2024

Power Trends

THE NEW YORK ISO ANNUAL GRID AND MARKETS REPORT

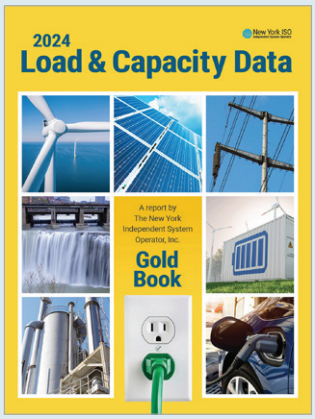
New York ISO

POWER TRENDS 2024 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.

POWER TRENDS 2024 DATA is from the *2024 Load & Capacity Data* Report (also known as the Gold Book), unless otherwise noted.

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

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



THE NEW YORK INDEPENDENT SYSTEM OPERATOR, INC. (NYISO) is a not-for-profit corporation responsible for operating the state's bulk electricity grid, administering New York's competitive wholesale electricity markets, conducting comprehensive long-term planning for the state's electric power system, and advancing the technological infrastructure of the electric system serving the Empire State.

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A letter From the CEO

On behalf of our team at the New York Independent System Operator (NYISO), welcome to the 2024 edition of Power Trends. Power Trends summarizes and discusses the key issues and challenges shaping the grid of the future.

Our mission at the NYISO is to ensure power system reliability and competitive markets for New York in a clean-energy future, and to work with all stakeholders to build the cleanest, most reliable electric system in the nation.

The electric system is the backbone of our economy. It preserves the health and safety of all New Yorkers. At the NYISO, we are champions of the essential role the grid provides in our daily lives. Since the NYISO's inception in 1999, preserving electric system reliability has been our top priority in the face of great change, whether it be societal, policy-based, or more frequent extreme weather. As older resources retire and new resources transform the way the system responds, this commitment remains.

New York's public policies are increasingly prioritizing clean energy production and a rapid transition away from fossil fuels. It is imperative that during this time of rapid change we maintain adequate supply necessary to meet growing consumer demand for electricity. Power Trends shows that achieving this balance will be the central industry challenge over the next decade.

Power Trends also demonstrates that competitive electric markets continue to provide the most powerful vehicle available to speed investment in the grid. During a time of rising interest rates, supply chain constraints, and economic uncertainty, competitive electric markets continue to provide superior cost efficiency and strong investment signals while shifting that investment risk away from the consumer.

As residents and businesses across New York become more dependent on electricity to power their lives and livelihoods, the expectation for reliable electricity will also continue to grow. And as the pace and scale of the state's energy transition accelerates, the collective efforts of all stakeholders must adapt. A careful and collaborative approach is critical as we strive to meet the goals of the Climate Leadership and Community Protection Act while maintaining a reliable grid.

All of us at the NYISO are committed to a continued strong partnership with lawmakers, policymakers, market participants and industry stakeholders to address priorities set forth under the state's Climate Leadership and Community Protection Act. Our promise is always to provide our independent, fact-based perspective and expertise to assist in the reliable transition to a zero-emission power system.

We at the NYISO are proud of that work, the role we play in serving New York, and we are excited for the future. Thank you for reading.

Sincerely,

Rich Dewey
President and CEO

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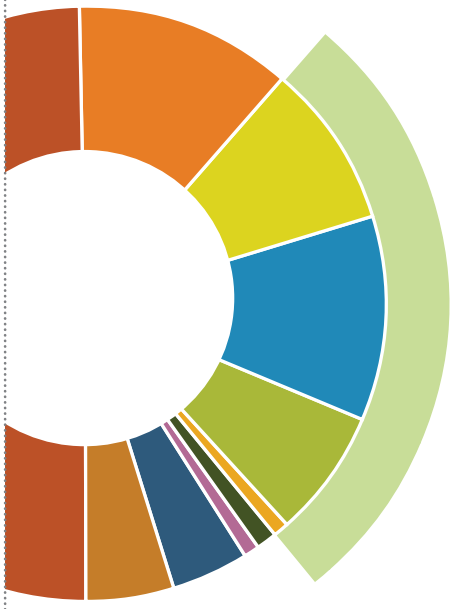


New York's Grid of the Future

Overview

The shift from fossil fuel-based systems of energy production to clean energy resources is advancing with a quickening pace. At the same time, consumer demand for electricity is increasing as we decarbonize the building and transportation sectors and attract large economic development projects to New York. The successful transition of the electric grid depends on the careful balance of reliable energy supply with the forecasted increase in demand.

