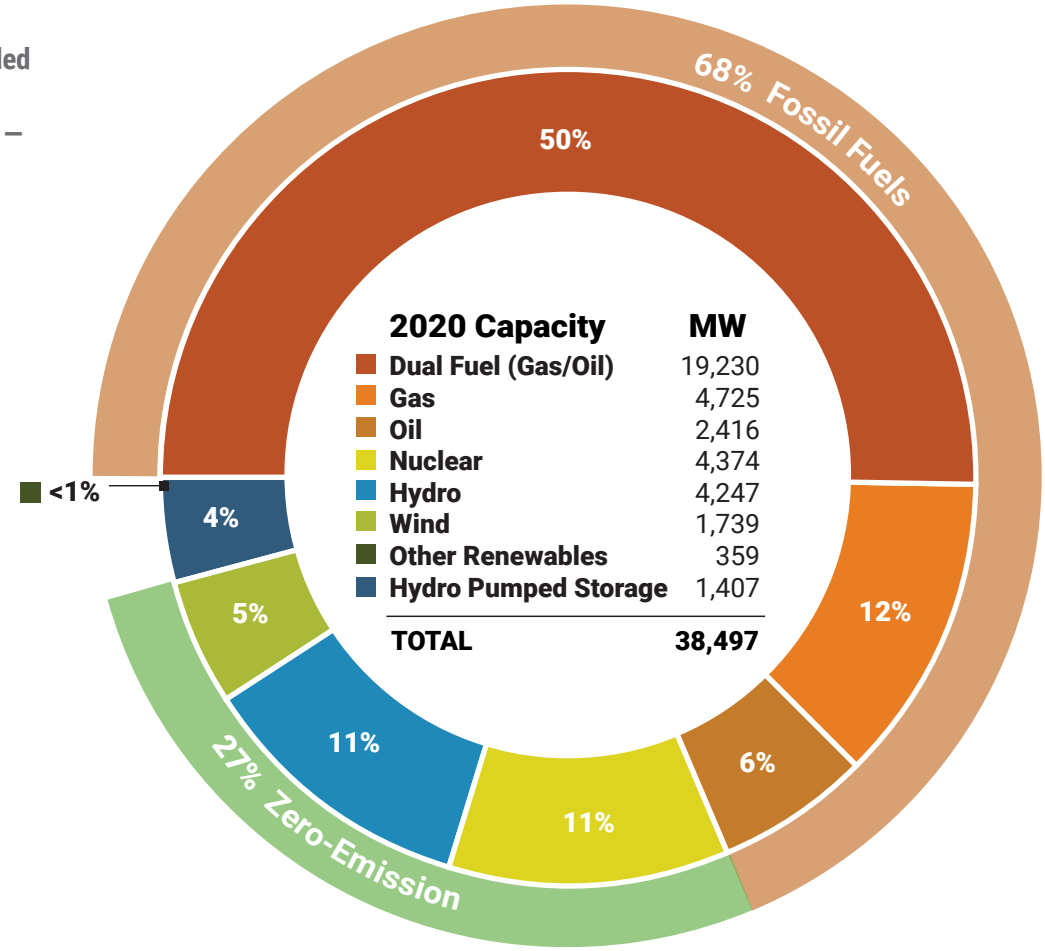
- **Maintaining ability to balance load and generation:** balancing high levels of intermittent generation with system demand that may be difficult to forecast in real-time operations.
- **Maintaining ten-minute operating reserves:** high levels of intermittent resources may result in challenges to maintaining sufficient ten-minute operating reserves and disturbance-control performance requirements.
- **Maintaining total thirty-minute operating reserves:** high levels of intermittent resources may lead to challenges in meeting operating reserve requirements in response to longer-term variations in generation levels from intermittent generation.
- **Maintaining ability to meet daily energy requirements:** reliance on high levels of intermittent resources and limited energy storage resources may present challenges to meeting control-performance requirements and daily energy requirements in real-time operations.
- **Maintaining reliable transmission operations:** it may become difficult to forecast system and locational demand requirements in real time when operating under high levels of intermittent generation.
- **Maintaining black start capability:** The NYISO may be challenged to effectively restore the system within expected timeframes following a blackout given a system with high levels of intermittent generation.
- **Maintaining voltage support capability:** The NYISO may be challenged to meet voltage performance requirements with high levels of intermittent generation.
- **Maintaining frequency response capability:** The NYISO may be challenged to meet frequency performance requirements for a power system with high levels of intermittent generation.
- **Maintaining resource adequacy:** The NYISO may be challenged to maintain acceptable levels of resource adequacy.
- **Maintaining the ability to manage supply resource outage schedules:** The NYISO may be challenged to manage supply resource maintenance outage scheduling.

None of the identified potential reliability gaps represent near-term concerns.

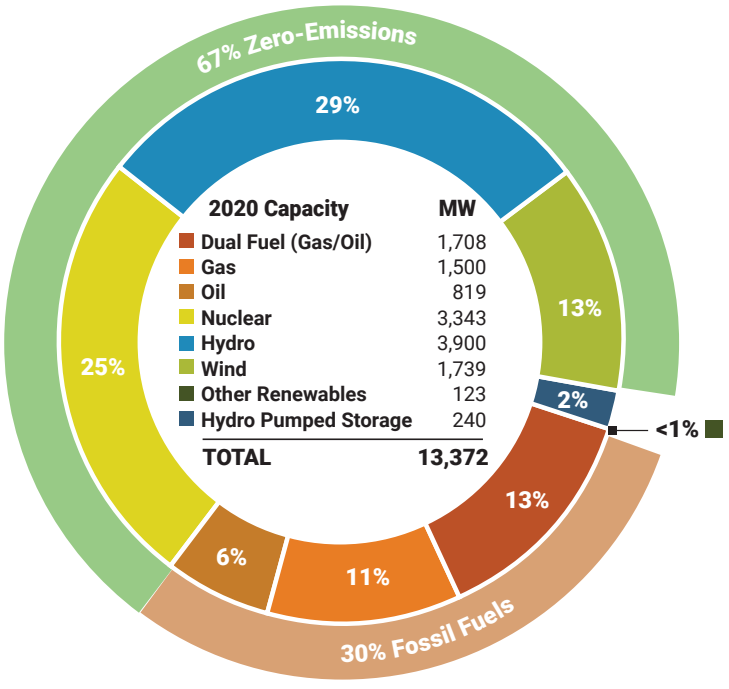
However, the challenge ahead for the NYISO is to design and implement a portfolio of market products, reliability planning, and operational enhancements that facilitate achievement of clean energy policies while maintaining system reliability through the competitive wholesale electricity markets. The challenge for the industry is to further expand and develop the operational capabilities of the types of clean energy technologies that are expected to interconnect to the grid.

Figure 13:
Summer Installed Capacity (MW) by Fuel Source — Statewide, Upstate & Downstate New York: 2020

NYCA Summer Installed Capacity



Upstate Summer Installed Capacity (Zones A-E)



Downstate Summer Installed Capacity (Zones F-K)

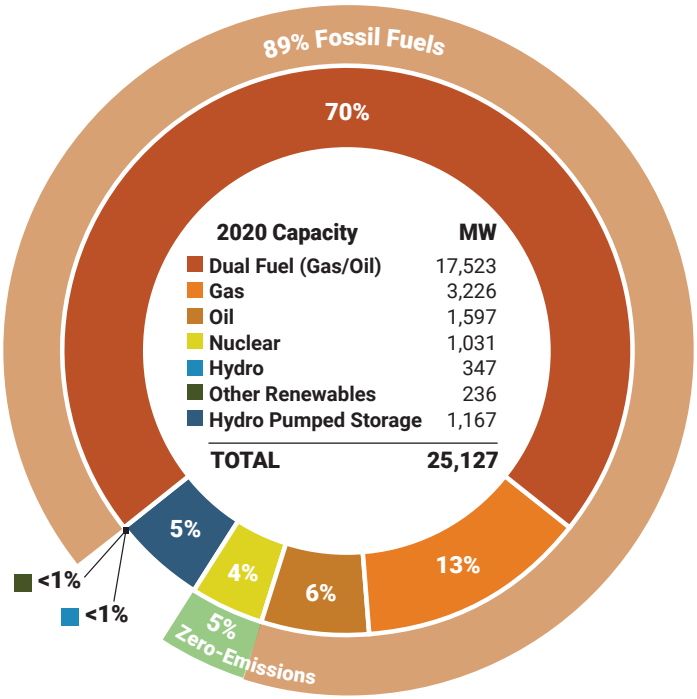
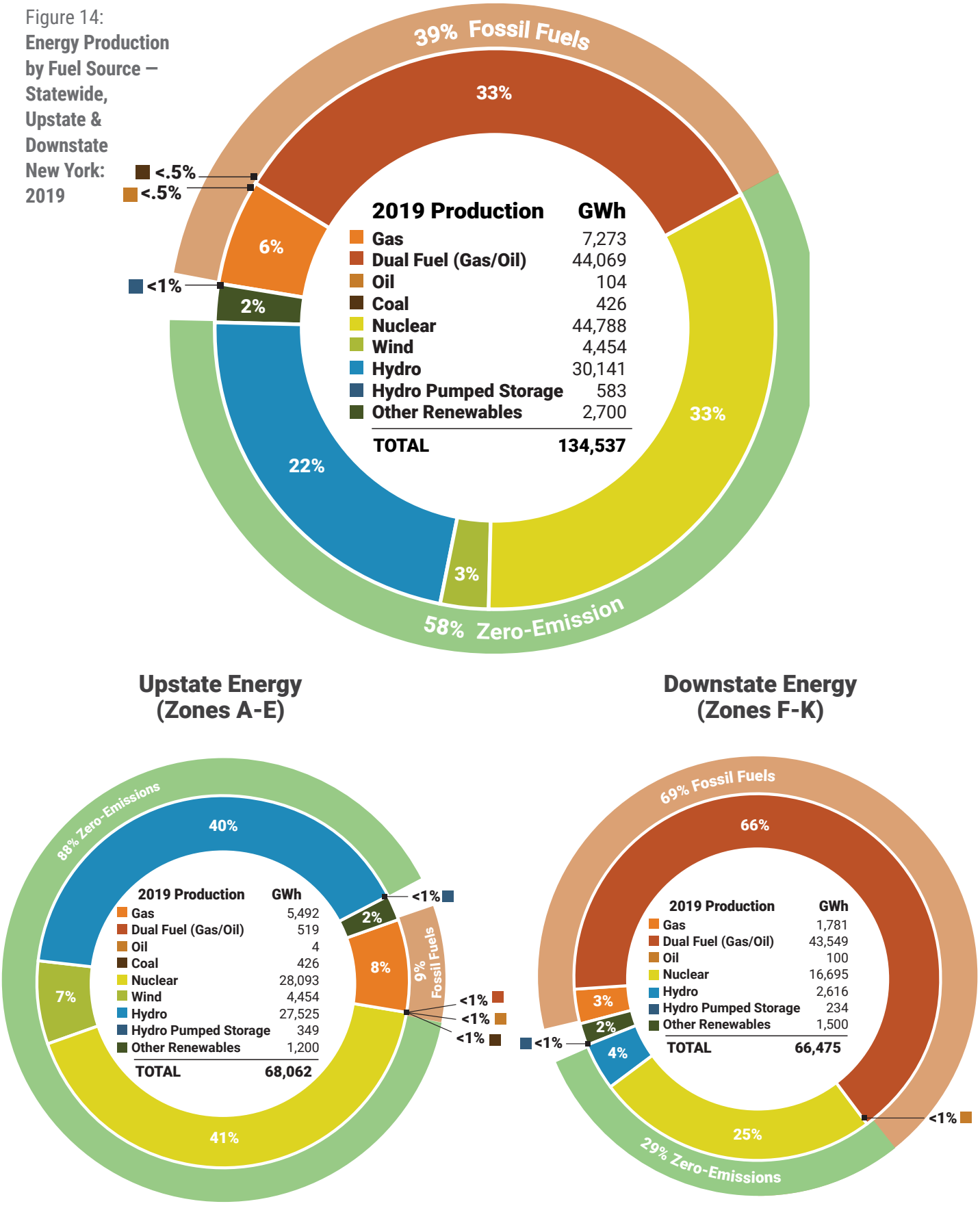


Figure 14:
Energy Production by Fuel Source — Statewide, Upstate & Downstate New York: 2019



Competitive Markets for a Grid in Transition

Overview

One of the main drivers behind introducing competitive wholesale electricity markets was to shift the risk and cost consequences of investment decisions from consumers to the owners of generation and other resources. Wholesale electricity markets harness competition to improve economic efficiency and encourage innovation while shifting risk to investors who are best able to manage it. Asset owners who are more responsive to system conditions and most efficient will thrive in the market and lower the costs to consumers for maintaining reliability.

