POWER TRENDS 2015

Rightsizing the Grid

New York Independent System Operator

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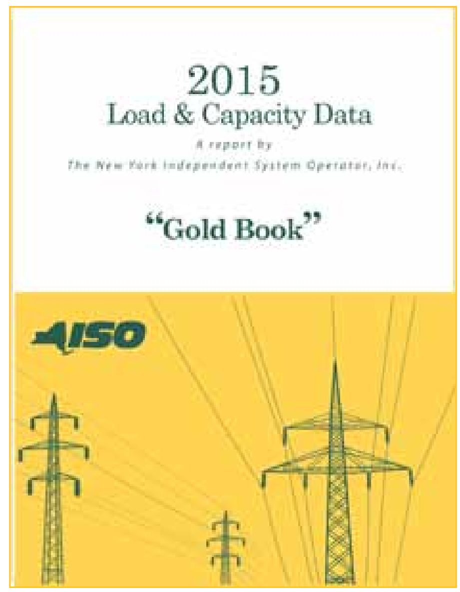
The New York Independent System Operator (NYISO) is a not-for-profit corporation responsible for operating the state's bulk electricity grid, administering New York's competitive wholesale electricity markets, conducting comprehensive long-term planning for the state's electric power system, and advancing the technological infrastructure of the electric system serving the Empire State.

Data used in *Power Trends 2015*, unless otherwise noted, are from the *2015 Load and Capacity Data Report* (also known as the "Gold Book").



Published annually by the NYISO, the "Gold Book" presents New York Control Area system, transmission and generation data and NYISO load forecasts for the 2015 – 2025 period. It includes forecasts of peak demand, energy requirements, energy efficiency, and emergency demand response; existing and proposed resource capacity; and existing and proposed transmission facilities.

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

Power Trends 2015 — By the Numbers

Power Resources

Generation

Total Generation -- 2015 .... 39,039 MW

Generation Added 2000 - 2015 .... 11,653 MW

Transmission

Total Circuit Miles of Transmission -- 2015 .... 11,086 miles

Transmission Capability Added 2000 - 2015 .... 2,315 MW

Demand Response

Demand Response -- Projected Summer 2015 .... 1,124 MW

Reliability Requirements

Reliability Requirement -- Summer 2015 .... 39,273 MW

Total Resources Available -- Summer 2015 .... 41,610 MW

Renewable Resources

Total Renewable Resource Capacity -- 2015 .... 6,264 MW

Total Existing Wind Generating Capacity *(Nameplate)* -- 2015 .... 1,746 MW

Proposed Wind Generating Capacity *(as of March 31, 2015)* .... 2,309 MW

Percentage of Electric Energy from Renewables in 2014 .... 25%

Power Demands

Total Usage in 2014 .... 160,059 GWh

Total Usage in 2013 .... 163,514 GWh

Total Usage in 2012 .... 162,840 GWh

Forecast Peak Demand - 2015 .... 33,567 MW

Actual Peak Demand - 2014 .... 29,782 MW

Record Summer Peak Demand *(July 19, 2013)* .... 33,956 MW

Record Winter Peak Demand (January 7, 2014) .... 25,738 MW

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EXECUTIVE SUMMARY

Transformative technology, shifting economics, and aging infrastructure all are converging to create an array of challenges for today's electric grid. Consumer demand for electricity has flattened, and the emergence of distributed energy resources "behind the meter" is changing historical patterns of consumption. A sizeable portion of the existing generation and transmission resources is several decades old, and increasingly stringent environmental regulations are accelerating the retirement of older generating units as compliance costs grow. A shift in the century-old model of centralized grid operation is coming, but its pace and scope remain to be seen.

The modern electric system evolved through massive generating facilities connected to high-voltage transmission lines, and the expansion of local distribution networks that deliver energy to customers. In that model, electricity is said to flow "downhill" from large power plants to a widespread set of residential, commercial and industrial customers.

While the grid began in the 1880s as local generation serving local customers, during the mid-20th century it evolved into today's network as economies of scale dictated investment in larger power plants delivered by higher voltage transmission, which were generally less expensive per unit of output than smaller generating and transmission facilities.

The Largest Machine in the World

Described by some observers as "the largest machine in the world," the modern grid is an amalgam of variously-sized grid systems that has historically provided delivery of power to customers with a high level of reliability.

New York's electric system, for example, is a collection of grid systems, connected to the larger Eastern Interconnection. An array of investor-owned electric utilities, public power authorities, municipal electric systems, and rural electric cooperatives serves designated territories and customer bases within the state.

These territories and customers are interconnected by a high-voltage grid operated by the New York Independent System Operator (NYISO). As an integral part of its management of the statewide high-voltage transmission system, the NYISO also administers open, competitive wholesale electricity markets to serve New York's customers.

Changing energy technologies have altered the conventional assumptions about economies of scale. Development of diverse smaller scale power supplies, including solar photovoltaics (PV) that are increasingly affordable to customers, have further challenged traditional models of centralized generation.

An increasing number of "microgrids" are envisioned to serve the particular needs of institutions, corporations, and communities, while retaining connections to the bulk power system.

Finding the rightsized grid and the best mix of power resources to most efficiently provide essential electric service is now a more complex endeavor as New York strives to address its future energy needs.

Electric grid operators, such as the NYISO, are always looking to the future through a set of progressive lenses -- from the immediate focus on balancing the supply of electricity with consumer demand every six seconds to long-range planning that scrutinizes future energy needs. Similarly, the NYISO's annual Power Trends report is designed to focus attention on specific, near-term issues and offer longer-range context.

Among the key trends discussed in *Power Trends 2015*:

Moderate Energy Usage / Greater Peak Demand

- **Year-to-year growth in the overall usage** of electric energy from the bulk electric system is **forecasted to be flat over the next decade**. In contrast, the **peak demand** is expected to **grow**.
- While peak demand represents only a small fraction of a year's overall power consumption, it is a

significant factor because **reliability reserve requirements are based on projected peaks**. These reliability reserve requirements determine the amount of capacity resources that must be purchased to meet the system's resource adequacy needs.

- **Energy efficiency programs and distributed energy resources** (solar photovoltaics and other "behind-the-meter" systems) in New York are expected to **reduce the growth of peak demand** on the bulk power system by more than **2,700 megawatts** from projected levels **by 2025**. They are also expected to **lower annual energy usage** served by the bulk power system by more than **14,000 gigawatt-hours in 2025.**

Markets Delivering Resources and Efficiencies

- **New generation** added since the start of New York's wholesale electricity market totals more than **11,600 megawatts**, providing enough power to meet **more than one-quarter of New York's power needs.**
- More than **80 percent of the new generation has been added in the Hudson Valley, New York City and Long Island,** where demand for power is greatest.
- The surplus of power resources -- in excess of the state's reliability requirements grew to **2,300 megawatts in 2015**, up from 1,900 megawatts last year.
- Since 2000, more than **2,300 megawatts of transmission capability have been added** to serve the southeastern New York region.
- **Demand response** programs continue to provide more than **1,100 megawatts** of resources to address peak demand, but legal challenges have made their future uncertain.
- Competitive wholesale electricity markets have **improved the fuel efficiency of New York's power resources by more than 27 percent, reducing fuel costs by a total of $6.4 billion** through 2013.
- Market-driven improvements in generation efficiency have enabled **reductions in reserve requirements, saving an estimated $540 million** from 2000-2014 while sustaining reliability.

New Capacity Zone Enhances Reliability Outlook

- Approximately **1,000 megawatts of power resources are returning at critical locations in southeastern New York.** The **new capacity zone in the Lower Hudson Valley played an instrumental** role in encouraging development of generation in the region that has addressed pressing reliability needs.
- The return and addition of new power resources are expected both to address reliability needs and reduce costs over the long term. **Capacity costs in New York are expected to be approximately $400 million lower** in the coming year due to the increase in supply driven by the creation of the new zone.

- In addition to resource investments related directly to the new capacity zone, another **1,000 megawatts** of resources are scheduled to be added elsewhere in the state. Taken together with these additions, successful completion of planned transmission upgrades, demand response measures, and other generation projects are expected to **address reliability needs through 2024.**

The Role of Transmission

- **Two-thirds of New York's electricity is used in the southeastern part of the state** (Long Island, New York City, and the Lower Hudson Valley). **Yet only half of the state's generating capacity is located in this region.** Sustained and enhanced transmission capability is vital to efficiently moving power to address regional power needs.
- **Over 80 percent of New York's high-voltage transmission lines went into service before 1980**. Of the state's more than 11,000 circuit-miles of transmission lines, **nearly 4,700 circuit-miles will require replacement** within the next 30 years, at an **estimated cost of $25 billion**.
- **New and upgraded transmission capacity can play a valuable role in addressing** concerns about **aging infrastructure**, providing **greater flexibility** in grid operations, advancing **integration of renewable energy resources,** and enhancing **environmental quality** by helping to meet needs that may develop when environmental regulations limit the production of fossil-fuel generation.

Growing Reliance on Natural Gas

- Power projects using natural gas (gas-only and dual-fuel units capable of using either natural gas and/or oil) account for **56 percent** of New York's generating capacity.
- More than **70 percent of all proposed generating capacity** in New York are natural gas or dual fuel power projects.
- **Winter 2014 price spikes**, driven by increased cost of natural gas delivered to New York, increased the average wholesale electric energy price to $69.30 per megawatt-hour in 2014, up from $59.13 per megawatt-hour in 2013. **Winter 2015 saw less volatility** as a result of improved fuel supplies and enhancements to gas-electric coordination.
- The NYISO and its stakeholders are exploring the creation of additional **market-based incentives for fuel supply assurance** during periods of summer and winter peak demand that can stress both the electric and the natural gas delivery systems.

Cultivating Green Power

- In 2014, 35,756 gigawatt-hours of New York's electricity were produced by **renewable resources**, representing approximately **25 percent of New York's electric generation.**
- New York's large base of **hydropower resources generated 28,525 gigawatt-hours** of the renewable power produced in 2014.
- **Electric energy generated by wind power totaled 3,986 gigawatt-hours in 2014, representing a 3,000 percent increase** from the 112 gigawatt-hours generated by wind power in 2004.
- The nameplate **generating capacity of wind-powered** projects in New York grew from 48 megawatts in 2005 to **1,746 megawatts in 2015**.
- Another **2,300 megawatts of wind power currently are proposed for interconnection** with the New York grid.

Addressing Environmental Goals

- From 2000 through 2014, **New York power plant emission rates dropped by double digits**. SO_2 emissions rates declined 94 percent. NO_X emission rates declined 78 percent. CO_2 emission rates declined 39 percent.
- New and proposed environmental regulations are estimated to affect **33,800 megawatts of generation**, more than **80 percent** of New York's generating capacity.
- The **Clean Power Plan proposed by the U.S. EPA** presents **potentially serious reliability implications** for New York and fails to **credit New York's progress in cutting emissions reductions.** A **"reliability safety valve"** is needed to provide sufficient flexibility to address circumstances – such as metropolitan New York's reliance on dual-fuel resources – when reliability may be at risk.

Integrating Distributed Energy Resources

- Rapid expansion of **distributed energy resources**, such as customer-sited solar photovoltaic systems, offers **challenges and opportunities. Successful integration** is vital to avoiding reliability issues and **enhancing the potential value of distributed resources to grid resilience.**
- New York's **current mix of distributed resources** is led by **combined heat and power (57 percent),** followed by **solar PV (41 percent)**, and **energy storage (2 percent)**.
- **New York ranks in the top five states** for total distributed energy installations with significant **potential for additional rooftop PV and smaller-scale Combined Heat and Power (CHP) systems.**

- New York's **Reforming the Energy Vision (REV)** is identifying and implementing regulatory changes necessary to expand the role of distributed resources.
- Among the regulatory changes that may facilitate the proliferation of distributed resources are rate structures that provide **time-variant or "dynamic" pricing.** A 2009 study conducted by the Brattle Group for the NYISO concluded that "…dynamic pricing can provide substantial benefits…With **estimated market-based cost savings in the range of $171 million to $579 million per year…"**
- **Load forecasting** techniques will **need data currently hidden "behind-the-meter"** to effectively integrate distributed resources into power system operations and planning. Advances in metering and communications infrastructure will be essential.
- **Wholesale market potential of distributed resources** may include **price responsive demand** (reducing consumption when prices rise or increasing use when prices fall) or supplying **capacity and ancillary (reserves and regulation) services through aggregators**.

Interregional Collaboration

- **Removing barriers to the efficient flow of power** between electric systems is a vital component of **improved flexibility in grid operations** and **enhanced wholesale market efficiency.**
- **Broader Regional Markets** initiatives are reducing the need to use more expensive local power when less costly power is available from a neighboring grid operator; and shortening the time commitment for moving power across control area borders, allowing faster responses to changing conditions.
- **Eastern Interconnection Planning Collaborative (EIPC)** is continuing cross-boundary assessments of key issues such as the adequacy of the natural gas pipeline system to supply the needs of gas-fueled power generation. The new **Eastern Interconnect Data Sharing Network** has been formed to build and coordinate the reliable and secure exchange of critical infrastructure information among power systems in the region.

STATE OF THE GRID

Demand Trends and Forecasts

As noted in last year's Power Trends report, the amount of power used during periods of the highest electricity demand is increasing at a faster rate than the electric energy used on a day-to-day basis.

Annual Energy Usage

Since the 1950s, annual electricity usage in the nation increased each decade, though it did so at a slower pace as each decade passed. Growth rates fell from nearly 10 percent annually during the 1950s to less than 1 percent per year since 2000. U.S. electricity use continued to remain relatively flat from 2013 to 2014.[1]

In New York, annual electric energy usage since 2000 has been relatively flat. For the past 15 years, annual usage grew at an average annual rate of 0.21 percent. Most recently, energy usage in New York declined 2.10 percent between 2013 and 2014, due in large measure to cooler than normal summer temperatures.

The economic downturn of 2008-2009 contributed to the decline of electricity usage in New York, as it did throughout the nation. Other factors, such as improved energy efficiency from new appliance standards, energy conservation programs, and alternatives to grid-supplied power, also have dampened demand for electricity. These fundamental changes in the use of electricity are expected to slow growth in the future, even as the economy revitalizes. [2]

Annual Energy Usage

- *Relatively flat growth since 2000 – 0.21% average annual increase*
- *Decline from 2013 to 2014 – 2.10% drop (largely due to cooler than normal summer temperatures)*

Figure 1 – Annual Electric Energy Usage Trends in New York State: 2000-2014

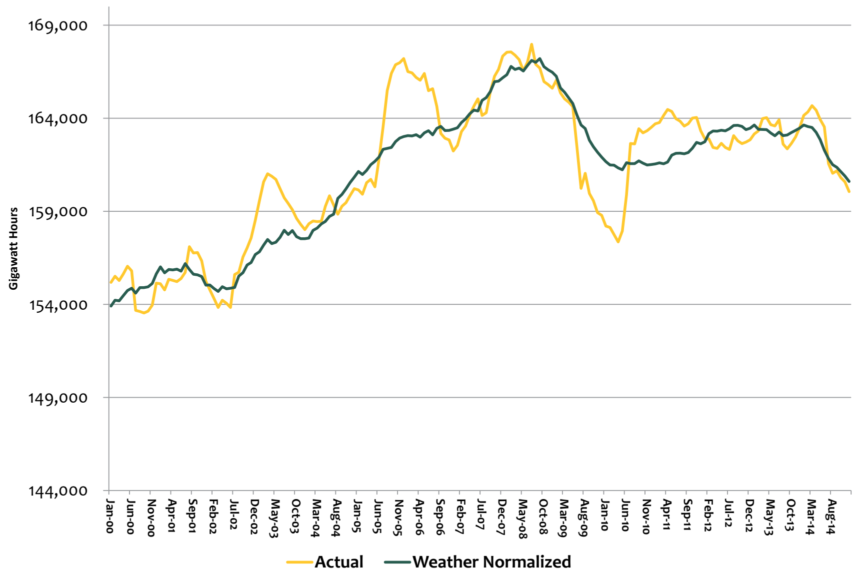


Figure 2 - Annual Electric Energy Usage by Region: 2010-2014

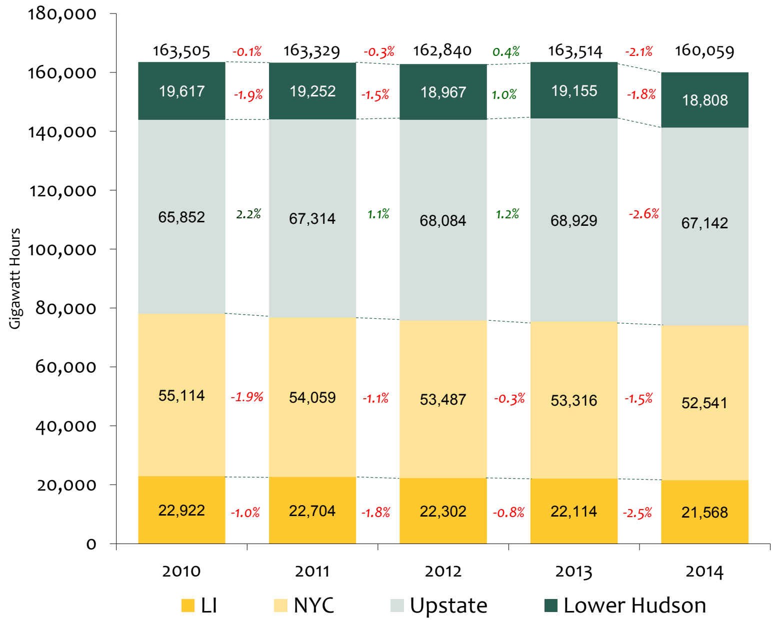
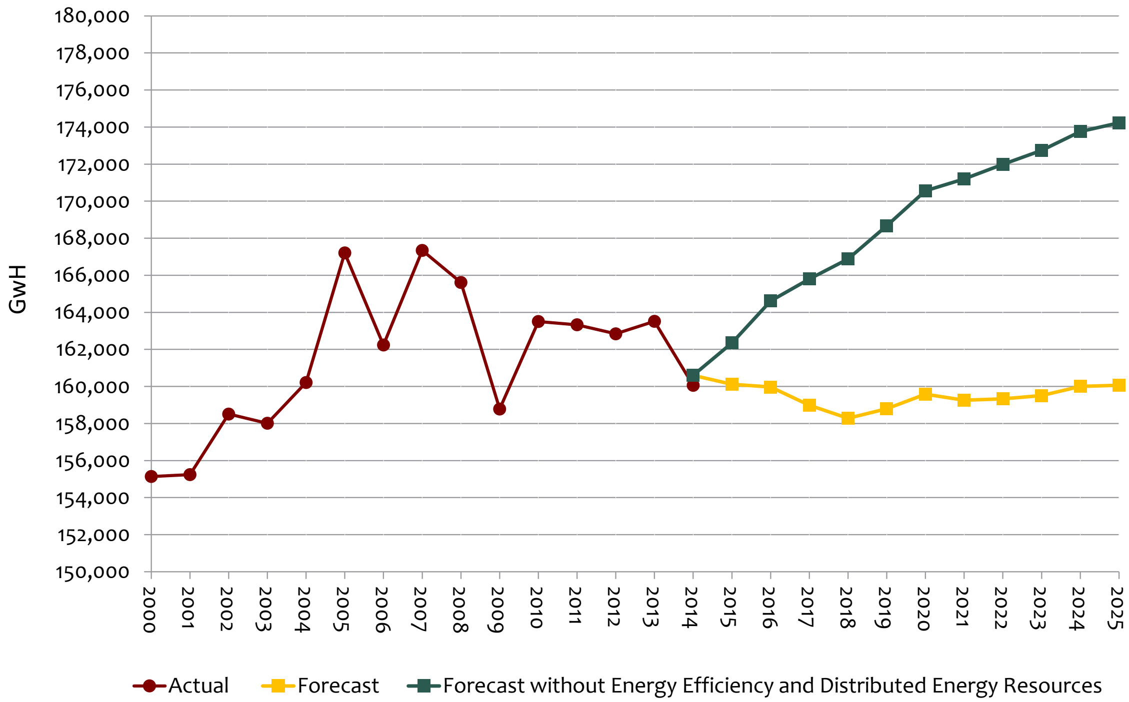


Figure 3 - Electric Energy Usage Trends in New York State: 2000-2025



Peak Demand

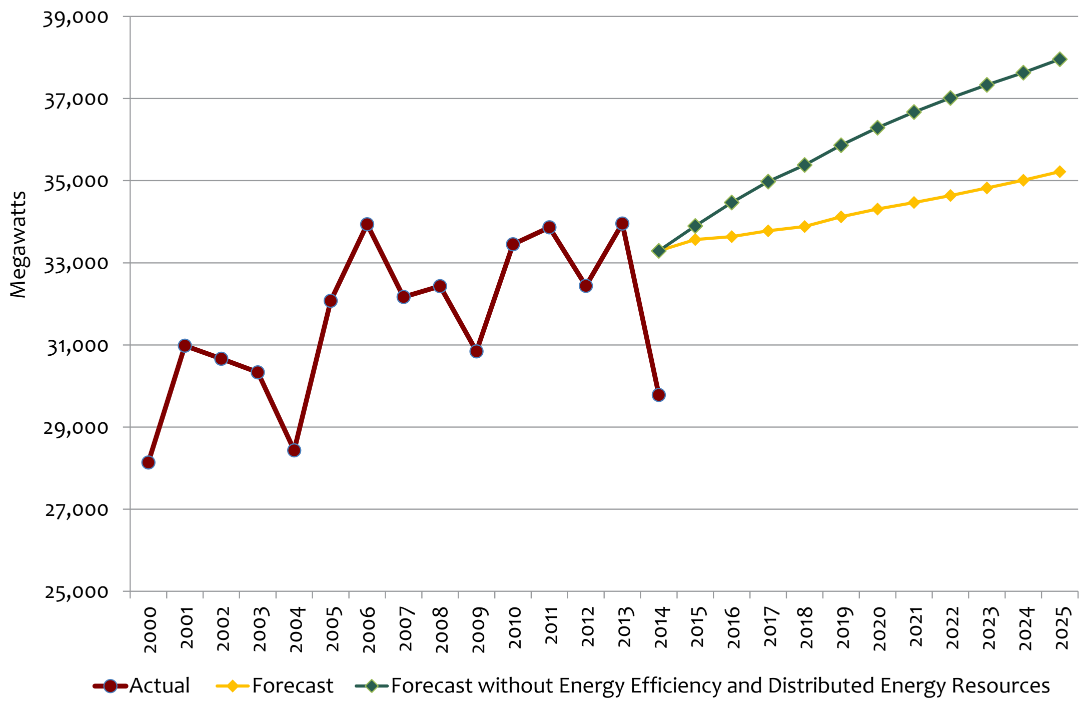
Annual electric energy usage provides a measure of overall electricity consumption, but is not the only vital sign of the electric system's health. Annual peak demand, which measures the maximum amount of electricity the system is called upon to deliver, is a metric of equal importance. While peak demand represents only a small fraction of a year's overall power consumption, it is a significant factor because reliability standards, such as reserve requirements, are based on projected peak demand. These reserve requirements, in addition to projected peak demand, determine the total amount of power capacity that must be purchased to meet the system's reliability needs.

