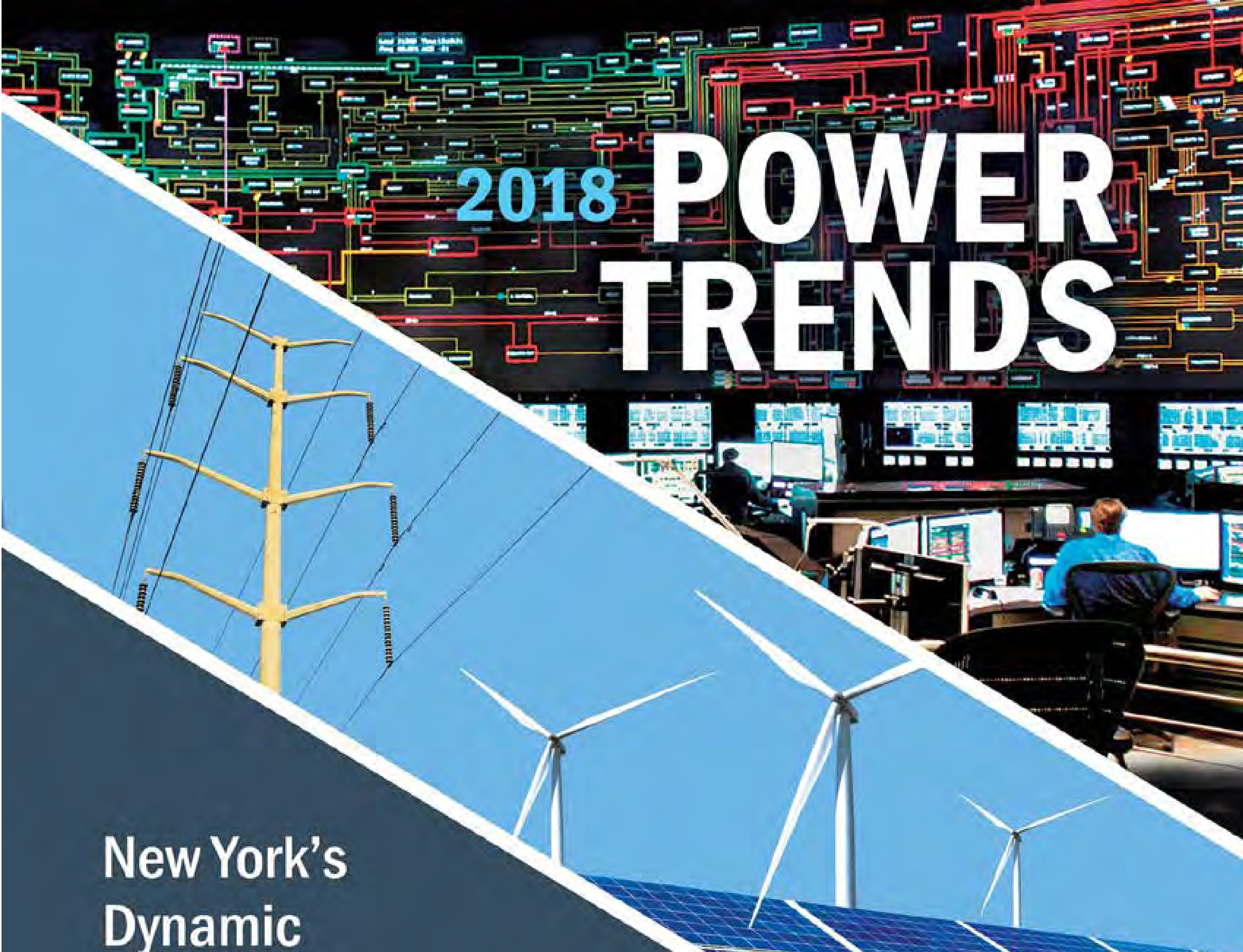
2018 POWER TRENDS



New York's Dynamic Power Grid

NYISO

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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From the CEO

BRADLEY C. JONES

Thank you for your interest in *Power Trends 2018*. I am pleased to once again provide you with the New York Independent System Operator's (NYISO) in-depth, annual assessment of New York's power grid.

In the world of energy, change is all around us. Technology and policy advancements are combining to make this a time of exciting innovation in our industry. Throughout this document you will find important data, expert analysis, and unbiased information on the opportunities and challenges we face operating today's complex power grid. Equally as important, you will find perspectives on the actions we must take to build the grid of the future and meet consumers' needs in a fast-paced, dynamic economy.

Power Trends demonstrates our strong commitment to being the authoritative source of information on New York's electric system. That role is part of our mission, and it is as important today as it has ever been. Policymakers, stakeholders, market participants, and the public need to understand how the forces influencing change are impacting the electric system today — and in the years to follow. We believe *Power Trends 2018* serves that need.

In last year's *Power Trends* we introduced the *Tale of Two Grids* to illustrate some of the challenges we face in expanding the grid to meet future needs. This year, we continue that theme and speak of *Great Expectations* for New York's bulk power system.

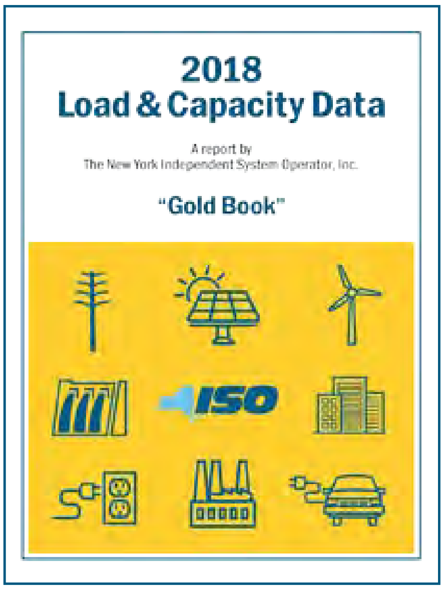
Since 1999, the NYISO's competitive markets for wholesale electricity have increased the efficiency of the grid, while operating the system to the most stringent reliability standards. Billions have been saved in reduced fuel costs, and New York's power sector has reduced the emissions rates of carbon dioxide by 52%, nitrogen oxide by 88%, and sulfur dioxide by 99%. Looking forward, the employees of the NYISO know we must do more.

With that, we are leading the way with cutting-edge efforts like integrating distributed energy resources, energy storage technologies, and variable renewable resources. We are hard at work on the design and implementation of future-state markets that will support new technology and an even cleaner fuel mix.

Power Trends 2018 serves to explain these efforts and our path forward. With our market participants and policymakers, the NYISO will continue to advance the leadership of New York's electric system towards an efficient, affordable, and reliable future.

Sincerely,

Bradley C. Jones
President and CEO



DATA USED IN POWER TRENDS 2018 is from the 2018 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

www.nyiso.com

POWER TRENDS

New York's Dynamic Power Grid

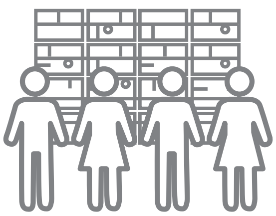
2018

Contents

Executive Summary

Great Expectations

It cannot be overstated: this is a time of great transition for the power grid. New York's centralized bulk power system, which has existed primarily to deliver reliable energy to every corner of the Empire State, is increasingly viewed as a critical element to achieving broader public policy goals for clean energy. Additionally, the advancement of new technologies continues to push the boundaries of what consumers expect from the grid. The NYISO sees these challenges clearly, and embraces the work and change necessary to meet them. We understand that these new expectations for the grid require an examination of the markets and planning processes that shape it.



▸ **The New York Independent System Operator (NYISO)** is at the center of this changing landscape. Working with New York State and federal policymakers and over 400 Market Participants, the NYISO serves as an independent organization responsible for operating New York's bulk power system and wholesale energy markets, 24 hours a day, every day of the year.

The New York Independent System Operator's (NYISO) pioneering energy markets, implemented in 1999, have demonstrated significant value for New Yorkers, delivering billions in savings while also aiding in emissions reductions and improved system efficiency. Similarly, the NYISO's grid planning functions have served policymakers and investors well by providing authoritative, independent information on potential challenges. The NYISO's markets and planning functions have established a solid platform to address new and emerging goals in support of what will be a more dynamic system of the future.

The growth of renewable and distributed resources has begun to measurably change the dynamics of both energy consumption and energy production. A grid in transition will challenge the NYISO to develop effective mechanisms to incentivize the resource flexibility needed to balance that future mix of resources reliably and efficiently. In addition, effective planning resources are vital to inform investors and policymakers on how and where new challenges may need to be met.

The NYISO has great expectations that we are well positioned to meet the challenges ahead. We also have great expectations that we are poised to lead the way in reliable grid operations, efficient and effective market designs, and planning strategies to serve New Yorkers now and into the future.

A Grid in Transition

Historically, electric power flowed from generators across a vast network of transmission and distribution lines before reaching consumers. Energy usage and peak demand grew incrementally, year by year, and growing demand for energy was met through physical expansion of the grid to increase its generating and delivery capacity.

While demand on the grid may no longer be growing at historical levels, planning and operating the grid has grown more complex. Technology, economic forces, and public policy are shaping a more dynamic grid. We are moving away from historical patterns of supply and demand, and towards emerging trends that reflect advances in how electricity is generated and consumed. Public policies are expediting this transformation.

This means historical, predictable demand patterns that characterized infrastructure planning over much of the last century are shifting. Consumers, increasingly empowered with intelligent digital technologies and advanced communications tools, are becoming active participants on the grid — adjusting their energy use patterns to reflect grid conditions, and tailoring their energy use to meet their own needs for reliability and clean power.

This dynamic introduces new variables that the NYISO is uniquely poised to meet. In collaboration with policymakers and market participants, the NYISO will continue to leverage our expertise in operating New York's power grid, advanced energy market design, and open and transparent system planning, in order to reliably and efficiently respond to the energy needs of all New Yorkers.

The NYISO's *Power Trends 2018* report provides information and analysis on current and emerging trends that are working to transform the power grid and wholesale electricity markets. Shifting patterns of demand for electricity serve to influence how investors, policymakers, and consumers view electricity production, transmission, and consumption.

These patterns include:

- Energy efficiency and distributed energy resources that shape energy usage.
- Infrastructure replacement and expansion to address risks to aging facilities, support of public policy goals, and meet the needs of a more dynamic grid.
- Economic influences led by low natural gas prices and changing consumption forecasts.
- Public policies aimed at reducing emissions and expanding the use of renewable power resources.
- Bolstering grid resilience through effective federal, state, and local reliability rules, effective grid operations and planning, and effective market design.

Changing Energy Usage & Moderating Peak Demand

Distributed energy resources — such as rooftop solar — are transforming historical patterns of consumption, and affecting consumer reliance on electricity provided by the bulk power system.

For instance, energy usage from New York's bulk power system is expected to decline over the next decade at a rate of 0.14% per year. Peak demand — a critical element to reliable system planning that establishes the total amount of capacity that must be procured to meet reliability standards — is projected to decline at a pace of 0.13% per year, through 2028.

Energy efficiency efforts, and expansion of solar and other distributed energy resources on the distribution system, continue to have a strong influence on future consumption forecasts. Energy efficiency alone is expected to reduce peak demand on New York's bulk power system by 245 MW in 2018 and by 2,262 MW in 2028. The combined effects of energy efficiency and distributed energy resources are expected to reduce demand from the bulk power system by nearly 3,700 MW by 2028, as consumers install onsite systems to meet some portion of their electricity needs.

▸**Megawatt (MW):** A measure of electricity that is the equivalent of one 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 used continuously for one hour.

Expansion & Contraction of Generating Supply

New power plants are built, and existing facilities are upgraded, to expand generating capacity as price signals associated with the demand for electricity and available supplies of power warrant new investment. Alternatively, power plants may elect to retire or suspend operation in response to economic circumstances, physical plant conditions, or regulatory requirements.

The margin between available capacity and capacity requirements reflects the dynamic balancing that markets provide in maintaining sufficient resources to meet reliability. The NYISO's markets have maintained this balance through price signals that sustain reliability in an economically efficient manner. However, power plant deactivations can present challenges to electric system reliability.

Reflecting economic and public policy investment signals, generation additions have primarily been natural gas-fueled or wind-powered. Since 2000, nearly 12,000 MW of new generating capacity came online in New York State. This additional generation represents approximately 30% of New York's current generation capacity. Nearly 80% of that new generation has been developed in southern and eastern New York, 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 the demand for electricity is the highest.

Public Policy Influence on the Grid of the Future

Wholesale energy markets reflect the confluence of economics, technology, and public policy. Markets have successfully facilitated efficiency gains on the grid and cleaner energy production in the state since their inception. Those gains and improvements have been gradual, as price signals have worked over time to influence more efficient — and often cleaner — generation. As policymakers look for opportunities to accelerate the kinds of changes on the grid that markets have induced, **the NYISO views open markets as an essential, effective platform for pursuing those public policy goals in an economically efficient manner.**

The challenge for the NYISO will be to examine its market structures to develop incentives for investment in, and maintenance of, the types of resources needed to sustain reliability. The addition of renewable resources expected from the Clean Energy Standard, for example, will create a more dynamic grid where supply is heavily influenced by weather. This necessitates a look at what types of incentives for flexible resources are needed to balance intermittent renewables. We will also look at market designs that preserve revenue adequacy for generators that are necessary for reliability.

Meanwhile, the pace of change on the grid requires more flexibility in the NYISO's planning processes to identify and act on reliability needs. This means closer coordination with local system planners to understand how local system needs might influence, or be influenced by, changes on the bulk power system brought about by public policy. Subsequent sections of this document will describe some of the plans the NYISO is developing to achieve those goals.

Transmission Expansion to Meet Public Policy Needs

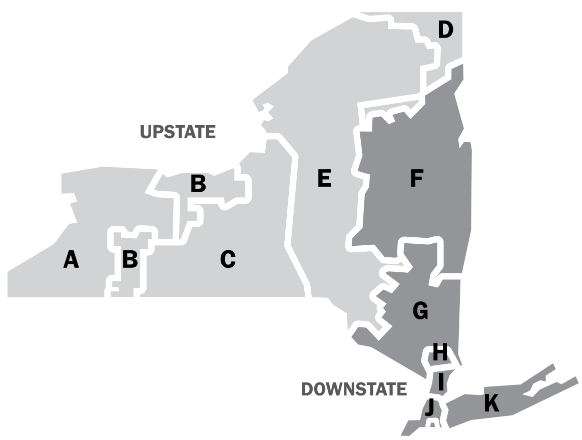
In *Power Trends 2017,* the NYISO introduced the concept of New York's *Tale of Two Grids* — a reference to the fact that the characteristics of upstate's energy sector differ dramatically from those of the downstate sector. Upstate — defined as NYISO load zones A-E — is largely supplied by clean energy resources, yet carries relatively little demand for energy in comparison to downstate load zones F-K. In fact, zero-emitting resources accounted for approximately 88% of the energy produced in load zones A-E in 2017. Downstate, which consumes approximately 66% of the energy in New York, received 70% of its energy from fossil fuel-fired generation in 2017. While some energy flows from upstate to downstate, transmission constraints on the grid limit the ability to supply more clean energy to downstate consumers. The NYISO is working closely with policymakers and stakeholders to address these challenges:

- In a decision that will support New York's goal of maximizing the flow of energy from renewable resources in the region, in October 2017 the NYISO's Board of Directors selected a proposal from NextEra Energy Transmission New York to address the public policy need for new transmission in Western New York. The decision represents the first selection of a transmission project by the NYISO using the Public Policy Transmission Planning Process (PPTPP), approved by the Federal Energy Regulatory Commission (FERC) under Order No. 1000.
- In January 2017, the New York State Public Service Commission (PSC) issued an order confirming the AC Transmission Public Policy Transmission Need to relieve congestion on the UPNY-SENY and Central East interfaces — which run from central New York, through the Capital Region to the lower Hudson Valley. The NYISO is evaluating the competing transmission projects, and expects to identify the more efficient or cost-effective transmission project to meet the AC Transmission Needs this year.

Meeting the Challenge of a Grid in Transition

Ultimately, if transmission constraints are not alleviated, the *Tale of Two Grids* will, over time, unfold into a *Tale of Two Markets*, where there are growing disparities in bulk power costs and system investment needs in different regions of the state. Working with stakeholders, the NYISO intends to evaluate opportunities to leverage competitive wholesale market products and services to address these issues and bolster the resiliency 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.

Collaboration among electric industry participants is essential to the development of solutions to these challenges in an effective and equitable manner. The NYISO's shared governance process has a proven track record of success in addressing the challenges and opportunities facing the bulk power system and wholesale energy markets in New York. These market design enhancements will be tailored toward refining price signals to attract the types of characteristics necessary to sustain reliability, resilience, and effective investment signals for the grid of the future.



▶**Downstate regions** (New York City, Long Island, and the Hudson Valley — Zones F-K) consumed 66% of the state's electric energy in 2017.

▶**Upstate regions** (Zones A-E) accounted for 50% of the electricity produced in the state in 2017.

Demand Trends & Forecasts

Energy Usage Trends & Forecasts

From 2000-2008 the NYISO managed the grid through a period of increasing energy use. **In the past decade, electricity provided by the grid has decreased, while energy production from distributed energy resources, such as solar, has increased.** These distributed energy resources (DERs) are beginning to displace energy that was traditionally supplied by the grid. However, displacement is not the same as elimination, and the energy provided by many DERs is not continuous, but intermittent. When those intermittent resources are unavailable to produce energy, the grid must still provide energy to those homes and businesses. As a result, planning for the reliable operation of the grid requires consideration of total expected consumption of energy, including energy provided by the DERs.

> **▸Distributed Energy Resource (DER):**
>
> A broad category of resources that includes distributed generation, energy storage technologies, combined heat and power systems, and microgrids.

The NYISO forecasts that energy use in New York — including the impacts of energy efficiency and customer-based DERs — will decrease annually by an average rate of 0.14% from 2018 through 2028. In 2017, the 10-year forecast for energy use was projected to decrease 0.23% annually.

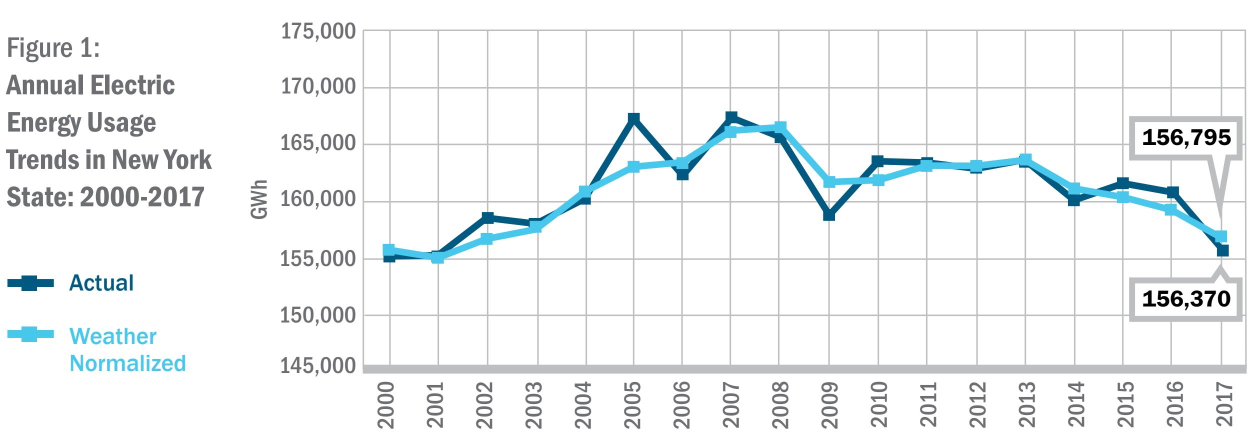
The NYISO's forecast for energy use in New York State is consistent with national trends. According to the U.S. Energy Information Administration (EIA), electricity demand growth was negative nationally in 2017.[1] Through its *Annual Energy Outlook*, the EIA suggests that demand will slowly increase through 2050, but increasingly efficient lighting, appliances, and tighter efficiency standards will work to minimize overall growth in demand during this period.

Peak Demand Trends & Forecasts

Peak demand is the maximum amount of energy use for a one-hour period during the year. It represents a small fraction of annual overall electrical energy use.[2] However, **peak demand is an important metric because it defines the amount of energy producing resources, or power capacity that must be available to serve customers' maximum demand for energy to avoid disruptions to service.** Reliability standards, such as installed capacity requirements, are based on projected peak demand. These reserve requirements determine the total amount of power capacity that must be available to meet expected maximum energy needs.

> **▸In New York,** the peak occurs during summer months when air conditioner use adds to demand.

Figure 1: Annual Electric Energy Usage Trends in New York State: 2000-2017



New York's all-time record peak demand is 33,956 MW, reached in July 2013 at the end of a week-long heat wave.

In 2017, the annual peak reached 29,699 MW, which was 12.6% below the record peak, and 7.4% below the 2016 peak of 32,075 MW.

Peak demand in New York is forecasted to decrease at an annual average rate of 0.13% from 2018 through 2028, which is the lowest rate of annual growth in the history of the NYISO. Over the past four years, the NYISO's long-term forecasts have shown peak demand declining from a projected 0.83% average annual increase in 2014 to a 0.13% annual decrease projected in 2018.