Across the United States, a combination of new technologies and public policies are accelerating the drive toward decarbonization and sustainable energy. To date, twenty-nine states have adopted some form of clean energy requirements.

New York is leading this change. The Climate Leadership and Community Protection Act of 2019 (CLCPA), requiring a decarbonized electric system by 2040, has driven new investments in wind, solar, and battery storage technology. Stricter state emissions regulations have resulted in the exit of inefficient fossil fuel generation. Still, the demand for more electricity is increasing. So too are expectations for a reliable grid.

Incentives through the federal CHIPs and Science Act and the Inflation Reduction Act have helped attract large investments in renewable energy and high-tech manufacturing in New York. Several of those projects are underway, promising to create thousands of jobs for New Yorkers, while also highlighting the need for large investments in energy infrastructure.

The challenge for policymakers and industry stakeholders is how to continue to power our society and economy in a way that is sustainable, just, and equitable — even while much of the clean generation technologies mandated by state policies are weather-dependent and thus variable in nature.

To manage the challenges associated with the clean energy transition, we must keep a careful watch on how the electric system itself is reacting and responding to this change. Reliability of the system is showing strains under a mix of changing conditions and new pressures. Balancing the needs of grid reliability with the growing amount of weather-dependent generation and policy requirements for a just transition requires careful attention to system data and information.

A reliable power system is critical to the health and safety of all New Yorkers. It is essential to a vibrant state economy. At the same time, climate change is a threat to our way of life. The transition to clean energy poses a set of fresh challenges that can only be solved through a coordinated effort of industry, government, and stakeholders. Together, we must carefully and responsibly advance a clean and reliable grid of the future.

Power Trends Key Messages

> Public policies continue to drive rapid change in the electric system in the state, impacting how electricity is produced, transmitted, and consumed.

> Electrification programs and economic development initiatives are driving projected demand higher. Generator deactivations are outpacing new supply additions. Together, these forces are narrowing reliability margins across New York.

> The potential for delays in construction of new supply and transmission, higher than forecasted demand, and extreme weather are threatening reliability and resilience to the grid

> Electricity supplies are adequate to meet expected summer demand under normal conditions, but extreme weather and other factors pose reliability risks.

> The New York statewide grid is projected to become a winter-peaking system in the 2030s, primarily driven by electrification of space heating and transportation.

> On the coldest days, the availability of natural gas for power generation may be limited and significant interruptions to natural gas supply can disrupt reliable operations.

> NYISO's interconnection processes continue to evolve to balance developer flexibility with the need to manage the process to more stringent timeframes. Efforts are underway to make this process more efficient while protecting grid reliability.

> To achieve the mandates of the CLCPA, new emission-free supply capable of providing the necessary reliability services are needed to replace the capabilities of today's generation. Such new supply is not yet available on a commercial scale.

> The wholesale electricity markets administered by the NYISO exist as an important tool to attract necessary investments to facilitate the transition of the grid in the coming decades.

A Powerful Purpose

MISSION

Ensure power system reliability and competitive markets for New York in a clean energy future

VISION

Working together with stakeholders to build the cleanest, most reliable electric system in the nation

Maintaining and enhancing regional reliability

Planning the bulk power system for the future

Operating open and fair wholesale electricity markets

Providing factual information to policymakers, stakeholders and investors

The NYISO's mission is to ensure power system reliability and competitive markets in a clean energy future. A core activity through which we serve that mission is to perform in-depth analyses of power system data and then provide information on the changing electric system to all stakeholders. This information is intended to help policymakers, developers, market participants, and stakeholders to make the most informed decisions possible. With a focus on system and resource planning, competitive markets and grid operations, Power Trends captures much of the recent work the NYISO has performed in fulfilling that role and responsibility.