In 2004, New York recorded a peak demand of 28,433 megawatts. A decade later a new all-time record peak of 33,956 megawatts was recorded in July 2013. In 2014, very moderate summer weather produced an annual peak that only reached 29,782 megawatts, 12 percent below the previous year and the lowest annual peak since 2004. The 2014 peak occurred in September, far later in the summer season than usual. The last time New York had recorded an annual peak in September was 1983.

2014 Peak Demand
29,782 megawatts

- *12% below 2013 record-setting peak (33,956 megawatts)*
- *Lowest since 2004*
- *First annual peak to occur in September since 1983*

Figure 4 - Electric Peak Demand Trends in New York State – Actual & forecast: 2000-2025

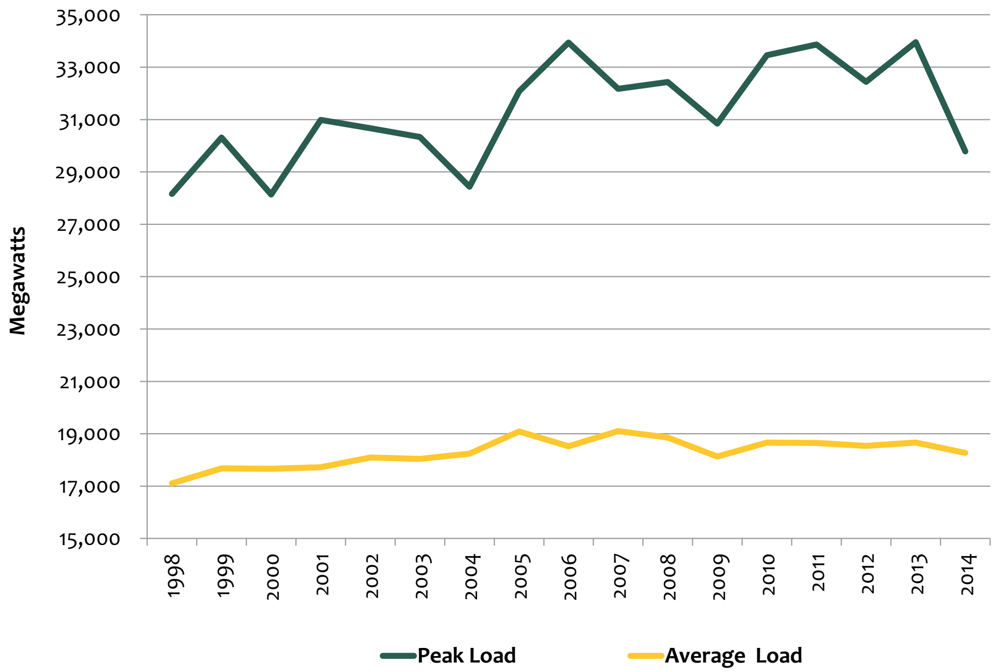


Peak demand in New York is forecast to grow at an annual average rate of 0.48 percent from 2015 through 2025. In contrast, overall electric energy use is projected to remain flat over the next decade.

This pattern of peak demand growing faster than average electricity use is occurring throughout the nation.[3]

While the periods of extremely high demand represent a small portion of total power consumption, the electric system has to be constantly ready to meet that high level of demand. Consequently, a significant amount of generating capacity remains idle most of the time.

Figure 5 - Peak vs. Average Load in New York State: 1998-2014



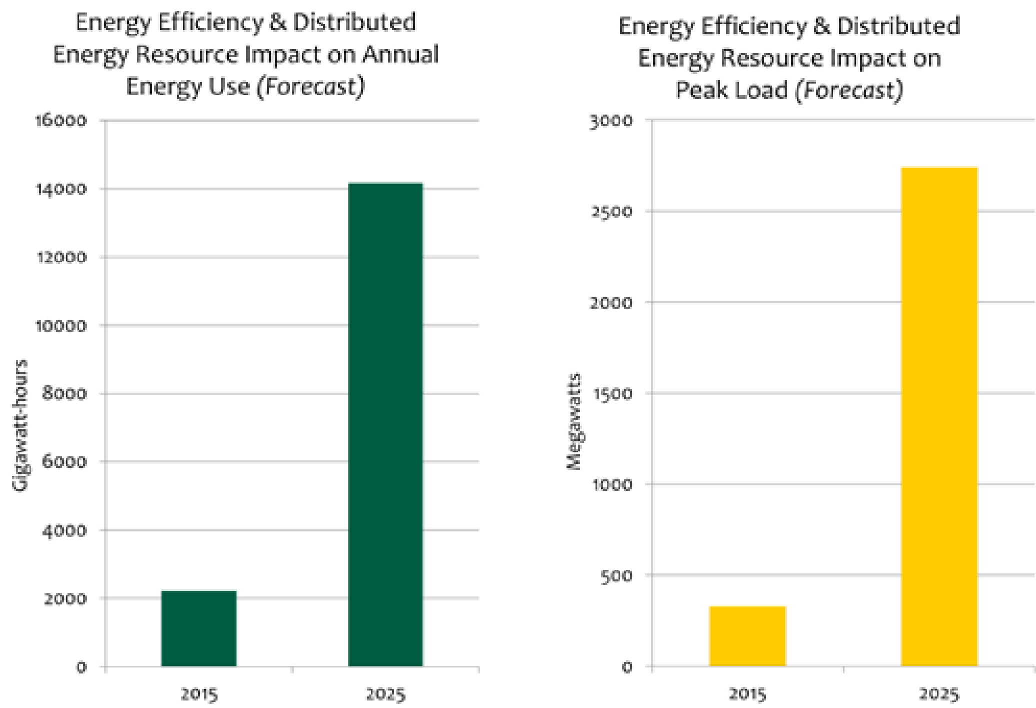
Electricity Trends, Energy Efficiency and Distributed Resources

Among its goals, the New York State's "Reforming the Energy Vision" (REV) initiative aims to deploy distributed resources and demand-side measures.

"Finding ways to reduce peak demand represents the single largest savings opportunity for consumers in New York. The only way this savings can be realized is by modernizing the grid, and incorporating new technologies that are now available and continue to be developed all the time," Governor Andrew Cuomo said in statement announcing the REV initiative last year.[4]

The NYISO's independent estimate of the impact energy efficiency programs, distributed solar, and non-solar distributed resources will have on peak loads suggests that their combined impact will reduce the 2015 peak by an estimated 330 megawatts. That impact is forecasted to grow to more than 2,700 megawatts of peak reduction in 2025. The impact on energy usage is expected to be more than 2,200 gigawatt-hours in 2015, growing to more than 14,000 gigawatt-hours in 2025. (*See Distributed Resource section for more discussion.*)

Figure 6 – Projected Impact of Energy Efficiency Programs and Distributed Energy Resources on Peak Loads and Energy Usage: 2015 & 2025



Resource Trends

The outlook for New York's electric system remains positive. Various generation, transmission, and demand-side resources are expected to be available to meet the moderate growth of demand forecasted to occur over the next decade.

New Resources

2000-2014

- *11,600+ megawatts of generating capacity*
- *2,300+ megawatts of transmission capability*
- *1,100+ megawatts of demand response*

Generation

Since 2000, private power producers and public power authorities have added more than 11,600 megawatts of generating capacity in New York State. The added generation represents more than one-quarter of New York's power needs.

Over 80 percent of the new generation is located in New York City, on Long Island and in the Hudson Valley — the regions of New York State where power demand is greatest. New York's wholesale electricity market design, which includes locational based pricing and the regional capacity requirements, encourages investment in areas where the demand for electricity is the highest.

The locations of the other additions to New York's power-producing resources were largely influenced by physical factors, such as the suitability of wind conditions in the northern and western regions of the state, and upgrades to existing nuclear and hydropower plants in upstate regions.

Despite significant new generating capacity since 2000, the issue of aging power plant infrastructure persists. While 8.5 gigawatts of New York's generating capability is currently more than 50 years old, that segment is expected to double over the next decade, reaching 16.7 gigawatts by 2025, in the absence of new generation being built to replace aging assets.

Figure 7 – New Generation in New York State: 2000-2014

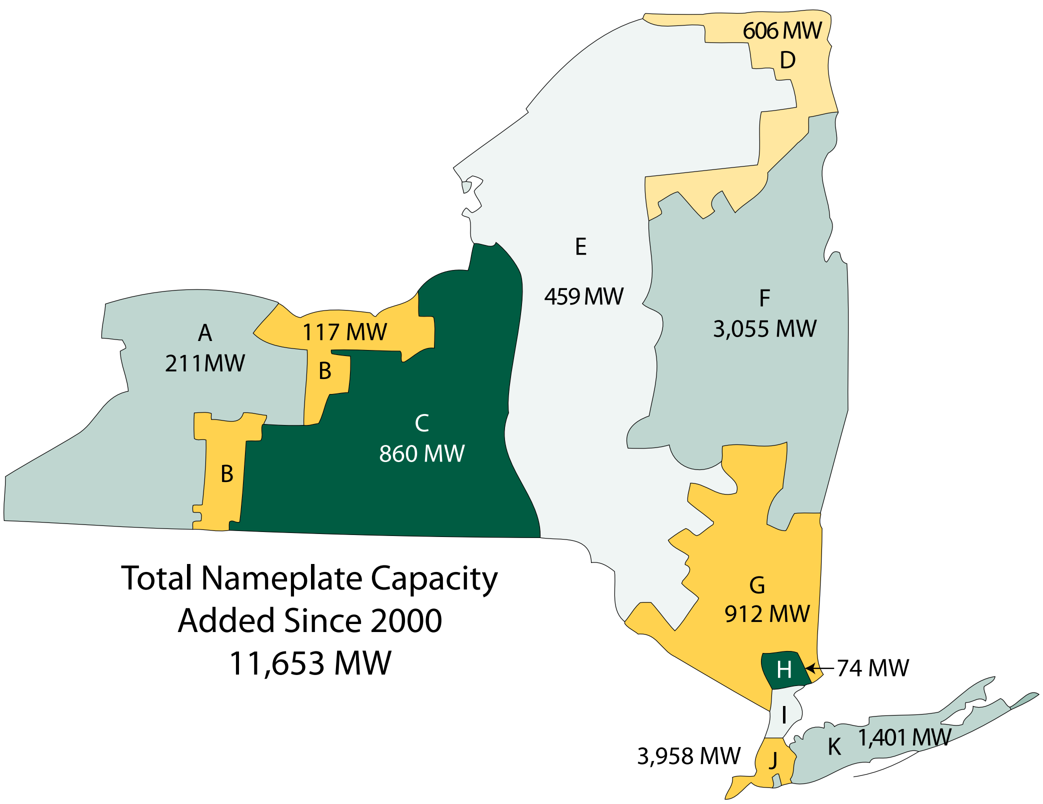
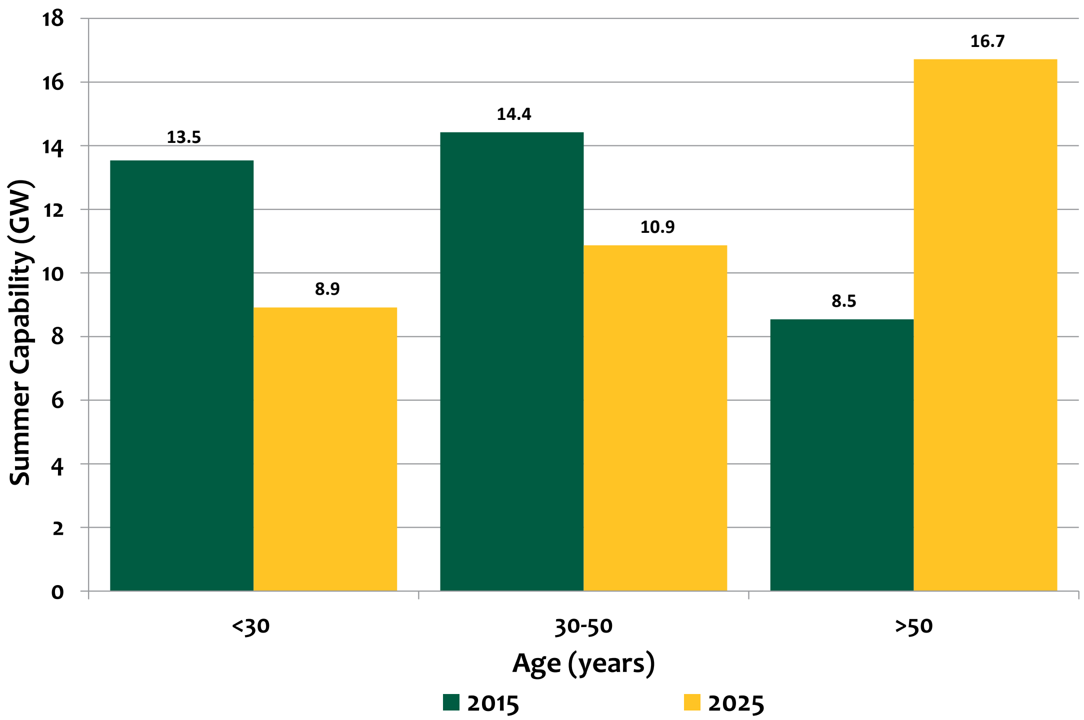


Figure 8 – Age of New York State Generation Fleet: 2015 & 2025



Among the newest generating facilities are renewable power projects such as wind and solar units. Combined cycle units fueled by natural gas have an average age of little more than a decade. The average age of New York's hydropower facilities is over 50 years, although the major hydropower projects have undergone life extension and modernization within the past decade and a half.

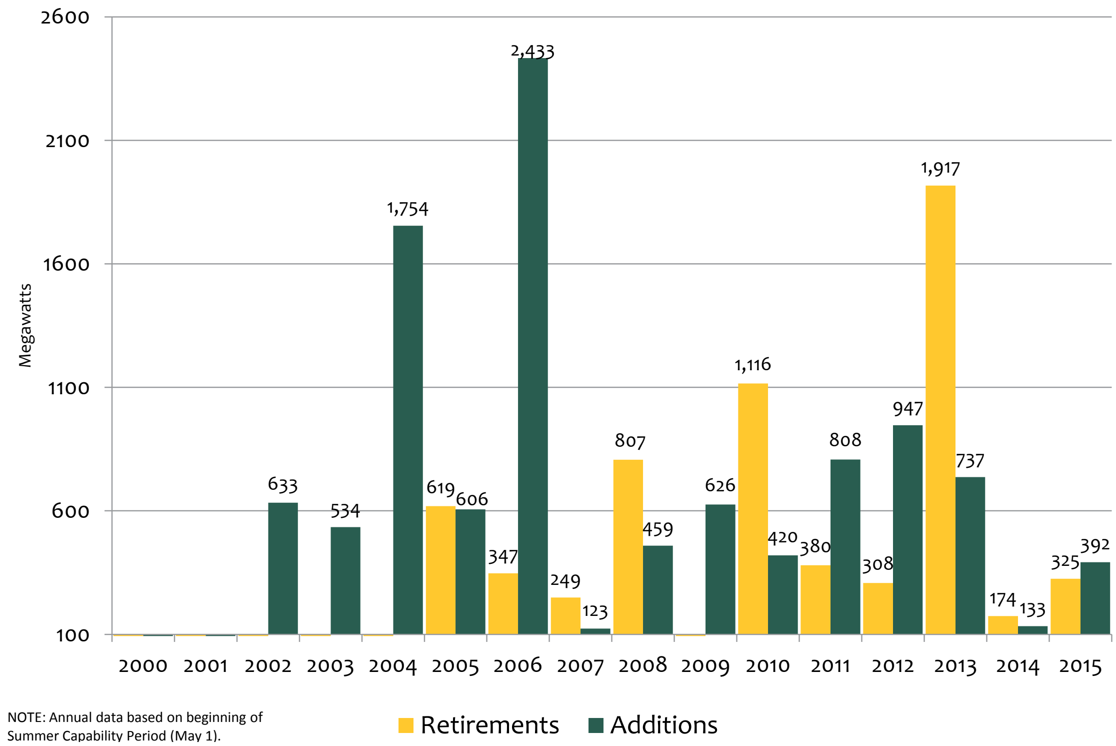
Expansion and Contraction

New power plants are built and existing facilities are upgraded to expand generating capacity as the demand for electricity and available supplies of power warrant new investment. In the alternative, power plants may elect to retire or suspend operation (so-called "mothballing") in response to competitive forces.

Since 2000, more than 10,000 megawatts of generation have been added to the system while more than 6,000 megawatts have retired or suspended operation. The pattern of expansion and contraction has ranged from an increase in net generating capacity of more than 2,000 megawatts between 2005 and 2006 to a reduction of nearly 1,200 megawatts between 2012 and 2013.[5]

Generation additions were primarily natural gas-fueled and wind-powered facilities. Significant portions of New York's remaining coal generation fleet retired or converted to natural gas.

Figure 9 – Generation Additions and Retirements: 2000-2015



The pattern of expansion and contraction has continued in recent years. In 2012, statewide power resources exceeded peak demand and reserve requirements by more than 5,000 megawatts. In 2013, the margin declined to approximately 2,500 megawatts, dropping to roughly 1,900 megawatts in 2014. In 2015, the surplus of power resources in excess of reliability requirements rebounded to total more than 2,300 megawatts.

Periodic power plant retirements are a natural consequence of competitive markets for electricity, which are designed to facilitate investment in more efficient resources to meet demand. However, retirements may also raise concerns from policy makers about the local economic impacts of a power plant's closing. Accelerated or unplanned power plant retirements can present challenges to electric system reliability.

Reliability Service Agreements

In New York, the reliability impacts of power plant closings are currently assessed through a New York State PSC requirement that generators provide advance notice of retirements. In collaboration with the NYISO and the affected transmission-owning utility, the PSC has determined the steps needed to address any potential reliability concerns. That evaluation process has led to Reliability Support Service Agreements, which extend the operation of facilities that had planned to retire.