Figure 2: **Annual Electric Energy Usage by Region: 2016-2017**

REGION	2016 GWh	2017 GWh	% CHANGE
New York State (NYCA)	160,798	**156,370**	-2.75%
Upstate (Zones A-E)	54,286	**52,938**	-2.48%
Downstate (Zones F-I)	31,268	**30,351**	-2.93%
New York City (Zone J)	53,653	**52,266**	-2.59%
Long Island (Zone K)	21,591	**20,815**	-3.59%

Figure 3:
Electric Energy Usage Trends and Forecast in New York State: 2005-2028

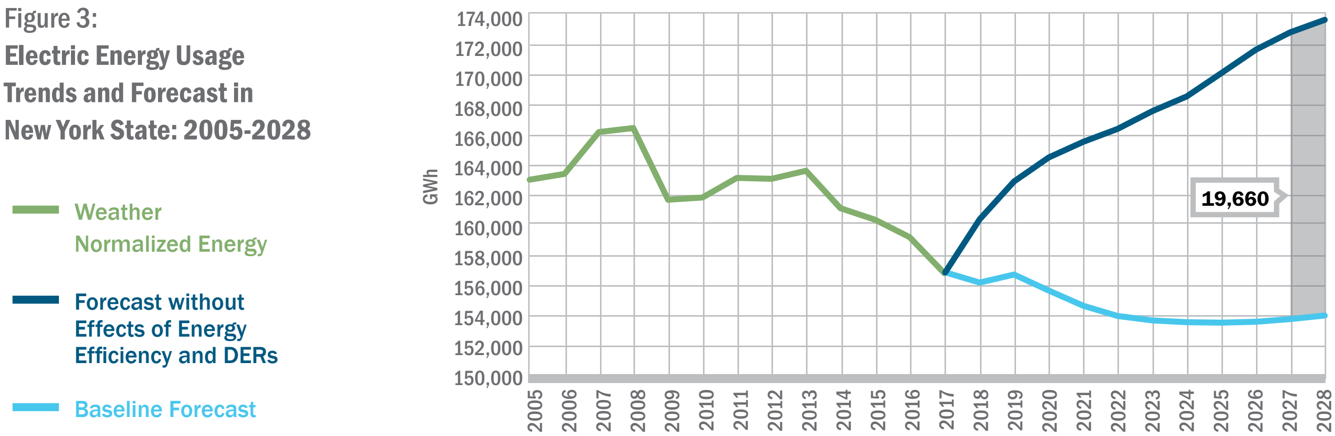
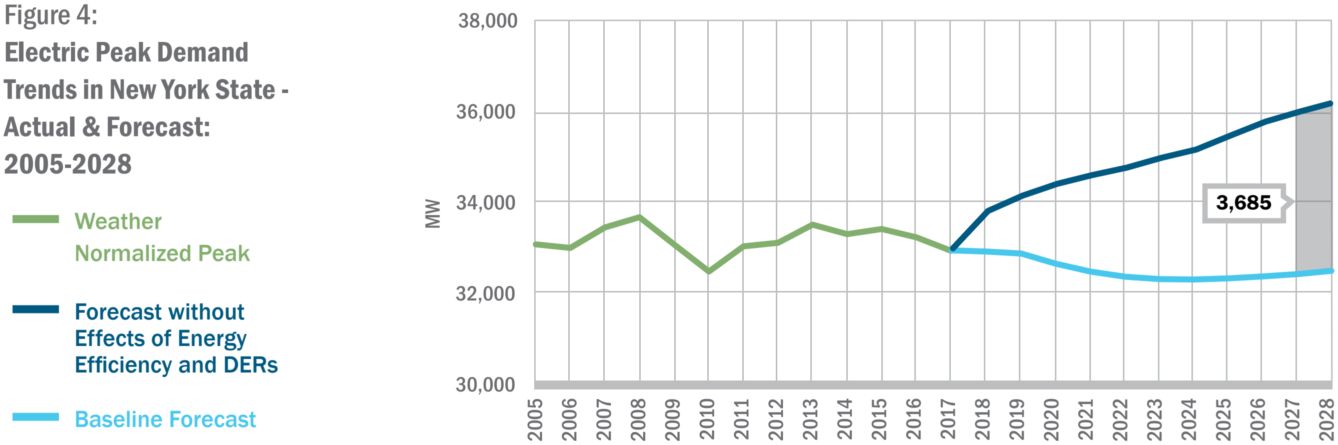


Figure 4:
Electric Peak Demand Trends in New York State - Actual & Forecast: 2005-2028

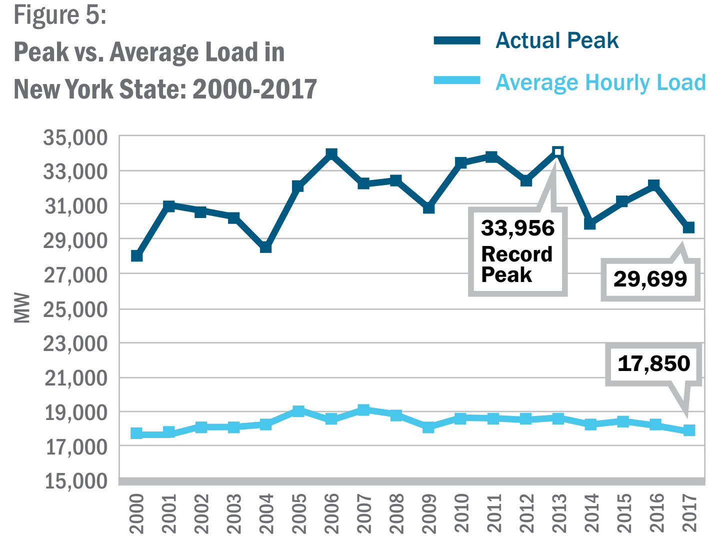


Energy Efficiency & Distributed Energy Resources

Energy efficiency programs, distributed solar, and non-solar distributed resources — such as energy storage or small generators — are combining to moderate the growth of energy supplied by the grid, as well as peak demand.

Energy efficiency is improving with new building codes and appliance standards, along with the proliferation of government, utility, and community programs and policies designed to encourage usage of energy efficient products. These energy efficiency gains are expected to reduce peak demand on New York's bulk power system by 245 MW in 2018 and by 2,262 MW in 2028. They are also expected to lower annual energy usage served by the bulk power system by 1,399 GWh in 2018 and by 12,930 GWh in 2028.

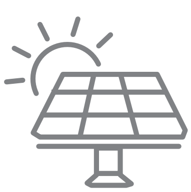
Figure 5:
Peak vs. Average Load in New York State: 2000-2017



Behind-the-meter solar resources in New York are expected to reduce peak demand on the bulk power system by 440 MW in 2018 and by 1,038 MW in 2028 based on an anticipated total installed capacity of 1,504 MW in 2018 and 3,577 MW in 2028. These solar resources are also expected to lower annual energy usage served by the bulk power system by 1,768 GWh in 2018 and by 4,420 GWh in 2028. The NYISO anticipates that the contribution of solar toward system peak will be less than the total installed capacity of the resource, due to the reduction in available sunlight late in the afternoon when system peak typically occurs.

In addition to distributed solar, other behind-the-meter resources are expected to reduce peak demand on the bulk power system by 174 MW in 2018 and by 385 MW in 2028. They are also expected to lower annual energy usage served by the bulk power system by 1,033 GWh in 2018 and by 2,310 GWh in 2028.

Included in the NYISO's 2018 data is a forecast of the cumulative impacts of electric vehicles (EVs) on energy usage and peak demand. EVs are expected to increase peak demand on the system by 15 MW in 2018 and by 343 MW in 2028. Similarly, EVs are expected to increase annual energy usage served by the bulk power system by 69 GWh in 2018 and 2,078 GWh in 2028.



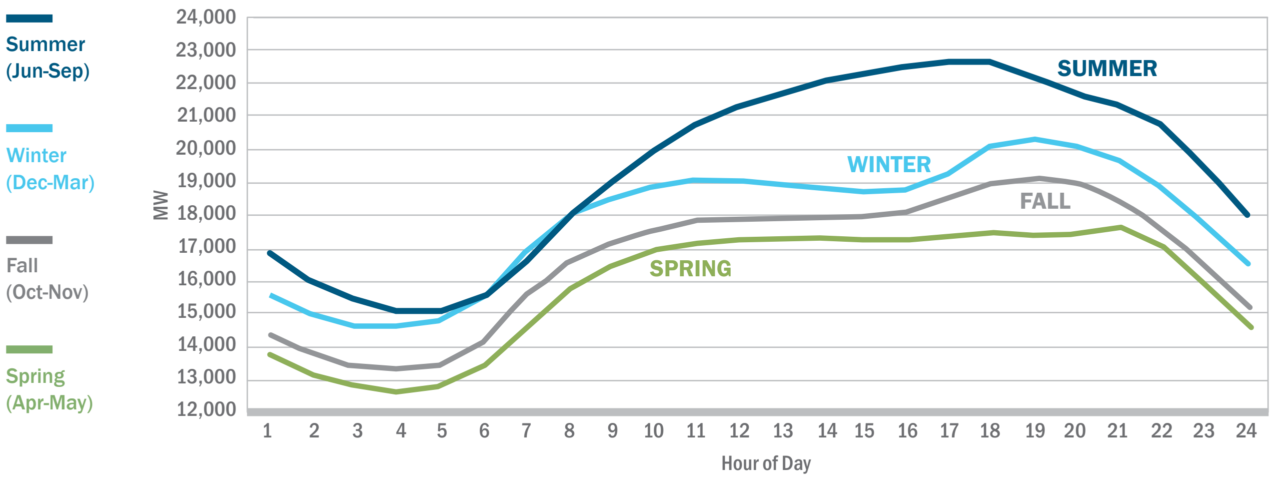
▸ **"Behind-the-meter"**
A generation unit that supplies electric energy to an end user on-site without connecting to the bulk power system or local electric distribution facilities.

Daily & Seasonal Demand Patterns

The demand for electricity fluctuates throughout the day and varies by season. Within the day, hourly demand for electricity is influenced by the time of day and weather. Seasonal variations in demand patterns are largely weather-related. **It is worth noting that, as the level of renewable energy generation grows, more and more of the electricity supply will be influenced by weather conditions.** Wind and solar generation vary with the level of wind and sunshine across New York. Ultimately, enhanced transmission capabilities and expanded energy storage are expected to offer grid operators added tools to balance simultaneous variations in supply and demand, but the increased influence of weather on both supply and demand will add complexity to grid operations.

In New York, peak demand occurs during the summer when heat waves prompt greater use of air conditioning. For example, the highest recorded peak demand in New York — 33,956 MW — occurred in July 2013. In comparison, New York's record winter peak demand — recorded in January 2014 — totaled 25,738 MW.

Figure 6: **Seasonal Hourly Demand Patterns: 2017**



Resource Trends

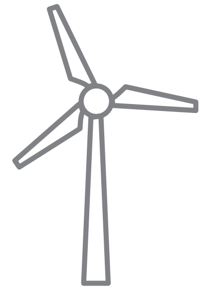
Power Generation Trends

Since 2000, private power producers and public power authorities have added 11,846 MW of new generating capacity in New York State. This additional generation represents approximately 30% of New York's current generation.

Nearly 80% of that new generation has been developed in southern and eastern New York (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 the demand for electricity is the highest.

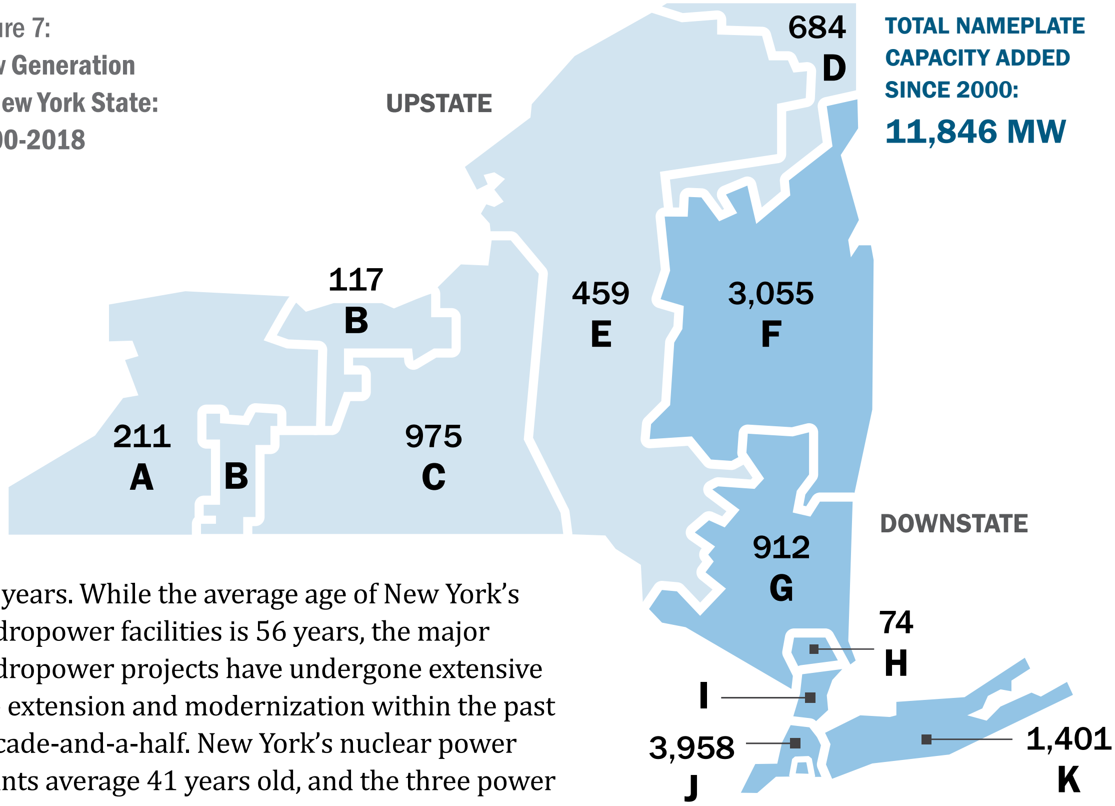
Other additions to New York's power-producing resources resulted from upgrades to existing power plants in upstate regions, or were renewables for which siting is largely influenced by physical factors such as the suitability of wind conditions.

Renewable power projects, such as wind and solar units, are among New York's newest generating facilities, averaging nine years and three years, respectively. Combined cycle units fueled by natural gas — many of which were built after the start of New York's wholesale electricity markets — have an average age of



▸ **Wind generators** use air movement to turn a turbine to create electricity, much the same way hydropower generators use water to turn a turbine. Solar panels use solar cells to convert sunlight to electrical energy without any moving parts. Fossil-fired and nuclear generation use fuel to provide heat that gets converted to electricity through a generator. For ease of communicating, all of these energy producing resources will be referred to as generators in this document, even though they have completely different methods for converting energy to electrical energy.

Figure 7: **New Generation in New York State: 2000-2018**

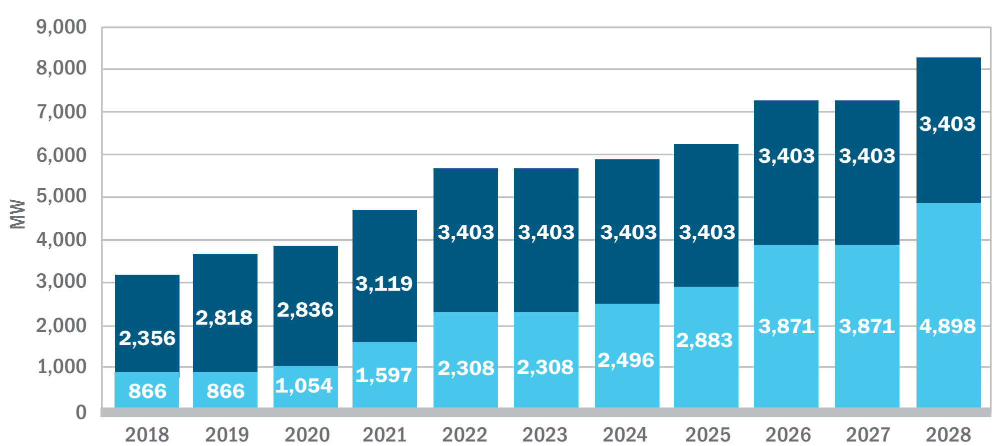


17 years. While the average age of New York's hydropower facilities is 56 years, the major hydropower projects have undergone extensive life extension and modernization within the past decade-and-a-half. New York's nuclear power plants average 41 years old, and the three power plants in New York capable of combusting coal have an average age of 44 years.

A growing amount of New York's gas-turbine and fossil fuel-fired steam-turbine capacity is reaching an age at which, nationally, a majority of similar capacity has been deactivated. In 2018, 866 MW of steam-turbine generating capacity in New York State is 62.5 years of age or older — an age at which, nationally, 95% of such capacity has ceased operations. For gas turbines, 2,356 MW of capacity in New York State is 46 years of age or older. Nationally, 95% of capacity using this technology has deactivated by this age. By 2028, more than 8,300 MW of gas-turbine and steam-turbine based capacity in New York will reach an age beyond which 95% of these types of capacity have deactivated. **While there have been significant additions to New York's generating capacity since 2000, power plants age like all physical infrastructure. The need to maintain, upgrade, or replace aging generation infrastructure requires attention.**

Figure 8: **Aging Fossil Fuel Nameplate Capacity: Gas Turbines & Steam Turbines Nearing Retirement**

Nationally, 95% of Steam Turbine capacity retires by the time it reaches 62.5 years of operation. Similarly, 95% of Gas Turbine capacity ceases operating by the time it reaches 46 years of operation. The chart shows the amount of capacity in operation in New York which is approaching these ages.

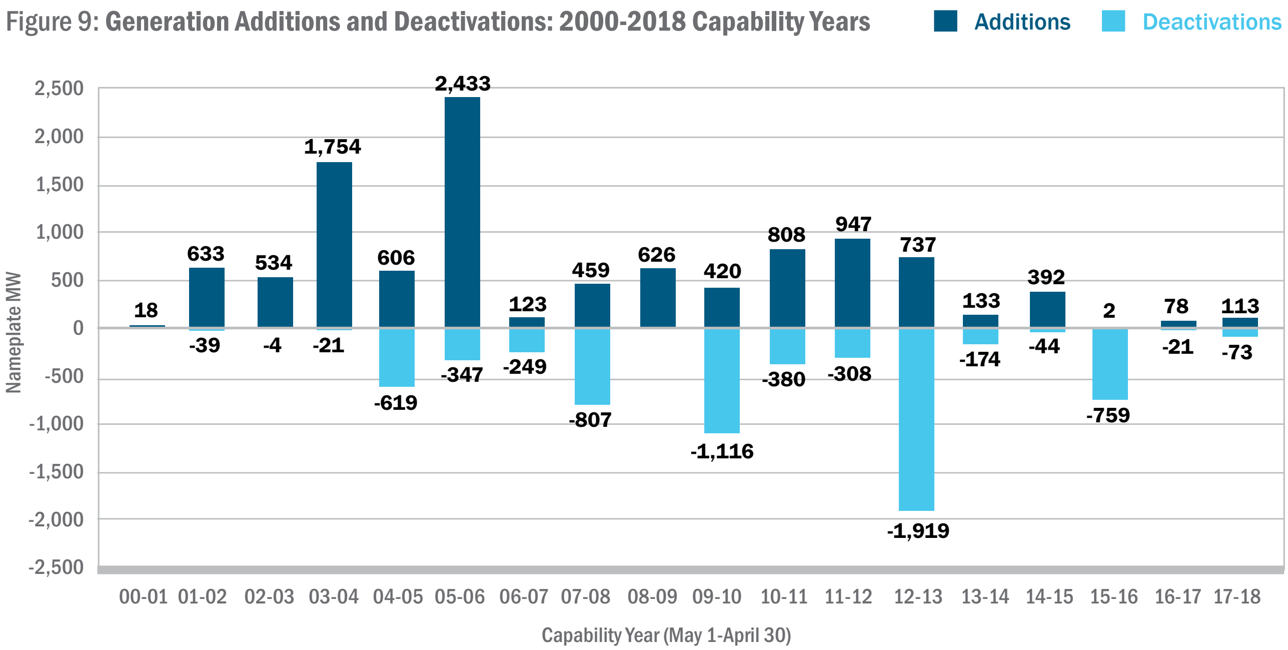


Expansion & Contraction

As the demand for electricity and available supplies of power warrant new investment, new power plants are built and existing facilities are upgraded to expand generating capacity. Power plants may also elect to deactivate in response to economic circumstances, physical plant conditions, or regulatory requirements.

According to the U.S. Energy Information Administration (EIA), more than 25,000 MW of generating capacity was added nationwide in 2017, nearly half of which came from renewables.[3] The additions offset the retirement of more than 10,000 MW of capacity, nearly all of which was powered by fossil fuels. EIA notes that the eastern region of the U.S., a region that stretches from Maine to the Rocky Mountains, saw retirements of roughly 82,000 MW of capacity from 2008-2017 — compared to 112,000 MW of capacity additions. Coal-fired capacity in particular has declined, with 19% of the eastern region's coal capacity retired in the past decade.[4]

Figure 9: **Generation Additions and Deactivations: 2000-2018 Capability Years**



Since 2000, 11,846 MW of new generation have been added to New York's electric system — and existing facilities have improved their generating capacity — while nearly 7,000 MW have retired or suspended operation. The pattern of expansion and contraction has ranged from the net addition of more than 2,000 MW between 2005-2006 to a net reduction of more than 1,100 MW between 2012-2013.[5]

Generation additions were primarily natural gas-fueled or wind-powered. Since 2000, nearly 3,000 MW of generation fueled by coal have retired or suspended operation.

The pattern of expansion and contraction has continued in recent years. **Price signals from the NYISO's markets have encouraged more efficient resources to enter the market, while signaling less efficient generation that is no longer economically competitive to exit the market.** These locational signals inform investors when to add generation, and where to invest in new resources on the grid to most efficiently serve consumer needs. In parallel, state and federal policies are promoting investment in new renewable generation. In 2012, statewide power resources exceeded peak demand and reserve requirements by more than 5,000 MW. By 2017, the margin had declined to approximately 1,649 MW. In 2018, the surplus of power resources beyond reliability requirements totals 3,946 MW.

▸**New York's Installed Reserve Margin:** 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 the Federal Energy Regulatory Commission and the New York State Public Service Commission.

The changing margin between available and required capacity reflects the dynamic balancing that markets provide in maintaining sufficient resources to meet reliability. The NYISO's markets have maintained this balance through price signals that sustain reliability in an economically efficient manner. However, power plant deactivations can present challenges to electric system reliability.

New York's Regional Transmission

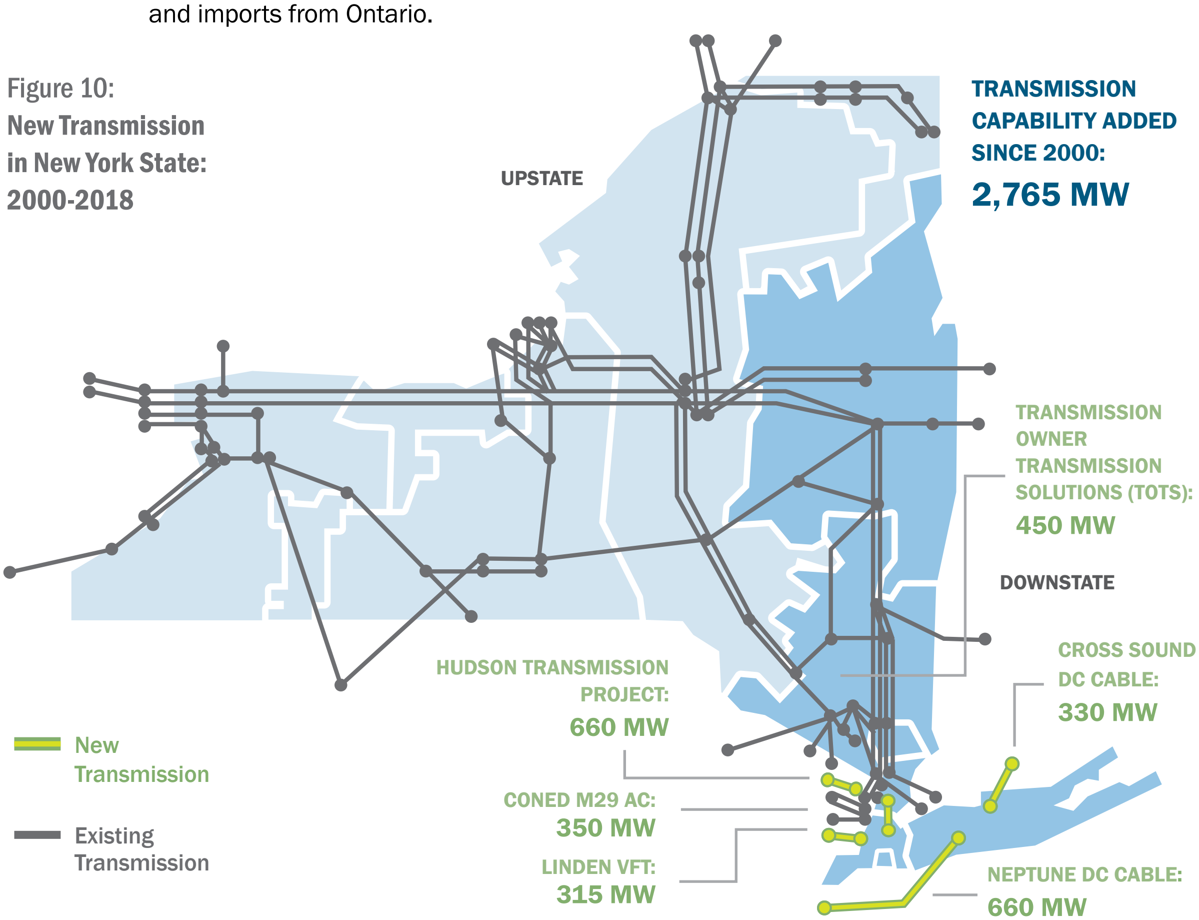
New York's bulk power system moves electricity over 11,173 circuit-miles of high-voltage transmission lines to meet the needs of energy consumers, from the remote and sparsely populated regions of the Adirondacks to the densely packed heart of Manhattan.[6] Over 80% of the transmission system went into service before 1980.