Declining reliability margins and the need for new generation

While the pace and scale of change is accelerating with the adoption of electric vehicles and electric heating equipment, traditional fossil-fueled generation is retiring faster than renewable and other clean energy resources are entering service.

This has, in part, contributed to declining electric system reliability margins across the state. Strong reliability margins contribute to the ability of the power system to meet peak demand or respond to sudden disturbances and avoid outages.

The NYISO first identified rapidly declining reliability margins in our *2021 Comprehensive Reliability Plan* and restated those concerns in our *2022 Reliability Needs Assessment.*

In July 2023 the NYISO identified a reliability violation beginning in the summer of 2025 in the New York City area. By November, 2023, the NYISO had identified and announced the retention of certain peaker plants in New York City as a short-term solution to the reliability violation (discussed in detail in the Planning section of Power Trends). Beyond 2025, the NYISO found that New York City's reliability margin would improve when the Champlain Hudson Power Express (CHPE) transmission line from Quebec to New York City is completed. CHPE is expected to enter service in the spring of 2026.

While the NYISO identified a short-term solution to the New York City reliability violation, reliability margins are also observed to be narrowing across the grid in New York, which poses significant challenges for the electric system over the next ten years.

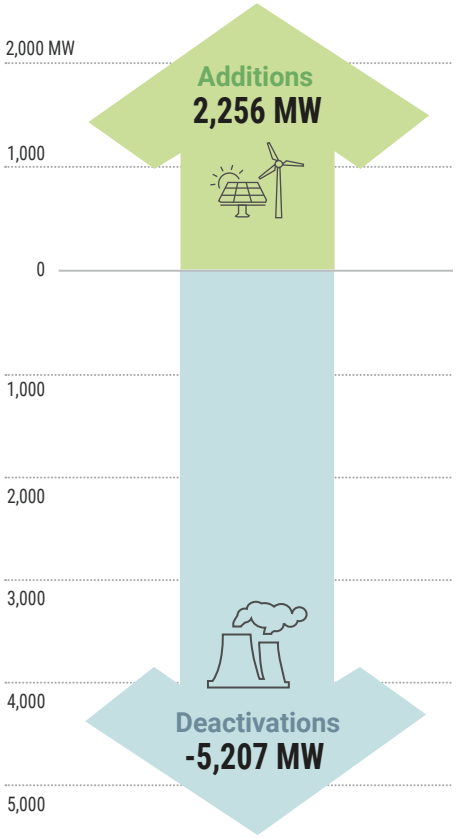
New large, energy-intensive economic development projects

The recent announcement of several large investments in microchip manufacturing and state-of-the-art data centers across the state are contributing to the increase in forecasted demand on the electric system. These new facilities are expected to consume large amounts of energy, underscoring the coming need for additional large-scale electric generation and robust investments in transmission and distribution facilities.

To accommodate the forecasted increase in demand, new clean energy supply will need to interconnect to the grid at a pace commensurate with the departure of existing fossil-fuel supply. Just as important, new supply must provide reliability services comparable to departing generation for the grid to remain reliable and resilient through the ongoing transition.

The nature and operation of these new high-tech manufacturing facilities also requires superior "grid strength," or the ability of the power system to remain stable under normal conditions and expeditiously return to a steady state condition following a system disturbance.