A February 2015 FERC order concluded that reliability agreements should be a "last resort" and "should be of a limited duration so as to not perpetuate out-of-market solutions that have the potential, if not undertaken in an open and transparent manner, to undermine price formation." Accordingly, the order directed the NYISO to file tariff revisions establishing rates, terms and conditions for reliability must run agreements as part of its tariff.[6]

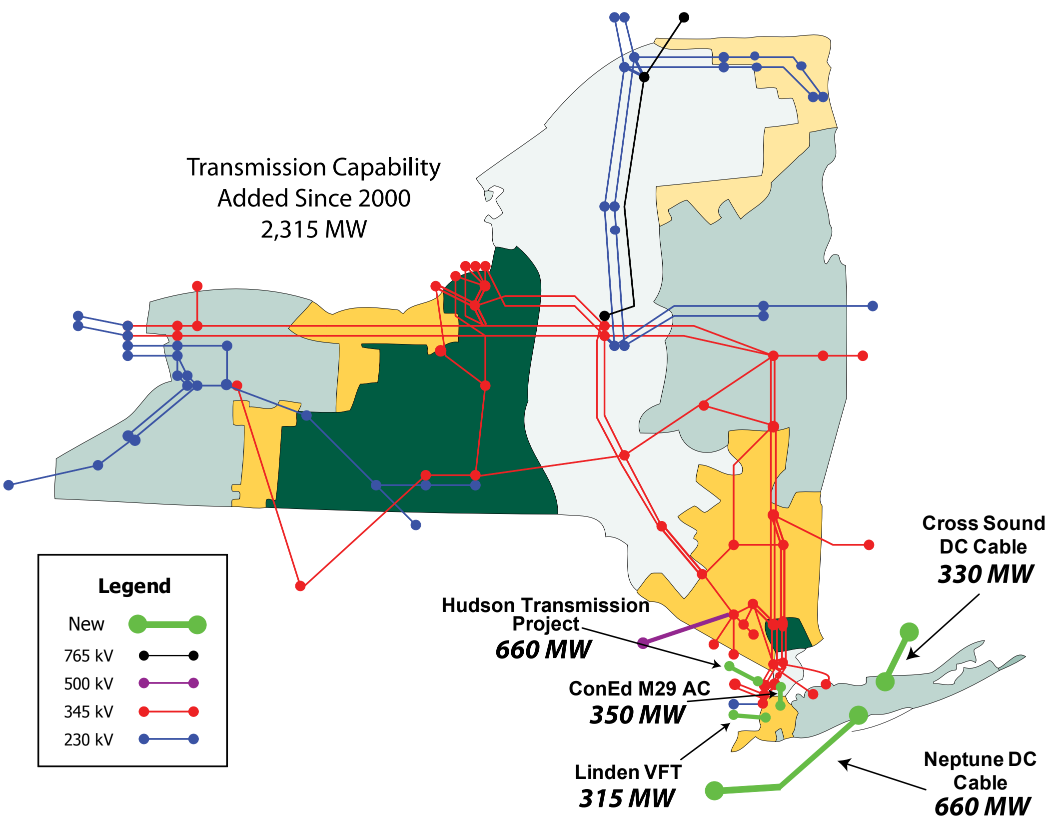
Transmission

The power demands of the downstate and metropolitan regions of New York have attracted the development of various transmission projects. Since 2000, more than 2,300 megawatts of transmission capability have been added, primarily interregional transmission over cables that bring power to the southeastern New York region from neighboring electricity markets.

A recent review of transmission investments by ESAI Power noted, "To date, we have seen capacity markets drive a limited amount of interregional transmission investment, with New York leading the way."[7]

These investments include the Cross Sound Cable, connecting Long Island with ISO-NE, and the Neptune Regional Transmission System, connecting Long Island with PJM. Two more projects also connect New York City with PJM-- the Hudson Transmission Partners project and the Linden Variable Frequency Transformer project.

Figure 10 - New Transmission in New York State: 2000-2014



New interstate transmission has been added, but the need to upgrade and enhance aging transmission infrastructure persists. Upgrades would address congestion concerns, deliver renewable power resources from upstate locations, and make better use of the full range of New York's power resources. *(See "The Role of Transmission" section for further discussion.)*

Demand Response

Demand response[8] enlists large electricity consumers and aggregations of smaller energy users to reduce consumption during periods of peak demand. Demand response continues to evolve as demand management capabilities broaden and technology grows ever more sophisticated. However, the role of demand response in wholesale electricity markets faces regulatory uncertainty and legal challenges.

Prior to the establishment of wholesale electricity markets, the electric system generally addressed growth in peak demand with comparable increases in generating capacity. Demand response programs have helped alleviate the need for more generation by focusing on consumers to assist in reducing the use of electricity.

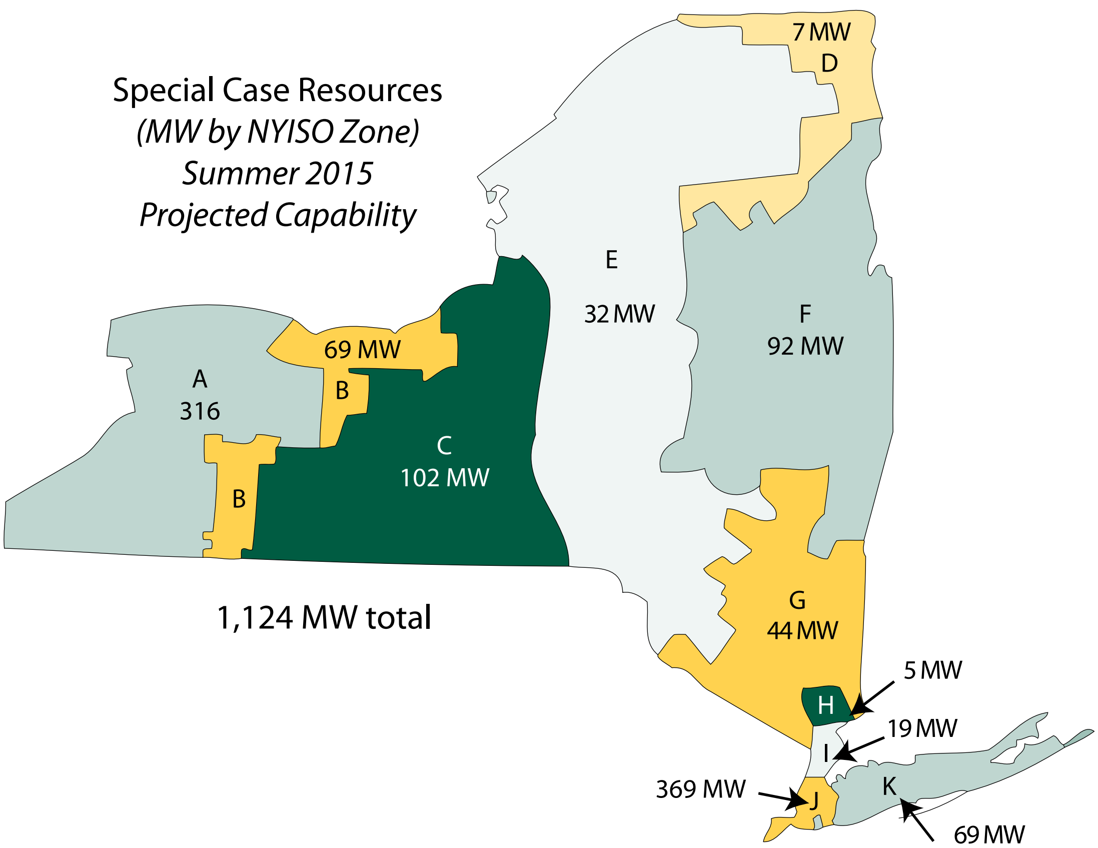
Today, the scope of consumer-controlled electricity demand is growing. So-called "smart" thermostats and other sophisticated meters are enabling consumers to monitor and manage their electricity use. Similarly, a growing array of distributed energy resources, which allow consumers to shift their power supply to on-site generation, can also serve to reduce peak loads during periods of high demand.

According to the Federal Energy Regulatory Commission, demand response resources in the nation's seven FERC-regulated ISO/RTO regions totaled nearly 28,800 megawatts in 2013, up 9.3 percent from the previous year.[9]

Large power customers and aggregated groups of smaller consumers participate in several demand response programs developed in the NYISO markets. In summer 2014, the programs involved more than 4,022 end-use locations providing a total of 1,210 megawatts of load reduction capacity, representing 4.1 percent of the 2014 summer peak demand.[10]

For the summer of 2015, the NYISO's largest demand response program, Special Case Resources, is projected to be capable of offering up to 1,124 megawatts. In addition, the Emergency Demand Response Program is expected to provide 86 megawatts in summer 2015.

Figure 11 – Demand Response – Summer 2015 Projected Capability



Participation in demand response programs in New York and elsewhere has declined as the programs face an uncertain future. In question is FERC Order 745, which was issued in 2011 and required that demand response resources be compensated at market prices for energy. In May 2014, the U.S. Court of Appeals for the District of Columbia invalidated the order as an infringement on state powers to regulate retail electricity sales.[11] A petition for review of that decision was filed at the U.S. Supreme Court. The Court has agreed to hear the case in its term that begins October 2015.

Pending final resolution of the matter by the courts and the FERC, the NYISO will continue to operate its demand response markets as prescribed by its tariffs. In the meantime the NYISO, in partnership with stakeholders, is pursuing backstop designs to ensure that program operations can continue seamlessly after a resolution is achieved.[12]

Although no demand response resources were activated by the NYISO during 2014's moderate summer weather, about 900 megawatts of demand response resources were called upon during the extreme cold of January 7, 2014, when a new record was set for winter peak demand.

Resource Outlook

Reliability Assessment

The NYISO conducts a Comprehensive Reliability Planning Process that examines emerging reliability needs over a 10-year planning horizon. The findings of the most recent review are detailed in the 2014 Comprehensive Reliability Plan (CRP), which was reviewed by NYISO stakeholders in spring 2015 and is scheduled to be approved in summer 2015. It concluded that sufficient resource additions and interim operating procedures are available to meet reliability needs that had previously been identified in the 2015-2024 study period.[13]

Last year, when the NYISO conducted the *2014 Reliability Needs Assessment* (RNA) that formed the basis for the CRP, it identified resource adequacy needs in Southeast New York beginning in 2019 and transmission security needs in four regions starting in 2015.

Subsequent to that assessment transmission owners updated their plans for enhancements of facilities, demand response programs, and operating procedures. In addition, several generation owners returned units to service or restored facilities to full capacity operation. These changes include approximately 1,000 megawatts of resources returning at critical locations in southeastern New York. Another 1,000 megawatts of resources were scheduled to be added elsewhere in the state. Transmission security issues were addressed by returning resources and operational procedures that the transmission owners will rely upon until local transmission plan upgrades are completed, including the potential for limited load shedding in Rochester and Syracuse.

The CRP indicates that there a number of potential risks to the plan, including:

- the operational procedures which utilities will rely on between now and the 2017 completion of their local transmission upgrades includes the potential for limited load shedding in Rochester and Syracuse during periods of peak demand;
- aging generation and transmission infrastructure;
- the potential for higher than forecasted system loads under the 50-50 probability level;
- failure of resources to return to service as planned, or unplanned loss of resources due to emerging environmental requirements or other factors; and,
- potential retirement of the Ginna Nuclear Power facility near Rochester.

The NYISO will continue to monitor the implementation of local transmission plans and maintain a close watch on these risk factors.

Summer Outlook

For the summer of 2015, power resources available to serve New York State total 41,610 megawatts. These resources include the installed generating capacity of in-state power projects (39,039 megawatts), projected levels of demand response participation (1,124 megawatts of Special Case Resources), and power available for imports from neighboring electric systems (1,446 megawatts of net long-term purchases and sales).

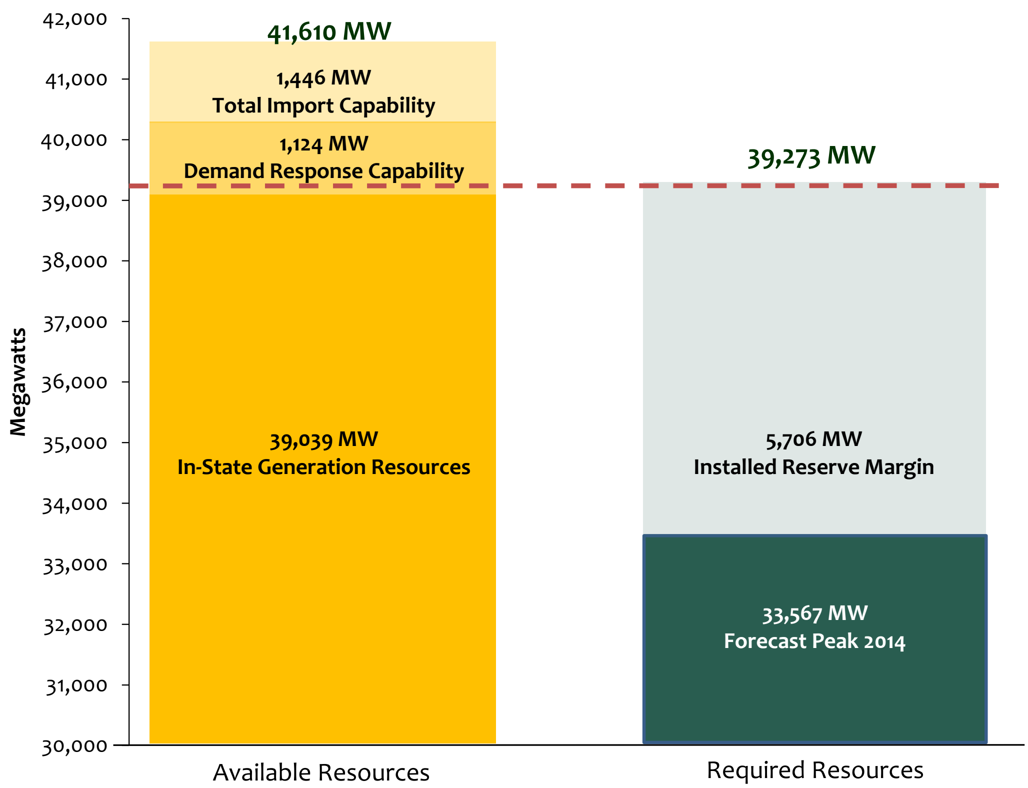
The 2015 total capacity is 312 megawatts above last year's level. Total capacity remains well above the projected peak demand of 33,567 megawatts plus the reserve requirement, which totals 39,273 megawatts.

Available Resoures

Summer 2015

- *41,610 megawatt total*
  - *312 megawatts above 2014*
- *Surplus rebounding*
  - *2,300 megawatts above reserve requirements*
  - *Up from 1,900 megawatts in 2014*

Figure 12 - Statewide Resource Availability: Summer 2015



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. Weather extremes could produce a peak load ranging from 30,500 to 35,900 megawatts in 2015.

Improved Generation Efficiency Reduces Reserve Requirements

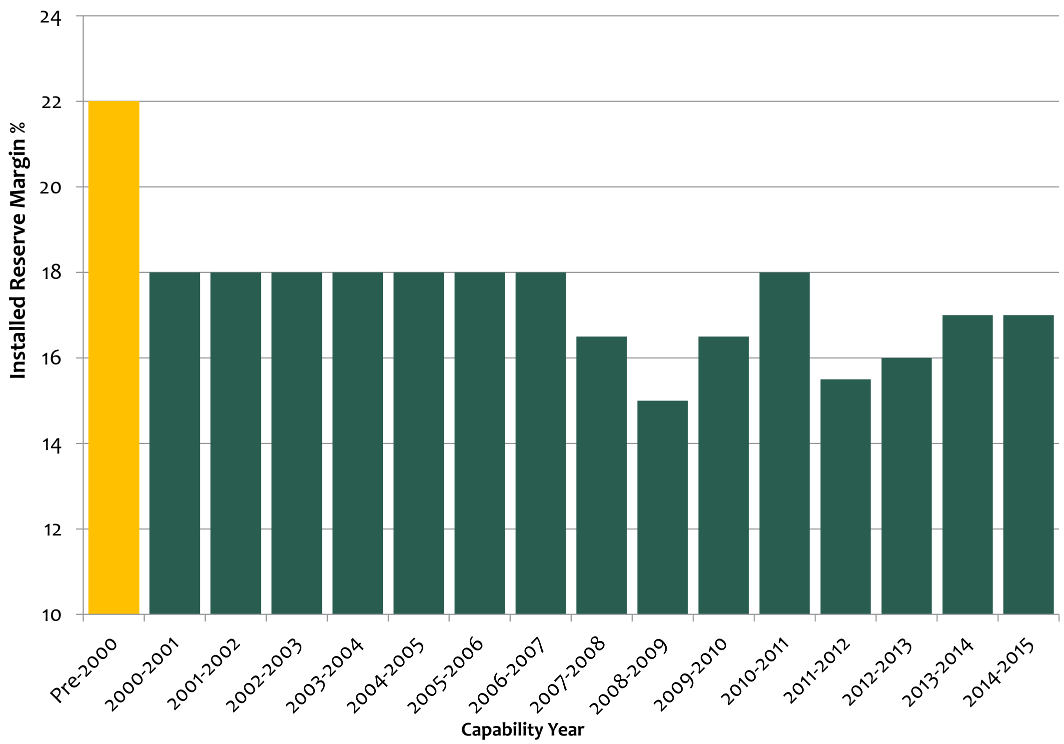
Prior to the establishment of the competitive wholesale electricity market, New York's electric system typically maintained 22 percent reserve margins above the forecasted peak demand.

Since 2000, reserve margins have declined, averaging approximately 17 percent above peak demand levels over the past 15 years.

Improved efficiencies in grid management have enabled reductions in the reserve requirements, saving an estimated $540 million in consumer costs from 2000-2014 while still meeting reliability requirements.

Investment in transmission infrastructure that addresses constraints on the system and reduces congestion during high demand periods potentially could further reduce reserve requirements, yielding additional savings.

Figure 13 – Installed Reserve Margins: 1999-2015



Installed Reserve Margin

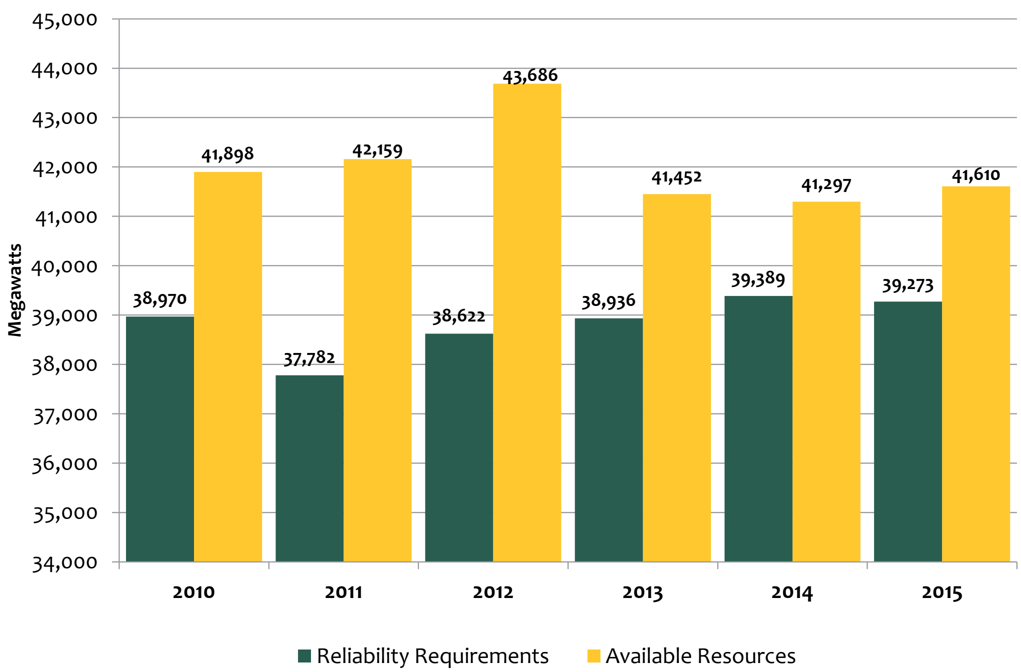
- *A fundamental requirement of the reliable operation of an electric system is the availability of more supply than may be required by the highest anticipated level of demand for electricity in case a resource or transmission facility is knocked out of service. This reliability requirement is generally known as "the reserve margin."*
- *The not-for-profit New York State Reliability Council (NYSRC) develops and monitors compliance with reliability rules specifically established for New York State's electric system. Those rules include an Installed Reserve Margin (IRM), established annually with approval from the Federal Energy Regulatory Commission (FERC) and the New York State Public Service Commission (PSC).*
- *The IRM represents the percentage of capacity (over 100% of capacity needed to serve forecasted peak load) required to be available for the bulk power system to operate reliably in the event that generators or transmission facilities are forced out of service.*
- *The IRM for the 2015/2016 Capability Year (May 1, 2015 through April 30, 2016) is 17 percent. Since the projected peak demand for electricity in New York State during 2015 is 33,567 megawatts, the IRM requires that New York's electric system have 39,273 megawatts of capacity resources installed and available. (33,567 megawatts X 1.17 = 39,273 megawatts)*

Surplus Dynamics

As previously noted, the surplus of available resources above and beyond reliability requirements has declined in recent years. In 2012, power resources totaled 43,686 megawatts, more than 5,000 megawatts greater than the 2012 reliability requirements (peak forecast plus installed reserve margin). In 2015, the 41,610 megawatts of available resources are slightly more than 2,300 megawatts above the reserve margin requirements. While the 2015 surplus is lower than the 2012 level, it has grown from last year's surplus of 1,900 megawatts, due to the addition or return of generating capacity.

New York's wholesale electricity markets are designed to achieve an economically efficient balance between supply and demand. When surplus generation is abundant, markets do not support new resources to enter the markets. As supplies grow scarcer, markets incent the development of new power resources.

Figure 14 – Power Resources & Reliability Requirements: 2010-2015



Resource Diversity and Energy Costs

The array of fuels used to generate power affects both the reliability of the power system and the economics of electricity. A balanced mix of fuels helps the electric system address issues such as price volatility, fuel availability, and the requirements of public policy.