The power demands of the downstate region have attracted the development of various transmission projects, primarily to serve southeastern New York, which includes Manhattan. More than 2,700 MW of transmission capability have been added to serve New York's electric system since 2000.

Further upgrades and enhancements of New York's transmission infrastructure are being planned in response to New York State public policy-related transmission expansion needs. In 2017, the NYISO evaluated competing projects and selected NextEra's proposal to satisfy New York State's Western New York Public Policy objectives. The proposed project is expected to:

- Add new transmission capability between Buffalo and Rochester
- Address grid constraints that limit output of the Niagara Hydroelectric Facility and imports from Ontario.

Figure 10: New Transmission in New York State: 2000-2018

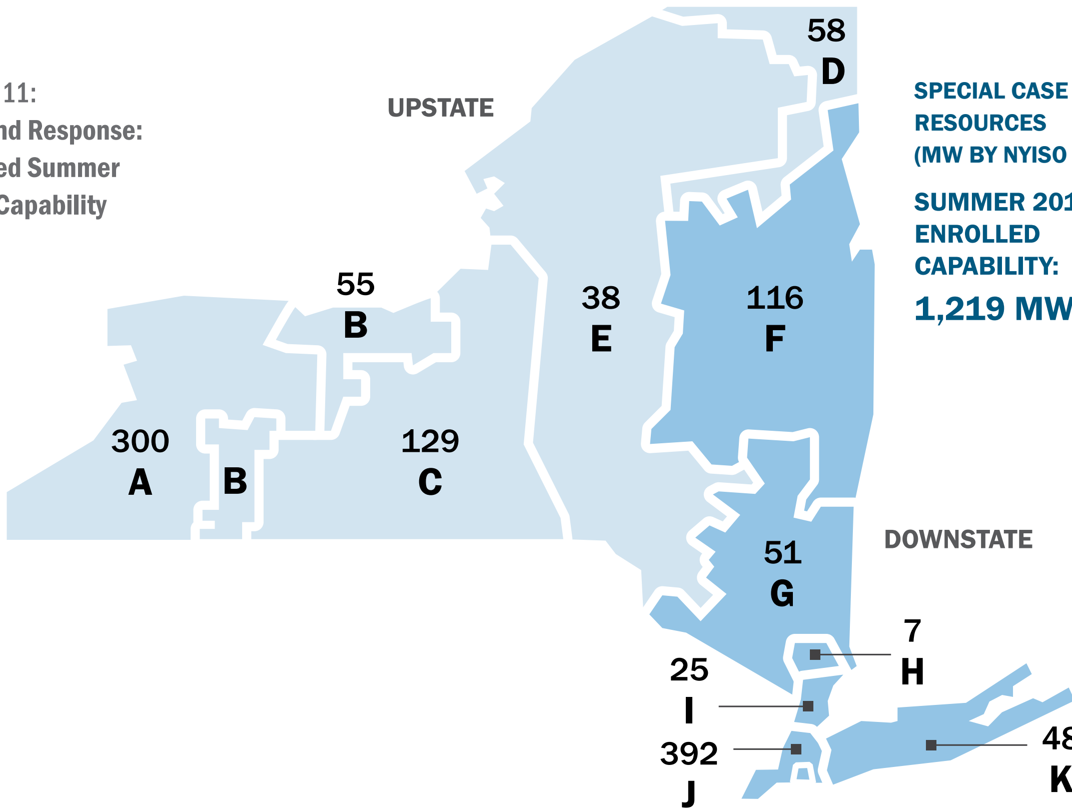


In 2018, the NYISO is evaluating competing proposals related to the AC Public Policy initiative, which aims to expand transmission capability within existing rights of way in the Central New York – Hudson Valley transmission corridor. Once constructed, the project will increase the flow of renewable energy from upstate to downstate.

Demand Response

Demand response enlists large electricity consumers, and aggregations of smaller energy users, to reduce consumption from the grid during periods of peak demand or in response to price signals. Demand response providers continue to adapt as technology enables increasingly sophisticated management of power consumption.[7]

Figure 11:
Demand Response: Enrolled Summer 2018 Capability



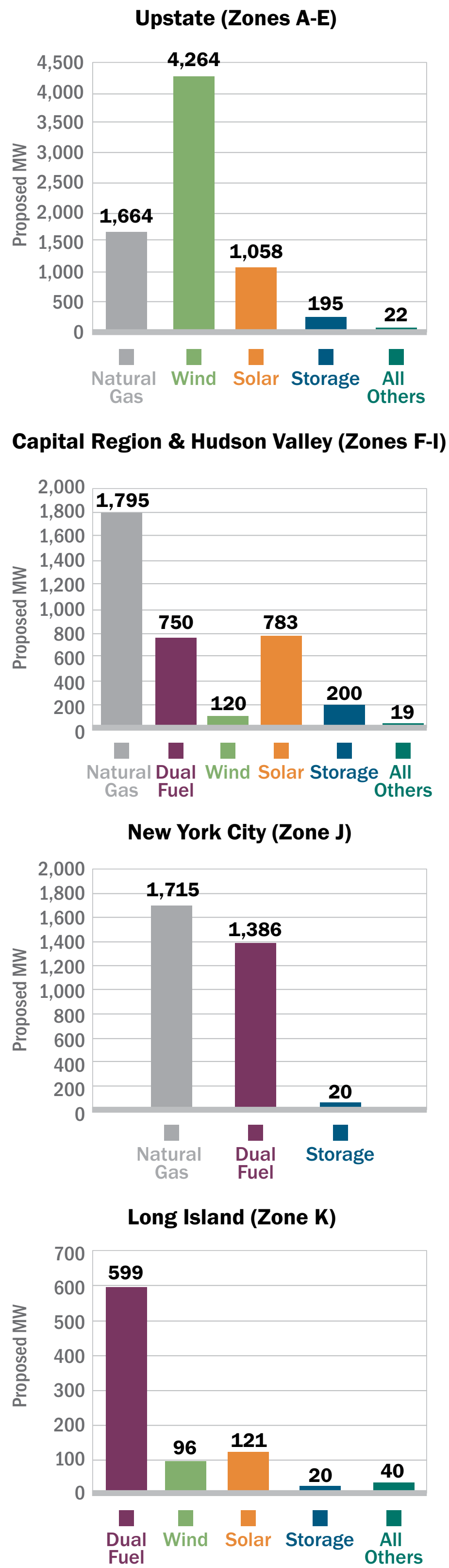
Prior to the establishment of wholesale electricity markets, the electric system addressed growth in peak demand with comparable increases in generating capacity. Demand response programs have provided a conservation-orientated alternative by incentivizing and coordinating consumers to reduce their use of electricity from the grid.

According to the Federal Energy Regulatory Commission (FERC), demand response resources in the nation's seven ISO/RTO regions totaled 28,673 MW in 2016, representing 5.7% of peak demand — down from 6.6% of peak demand in 2015.[8]

Large power customers and aggregated groups of smaller consumers participate in several demand response programs in the NYISO markets.[9] In summer 2017, the programs involved 3,361 end-use locations, providing a total of 1,237 MW of load reduction capacity — representing 4.2% of the 2017 summer peak demand. The 2017 enrollment level represented a 2.3% decline in demand response capacity, compared to the 2016 level.

▸**Special Case Resources:** A demand response program which helps to maintain reliability of the grid by calling on electricity users to reduce consumption during times of shortage conditions.

Proposed Generation By Region
As of March 1, 2018



For the summer of 2018, the NYISO's largest demand response program, Special Case Resources, is projected to be capable of providing up to 1,219 MW of demand reduction. Additionally, the Emergency Demand Response Program is expected to be able to provide 18 MW of demand reduction.

Resource Outlook

Reliability Assessment

The NYISO conducts system planning to maintain the long-term reliability of New York's bulk power system. Every two years, the NYISO's Reliability Planning Process examines the reliability of the state's electric system over a 10-year planning horizon. Using a multi-faceted approach, the NYISO's planning process strives to achieve market-based solutions whenever possible. This allows developers and investors to assess and assume the risks of such investments to avoid imposing the costs on rate-paying consumers.

Reliability planning is the key to maintaining the integrity of the electric grid. The NYISO regularly performs an evaluation through its *Reliability Needs Assessment (RNA)*. If the assessment finds emerging needs, the NYISO solicits market solutions. Regulated solutions are also solicited as a backstop, in the event they are needed to maintain grid reliability. Then, a *Comprehensive Reliability Plan (CRP)* details the solutions proposed for meeting any needs identified through the process. If a regulated backstop solution is required to meet reliability needs, the NYISO selects the most efficient or cost-effective transmission project. The costs of a transmission project can be allocated to, and recovered from, those customers benefitting from the upgrade through the NYISO's tariffs following regulatory approval.

The NYISO's planning studies use sophisticated models to assess the capability of the transmission system and the adequacy of resources to meet New York's electric needs. There are numerous factors included in these models to determine whether there are any reliability needs, including:

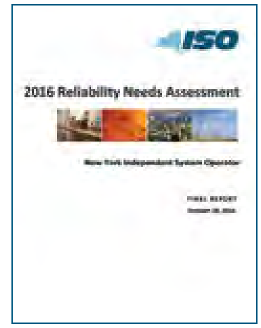
- The impact of changes in generation and transmission resources available to the electric system
- Forecasts of consumer demand and peak loads
- Economic outlook data
- Weather models
- The impact of demand response resources that are paid to reduce energy usage at peak times

The NYISO is in the initial stages of developing the *2018 Reliability Needs Assessment (RNA)*. Scheduled for completion in the fall of 2018, it will evaluate the 2019-2028 planning horizon, identify any potential reliability needs, and establish the process for soliciting solutions if necessary. Consistent with past practice, the *2018 RNA* will also assess the impacts of possible scenarios that may identify possible reliability concerns to inform policymakers and investors about longer-range uncertainties, but will not result in the NYISO seeking solutions for those scenarios.

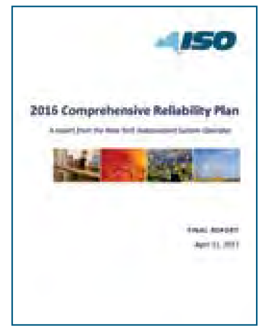
Extending Plant Operations for Reliability

The *Comprehensive Reliability Plan (CRP)* is the cornerstone of the bi-annual planning process. Furthermore, the NYISO continuously examines the reliability of the state's bulk power system by monitoring the implementation of local transmission plans and potential risk factors. In addition to its regular reliability planning processes, the NYISO conducts a facility-specific generator deactivation assessment to address any reliability needs that could result from a generator deactivation.

Pursuant to this process, upon receipt of a completed deactivation notice, the NYISO assesses whether the proposed deactivation could result in a reliability need (transmission security or resource adequacy) over a five-year planning horizon. If a reliability need is identified, the NYISO solicits for solutions, which could include replacement supply, transmission facility upgrades, or transmission additions. As a last resort, NYISO may enter into an agreement with the deactivating generator to retain its services temporarily until a longer-term solution to the reliability need can be implemented.



► **Reliability Needs Assessment**



► **Comprehensive Reliabilty Plan**

To download NYISO publications, visit our website at www.nyiso.com.

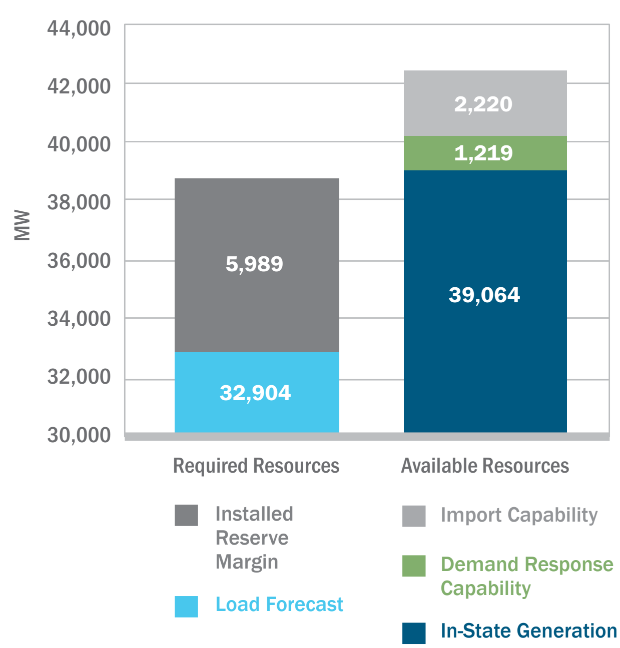
2018 Reliability Outlook

For the summer of 2018, the total resource capability available to serve New York State is 42,839 MW. These resources include the installed generating capacity of in-state power projects, imports available to the system, and projected levels of demand response participation.

The total resource capability in 2018 is 2,040 MW above last year's level. Available resources remain well above the projected peak demand of 32,904 MW, plus the reserve requirement — a combined total of 38,893 MW.

This estimate of total resources measures the maximum potential of resources. However, outages of generating and transmission facilities, or lower-than-expected participation in demand response can reduce the availability of resources. Similarly, the forecasted peak represents a baseline estimate. Extreme weather could drive the peak demand to more than 35,000 MW in 2018.

Figure 12: **Statewide Resource Availability: Summer 2018**



Capacity Reserve Margins

The NYISO's capacity market assists with maintaining reliability by ensuring that sufficient resource capability is available to meet expected maximum energy needs, plus an Installed Reserve Margin (IRM). **The IRM is intended to set the level of resources necessary to adequately serve system needs in light of potential contingencies and other unanticipated events.**

The NYISO, in coordination with the New York State Reliability Council (NYSRC), conducts a technical analysis each year to determine the appropriate level for the capacity reserve margin. Based on this analysis, the NYSRC determines the level of capacity required statewide. Factors that influence the reserve margin value include:

- Load forecasts
- Variability of load due to uncertainties related to weather
- Historical performance of generation and demand response resources
- Constraints on the transmission system
- Emergency operating procedures that can be deployed during system emergencies

Thus, the capacity market and its associated reserve margin bolster resiliency by preparing the system to cope with equipment breakdowns, severe weather, or other unplanned events that could affect system reliability.

The approved IRM for the 2018-2019 Capability Year, including the Summer Capability Period that begins on May 1, 2018, is 18.2%. This represents a 0.2% increase from the 2017-2018 IRM of 18.0%.[10] The IRM requires utilities, energy service companies, and other load-serving entities to purchase capacity equal to 118.2% of the forecasted peak summer load. Factors influencing the slight increase to the IRM include updates to load forecasts for 2018, additions of conventional and intermittent generation, and modeling of the electricity systems adjacent to New York.

▸**The approved Installed Reserve Margin (IRM)** for the 2018-19 Capability Year that began on May 1 is 18.2%.

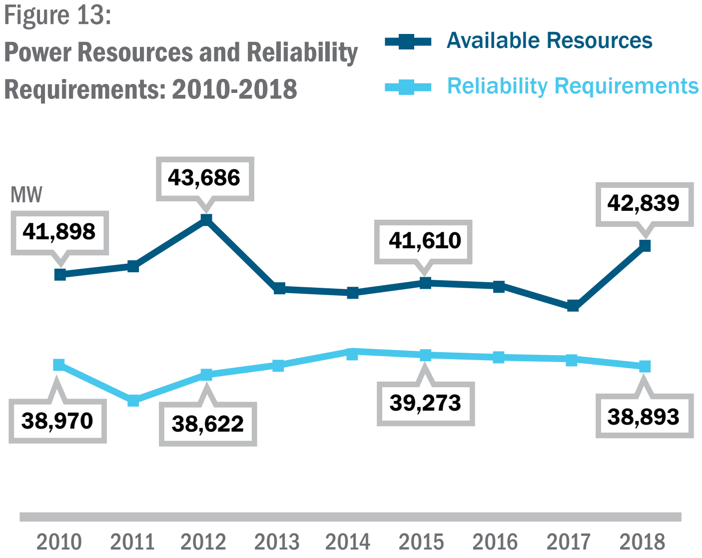
The NYISO ensures statewide resource adequacy through its capacity market, which must procure sufficient resources to meet forecasted seasonal peak demand, plus IRM requirements, on a statewide basis. In complying with this statewide resource adequacy obligation, the capacity market also must procure sufficient local capacity resources for three separate downstate regions (zones G-J in the lower Hudson Valley, New York City, and Long Island) where transmission constraints limit power flows into these regions. To address these constraints, **Locational Capacity Requirements (LCRs) are analyzed and established annually for each region. These LCRs set the minimum amount of capacity that must be procured within the region to reliably serve load.** The LCRs also serve to bolster system resiliency by seeking to ensure an appropriate distribution of available resources to meet forecasted demand and expected system conditions. For the 2018-19 Capability Year, the LCR for New York City (Zone J) is 80.5%; for Long Island (Zone K), 103.5%; and, for the lower Hudson Valley region (zones G-J), 94.5%.

Resource Diversity & Energy Costs

Both the reliability of the electric system and the price of power are affected by the mix of fuels used to generate electricity. **A balanced array of resources enables the electric system to better address issues such as price volatility, fuel availability, and requirements of public policy.**

Policy goals and environmental regulations affect fuel mix for power generation through overall emissions caps and emissions standards, which require power plants that burn fossil fuels to limit production, procure allowances to cover emissions, and/or install pollution controls. These public policies interact with markets and technology trends to influence the fuel mix over time. For instance, New York and 28 other states in the nation have adopted renewable portfolio standards with the goal of having green power resources, such as solar and wind, provide a specified portion of generation.

Figure 13:
Power Resources and Reliability Requirements: 2010-2018



Market factors — including the relative costs of fuel, operation and maintenance — as well as the costs of siting, permitting, and construction, have significant influence on the mix of generation technologies and fuels used to produce power. For example, the current price advantage of natural gas is driving significant development of gas-fired generation throughout the nation, and placing economic pressure on resource types that use less economic fuels or have higher production costs.

Fuel Mix in New York State

From a statewide perspective, New York has a relatively diverse mix of generation resources. However, New York's grid is characterized by stark regional differences whereby the downstate supply mix is less diverse than the upstate supply mix. Several factors have resulted in the power demands of New York City and Long Island being served with local generation primarily fueled by natural gas. These factors include transmission constraints and reliability standards that establish local generation requirements in the downstate region. However, many of these are dual-fuel units capable of using oil when necessary — which provides fuel diversity and reliability benefits to the system.

In addition to looking at capacity — the maximum potential output of the various types of power plants — it is important to consider the actual energy generated by those power plants.

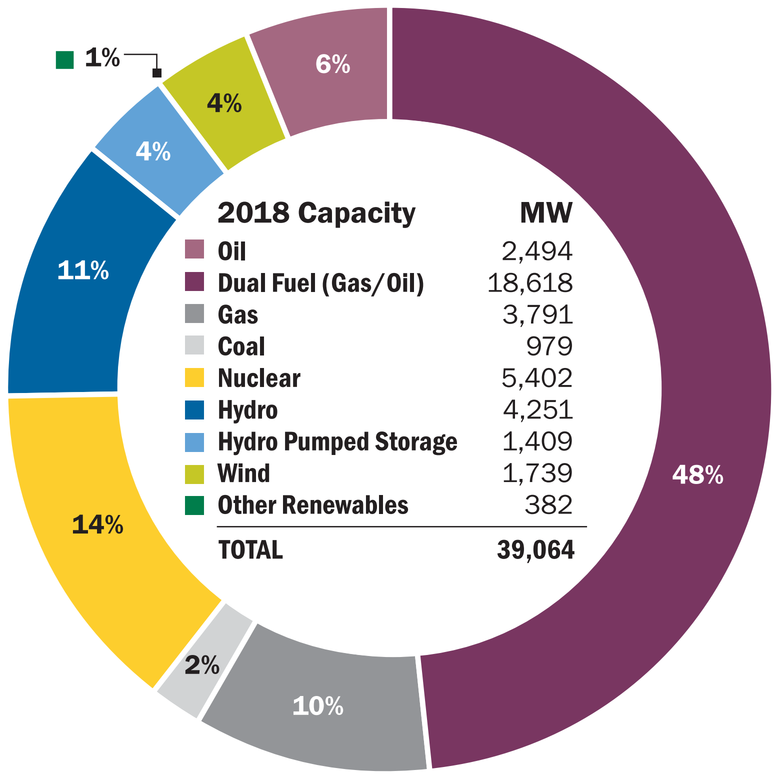
For example:

- Fossil fuels (natural gas, oil and coal) account for 66% of New York's generating capacity, and 39% of its production.
- Nuclear accounts for 14% of the state's generating capacity, and 32% of its production.
- Hydropower accounts for 11% of the state's generating capacity, and 23% of its production.

New York's fleet of fossil fuel power plants includes older facilities with higher operating expenses or fuel costs, which are selected to run only during periods of higher demand. While these facilities add to overall capacity totals, they contribute less to the annual amounts of electric energy produced in New York.