DEACTIVATIONS AND ADDITIONS SINCE 2019



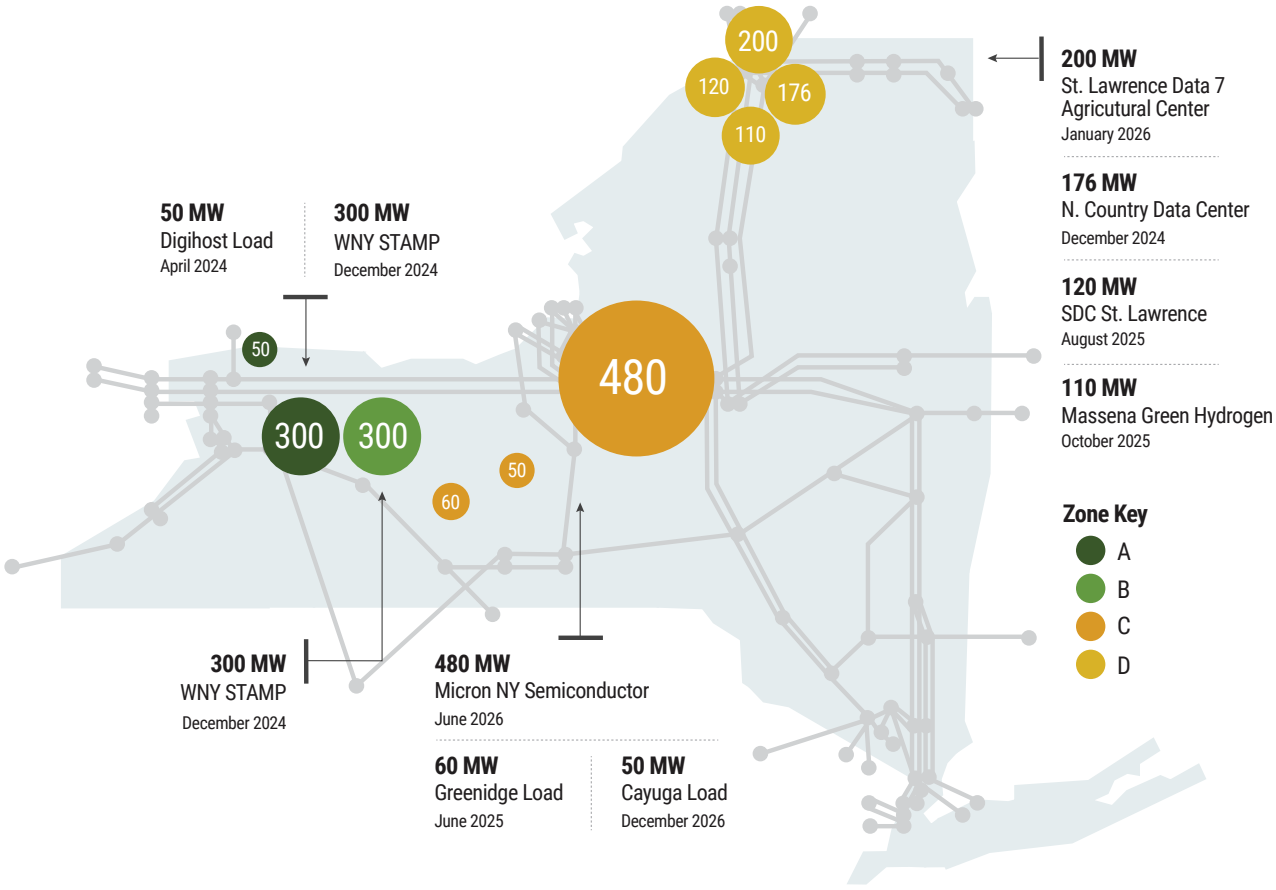
Generator retirements are outpacing additions

Microchip manufacturing is highly dependent on a reliable grid. Minor system disturbances can interrupt and compromise production. As the grid changes, the issues of power quality and grid strength are highlighted. The semiconductor industry is a major driver of technological innovation and is also highly energy-intensive. As demand for microchips continues rising, understanding and addressing the power needs of semiconductor manufacturing becomes crucial.

A significant share of new renewable generation slated to come online in the future will be comprised of "inverter-based resources," whose technological performance characteristics and reliability features are dissimilar from traditional fossil-based generation, or "synchronous" generation. Both inverter-based resources and synchronous generation can provide essential reliability services to the electric system. However, the industry is facing challenges integrating significant levels of inverter-based resources because of the unique differences between technologies. Planning, design, protection, and operations practices will all need to evolve to ensure reliability and resilience under this rapid pace of change.

Renewable energy generation, subject to sudden changes in weather, also provides new challenges to grid operators that must balance supply and demand in real time. These variables highlight the need for new generation technologies that can fill in when weather-dependent resources are unavailable. Such new technologies, collectively referred to as Dispatchable Emission Free Resources (DEFRs), must be dispatchable, emissions free, and able to respond quickly to changing grid conditions. Such technologies do not exist yet on a commercial scale.