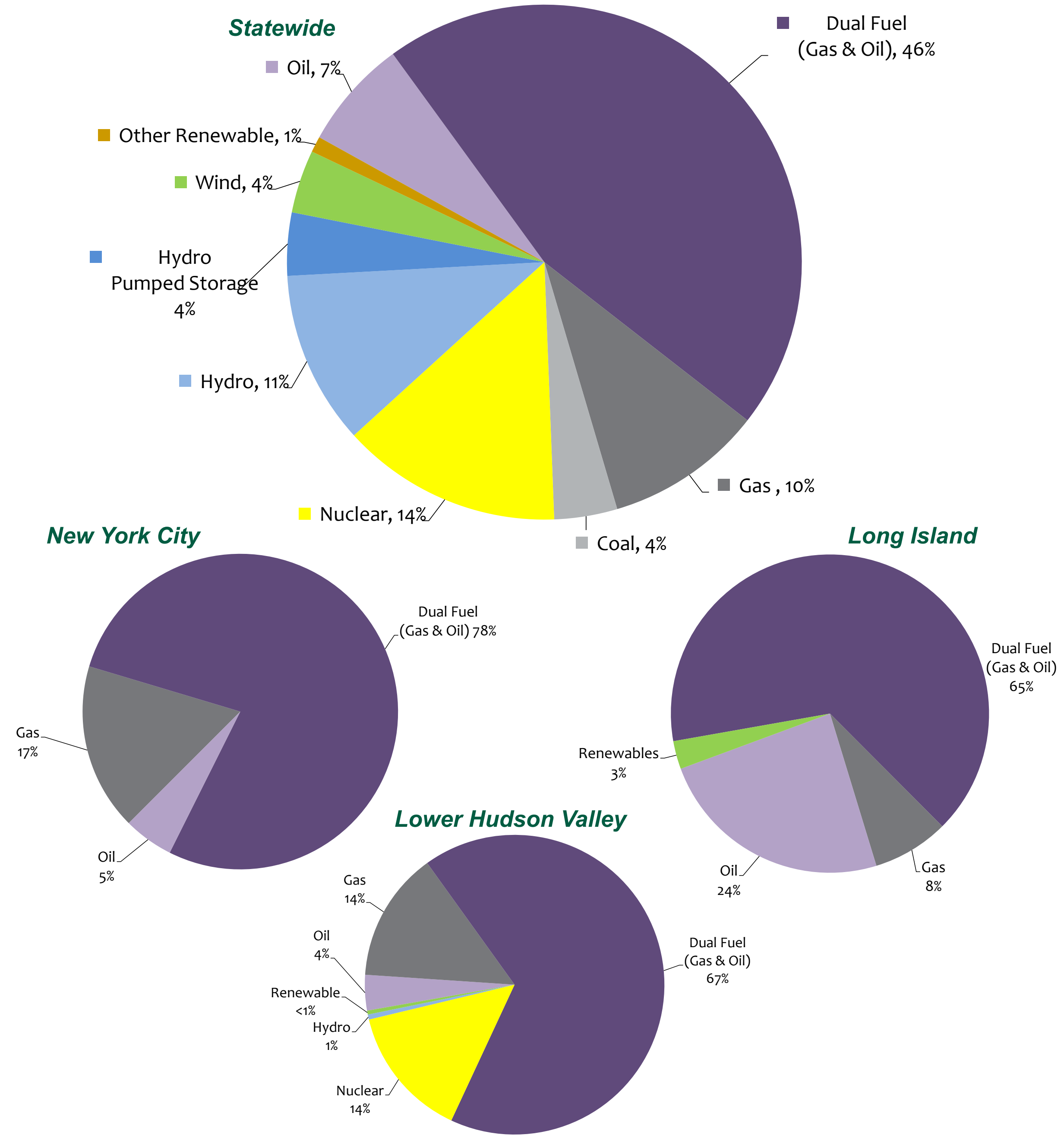
Market factors and public policy influence the mix of generation technologies and fuels used to produce power. Private investment is primarily compelled by economic factors – the relative costs of fuel, operation and maintenance, as well as the initial costs of siting, permitting, and construction. For example, the current price advantage of natural gas is driving significant development of gas-fired generation throughout the nation.

Policy goals and environmental regulations affect fuel mix through overall emission caps and targeted emissions standards, which require power plants that burn fossil fuels to limit production and/or install pollution controls. New York and several other states have adopted renewable portfolio standards with the goal of having "green power" resources, such as solar and wind, provide a specified portion of generation.

Fuel Mix – Statewide & Regional

New York State has a relatively diverse mix of generation resources. At the regional level, however, the supply mix is less diverse. While a predominant portion of New York's electric demand is situated downstate, much of the state's power supplies (and particularly the sources that historically have had comparatively lower operating costs, such as hydroelectricity and nuclear power) are located upstate. A combination of stringent air quality regulations, transmission limitations, and reliability standards that require local generation in the downstate region has resulted in the power demands of New York City and Long Island being served with generation primarily fueled by natural gas. However, many of these units also are capable of using oil when necessary, which provides fuel diversity and reliability benefits to the system.

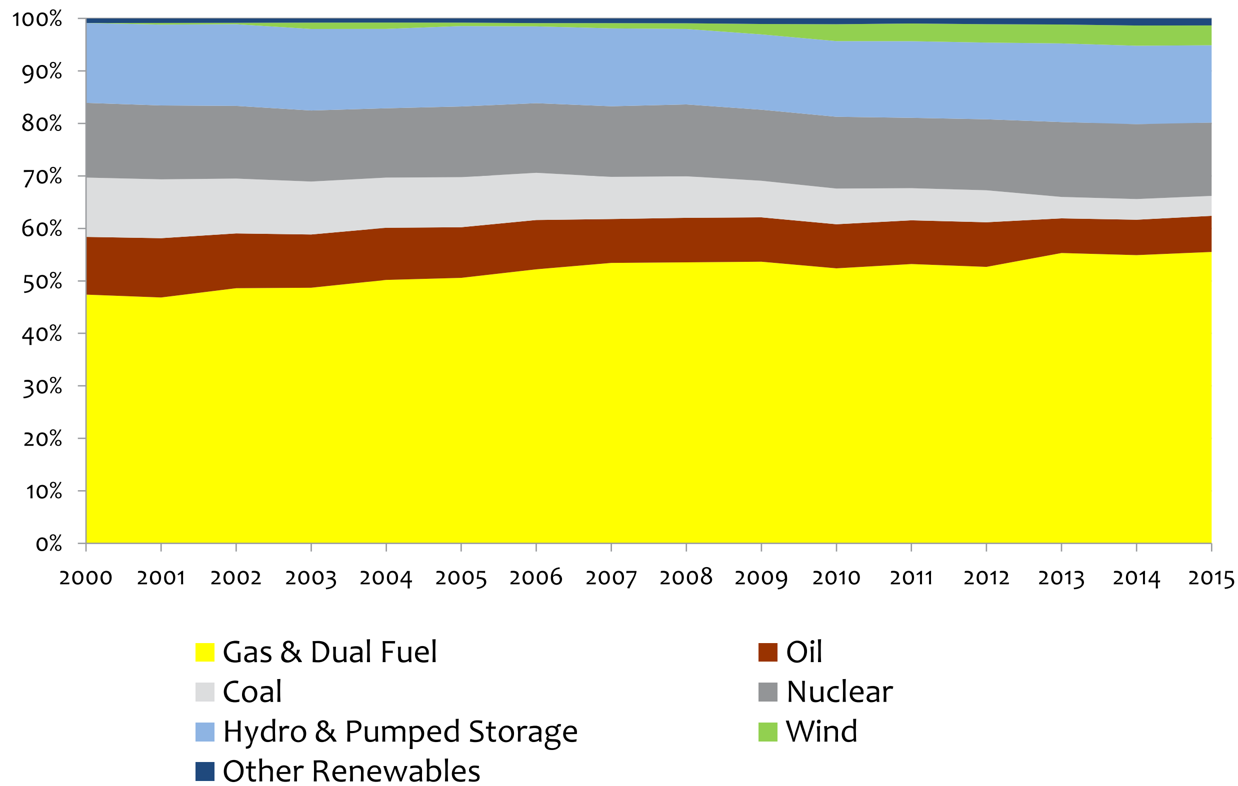
Figure 15 - Generating Capability in New York State by Fuel Source – Statewide, New York City, Long Island and Lower Hudson Valley: 2015



The combination of fuels used to produce power in New York has changed over the past decade and a half. Electricity generated by natural gas and wind has grown. The portion of New York's generating capability from gas plus dual fuel (gas and oil) facilities grew from 47 percent in 2000 to 56 percent in 2015. Wind power, virtually non-existent in 2000, has grown to 4 percent of New York State's generating capability in 2015.

In contrast, New York's generating capability from power plants using coal declined from 11 percent in 2000 to 4 percent in 2015. Generating capability from power plants fueled solely by oil also dropped from 11 percent in 2000 to 7 percent in 2015. The shares of generating capability from nuclear power plants and hydroelectric facilities have remained relatively constant since 2000, with each accounting for approximately 15 percent of New York's generating capability over the years.

Figure 16 - New York State Fuel Mix Trends: Generating Capacity 2000-2015



New York Fuel Mix Trends

(2000-2015)

- *Natural gas and wind power capability increased*
- *Coal and oil declined*
- *Hydropower and nuclear remained the same*

Electricity Prices & Fuel Costs

Wholesale electricity prices are directly influenced by the cost of the fuels used by power plants to meet the demand for electricity. Power plants fueled primarily by natural gas account for more than half of the electric generating capacity in New York State. Consequently, the price of natural gas and the cost of electricity are closely correlated. The cost of fuel for these units is reflected in their offers.

The average wholesale electric energy price in 2014 was $69.30 per megawatt-hour, up from $59.13 per megawatt-hour in 2013. The 2014 yearly average was significantly affected by winter price spikes that produced monthly averages exceeding $100 per megawatt-hour in January, February and March. The winter prices reflected major increases in the cost of natural gas delivered to New York, which had soared 400 percent over December 2013 costs.

The situation is not unique to New York. Wholesale electricity prices increased across the nation in 2014. According to the U.S. Energy Information Administration, "Wholesale on-peak electricity prices were up at trading hubs across the nation between 2013 and 2014, driven largely by increases in spot natural gas prices and high energy demand caused by cold weather in the beginning of the year."[14]

According to the *2014 State of the Markets Report for the New York ISO*, "The strong relationship between energy and natural gas prices is expected in a well-functioning, competitive market because natural gas-fired resources were the marginal source of supply in more than three quarters of all intervals in 2014."[15]

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, and vice versa.

Figure 17 – Natural Gas Costs and Electric Energy Prices: 2000-2014

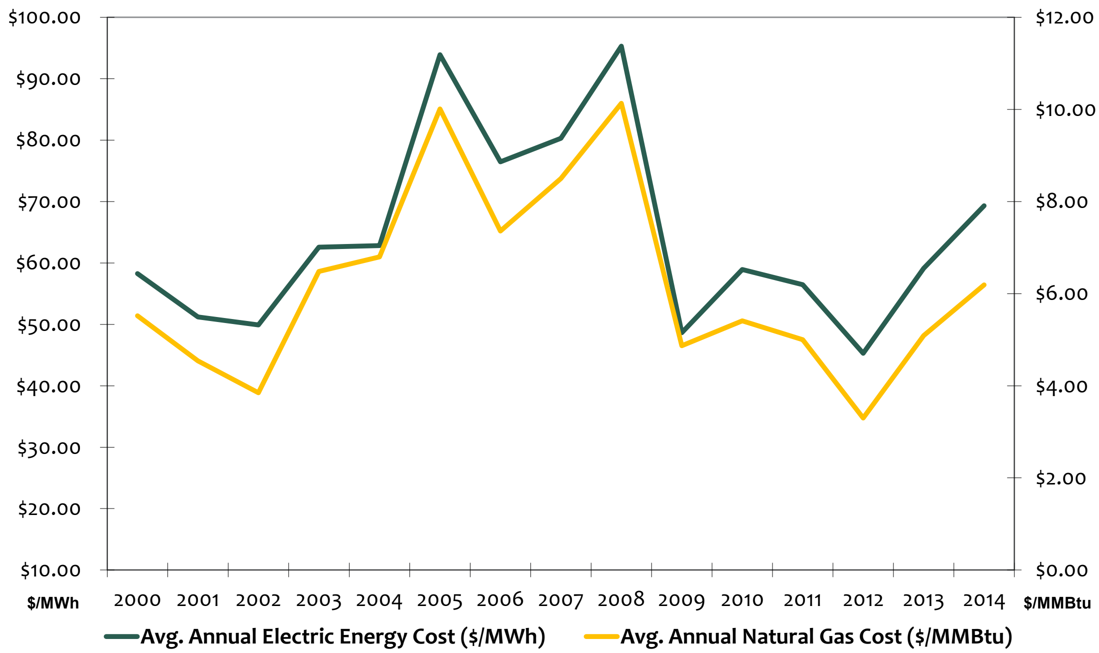
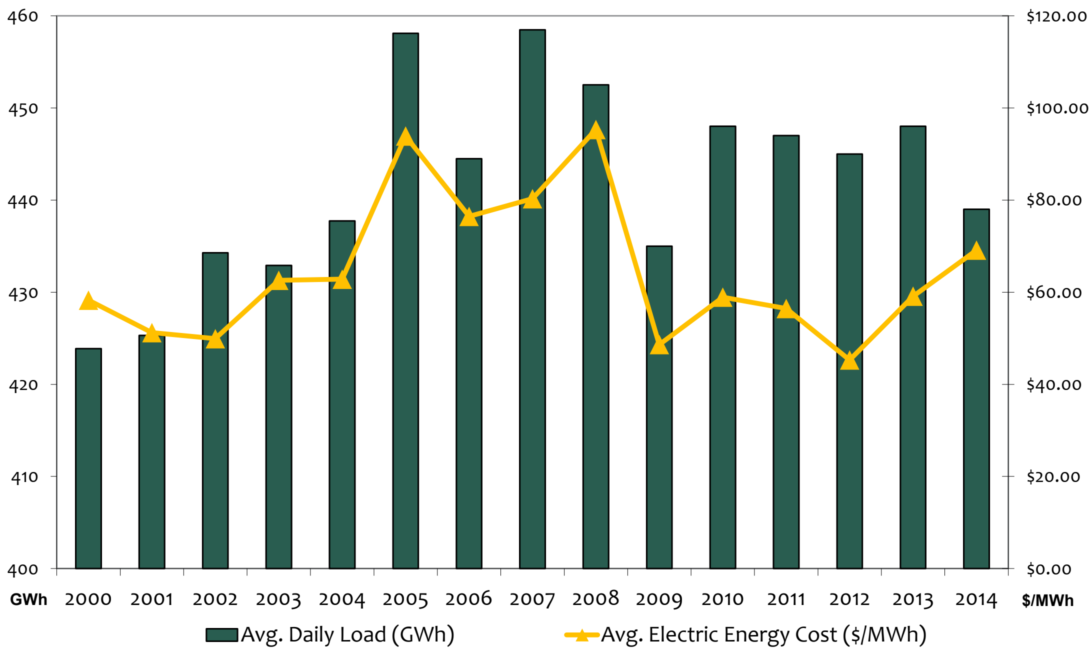


Figure 18 – Electricity Demand and Electric Energy Prices: 2000-2014

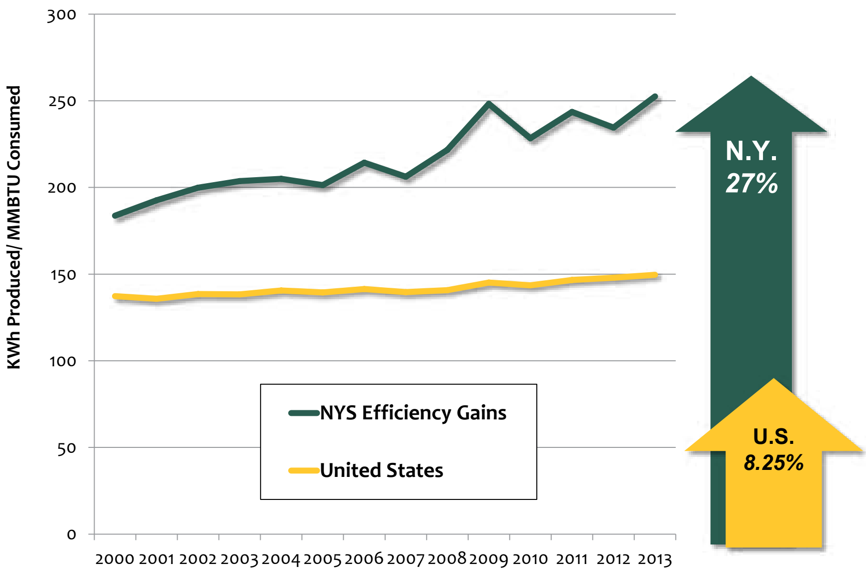


Electric System Fuel Efficiency

Competitive electricity markets create incentives for generators to invest in upgrades and new power plants that improve efficiency, reducing the amount of fuel needed to produce electricity.

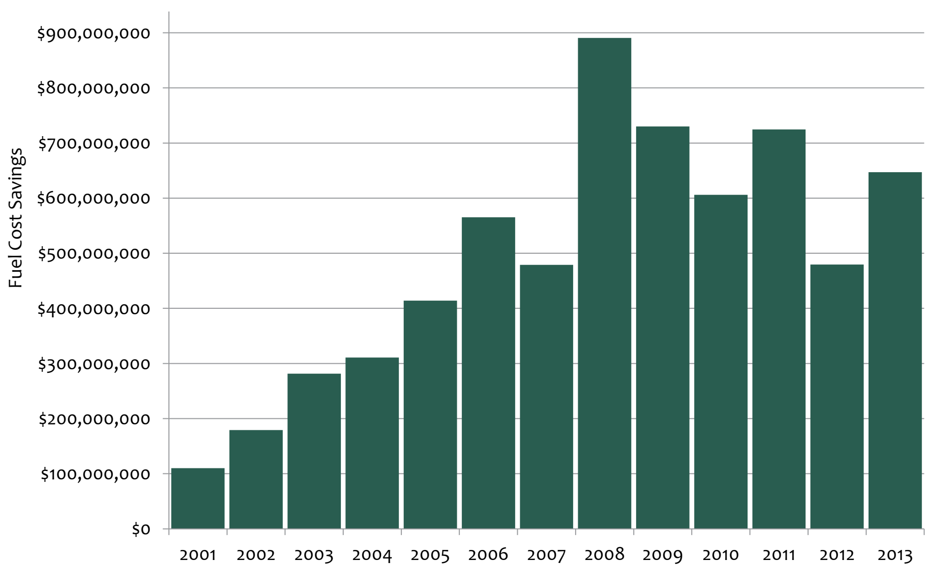
One way to measure the "fuel efficiency" of the electric system is to compare the amount of electricity generated (kilowatt-hours produced) to the amount of fuel energy used (in terms of British Thermal Units or BTU consumed). On that basis, the efficiency of New York's power generation has improved by more than 27 percent since the onset of competitive markets in 2000 through 2013. In comparison, the fuel efficiency in the nation's electric system improved 8.25 percent. In New York, the increased efficiency saved an estimated $6.4 billion in fuel costs from 2000 through 2013.

Figure 19 – Electricity System Fuel Efficiency: 2000-2013



Data Source: U.S. Energy Information Adminstration

Figure 20 – New York Electric System Fuel Cost Savings: 2000-2013



Data Source: U.S. Energy Information Adminstration

CHALLENGES & OPPORTUNITIES

Resource Diversity: Location, Timing & Type

Market Dynamics

The electric system is not immune to broader economic trends. For example, the 2008-2009 recession stifled investment in new power resources and contributed to the financial problems facing existing power providers. It also depressed demand for electricity, which reduced available revenues from wholesale electric energy markets and increased pressure on capacity markets for potential revenues. However, prices in capacity markets also reflected a significant surplus of available resources.

Consequently, older and less efficient power plants moved to retire or suspend operations. This reduced the size of the generation surplus and narrowed the margin of resources needed to maintain reliable operation of the grid. As noted earlier, transmission constraints make the southeastern region of the state particularly vulnerable to reliability issues, driving higher capacity needs in the region.

New Capacity Zone Attracts Needed Resources

Capacity markets compensate suppliers of all types to be available to meet demand. As noted, New York consumers purchase enough capacity to ensure that adequate supply is available to meet projected peak demands for energy. Capacity markets are designed to send locational price signals to inform new investment, retention of supply, or in times of capacity excess, supply retirement or mothballing.

In New York, the capacity markets address needs with statewide capacity procurement, local capacity requirements and corresponding market signals for specific regions. Originally those requirements applied to three geographic areas or "zones": New York City, Long Island, and the "Rest-of-State" (NYISO Zones A through I). In 2011, FERC approved a process to create new capacity zones. The process, developed by NYISO stakeholders, required a new capacity zone to be created if needed to address transmission constraints.

The NYISO's independent Market Monitoring Unit, Potomac Economics, recommended creation of a new capacity zone. In its review of the NYISO's 2012 Comprehensive Reliability Plan, the market monitor said, *"…the Southeast New York ("SENY") capacity zone will enable the NYISO to satisfy its resource adequacy criteria more efficiently over the next decade…"*[16]

As a result of extensive, collaborative stakeholder deliberations, a new zone was created to address the need for power resources to reliably serve southeastern New York covering the lower Hudson Valley and New York City (NYISO Zones G, H, I and J). The new zone took effect in May 2014.