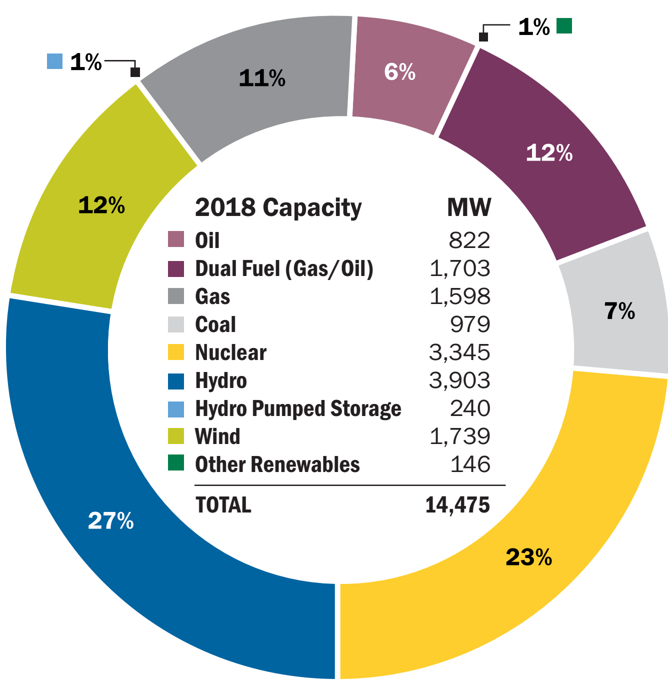
Figure 14: **Generating Capacity in New York State by Fuel Source — Statewide, Upstate New York and Downstate New York: 2018**

NYCA SUMMER INSTALLED CAPACITY



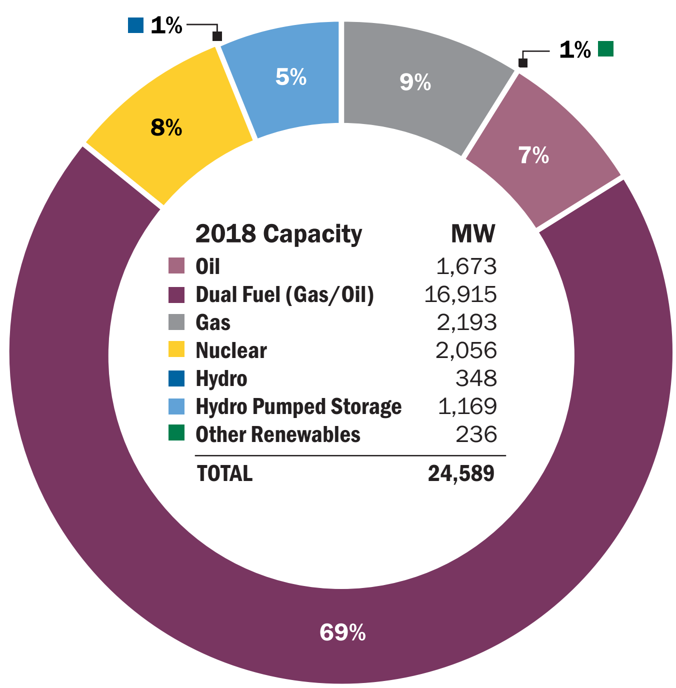
2018 Capacity	MW
Oil	2,494
Dual Fuel (Gas/Oil)	18,618
Gas	3,791
Coal	979
Nuclear	5,402
Hydro	4,251
Hydro Pumped Storage	1,409
Wind	1,739
Other Renewables	382
TOTAL	39,064

UPSTATE SUMMER INSTALLED CAPACITY (Zones A-E)



2018 Capacity	MW
Oil	822
Dual Fuel (Gas/Oil)	1,703
Gas	1,598
Coal	979
Nuclear	3,345
Hydro	3,903
Hydro Pumped Storage	240
Wind	1,739
Other Renewables	146
TOTAL	14,475

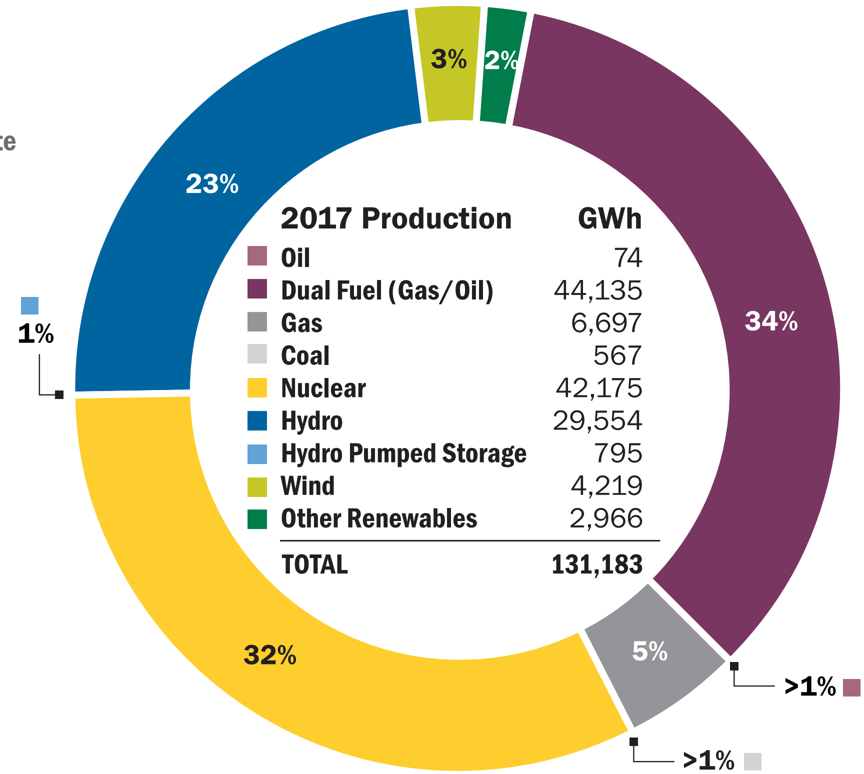
DOWNSTATE SUMMER INSTALLED CAPACITY (Zones F-K)



2018 Capacity	MW
Oil	1,673
Dual Fuel (Gas/Oil)	16,915
Gas	2,193
Nuclear	2,056
Hydro	348
Hydro Pumped Storage	1,169
Other Renewables	236
TOTAL	24,589

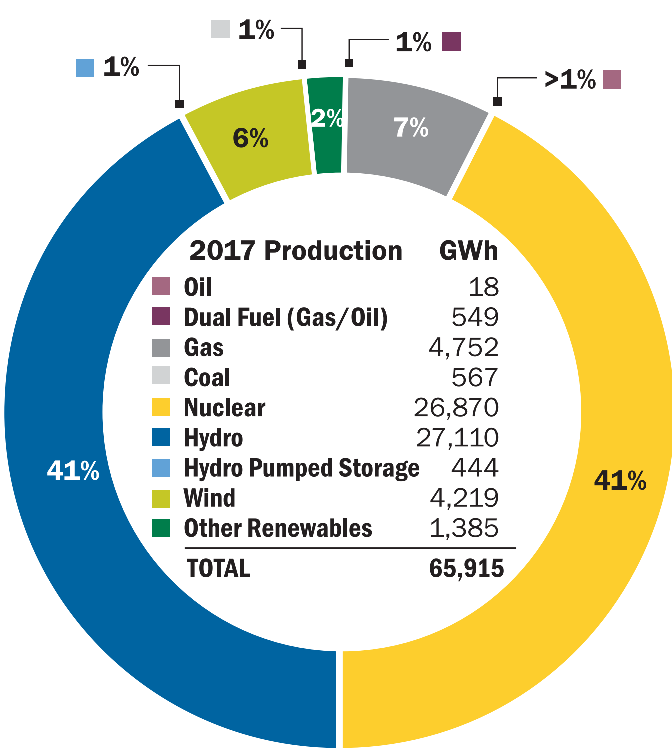
Figure 15: **Electric Energy Production in New York State by Fuel Source — Statewide, Upstate New York and Downstate New York: 2017**

NYCA ENERGY PRODUCTION



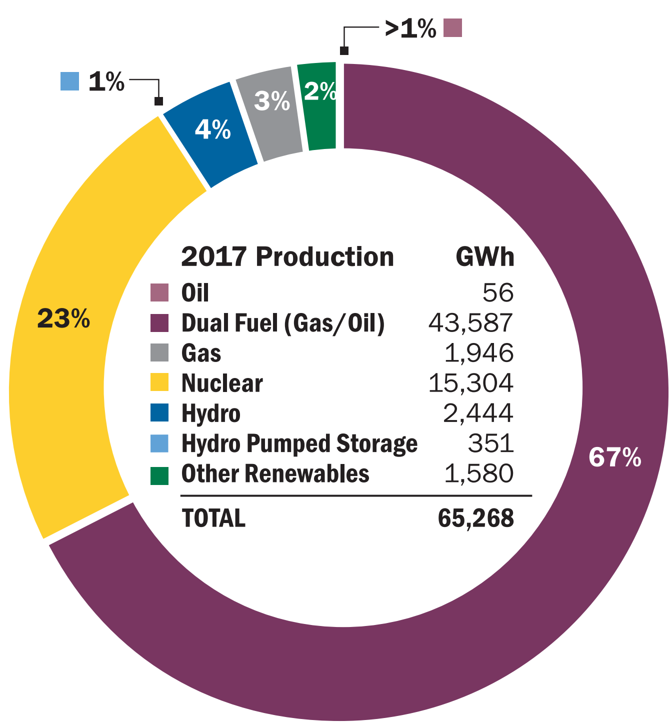
2017 Production	GWh
Oil	74
Dual Fuel (Gas/Oil)	44,135
Gas	6,697
Coal	567
Nuclear	42,175
Hydro	29,554
Hydro Pumped Storage	795
Wind	4,219
Other Renewables	2,966
TOTAL	131,183

UPSTATE ENERGY (Zones A-E)



2017 Production	GWh
Oil	18
Dual Fuel (Gas/Oil)	549
Gas	4,752
Coal	567
Nuclear	26,870
Hydro	27,110
Hydro Pumped Storage	444
Wind	4,219
Other Renewables	1,385
TOTAL	65,915

DOWNSTATE ENERGY (Zones F-K)



2017 Production	GWh
Oil	56
Dual Fuel (Gas/Oil)	43,587
Gas	1,946
Nuclear	15,304
Hydro	2,444
Hydro Pumped Storage	351
Other Renewables	1,580
TOTAL	65,268

▸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.

Renewable resources, such as hydro, wind, and solar energy have no fuel costs, making them more competitive in the NYISO energy market's scheduling process than older and potentially less efficient fossil units. However, the fuel supplies of these renewable resources are made variable by weather conditions. The intermittency of renewable resource operation influences the availability of their supplies, measured by a metric called capacity factor. Capacity factor compares how much electricity a generator produces, on average, relative to the maximum output it could produce at continuous, full-power operation.

Generators with comparatively low fuel and operating costs are usually selected in wholesale electricity markets to consistently supply power. They typically have average annual capacity factors of 70% or higher. Lower capacity factors indicate that a generator operates less frequently, such as during peak demand periods, or that its operation depends on the intermittent availability of its fuel supply, such as hydro, solar, and wind energy.

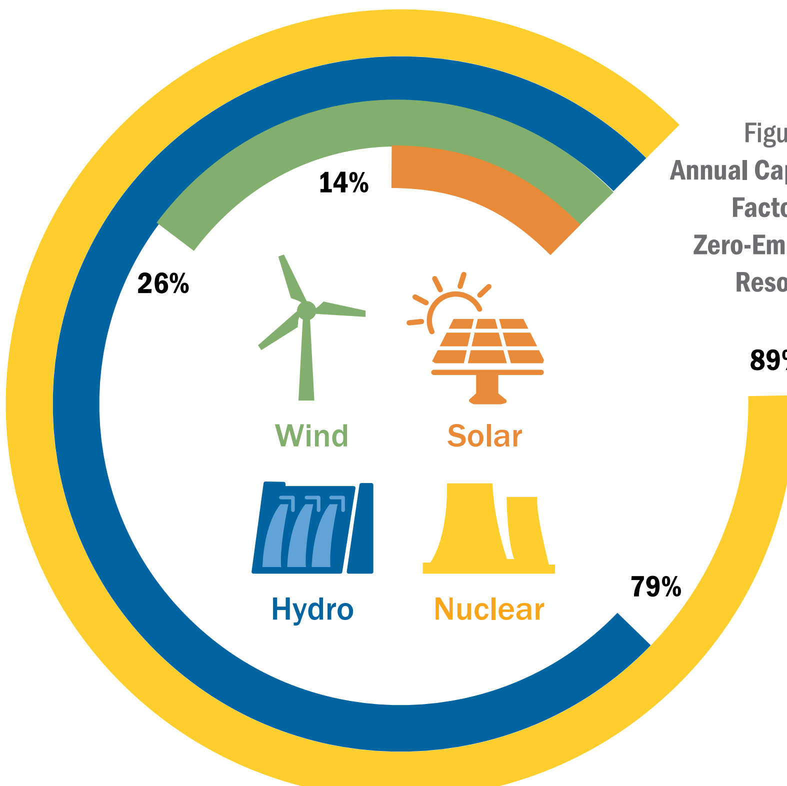


Figure 16: **Annual Capacity Factors for Zero-Emission Resources**

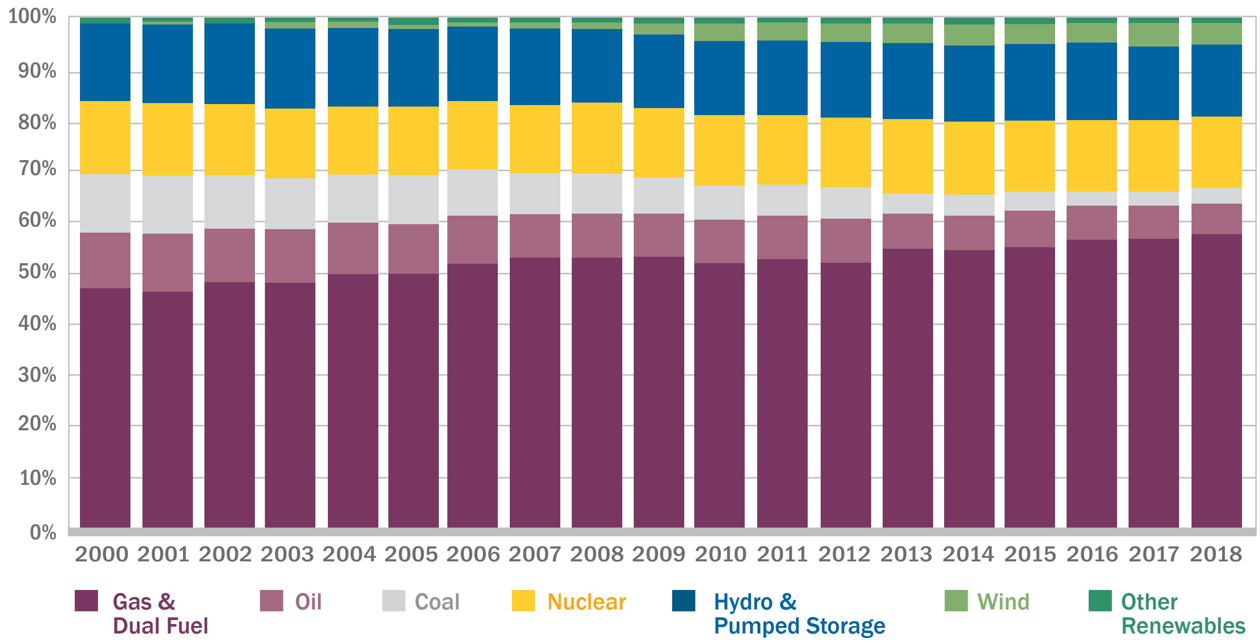
The relative capacity factors of different types of generation are important considerations in planning the future fuel mix. For example, based on 2017 operating performance, it would require nearly 3.4 MW of wind capacity to produce the same amount of energy as 1.0 MW of nuclear capacity over the course of a year. This is due to the variable nature of supply from these intermittent resources. From an operational perspective, the intermittent nature of these resources is challenging as they cannot respond to dispatch signals in the same manner that dispatchable supply resources can. For example, these resources can be signaled to supply less energy when reliability conditions warrant, but cannot increase output in the same manner as dispatchable resources can.

The combination of fuels used to produce power in New York has changed since 2000. New York's capability to produce power from natural gas and wind has grown, reflecting economic trends in natural gas costs and production as well as public policies supporting development of cleaner energy resources. During this time, the generating capacity from coal- and oil-fired plants has declined.

The portion of New York's generating capability from natural gas and dual-fuel facilities grew from 47% in 2000 to 58% in 2018. Wind power — virtually non-existent in 2000 — grew to 4.5% of New York State's generating capability in 2018.

In contrast, New York's generating capability from power plants using coal declined from 11% in 2000 to 2.5% in 2018. Generating capability from power plants fueled solely by oil dropped from 11% in 2000 to 6% in 2018.

Figure 17: **New York State Fuel Mix Trends: 2000-2018**



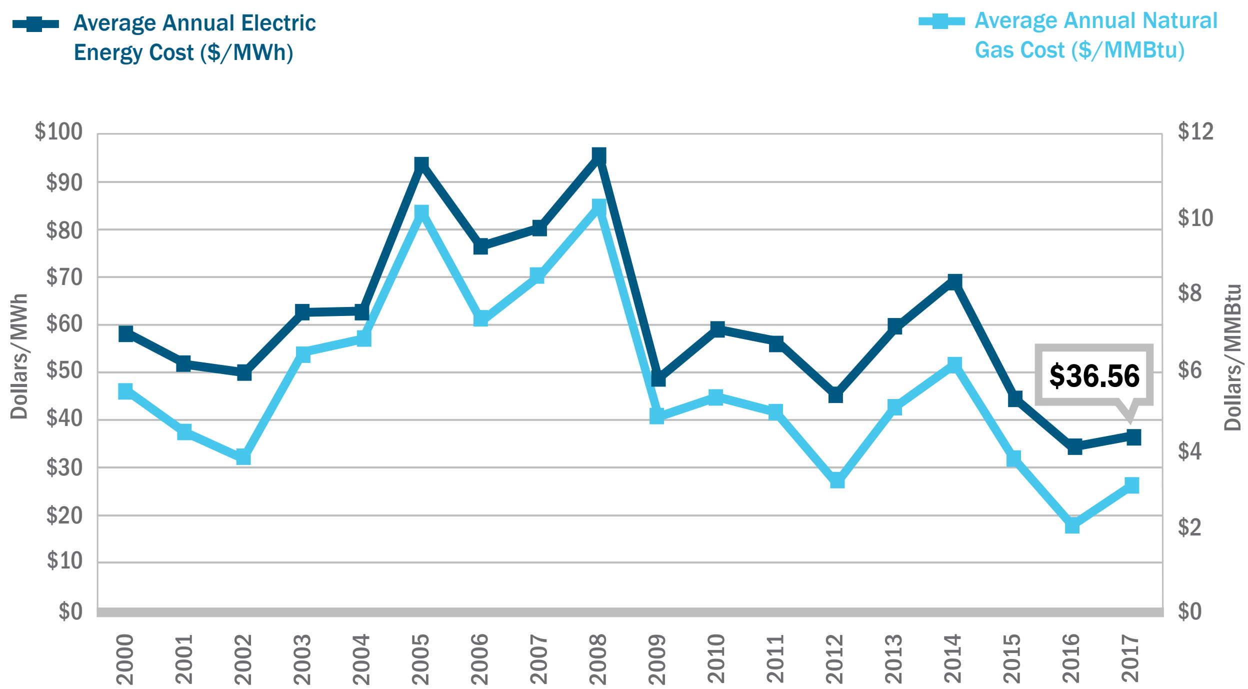
The shares of generating capability from nuclear power plants and hydroelectric facilities have remained relatively constant since 2000. Nuclear accounted for 14% of New York's generating capability in 2000-2018. Hydropower (including pumped storage) represented 15% of the state's generating capability in 2000 and 14% in 2018.

Electricity Prices & Fuel Costs

The average wholesale electric energy price in 2017 was $36.56 per megawatt-hour (MWh), increasing slightly from $34.28 in 2016.

Wholesale electricity prices are directly influenced by the cost of the fuels used by power plants to meet the demand for electricity. In New York, the price of natural gas and the cost of electricity are closely correlated because gas-fired generation often establishes the clearing price for electricity in NYISO's wholesale energy market.

Figure 18: **Natural Gas Costs and Electric Energy Prices: 2000-2017**



► **$36.56 per MWh,** was the average annual wholesale electric price for 2017.

Energy Prices & Demand

Wholesale electricity prices also rise and fall with power demands. Lower demand for electricity allows a larger proportion of electricity to be generated by more efficient and less costly facilities, resulting in lower prices. In 2017, the average hourly load on the New York grid was 17,850 MW, representing a 2.5% decline from 2016 and reaching its lowest level since 2001, when the average hourly load on the grid was 17,721 MW.

Capacity Prices

Capacity prices during the 2017 Summer Capability Period were mixed compared to those of the previous Summer Capability Period. The average Spot Market Auction price in New York City was lower at $10.04/kW-month compared to $12.24/kW-month in 2016. In Long Island, the average price was higher at $6.66/kW-month compared to the 2016 average of $4.63/kW-month. The average Spot Market Auction price over the Summer 2017 Capability Period was also higher in the lower Hudson Valley regions (zones G-J), where the 2017 average price was $9.85/kW-month compared to $9.24/kW-month in 2016. For the New York Control Area (NYCA), the average price in 2017 was $2.35/kW-month compared to $4.09/kW-month in the previous Summer Capability Period. These changes were driven primarily by changes in the respective Locational Capacity Requirements, as well as by the changes in available capacity.

Public Policy Influence on Resource Outlook

Economic efficiency has been a hallmark of New York's grid since the inception of competitive markets under the NYISO's administration. **Underlying all NYISO processes is the core belief that open, competitive markets for wholesale electricity result in the most efficient allocation of resources, thereby serving New York's energy consumers by minimizing the costs of energy production.** Historically, economic signals have heavily influenced the types of resources that enter and exit the grid, enabling New York's grid to operate in an efficient as well as reliable manner. In addition, the NYISO's long-term system planning activities serve to inform economic decisions.

These economic and planning signals have generally resulted in a gradual shift in resources as specific generating units evaluate their economic viability, based on price signals and expected system needs.

Public policy initiatives are taking an increasingly prominent role in re-shaping the grid. Environmental and energy resource requirements impact how generation is provided to the bulk power system. These local, state, regional, and federal regulatory initiatives may require owners and developers of New York's power plants to make investments to achieve compliance. If existing plant owners must make considerable investments to comply with environmental regulations, those costs could impact whether they remain in the NYISO's markets, potentially affecting system reliability.

The NYISO expects regulatory policy initiatives to accelerate the shift in supply resources on the grid, as evolving environmental regulations and renewable energy goals accelerate the transition from higher-emitting generation to lower-emitting resources. While market stability and gradual change have characterized New York's grid under the NYISO's competitive market structure, public policy initiatives and rapid technological advances are shaping a different paradigm. This shift requires greater operational flexibility to more quickly adapt to real-time changes in how the grid produces and delivers energy, and adept system planning to identify system needs as the grid undergoes a transition toward cleaner energy technologies.

Transparency

Markets create transparent price signals that establish a level playing field for all market participants

Reliability

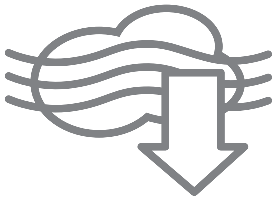
Price signals reflect system conditions and drive investment and operation decisions that ensure reliability

Innovation

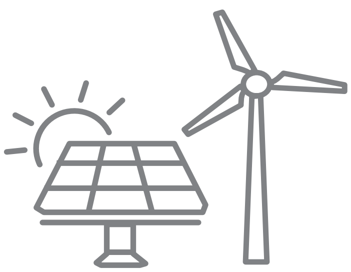
Competition incentivizes cost reductions through efficiency, demand response, and technology advancement

Environment

Markets favor lower operating costs creating incentives for renewable resources that promote efficiency and reduce emissions



▸**The NYISO's Markets** provide price signals to encourage generators to operate more efficiently which has led to reduced emissions.



▸**70,500 GWh** of total renewable energy will need to be generated by 2030 in order to acheive the 50-by-30 goal, as determined by the PSC Order on August 1, 2016. The increment of new renewable energy generation needed for compliance by 2030 will be approximately 29,200 GWh.

▸**96 MW** of offshore wind was proposed for interconnection with the New York bulk power system on Long Island, the first such proposal in New York.