Wholesale energy and ancillary services markets provide least-cost dispatch and maintain short-term operational reliability. Capacity markets work in tandem with the energy and ancillary services markets to help meet least-cost, longer-term resource adequacy objectives.

12,512 MW
of new generation has been developed since 2000.

Electricity markets provide a framework to facilitate change in the power system. The wholesale markets have played a significant part in meeting New York's environmental goals since the inception of the NYISO. Since 2000, New York's generation fleet has evolved to become markedly cleaner and more efficient. 12,512 MW of new generation has been developed, with the locations thereof informed by locational energy and capacity price signals. **Price signals from the NYISO's markets have encouraged more efficient resources to enter the market, while at the same time signaling less efficient generation to exit the market.** These locational signals inform investors when to add generation, and where to invest in new resources on the bulk power system to most efficiently serve consumer needs. Competitive market pricing has also contributed to 8,642 MW of older and less efficient facilities retiring or suspending operations and being replaced by cleaner and more efficient technologies.

In 2020, the NYISO implemented a new Energy Management System/Business Management System (EMS/BMS) software platform. The project is a strategic investment in grid reliability and market operations, which establishes a long-term platform to support the evolution of our market design and grid operations capabilities as we anticipate the needs of the grid of the future.

Evolving Energy Markets to Meet Changing Needs

The NYISO's wholesale markets will continue to successfully fulfill the mission and goals of reliability and economic efficiency. They can also serve as an effective platform for facilitating achievement of New York State policy objectives. The NYISO continuously engages stakeholders and policymakers in developing plans to meet the future challenges expected to arise from a grid characterized by high levels of energy supply from intermittent renewable resources and DERs.

The NYISO has already identified several recommended market design enhancements. However, as technologies change and the asset mix evolves, wholesale markets will need to evolve as well. The wholesale market enhancements presented below are recommended for implementation in the next five years, through 2024.

Figure 15: **Recommended Enhancements Requiring Immediate Attention**

MARKET ENHANCEMENT OPPORTUNITY	DESCRIPTION
ENERGY & ANCILLARY SERVICE MARKET OPPORTUNITIES	
Carbon Pricing	Internalize the social cost of carbon dioxide emissions via a $/ton charge to participants in the energy and ancillary services markets. Implementation requires state support.
Enhance Energy & Ancillary Services	Enhance energy and ancillary pricing such that prices are consistent with real-time grid conditions and encourage supply and demand to respond to real time system conditions.
Energy Storage Resources	In 2018, the NYISO developed market rules for integration of energy storage resources in wholesale markets. FERC accepted these rules, which are expected to be implemented this year. Following the success of its energy storage resource design, the NYISO is exploring *Hybrid Storage Resource* market participation options.
Distributed Energy Resources	In 2019, NYISO worked with its stakeholders to develop a comprehensive set of rules to integrate Distributed Energy Resources into wholesale markets.These rules received FERC approval in January 2020 and are scheduled to go into effect in 2021.
CAPACITY MARKET OPPORTUNITIES	
Comprehensive Mitigation Review	A holistic evaluation of the NYISO's capacity market rules to evaluate how to modify NYISO market structures in a manner that preserves competitive price signals and economic efficiency while maintaining system reliability and supporting the CLCPA requirements.
Capacity Markets & Alignment	Develop enhanced capacity ratings for all supply resources that reflect the marginal contribution to meeting resource adequacy criterion, accounting for system dynamics, resource availability and performance (including the impact of outage correlations). Ongoing efforts include: ▪ Expanding Capacity Eligibility ▪ Tailored Availability Metric

Carbon Pricing Proposal

An obvious way to harmonize wholesale electricity markets with decarbonization goals is through carbon pricing. This is already done through the existing RGGI program, but at carbon price levels that are too low to support New York's objectives. The NYISO's Carbon Pricing Proposal can build on the success of the RGGI effort by introducing a "social cost" of carbon dioxide emissions into New York's competitive wholesale electricity markets. With passage of the CLCPA, New York State has set aggressive requirements for increased renewable energy production and carbon dioxide emissions reductions. The most efficient way to facilitate achievement of these requirements is through competitive markets that reflect the value of avoided emissions. Carbon pricing uses market-based price signals to incent reductions in emissions from fossil fuel-based generators while strengthening investment signals for carbon dioxide-free generation.

Carbon pricing would embed a cost per ton of carbon dioxide emissions in the sale of wholesale electricity, creating a price signal for investment in new clean energy resources, as well as for existing generators to minimize their carbon dioxide emissions through changes in operation, upgrades and efficiency improvements. It would also better align NYISO's wholesale electricity markets with New York State's environmental objectives. Simply stated, it rewards investment in cleaner energy technologies, making carbon dioxide-emitting energy prices comparatively higher than those of non-emitting resources. Leveraging a key benefit of New York's wholesale markets, carbon pricing is designed to help achieve the state's energy policy objectives while seeking to reduce the need for out-of-market payments to incentivize developing clean energy technologies.

The proposal has been extensively evaluated. An initial study by the Brattle Group found that carbon pricing would produce incremental reductions in carbon dioxide emissions while minimizing additional costs to consumers. This cost minimization largely stems from reducing the need for (or cost of) out-of-market payments to support the development of new clean energy resources. Carbon pricing also provides signals to spur investment in new, more efficient supply options to replace older, less efficient generation.

A recent, additional study on carbon pricing by the Analysis Group found the potential for significant benefits, including:

- **Long-term savings** to consumers

- **Reducing the consumer cost** of reaching a 100% carbon dioxide emissions free electricity supply

- **Helping to grow investment** in clean energy generation

- **Promoting innovation and improved efficiency** in fossil fuel-burning technology
- **Promoting innovation with incentives** to develop new supply-side and demand-side technologies, products, and services.

- **Improving public health** by encouraging the retiring or repowering of fossil fuel generators that emit the most carbon dioxide

- **Affirming New York State's position** as a national leader on climate change

Carbon Pricing next steps

1. If the state and NYISO stakeholders support moving forward with carbon pricing, stakeholders vote whether to approve carbon pricing wholesale market rules.

2. NYISO Board of Directors votes whether to integrate carbon pricing into New York's wholesale energy markets.

3. The Federal Energy Regulatory Commission considers acceptance of the NYISO's carbon pricing proposal.

4. The state sets the social cost of carbon as a price per ton of CO_2 emissions.

5. NYISO incorporates the state's carbon price into the wholesale energy markets.

▸ **Learn more:**
Watch a video on 'How Carbon Pricing Works' and the 'Top 10 Benefits of New York ISO's Carbon Pricing Plan' at www.nyiso.com/carbonpricing

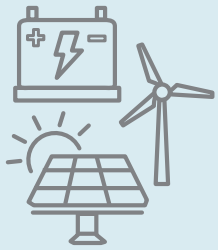
The NYISO and many of its stakeholders believe that instituting carbon pricing would help the state meet its clean energy objectives faster and more cost-effectively while preserving appropriate market-based price signals for maintaining grid reliability.

Carbon pricing has been recognized by leading economists as the fastest path to reduce carbon dioxide emissions. Carbon pricing proposals have been supported by organizations including the Climate Leadership Council and the Center for American Progress. A number of other countries are currently pursuing some form of carbon pricing in an effort to reduce their own carbon dioxide footprints. For more information on the proposal and the growing list of supporters for the initiative, please see the NYISO's carbon pricing page on its public website.

While the NYISO continues to see the implementation of carbon pricing as the most effective means to directly reflect the public policy goals of reducing carbon dioxide emissions into the markets, other energy and ancillary services markets enhancements to support the grid in transition are also being evaluated.

Energy and Ancillary Services Enhancements

The energy and ancillary services markets are designed to provide locational pricing signals for resources to deliver the services and capabilities needed to meet system conditions. Quick start, ramping, and load-following capabilities (*i.e.,* flexible and controllable operation) are needed for a system comprised of a large percentage of intermittent resources. An approach that emphasizes energy market pricing that reflects system conditions and ancillary services products that support operational requirements is important for incenting the needed attributes to meet demand and maintain grid reliability.



▸ What's an ESR?

As the grid evolves, ESRs' contribution to maintaining a reliable and cost-effective grid is growing. ESRs can promote reliability and efficiency, particularly when paired with intermittent renewable generation. At the NYISO, we continue to look for better ways to integrate ESRs into New York's wholesale electricity markets and harness the value that ESRs can bring to the grid.

▸ Capabilities & Benefits

- Provide regulation services
- Shift load
- Manage intermittent renewable energy
- Add to grid reliability
- Provide operating reserves
- Support Black Start service
- Reduce transmission congestion

Energy Storage Resources (ESRs)

Energy Storage Resources, which include batteries, flywheels, pumped storage, and compressed air storage, have unique capabilities that can help grid operators meet demand, manage the variability of intermittent resources, and potentially defer transmission upgrades. Their unique ability to withdraw from and inject energy into the grid can provide resource flexibility and grid resilience. ESRs can also help improve the cost effectiveness of the system by charging during periods of low demand and low prices, and supplying energy to the grid during periods of high demand when prices typically rise.

The Federal Energy Regulatory Commission (FERC) has approved a comprehensive set of rules that will allow the expansion of wholesale market participation for ESRs. The NYISO's ESR participation model will allow storage resources to self-manage their energy levels or to use the NYISO's energy level monitoring capabilities. The option of relying on the NYISO's capabilities to monitor and manage energy storage levels is intended to optimize storage resource availability for periods when they can best support bulk power system reliability.

The NYISO is engaging stakeholders in exploring a *Hybrid Storage Model* project, which seeks to develop market participation rules for generating resources co-located with ESRs. This project will build on work completed as part of the Energy Storage Resource and Distributed Energy Resource Integration initiatives to develop market rules that offer alternate accommodations for resources and ESRs that share a common interconnection point. Developing a method for hybrid resource participation in the wholesale markets will support policy efforts to integrate more clean energy into the grid.

▸ Examples of ESRs include:

Capacitors
Components that store potential energy in an electric field

Superconductors
Systems that store energy in a magnetic field

Pumped Hydro
Water stored in a reservoir to provide energy on demand

V2G
Vehicle-to-grid systems that use electric cars for energy storage

Thermal
Excess heat stored for later use

Lithium Batteries
Move lithium ions between positive and negative electrodes to store energy

Distributed Energy Resources (DERs)

The NYISO has been engaged in a multi-year effort to allow smaller and often shorter-duration resources to be eligible to participate in the NYISO markets. DERs offer the potential to make load more dynamic and responsive to wholesale market price signals, potentially improving overall system efficiencies. The DER Participation Model provides a means by which DER resources, through the use of aggregations, may participate in the NYISO markets. More recently, the NYISO rules began allowing "dual participation" of resources, which provides for DERs to serve both bulk-system and local distribution systems. As a next step, the NYISO will develop market concepts to encourage the participation of flexible load, which will become increasingly important as deployments of intermittent wind and solar resources rise to support New York's decarbonization goals.

Capacity Market and Alignment

For more than a century, "dispatchable" generation primarily supplied the grid, meaning grid operators could dispatch the output from these resources in real time to match changing load conditions. The CLCPA requires that 70% of energy consumed in the state be supplied by renewable energy sources by 2030. Many renewable resources are considered "intermittent" — solar power only works when the sun is shining; wind turbines only turn when wind is blowing. Intermittent resources are not fully dispatchable because of this dependence on weather conditions. An increased reliance on these resources will fundamentally change the manner in which the balance between supply and demand is maintained, and will require changes in how the NYISO manages the grid.