As previously noted, the 2014 *Reliability Needs Assessment* found that New York's electric system would violate resource adequacy criteria beginning in 2019 due to inadequate resource capacity located in southeastern New York. That assessment was developed prior to market responses that returned and added resources to the new zone.

In response to the market signals provided by the new zone, approximately 1,000 megawatts of power resources were returned to service in southeastern New York.

The resources include the Danskammer Generating Station in Newburgh, New York, and restored capability at the Bowline Generating Facility in Haverstraw, New York.

The previous owner of the Danskammer Generating Station had announced the retirement of the facility with the intention of transferring the idle power station to a salvage company for dismantling. Subsequent to the creation of a new capacity zone, the new owners decided instead to invest in refurbishment and return the facility to service. The Danskammer refurbishing project converted the former coal-fired plant to a natural gas facility, with fuel oil as a backup, and went into service at the end of 2014.

NRG, the owner of the Bowline facility, stated that, "After the price signal was created, NRG can financially justify the restoration of the Bowline Unit 2 to full service by Summer 2015."[17]

Although not attributed directly to the new zone, several other projects in eastern and southeastern New York have announced plans to remain in service or to return to service, including the Selkirk Cogeneration Project and the Astoria Steam Unit 20 in Queens.

While the new zone was controversial due to the initial costs associated with higher capacity prices, the addition of new power resources is expected to reduce costs over the long term and improve reliability, by bringing investment to a region with limited capacity and increasing supply where it is needed most.

The NYISO estimates that for the 2015/2016 Capability Year, total capacity costs in New York will be approximately $400 million lower due to the increases in supply driven by the creation of the new zone.[18]

Market Evolution

Along with the energy and ancillary services markets, the capacity market sends economic signals that attract investment to the locations where it is needed. As with the establishment of a new capacity zone, the wholesale electricity markets serving New York are continually evolving to address emerging needs.

Participation in the wholesale electricity market is open to various resource types, including conventional generation, renewable resources, imports from other regions, and demand response. Much of the investment since the creation of New York's competitive marketplace for wholesale electricity has been in clean, efficient combined cycle units, as 6,000 megawatts of older, and generally higher emitting, generation has retired or ceased operation.

Moving forward, FERC is considering whether to exempt resources from buyer-side capacity market mitigation when investment decisions do not result from an attempt to exercise market power that would lower capacity prices to below economic levels. Moreover, the NYISO and its stakeholders are considering whether to propose market design changes to provide an exemption from buyer-side capacity market power mitigation for renewable energy resources, as well as a repowering exemption that could facilitate investments in existing plants to lessen their environmental impact.

The NYISO and its stakeholders are also exploring the creation of additional market-based incentives for resources to be available to meet New York's electricity needs when there is high demand on a region-wide basis or fuel supply uncertainty. Although current market designs already incent performance, consideration of fuel assurance is increasingly important as the electric system's reliance on natural gas-fired resources grows.

A recent, independent review of New York's capacity market found that changing from the current structure to a forward market would introduce uncertainty into a well designed and functioning structure. The report, *NYISO Capacity Market: Evaluation of Options*, was conducted by The Analysis Group and approved in May. The study found that a move to a forward market would be manageable over a long lead-time, but it would be costly and resource-intensive. In addition, the impacts would occur regionally, with the largest impact in Long Island and Western New York.

"With a forward market, prices are higher or unchanged, and the quantity of resources procured is lower or unchanged," the Analysis Group said in its report. By committing three years in advance under a forward market, a resource loses its flexibility and faces a higher opportunity cost.

"There is an existing wholesale market structure that has operated in tandem with planning processes and operational procedures to reliably and economically meet New York demand for decades," the report said.[19]

The Role of Transmission

Electric system planning studies by the NYISO and other planning authorities examine transmission resources from the perspectives of maintaining reliability, relieving costly congestion, and addressing public policy initiatives such as the integration of renewable resources.

The impacts of transmission resources span a wide array of factors. A 2013 report by the Brattle Group highlights the broad range of benefits that may be created by new and upgraded transmission infrastructure. These include enhanced market competition, capacity cost savings, environmental benefits resulting from increased use of cleaner resources, and reduced costs of meeting public policy goals.[20]

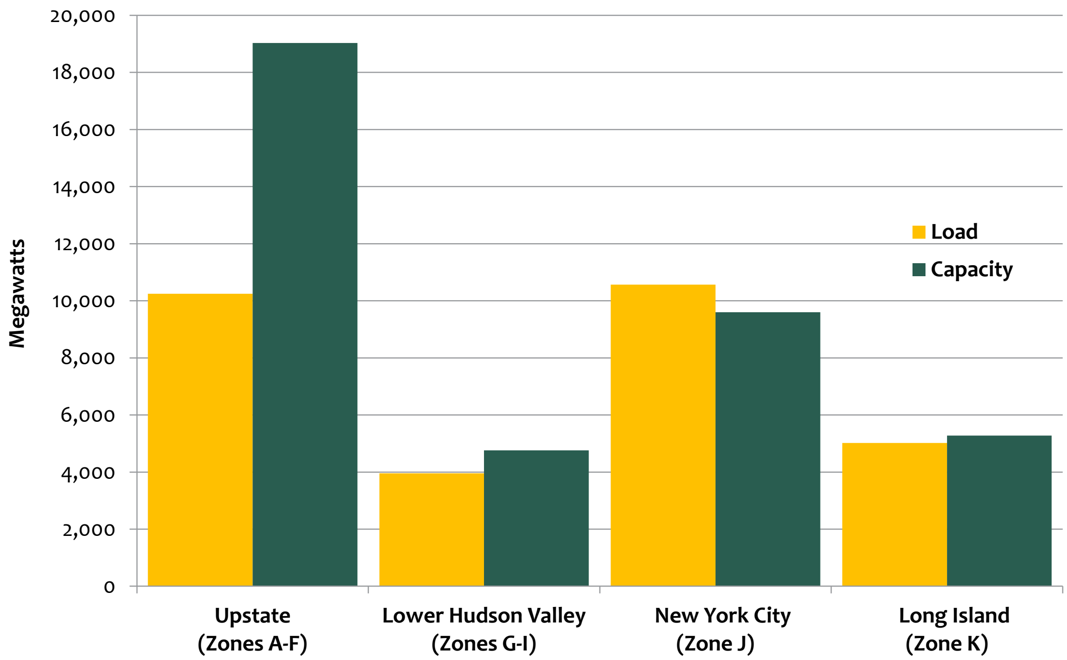
In New York State, new and upgraded transmission capacity would help to address concerns about maintaining or replacing aging infrastructure,[21] provide greater operational flexibility for dispatching resources, enhance access to operating reserves and ancillary services, and facilitate the ability to remove transmission for maintenance when needed. Increased transmission capacity can further advance the integration of renewable energy resources by enabling wind resources in western and northern New York to serve the more populous southeastern region of the state. Enhanced upstate/downstate transmission capability would likewise help to serve southeastern New York's electricity demands more efficiently when environmental regulations limit the production of local fossil-fueled generation.[22]

Transmission Congestion

On a statewide basis, New York has a surplus of power resources needed to sustain system reliability. However, the reliability of the region's power grid is made more complex by physical limitations on the transmission system's ability to freely move electricity from more efficient generation resources where and when it is needed.

Two-thirds of New York's electricity is used in the southeastern part of the state (Long Island, New York City, and the Lower Hudson Valley). Yet only half of the state's generating capacity is located in this region.

Figure 21 - Regional Load and Capacity in New York State



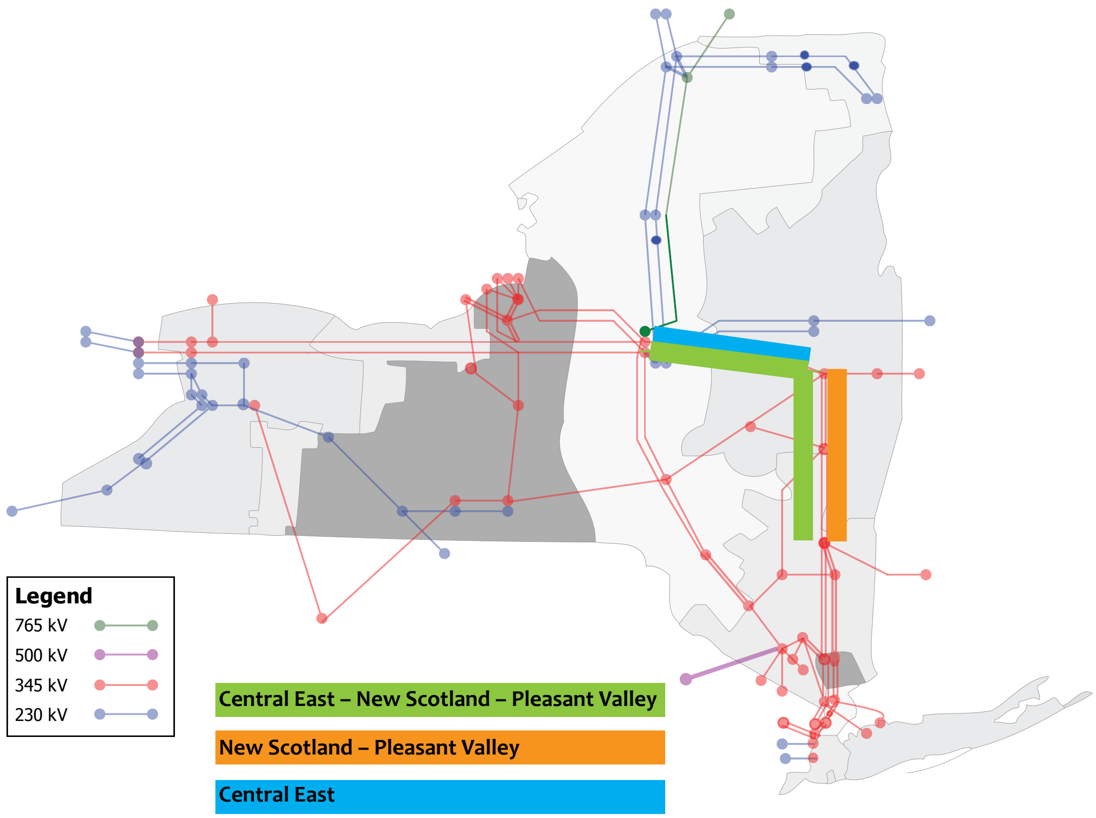
Electric Load = 2014 Peak Load *Generating Capacity = 2015 Summer Generating Capability*

NYISO's markets are designed to use the lowest cost power available to reliably serve demand. However, the physical limitations of the transmission system, such as thermal line ratings, cause delivery constraints that require the scheduling of higher-cost electricity supply resources to serve areas unable to receive lower-cost energy from other parts of the grid. Physical transmission constraints limit the economically-efficient dispatch of electricity and cause "congestion" on the system. More expensive local generation is then operated to meet customers' needs.[23]

The NYISO addresses congestion as part of its planning processes with its 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, or employing measures to reduce demand for electricity in the congested locales.

The most recent CARIS report, approved in November 2013, identified the most congested parts of the New York State bulk power system based upon historic data as well as estimates of future congestion. Those areas include all or parts of the high-voltage transmission path from Oneida County through the Capital Region and south to the Lower Hudson Valley. The CARIS process analyzed generic transmission, generation, and demand response solutions in these regions that could ultimately yield savings for power consumers.

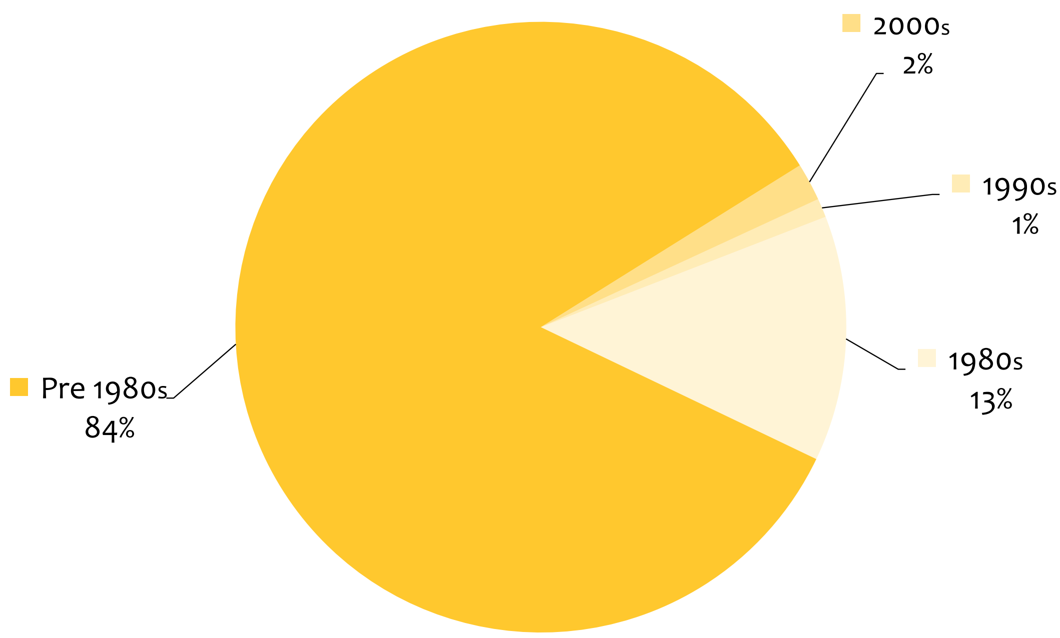
Figure 22 - Transmission Congestion Corridors in New York State



Aging Infrastructure

Over 80 percent of New York's high-voltage transmission lines went into service before 1980. Of the state's more than 11,000 circuit-miles of transmission lines, nearly 4,700 circuit-miles will require replacement within the next 30 years, at an estimated cost of $25 billion.[24]

Figure 23 - Age of New York Transmission Facilities by Percentage of Circuit Mile



In 2012, New York State's *Energy Highway Blueprint* recommended actions and policies for significant investments in New York State's energy infrastructure. It called for 3,200 megawatts of new generation and transmission capacity funded by an investment of up to $5.7 billion in public and private funds.[25]

Transmission-related elements of the *Blueprint* address the congested corridors identified by NYISO's CARIS process and the State Transmission Assessment and Reliability Study (STARS), conducted by the owners of the interconnected electricity transmission facilities in New York State.[26]

The *Blueprint* recommended "the upgrade of existing lines and the building of new lines following existing rights-of-way," estimating that cost-effective upgrades along congested corridors could provide 1,000 megawatts of additional transmission capacity between upstate and downstate New York. It highlighted the value of Alternating Current (AC) system developments, noting the AC system's ability to allow "the interconnection of needed generation resources at multiple points on the system."

Citing findings of the NYISO's 2010 *Growing Wind* study,[27] the Blueprint recommended upgrades to transmission serving northern New York to transport wind power produced in that region. Consistent with those recommendations, upgrades to two 230-kilovolt power lines in northern New York (New York Power Authority transmission lines connecting the St. Lawrence-FDR Power Project to a substation in the Town of Chateaugay) were completed in March 2014.

As part of the Energy Highway initiative, the New York State PSC approved a set of projects collectively named the Transmission Owner Transmission Solutions (TOTS), scheduled to be in-service by June 2016. The objective of the three distinct projects is to increase transfer capability into southeastern New York. The transmission projects include the Marcy-South Series Compensation and Fraser–Coopers Corners 345 kV line reconductoring; construction of a second Rock Tavern–Ramapo 345 kV line; reconfiguring substations to mitigate system contingencies; and enhanced cooling of underground transmission circuits from Staten Island to the rest of New York City. These projects have been permitted and are under construction by the Transmission Owners.

The Energy Highway Initiative remains the focus of the New York State PSC proceedings in initiated 2012 to expand AC transmission capacity and develop other resources.[28] In December 2014, the NYISO filed comments supporting transmission upgrades to meet these Energy Highway objectives.

To encourage transmission proposals developed within existing rights-of-way while limiting potential impacts to communities, the New York State PSC adopted an expedited siting process[29] for transmission facilities built within the current right-of-way "envelope" (height and width), and in December 2014 asked developers with proposed plans to revise their initial proposals to minimize community impacts. Four developers (the New York Transmission Owners, Boundless Energy, North America Transmission, and NextEra) filed modified proposals in January 2015. The alternative projects would be developed primarily within existing rights of way.[30]

The New York State PSC also ordered a further evaluation of the need for transmission solutions to upstate-downstate congestion and other public policy objectives "in light of other proceedings related to improving energy efficiency and modernizing the grid." A report on this evaluation is being prepared with technical assistance from the NYISO. A technical conference is scheduled for mid-2015.[31] In May 2015, the PSC issued an order delaying the issuance of the staff report by about a month, which may affect the timing of the subsequent action.[32]

Separately, the New York State PSC is considering transmission to mitigate constraints in Western New York based upon proposals submitted in response to the NYISO's solicitation under its Public Policy Transmission Planning Process *(See discussion below)*. The New York Power Authority and National Grid have identified emerging transmission constraints in Western New York that could reduce the ability of the grid to transmit the output of the Niagara hydroelectric power plant and imports from Ontario east to load centers in the rest of New York State. The utilities have identified potential transmission solutions that include upgrades of transmission facilities south of Buffalo. The New York State PSC has solicited public comments on the proposal, and is considering whether there is a need for upgrades based on the reliability, economic and environmental benefits of maintaining transfer capability from Niagara and Ontario. In May 2015, the NYISO filed comments supporting the need for transmission in Western New York.[33]

Planning for Public Policy Requirements

In 2011, FERC issued Order No. 1000, which expanded upon previous orders related to transmission planning and cost allocation to reduce barriers to transmission system investment. Among its components, the order required that planning processes consider transmission needs driven by public policy requirements

Under compliance orders subsequently issued by FERC over the past several years, 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 solution to the need identified by the New York State PSC. Under provisions of the NYISO tariff, the New York State PSC reviews and identifies the public policies (including existing federal, state or local law or regulation, or a new legal requirement that the PSC establishes after public notice and comment under the state law). An example of an existing public policy requirement that may drive the need for new transmission is the Renewable Portfolio Standard, now part of the state's Clean Energy Fund, which established the policy goal of renewable resources supplying 30 percent of the state's electricity consumption. Once the New York State PSC determines the Public Policy Transmission Needs, the NYISO solicits transmission and other types of projects, performs the planning studies based on the 2014 RNA, and selects the transmission projects that will meet those needs in a more efficient or cost-effective manner.

The process began with the reliability planning process, which resulted in the 2014 RNA. Based on a system model that provides for fulfillment of reliability needs first, in August 2014, the NYISO issued a letter inviting stakeholders and interested parties to submit proposed transmission needs driven by public policy requirements. The NYISO received, and subsequently submitted to the PSC, proposed public policy transmission needs from eight entities. Among these proposals, there were two common, reoccurring themes: increased transfer capability between upstate and downstate; and (as previously noted) mitigation of transmission constraints in Western New York to facilitate full output from the Niagara Hydro Power Project and imports from Ontario.

Subsequent to completion of New York State PSC review and determination of public policy transmission needs, the NYISO will conduct its public policy planning process to solicit solutions, determine their viability and sufficiency to meet the identified need, and select the more efficient or cost effective transmission solution that, if built, would be eligible for cost recovery through the NYISO's tariff.

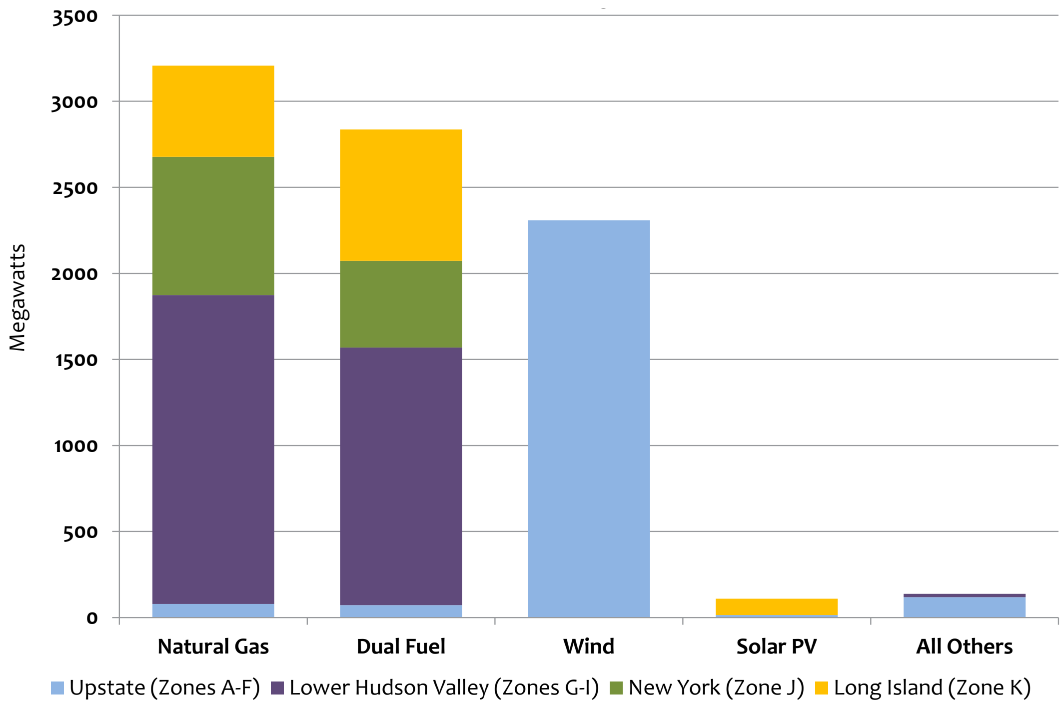
Gas-Electric Interaction & Fuel Assurance

With the emergence of abundant, low-cost supplies of natural gas, demand for the fuel has increased. This is especially true for the use of natural gas in the production of electricity. In the U.S., electricity fueled by natural gas increased from 18% of total power generation in 2002 to 34% in 2013.[34]

Natural gas has become the predominant fuel for new generation. More than half of the new generating capacity built in the U.S. during 2014 was gas-fired.[35] Natural gas, which currently supplies about 30 percent of the nation's power generation, could fuel as much as 50 percent in two decades.[36]

Natural gas and dual-fuel power plants produced more than 40 percent of New York's electricity in 2014. The NYISO interconnection queue shows that power projects using natural gas account for more than 72 percent of all proposed generating capacity.