NEW LARGE LOAD PROJECTS IN NEW YORK STATE



Summer 2024 reliability outlook

NYISO grid operations and planning teams collaborate with utilities, suppliers, and stakeholders to prepare for expected summer weather conditions. The NYISO forecasts conditions based upon normal, or baseline, expected weather conditions as well as extreme weather conditions. New York recorded a record peak of 33,956 megawatts (MW) in July 2013. For summer 2024, the NYISO expects electricity supplies to be adequate to meet expected summer demand under baseline conditions, but under more extreme summer weather scenarios, potential reliability concerns have been identified

For summer 2024, the NYISO expects 34,913 MW of resources available to meet 31,541 MW of forecasted demand under normal conditions. Under extreme summer weather conditions, however, forecasted reliability margins could potentially be deficient without reliance on emergency operating procedures. For example, if the state experiences a heatwave with an average daily temperature of 95 degrees lasting three or more days, demand is forecasted to rise to 33,301 MW, while predicted supply levels are reduced to 34,502 MW. When accounting for the required 2,620 MW of operating reserves that must be maintained, this scenario results in a forecasted reliability margin of -1,419 MW. That reliability margin declines further to -3,093 MW under an extreme heatwave with an average daily temperature of 98 degrees. Under these more extreme summer weather conditions, the NYISO forecasts an available supply of 34,317 MW to meet the required 2,620 MW of operating reserve requirements, plus a forecasted demand of 34,790 MW.

To maintain reliability, NYISO operators can dispatch up to 3,275 MW of incremental capability through emergency operating procedures. These emergency operating procedures are not reflected in the forecasted reliability margins described above. To mitigate risks to reliability, NYISO operators conduct weekly outreach to suppliers to address risks to resource availability and coordinate with both generation and transmission owners to reduce the impacts of outages during hot weather periods. In addition, NYISO operators coordinate with neighboring regions to support regional grid reliability.

Winter reliability and forecasted consumer demand

Currently, the New York electric system is a summer-peaking electric system. Historically, investments have been made to meet consumer demand driven primarily by air conditioning during prolonged heat waves.

The grid is expected to become a winter-peaking system in the mid-2030s as winter demand grows by approximately 1,000 MW per year through 2040 to accommodate electrification. As more consumers rely on the electric system to meet critical space heating needs, the NYISO must ensure the grid is prepared to supply winter peak periods reliably under various conditions.

Current statewide reliability margins in winter are sufficient. However, as NYISO reliability studies are beginning to show, if natural gas for electricity production is unavailable, and supply cannot be secured elsewhere, statewide deficiencies could arise as soon as winter 2029-2030 under normal weather conditions. Under extreme winter weather conditions this scenario may happen as early as 2027-2028. On the coldest days, natural gas distribution companies prioritize residential heating and other critical loads and limit the fuel available to generators.

With increasing winter peak loads and consideration of limitations on gas availability, there may be insufficient generation to serve forecasted demand for expected weather while maintaining required operating reserves (i.e., excess supply to meet unexpected changes in real-time system conditions). The NYISO will continue to evaluate if this could require action to solve a reliability need.