The NYISO has worked with stakeholders to create new, innovative rules for integrating energy storage technology and DERs onto the grid, including limited-energy resources that can provide capacity to the grid for a minimum of two hours. The NYISO continues to assess further opportunities to enhance our markets in response to the ongoing evolution of the grid. The NYISO outlined its approach through a recent report, entitled *The Grid in Transition,* which details a comprehensive approach to redesigning flexible, competitive electricity markets to create incentives that align with the changing needs of the grid.

▸ DERs & the Grid of the Future

New York PSC Resource Adequacy Matters Proceeding

On August 8, 2019, the New York State Public Service Commission (PSC) initiated a proceeding *"In the Matter to Consider Resource Adequacy Matters."* The proceeding intends to: assess the policy position the PSC should take with respect to resource adequacy; consider how public policies can best be aligned under existing market mechanisms such as the NYISO's Installed Capacity (ICAP) auctions or whether new alternative approaches should be pursued; and consider cost impacts and benefits to consumers under various resource adequacy mechanisms.

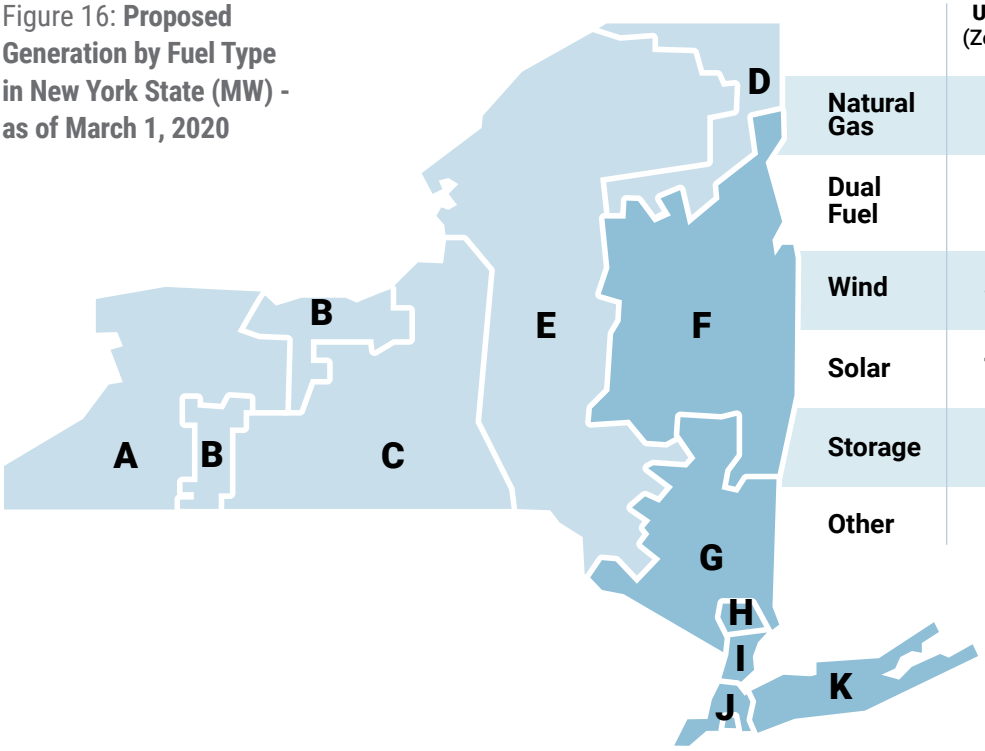
A central theme of the NYISO's comments[3] in this proceeding is that collaboration in the NYISO shared governance process can best leverage competitive markets to help facilitate achievement of the state's policy objectives. The NYISO cautioned that "unilateral attempts to change the NYISO's resource adequacy structures . . . are likely to result in extended delays and litigation with stakeholders that would impede New York's ability to achieve its objectives."

Many of the initial comments submitted to the Commission in this proceeding expressed support for the NYISO's recommended approach. A few commenters raised concerns about existing resource adequacy arrangements, but also expressed an openness to working towards market improvements. The breadth and depth of stakeholder support clearly demonstrates that the PSC should prioritize improvements to existing capacity market structures over pursuing alternative procurement models.

Comprehensive Mitigation Review

The NYISO and its stakeholders are reviewing the mitigation rules for its capacity market to create a balanced framework that preserves competitive price signals and economically efficient market outcomes required to maintain system reliability, but also enables the CLCPA goals. The NYISO is evaluating the current framework of Buyer-Side Market Power Mitigation (BSM) rules in consideration of a future with significant penetration of weather-dependent intermittent, energy storage, and distributed energy resources that are expected to result from policy objectives such as those found in the CLCPA. A recent example of this effort is the proposal to enhance the "Part A Exemption Test"

Figure 16: **Proposed Generation by Fuel Type in New York State (MW) - as of March 1, 2020**



	UPSTATE (Zones A-E)	DOWNSTATE (Zones F-K)
Natural Gas	1,999	3,099
Dual Fuel	0	215
Wind	5,112	16,432
Solar	7,939	2,074
Storage	1,741	6,800
Other	900	93

under the NYISO's "buyer-side" capacity market power mitigation measures. Continuing to evaluate the mitigation framework is an essential part to maintaining efficient resource entry and exit as the generation mix rapidly changes in the coming years.

The installed capacity market has undergone significant changes in both design and resource mix since the BSM measures were first implemented in May 2008. BSM rules were originally developed to evaluate traditional generators, but new resource types, such as battery storage, weather-dependent intermittent resources and DERs, are fundamentally different in design and operation. Additionally, these resources are more likely than traditional generator technologies to be partially funded by governmental entities to meet policy goals or promote environmental attributes. New rule sets and tests may provide a better evaluation of these resources for instances of buyer-side market power and thus result in more accurate BSM determinations.

Capacity Markets Enhancements

Improving market signals is important for the NYISO to prepare for the grid of the future, including capacity market enhancements to align resource incentives with the reliability needs of the grid.

Expanding Capacity Eligibility/Capacity Value Studies

Anticipating that shorter-duration resources will increasingly enter the markets in the upcoming years, the NYISO worked with its stakeholders to review the eligibility rules for its capacity market and proposed new rules to allow shorter-duration resources to participate. This new market design aligns participation rules with the reliability benefit that these resources can provide to the system. FERC accepted the NYISO's proposed tariff revisions to support the market design for the DERs.

Included in the proposal approved by FERC is a commitment to conduct periodic reviews of capacity market participation rules, which the NYISO will do in conjunction with its stakeholders every four years. Through Expanding Capacity Eligibility/Capacity Value studies, the NYISO will re-evaluate capacity values every four years to accurately reflect the reliability benefit of short duration resources.

Tailored Availability Metric

Resource incentives in the NYISO markets typically originate from energy market payments dependent upon real-time performance, or capacity market payments dependent upon resource qualification. The NYISO's tailored availability metric project ties these two concepts together by incenting resource performance and availability during peak load periods through capacity payments. Currently, when evaluating resource availability, all periods of operation are weighted equally. A tailored metric could weigh critical operating periods higher than others, under the assumption that these stressed conditions occur during peak periods. Tailored metrics will better indicate how much capacity resources will be allowed to sell in the market to more accurately reflect the reliability contribution of these resources.

Wholesale electricity markets have provided substantial benefits to New Yorkers. Engagement with policymakers and stakeholders to address the needs of the evolving grid will play an important role in helping to achieve the state's energy policy objectives while maximizing the benefits of wholesale markets for New York's energy consumers.

Planning for a Grid in Transition

Overview

The NYISO's planning processes provide independent and authoritative information to investors, stakeholders, and policymakers. The NYISO has been actively engaged in developing a series of improvements to our transmission planning processes to address the infrastructure needs in a rapidly changing power system. As the composition of the power grid changes and the pace of new technology development and investment accelerates, the NYISO's planning processes will continue to evolve to provide independent and authoritative information, and facilitate the reliability entry of expected new resources.

The NYISO's planning studies consider numerous factors in evaluating and informing potential system needs, including:

- The impact of changes in generation and transmission resources available to the electric system;
- Forecasts of consumer demand for electricity, including the impacts of energy efficiency and beneficial electrification initiatives on such demand, economic outlook data, and weather models; and
- The impact of the growth of behind-the-meter and other distributed energy resources.

Given the ongoing effects of the COVID-19 pandemic on businesses and the economy, near-term uncertainty around many of these factors has grown. According to published analysis, most economists expect a peak unemployment rate of 15-30%.[4] According to the U.S. Bureau of Labor Statistics, the U.S. unemployment rate in April 2020 reached 14.7%.[5] **Economic impacts such as these will lead to lower demand for energy from the grid, which the NYISO has observed. This unexpected change in conditions will have broader implications across the industry.**

6-7%

The NYISO reduced its annual energy consumption projection by 6-7% reflecting reductions that occurred as a result of the COVID-19 pandemic

Altered financial conditions and market uncertainty will affect the cost of capital, liquidity, and financing arrangements for utilities and developers seeking to invest in infrastructure and new generation.[6] The U.S. Energy Information Administration projects that, at the national level, COVID-19 impacts on electricity will cause a delay or cancellation of roughly 4.9 GW of previously planned capacity expansions through September 2020. According to analysts, many state programs for DER deployment and electrification are likely to become lower priorities and less economical as lower prices for fossil fuels make savings from such investments smaller or less plausible in the near-term, while reduced disposable income among consumers may make them more risk averse.[7]

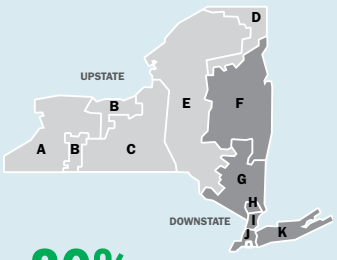
The NYISO continues to monitor the impacts of the COVID-19 crisis on these important planning considerations in an effort to keep policymakers, investors, and other stakeholders informed. NYISO has examined several economic scenarios associated with the crisis and issued a preliminary forecast on expected energy consumption reductions for the remainder of 2020. Based on these scenarios, the NYISO expects annual energy consumption for 2020 will be 6-7% lower than expected prior to the pandemic crisis.

Power Supply Trends

Since 2000, private power producers and public power authorities have added 13,969 MW of new generating capacity in New York State, including new power plants, upgrades to existing power plants, and power plants returning to service following a deactivation. This additional generation represents more than 35% of New York's current generating capacity.

Nearly 80% of that new generation has been developed in downstate portions of New York (Load Zones F-K), where power demand is greatest. New York's wholesale electricity market design, which includes locational based pricing and regional capacity requirements, encourages investment in areas where it is most needed.

Additions to New York's power-producing resources in upstate regions have primarily represented upgrades to existing power plants or the interconnection of new renewable resources sited in upstate regions based on physical factors such as the suitability of wind conditions for energy production and land availability.



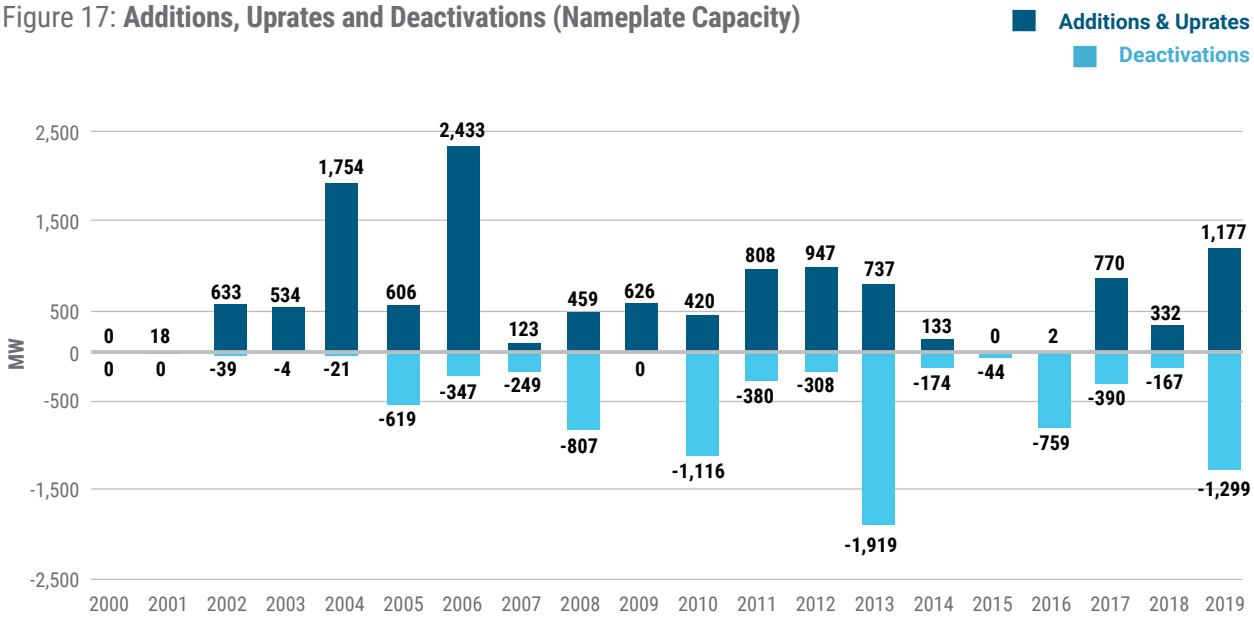
80%

of new generation has been developed since 2000 in downstate portions of New York (Load Zones F-K), where power demand is greatest.