Figure 24 - Proposed Generation by Fuel Type and Region: 2015



SOURCE: New York Independent System Operator Interconnection Queue, March 31, 2015

Today, power plants using natural gas total 56 percent of New York State's generating capability. Dual-fuel facilities that can use either natural gas or oil account for 46 percent. During periods of high gas usage, reliability rules require many of these plants to switch to burning oil in order to avoid reliability issues. Outside of peak times, dual fuel generators may choose to run on whichever fuel is less expensive. This operational flexibility provides both fuel diversity and reliability benefits.

The increasing dependence upon natural gas to produce power raises concerns regarding the potential impacts of gas availability on electric system reliability and power costs. Disruptions in natural gas supply and/or delivery can affect the ability of gas-fueled generation to provide power, which could impact electric system reliability. Likewise, power costs will be increasingly subject to volatility associated with natural gas prices. The NYISO has been working with market participants in its stakeholder process on market structure improvements that send the correct price signals and incentives for generators to maintain or procure adequate fuel supplies which operate in the event that their primary fuel becomes unavailable.

Addressing Extreme Winter Weather

Price volatility relating to the costs of delivered gas was well illustrated when extremely cold weather across large parts of the country in early 2014 pushed many electric systems to record levels of winter demand. New York set a new winter peak of 25,738 megawatts on January 7, 2014. System reliability was successfully sustained during the January cold snap. However, severe price spikes and operational challenges reflected the growing reliance of the electric system on natural gas.

New York's wholesale electricity markets facilitate gas-electric coordination that enabled the NYISO to manage winter-related events, including the extreme conditions experienced in 2014. Suppliers in the NYISO-administered energy and ancillary services markets may offer unique hourly bids and may increase them in real-time based on their expectations of fuel prices. This feature helps to maintain plant availability during periods of volatile fuel prices such as those noted above. The NYISO also has procedures to coordinate with generators on fuel inventory and with all market participants on maintenance outage scheduling.

> *"The day-ahead market provides price signals and scheduling information that enables suppliers to make better fuel purchasing and consumption decisions. This underscores the importance of the NYISO markets in helping coordinate the efficient use of scarce fuel supplies during cold weather conditions."*
>
> 2014 State of the Market Report for the New York ISO Markets,
> Potomac Economics, May 2015

In January 2012, the NYISO established an Electric and Gas Coordination Working Group to address joint operational, planning and market design issues. The working group has engaged in extensive study and analysis of electric-gas issues. This includes research that assessed the cost of providing fuel assurance through dual-fuel capability and oil supply provisions, and compared the cost of dual-fuel capability to firm pipeline transportation under a range of scenarios.[37]

Leading up to the winter of 2014-2015, the NYISO took additional steps to improve electric-gas coordination. These steps included:

- adding an experienced gas system operator to monitor daily fuel inventories, conditions on interstate and LDC gas pipelines, and overall gas-electric coordination;
- enhancing the ability of resources to update the costs used in their day-ahead reference levels; and,
- improving operational processes for monitoring supplier fuel inventories in collaboration with generators.

In March 2015, FERC staff provided an assessment of the nation's electricity market performance during the frigid 2014-2015 winter, which stated, "By many measures, this winter rivaled last year's in terms of record low temperatures across much of the country, and in overall demand for electricity. However, compared to last winter, with its series of Polar Vortex events in early 2014, the wholesale power markets and natural gas pipeline system performed remarkably well…electric transmission and natural gas pipeline operators are now communicating more effectively during periods of stress to improve coordination and the reliability of their systems."[38]

In addition to enhanced coordination of electric grid and gas pipeline operations, the development of market designs that recognize the value of "fuel assurance" would provide incentives for power producers to assure the availability of fuel supplies. *(See previous discussion in Market Dynamics section.)*

Nuclear Energy Trends

There are 99 nuclear power plants currently operating in the U.S. They produced 19 percent of the nation's power in 2014.[39] New York's six nuclear power projects generated 30 percent of the state's electricity last year.

Across the nation, few new nuclear power projects have been built in the past three decades. However, several new reactors, all located in the southeastern U.S., may come on line by 2020.

Competition from lower-cost natural gas power plants, increased safety and security requirements, and the moderation of demand for electricity are negatively influencing the economics of nuclear power projects. The owners of several nuclear-powered generating projects have announced plans to retire their facilities.

Entergy Corporation shut down its Vermont Yankee Nuclear Power Station in southern Vermont at the end of 2014. Among the reasons cited by the company for the closure decision were the impact of natural gas costs on wholesale electricity prices and the "financial impact of cumulative regulation" that challenges single-plant nuclear units. Entergy also suggested that wholesale electricity markets "do not provide adequate compensation to merchant nuclear plants for the fuel diversity benefits they provide."[40]

The Ginna Nuclear Power Plant, operated by a subsidiary of Constellation Energy Nuclear Group, is located on Lake Ontario near Rochester, N.Y. It is currently licensed to operate until September 2029. In January 2014, Ginna management announced that it was considering retiring the facility. Subsequent to a NYISO review of the reliability impacts, the New York State PSC authorized Rochester Gas & Electric and Exelon Corporation, Ginna's owner, to negotiate a reliability support services agreement to keep the plant in operation until at least 2018 in order to maintain system reliability in western New York. Exelon filed a proposed agreement with state and federal regulators. FERC has set the contract terms for hearing and settlement procedures.

In addition to reviewing reliability impacts of specific power project retirements, the NYISO identifies risk scenarios that could adversely affect reliability of the electric system as part of its comprehensive reliability planning process. Among the scenarios studied is the unplanned retirement of large amounts of generation, such as a potential retirement of the Indian Point Energy Center.

The Indian Point Energy Center (IPEC), located in Westchester County, includes two nuclear power generating units capable of producing a total of 2,060 megawatts. Entergy, which owns the units, has applied to the Nuclear Regulatory Commission for a 20-year renewal of the licenses. The federal operating license for Unit 2 of the Indian Point nuclear power project, originally scheduled to expire in September 2013, has been extended until the license renewal process is complete. The license for Unit 3 is scheduled to expire in December 2015. (Indian Point Unit 1 was shut down permanently in 1974.) The State of New York is opposing the license renewals of Indian Point units 2 and 3 based on safety and environmental concerns.

The 2014 Reliability Needs Assessment reported, "Reliability violations would occur in 2016 if the Indian Point Plant were to be retired at the latter of the two units' current license expiration dates in December 2015."[41] This finding has been re-affirmed in the draft *2014 Comprehensive Reliability Plan*.

To meet electric system reliability requirements, replacement resources have to be in place prior to a closure of the Indian Point Energy Center.

In 2012, the New York State PSC asked Con Edison and the New York Power Authority to develop contingency plans so resources are in place by 2016 to address power supply needs in the event of Indian Point's closure. In 2013, the New York State PSC approved plans to build three transmission projects capable of reducing capacity needs. *(See previous discussion of Transmission Owner Transmission Solutions in "The Role of Transmission" section.)*

It also approved a set of energy efficiency, demand response, and combined heat and power programs designed to reduce downstate electricity use. These projects will provide 185 megawatts of load reduction in New York City.

The Commission determined that the solutions "provide net benefits to customers even in the event IPEC continues operating beyond its current license term."[42]

Renewable Resources and Energy Efficiency

Enhanced energy efficiency and increased supply of electricity from renewable resources are among the longstanding goals of New York State's energy policy.

The New York State PSC established a Renewable Portfolio Standard (RPS) in 2004, aimed at expanding the portion of renewable power consumed by New Yorkers to 25 percent. In 2009, the PSC increased the target to 30 percent of forecasted electricity consumption by 2015.

In 2014, 35,756 gigawatt-hours of New York's electricity was produced by renewable resources (hydropower, wind, solar and other) representing approximately 25 percent of New York's electric generation.

Renewable Resources

25% of New York's electric energy was generated by renewable resources in 2014

The New York State PSC also established an Energy Efficiency Portfolio Standard (EEPS) in 2008 with a goal of reducing electricity use by 15 percent from forecasted levels by 2015. This goal equates to lowering statewide annual electricity consumption to a level below 157,000 gigawatt-hours by 2015. The NYISO's current estimates of energy use in 2015, including the projected effects of state energy efficiency and clean energy initiatives, range from 157,707 to 162,535 gigawatt-hours.

New York's Clean Energy Fund

While the RPS is set to expire in 2015, the Cuomo Administration is moving forward with a series of renewable energy and energy efficiency measures. In May 2014, the New York State PSC began a proceeding to develop a Clean Energy Fund as a part of a "strategy to bridge the transition from the current portfolio of clean energy programs to the new Reforming the Energy Vision (REV) market and required regulatory framework."[43]

The New York State PSC ordered the New York State Energy Research and Development Authority (NYSERDA) to develop a proposal for the Clean Energy Fund, which NYSERDA submitted in September 2014.

The proposed Clean Energy Fund is a 10-year program to invest $5 billion in New York's clean energy economy through 2025. It would replace the current System Benefits Charge, Energy Efficiency Portfolio Standard, and Renewable Portfolio Standard. Components of the new program include the New York Green Bank and the New York Sun (NY-Sun) initiative.

The New York Green Bank is a $1 billion initiative proposed by Governor Andrew M. Cuomo to attract private sector financing for energy efficiency and clean energy projects.[44]

Under the NY-Sun Initiative, New York State will fund approximately $150 million annually for solar PV initiatives aimed at producing 3,000 megawatts of solar capacity by 2025.

According to U.S. EIA data, distributed solar PV increased across the nation between 2012 and 2013 (the most recent years for which data are available). Of the 794 utilities in the U.S. that provided voluntary net metering data to the U.S. EIA in 2012 and 2013, 592 reported growth that represented a 39 percent increase in net-metered PV capacity.[45]

Based on that data, electric utilities in New York State reported a 79 percent increase, with net-metered PV capacity growing from 98.25 megawatts in 2012 to 175.5 megawatts in 2013. Net-metered PV is only a portion of installed solar capacity. For example, the NY-Sun initiative reported 316 megawatts of solar power were installed or under contract as part of the program in 2013.[46]

Markets Designed for Renewable Integration

Wholesale electricity markets and open access to the grid provided by independent system operators, such as the NYISO, facilitate development of renewable resources. Open access enables any resource to interconnect to the grid and transmit power if it does not adversely affect system reliability.

The NYISO shared governance system, which guides market evolution, provides a forum for market participants and stakeholders to collaborate on market changes that address new technologies. In recent years, the design of New York's wholesale electricity markets has been revised to address the unique characteristic of wind power by:

- Recognizing wind in 2006 as a "variable energy resource" and revising market rules to exempt it from undergeneration penalties that apply to conventional generation.
- Establishing a centralized wind forecasting system in 2008 to better utilize and accommodate wind energy by forecasting the availability and timing of wind-powered generation.
- Pioneering the economic dispatch of wind power in 2009 to fully balance the reliability requirements of the power system with the use of the least costly power available.

The variable nature of the power output from renewable resources also highlights the value of energy storage. In 2009, the NYISO became the first grid operator in the nation to establish market rules for a new category of energy storage resources, which provide frequency regulation service to balance supply and demand on the grid. Storage systems, such as flywheels and advanced batteries, can inject power in microseconds when needed.

While much of the solar power produced in New York is generated either off-grid or at the distribution level of interconnection, New York's wholesale electricity markets have changed to integrate grid-scale solar. In 2012, provisions of NYISO market rules were adapted to address solar power as a variable energy resource. There is currently one grid-scale solar project in New York. The Long Island Solar Farm, a 32-megawatt facility located at the Brookhaven National Laboratory, is the largest solar photovoltaic power plant in the Eastern United States.

Wholesale electricity market initiatives have contributed to the growth of New York's renewable resources. The generating capacity of wind-powered projects in New York grew from 48 megawatts in 2005 to 1,746 megawatts in 2014. Electricity generated by wind power increased from 112 gigawatt-hours in 2004 to 3,986 gigawatt-hours in 2014.

Wind power output in New York marked a new record of 1,524 megawatts on March 2, 2015. At the time of record production, wind power provided 7 percent of New York's 20,894 megawatts of total system demand.

Projects capable of supplying another 2,300 megawatts of wind power currently are proposed for future interconnection with the New York bulk electricity grid.

Figure 25 - Wind Generation in New York: Installed Capacity - 2003-2015

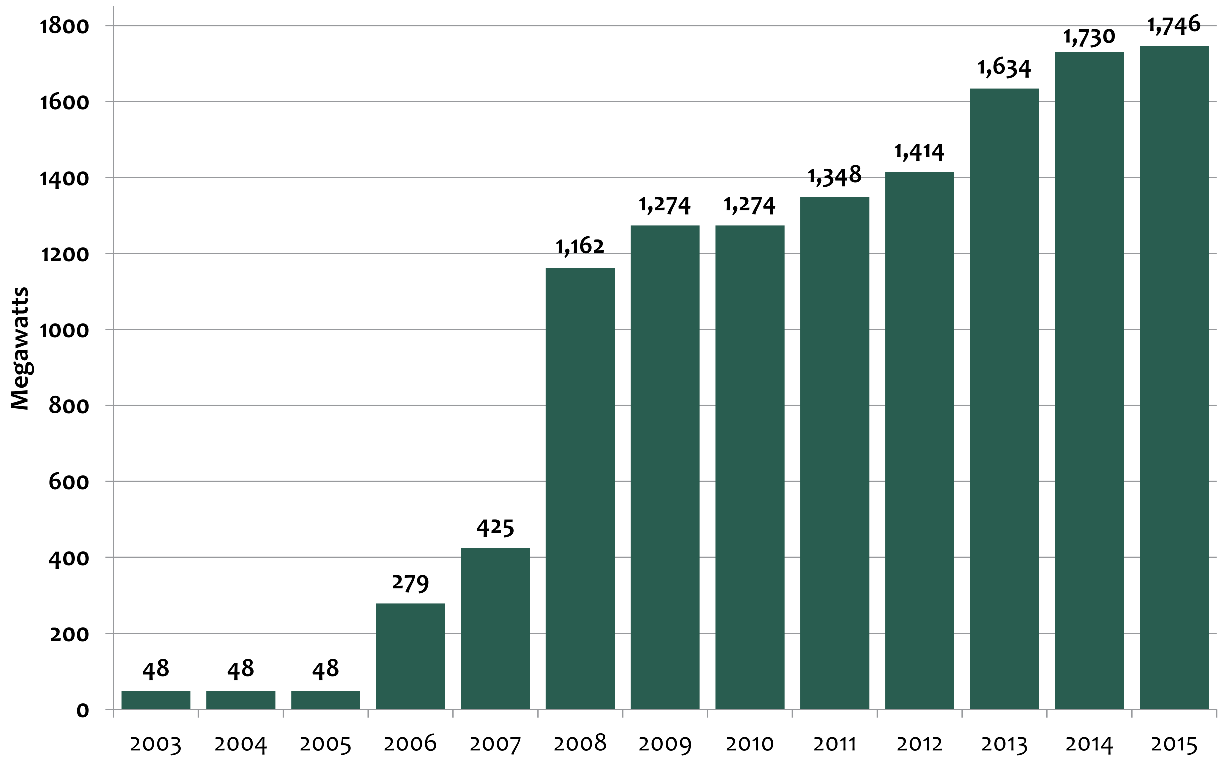


Figure 26 - Wind Generation in New York State: Energy Produced – 2003-2014

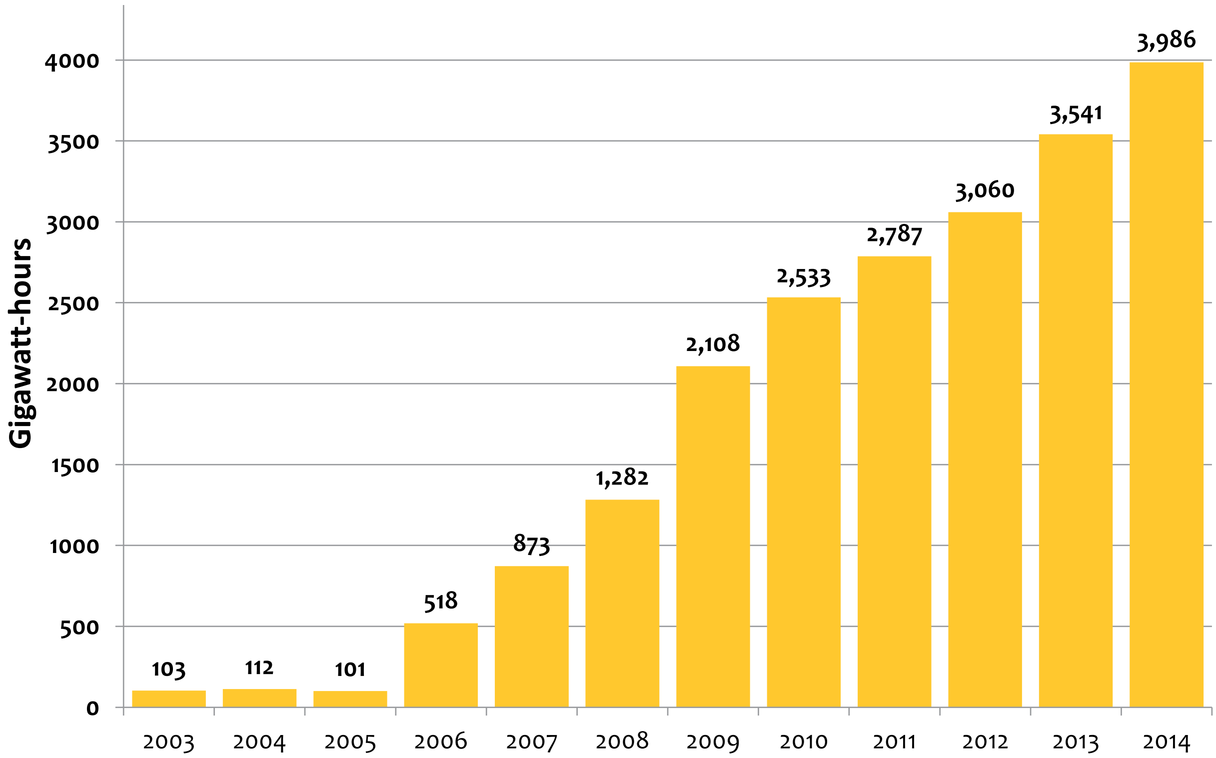
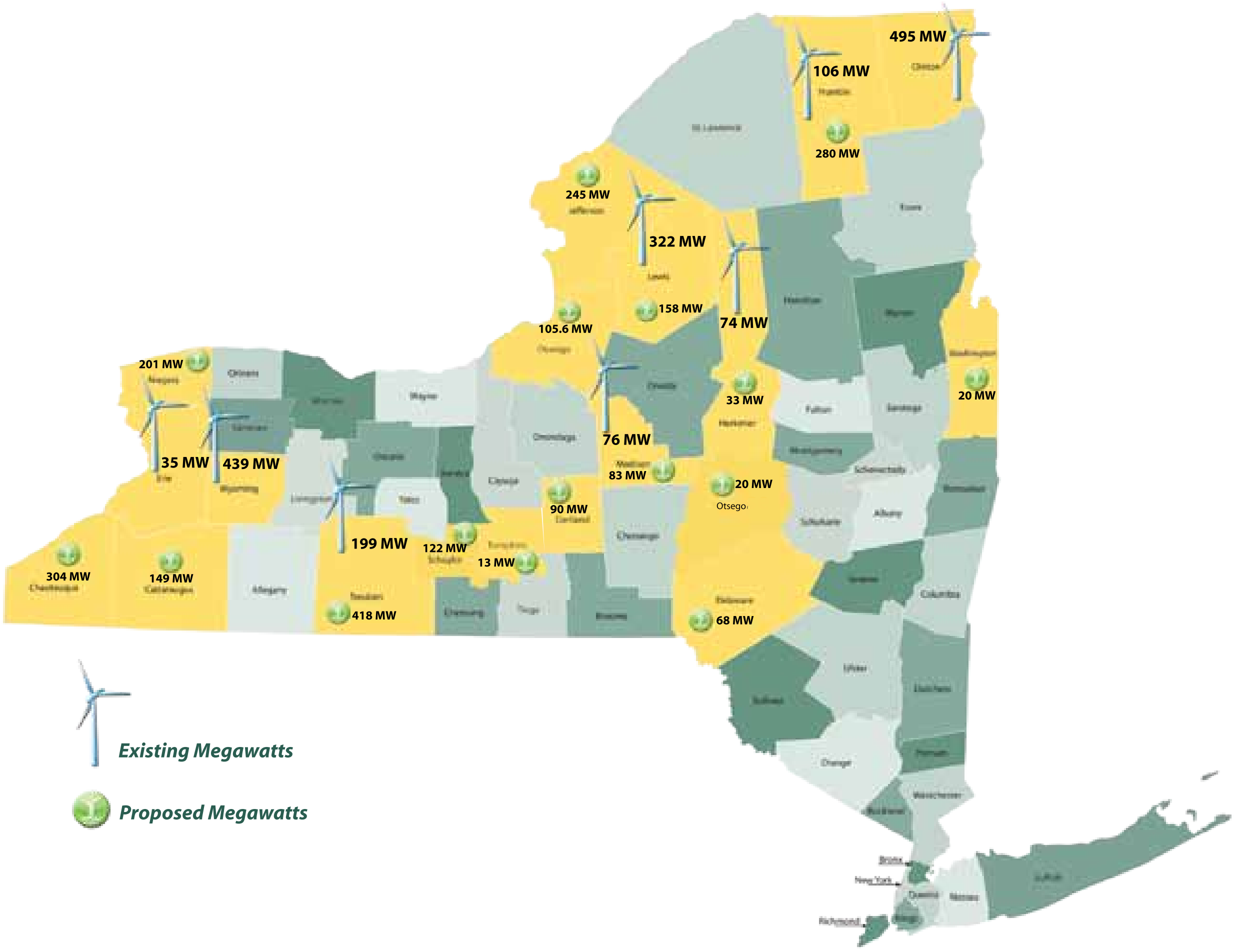


Figure 27- Wind Power in New York: Map of Existing and Proposed Wind Projects – 2015



Environmental Quality & Electric Reliability

In the 1990s, as policymakers deliberated the restructuring of the electric industry, environmental concerns were among the considerations prompting changes. The Clinton Administration included electricity restructuring in the 1997 White House Climate Change Initiative, saying, "With appropriate market-based provisions, electricity restructuring legislation could reduce carbon emissions by creating incentives to produce and use electricity more efficiently and with less pollution."[47]

To complement public policy and environmental regulations, wholesale electricity markets have encouraged new renewable resources, more efficient generation, and demand reduction programs that contribute to significantly reduced emissions.