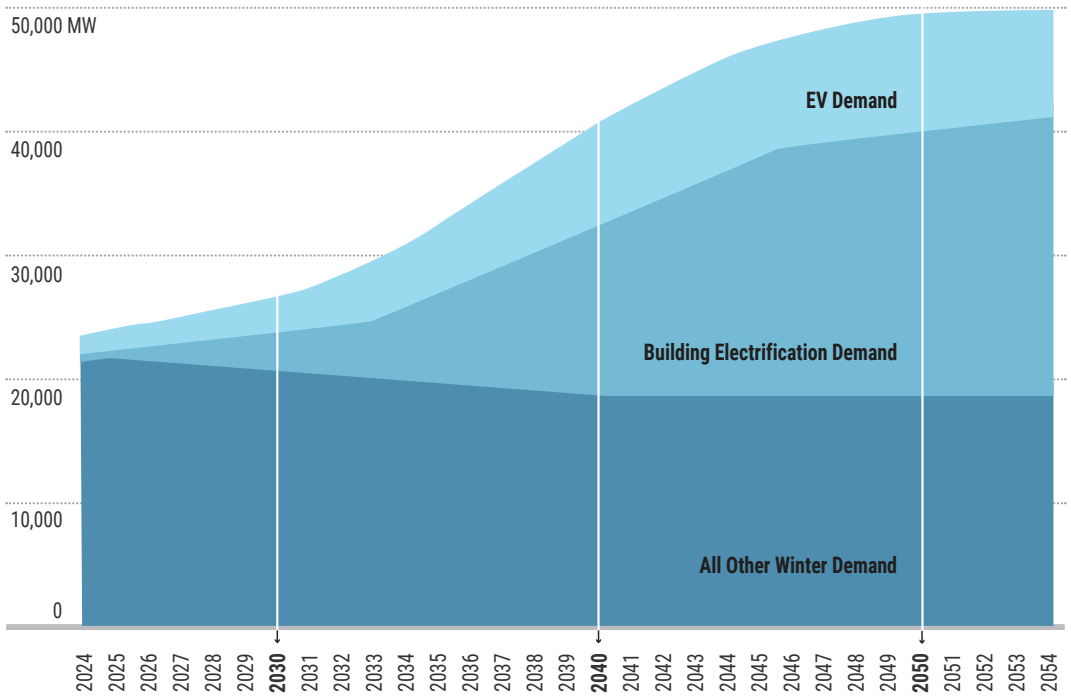
Recent events like Winter Storm Elliott in December of 2022 illustrate the evolving challenges and considerations for ensuring power system reliability under extreme winter conditions. That intense storm system rolled through the United States, straining gas networks and electricity grids across the nation. Elliott had lesser impacts in New York due in large part to the ability of downstate generators to switch fuels in times of tight gas supply.

In New York, more than half of the current generating fleet possess dual-fuel capability, meaning they can burn either oil or natural gas. Currently, dual-fuel generation represents nearly 75% of the capacity of the downstate generation fleet. In New York City and Long Island, most generators are required to maintain dual-fuel capability and supply. This capability bolsters reliability during extreme weather events like Winter Storm Elliott and the deep freeze event in January 2024.

As noted above (and explored further in the Planning section of Power Trends) the ability of the New York generation fleet to serve increased winter demand will be more challenging if faced with a natural gas shortage going forward. NYISO studies show that potential deactivations of dual-fuel generation beyond what is currently planned will exacerbate winter reliability risks.

While the New York grid transitions to zero emissions by 2040, reliability will continue to rely heavily on dual-fuel resources to support winter reliability into the next decade.

EXPECTED IMPACT OF ELECTRIFICATION ON STATEWIDE WINTER PEAK DEMAND (MW)



Joint FERC/NERC report highlights concerns about the impacts of fuel security on grid reliability

Generation outages during Winter Storm Elliott spiked to 90.5 GW or 13% of all resources in the Eastern Interconnection just as the storm's deepest cold conditions set in.

That finding was one of many concerns unveiled by the Federal Energy Regulatory Commission (FERC) and North American Electric Reliability Corporation (NERC) as part of their joint inquiry into the December 2022 winter storm. The final report highlights an urgent need for new cold weather reliability standards for power and gas systems.

The report also details the increased threat of fuel availability during extreme cold weather events as the electric system marches toward "winter peaking." According to NERC and FERC, freezing and mechanical issues on pipeline infrastructure caused a steep drop in natural gas production, risking outages for consumers.

"Every cold-weather inquiry report that has studied natural gas production has found cold-related declines in natural gas production, by as much as 70% in some cases," the FERC and NERC stated..[1] FERC and NERC also described how Consolidated Edison, serving New York City, "faced reliability-threatening low pressures on its delivery pipelines, forcing it to declare an emergency and use its own liquefied natural gas facility to maintain service."[2]

Thanks to accurate forecasting and strategic planning, NYISO control room operators were able to dispatch energy from generating units with dual-fuel capability to help maintain bulk electric system reliability during Winter Storm Elliott. These generators largely switched from burning natural gas for electricity production to oil stored on-site in reserve.