Power Supply Expansion & Contraction Trends

As the demand for electricity and available supplies of power warrant new investment, new resources are built and/or existing facilities are upgraded to expand generating capacity. At the same time, existing resources may elect to deactivate in response to economic circumstances or facility conditions. As discussed throughout Power Trends, public policies play a role in both attracting investment in new resources, and influencing resource deactivation decisions. Policies such as the CLCPA are expected to attract new renewable, clean energy resources, while the New York State DEC's "Peaker Rule" requires generation owners to submit compliance plans which may include retrofitting, replacing, or deactivating existing peaking unit generation. As the statewide generation resource

Figure 17: **Additions, Uprates and Deactivations (Nameplate Capacity)**



mix changes in response to these policies, new challenges will arise in maintaining the long-term reliability of the New York electric grid. The NYISO continues to address these challenges through the Comprehensive System Planning Process and the Climate Change Impact & Resilience Study.

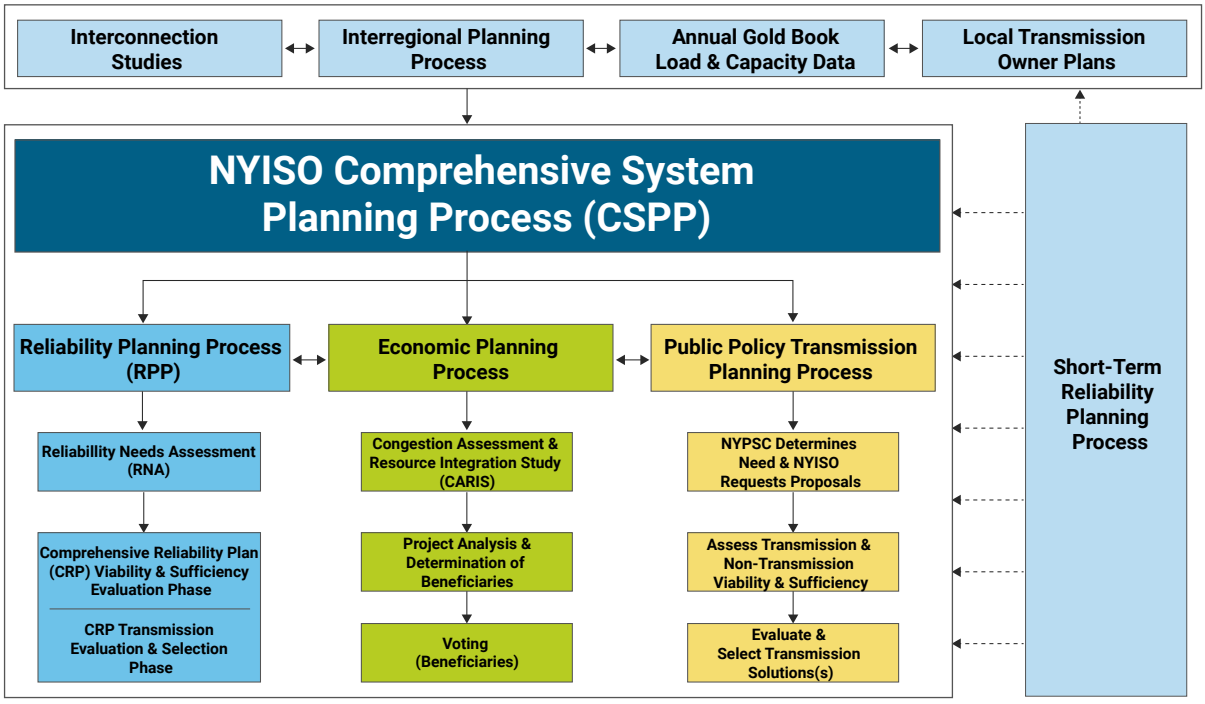
Excluding power plants that deactivated and subsequently returned to service, 12,512 MW of capacity from new generating units and unit upgrades have been added to New York's electric system since 2000. In that same timeframe, 8,642 MW retired or suspended operation. The pattern of expansion and contraction has ranged from the net addition of more than 2,000 MW between 2005 and 2006 to a net reduction of more than 1,100 MW between 2012 and 2013.

NYISO's Comprehensive System Planning Process Enhancements

The process of transmission planning continuously evolves to address the challenges of meeting infrastructure needs in a rapidly changing power system. In 2018, the NYISO began an initiative to examine how to improve its Comprehensive System Planning Process (CSPP) to be more responsive to evolving reliability, economic, and public policy needs. In 2018 and 2019, the NYISO pursued enhancements to its public policy process. The NYISO adopted new provisions that expedite the process of NYISO evaluation and selection from among competing transmission projects. FERC also approved tariff amendments that allow transmission developers to propose, and the NYISO to consider, cost containment commitments for transmission projects. These provisions enable the NYISO to better identify the more efficient or cost-effective transmission solutions to meet public policy transmission needs and protect ratepayers from project cost overruns.

NYISO planning processes must continue to be made to be more flexible to account for the increased pace of change on the grid in response to state policies that promote a rapid shift to clean energy technologies. To this end, the NYISO worked with stakeholders in 2019 to develop a quarterly reliability

▸ NYISO Comprehensive System Planning Process (CSPP)



planning process that will more nimbly and efficiently address near-term reliability needs as they arise. The resulting proposed Short-Term Reliability Planning process, which was accepted by FERC, will more efficiently identify and address any reliability needs that may arise in the near-term (*i.e.,* within the next five-years, with a focus on the initial three years).

The newly accepted rules also give the NYISO greater flexibility in identifying and responding to reliability needs that may arise due to rapid changes in the supply mix. In this new process, known as Short-Term Assessments of Reliability (STAR), the NYISO is implementing quarterly analyses that will focus on reliability needs arising on a rolling basis within the coming 5 years. This process enables the NYISO to focus its resources on efficiently identifying and addressing system reliability issues that occur in the short term, while freeing the biennial RNA to be more strategically focused on long-term reliability needs (years 4 through 10).

Generator Interconnection Queue Process Enhancements

The NYISO's interconnection processes are designed to identify potential adverse reliability impacts associated with new resources entering operation. The NYISO, in coordination with each connecting utility and any potentially affected systems (such as neighboring utilities), assesses the reliability impacts of a connecting resource to the grid. If studies identify any reliability issues, the interconnection study process identifies upgrades and their estimated costs to allow the resource to interconnect reliably.

As the composition of the power grid changes and the pace of new technology development and investment accelerates, the NYISO interconnection process is evolving to facilitate new entry. The sheer volume of supply resources seeking to interconnect to the grid has increased dramatically in recent years. To better facilitate this increase, the NYISO, in collaboration with the stakeholders, developed a comprehensive redesign of the interconnection study process in 2019. One proposal entails offering a new, abbreviated Expedited Delivery Study through which projects can request a deliverability evaluation outside of the Class Year Process. This enhanced process will enable developers to obtain capacity rights without having to go through an entire Class Year Study.

Combined with additional reforms, this new interconnection process will provide developers with more frequent opportunities and flexibility to obtain certainty over their interconnection costs and obligations and subsequently accelerate the interconnection of renewables and other new resources onto the grid.

The enhancements are being applied for the first time to the Class Year Study process currently underway. This Class Year Study is the largest

Listen now

Episode 4: Zachary G. Smith, VP, System and Resource Planning, talks about 'Demystifying the Interconnection of Renewables to the Grid'.
www.nyiso.com/podcast

▸ Interconnection Queue:

A queue of merchant transmission and generation projects that have submitted an Interconnectoin Request to the NYISO to be interconnected to the state's electric system. Depending on the level of proposed capacity, most projects must undergo three studies before interconnecting to the grid: a *Feasibility Study* (unless parties agree to for go it), a *System Reliability Impact Study* (SRIS), and a *Facilities Study*.

▸ Class Year:

A group of supply projects seeking to interconnect to the transmission system in similar timeframes, and which have reached similar milestones in their development efforts. These projects are studied to assess the cumulative impact they may have on the system and determine the costs to mitigate those impacts.

ever, tripling the number of projects in the previous Class Year, the majority of which are renewable generation or energy storage. The NYISO anticipates that these new rules will expedite and enhance the interconnection study process for developers.

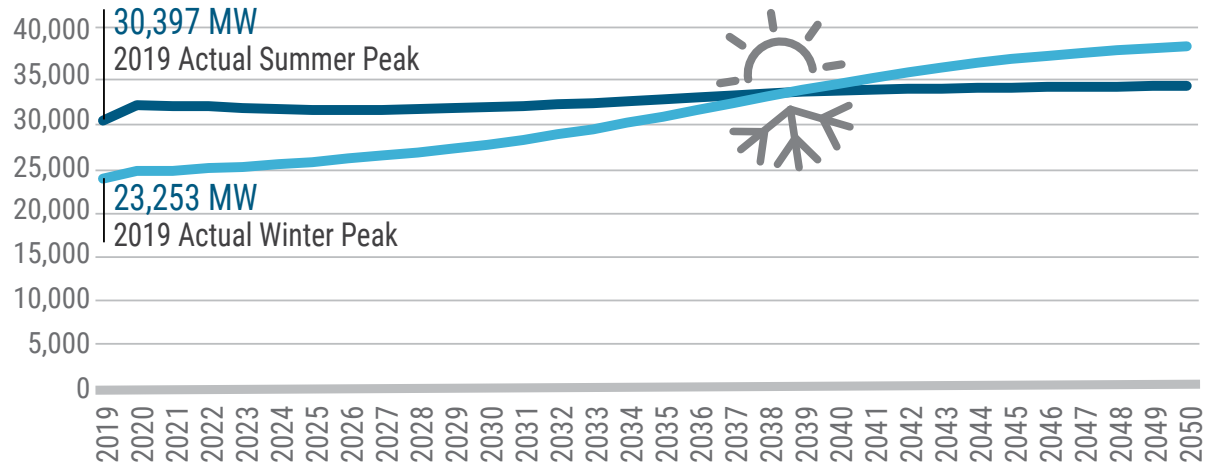
Assessing Future Scenarios Driven by Climate Change and State Policies to Address it

The NYISO is undertaking a multi-phase Climate Change Impact & Resilience Study,[8] which initially attempts to assess the potential implications for load associated with climate change and the state's policies to promote beneficial electrification. The study projects load and demand forecasts beyond the normal 10-year planning horizon to evaluate the potential impacts rising temperatures and state policies might have on system loads through 2050. This study will help inform future market, planning and operations enhancements that might be necessary to meet system needs and conditions as demands on the grid change over time. The study is being conducted in three phases. Phase 1 of the study, which was completed in 2019, developed long-term forecasts for energy and demand, and evaluated statewide temperature and humidity trends. It also constructed long-term forecast scenarios that reflect the potential impacts of state policies to address climate change, including the CLCPA, accelerated adoption of energy efficiency, and beneficial electrification measures.