Power Plant Emission Trends

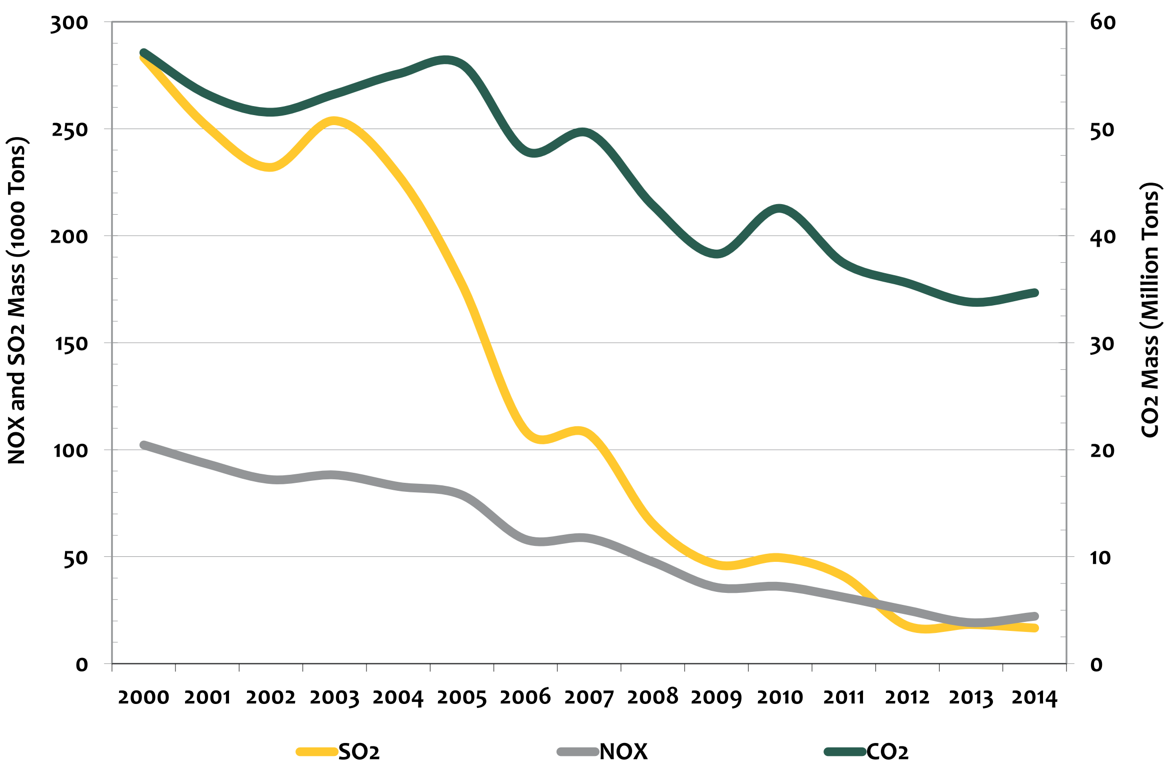
Based on available emissions data from the U.S. Environmental Protection Agency, power plant emission rates have significantly improved since 2000. From 2000 through 2014, sulfur dioxide (SO_2) emissions rates dropped 94 percent. The emission rates for nitrogen oxides (NO_X) and carbon dioxide (CO_2) declined by 78 percent and 39 percent, respectively, during that period.

Declining Emission Rates

From 2000 through 2014

- *SO_2 emissions rates dropped 94%*
- *NO_X emission rates dropped 78%*
- *CO_2 emission rates dropped 39%*

Figure 28 - New York Emission Rates from Electric Generation: 2000-2014



Data Source: U.S. Environmental Protection Agency

New York is part of the Regional Greenhouse Gas Initiative (RGGI), which is an agreement among nine eastern states designed to restrict carbon emissions from power plants. RGGI states agreed to set the cap at 91 million tons of emissions in 2014, declining by 2.5 percent per year through 2020. In addition to sustaining the CO_2 reductions that have already occurred, the cap is expected to yield an estimated 80-90 million tons of cumulative emission reductions by 2020.[48]

Cumulative Impact of Environmental Regulations

A diverse and complex set of environmental regulations affecting power generation are underway or in process. These regulations include control technology requirements for nitrogen oxides (NO_X), mercury from coal plant emissions, interstate transportation of air emissions, and other emerging environmental standards.

The compliance costs associated with the proposed state and federal environmental regulations could result in unplanned plant retirements that may affect electric system reliability. The new and proposed environmental regulations are estimated to affect 33,800 megawatts of generation, more than 80 percent of New York's generating capacity.[49]

Figure 29 –Summary of Environmental Regulations and Estimated Impact on New York Generation

Program	Description	Goal	Status	Estimated Capacity Affected (MW)
NO_x RACT Reasonably Available Control Technology for Oxides of Nitrogen	Limits emissions of nitrogen oxides (NOx) from fossil-fueled power plants by establishing presumptive limits for each type of fossil fueled generator and fuel used.	To reduce emissions from the affected generators by 50%	In effect Compliance Period began July 2014	27,100 5,300 potential to reach operational limit
BART Best Available Retrofit Technology	Requires an analysis to determine the impact of certain affected unit's emissions. If the impacts are greater than a prescribed minimum, then emission reductions must be made at the affected unit.	To limit emissions that may impact visibility in national parks. Emissions control of sulfur dioxide (SO_2), nitrogen oxides (NO_X) and particulate matter (PM) may be necessary.	In effect Compliance Period began January 2014	8,400 1,600 potential to reach operational limit
MATS Mercury and Air Toxics Standard	Establishes limits for Hazardous Air Pollutants (HAP). Will apply to coal and oil-fired generators.	To limit emissions, under the federal Clean Air Act, of certain substances classified as hazardous air pollutants.	In effect Compliance Period began April 2015	10,300 8,800 potential to reach operational limit
BTA Best Technology Available for Cooling Water Intake Structures	Would apply to power plants with design intake capacity greater than 20 million gallons/day and prescribes reductions in fish mortality.	To establish performance goals for new and existing cooling water intake structures, and the use of wet, closed-cycle cooling systems.	In effect Compliance deadline – Upon Permit Renewal	16,400 1,600 potential to reach operational limit
CSAPR Cross State Air Pollution Rule	Limits Emissions of SO_2 and NO_x From Power Plants Greater Than 25 MW in 28 Eastern States through the use of emission allowances with limited trading.	Attain and maintain air quality consistent with Nation Ambient Air Quality Standards.	In effect Compliance Period Started January 2015	27,500
RGGI Regional Greenhouse Gas Initiative	Multi-state compact to limit CO_2 emissions by power plants.	The 2014 RGGI cap is 91 million tons of CO_2, declining 2.5% annually from 2015-2020.	In effect	27,100

Clean Power Plan Proposal

Nationwide debate about the economic impact of the environmental regulations on power generation and electricity rates is expected to continue as the U.S. Environmental Protection Administration (EPA) moves forward with plans to curb carbon emissions from power plants.

In June 2014, the EPA proposed the Clean Power Plan, a rule intended to limit CO_2 emissions from existing power plants by 30 percent from 2005 levels. The proposal calls for an initial reduction by 2020 with achievement of final reductions by 2030. State implementation plans could make use of coal-fired power plant efficiency improvements, shifts in dispatch patterns to increase production from gas-fired combined cycle plants, expanded use of low-emission and non-emitting generators, and/or aggressive deployment of energy efficiency measures.

In comments on the proposal, the NYISO, New York's electric utilities and the State of New York have voiced concerns about the potential implications for electric system reliability and the lack of recognition of the progress New York has already made in achieving significant reductions in CO_2 emissions.

"As proposed, the Clean Power Plan presents potentially serious reliability implications for New York. A majority of the electric capacity within New York City is dual-fuel oil/gas steam-fired electric generating units. These units are critically important, both due to their location within the transmission constrained New York City area and because they possess dual-fuel capability that provides a needed measure of protection against disruptions in the natural gas supply system," the NYISO stated in its comments to the EPA. The comments questioned the EPA's assumption that the output from vital dual fuel units could be reduced by over 99 percent while maintaining reliable electric service to New York City.[50]

In addition, New York's success in reducing power plant emissions and its future commitments under the Regional Greenhouse Gas Initiative (RGGI) should be recognized by the EPA as it develops the final plan.

Carbon dioxide emissions from New York's power sector are already 41.6 percent below 2005 levels. New York generates approximately 53 percent of the electricity it uses on an annual basis from non-carbon emitting resources. Moreover, the NYISO's comments highlighted the importance of a "reliability safety valve" that would permit power plant operations if needed to accommodate circumstances that could otherwise jeopardize electric system reliability. The NYISO also participated in joint comments submitted by the ISO/RTO Council, which proposed a reliability safety valve. The NYISO has participated in national and regional technical conferences at FERC regarding the need to include a process for consideration of reliability impacts in state implementation plans, and provision for a reliability safety valve to permit plant operations to maintain reliable electric service during unforeseen circumstances.

Sustaining & Enhancing Resources

Distributed Energy Resources

As the electric system strives to reduce its environmental impact, foster cleaner, renewable resources, and promote energy efficiency, attention increasingly turns to the potential of distributed energy resources (DER).

In the traditional model of the centralized power system, electricity is said to flow "downhill" from large power plants to a widespread set of residential, commercial and industrial customers. The emergence and growth of distributed resources is leveling the landscape of the electric system.

DER include a diverse array of power generation and storage resources that are typically located on or near an end-user's property and supply all or a portion of the end-user's electricity. Such resources also may deliver power into the grid. Distributed energy technologies include solar photovoltaic (PV), combined heat and power (CHP) systems, microgrids, wind turbines, microturbines, back-up generators, and energy storage devices.

Connection vs. Defection

Many existing distributed resources are off-grid, serving only their host's power needs. Whether it is a solar array dedicated to a single building or a stand-by generator serving a home, these DER installations have been purpose-built units not intended to be connected to the grid.

Some of the analysis being conducted focuses on DER as a vehicle to become grid independent. A 2014 Rocky Mountain Institute (RMI) report assessed solar PV/battery storage combinations that could allow electricity customers to become so-called "grid defectors."[51]

Whether distributed energy technology results in trends like mobile phones replacing land-lines, or new media replacing cable, is yet to be seen, but the RMI study suggests it could happen sooner than expected.

A growing number of customer-sited PV installations are connected to the grid and take advantage of available net metering opportunities. Authorized by New York State law in 1997, net metering enables customers to provide power generated by their distributed energy system to their host utility in return for credits on their electric bill. It is available on a first-come, first-served basis to customers of New York State's major electric utilities, subject to technology, system size, and aggregate capacity limitations.

Connection & Integration

Examining grid-connected distributed resources, the Electric Power Research Institute (EPRI) clarified an important distinction between DER that is connected to the grid and resources that are truly integrated into grid operations. The study stated, *"…rapidly expanding deployments of DER are connected to the grid but not integrated into grid operations, which is a pattern that is unlikely to be sustainable."*[52]

In September 2014, the NYISO issued a report assessing the state of distributed technologies and their prospects for growth in New York State. Prepared for the NYISO by DNV GL, the report *(A Review of Distributed Energy Resources)* evaluates the outlook for several key DER technologies.[53]

According to the report, more residential and commercial customers are interested in adopting DER technologies to lower their utility costs, improve power quality and access new revenue. The study cites a need for government and utility sectors to address several key challenges to expanding the use of DER, including technical requirements, regulatory policies, cost allocation, and project financing.

New York's current DER base is led by small-scale CHP with 57 percent of the state's distributed generation capacity. In other states, solar PV is the dominant DER technology. Solar PV ranks second in New York at 41 percent. Energy storage accounts for the remaining two percent.

While New York already ranks in the top five states for total distributed energy installations, there is considerable potential for increased penetration of DER technologies. For example, New York ranks high in potential for additional rooftop PV and small-scale CHP systems.

Reforming the Energy Vision

The NYISO study was conducted to help inform New York State's REV initiative. In April 2014, the New York State PSC initiated a proceeding to align New York's electric utility practices and the state's regulatory paradigm with technological advances in power generation, distribution, and information management in support of improvements in system efficiencies, customer choice, and clean energy technologies. The proceeding is geared toward identifying and implementing policy and regulatory changes necessary to expand the role of distributed resources in system planning, operations, and markets in ways that align customers' desires for greater flexibility in meeting their own energy needs with the system investment needs of distribution utilities and grid operators.

The New York State PSC suggests that this new approach would facilitate the growth of demand-side resources as the primary tool to manage distribution system flows, shape system load, and enable customers to choose cleaner, more resilient power options. The REV report by Department of Public Service staff[54] recommends considering fundamental changes to the manner in which utilities provide service, including:

- A new business model in which distributed energy resources become a primary tool in the planning and operation of electricity systems. Utilities would be encouraged to invest in DER that mitigate or lessen the need for traditional distribution system investments.

- A Distributed System Platform Provider (DSP) that actively manages and coordinates DER while providing a market in which customers use DER in response to dynamic system conditions. Such customers would provide, and be compensated for, any system benefits associated with their responses.

Among the regulatory changes that may facilitate the proliferation of distributed resources are rate structures that provide time-variant or "dynamic" pricing. Power prices that change to reflect the actual cost of electricity could encourage consumers to adjust energy usage to take advantage of lower-priced energy in low-demand hours and to limit consumption in high demand, higher-priced hours.

In addition to reducing their individual bills, the combined impact of consumers cutting demand during peak periods can lead to a more efficient and lower-cost electric system. A 2009 study conducted by the Brattle Group for the NYISO concluded, "…dynamic pricing can provide substantial benefits in New York State by reducing total resource costs, lowering customer market costs, and improving economic efficiency. With estimated market-based cost savings in the range of $171 million to $579 million per year, the benefits to electric consumers can be significant, especially when technology serves to facilitate demand response and energy conservation."[55]

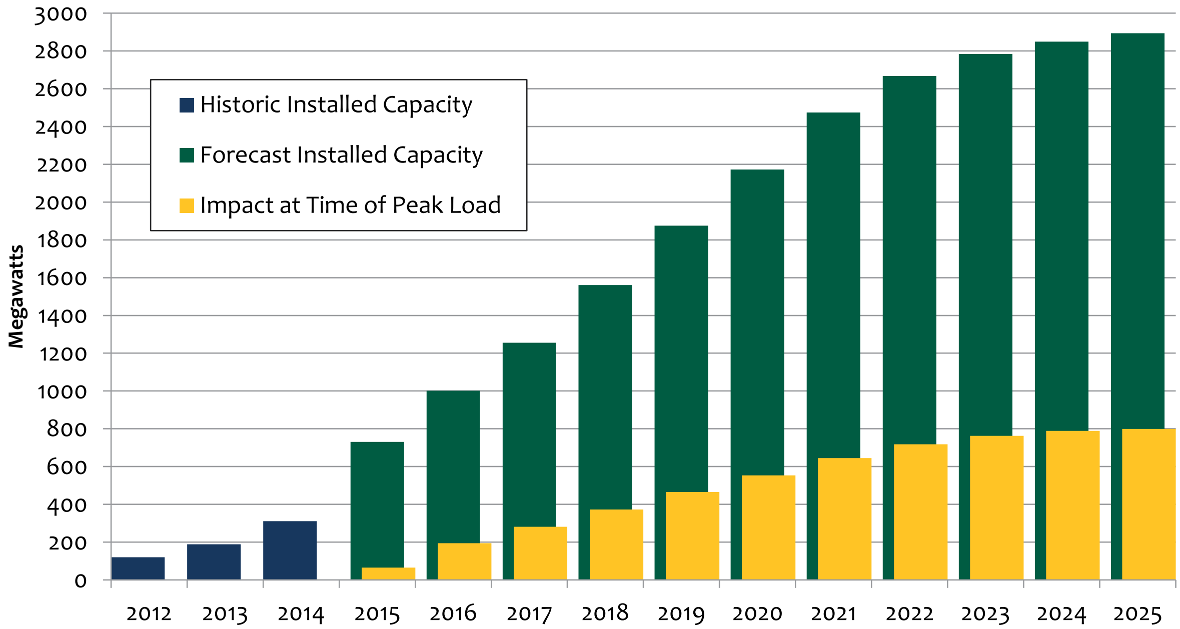
While the precise shape and scope of the reformed system envisioned by REV is yet to be determined, it seems likely that distributed resources may play a much larger role in the grid of the future. Proliferation of customer-installed solar photovoltaic systems, development of community-level microgrids, expansion of combined heat and power systems, and other distributed energy resources present various complex challenges for the electric system.

However, it seems equally clear that the wholesale electricity markets will need to evolve to address the challenges of DER, much as they have changed to integrate grid-scale renewable resources. *(See Renewable Resources and Energy Efficiency section.)*

As distributed resources grow, they can be expected to modify the load profile. The NYISO's real-time and long-range load forecasting techniques will consequently need data currently hidden "behind-the-meter."

In terms of the wholesale market potential of DER, they may evolve to serve as price responsive load or supply capacity and ancillary (reserves and regulation) services to the wholesale market through aggregators. Advances in metering and communications infrastructure will be essential to the integration of DER.

Figure 30 - Distributed Solar Photovoltaics in New York: Historic & Forecast



NOTE: Data represent "behind the meter" solar photovoltaic only.

A Smarter, More Secure Grid

Evolution of the electric system with the emergence of distributed resources is closely linked to the deployment of advanced technology aimed at making the grid "smarter." The concept of "Smart Grid" encompasses technological solutions intended to enhance the operation of the transmission and distribution systems, and ultimately improve the ability of electricity consumers to manage their use of power. Efforts to expand smart grid technology build on a foundation of upgrading and modernizing key elements of the grid to enhance the precision with which grid operators manage the flow of electricity.

Among the advanced technologies being deployed by grid operators and transmission owners are synchrophasors and phasor measurement units (PMU) that will help avoid major electric system disturbances like the 2003 blackout. These sophisticated monitoring devices relay system electric conditions at a rate of up to 60 times per second—360 times faster than previously available.

The NYISO's new control center uses the capabilities of these devices, installed as part of a 2013 Smart Grid Investment Grant project funded by a grant from the U.S. Department of Energy (DOE) with matching state funding. DOE worked with utilities throughout the nation to increase the number of synchrophasors five-fold, growing from less than 200 in 2009 to more than 1,700 in 2014.[56]

Connecting with PMU networks in New England, the mid-Atlantic, and the Midwest provides the NYISO faster and wider situational awareness of grid conditions throughout the eastern United States.