But the findings of the joint FERC/NERC report raise important issues about future fuel availability and winter reliability in New York. Rising demand from the electrification of housing and transportation and large load projects, and more frequent extreme weather events like Winter Storm Elliott all pose future risks to the grid and ultimately, the health and safety of all New Yorkers.

Assessing the Challenges of Fuel and Energy Security in a Winter-Peaking System

In anticipation of the growing winter challenge, the NYISO commissioned a study that modeled three future winter scenarios to assess the fuel and energy security in New York and identify conditions that would trigger potential outages.

The NYISO's 2023 Fuel and Energy Security Assessment (FESA) considers factors such as weather, electricity and gas demand, and pipeline capacity. Assessing reliability for the winters of 2023-24, 2026-27, 2030-31, the report underscores the need for reliable and secure sources of fuel for generators essential to maintaining reliability as the electric system is increasingly served by intermittent, variable forms of renewable energy.

Key takeaways of the 2023 FESA include:

- Dual-fuel capability will continue to be vital for maintaining winter reliability, especially downstate, through 2030.
- The potential for operational challenges and system outages is present across all three winters studied.
- The frequency and severity of such events grows over time.
- Compared to earlier assessments of winter reliability risks, this analysis suggests the power system has grown more sensitive to fuel disruption events.

Planning for the future

The report outlines new reliability criteria, which will be incorporated into the NYISO's scenario-based planning and market enhancements. The NYISO also continues to refine its fuel security modeling processes to evaluate fuel availability risks during the transition.

The report also makes the point that diversity of fuels and a balanced mix of resources enables the system to better address issues such as price volatility, fuel availability, and stressed or abnormal operating conditions.

Finally, the report highlights the need to bolster the state's fleet of renewable resources to keep pace with growing winter demand, while factoring in the impacts of the CLCPA and the intermittent nature of resources like wind and solar. In the interim, the state's aging dual-fuel units must stay online to prevent outages during extreme weather.

NYISO's efforts to improve the interconnection process

As noted above the power system is experiencing a growing imbalance between the number of new renewable generating facilities entering service and the retirement of traditional fossil-based resources that have powered the grid for the last several decades.

The interconnection queue is where proposed renewable energy and other generation projects, new transmission infrastructure and major manufacturing facilities seek approval to connect to the grid safely and reliably. The NYISO's System and Resource Planning Department is responsible under FERC regulations for performing studies in concert with local utilities of each project proposal for reliability impacts to the high voltage electric system.

The process, established long before the passage of the CLCPA, is intended to allow facilities to connect to the grid without harming the system or imposing undue costs on consumers. As the wholesale electricity market administrator and grid operator, NYISO leads the process for New York. The process requires strong coordination between utilities, developers, and state and local governments in the communication and sharing of technical information and coordination of necessary study materials.

The state's CLCPA immediately jump-started investment in a decarbonized grid, and the interconnection queue grew rapidly. In 2019, 275 applications were under consideration. Today, the queue holds more than 500. Like other grid operators across the country, we have been challenged by the sudden growth. In response the NYISO has made several improvements to the interconnection process. The NYISO has improved technology serving developers in the interconnection queue, hired more personnel, and instituted efficiencies to speed the process.

Our recent studies estimate that approximately 20 gigawatts (GW) of new renewable resources may be needed by 2030 to reach the goals of the CLCPA while maintaining electric system reliability. The interconnection process must be as swift as possible while also serving the important purpose of safeguarding reliability of the electric system during this period of great change.

In July 2023 FERC issued Order 2023. These orders direct reforms to generator interconnection procedures aimed at alleviating constraints in queues throughout the country. Many reforms included in these orders were improvements the NYISO already had underway, including a "First-Ready, First-Served Cluster Study Process." This reform allows for a group of interconnection requests by multiple generating facilities to move through the process at the same time, rather than individually and sequentially, which can be less efficient.

FERC Order 2023

In July 2023, FERC issued Order 2023: *Improvements to Generator Interconnection Procedures and Agreements*.