As public policies assume greater prominence in shaping the grid, the NYISO provides a critical and necessary role to inform those policies. **The NYISO seeks to leverage the power of competitive markets to efficiently meet policy goals while maintaining system reliability.**

The NYISO plays an important role as an independent, authoritative source of information and analysis to aid regulators in crafting policies that balance desired environmental and market outcomes, such as reduced emissions or increased renewable energy production, with reliability considerations. This input helps policymakers refine regulatory proposals and better understand the broader ramifications of specific policy proposals before they are implemented. One significant regulation the NYISO has examined in prior *Power Trends* reports is the U.S. Environmental Protection Agency's (EPA) *Clean Power Plan*, which would require existing generators to adapt to new greenhouse gas emission limits. The rule has since been stayed by the U.S. Supreme Court, and the EPA has initiated proceedings to repeal and replace the rule. The NYISO continues to monitor this policy closely. **In our rapidly evolving energy landscape, the value of the NYISO's role and mission has never been more important.**

The broad-ranging nature of this shift necessitates a fresh look at planning processes and market design to assess and address the implications of older conventional capacity exiting the market as new intermittent renewable capacity enters the energy market. The NYISO believes these changes can be managed reliably and effectively through a market-based approach that has proven value for New York's consumers. Nevertheless, market design, planning processes, and operational tools will need to continue to advance in order to address the dramatic nature of the changing resource base on the grid that the state's policies are designed to induce.

The NYISO routinely identifies and reports on new and existing environmental regulatory programs and energy policies that could impact the operation of the bulk power transmission facilities. These federal, state, and local regulatory initiatives cumulatively may require considerable investment to refurbish, replace, or repower New York's existing power plants.

Environmental Regulations & Energy Policies

The NYISO is examining several significant policies listed in the table at right, and working with regulators to determine potential impacts on reliability. Each topic is discussed in more detail following the table.

PUBLIC POLICY INITIATIVE	POLICY GOAL	POLICYMAKING ENTITY	NY GRID RESOURCE IMPACTS
Clean Energy Standard (CES)	50% of energy consumed in New York State generated from renewable resources by **2030**.	New York State Public Service Commission (PSC) / New York State Energy Research and Development Authority (NYSERDA)	About **17,000 MW** of new, largely intermittent capacity to enter grid and markets.
Indian Point Deactivation	Deactivate Indian Point units 2 and 3 by **2020 and 2021**, respectively.	Agreement between New York State and Entergy	NYISO Deactivation Assessment found no reliability need with loss of **2,311 MW** (nameplate) and expected addition of new resources.
New York City Residual Oil Elimination	Eliminate combustion of fuel oil numbers 6 and 4 in New York City by **2020 and 2025**, respectively.	New York City	**2,946 MW** of installed capacity affected.
Offshore Wind Development	Develop 2,400 MW of offshore wind capacity by **2030.**	New York State Public Service Commission (PSC) / New York State Energy Research and Development Authority (NYSERDA)	As much as **2,400 MW** of new intermittent capacity interconnecting to the grid in southeastern New York by 2030.
Part 251: Carbon Dioxide Emissions Limits	Establish restrictions on carbon dioxide emissions for fossil fuel-fired facilities in New York by **2020**.	New York State Department of Environmental Conservation (DEC)	**1,000 MW** of coal-fired capacity expected to deactivate or re-power.
Regional Greenhouse Gas Initiative (RGGI)	Reduce carbon dioxide emissions cap by 30% from **2020 to 2030** and expand applicability to currently exempt "peaking units" below current 25 MW threshold.	New York and other RGGI states	**26,100 MW** of installed capacity participate in RGGI.
Smog-Forming Pollutants Rule Proposal	Reduce ozone-contributing pollutants associated with New York State-based peaking unit generation.	New York State Department of Environmental Conservation (DEC)	DEC proposal is under development. There is nearly **3,500 MWs** of peaking unit capacity in New York State.
Storage Deployment Target	Reduce costs and install storage capacity by **2025.**	New York State Public Service Commission (PSC) / New York State Energy Research and Development Authority (NYSERDA) / New York Power Authority (NYPA)	Installation of **1,500 MW** of battery storage capacity.
U.S. Clean Water Act	Adoption of "Best Technology Available for Cooling Water Intake" to protect aquatic biota.	U.S. Environmental Protection Agency / New York State Department of Environmental Conservation (DEC)	**16,900 MW** of installed capacity must achieve compliance upon licensing renewal.

Clean Energy Standard (CES)

In August 2016, the New York State Public Service Commission (PSC) adopted a Clean Energy Standard (CES), requiring that 50% of the energy consumed in New York State be generated from renewable resources by 2030 (50-by-30 goal). Under the CES, electric utilities and others serving load in New York State are responsible for securing a defined percentage of the load they serve from eligible renewable and nuclear resources. The load serving entities will comply with the CES by either procuring qualifying credits or making alternative compliance payments.

In order to achieve the 50-by-30 goal, the PSC determined that approximately 70,500 GWh of total renewable energy will need to be generated by 2030 — including approximately 29,200 GWh of new renewable energy production in addition to existing levels of production at the time the order was adopted. The New York State Energy Research and Development Authority (NYSERDA) will continue to offer long-term (20 year) contracts for Renewable Energy Credits (RECs) associated with eligible renewable resources, and administer the procurement of Zero-Emissions Credits (ZECs) associated with the generation from eligible nuclear plants.

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 must perform on all proposed generator retirements. The NYISO issued its analysis of the proposed Indian Point retirement on December 13, 2017, concluding that the deactivation will not create a system reliability need, assuming that sufficient replacement sources of power are added within the lower Hudson Valley.

For this assessment, the NYISO evaluated a five-year study period — November 13, 2018 through November 13, 2023 — evaluating the reliability of the grid given assumptions about other announced power plant retirements and expected power plant additions to the grid in that timeframe, including three power plants currently under construction:

- Bayonne Energy Center II Uprate (120 MW in Zone J)
- CPV Valley Energy Center (678 MW in Zone G)
- Cricket Valley Energy Center (1,020 MW in Zone G)

This assessment does not identify a Generator Deactivation Reliability Need following the deactivation of the Indian Point Energy Center for the study period under base case assumptions. The assessment did determine that following the deactivation of the Indian Point Energy Center, the reliability of the existing system could only be maintained if sufficient replacement sources of power are added within the lower Hudson Valley. In the absence of the expected new generation facilities currently under construction, resource needs would have to be met through other solutions, as identified in the assessment.[11]

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 the borders of 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 by reliability rules to maintain alternative fuel combustion capabilities — most notably oil. The rule is intended to provide assurance that system reliability can be maintained in the event of gas supply interruptions during high demand periods. Typically, these interruptions occur in the winter months when gas is needed for heating.

These generators will need to make decisions about whether to invest in the equipment necessary 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 on an annual basis, it is often called upon to fuel generation during critical periods when severe cold weather limits access to natural gas and system demand is typically higher than normal for the season. **Dual-fuel capability serves as both an important tool in meeting reliability, and as an effective economic hedge against high natural gas prices during periods of high demand for natural gas as a heating fuel.** Uncertainty over generator compliance strategies and future fuel oil combustion capabilities compounds the consequences of the other public policy initiatives described here.

Offshore Wind Development

In his January 2017 State of the State address, Governor Cuomo called for the development of up to 2,400 MW of offshore wind to be constructed by 2030. In his 2018 address, the Governor called for a solicitation for as much as 800 MW of offshore wind.

The NYISO has assessed a variety of scenarios to determine whether 2,400 MW of offshore wind production could be injected into the grid without thermal overloads. The NYISO's analysis concluded that it was feasible to accommodate the injection of 2,400 MW of offshore wind without overloading transmission lines and violating thermal reliability criteria. This assessment did not examine system upgrade costs or other interconnection costs that would likely be associated with reliably delivering new capacity on the grid. These types of issues will ultimately come to light as specific proposed projects are examined through the NYISO's interconnection study process.

▸**Thermal Line Limits:** The maximum amount of electrical energy that can flow on a transmission line without overheating the line.

After incorporating the NYISO's analysis of the feasibility of injecting 2,400 MW of offshore wind on the grid, the New York State Energy Research and Development Authority (NYSERDA) issued the *New York State Offshore Wind Master Plan* in January 2018 that discusses many issues around the siting of such facilities, as well as options for various approaches the state may take to procure the resource.

Part 251: Carbon Dioxide Emissions Limits

Governor Cuomo has called for the elimination of coal-fired power generation in New York State by 2020, directing the New York State Department of Environmental Conservation (DEC) to implement carbon dioxide emissions restrictions from fossil fuel-fired generators. As a result, the roughly 1,100 MW of remaining coal-fired generation in New York State is expected to exit the market in 2020. New York's coal-fired generation accounted for less than 1% of the total energy produced in the state in 2017. Upon receipt of deactivation notices from the generators, the NYISO's planning processes will assess whether such deactivations trigger potential reliability needs.

Regional Greenhouse Gas Initiative (RGGI)

RGGI is a multi-state carbon dioxide emissions cap-and-trade initiative that requires affected generators to procure emissions allowances enabling them to emit carbon dioxide. The cost for these allowances is essentially factored into the costs of operating the generator, and recovered through the NYISO's wholesale market. Through this initiative, each participating state is allotted a set number of allowances, which are auctioned to generators or other stakeholders. For the initiative to be successful at reducing carbon dioxide emissions, the level of available allowances must be 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. Based on previous program reviews, the RGGI states had a schedule of allowances through 2020.

Through a program review in 2017, the RGGI states agreed to a number of program changes, including a 30% cap reduction between 2020 and 2030, essentially ratcheting down the availability of allowances to generators that produce greenhouse gases. More recently, in his 2018 State of the State address, Governor Cuomo directed the New York State Department of Environmental Conservation (DEC) to expand RGGI by grouping together currently exempt peaking units below 25 MW in nameplate capacity. At the same time, other states have indicated a desire to join the initiative, which may affect the dynamics of allowance cost and availability going forward.

Tighter requirements through RGGI are not likely to trigger reliability concerns, but, when combined with the numerous public policy actions described in this section, raise uncertainties about the makeup of the future grid.

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

Smog-Forming Pollutants Rule Proposal

In his 2018 State of the State address, New York Governor Andrew Cuomo announced that the New York State Department of Environmental Conservation (DEC) will propose emissions requirements intended to reduce emissions of smog-forming pollutants from peaking units.

"Peakers," as they are commonly known, have historically operated to maintain grid reliability during the most stressful conditions on the grid, such as periods of high demand. Many of these units also ensure reliability in specific regions of New York City and Long Island — known as load pockets.

Load pockets represent transmission-constrained geographic areas where energy needs in that area can only be served by local generators due to the inability to import energy over the transmission system during certain high-demand conditions. Despite their relatively limited operation throughout the year, these peakers are a significant contributor to ozone-forming pollutants because their operation is typically concentrated during hot weather conditions — when smog formation is most likely to occur.

The NYISO will continue to monitor the development of new emissions rules that may impact the operation of peaking units.

Storage Deployment Target

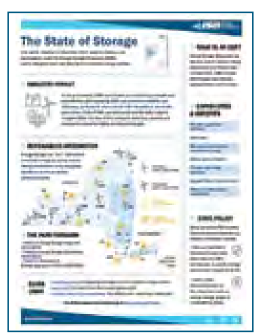
Governor Cuomo's 2018 State of the State address also called for a $200 million investment from the New York Green Bank to support the development and deployment of up to 1,500 MW of energy storage capacity by 2025. The goal of the initiative is to drive down costs for storage while strategically deploying storage resources in locations where they best serve the needs of the grid. The New York State Energy Research and Development Authority (NYSERDA) will initially focus on storage pilots and activities that reduce barriers to deploying storage, including permitting, customer acquisition costs, interconnection, and financing costs.

U.S. Clean Water Act: Best Technology Available for Plant Cooling Water Intake

The U.S. Environmental Protection Agency (EPA) has issued a new Clear Water Act Section 316b rule providing standards for the design and operation of power plant cooling systems. This rule will be implemented by New York State Department of Environmental Conservation (DEC), which has finalized a policy for the implementation of the Best Technology Available (BTA) for plant cooling water intake structures. This policy is activated upon renewal of a plant's water withdrawal and discharge permit. Based upon a review of current information available from the DEC, the NYISO has estimated that 16,900 MW of nameplate capacity is affected by this rule, some of which could be required to undertake major system retrofits, including closed cycle cooling systems.

►Storage Report:

The State of Storage: Energy Storage Resources in New York's Wholesale Electricity Markets



►Storage Infographic:

This one-pager summarizes the NYISO model for integrating energy storage onto the electric grid.

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Implications of Public Policy

Wholesale energy markets reflect the confluence of economics, technology, and public policy. Markets have successfully facilitated efficiency gains on the grid and cleaner energy production in the state since their inception. Those gains and improvements have been gradual, as price signals have worked over time to influence more efficient — and often cleaner — operations of generation, and investments in the grid which have further enabled energy production from cleaner resources. The NYISO views its markets as an essential, effective platform for reflecting public policy and technological influences in an economically efficient manner to reliably meet consumers' energy needs.

Policymakers in New York are looking for opportunities to accelerate the kinds of changes on the grid that markets have induced. **The challenge for the NYISO will be to examine its market structures to develop incentives for investment in, and maintenance of, the types of resources needed to sustain reliability.** The NYISO must also examine its planning processes to incorporate more flexibility in identifying and resolving reliability needs that may be triggered by new policies.

Flexibility will be a key element to any market or planning enhancements developed by the NYISO. The potential loss of peaker units and oil-fired capacity in the New York City region necessitates a look at the developing market incentives for enhanced flexibility — either from existing generation, enhancements to transmission capabilities, or from emerging technologies such as storage or DERs. The addition of renewable resources expected from the Clean Energy Standard will create a more dynamic grid, where supply is heavily influenced by weather. This necessitates a look at what types of incentives for flexible resources needed to balance intermittent renewables, as well as alternative market designs that preserve revenue adequacy for generators needed for reliability.

The NYISO expects to introduce new market-based incentives for flexibility that will continue to offer grid operators tools to withstand weather events and high-demand periods, despite the likely loss conventional resources. In this manner, the NYISO expects to maintain a resilient grid through the rapid transformation taking place as a result of increased regulatory pressure on various generators.

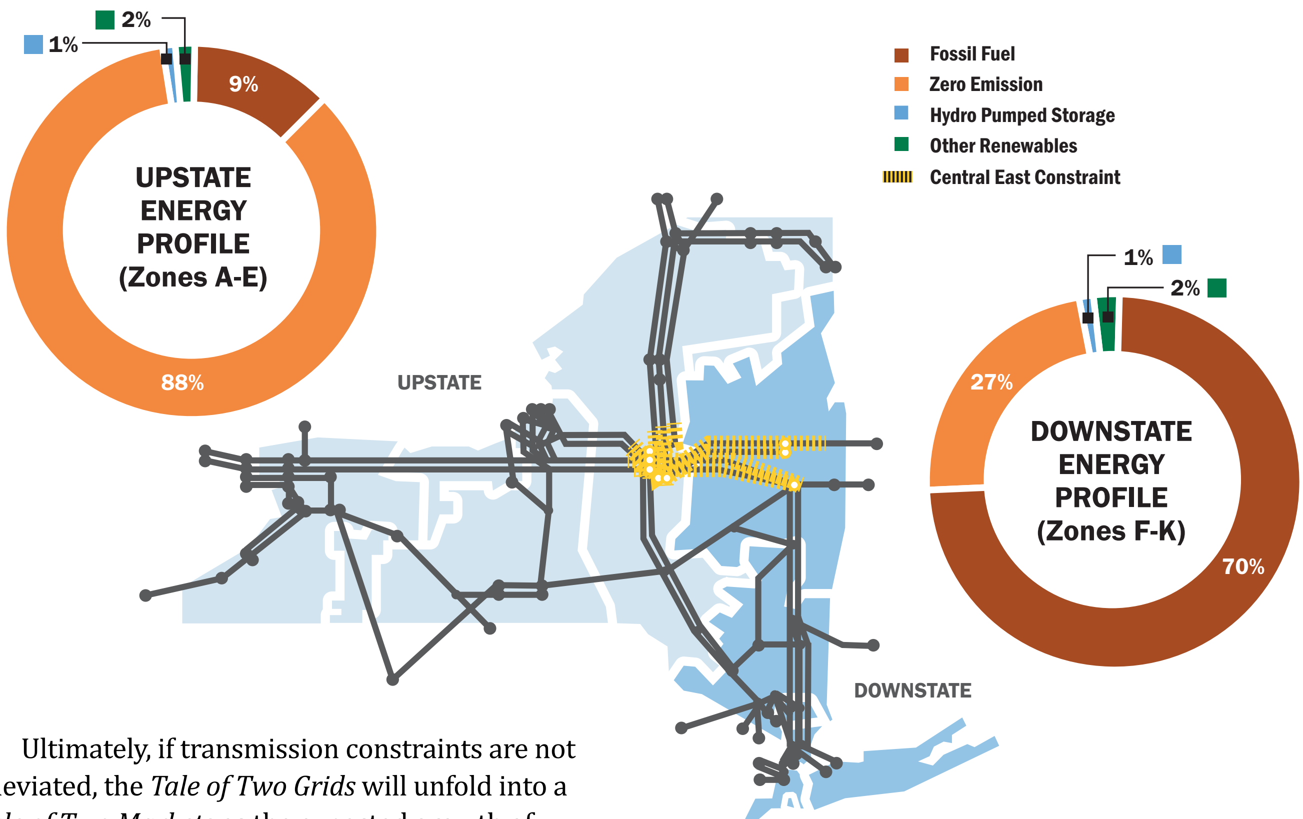
Meanwhile, the pace of change on the grid requires the NYISO's planning processes to become more flexible in identifying and acting upon reliability needs. Closer coordination with distribution system planners will be required to understand how distribution system needs might influence — or be influenced by — changes on the bulk power system brought about by public policy. Subsequent sections of this document will describe some of the plans the NYISO is developing to achieve those goals.

Tale of Two Grids Revisited

In *Power Trends 2017*, the NYISO introduced the concept of New York's *Tale of Two Grids* — a reference to the fact that the characteristics of upstate's energy sector differ dramatically from those of the downstate sector.

- **Upstate, defined as NYISO load zones A-E, is largely supplied by clean energy resources** yet carries relatively little demand for energy in comparison to downstate load zones F-K. In fact, zero-emitting resources accounted for approximately 88% of the energy produced in load zones A-E in 2017.
- **Downstate, which consumes approximately 66% of the energy in New York, received 70% of its energy from fossil fuel-fired generation in 2017.** While some energy flows from upstate to downstate, transmission constraints on the grid limit the ability to supply more clean energy to downstate consumers.

Figure 19: **Tale of Two Grids**



Ultimately, if transmission constraints are not alleviated, the *Tale of Two Grids* will unfold into a *Tale of Two Markets* as the expected growth of renewable resources upstate impacts the economic viability of existing resources — including those generators that may be needed for reliability. Emerging resources like battery storage may have a role to play in mitigating transmission congestion and smoothing out the production of intermittent renewables; however, market rule enhancements are necessary to capture the potential of such resources. These market design enhancements will be tailored toward refining price signals to attract the types of operational characteristics needed to sustain reliability on the grid through the transition toward cleaner energy resources.

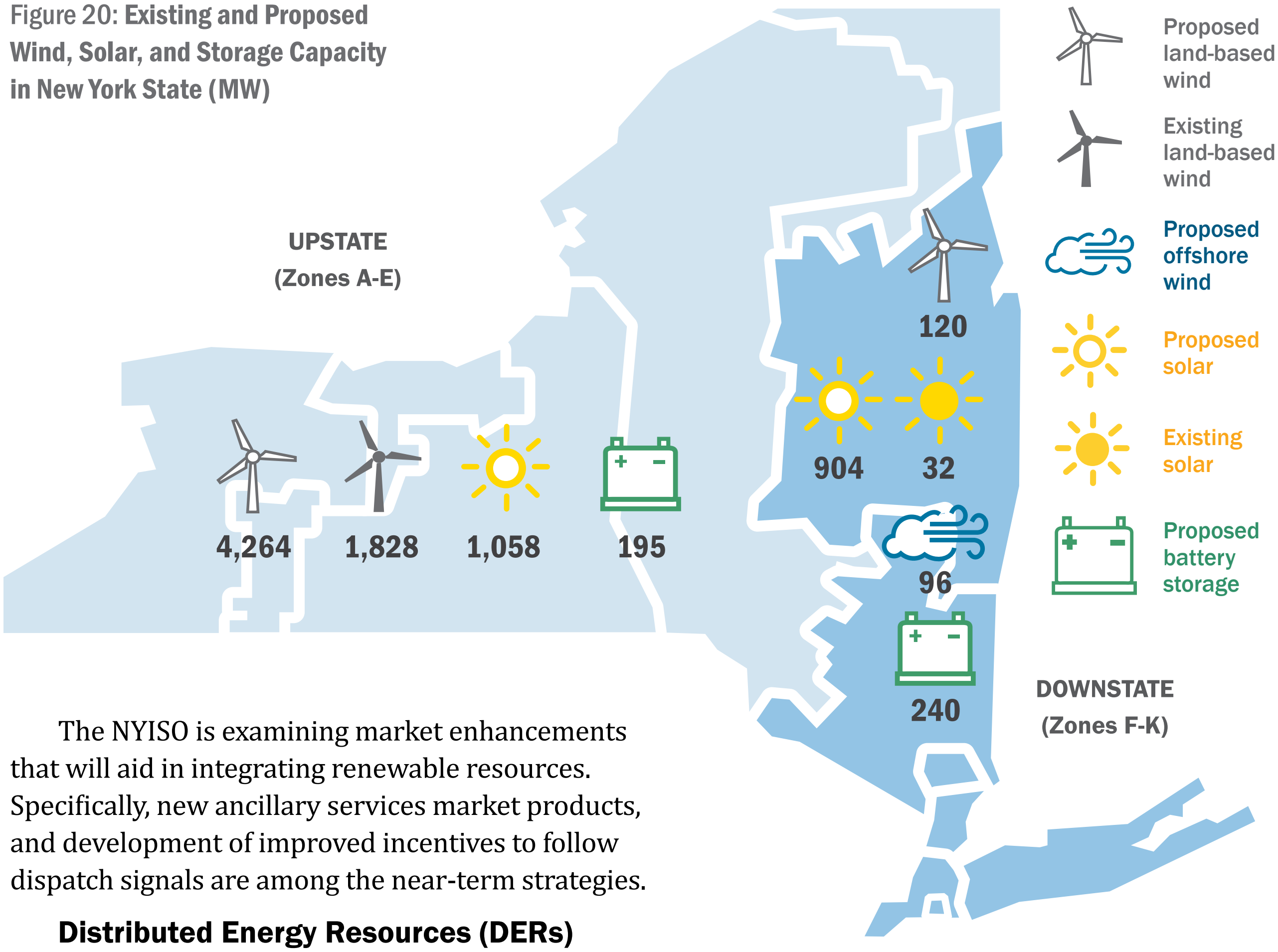
Intermittent Renewables Effect on Supply and Demand

The state's Clean Energy Standard (CES) seeks to ensure that 50% of the electricity consumed is derived from renewable resources by 2030. In 2017, the NYISO modeled several energy and capacity market scenarios to understand the effects that the CES public policy could have on the wholesale markets. Based on its findings, variable resources on the future grid will alter market outcomes and create needs for new capabilities.