Grid Security

Protecting the grid from threats, natural and man-made, is a fundamental requirement of electric system reliability. As the systems that control and monitor the power grid become more technologically advanced and interconnected, the scope of cyber security concerns expands. Concurrently, heightened concern about terrorist threats to critical infrastructure, including the electric system, are also putting physical security issues in the national spotlight.

Mandatory federal reliability standards include Critical Infrastructure Protection (CIP) standards. Developed by the North American Electric Reliability Corporation (NERC) and approved by the Federal Energy Regulatory Commission (FERC), these standards cover both physical and cyber security. They address asset identification, security personnel and training, incident reporting, and response/recovery planning.

In 2013, President Barack Obama issued an Executive Order (E.O. 13636) "to strengthen the cyber security of critical infrastructure by increasing information sharing and by jointly developing and implementing a framework of cybersecurity practices with our industry partners." Among its provisions, the Order directed the National Institute of Standards and Technology (NIST), which is part of the U.S. Department of Commerce, to develop a "Cybersecurity Framework" that includes a set of standards, methodologies, procedures, and processes that align policy, business, and technological approaches to addressing cyber risks.

The Order created a voluntary partnership between owners and operators of critical infrastructure and the government to develop standards and enhance information sharing. The ISO/RTO Council (IRC), of which the NYISO is a member, provided extensive information on electric industry cyber security standards and programs in response to a Request for Information issued by NIST. Issued in February 2014, the Framework provides uniform, voluntary guidelines for organizations to: 1) Describe their current cybersecurity posture; 2) Describe their desired end state for cybersecurity; 3) Identify and prioritize opportunities for improvement within the context of a continuous and repeatable process; 4) Assess progress toward the end state; 5) Communicate among internal and external stakeholders about cybersecurity risk.[58]

Mandatory CIP standards for owners and operators of the bulk electric system were developed by NERC and approved by FERC in 2008. Those standards undergo continuous updates as the nature and scope of threats change. The NYISO participated in the development of the standards and remains actively engaged in improving them, collaborating with various government agencies, such as NIST, and other entities involved in maintaining rigorous cyber security protections.

In November 2013, FERC approved the latest version of the standards (CIP Version 5), which uses a new, tiered approach to identify and classify bulk electric system cyber assets according to their potential impact on electric system reliability. The tiered approach is intended to identify and include all cyber assets that could impact Bulk Electric System facilities within the scope of the CIP standards. The plan includes requirements for electronic security perimeters, systems security management, incident reporting, response planning, recovery plans, configuration change management, and vulnerability assessments. The new standards become effective on April 1, 2016.

Subsequent to a 2013 California incident involving gunfire that damaged a major substation, FERC directed NERC to develop new physical security standards. In November 2014, FERC approved new physical grid reliability standards for the most-critical Bulk Power System facilities in order to reduce the overall vulnerability of the grid to attacks.[59] The NYISO implements the cyber and physical security standards as part of a layered defense-in-depth posture that seeks to defend its critical infrastructure assets from incursions.

Interregional Collaboration

The power grids and wholesale electricity markets serving various regions of the United States and Canada were developed separately and reflect differences in geography, climate, reliability requirements, and power resources. Where the regions interface, the differences can lead to market inefficiencies and inhibit efficient coordination of grid operations. Mitigating the differences and strengthening interregional market coordination and planning, enhances the availability of resources for power systems and enables more efficient use of power system assets to benefit the regional economy and electric consumers.

Removing barriers to the efficient flow of power between electric systems is a vital component of enhanced operational flexibility. The electric system has a long tradition of interconnected operations to bolster reliable operations across utility and regional boundaries, as well as mutual aid among utilities when recovering from major disasters. Increased flexibility in system operations gained through expanded collaboration will help to address the need to balance the variable output of renewable resources, integrate the growing array of distributed energy resources, and bolster system resilience during extreme weather events. Accordingly, grid operators, market administrators and system planners of the electric systems serving North America have recognized that greater interregional collaboration can enhance efficiency on the electric grid system and deliver cost savings for consumers.

Increasing Regional Resource Efficiency

Interregional collaboration, such as the Broader Regional Markets initiative, is intended to optimize the use of existing resources. For example, markets incentivize power plants to operate more efficiently and effectively. When electric power generators compete to supply electricity, they are more inclined to perform to the best of their abilities. That results in increased availability among existing power plants—reducing the need to build new plants.

The effect of this increased competition on power plant availability is most evident in New York's nuclear power sector. On average, the nuclear fleet produced 12,600 gigawatt-hours more energy each year under NYISO markets than during the years prior to restructuring. The increased production is equivalent to adding a new 1,400-megawatt, zero-emission generator working at its maximum output 24 hours a day, seven days a week. Without the increased output from nuclear projects, carbon, sulfur and nitrogen emissions in New York State would be approximately nine percent higher than current levels based on the emissions profile of the state's generation fleet.

Broader Regional Markets

The Broader Regional Markets initiative centers on the premise of helping New York and its neighboring wholesale electricity markets to better coordinate their operations. The effort aims to avoid or minimize conditions on the grid, such as loop flows and congestion, which add cost, while also facilitating a more dynamic system. These efforts are being completed through a combination of physical and market-based tools designed to maximize the flexibility of operators' response to real-time conditions on the grid.

In addition to the NYISO, the regional initiative involves PJM Interconnection, ISO New England, Midcontinent ISO, Ontario's Independent Electricity System Operator, and Hydro Québec.

Through the regional initiatives, the need to use more expensive local power is reduced if less costly power is available from a neighboring grid operator. Coordination efforts also shorten the time commitment for moving power across control area borders, allowing faster responses to changing conditions.

Several components of the Broader Regional Markets initiatives have been implemented, and more efforts are ongoing. In 2014, the NYISO and PJM enhanced their 15-minute scheduling protocol (called Interregional Transaction Coordination) with a new Coordinated Transaction Scheduling function. That protocol—which lowers overall system operating costs, provides system operators with additional resource flexibility, and increases the efficiency of real-time markets—is expected to come online between the NYISO and ISO-New England in 2015, as well. Enhanced coordination with PJM is expected to create annual production cost savings between $9 million and $26 million, and between $9 million and $11 million with ISO-New England.

In 2013, the NYISO and PJM launched Market-to-Market Congestion Relief Coordination, enabling joint management of the transmission limits that occur near the borders of their control areas. Enhanced Interregional Transaction Coordination was implemented by the NYISO with Hydro Québec in 2011 and with PJM in 2012. Overall, the Broader Regional Markets initiatives have been projected to yield production cost savings of up to $362 million a year throughout the region.[60]

Figure 31– Summary of Broader Regional Market Components

Broader Regional Markets

Enhanced Interregional Transaction Coordination

Enables market participants to access the least-cost source of power across regions and helps lower the combined energy production cost across systems. Operators more efficiently use the transmission lines connecting regions, and coordination minimizes counterintuitive power flows by incorporating projected price differences among markets into interregional scheduling decisions.

Phase 1 – 15-minute scheduling (NYISO/HQ)	Complete
Phase 2 – Ancillary Service Concepts	Complete
Phase 3 – 15-minute scheduling (NYISO/PJM)	Complete
Phase 4 – Coordinated Transaction Scheduling (NYISO/PJM)	Complete
Phase 5 – Coordinated Transaction Scheduling (NYISO/ISO-NE)	2015
Phase 6 – Coordinated Transaction Scheduling (PJM/MISO)	2016
Phase 7 – 15-minute with NYISO/IESO	Future

Market-to-Market Coordination

Grid operators jointly manage transmission limits that occur near the "seams" between regions. This coordination increases the efficiency and lowers the costs of electric transmission congestion management, which lowers overall congestion costs for consumers. In addition, reliability is enhanced because a broader pool of resources is available.

NYISO/PJM Coordination	Complete
PJM/MISO Coordination	Ongoing

Interface Pricing

Improves the pricing at the points at which energy moves between individual grid operators to allow for more efficient regional power transfer.

Proxy Bus Revisions	Complete

Expanded Interregional Planning

FERC Order 1000 requires that all transmission providers have a regional transmission planning process in place to meet reliability, economic, and public policy planning standards.

As part of their regulatory requirements, ISOs, RTOs and other transmission providers conduct interregional planning.

In collaboration with its New England (ISO-NE) and Mid-Atlantic (PJM Interconnection) neighbors, the NYISO has proposed an interregional planning process that expands upon the existing Northeast Coordinated Planning Protocol that has been in place for over 10 years. The expanded process includes a cost-allocation process for voluntarily sharing the expense of interregional projects that are contained in each region's plan. The NYISO is also engaging in collaborative efforts with planning authorities across the entire Eastern Interconnection.

One of those efforts is conducted through the Eastern Interconnection Planning Collaborative (EIPC), created in 2009 to foster interstate transmission cooperation. The Eastern Interconnection includes 40 states and several Canadian provinces from the Rocky Mountains to the Atlantic Ocean and from Canada south to the Gulf of Mexico. Prior to the creation of the EIPC, there was no single organization to conduct interconnection-wide planning analysis across the eastern portion of North America. Two dozen electric system planning authorities from the Eastern United States and Canada work together through the EIPC.

From 2010 through 2012 the EIPC, with the support of U.S. Department of Energy funding, identified and analyzed resource expansion scenarios. In addition to the EIPC, state governments formed the Eastern Interconnection States Planning Council (EISPC), which also was awarded federal funding to participate in the collaborative process.

The varied "energy futures" evaluated by the EIPC included a national renewable energy standard implemented on a regional basis, a nation-wide carbon emission reduction requirement implemented primarily via emission reductions in the electric utility sector, and a "business as usual" scenario reflecting current and expected environmental and renewable energy requirements. The analysis found that the reliability plans of electric system planners in the Eastern Interconnection integrate well to meet the reliability needs of the entire interconnection. The EIPC reported its results to the U.S. Department of Energy in December 2012.

In addition to these analyses, during 2013 through 2015 as an extension of the DOE grant, the EIPC conducted the Gas-Electric System Interface Study, reviewing the region's natural gas delivery infrastructure and its ability to support the growing use of natural gas for electric power production. The study region for this analysis is comprised of the service territories of the six participating planning authorities (NYISO, PJM, ISO-New England, the Midcontinent ISO, the Tennessee Valley Authority and Ontario's Independent Electric System Operator). Across the study region, nearly 40 percent of installed generating capacity can be fueled by natural gas.

The Gas-Electric System Interface Study is nearing completion. The results provide a comprehensive analysis across the study region of the adequacy of the natural gas pipeline delivery system to meet the needs of gas-fired electric generation under various conditions over a 10-year horizon.

In addition, the study identifies constraints on the natural gas pipeline system that affect the delivery of gas to specific generators following a variety of postulated gas and electric system contingencies. The EIPC study also identifies a number of mitigation measures that may be considered by gas and electric system operators to alleviate the impacts on the electric system under such conditions.

The results of EIPC's study provide a wealth of information for consideration by the NYISO and other participating planning authorities to inform their respective operational and planning analyses. The study will be completed in July 2015 with the submission of a final report to the DOE.

Eastern Interconnect Data Sharing Network

Effective collaboration requires efficient exchange of information. To bolster communications, in the spring of 2013 the NYISO and other reliability coordinators in the Eastern Interconnection cataloged the operations data transferred among regions, and how that data is shared. As grids rely more heavily on information technology and as operations become more data-driven, the NYISO and its neighbors have identified an opportunity to provide additional communication methods that ensure consistency and security.

To further that cause, the Eastern Interconnect Data Sharing Network, Inc. (EIDSN), a non-profit corporation, was formed in January 2014. The EIDSN is positioned to build and coordinate the reliable and secure exchange of critical infrastructure information among its 12 members. This new infrastructure and network are expected to be operational by mid 2015.

The EIDSN board of directors includes Duke Energy Carolinas, LLC, Florida Reliability Coordinating Council, Inc., Hydro-Quebec TransEnergie, Independent Electricity System Operator, ISO New England, Inc., Midcontinent Independent System Operator, Inc., NB Power Corporation, New York Independent System Operator, Inc., PJM Interconnection, L.L.C., Southern Company Services, Inc., Southwest Power Pool, Inc., and Tennessee Valley Authority.

CLOSING COMMENTS

The Grid Abides

Reliable electricity has provided a foundation for growth and innovation in our economy. The modern grid is capably serving the needs of consumers as the electric devices essential to our lives and livelihoods continue to grow. As EPRI's study of the integrated grid notes, "Today's power system has served society well, with average annual system reliability of 99.97% in the U.S., in terms of electricity availability."[61]

Over the course of the last 15 years, New York's electric system has consistently met or exceeded the nation's strictest reliability standards.

Despite the record of sustained, dependable electric service, there is growing concern about the future of the grid. Various analysts suggest that an electric utility "death spiral" could result from the growth of new technologies that reduce electricity sales and compel the cost of service to be spread over a shrinking customer base.[62]

Yet, other assessments suggest that reports of the electric grid's death are premature. A 2014 study by the American Council for an Energy Efficient Economy examined potential scenarios for the effect of increased energy efficiency and distributed energy resources on electric sales. "This study estimates future electric sales under several scenarios, concluding that in the coming two decades sales will either be level, increase modestly or decrease modestly. Even under the most extreme case examined we find that a "death spiral" is unlikely," the study stated.[63]

Along similar lines, a November 2014 report from Moody's Investor Service stated, "The electric grid is a critical piece of infrastructure, and its value could be even greater in the future." Moody's suggested that regulatory responses to the emerging trend of distributed generation are beginning to address the need to sustain the centralized grid as a foundation for coming changes in electric service.[64]

Rather than prompting the disintegration of the grid, evolving energy technologies may drive the need for further integration of distributed energy resources across a more robust and responsive networked electric system.

"The United States' electric grid is in the midst of transformation, but that shift need not be an either/or between central and distributed generation. ***Both forms of generation, connected by an evolving grid, have a role to play."***

The Economics of Grid Defection – Rocky Mountain Institute, 2014

More than two decades ago, the electric industry began a period of transformation set in motion by significant changes in federal and state policies that restructured the electric system and established competitive wholesale electricity markets. The policy decisions that produced electric industry restructuring were founded on the conviction that competitive wholesale electricity markets expeditiously and effectively facilitate evolution of the grid.

Throughout its first decade and a half, New York's competitive marketplace for electricity has sustained and enhanced reliability, fostered efficiencies to reduce costs, and cultivated the growth of cleaner, renewable supplies of electricity.

The NYISO was established to operate the restructured electricity grid, administer competitive wholesale electricity markets, provide comprehensive electric system planning, and advance the technologies serving the system. In collaboration with market participants, stakeholders, regulators, and policy makers, the NYISO - as an independent source of information and technical expertise – is working to address emerging challenges as the power grid and electricity markets continue to evolve to best serve the public interest and benefit consumers.

Glossary

The following glossary offers definitions and explanations of terms and phrases used in *Power Trends 2015*and others generally used in discussions of electric power systems and energy policy.

"50/50 and "90/10": Load forecast scenarios used in transmission planning analyses to help account for increases in system peak demand that can occur in extreme weather. A 50/50 scenario means there is an equal probability of the actual peak load being higher or lower than the forecast value. A 90/10 scenario means there is a 90% chance the actual peak load will below the forecast and a 10% chance it will be above the forecast.

Adequate: A system is considered adequate if the probability of having sufficient transmission and generation resources to meet expected demand is greater than the minimum standard to avoid a blackout. A system has adequate resources under the standard if the probability of an involuntary loss of service is no greater than one occurrence in 10 years. This is known as the loss of load expectation (LOLE), which forms the basis of New York's installed capacity (ICAP) requirement.

Behind the Meter Generation: A generation unit that supplies electric energy to an end user on-site without connecting to the bulk electric 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 regions 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 Electricity Grid: The transmission network via which electricity flows from suppliers to local distribution systems that serve customers. New York's bulk electricity grid includes electricity generating plants, high voltage transmission lines, and interconnections with neighboring electric systems located in the New York Control Area (NYCA).

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

Capacitor Banks: These devices are used to improve the flow and the quality of the electrical supply and the efficient operation of the power system.

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 electricity grid 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 and Comprehensive Reliability Plan. Using the most recent reliability planning model, economic planning is conducted through the Congestion Assessment and Resource Integration Study 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: A situation where all available transmission lines between two locations are fully utilized. Congestion can be relieved by increasing transmission, generation or by reducing load.

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. The CARIS is based on the most recently approved CRP.

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. The DAM sets prices based on a least-total cost methodology, based on generation and energy transaction bids offered in advance to the NYISO.

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

Demand Response (DR) Programs: A series of programs designed by the NYISO to maintain the reliability of the bulk electricity grid by calling on electricity users to reduce consumption, usually in capacity shortage situations. 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).

Demand Side Ancillary Services Program (DSASP): A NYISO 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 small generator, typically 10 megawatts 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 generation (See "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 back 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.

Emergency Demand Response Program (EDRP): A NYISO demand response program designed to reduce power usage through voluntary electricity consumption reduction by businesses and large power users. The companies are paid by the NYISO for reducing energy consumption upon NYISO request.

Energy Highway Initiative: In the 2012 State of the State Address, New York Governor Andrew Cuomo proposed an "energy highway" to transport surplus power supplies in upstate New York and north of the border in Quebec to high-demand regions in downstate New York. The Energy Highway Task Force appointed by the Governor solicited proposals and produced an *Energy Highway Blueprint* that outlines plans for 3,200 MW of new generation and transmission funded by public/private investment of up to $5.7 billion.

Energy Independence and Security Act of 2007: A federal energy statute approved in December 2007. The stated purposes of the act are "to move the United States toward greater energy independence and security, to increase the production of clean renewable fuels, to protect consumers, to increase the efficiency of products, buildings, and vehicles, to promote research on and deploy greenhouse gas capture and storage options, and to improve the energy performance of the Federal Government, and other purposes."

Energy Policy Act of 2005 (EPAct): An extensive energy statute approved in August 2005 that requires the adoption of mandatory electricity reliability standards and gave the Federal Energy Regulatory Commission (FERC) the authority to site major transmission lines under certain circumstances in National Interest Electric Transmission Corridors (NIETC) identified by the U.S. Department of Energy. The EPAct also made major changes to federal energy law concerning wholesale electricity markets, fuels, renewable resources, electricity reliability, and the energy infrastructure needs of the nation.

Federal Energy Regulatory Commission (FERC): The federal energy regulatory agency that approves the NYISO's tariffs and regulates its operation of the bulk electricity grid, wholesale power markets, and planning and interconnection processes.

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

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 percent of the forecasted peak electricity consumption that is required to meet New York State Reliability Council (NYSRC) and Northeast Power Coordinating Council (NPCC) 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. All projects must undergo three studies – a Feasibility Study (unless parties agree to forgo it), a System Reliability Impact Study (SRIS), and a Facilities Study – before interconnecting to the grid.

Load: A consumer of energy (an end-use device or customer) or the amount of energy (megawatt hour - MWh) or demand (megawatt - MW) consumed.

Locational Installed Capacity Requirement: A NYISO determination of that portion of the statewide installed capacity requirement that must be located electrically within a locality to provide that sufficient capacity is available there to meet the reliability standards. Locational Installed Capacity Requirements have been established for the New York City (NYISO Zone J), Long Island (NYISO Zone K), and lower Hudson Valley (NYISO Zones G-J) capacity zones.

Loss of Load Expectation (LOLE): The amount of generation and demand-side resources needed (subject to the level of the availability of those resources, load uncertainty, available transmission system transfer capability and emergency operating procedures) to minimize the probability of an involuntary loss of firm electric load on the bulk electricity grid. The state's bulk electricity grid is designed to meet LOLE that is not greater than one occurrence of an involuntary load disconnection in 10 years, expressed mathematically as 0.1 days per year.

Marcellus Shale: A black shale formation extending deep underground from Ohio and West Virginia northeast into Pennsylvania and southern New York. Geologists estimate that the entire Marcellus Shale formation may contain up to 489 trillion cubic feet of natural gas, although it is not yet known how much gas will be commercially recoverable from the Marcellus in New York.

Market-Based Solutions: Investor-proposed projects that are driven by market needs to meet future reliability requirements of the bulk electricity grid as outlined in the Reliability Needs Assessment. 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.

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 electricity grid, 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 July 21, 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.

Peak Load: The maximum instantaneous power demand averaged over any designated interval of time and measured in megawatt hours (MWh). Peak demand, also known as peak load, is usually measured hourly.

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') interconnection-wide awareness of the system's state 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 driven by Public Policy Requirements identified for evaluation, 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.

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 energy modernization initiative proposed by New York Governor Andrew M. Cuomo. 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.

Resource Adequacy: The ability of the electric system to supply aggregate electrical demand and energy requirements at all times, taking into account scheduled and unscheduled outages of system elements.

Special Case Resources (SCR): A NYISO 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. Companies that sign up as SCRs are paid in advance for agreeing to cut power upon NYISO request during periods of system stress.

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 during normal or emergency system conditions.

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

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NYISO at a Glance

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 policy makers, 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. As the administrator of the competitive wholesale markets, the NYISO conducts auctions that match the retail electric service companies looking to purchase power and the suppliers offering to sell it.

In addition 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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