Phase 1 concluded that, on an annual basis, increasing temperatures have a modest impact on system energy requirements. While some increase in cooling load is expected for summer peak-cooling requirements, diminished heating load for winter partially offsets this. Further, the state's energy efficiency targets are expected to mitigate the impact of increasing temperatures on energy use over the next two decades.

In terms of peak demand, the study found that by 2050, increasing temperatures will potentially add between 1,600 and 3,800 MW to summer peak load requirements. The study also found that beneficial electrification programs encouraging consumer adoption of electric vehicles and conversion building heating systems to electricity will likely shift peak demand on New York's bulk power system from summer to winter.

Figure 18: **2020 Gold Book Baseline Summer and Winter Peak Forecasts**



The NYISO leveraged the climate study's assumptions about electrification to inform its own winter and summer peak forecasts, which it issued in the *2020 Gold Book*. Notably, the NYISO's peak forecasts suggest that the impacts of EVs and increased reliance on electricity for heating will lead to the system peak shifting from summer to winter as early as 2039.

Energy efficiency initiatives, technology improvements, and demand response can work to manage and reduce the magnitude of increases in peak demand, but greater economy-wide reliance on electricity will inherently result in load and demand increases. Phase 1 did not address the role these tools could play in mitigating increased demand.

In 2020, the NYISO is undertaking Phase 2 of the *Climate Change Impact & Resilience Study*, which focuses on the CLCPA requirement of 100% zero-emissions resources to supply the grid by 2040. The study will incorporate the Phase 1 load forecasts and assess whether resource deficiencies may arise under various assumptions and scenarios related to the impact of climate change. A future third phase of the study will seek to identify potential market, system planning, and operational enhancements that could help to ensure the availability of adequate resources and attributes needed to maintain bulk power system reliability.

Comprehensive Reliability Plan and Reliability Needs Assessment

The 2020-2021 Reliability Planning Process cycle has begun developing the *2020 Reliability Needs Assessment* (RNA), which serves as the foundational study used in the development of the *NYISO Comprehensive Reliability Plan* (CRP). Each RNA is performed to evaluate electric system reliability for both resource adequacy and transmission security over a 10-year study period. If the RNA identifies any violation of reliability criteria for the bulk power system in New York State, the NYISO issues a report quantifying the general location and amount of capacity needed to resolve the identified reliability need.

▸ Download the RNA & CRP Reports: Visit www.nyiso.com/library under Planning Reports to download the CARIS, Gold Book, Public Policy Planning Reports, and other NYISO planning reports.

Leveraging the power of competition and seeking to minimize ratepayer costs, the NYISO responds to identified reliability needs by soliciting market-based solutions, which may entail investment in transmission, new supply resources, or demand-reduction measures. To ensure that solutions are available where and when needed, the NYISO also designates one or more responsible transmission owners to develop regulated backstop solutions to address each identified reliability need, while other developers can also provide alternative regulated solutions. The RNA is conducted by the NYISO with ongoing stakeholder engagement.

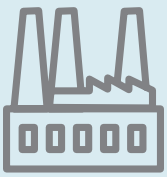
Following the issuance of the RNA, the CRP details the NYISO's plans for continued reliability of the bulk power system over the ten-year planning horizon. The CRP also updates assumptions critical to determining system needs and evaluates solutions proposed to resolve identified reliability needs found in the RNA. Market-based solutions to reliability needs are favored over regulated solutions. If the market does not adequately respond to an identified need, the NYISO will secure reliability through regulated backstop solutions developed by incumbent transmission owners, or alternative-regulated solutions by other developers. The NYISO selects the more efficient or cost-effective regulated transmission solution that is eligible for cost recovery under the NYISO's tariff.

NYISO's CRP and RNA

The *2019-2028 CRP* was a critical first step to effectively plan for the New York State Department of Environmental Conservation's (DEC) Peaker Rule. The *2019-2028 CRP* included an assessment of the impacts to system reliability from the potential deactivation of all generators impacted by the new rule. The scenario also reflected the deactivation of the Indian Point nuclear units, as well the deactivation of all remaining coal units in accordance with the DEC rule on carbon dioxide emissions from existing sources. This scenario identified reliability needs associated with the potential loss of the affected peakers and the amount of resource capacity needed to maintain reliability. If all of the generators affected (approximately 3,300 MW) were to deactivate without replacement resources or system reinforcements, the transmission system would be unable to reliably serve the forecasted load within specific load pockets in New York City and Long Island, as well as across Southeast New York. Specifically, the *2019-2028 CRP* assessment noted supply deficiencies in certain load pockets in New York City, starting in 2023 when the first implementation phase of the Peaker Rule occurs. By 2025, with the second implementation phase of the rule, the assessment noted that the New York system as a whole would see resource deficiencies that violate reliability criteria.

While findings from the 2019-2028 CRP were informative, the *2020 Reliability Needs Assessment* will re-evaluate and refine these findings based on specific compliance plans filed with the DEC by each affected unit. Any reliability needs identified as a result of the 2020 RNA will result in the NYISO soliciting market-based and regulated backstop solutions to satisfy the identified needs prior to the deactivation of needed resource capability.

The 2020 RNA will also include a CLCPA scenario that will examine the impacts of the requirement that 70% of energy be supplied in New York from renewable energy by 2030. Since this will only be a scenario, it will be offered for informational purposes only, and any identified reliability needs associated with this scenario will not result in regulated solutions.



▸ **Peakers:** Peaking power plants, also known as peaker plants or just "peakers", are power plants that generally run mainly when there is a high demand — known as peak demand — for electricity.

Assessing the Implications of Peaker Rule-Related Deactivations

While the *2020 RNA* will evaluate the impacts of the compliance plans of units affected by the DEC Peaker Rule, each peaking resource owner that is planning to deactivate will be subject to the NYISO's deactivation assessment process.

Based on the required deactivation assessments, the NYISO may designate certain units as necessary to remain in service to maintain system reliability. The Peaker Rule includes provisions to permit such designated resources to initially remain in service for two years beyond the otherwise required deactivation date for compliance with the rule, with a potential to extend such period for an additional two years to maintain reliability while a permanent solution is implemented.

The challenge before policymakers, investors, peaking unit owners, and the NYISO will be to consider proposed projects in response to any identified reliability needs resulting from the proposed deactivation of affected peakers in an effective and timely manner. While the DEC's rule aligns closely with state public

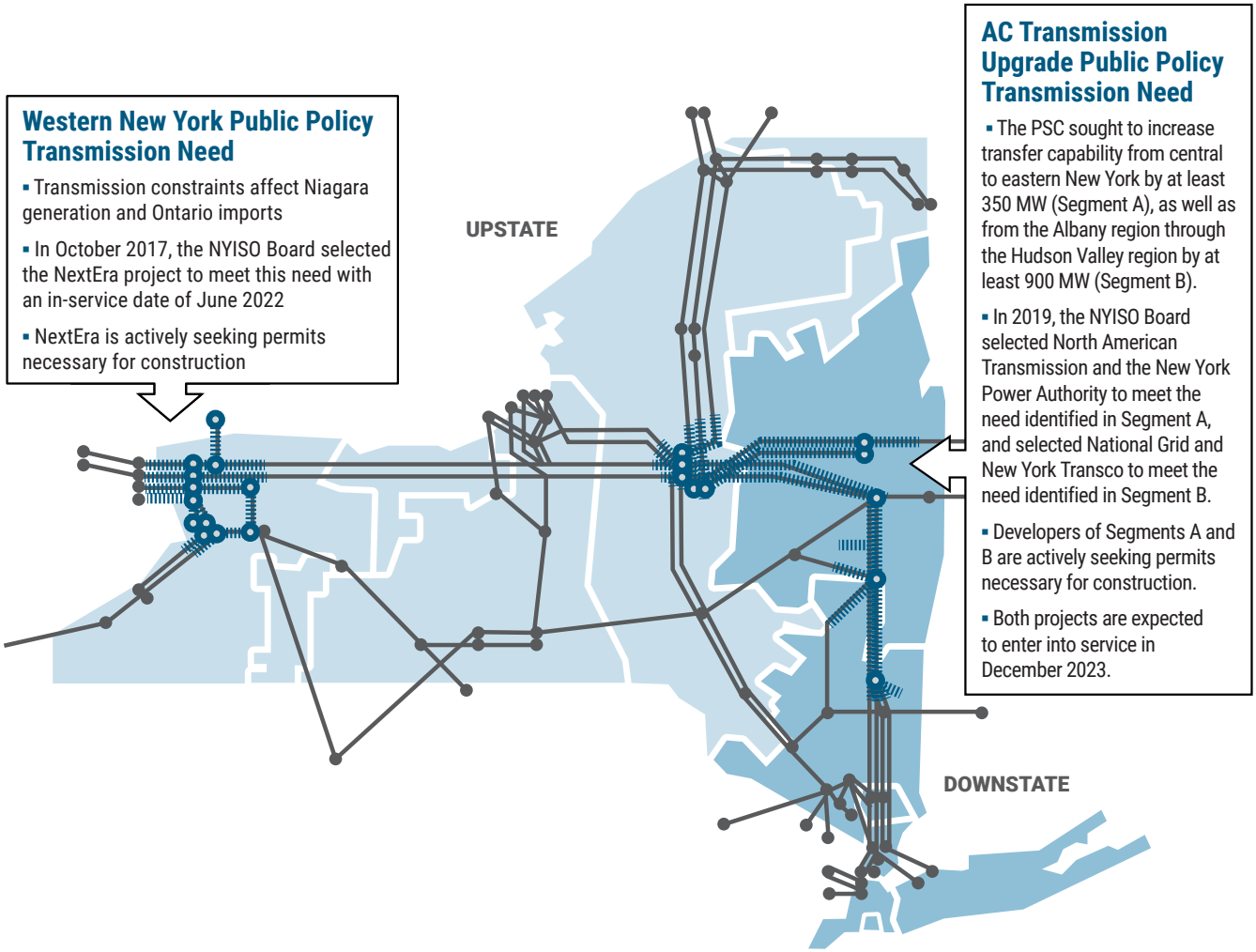
policy initiatives designed to promote storage and renewable energy investment, the breadth and scope of the rule and its implications to bulk power system reliability require careful consideration of all proposed infrastructure investments.

Planning Transmission Infrastructure for Public Policy Requirements

Under the NYISO's public policy transmission planning process, interested entities propose, and the PSC identifies, transmission needs driven by public policy requirements. A public policy requirement is a federal or state law or regulation, including a PSC rulemaking order, which drives the need for additional transmission capability in the state.

In response to a declared public policy need, the NYISO requests that interested entities submit proposed solutions and evaluates the viability and sufficiency of those proposed solutions to satisfy

Figure 19: **Public Policy Transmission Needs in New York State**



each identified need. Following NYISO staff ranking of proposed solutions, the NYISO Board may select the more efficient or cost-effective transmission solution to each identified need. The NYISO issues its findings through a Public Policy Transmission Planning Report.

NYISO studies indicate that achieving New York's public policy objectives will require additional transmission capacity to deliver renewable resources from constrained pockets to the bulk electric grid for delivery across the state to consumers. Much of New York's existing and proposed renewable energy capability is upstate. The resource mix and geographic distribution of new renewable resources are expected to dramatically change power flows. To maximize the load served by renewable generation, cross-state energy transfers will need to increase — even as statewide load decreases — because more renewable generation and resource potential is available upstate to serve the downstate load.

Western New York Public Policy Need

In October 2017, the NYISO's Board of Directors selected a proposal from NextEra to address the public policy need for new transmission in Western New York. This need was identified to support the state's goal to more fully utilize renewable energy from the Robert Moses Niagara Hydroelectric Power Station as well as imports from Ontario. The decision represented the first selection of a transmission project by the NYISO using the Public Policy Transmission Planning Process approved by FERC under Order No. 1000.

The transmission upgrades are also expected to provide reliability, environmental and economic benefits, including:

- Improving transmission security
- Reducing emissions
- Increasing consumer access to lower-cost resources

NextEra applied to the PSC for siting approval of its transmission facilities under Article VII of the Public Service Law in August 2018. Stakeholders in that proceeding filed a joint proposal outlining terms, conditions, practices, and guidelines for inclusion in the permit for constructing the project in April 2020. The PSC is expected to act on the proposal following a public comment period. The NYISO entered into an agreement with NextEra for the development of the transmission project, including a schedule for siting, permitting, interconnection and construction. NextEra and the NYISO will also enter into an operating agreement for the new facility, which is planned to enter into service by June 2022.