> **▸ Intermittent Resources:**
>
> Energy resources that have varying output due to their fuel type, most commonly renewable generation. For example, solar panels and wind turbines can only generate electricity when the sun is shining or the wind is blowing.

The NYISO's analysis found that the increase of renewable energy supply will place economic pressure on the existing conventional resources, which will run less often and be called upon to serve a new role of balancing the intermittent supply. Highly flexible resources will be necessary to balance the traditional variability of load and emerging variability of new intermittent supply resources. **Operating characteristics such as availability, flexibility, and willingness to cycle are important to long-term grid stability and will need to be incentivized.**

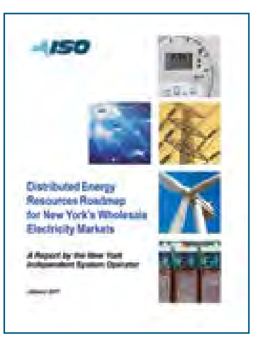
Figure 20: **Existing and Proposed Wind, Solar, and Storage Capacity in New York State (MW)**



The NYISO is examining market enhancements that will aid in integrating renewable resources. Specifically, new ancillary services market products, and development of improved incentives to follow dispatch signals are among the near-term strategies.

Distributed Energy Resources (DERs)

The supply mix being driven by advancements in technology as well as state policy is expected to increasingly shift toward DERs — including behind-the-meter solar, storage, and other technologies that meet a portion of the needs of host facilities but do not necessarily participate directly in the NYISO's markets.



▸ **DER Roadmap:**

This report outlines plans for a future grid that moves from a primarily central station model to a distributed renewables, bi-directional model.

DERs represent a potentially flexible tool for grid operators to better manage the variability of renewable resources, but they also introduce uncertainty and present their own challenges to grid operators. While renewable resources incentivized by the CES will lead to a more dynamic and less predictable supply mix, these DERs will affect the predictability of load as well.

DERs, which in many cases are not directly visible to the NYISO from an operations perspective, effectively shift load from the bulk power system by supplying the load more locally. For any individual DER, the uncertainty over whether the DER is available to supply load or whether the grid needs to supply load is easily manageable. However, with greater penetration of DERs on the system, the uncertainty over DER capabilities to meet load and any contractual obligations between consumers and DER developers introduces new variables into grid operations and reliability planning. When DERs are not capable of supplying local load, that load shifts back to the grid. Effectively, the NYISO must plan to ensure the bulk power system remains reliable in the event that DERs are not able to supply load.

Managing a grid with large quantities of DERs requires enhanced coordination with distribution utilities to optimize the potential of DERs, as well as wholesale market enhancements to better reflect DER value in the wholesale market and assure its performance. The NYISO's *DER Roadmap* envisions a series of market enhancements to more fully integrate and optimize DERs in response to wholesale market signals. The NYISO's first-ever pilot effort will test up to five DER projects totaling 50 MW of capacity starting this year, producing real-world data on the ability of DERs to respond to wholesale market signals, as well as the performance and verification of those resources' contribution to the system.

There remains much uncertainty over the amount of DERs that should be expected when planning and operating the grid. Much of the future of DERs in New York will depend on the value that these resources can provide. The New York State Public Service Commission (PSC) has moved toward a Value of DER (VDER) concept in which DERs are compensated for values that they offer based on their location and performance capabilities. The VDER concept is still unfolding and, therefore, it remains to be seen to what extent DERs will respond to the distribution-level price signals and how those signals interact with wholesale market signals. The NYISO continues to work with stakeholders and policymakers as it leads efforts to integrate of DERs onto the grid.

Energy Storage

Like DERs, energy storage presents both opportunities and challenges for the NYISO. With a state goal for 1,500 MW of storage capacity to be installed by 2025, and a commitment of $200 million in storage-related investments from the NY Green Bank to support this goal, the NYISO anticipates investments in both behind- and in front-of-the-meter storage resources. For those installations behind the meter, the NYISO expects to integrate them through its *DER Roadmap* initiatives.

For storage resources either in front of, or behind the customers' meter, the NYISO anticipates a new participation model to fully exploit the capabilities that new storage technologies can offer in terms of balancing system variability and supplying capacity during critical peak periods.

The state's energy policies are accelerating the adoption of emerging technologies in ways that address challenges and raise new ones. The NYISO will adapt to the changing policy landscape by leveraging competitive markets to support state goals and enhance planning activities to account for more rapid changes to the grid's supply resource mix. More details about the NYISO's approach to integrating public policy are discussed later in this document.

▸What's an ESR?

Energy Storage Resources are devices used to capture energy produced at one time for use at a later time.

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

Flow Batteries
Batteries that contain liquid chemicals that store energy

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

Advancing Market Design

The NYISO's wholesale market design has been praised as best in class. Going forward, our markets must continue to advance in order to reflect the transition that the grid is undergoing. Working closely with stakeholders and policymakers, the NYISO is committed to leveraging its pioneering wholesale market design to lead a new generation of products and planning initiatives that will support the needs of the grid.

Based on analyses[12] of the impact of certain policies on existing markets to date, the NYISO anticipates that achieving the state's goals will challenge the effectiveness of current pricing signals, from both operational and investment perspectives. In order to maintain effective and efficient wholesale energy markets, the NYISO must consider market design enhancements.

The Importance of Transparent Investment Signals

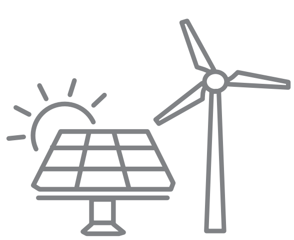
Among the challenges facing all grid operators today is the prospect of generation fleet turnover. Public policies and competition from emerging technologies are expected to accelerate the pace of change in the generation mix over the next ten years, creating an influx of new, clean energy resources while many older conventional resources exit the grid. The integration of public policy objectives and the growing integration of new technologies are changing the nature of traditional electricity market design. Over the coming decade, performance incentives will become instrumental as the entry of new intermittent renewable generation will require more complementary flexible resources.

In order to provide efficient incentives to an increasingly diverse mix of supply resources, it is important for the markets to continue to advance to maintain and improve alignment between the design of wholesale markets and the reliability needs of the system. The NYISO is working to ensure that markets receive the needed transparent signals that will lead to investment of new resources in the most optimal locations. The NYISO is undertaking efforts in the following areas in support of greater price transparency.

Pricing Upstate Lower Voltage Transmission Constraints

Steps are being taken to more efficiently secure and price lower kV transmission facilities on the upstate grid. The NYISO is working with market participants and stakeholders to further the market concepts and procedures necessary to support securing select 100+kV transmission facilities in the NYISO's wholesale market model.

This is important because securing 100+kV facilities in the NYISO's market model will lead to more economic commitment and dispatch and increase price transparency — leading to more effective investment signals. Furthermore, securing these transmission facilities in the market model will become increasingly important as additional DERs connect to lower voltage systems.



▸ **Policy and markets:**

Public policies and competition from emerging technologies are expected to accelerate the pace of change in the generation mix.

Capacity Requirements and Pricing

Capacity markets must facilitate investment in new and existing energy supply by providing efficient price signals that reflect both statewide and more localized system needs. As a result of constraints on the ability to deliver capacity to varying regions of the state, the benefits to improved reliability from additional supply is dependent upon where it is located. Future NYISO capacity market designs must be developed with a focus on price transparency and predictability. Effective markets serve investors who are seeking opportunities to develop resources where and when needed, and wholesale customers who seek to develop purchasing strategies to procure the necessary amounts of capacity supply to meet the reliability needs of their consumers.

Encouraging DERs with Granular Pricing

In order to improve price transparency and facilitate DER investment and operation, the NYISO — in conjunction with New York's distribution utilities — has developed a methodology to offer more locational pricing points on the transmission system. Currently, prices are calculated and published on a zonal basis every five minutes. This current approach does not provide DERs the necessary level of granular pricing needed to determine the most effective locations within a zone to invest.

In this new approach, the NYISO will publish intra-zonal prices, which offer more granular signals to precisely identify locations on the grid where DERs will be most beneficial. The NYISO will work with the distribution utilities to identify these pricing points. Using granular pricing in this manner will encourage investment at the most economically efficient transmission locations.

Resources with the ability to follow dispatch signals to ramp up, ramp down or turn off are critical to the reliable operation of the bulk power system. New resources that exhibit these characteristics will strengthen the operation of the bulk power system.

Changing Supplier Landscape

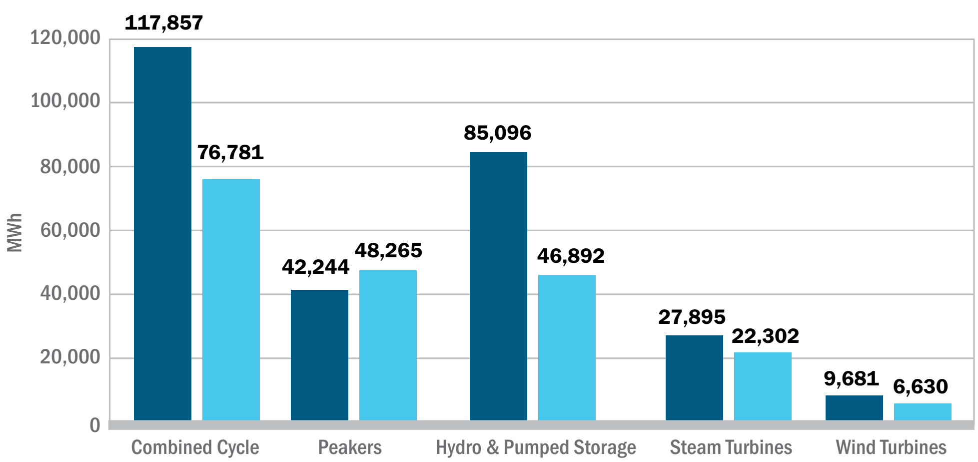
Clean Energy

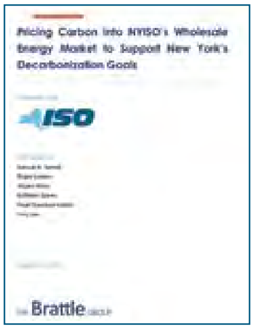
New York's Clean Energy Standard (CES) provides for the procurement of Renewable Energy Credits (RECs) to attract investment in new renewable generation, and the procurement of Zero-Emissions Credits (ZECs) to retain existing nuclear generation. The CES characterizes these measures as, "part of a strategy to reduce statewide greenhouse gas (GHG) emissions 40% by 2030."[13] These measures complement numerous other state policies that reduce electric-sector greenhouse gas emissions, including energy efficiency programs, the Reforming the Energy Vision (REV) strategy, and participation in the Regional Greenhouse Gas Initiative (RGGI).

Figure 21: **Wholesale Market Assessment of the Impact of 50% Renewables on Existing Generation Resources**

March 22, 2016 Actual Energy Production

2030 Study Comparison of Energy Production





Brattle Report:

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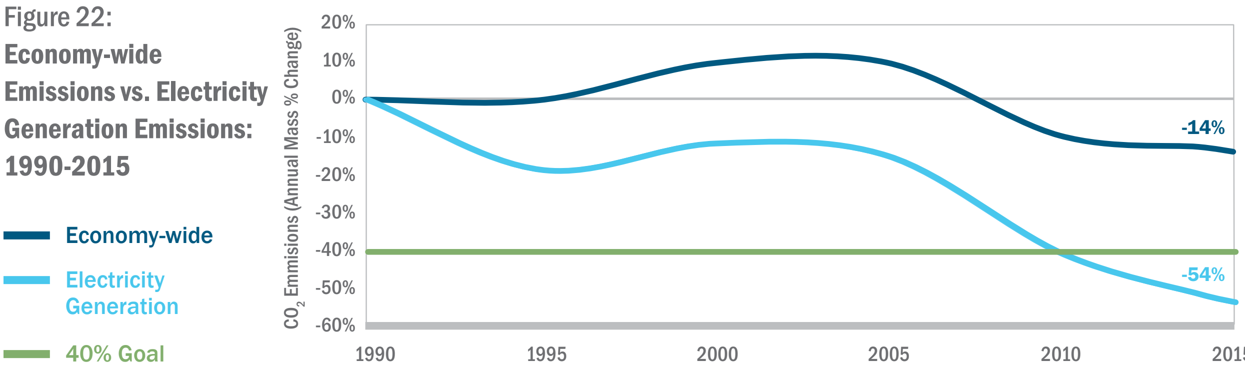
While the CES is a major component of the state's approach toward decarbonizing the grid, the state's overall decarbonization goal is an economy-wide commitment. Decarbonizing other sectors will likely require significant electrification and deeper emissions reductions from the electricity sector by 2030 in order to achieve broader, economy-wide goals.

Wholesale electricity markets are designed to provide electricity in a reliable and cost effective manner. Wholesale markets do not directly include a cost component to reflect the cost of carbon emissions. To the extent that achieving the state's overall decarbonization goals may require deeper carbon dioxide emissions reductions from the grid, the lack of an effective price signal for carbon dioxide emissions in the wholesale electricity markets may represent a missed opportunity to spur emissions reductions through market forces.

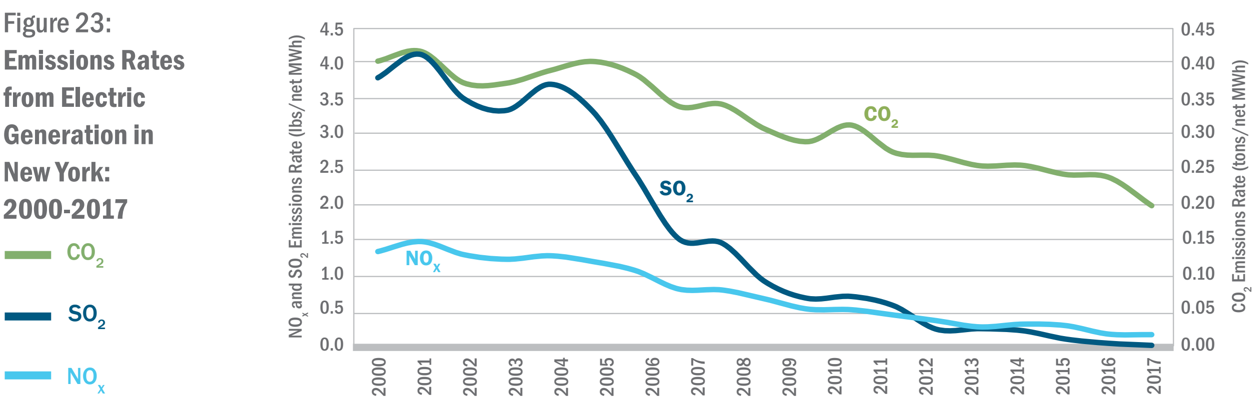
In this regard, the NYISO began a project through its stakeholder process in the fall of 2016 to examine the potential for pricing carbon dioxide emissions within wholesale markets to more effectively align with New York's energy goals. **The Brattle Group was retained by the NYISO to evaluate conceptual market design options for integrating the social cost of carbon[14], a widely recognized regulatory standard that was used in shaping New York's CES, into competitive wholesale energy markets administered by the NYISO.** The Brattle report explored how pricing carbon dioxide emissions in the market can align wholesale markets with state energy policies. The report looked at several factors, including the effect on customer costs and emissions reductions.

Figure 22:
Economy-wide Emissions vs. Electricity Generation Emissions: 1990-2015



Source: NYSERDA

Figure 23:
Emissions Rates from Electric Generation in New York: 2000-2017



Sources: U.S. EPA, U.S. EIA

Aligning state policy objectives and the wholesale electricity markets could leverage market forces to more efficiently meet both state policy objectives and traditional wholesale electric market design elements of providing affordable, reliable supply. Any carbon dioxide emissions pricing proposal must contribute to achieving New York State's public policy objectives while providing the greatest benefit at the least cost to consumers — and also provide appropriate price signals to incentivize investment and maintain grid reliability.

Integrating the cost of carbon dioxide emissions into wholesale market prices would incentivize competition from low-cost sources of carbon abatement to support decarbonizing the grid. **More explicit carbon dioxide emissions pricing might make renewable energy credit procurements under the state's CES initiative more effective by increasing the rewards for clean energy produced at times and locations that reduce emissions the most.** This approach could potentially achieve more carbon dioxide emissions abatement from the same resources, which in turn serves as an effective signal to investors in new resources.

Preparing for Significant Renewable Generation

Wholesale energy markets will play a vital role in efficiently meeting the State's 50-by-30 goal. In 2017, NYISO staff studied both the energy and capacity markets to identify the market needs that might arise from the significant statewide increase in renewable resources.

The NYISO is anticipating the future needs on the grid by identifying and implementing wholesale market design changes that will foster the continued participation — and new entry of — resources required to reliably operate the system. Study findings indicate that themes like dispatchability (ability to ramp), predictability (ability to forecast load and supply), and flexibility will be the focus of future wholesale market evolutions.

Figure 24: **Wind Generation in New York – Nameplate Capacity: 2003-2018**

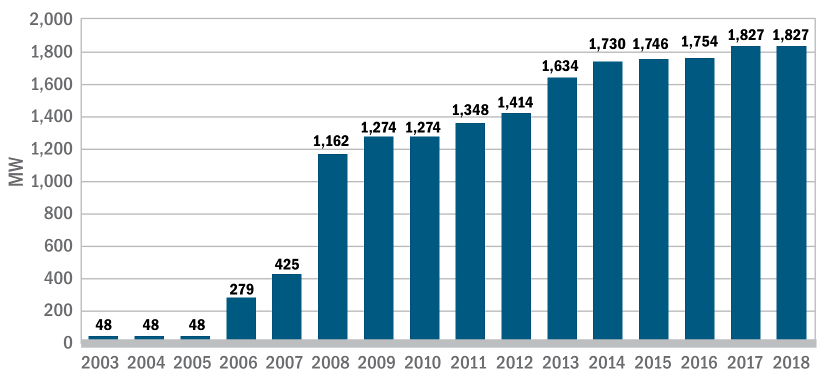
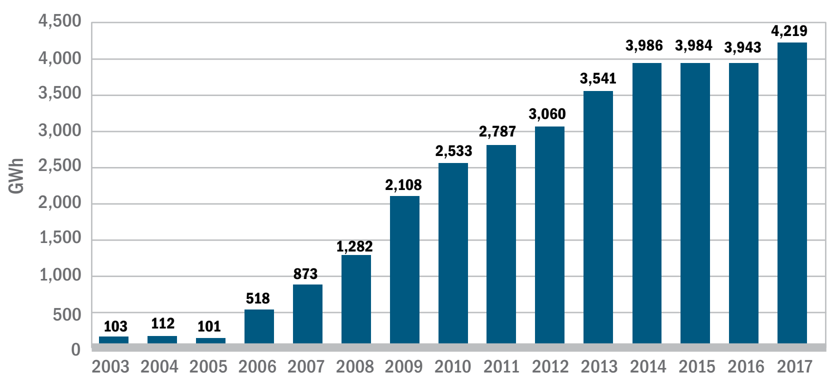


Figure 25: **Wind Generation in New York – Energy Produced: 2003-2017**

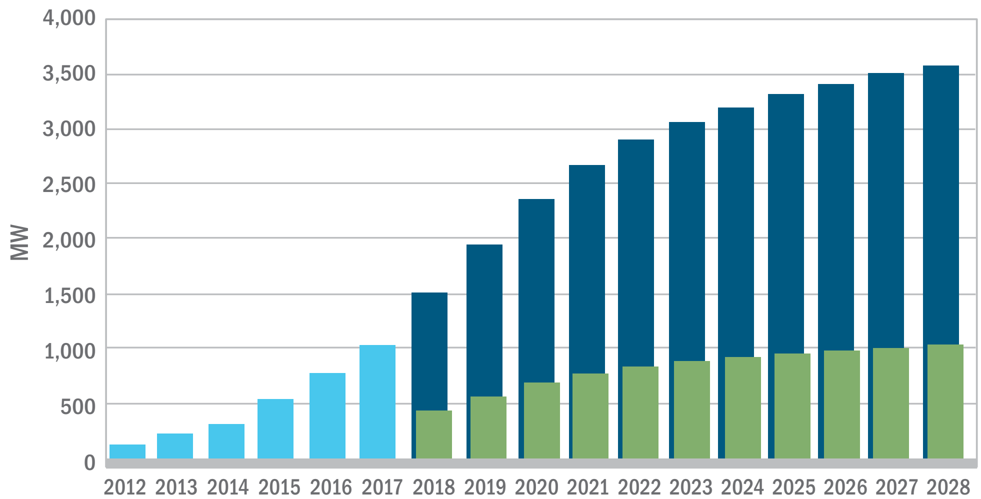


Expanding Role of Ancillary Services

The NYISO continuously evaluates the changing needs of New York's grid to ensure that the products and services procured by the NYISO's wholesale markets remain aligned with changing system needs. For instance, since the polar vortex experiences of the 2013-2014 winter period, the NYISO has revised its operating reserve requirements to:

- **Implement a new reserve region for Southeastern New York** with an associated 1,300 MW 30-minute operating reserve requirement.
- **Increase the statewide 30-minute reserve requirement** by 655 MW to 2,620 MW.

Figure 26: **Distributed Solar in New York - Historical & Forecast: 2012-2028**



Assessments conducted by the NYISO regarding the potential future state of resources serving the grid have identified a variety of opportunities and enhancements to pursue with stakeholders. In the near term, the NYISO plans to re-evaluate its current suite of ancillary services products and assess whether modifications or additions are needed to facilitate a more resilient and reliable system. As part of this review, the NYISO plans to evaluate with stakeholders the potential benefits that may be achievable through changes to the locations and levels of operating reserves procured through the competitive markets. Similar to the construct currently employed in the capacity market, the NYISO and its stakeholders will assess the potential for implementing a market design that provides appropriate incentives to procure additional operating reserves in excess of the minimum requirements.

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

These efforts will also evaluate the potential need for additional ancillary services products to incent flexibility and dispatchability in order to more effectively and efficiently respond to increased variability resulting from higher levels of intermittent renewable generation and DERs.

Finally, the NYISO will re-examine its current ancillary services shortage pricing levels to determine whether changes are needed to ensure price signals accurately reflect the value of these services, especially during periods of critical system need.

More Frequent Transaction Scheduling

More frequent transaction scheduling with neighboring regions could help the NYISO manage real-time variability associated with the expected integration of greater levels of renewable and DER supply. More frequent transaction scheduling provides for increased supply flexibility and allows regional interchange schedules to change more frequently than once every 15 minutes or once every hour, as is currently permitted. The NYISO continues to work with its neighboring market areas to improve coordination of energy and find opportunities to schedule energy transactions between regions more frequently.