▸ Public Service Commission (PSC):

The Department of Public Service (DPS) is the staff arm of the Public Service Commission (PSC). The PSC regulates the state's electric utilities and exercises jurisdiction over the siting of major electric transmission facilities in New York State.

AC Transmission Public Policy Need

In December 2015, the PSC advanced its AC transmission proceeding to a competitive process managed by the NYISO. The proceeding identified a Public Policy Transmission Need to relieve congestion on the Central East (Segment A) and the interfaces between upstate and southeastern New York (Segment B), which run from central New York, through the Capital Region, to the lower Hudson Valley. The PSC action sought to increase transfer capability from central to eastern New York by at least 350 MW (Segment A) and from the Albany region through the Hudson Valley region by at least 900 MW (Segment B).

New York State Accelerated Renewable Energy Growth & Community Benefit Act

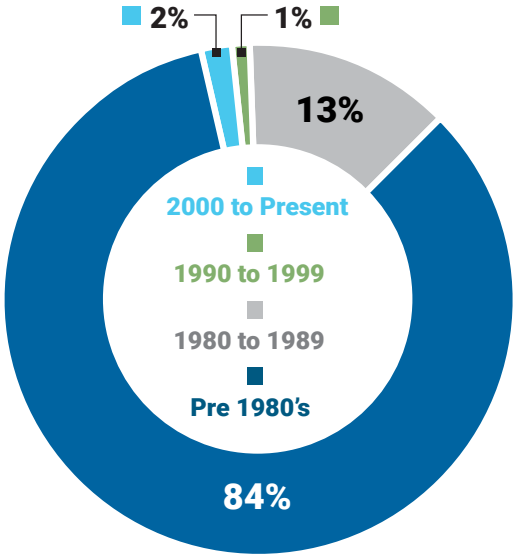
Included in the enacted 2020 New York State Budget, the Act calls on the the New York State Department of Public Service to conduct a State Power Grid Study by December 29, 2020 with NYPA, LIPA, NYSERDA, the investor-owned utilities and the NYISO to identify transmission and local transmission projects needed to implement the CLCPA. The law calls on the PSC to commence a proceeding based upon the study, utilize the NYISO's Public Policy Process to implement transmission projects, except that the PSC may assign projects that are needed expeditiously to NYPA to develop on its own or with other participants. The NYISO is pleased that the legislation recognizes the value of our Public Policy Process and welcomes the opportunity to work collaboratively to address needed transmission system upgrades that support state energy policies.

In April 2019, the NYISO's Board of Directors selected a joint proposal by North American Transmission and the New York Power Authority (NYPA) for Segment A, and the joint proposal by National Grid and New York Transco for Segment B. When completed, these projects will add the largest amount of free-flowing transmission capacity to the New York bulk power system in more than 30 years.

Both the Segment A and Segment B projects are planned to enter into service by December 2023. These projects will add significant transfer capability to deliver renewable resources from upstate to meet the power needs of downstate New York. The projects are also expected to lower total system electricity production costs, lower system capacity procurement costs, replace aging transmission infrastructure, improve system performance, reduce emissions, and add resilience and operating flexibility to the New York bulk power system.

The selected developers of the projects have each applied to the PSC for siting approval of its transmission facilities under Article VII of the Public Service Law. The NYISO has entered into separate agreements with the developers for the development of the transmission projects, including a schedule for siting, permitting, interconnection, and construction. The NYISO will continue to monitor and track the progress of the projects.

▸ Age of New York Transmission Facilities by Percentage of Circuit Miles



Identifying New Public Policy Transmission Needs

The NYISO initiated the biennial 2018-2019 Public Policy Transmission Planning Process (Public Policy Process) cycle on August 1, 2018 by issuing a solicitation for proposed transmission needs driven by public policy requirements. Fifteen entities proposed transmission needs to the NYISO, which in turn submitted these proposals to the PSC. The NYISO also submitted comments to the PSC in January 2019 stating that additional transmission is needed in order to achieve the state's clean energy objectives. The NYISO also recommended further study of the need for a transmission backbone for offshore wind. If the PSC determines that there is a

public policy need for transmission, the NYISO will solicit projects from developers to fulfill that need.

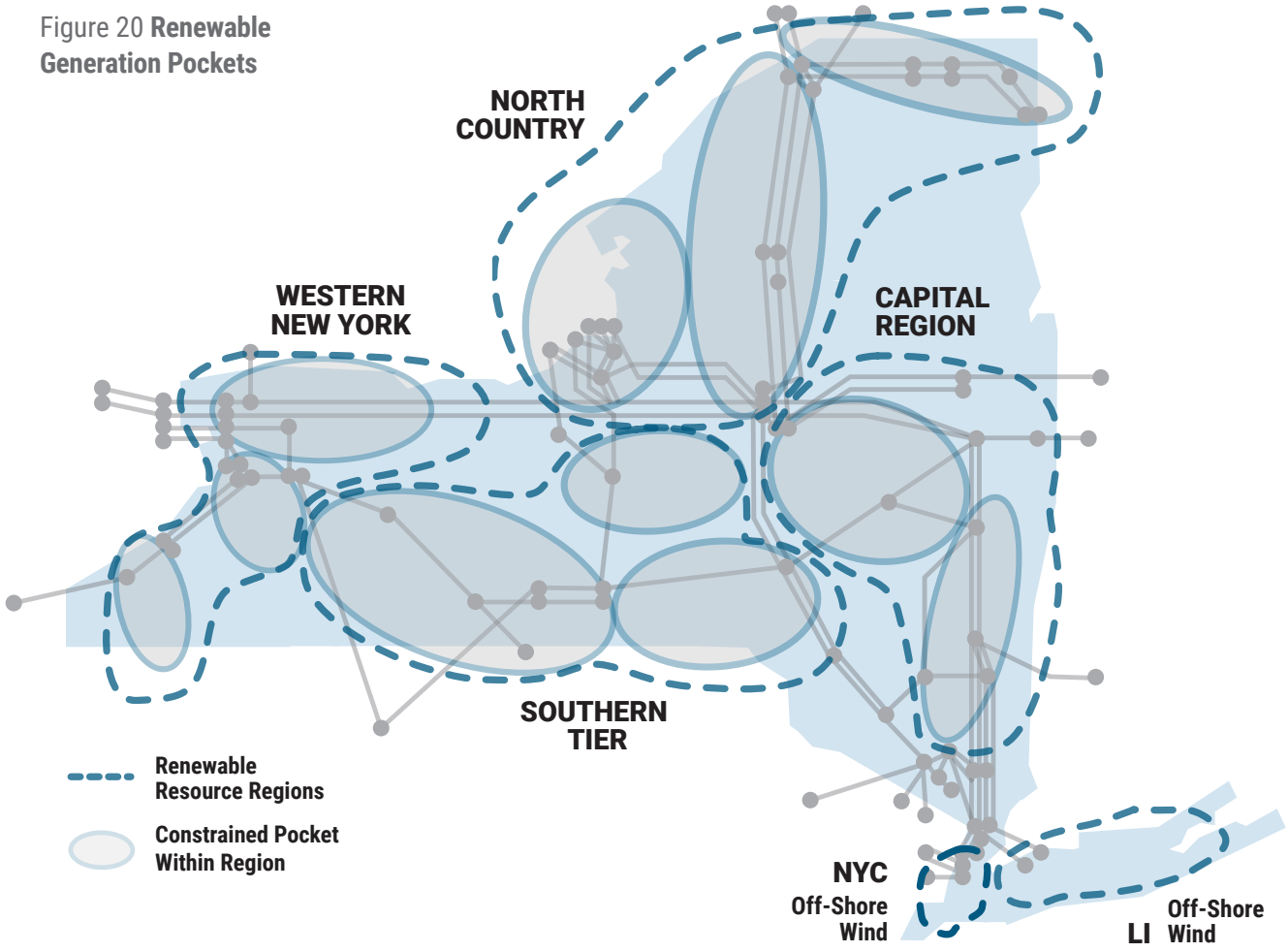
The NYISO will initiate its 2020-2021 Public Policy Process on August 3, 2020 by issuing a new solicitation for proposed transmission needs driven by public policy requirements.

Congestion Assessment and Resource Integration Study (CARIS)

▸ Download the CARIS Report:
Go to www.nyiso.com/library under Planning Reports

The NYISO evaluates congestion on the New York bulk power system as part of its planning processes with its biennial Congestion Assessment and Resource Integration Study (CARIS). The study is an economic analysis of transmission congestion on the New York bulk power system and the potential costs and benefits of relieving transmission congestion.

Figure 20 **Renewable Generation Pockets**



Solutions may include:

- Building or upgrading transmission lines and related facilities
- Building generation within constrained areas
- Employing measures to reduce annual energy consumption for electricity in the congested locales
- Employing measures to reduce peak demand for electricity in the congested locales

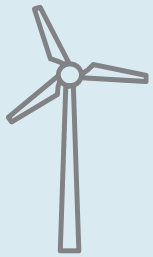
The CARIS process analyzes generic transmission, generation, energy efficiency, and demand response solutions in regions that could ultimately yield congestion cost savings.

CARIS includes a "70x30" scenario analysis of New York's bulk power system. The primary purpose of the 70x30 scenario is to identify transmission constraints that may prevent the delivery of renewable energy to achieve the 70% renewable energy by 2030 state policy target. Combining the congestion and transmission constraint results from sensitivity cases, generation pockets are identified in areas within the state to illustrate transmission constraints that could prevent fully utilizing renewable generation.

The resulting renewable curtailment in the scenario could stem from a combination of drivers, including:

- Resource siting location;
- Size of renewable buildout;
- The congestion pattern of transmission constraints; and
- Existing thermal unit operations.

Renewable generation located upstream of transmission constraints is more likely to be curtailed compared with those located downstream of the constraints.



▸ **Wind Curtailment:** Signals from the NYISO directing wind resources to reduce output based on transmission constraints and price offers from wind generators in the wholesale energy market.

In each of the major pockets observed, renewable generation would be curtailed due to the lack of sufficient bulk and local transmission capability to deliver the power. The results support the conclusion that additional transmission expansion, at both bulk and local levels, will be necessary to efficiently deliver renewable power to New York consumers.

Interregional Planning

Under FERC Order No. 1000, and in collaboration with its New England (ISO-NE) and Mid-Atlantic (PJM Interconnection) neighbors, the NYISO expanded its interregional planning process based upon the existing Northeastern ISO/RTO Planning Coordination Protocol that had been in place for more than a decade. The three planning regions have completed an updated *2019 Northeastern Coordinated System Plan*. On an ongoing basis, the regions also coordinate interconnection requests and transmission requests that have potential impacts across regional borders.

Enhancing Grid Resilience

Appropriate levels of reliability and security are clearly defined in the reliability standards, operating and system planning requirements, and security and infrastructure protection rules established by Federal Energy Regulatory Commission (FERC), the North American Electric Reliability Corporation (NERC), the Northeast Power Coordinating Council, Inc. (NPCC), and the New York State Reliability Council (NYSRC).

Resilience that goes beyond traditional measurements of reliability includes measures that could assist with more expeditious recovery from disruptive events.

In this way, resiliency is closely linked to the importance of:

- Maintaining and expanding interregional interconnections
- The building out of a robust transmission system, and
- Evaluation of additional resources, resource capabilities, and services in critical areas, such as energy storage, which could support rapid recovery from system disturbances.

Wholesale Markets, System Planning, & Grid Operations Enable Resilience

The NYISO continues to evaluate, with its stakeholders, opportunities to leverage competitive wholesale electricity market products and services to bolster the resilience of New York's bulk power system. The changing portfolio of resources serving the electric needs of New York will require a careful and comprehensive review of the NYISO's existing market products and operational practices to efficiently and reliably serve New York's electricity requirements.

Enhancing Fuel and Energy Security Analysis

Over 1,000

FERC, NERC, NPCC and NYSRC requirements that the NYISO must adhere to in the operation and planning of the grid.

The mix of fuels used to generate electricity affects the reliability and resilience of the bulk power system. A balanced array of resources enables the system to better address issues such as price volatility, fuel availability, and stressed or abnormal operating conditions. Historically, New York's electric generation fleet consisted of a diverse mix of fuel types including nuclear, oil, coal, natural gas, hydro, and other renewable resources.

In 2019, as part of the NYISO's Fuel & Energy Security Initiative, the NYISO conducted an assessment of the fuel and energy security of New York's bulk power system to identify potential reliability challenges.

The primary objectives of the assessment were to:

- Evaluate potential vulnerabilities and reliability gaps across a wide range of fuel-related risks during extreme weather and other stressed operating conditions, and
- Develop recommendations for potential market and/or operational enhancements to improve grid resilience in response to identified risks.

The assessment did not identify any short-term reliability risks that warrant the development of market rule enhancements at that time to address fuel and energy security issues. It did, however, recommend continued and expanded monitoring of conditions such as availability of fuel for generating resources, changes in the portfolio of resources available, and peak winter demand conditions. The NYISO will continue to focus on maintaining awareness of relevant factors that will help inform our understanding of New York's evolving fuel security needs.

Collaboration among electric industry participants is essential to the development of solutions to meet the needs of the evolving grid in an effective and equitable manner. The NYISO's shared governance process has a proven record of success in addressing the challenges and opportunities facing the bulk power system and wholesale electricity markets in New York.

Climate Change and Grid Resilience

There has been a growing concern about the impact of climate change on the environment. It has been well documented that the air mass and oceans are warming, contributing to degradation of our environment, more extreme weather events, and potentially catastrophic events in the future. Given our role in managing wholesale power markets, maintaining system reliability, and planning for future capacity needs, NYISO is concerned about how climate change may impact the state transmission system.

To this end, the NYISO's Climate Change Impact Study was developed to examine long-term energy, peak, and hourly load projections that capture the impact of increasing temperatures and state policy designed to improve energy efficiency and address climate change. Long-term hourly zonal level load forecasts will be used to evaluate system impact and develop a climate resiliency plan.

Resilience through Cyber & Physical Security

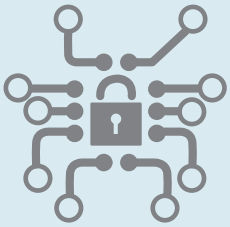
Threat actors are innovative, adaptive, and quick to exploit any weakness. The NYISO has a comprehensive program to address these cyber and physical security risks and to maintain our ability to operate New York's bulk power system to stringent reliability standards.

This program draws from both mandatory NERC Critical Infrastructure Protection (CIP) standards and other industry standards and guidelines. The NYISO's security posture is premised on continuous evaluation of its assets, vulnerabilities, and threats. The NYISO implements its compliance with mandatory cyber and physical security requirements as part of a layered, defense-in-depth strategy that relies on processes, state-of-the-art technology, and skilled staff to protect its critical infrastructure assets from incursion.

NERC CIP standards require that the NYISO conduct in-depth, risk-based analyses to identify, classify, and protect cyber assets based on their potential impact on electric system reliability. The NYISO is actively engaged in enhancing cyber and physical security practices to address evolving risks by collaborating with various state and federal agencies, other ISOs/RTOs, and other industry partners. This collaboration includes information sharing to enhance situational

▸ Critical Infrastructure Protection (CIP):

A set of standards designed to secure the assets required for operating the bulk power system.



The NYISO implements the cyber and physical security standards as part of a layered, "defense-in-depth" posture that seeks to defend its critical infrastructure assets from incursions.

— NYISO's stance on the CIP standards

awareness and grid security exercises that simulate the electric sector's response to potential cyber and physical security threats and incidents.

At the national level, the NYISO is engaged with FERC, NERC, the Electricity Information Sharing and Analysis Center, Cybersecurity Risk Information Sharing Program (CRISP), Department of Energy, Department of Homeland Security, and the Federal Bureau of Investigation. The NYISO actively participates in the cyber and physical security policy and standard development activities undertaken by these entities and is fully engaged in collaborative relationships with these entities for classified briefings and real-time cybersecurity information sharing and threat detection.

The NYISO is also subject to mandatory reliability standards designed to enhance supply chain risk management protections for the nation's bulk power system. These standards are designed to mitigate threats to power grid operations by threat actors seeking to circumvent the strong security programs of electric sector organizations. The NYISO has implemented these supply chain security standards to make certain that vendors and other external partners employ strong security practices.

▸ Federal Energy Regulatory Commission (FERC):

The federal regulatory agency that approves the NYISO's tariffs and regulates its operation of the bulk power system wholesale power markets, and planning.

▸ North American Electric Reliability Corporation (NERC):

The not-for-profit international regulatory authority whose mission is to assure the effective and efficient reduction of risks to the reliability and security of the grid. NERC's jurisdiction includes users, owners, and operators of the bulk power system.

A key element of the cybersecurity program is maintaining a high degree of situational awareness to reduce the time between the introduction of a potential threat to when that threat is identified and effectively mitigated. In October 2019, the NYISO opened a state-of-the-art Cyber Security Operations Center (CSOC), operating around-the-clock to monitor the NYISO's cyber posture and to continuously evaluate and respond to rapidly evolving cyber risks. Using advanced technologies that collect and orchestrate threat and vulnerability indicators, security events, and alerts from government and commercial sources around the world every second, skilled analysts are able to assess and remediate cyber risks as they occur.

Recognizing that the capabilities of threat actors could be amplified if there is inadequate threat intelligence and sharing of information throughout the New York electric sector, the NYISO regularly collaborates on security initiatives with a number of New York State and local agencies. These partnerships include the Department of Public Service, Division of Homeland Security and Emergency Services, New York State Police, and New York City Police Department. In coordination with local, state and federal agencies, electric and gas utilities, and other industry organizations, the NYISO has developed and led New York State cybersecurity exercise events. These exercises facilitate the testing of incident response plans, identify opportunities for improvement, and enhance collaboration and information sharing among state agencies and the industry.

The NYISO also participates in GridEx, a biennial sector-wide grid security exercise conducted by NERC. As NERC stated in testimony before the United State Senate Energy and Natural Resources Committee, "NERC's biennial GridEx exercise is the largest of its kind in the sector and helps industry

and government exercise their emergency response plans, and drive new and innovative approaches to reduce security risk to the electric grid.9 ”

While national in scope, GridEx involves coordination with New York State agencies and market participants. GridEx is designed to enhance coordination of cyber and physical security resources and practices within the electric industry, improve communication and coordination between the industry and government partners, and support continuous improvement through lessons learned.

Business Continuity and Pandemic Planning

Business continuity is the practice of coordinating, facilitating and executing activities that identify and mitigate operational risks that can lead to business disruptions before they occur, and provides plans and training for responding to disruptive events when they do occur. As the Balancing Authority, Reliability Coordinator, and as a Transmission Operator for New York, the NYISO is subject to NERC CIP standards requiring the development and testing of continuity plans to recover reliability functions performed by critical cyber systems. This planning maintains the continuous stability, operability, and reliability of the bulk power system. In addition, the NYISO has established a comprehensive organizational business continuity and disaster recovery program that safeguards business information systems and provides contingency plans in the event of a significant disruption of NYISO systems or facilities.

Similarly, the NYISO’s pandemic plan enables it to sustain operations and carry out essential functions during a widespread infectious disease outbreak, where impacts may affect availability of labor and intellectual capital. The NYISO pandemic plan provides escalating levels of action that are proportional to the risk to NYISO operations resulting from the outbreak. In February 2020, the pandemic plan was activated in response to the COVID-19 outbreak to maintain operations throughout the pandemic.

Conclusion

The transformative mission before the NYISO is to align the critical objectives of reliability and economic efficiency with public policy initiatives. New York State is a national leader in accelerating change and promoting a cleaner grid. As policymakers seek a more rapid and widespread change in how energy is produced and consumed, the NYISO markets and planning processes serve as a platform to facilitate this transformation. Through engagement with policymakers, regulators, and stakeholders, the NYISO intends to develop the innovative market products and planning tools designed to address the needs of the grid of the future.

Glossary

The following glossary offers definitions and explanations of phrases used in *Power Trends 2020,* as well as terms generally used in discussions of electric power systems and energy policy.

Ancillary Services: Services that support the reliable operation of the power system, which can include voltage support, frequency regulation, operating reserves, and blackstart capabilities.

Behind-the-Meter Generation: A generation unit that supplies electric energy to an end user onsite without connecting to the bulk power system or local electric distribution facilities. An example is a rooftop solar photovoltaic system that primarily supplies electricity to the facility on which it is located.

Bulk Power System: The transmission network over which electricity flows from suppliers to local distribution systems that serve end-users. New York's bulk power system includes electricity-generating plants, high-voltage transmission lines, and interconnections with neighboring electric systems located in the New York Control Area (NYCA).

Capability Period: Lasting six months, the Summer Capability Period runs from May 1 through October 31. The Winter Capability Period runs November 1 through April 30 of the following year. A Capability Year begins May 1 and runs through April 30 of the following year.

Capacity: Capacity is the maximum electric output that a generator can produce. It is measured in megawatts (MW).

Capacity Factor: Capacity factor measures actual generation as a percentage of potential maximum generation. For example, a generator with a 1 megawatt capacity operating at full capacity for a year (8,760 hours) would produce 8,760 megawatt-hours (MWh) of electricity. That generator would have an annual capacity factor of 100%.

Carbon Pricing: A market-based approach to create incentives for reduced carbon dioxide emissions by incorporating costs associated with carbon dioxide emissions, such as damage to crops or health care costs, into energy markets.

Class Year: A group of supply projects seeking to interconnect to the transmission system in similar timeframes, and which have reached similar milestones in their development efforts. These projects are studied to assess the cumulative impact they may have on the system and determine the costs to mitigate those impacts.

Comprehensive Reliability Plan (CRP): A study undertaken by the NYISO that evaluates projects offered to meet New York's future electric power needs, as identified in the *Reliability Needs Assessment* (RNA). The CRP may trigger electric utilities to pursue regulated solutions to meet reliability needs if market-based solutions will not be available to supply needed resources. It is the second step in NYISO's reliability planning process.

Congestion Analysis and Resource Integration Study (CARIS): Part of the NYISO's comprehensive System Planning Process, CARIS evaluates the economic impact of proposed system changes. It consists of congestion studies developed with market participant input, as well as additional studies that individual market participants may request and fund. CARIS is based on the most recently approved CRP.

Critical Infrastructure Protection (CIP) Standards: A set of requirements designed to secure the assets required for operating the bulk power system. CIP requirements include the security of electronic perimeters, protection of critical cyber assets, personnel training, security management, and disaster recovery planning. CIP standards are developed by NERC, and approved by FERC.

Curtailment: In the context of intermittent sources of generation, refers to signals from the NYISO directing an intermittent resource to reduce its output. Sometimes referred to as economic curtailment, the NYISO's signal is based on the intermittent resources' price offers in the energy market, whereby transmission constraints induce prices that make the continued operation of certain intermittent resources uneconomic, prompting a reduction in output to alleviate the transmission constraint.

Day-Ahead Market (DAM): A NYISO-administered wholesale electricity market in which electricity and ancillary services are auctioned and scheduled one day prior to use.

Demand Response (DR) Programs: A series of programs designed to facilitate economic- and reliability-based load reduction measures by compensating electricity users that reduce consumption at the direction of the NYISO, either by economic dispatch or in response to a reliability condition. The NYISO demand response programs include Day-Ahead Demand Response Program (DADRP), Demand Side Ancillary Services Program (DSASP), Emergency Demand Response Program (EDRP), and Special Case Resources (SCR) program.

Distributed Energy Resource (DER): A broad category of resources that includes distributed generation, energy storage technologies, combined heat and power systems, and microgrids. A DER is generally customer-sited to serve the customer's power needs, but may, in some instances, sell excess energy production or ancillary services to the power system.

Eastern Interconnection: The Eastern Interconnection is one of the three electric grid networks in North America. It includes electric systems serving most of the United States and Canada, from the Rocky Mountains to the Atlantic coast. The other major interconnections are the Western Interconnection and the Texas Interconnection.