Assessing Capacity Supplier Requirements

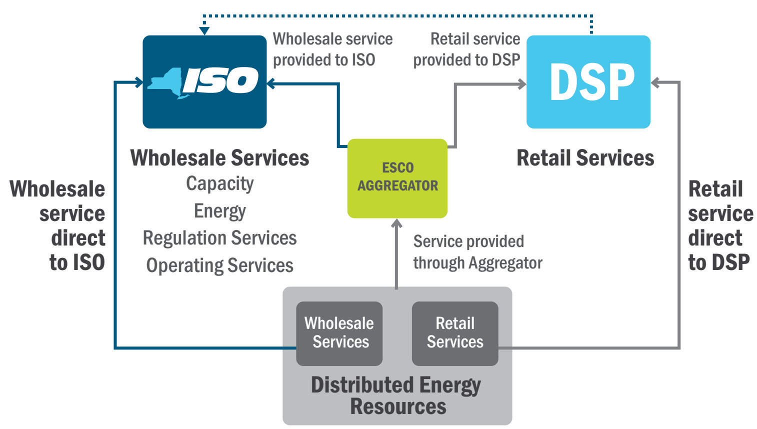
Currently, one NYISO market requirement for resources to be eligible to sell capacity is that resources must be capable of sustaining output for a minimum of four hours. However, some resources that are not capable of providing services for that minimum period may still be able to provide services that benefit reliability. At the same time, capacity providers that may be able to exceed the minimum output period may not be fully realizing the benefit for that service. The NYISO is currently appraising the relative values of different output durations as part of the DER participation model. That initiative will provide insights into how different eligibility requirements would influence resource adequacy and evaluate the relationship between capacity value and the output duration. Any changes to capacity eligibility requirements should also ensure that capacity suppliers are adequately compensated for the true value of the reliability they provide.

Distributed Energy Resources Roadmap

In support of its efforts to harness the benefits of DER, the NYISO released a *Distributed Energy Resource (DER) Roadmap*. The *DER Roadmap* offers routes to a future where consumers and emerging technologies support more optimized grid utilization. It offers the NYISO's vision of seamlessly transitioning from a central station-based grid to a diverse, bi-directional grid. However, the *DER Roadmap* represents just the first step toward building that grid of the future.

Through the *DER Roadmap*, the NYISO's goal is to develop a series of market enhancements to more fully integrate DERs into energy, ancillary services, and capacity markets in support of five key objectives that, once achieved, will improve market animation, increase system-wide efficiency, and improve reliability and resiliency.

Figure 27: **Integrating DER in Wholesale Markets**



The fundamental premise behind the NYISO's *DER Roadmap* is straightforward:

1. Competitive markets and system operations will benefit from access to emerging technologies that can adjust demand on an economic basis in response to price signals from the market.
2. Developing and implementing the market enhancements necessary to realize this premise will entail a considerable amount of time, effort, and stakeholder engagement.
3. The NYISO will use its *DER Roadmap* over the next three to five years as a framework to develop the market design elements, functional requirements, and tariff language necessary to implement its vision to integrate a dispatchable DER.

DER Integration Initiative

Beginning in 2018 the NYISO will develop an appropriate set of rules for DER integration, focusing on the value DERs provide the wholesale markets and bulk power system. The NYISO's proposal includes concepts related to:

- Aggregations and modeling
- Measurement and verification
- Monitoring and control
- Performance obligations
- Dual participation in wholesale and retail electricity markets

While DER installations may be used primarily to assist with distribution system reliability and resiliency, the NYISO believes they can provide valuable services to the wholesale market and is developing participation models for dispatchable and non-dispatchable DERs.

The dispatchable DER participation model that the NYISO is developing targets those resources that are able to respond to real-time signals from the NYISO at least on a five-minute interval basis. Participants in the dispatchable DER participation model, therefore, may be qualified to offer:

- Capacity
- Day-ahead energy and ancillary services
- Real-time energy and ancillary services

The non-dispatchable DER participation model is for those resources that cannot respond to real-time basepoints. Participants in the non-dispatchable DER model may be qualified to provide capacity and energy.

Finally, a third category of DER participation model is for resources that can be dispatched in real-time and are eligible to supply capacity, energy, and ancillary services, but that also:

- Qualify to be generators or Intermittent Power Resources under the NYISO's existing market rules.
- Qualify to be energy storage resources (ESRs) under the NYISO's forthcoming energy storage resource participation model.

Once the new market rules for dispatchable DER participation model are implemented, the only non-dispatchable DERs permitted to participate in the NYISO-administered wholesale markets will be those that meet the requirements to be Special Case Resources (SCRs) or Emergency Demand Response Program (EDRP) resources.[15] Because the NYISO seeks to integrate flexible resources able to react to rapidly changing system conditions, the market design concepts that the NYISO is pursuing focus on real-time dispatchable resources. While the NYISO has no plans at this time to retire the existing EDRP and SCR programs, it will reevaluate the value these programs provide the grid and wholesale markets in the future.

Energy Storage

Energy Storage Resources such as pumped hydroelectric generators, flywheels, and batteries can supply electricity to the grid to meet demand, and can withdraw electricity from the grid to alleviate excess supply. In 2009, the NYISO was the first of the Independent System Operators and Regional Transmission Operators (RTOs) to develop rules that allowed limited energy storage resources (LESR) supply regulation service. The NYISO's innovative approach included a process where the LESR's state of charge is managed by the NYISO's real-time energy market software.

In 2011, FERC issued an order known as "pay for performance" that would benefit fast-ramping resources by requiring regulation service payments to compensate for the amount of up- and down-ramping services that are supplied. In December 2017, the NYISO released its *State of Storage* report that outlines the NYISO's plans to more fully integrate storage into the wholesale markets.

On February 15, 2018, the FERC issued Order 841 to encourage the removal of barriers to ESRs in the wholesale markets.[16] FERC wants ISOs/RTOs to pursue the following: [17]

"I'd be remiss if I didn't give a shout out to the New York ISO, the first grid operator in this country right now to implement and approve market rules for energy storage resources."

— FERC Commissioner Robert Powelson [18]

- Create participation models that allow storage resources to provide all the services that they are physically able to in the wholesale markets
- Identify necessary scheduling parameters to let storage participate in the market
- Allow these resources to set market clearing price, and
- Establish a minimum size requirement no greater than 0.1 MW

ESRs' contribution to maintaining a reliable and cost effective grid is expected to grow.

Figure 28: **DERs and the Grid of the Future**

Transmission Infrastructure and the Grid of the Future

Nationwide, electric companies are continuing to build stronger and smarter energy infrastructure to provide consumers with economic and reliable electric service, and to integrate new renewable resources to meet public policy objectives. Testifying before the Senate Committee on Energy and Natural Resources this February, the Edison Electric Institute (EEI) highlighted the importance of investing in our transmission infrastructure, stating:

> **"Transmission serves such a vital role because it provides optionality similar to a robust system of highways for transportation. A robust transmission system alleviates costly congestion, provides access to lower-cost generation, increases the reliability and resilience of electricity delivery, and can flexibly adapt to changes in public policy and sources of electricity generation."**[19]

According to the EEI, in 2016 total transmission investment reached $20.8 billion — more than double the 2014 total investment of $10.2 billion. Transmission investment is expected to increase by another $90 billion through 2020.[20]

The trend toward higher levels of transmission investment will continue to grow as current transmission infrastructure ages. EEI finds that, "Much of the nation's transmission system is more than 40 years old, with some facilities many decades older."[21] New York State is also facing the need to replace its aging transmission, over 80% of which went into service before 1980. This need, together with new technologies and energy and environmental policy changes, has prompted a thorough reexamination of our transmission needs.

In 2015, The Brattle Group, an international economic consulting firm, conducted a study of the value of transmission investments and identified benefits that included enhanced system reliability, more effective market competition, capacity cost savings, environmental benefits resulting from expanded use of cleaner resources, and reduced costs of meeting public policy goals.[22] That study stated, "Ultimately, our transmission grid is the backbone that supports all future policy changes in the electricity sector."[23] Even in the context of expanding DER deployment, an integrated grid with a resilient transmission system is necessary to capture the full value DERs can offer to all of New York's electricity consumers.

Over the past several years, the NYISO, New York Transmission Owners, and New York State government have identified the need for new transmission investments in New York.

New and upgraded transmission capacity will help to address concerns about maintaining or replacing aging infrastructure; provide greater operational flexibility for dispatching resources; enhance access to operating reserves and ancillary services; and facilitate the ability to remove transmission and generation resources for maintenance when needed.

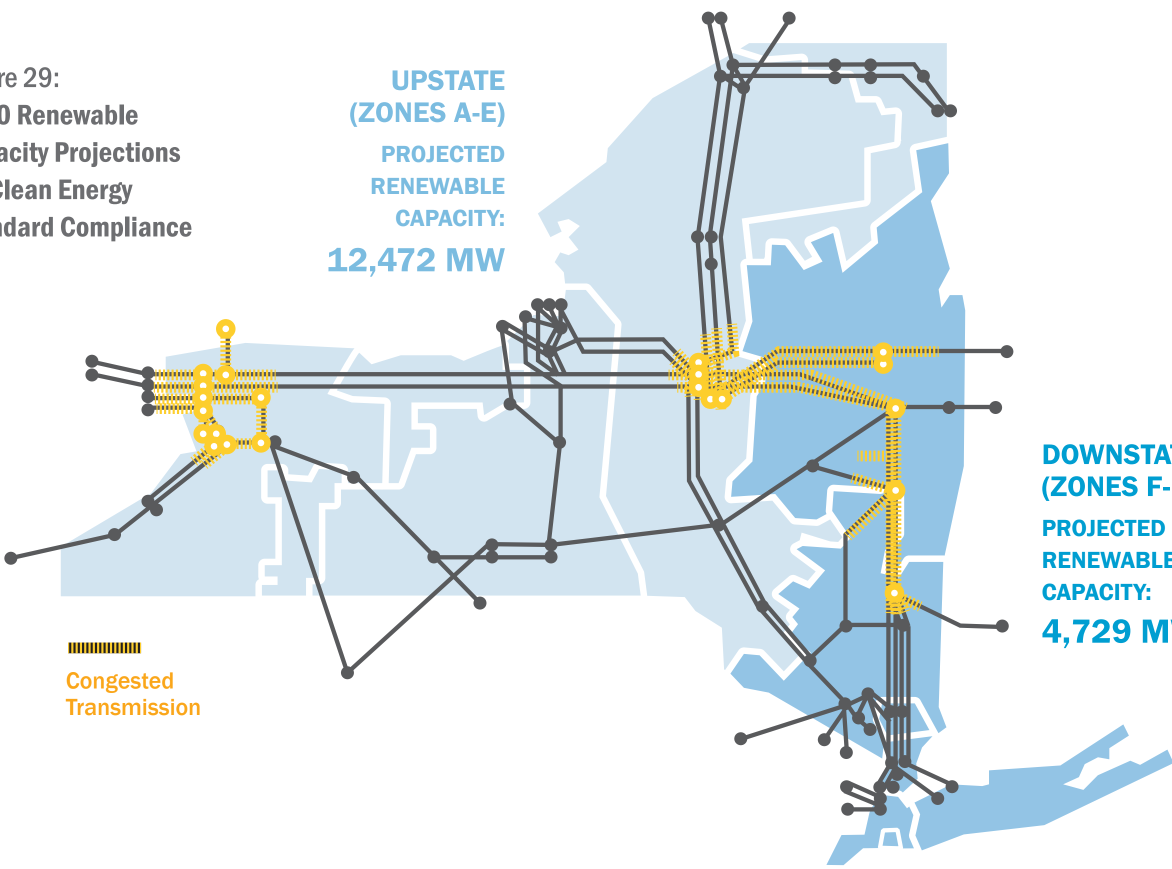
Achieving public policy objectives will require additional transmission capacity in New York State to deliver renewable resources from upstate and northern regions to consumers downstate. Much of New York's existing and proposed renewable energy capability is in upstate New York. The resource mix and geographic distribution of new renewable resources are expected to dramatically change power flows in New York State. To maximize the load served by renewable generation, cross-state energy transfers will need to increase — even as statewide load is decreasing — due to the fact that more renewable generation is available to serve the downstate load.

Key considerations:

1. As renewable penetration in the upstate regions exceeds the load in those same regions, additional energy transfers from upstate renewable resources to downstate load centers are necessary, subject to transmission system capability.
   - Failure to expand transmission capabilities from upstate to downstate will induce market inefficiencies, including increased curtailment of renewable generation to maintain transmission system reliability or generator deactivations notice from units needed for reliability.
   - Further, if markets are unable to produce appropriate price signals due to the expansion of renewable capacity without an adequate expansion of transmission capability, the goal of achieving 50% renewable energy generation by 2030 is jeopardized because energy delivery from renewable resources to downstate load centers will be constrained.
2. Specifically, expansion of the New York transmission system in the St. Lawrence to Marcy corridor would allow developers of renewable resources to provide additional output onto the high-voltage system for delivery to consumers in downstate New York.
   - Based upon the NYISO's experience, high-voltage transmission in the northern corridor would un-bottle the hydroelectric generating capacity in that region.
   - This would allow that existing capacity to operate at its full output, while simultaneously allowing for the delivery of other renewable resources to consumers in the eastern and southern load centers of New York State.

Figure 29:
2030 Renewable Capacity Projections for Clean Energy Standard Compliance

UPSTATE (ZONES A-E)
PROJECTED RENEWABLE CAPACITY:
12,472 MW



DOWNSTATE (ZONES F-K)
PROJECTED RENEWABLE CAPACITY:
4,729 MW

Congested Transmission

3. Furthermore, new transmission capacity could allow developers to explore sites that are attractive for wind and solar resources, but are underserved by the existing transmission system.
   - Access to the transmission system becomes an issue, as many sites with convenient access to the grid have already been taken or are under development. Conceptually, expanding transmission in certain key locations could facilitate the interconnection of new wind and solar resources that are not in proximity to the system, as well as un-bottle energy from existing wind resources.
   - Further analysis will be required to identify the areas of the State that have high potential for renewable resource development that could be facilitated through the expansion of the transmission lines that connect to the backbone of the high-voltage transmission system.

Planning Transmission Infrastructure for Public Policy Requirements

Among the components of Order No. 1000, the Federal Energy Regulatory Commission (FERC) required that planning processes consider transmission needs driven by public policy requirements. Transmission projects that fulfill such public policy requirements will be eligible for cost recovery through the NYISO's tariff if they are selected by the NYISO as the more efficient or cost-effective transmission solution to the need identified by the New York State Public Service Commission (PSC). Under provisions of the NYISO tariff, the PSC determines the need for transmission expansion driven by public policies. Once the PSC determines the need, the NYISO solicits transmission and other types of projects, performs planning studies, and selects the transmission projects that will meet those needs in a more efficient or cost-effective manner.

▸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.

Western New York Public Policy Need

In October 2017, the NYISO's Board of Directors selected a proposal from NextEra Energy Transmission New York to address the public policy need for new transmission in Western New York to support the State's goal of maximizing the flow of energy from renewable resources in the region. 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. It is the culmination of a joint effort by the NYISO, the PSC, developers, and stakeholders to address transmission needs in Western New York. Those needs are driven by New York State public policy requirements to more fully utilize renewable energy from the Robert Moses Niagara Hydroelectric Power Station as well as imports from Ontario.

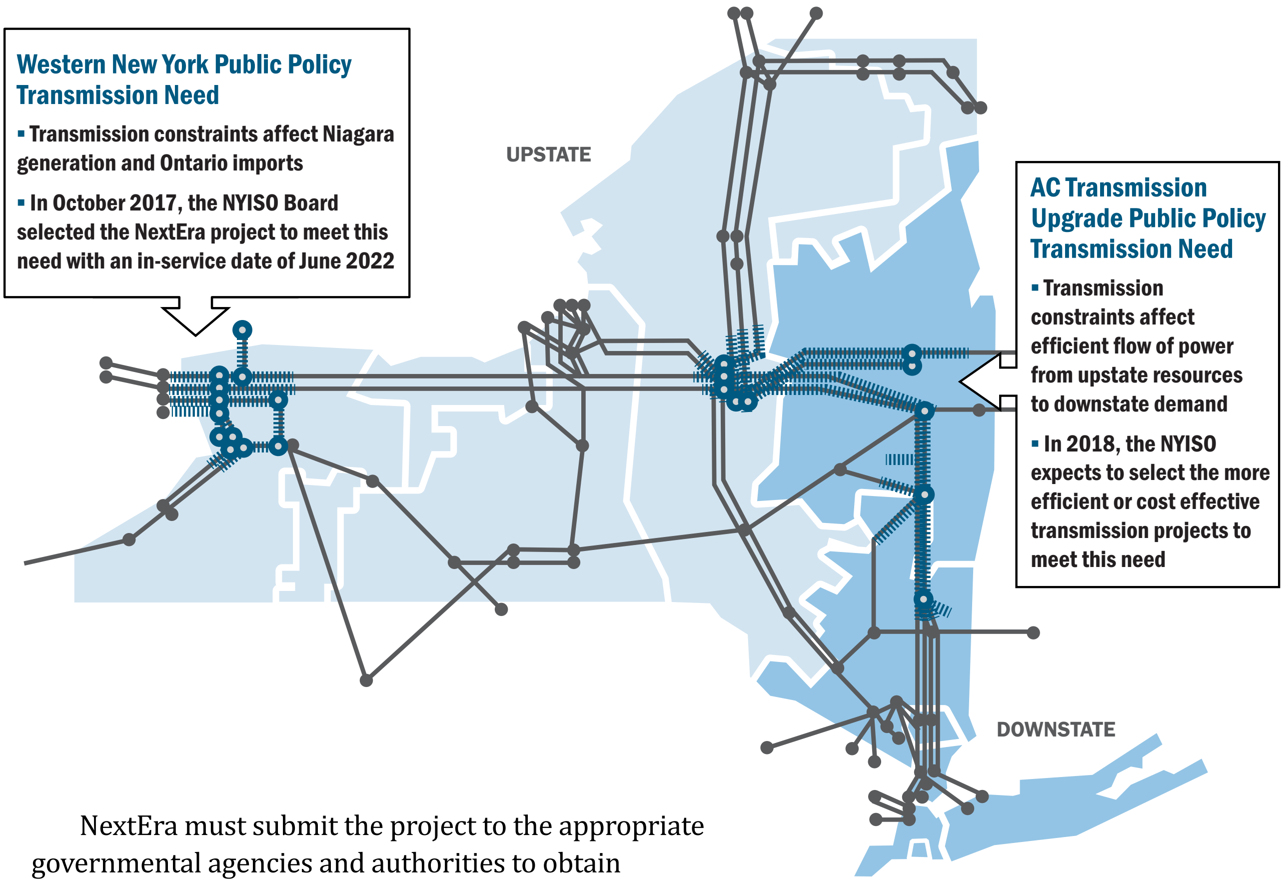
While maximizing the flow of energy from renewable resources, the transmission upgrades are expected to provide reliability, environmental and economic benefits, including:

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

Utilizing existing rights-of-way, NextEra's proposal includes:

- Two new 345 kV substations near Dysinger and Elma
- A 20-mile 345 kV line connecting the new substations
- A phase angle regulator (PAR) to control power flows

Figure 30: **Public Policy Transmission Needs in New York State**



NextEra must submit the project to the appropriate governmental agencies and authorities to obtain approvals and permits to site, construct, and operate the project. This includes the PSC's process for siting of major utility transmission facilities under Article VII of the Public Service Law. The NYISO will work with NextEra to enter into agreements for the development and operation of the transmission project, including a schedule for siting, permitting, interconnection, construction, and other milestones for entry into service by June 2022.

AC Transmission Upgrade Public Policy Need

In December 2015, the New York State PSC advanced its AC transmission proceeding to a competitive process managed by the NYISO by identifying a Public Policy Transmission Need to relieve congestion on the UPNY-SENY and Central East interfaces that run from central New York, through the Capital Region to the lower Hudson Valley.[24] The Commission action limited the new transmission lines to replacing and upgrading existing lines within existing rights-of-way, which is intended to reduce or eliminate adverse environmental, landowner, and economic impacts.

In April 2016, developers submitted 15 transmission projects and one non-transmission project in response to NYISO's solicitation of proposed solutions. Following a stakeholder review and comment period, the NYISO issued the *AC Transmission Public Policy Transmission Need Viability and Sufficiency Assessment.*[25] Out of the 16 proposed projects, the NYISO identified 13 viable and sufficient projects, and filed its assessment with the PSC. On January 24, 2017, following consideration of public comments, the PSC issued an order confirming the AC Transmission Needs and determined that the NYISO should proceed with its public policy process.[26] **The NYISO is evaluating the competing transmission projects and, with the input of policymakers and its stakeholders, expects to identify the more efficient or cost-effective project to meet the AC Transmission Needs this year.**

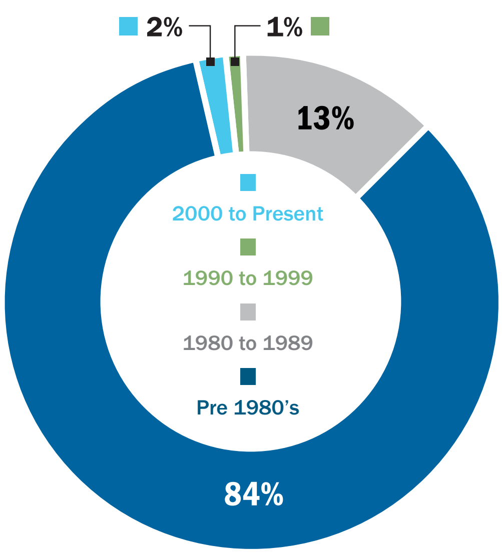
Ongoing Public Policy Transmission Planning Processes

In 2018, consistent with our obligations under FERC Order No. 1000, once the NYISO completes a new assessment of system reliability needs, the NYISO will again solicit all interested parties to propose public policy transmission needs and convey that input to the PSC for its consideration.

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 Northeast Coordinated Planning Protocol that had been in place for more than a decade. **In May 2018, the three ISO/RTOs expect to issue the 2017 Northeast Coordinated System Plan, which has not identified a need for new interregional transmission projects at this time.**[27] The NYISO also conducts joint evaluations with planning authorities across the entire Eastern Interconnection, a region that includes 40 states and several Canadian provinces from the Rocky Mountains to the Atlantic Ocean and from Canada south to the Gulf of Mexico.

Age of New York Transmission Facilities by Percentage of Circuit Mile



The NYISO was a leader in the formation of the Eastern Interconnection Planning Collaborative (EIPC), which involves 19 electric system planning authorities, and was created in 2009 as the first organization to conduct interconnection-wide planning analysis across the eastern portion of North America.

Among its efforts, the EIPC conducted studies assessing a range of possible energy futures which found the reliability plans of electric system planners in the Eastern Interconnection integrated well to meet potential reliability needs.

In March 2016, the EIPC issued its *Report for 2025 Summer and Winter Roll-Up Integration Cases*. The roll-up cases combine the electric system plans of the EIPC members in a comprehensive interconnection-wide model. The report evaluated summer and winter peak periods for the year 2025. Examining the amount of power that can be reliably moved between regions, based on current system plans, the report identified potential additional transfer capability that may be available in various parts of the Eastern Interconnect. In 2018, the EIPC plans to continue its work to provide an interregional transmission gap analysis and transfer analysis, as it has in prior roll-up studies.

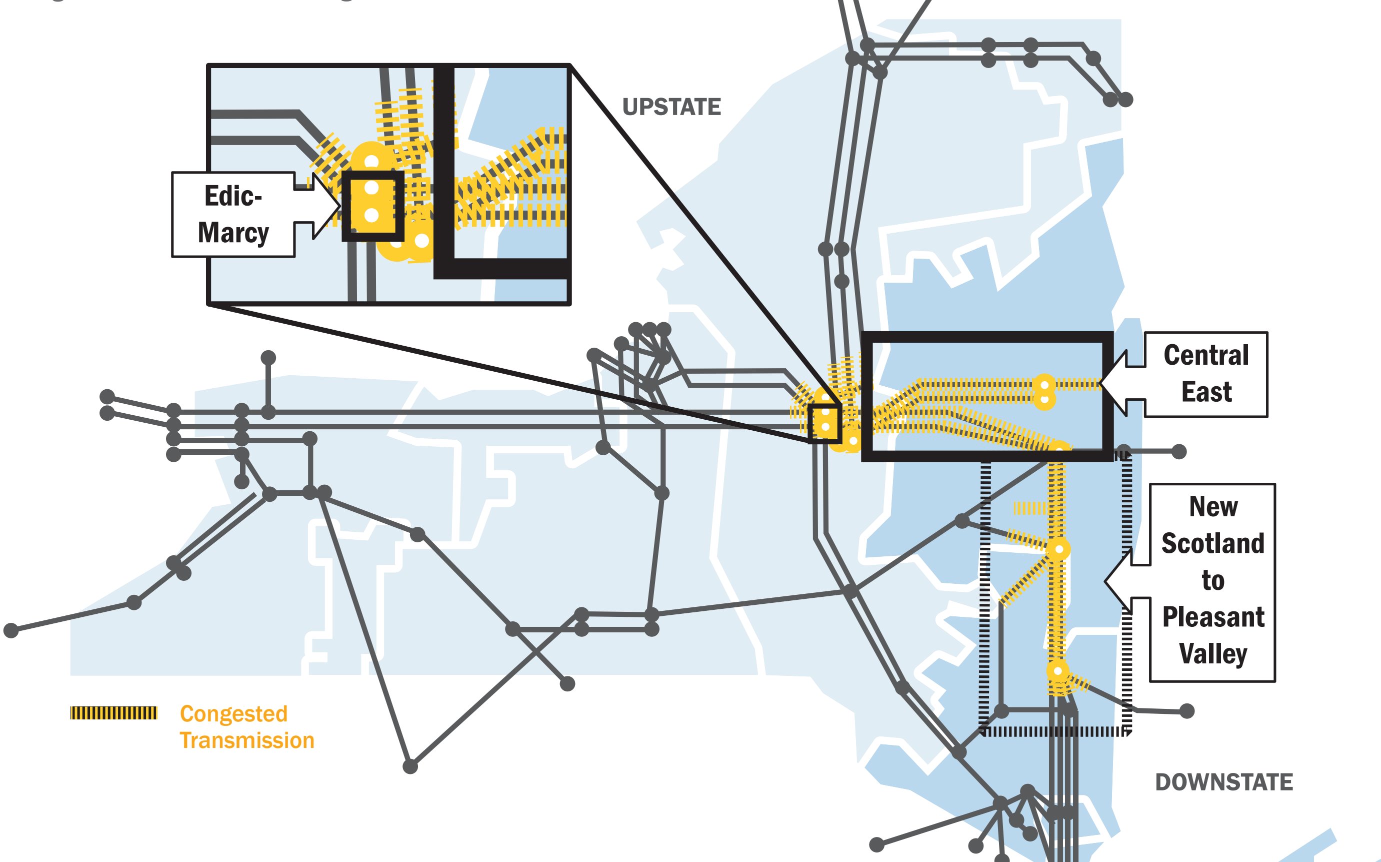
Congestion Assessment and Resource Integration Study (CARIS)

The NYISO is re-evaluating congestion on the New York 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. Solutions to congestion may include:

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

The *CARIS* process analyzes generic transmission, generation, and demand response solutions in regions that could ultimately yield congestion cost savings for power consumers.[28] The *2017 CARIS* identifies the most congested parts of the New York State bulk power system based upon historic data (2012-2016) as well as estimates of future congestion (2017-2026).

Figure 31: **Transmission Congestion Corridors in New York State**



The *CARIS* study shows the most congested areas of the transmission system are associated with the Central East Interface that runs between Utica and Albany. The study also shows increasing congestion towards the downstate load areas. These findings reinforce many prior studies demonstrating the benefits of relieving transmission constraints between upstate and downstate New York. By relieving these constraints, energy from existing upstate resources would economically flow to where it is needed downstate. It would also support the development of new and renewable sources of power upstate.

Merchant Transmission Proposals

Several merchant plans for transmission have emerged and are in various stages of development. High-Voltage Direct Current (HVDC) projects primarily designed to enhance transmission of power within New York State include the 1,000-megawatt Empire State Connector, announced by transmission developer OneGRID, which is a 260-mile project between Utica and New York City; and the West Point Transmission project, which aims to add a 1,000 MW facility from the Capital Region to a substation in Buchanan, NY.

▸Here's how the NYISO planning process works:

Identifying needs: Using a market-oriented process, NYISO examines a 10-year horizon to assess the future reliability of the power system.

Encouraging market-based solutions: NYISO's market-based approach encourages private-sector investment in projects to improve New York's energy infrastructure.

Evaluating proposed solutions: When projects are proposed, NYISO rigorously studies them to be sure they will operate safely and securely if connected to the grid.

HVDC projects primarily designed to bolster New York's electrical ties with neighboring areas include the Champlain-Hudson Power Express, proposed by Transmission Developers Inc., which is a 300-plus mile transmission project designed to deliver up to 1,000 MW from Québec to New York City; the Poseidon Transmission project, which is a 500 MW facility proposed to connect Long Island with New Jersey; the Alps project, which proposes to construct a 600 MW intertie between Rensselaer County and Berkshire, MA; and the Grand Isle Intertie project, which aims to export 400 MW from Plattsburgh, NY to New Haven, VT.

Toward the end of 2017, the NYISO saw two merchant transmission proposals designed to integrate offshore wind into the New York grid. Anbaric Development Partners has proposed to interconnect up to 1,200 MW of offshore wind capacity into the New York City grid, as well as up to 700 MW of offshore wind capacity into the Long Island grid. These proposals are not yet tied to specific offshore wind projects.

In addition, four projects — the Compass project in Rockland County, the Cedar Rapids project in St. Lawrence County, the Alps-Berkshire Intertie project in Rensselaer County, and the Renovo Intertie project in Pennsylvania — each aim to add AC capability to New York's grid.

Generator Interconnection Queue Process Enhancements

In order to safely interconnect to the grid, new generation must go through a rigorous interconnection study process. The NYISO conducts its assessment of bulk power system reliability impacts of a connecting generator in coordination with potentially affected local utilities and neighboring grid operators. The NYISO regularly reviews its interconnection processes and works collaboratively with its stakeholders to evaluate opportunities for improvement. In December 2017, FERC accepted a comprehensive reform to the NYISO's interconnection processes to improve the efficiency of the processes, while ensuring system reliability and the equitable treatment of developers. This filing was the culmination of eleven months of collaboration with stakeholders to identify challenges in the existing procedures and to develop workable solutions. **The revised procedures will provide all generation projects — including renewables — a more transparent and efficient path through the NYISO interconnection processes. The NYISO began implementing these enhancements in 2018.**

NYISO's Comprehensive Planning Process Enhancement Initiative

The NYISO is undertaking a myriad of initiatives with its stakeholders aimed at addressing the evolving nature of the electric system in New York. The transmission system is critical to enabling the envisioned transformation of New York's electric system. The objective of this effort is to identify potential enhancements and efficiency improvements across the NYISO's comprehensive planning process for reliability, economic, and public policy planning responsibilities. Building upon the success of current processes, this effort is intended to help ensure that the NYISO continues to effectively perform its mission of providing independent and authoritative information to market participants, investors, and policymakers who rely upon the NYISO for providing the critical information needed to meet the evolving needs of the grid.

Enhancing Resilience through Markets, Operations, and Planning

Appropriate levels of reliability and security are clearly defined in the reliability standards, operating and system planning requirements, and security and infrastructure protection requirements established by the 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). Together, these entities define over 1,000 requirements the NYISO must abide by in its operating and planning of the bulk power system, and in its administration of New York's competitive wholesale markets.

Reliability and resilience are not necessarily separate and distinct concepts in relation to the electric system. Rather, these two concepts are highly intertwined and often indistinguishable. For example, maintaining reliability encompasses resilience measures such as:

- **Forward looking design of the system** to withstand multiple contingency events and enable the capability to absorb the impact from the loss of multiple facilities.
- **Advanced operational planning** by operating the system to meet single contingency events, thereby ensuring that the failure of one system component will not disrupt the continued operation of the system.
- **Redundancy and rapid recovery** in the form of procuring voltage support, regulation service, and operating reserves to assist with responding to unanticipated disturbances that may arise.
- **Emergency preparedness,** such as black start capability, coordination of system restoration, and procedures for addressing geomagnetic disturbances.
- **Redundancy in infrastructure design** for critical infrastructure.
- **Development of business continuity plans** to provide for continued operation of critical functions in the event that unplanned disturbances or interruptions arise.

▸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.

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 and interconnection processes.

Resiliency that goes beyond traditional measurements of reliability includes measures that could assist in 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.
- Evaluation of additional resources, resource capabilities, and services in critical areas, such as energy storage, that could support rapid recovery from system disturbances.

NYISO Planning for Resilience

The NYISO, in coordination with its stakeholders, is undertaking a comprehensive re-evaluation of its current planning processes (*i.e.*, reliability, economic, and public policy). This assessment is intended to identify potential enhancements to our federally-regulated tariffs and improve the overall speed and efficiency of the NYISO's current planning processes. More efficient transmission planning processes are critical to achieving a more robust and resilient transmission system that serves as the catalyst for the industry's continued transformation.

NYISO's Wholesale Markets and Grid Operations Enable Resilience

Maintaining power system reliability is the NYISO's primary responsibility, and the role of wholesale markets is critical in carrying out this responsibility. **The NYISO administers both Day-Ahead and Real-Time Markets to procure the necessary energy and ancillary services to reliably operate the system and continuously meet the electricity demands of customers, at the lowest overall production cost based on the offers submitted by resources competing to provide service.** The NYISO's Day-Ahead and Real-Time Markets each perform a simultaneous co-optimized commitment/dispatch of resources to provide the necessary levels of energy, regulation service, and operating reserves to address all system needs and maintain reliability. These market processes also consider system contingencies necessary for maintaining reliability should system conditions change.

The NYISO intends to evaluate, with its stakeholders, opportunities to leverage competitive wholesale market products and services to bolster the resiliency 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 ensure the continued ability to efficiently and reliably serve New York's electricity requirements.

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

▸ Day-Ahead vs. Real-Time Markets:

In the Day-Ahead Market, electricity and ancillary services are auctioned and scheduled one day prior to use. Whereas, in the Real-Time Market, settlements take place every five minutes. Real-Time Markets provide added incentives for resources to ramp up or down rapidly in response to price signals that reflect the need for more or fewer resources to maintain reliability.

Resilience through Grid Cyber and Physical Security

The NYISO has a comprehensive program for addressing physical and cybersecurity risks. This risk-based 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 awareness, and grid security exercises that execute the electric sector's response to simulated cybersecurity 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. The NYISO further relies on its collaborative relationships with such entities for classified briefings and real-time cybersecurity information sharing and threat detection.

On a state level, the NYISO regularly collaborates on security initiatives with a number of New York State and local agencies, including 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 participated in New York State cybersecurity exercise events. These exercises facilitate the testing of incident response plans, identification of opportunities for improvement, and enhanced collaboration and information sharing among state agencies and the industry.

▸ **Critical Infrastructure Protection (CIP):**

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

The NYISO also participates in GridEx, a biennial sector-wide grid security exercises conducted by NERC. While national in scope, these exercises involve coordination with New York State agencies. 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.

Conclusion

The NYISO's competitive wholesale markets and comprehensive system planning processes have worked to sustain reliability on the grid since the NYISO's inception in 1999. Underlying all NYISO processes in this time has been the belief that open, competitive markets for wholesale electricity result in the most efficient allocation of resources — and serve New Yorkers best by minimizing the costs of producing the energy they need. Gains in system efficiency, improved environmental performance, and reduced costs have been the hallmark of the NYISO's management of the grid.

New York State's policies are clearly intended to accelerate change and promote a cleaner grid. As policymakers seek a more rapid and widespread transformation, the NYISO believes its markets and planning processes must continue to serve as a platform to facilitate the grid's evolution. The NYISO is planning for this transformation already and expects that wholesale markets will be enhanced to reflect emerging needs as this transformation takes place.

New products will be developed for the NYISO's markets to attract the types of capabilities to the grid that address the intermittent and variable nature of renewable resources. Existing market products will be refined to allow the markets to fully value those resources needed for reliability, and attract additional resources necessary to maintain reliability under increasingly dynamic system conditions. Furthermore, planning processes will be enhanced to better identify and address reliability needs that might result from policies that have the potential to significantly alter the mix of resources supplying the grid.

One aspect of the future grid that will not change, however, is the need for stakeholder involvement in the transformation. NYISO stakeholders and market participants have been critical to shaping the NYISO's best-in-class wholesale market design, and will continue to be critical in evaluating future needs and developing equitable solutions. Through its shared governance structure, the NYISO will work to align markets and planning processes with evolving system needs.

Glossary of Terms

The following glossary offers definitions and explanations of phrases used in *Power Trends 2018*, 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 only supplies electricity to the facility on which it is located.

Broader Regional Markets (BRM): A set of coordinated changes to the region's bulk electricity markets that will reduce the inefficiencies of moving power between markets. In addition to the NYISO, the regional initiative involves Ontario's Independent Electricity System Operator, the Midwest Independent Transmission System Operator, PJM Interconnection, ISO New England, and Hydro Québec.

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 goes 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%.

Clean Energy Standard (CES): A New York State requirement that 50% of the energy consumed in the state be generated by eligible renewable energy resources by 2030. Often referred to as the "50-by-30 goal."

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.

Comprehensive System Planning Process (CSPP): The NYISO's ongoing process that evaluates resource adequacy and transmission system security of the state's bulk power system over a 10-year period and evaluates solutions to meet those needs. The CSPP contains four major components: local transmission planning, reliability planning, economic planning, and public policy transmission planning. Each planning cycle begins with the Local Transmission Plans of the New York transmission owners, followed by NYISO's *Reliability Needs Assessment (RNA)* and *Comprehensive Reliability Plan (CRP)*. Using the most recent reliability planning model, economic planning is conducted through the *Congestion Assessment and Resource Integration Study (CARIS)*, and projects to meet transmission needs driven by federal, state, and local laws and regulations are analyzed through the Public Policy Transmission 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.

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.

Day-Ahead Demand Response Program (DADRP): A NYISO economic-based demand response program to allow energy users to offer their load reductions into the day-ahead energy market. The resources are paid the same market clearing price as generators.

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.

Demand Side Ancillary Services Program (DSASP): A NYISO economic-based demand response program to allow energy users to offer their load reductions into the ancillary services market to provide operating reserves and regulation service. These resources are paid the same ancillary service market clearing price as generators.

Distributed Generation: A generator — typically 10 MW or smaller — attached to the distribution grid. Distributed generation can serve as a primary or backup energy source and can use various technologies, including wind generators, combustion turbines, reciprocating engines, and fuel cells.

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.

Electric Grid: An interconnected network for delivering electricity from suppliers to consumers. It consists of generators that produce power, transmission lines that carry power to demand centers, and distribution lines that connect individual customers.

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 stewards the wholesale electricity markets in New York, enabling competing generators to offer their output to retailers. These markets include the Day-Ahead Market (DAM) and others.

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 participant 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 amount of installed electric generation capacity above 100% of the forecasted peak electricity consumption that is required to meet New York State Reliability Council (NYSRC) 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.

Intertie: A transmission line that links two or more regional electric power systems.

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.

Loss of Load Expectation (LOLE): The amount of generation and demand-side resources needed to minimize the probability of an involuntary loss of firm electric load on the bulk power system. The state's bulk power system, is designed to meet a LOLE that is not greater than one occurrence of an involuntary load disconnection in 10 years (expressed mathematically as 0.1 days per year).

Market-Based Solutions: Investor-proposed projects that are driven by market needs to meet future reliability requirements of the bulk power system as outlined in the *Reliability Needs Assessment (RNA)*. Those solutions can include generation, transmission, and demand response programs. Market-based solutions are preferred by the NYISO's planning process. The NYISO is responsible for evaluating all solutions to determine if they will meet the identified reliability needs in a timely manner.

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 only when there is a high demand — known as peak demand — for electricity.

Phasor Measurement Units (PMUs): These devices provide near instantaneous measurement and observation of bulk power system phase angles at strategic locations across the system. PMUs are enhancing the NYISO's (and transmission owners') awareness of the system's status and its vulnerabilities in real time.

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 York, Rhode Island, and Vermont.

Regulated Backstop Solutions: Proposals required of certain Transmission Owners to meet reliability needs as outlined in the *Reliability Needs Assessment*. Those solutions can include generation, transmission, or demand response. Non-Transmission Owner developers may also submit regulated solutions. The NYISO may call for a gap solution if neither market-based nor regulated backstop solutions meet reliability needs in a timely manner. To the extent possible, the gap solution should be temporary and strive to ensure that market-based solutions will not be economically harmed. The NYISO is responsible for evaluating all solutions to determine if they will meet identified reliability needs in a timely manner.

Reforming the Energy Vision (REV): The New York State Public Service Commission commenced the Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision (Case 14-M-0101) in April 2014.

Reliability Needs Assessment (RNA): A report that evaluates resource adequacy and transmission system security over 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.

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.

Thermal Line Limits: The maximum amount of electrical energy that can flow on a transmission line without overheating the line.

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] U.S. Energy Information Administration, Annual Energy Outlook 2018: with projections to 2050, https://www.eia.gov/outlooks/aeo/pdf/AEO2018.pdf

[2] *In 2016, for example, demand on the grid exceeded 30,000 MW for only 33 hours, or just 0.38 % of the total hours for the year.*

[3] *Today in Energy, U.S. Energy Information Administration, "Nearly Half of Utility-Scale Capacity Installed in 2017 Came from Renewables,"* January 10, 2018. https://www.eia.gov/todayinenergy/detail.php?id=34472

[4] *Today in Energy, U.S. Energy Information Administration, "Almost All Power Plants that Retired in the Past Decade were Powered by Fossil Fuels,"* January 9, 2018

[5] *Net capacity figures based on data for respective Summer Capability Periods (May 1- Oct. 31).*

[6] *A circuit-mile is one mile of one circuit of transmission line. For example, two 100-mile lines total 200 circuit-miles. One 100-mile double-circuit transmission line would also total 200 circuit-miles.*

[7] *The Federal Energy Regulatory Commission defines demand response as changes in electric usage by end-use customers from their normal consumption patterns in response to changes in the price of electricity over time, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized.*

[8] Federal Energy Regulatory Commission. "2017 Assessment of Demand Response and Advanced Metering." Staff Report. December 2017. https://www.ferc.gov/legal/staff-reports/2017/DR-AM-Report2017.pdf

[9] New York Independent System Operator. "NYISO 2017 Annual Report on Demand Response Programs." January 2018. https://nyisoviewer.etariff.biz/ViewerDocLibrary//Filing/Filing1348/Attachments/20180112_NYISO2017AnnlRprtDRPrgrms_Cmplt_PUBLIC.pdf

[10] New York State Public Service Commission. "Order adopting installed reserve margin for the New York control area for the 2018-2019 capability year." March 6, 2018. http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={207D00DF-7AEC-41CB-955F-6005F776032C}

[11] Generator Deactivation Assessment: Indian Point Energy Center, NYISO, December 13, 2017, http://www.nyiso.com/public/webdocs/media_room/press_releases/2017/Child-Indian-Point-Energy-Center-Retirement-Analysis/Indian_Point_Generator_Deactivation_Assessment_2017-12-13.pdf

[12] *NYISO Integrating Public Policy Project: Phase 2,* March 28, 2017, NYISO, https://www.nyiso.com/public/webdocs/markets_operations/committees/bic_miwg/meeting_materials/2017-03-28/NYISO%20Integrating%20Public%20Policy%20Project%2020170328%20FOR%20MIWG%20(2).pdf

[13] *Appendix A: Study Methodology, New York Clean Energy Standard*

[14] The Social Cost of Carbon is a measure, in dollars, of the long-term damage done by a ton of carbon dioxide emissions in a given year. The resulting dollar figure represents the value of damages avoided for a small emission reduction. U.S. Environmental Protection Agency, Social Cost of Carbon Fact Sheet; https://www.epa.gov/sites/production/files/2016-12/documents/social_cost_of_carbon_fact_sheet.pdf

[15] The NYISO's Day-Ahead Demand Response Program and Demand-Side Ancillary Service Program will be retired and replaced with the dispatchable DER market rules, and resources currently participating in DADRP or DSASP will be transitioned to participating as dispatchable DER.

[16] *Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators, Notice of Proposed Rulemaking,* 157 FERC ¶ 61,121, Nov. 17, 2016.

[17] *Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators, Notice of Proposed Rulemaking,* 157 FERC ¶ 61,121, Nov. 17, 2016.

[18] American Public Power Association. "FERC's Powelson says storage offers 'far reaching benefits' to grid." Feb. 14, 2018. https://www.publicpower.org/periodical/article/fercs-powelson-says-storage-offers-far-reaching-benefits-grid

[19] Statement of Philip D. Moeller, Edison Electric Institute, before Committee on Energy and Natural Resources, United States Senate (February 8, 2018)(emphasis added), at 2.

[20] Statement of Philip D. Moeller, Edison Electric Institute, before Committee on Energy and Natural Resources, United States Senate (February 8, 2018), at 3.

[21] Statement of Philip D. Moeller, Edison Electric Institute, before Committee on Energy and Natural Resources, United States Senate (February 8, 2018)(emphasis added), at 3.

[22] The Brattle Group. "The Benefits of Electric Transmission: Identifying and Analyzing the Value of Investments." July 2013.

[23] The Brattle Group. "Toward More Effective Transmission Planning: Addressing the Costs and Risks of an Insufficiently Flexible Electricity Grid." April 2015.

[24] New York State Public Service Commission. "PSC Votes to Advance Transmission System Upgrades for Further Review." Dec. 17, 2015.

[25] New York Independent System Operator. "AC Transmission Public Policy Transmission Need Viability & Sufficiency Assessment." Oct. 27, 2016. http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_espwg/meeting_materials/2016-09-26/NYISO_AC_Transmission_PPTN_VSA_Draft_Report.pdf

[26] New York State Public Service Commission. "Order Addressing Public Policy Transmission Need for AC Transmission Upgrades." Case Nos. 12-T-0502, et al. Jan. 24, 2017.

[27] New York Independent System Operator, et al. "2015 Northeastern Coordinated System Plan." April 11, 2016. http://www.nyiso.com/public/webdocs/markets_operations/services/planning/ipsac/2015_Northeastern_Coordinated_System_Plan.pdf

[28] New York Independent System Operator. "2015 Congestion Assessment and Resource Integration Study (CARIS) Phase 1 Report." November 2015. http://www.nyiso.com/public/webdocs/markets_operations/services/planning/Planning_Studies/Economic_Planning_Studies_(CARIS)/CARIS_Final_Reports/2015_CARIS_Report_FINAL.pdf

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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 $7.5 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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