Electricity Market: In economic terms, electricity is a commodity capable of being bought, sold, and traded. An electricity market is a system enabling purchases.The NYISO administers the wholesale electricity markets in New York, enabling competing generators to offer their output to retailers.

Electrification: Adopting technologies that support the transition of fossil-fuel-intensive sectors of the economy to electricity. Sometimes referred to as "beneficial electrification" due to its underlying goals of

promoting societal benefits through emissions reductions.

Emergency Demand Response Program (EDRP): A NYISO reliability-based demand response program designed to reduce power usage through voluntary electricity consumption reduction by businesses and large power users. Program participants are compensated for reducing energy consumption upon activation of the program by the NYISO.

Energy: Energy is the amount of electricity a generator produces over a specific period of time. It is measured in megawatt-hours (MWh). For example, a generating unit with a 1 megawatt capacity operating at full capacity for one hour will produce 1 megawatt-hour of electricity.

Energy Storage Resources (ESRs): Energy storage resources are devices used to capture energy produced at one time for use at a later time. ESRs include technologies like batteries and pumped hydro storage.

Federal Energy Regulatory Commission (FERC): The federal agency responsible for regulatory oversight of the NYISO's operation of the bulk power system, wholesale power markets, and planning and interconnection processes. The NYISO's tariffs and foundational agreements are overseen and approved by FERC.

Gigawatt (GW): A unit of power or capacity equal to one billion watts.

Gigawatt-Hour (GWh): A gigawatt-hour is equal to one gigawatt of energy produced or consumed continuously for one hour.

Installed Capacity (ICAP): A qualifying generator or load facility that can supply and/or reduce demand as directed by the NYISO.

Installed Reserve Margin (IRM): The level of capacity that must be secured, above projected system peak demand, to maintain reliability after accounting for unplanned and scheduled outages as well as transmission capability limitations. The IRM requirement can be met through a combination of installed generation, import capabilities, and demand response. The IRM is established by the New York State Reliability Council (NYSRC) and designed to maintain specific resource adequacy criteria.

Interconnection Queue: A queue of merchant transmission and generation projects that have submitted an Interconnection Request to the NYISO to be interconnected to the state's electric system. Depending on the level of proposed capacity, most projects must undergo three studies before interconnecting to the grid: a *Feasibility Study* (unless parties agree to forgo it), a *System Reliability Impact Study* (SRIS), and a *Facilities Study*.

Intermittent Resource: An electric energy source whose output varies due to the fluctuating nature of its fuel source. Examples include solar energy which is dependent upon sunlight intensity, or wind turbines where output is dependent on wind speeds.

Load: A consumer of energy, or the amount of energy consumed. Load can also be referred to as demand.

Load Serving Entity (LSE): An entity, such as an investor-owned utility, public power authority, municipal electric system, or electric cooperative that procures energy, capacity, and/or ancillary services from the NYISO's wholesale markets on behalf of retail electricity customers.

Locational Capacity Requirement (LCR): A portion of the statewide installed capacity that must be physically located within a locality to meet reliability standards. Locational Installed Capacity Requirements have been established for the New York City (zone J), Long Island (zone K), and lower Hudson Valley (zones G-J) capacity zones.

Megawatt (MW): A measure of electricity that is the equivalent of 1 million watts. It is generally estimated that a megawatt provides enough electricity to supply the power needs of 800 to 1,000 homes.

Megawatt-Hour (MWh): A megawatt-hour is equal to one megawatt of energy produced or consumed continuously for one hour.

New York Independent System Operator (NYISO): Formed in 1997 and commencing operations in 1999, the NYISO is a not-for-profit organization that manages New York's bulk power system, administers the state's competitive wholesale electricity markets, provides system and resource planning for the state's bulk power system, and works to advance the technology serving the power system. The organization is governed by an independent Board of Directors and a governance structure made up of committees, with market participants and stakeholders as members.

New York Control Area (NYCA): The area under the electrical control of the NYISO. It includes the entire state of New York, divided into 11 load zones.

New York Power Pool (NYPP): Established in 1966 in response to the Northeast Blackout of 1965, a voluntary collaboration of the state's six investor-owned utilities plus New York's two power authorities, created to coordinate the operations of the New York State power grid. The NYISO assumed this responsibility in 1999.

North American Electric Reliability Corporation (NERC): The not-for-profit international regulatory authority whose mission is to assure the effective and efficient reduction of risks to the reliability and security of the grid. NERC's jurisdiction includes users, owners, and operators of the bulk power system.

Peak Load: The maximum power demand on the electric grid measured in megawatts (MW). Peak load, also known as peak demand, reflects the highest average hourly demand experienced on the system.

Peakers: Peaking power plants, also known as peaker plants or just "peakers", are power plants that generally run when there is a high demand — known as peak demand — for electricity.

Public Policy Transmission Planning: Part of the NYISO's Comprehensive System Planning Process. Public Policy Transmission Planning consists of two steps: (1) identification of transmission needs driven by Public Policy Requirements that should be evaluated by the NYISO; and (2) requests for specific proposed transmission solutions to address those needs, and the evaluation of those specific solutions. The New York State Public Service Commission identifies transmission needs driven by Public Policy Requirements and warranting evaluation, and the NYISO requests and evaluates specific proposed transmission solutions to address such needs.

Real-Time Markets: A NYISO-administered wholesale electricity market in which electricity and ancillary services are settled every five minutes. The Real-Time Market

addresses changes in operating conditions relative to what was anticipated in the Day-Ahead Market. For instance, changes to load or anticipated generator output are accounted for in the Real-Time Market through a competitive auction process.

Regional Greenhouse Gas Initiative (RGGI): The first market-based regulatory program in the United States to reduce greenhouse gas emissions. RGGI is a cooperative effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont.

Reliability Needs Assessment (RNA): A report that evaluates resource adequacy and transmission system security over years four through 10 of a 10-year planning horizon, and identifies future needs of the New York electricity grid. It is the first step in the NYISO's reliability planning process.

Renewable Energy Credit (REC): A mechanism to link the environmental attributes associated with certain forms of renewable energy generators with the energy produced by those generators. One REC equates to one MWh of energy generated from eligible renewable energy resources. In New York State, NYSERDA procures RECs from eligible resources to incentivize development of renewable resources and measure compliance with the renewable energy goals of the state's Clean Energy Standard (CES).

Resource Adequacy: The ability of the electric system to supply electrical demand and energy requirements at all times, taking into account scheduled and unscheduled outages of system elements. A system is considered adequate if the probability of having sufficient resources to meet expected demand is greater than the minimum standards to avoid a blackout.

Short-Term Reliability Planning Process: NYISO process to examine reliability needs over a 5-year period, with a focus on the first three years, including the impact of generator deactivations.

Special Case Resources (SCR): A NYISO reliability-based demand response program designed to reduce power usage by businesses and large power users qualified to participate in the NYISO's installed capacity (ICAP) market. SCRs are awarded capacity payments for agreeing to reduce their load on the system upon NYISO request.

Transfer Capability: The amount of electricity that can flow on a transmission line at any given instant, respecting facility rating and reliability rules.

Transmission Constraints: Limitations on the ability of a transmission facility to transfer electricity.

Transmission Security: The ability of the electric system to withstand disturbances, such as electric short-circuits or unanticipated loss of system elements.

Zero-Emission Credit (ZEC): A mechanism to link the environmental attributes associated with the energy produced by certain eligible zero-emission generators. In New York, one ZEC equates to one MWh of energy generated by eligible nuclear generators. NYSERDA procures ZECs to measure compliance with the obligations under the State's Clean Energy Standard.

Endnotes

[1] Capacity factors for battery and hydro pumped storage are not included in this comparison, as these storage resources do not supply the grid in the same manner as generation resources.

[2] Clean Energy Standard Annual Progress Report: 2018 Compliance Year, NYSERDA, December 2019, https://www.nyserda.ny.gov/All-Programs/Programs/Clean-Energy-Standard/Important-Orders-Reports-and-Filings/Filings-Orders-and-Reports

[3] Case 19-E-0530, Proceeding on Motion of the Commission to Consider Resource Adequacy Matters, *Initial Comments of the New York Independent System Operator, Inc. on Resource Adequacy Matters* (November 8, 2019) https://www.nyiso.com/documents/20142/4602985/20191108-NYISO-Intl-Cmmnts-Rsrc-Adqcy-Cmplt.pdf/8f471886-1609-0473-4250-33ee34d9fafc; *id.;* Reply Comments of the New York Independent System Operator, Inc. on Resource Adequacy Matters (January 31, 2020) https://www.nyiso.com/documents/20142/10601510/20200131-NYISO-Reply-Comments-19-E-0530.pdf/499c09d5-3a33-f8dd-c596-84efe80d0f98

[4] *Impact of Covid-19 on the US Energy Industry;* The Brattle Group; February/March 2020; https://www.brattle.com/news-and-knowledge/publications/impact-of-covid-19-on-the-us-energy-industry

[5] U.S. Bureau of Labor Statistics, Economic News Release, Employment Situation Summary, May 8, 2020; www.bls.gov/news.release/empsit.nr0.htm

[6] *Impact of Covid-19 on the US Energy Industry;* The Brattle Group; February/March 2020; https://www.brattle.com/news-and-knowledge/publications/impact-of-covid-19-on-the-us-energy-industry

[7] *Impact of Covid-19 on the US Energy Industry;* The Brattle Group; February/March 2020; https://www.brattle.com/news-and-knowledge/publications/impact-of-covid-19-on-the-us-energy-industry

[8] New York ISO Climate Change Impact Study, Phase 1: Long-Term Load Impact; Itron, Inc. December 2019

[9] NERC testimony to United States Senate https://www.nerc.com/news/testimony/Testimony%20and%20Speeches/Senate%20Energy%20Committee%20Cyber%20Hearing%20Testimony%20February%2014%202019.pdf

NYISO In Brief

The New York Independent System Operator (NYISO) is a not-for-profit corporation responsible for maintaining the safe, reliable flow of power throughout the Empire State.

The mission of the NYISO, in collaboration with its stakeholders, is to serve the public interest and provide benefit to consumers by:

- Maintaining and enhancing regional reliability
- Operating open, fair, and competitive wholesale electricity markets
- Planning the power system for the future
- Providing factual information to policymakers, stakeholders and investors in the power system

The NYISO manages the efficient flow of power on more than 11,000 circuit-miles of electric transmission lines on a continuous basis, 24 hours-a-day, 365 days-a-year — in compliance with the most rigorous reliability requirements in the nation.

As the administrator of the wholesale electricity markets, the NYISO conducts auctions that match the power demands of electric utilities and energy service companies with suppliers offering to sell power resources. The NYISO's markets trade an average of $5.3 billion in electricity and related products annually.

The NYISO's comprehensive planning process assesses New York's electricity needs and evaluates the ability of proposed power options to meet those needs. This planning process involves stakeholders, regulators, public officials, consumer representatives, and energy experts who provide vital information and input from a variety of viewpoints.

The NYISO is governed by a 10-member, independent Board of Directors and a committee structure composed of diverse stakeholder representatives. It is subject to the oversight of the Federal Energy Regulatory Commission (FERC) and regulated in certain aspects by the New York State Public Service Commission (NYSPSC). NYISO operations are also overseen by electric system reliability regulators, including the North American Electric Reliability Corporation (NERC), Northeast Power Coordinating Council (NPCC), and the New York State Reliability Council (NYSRC).

The members of the NYISO's Board of Directors have backgrounds in electricity systems, finance, information technology, communications, and public service. The members of the Board, as well as all employees, have no business, financial, operating, or other direct relationship to any market participant. The NYISO does not own power plants or transmission lines.

The NYISO's independence means that its actions and decisions are not based on profit motives, but on how best to enhance the reliability and efficiency of the power system, and safeguard the transparency and fairness of the markets. The NYISO is committed to transparency and trust in how it carries out its duties, in the information it provides, and in its role as the impartial broker of the state's wholesale electricity markets.

Power Trends is the NYISO's annual analysis of factors influencing New York State's power grid and wholesale electricity markets. Begun in 2001 as *Power Alert,* the report provides a yearly review of key developments and emerging issues.

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