Among the goals of Order 2023 is streamlining interconnection processes to accommodate growing queues across the country. Many of the enhancements called for are already integral elements of the NYISO's interconnection process.

Order 2023 calls for rules to:

- Implement a first-ready, first-served cluster study process.
- Reduce interconnection queue processing timeframes.
- Incorporate technological advancements into interconnection processes.
- Establish transition processes to implement Order 2023.

The NYISO's existing stakeholder engagement laid the foundation for its response to FERC's Order, which represents the latest set of improvements the NYISO is introducing to its interconnection process. In November 2023, the NYISO submitted a filing to establish limited, interim transition rules to begin the phaseout of certain interconnection studies, avoiding unnecessary costs for developers and expediting the transition to Order 2023 compliant procedures.

In May 2024, the NYISO submitted its compliance filing to address Order 2023. The NYISO's full compliance plan is designed to meet the obligations of FERC's order while reflecting the unique elements of interconnection planning in New York.

The need for robust transmission investment

A reliable transition of the grid requires a significant increase in capital investment delivered at an unprecedented pace. An upgraded and expanded electric system at both the distribution and grid level will serve as the backbone of a more reliable and flexible system that is dependent on large amounts of weather-dependent generation.

As public policies continue to shape the grid of the future, the need to invest in the transmission system has never been greater. Without investment to expand transmission capabilities, energy deliverability is generally reduced as more renewable capacity is added to the system. The good news is that a historic level of investment is underway, with projects recently completed or under construction that will deliver more clean energy to consumers while enhancing grid reliability. However, to meet decarbonization goals, more transmission infrastructure is necessary.

In addition to interconnection process improvements, the NYISO continues to advance transmission projects to prepare the system for increasing sources of clean energy. Through the NYISO's Public Policy Transmission Planning Process, we have advanced three major projects in New York: the Empire State Line in Western New York; the AC Transmission Projects in the Mohawk-Hudson Valley; and most recently, Propel NY to deliver offshore wind interconnected to Long Island and improve reliability of the Long Island transmission system.

Through the NYISO's Public Policy Transmission Planning Process, we have advanced three major projects in New York:

1. **Empire State Line** in Western New York
2. **AC Transmission Projects** in the Mohawk-Hudson Valley
3. **Propel NY** to deliver offshore wind interconnected to Long Island and improve reliability of the Long Island transmission system.

The NYISO also is in the early stages of addressing a public policy need for transmission investments in the New York City area as identified by the New York State Public Service Commission (NYPSC). This effort calls for proposals to build transmission that will move nearly 4,800 MW of offshore wind energy directly into New York City. The scale of this public policy need is monumental.

The successful integration and deployment of clean energy will depend heavily on the availability of traditional, large-scale grid infrastructure. Consideration for recent global supply chain issues is important in this regard. As recent news reports have made clear, global supply chain disruptions and the impacts of inflation are affecting the supply of critical materials to the energy industry. Defining the scope of these challenges will be important in pointing New York toward solutions.

Planning for the grid of the future

The NYISO is committed to a carefully planned approach to enable a reliable transition of the power system. We are also committed to our role in meeting state and federal policy objectives. For 25 years, the NYISO has operated the New York power system to the strongest reliability standards in the nation. The challenge of providing safe, reliable, resilient, and affordable power, and enabling the energy transition has compelled the NYISO to reimagine grid planning processes and rethink longstanding paradigms for measuring and managing grid performance. Grid planning has become a critical strategic capability, requiring a combination of technology, expertise, and understanding of economic trends.

The NYISO's second installment of its System and Resource Outlook (the Outlook) is anticipated to be released in 2024 and will examine ways in which the power grid may evolve over the next 20 years in response to energy and climate policy mandates. The analysis undertaken in the Outlook identifies that unprecedented levels of investment in generation will be necessary to supply sufficient energy to meet future demand. At the same time, the analysis indicates that unprecedented investment in transmission capabilities will also be necessary to allow electricity generated from the influx of new renewable resources to be delivered reliably and efficiently to consumers.

Our next Reliability Needs Assessment (RNA) will be released in the fall. This important reliability report is conducted every two years and evaluates electric system changes over a ten-year time horizon. The RNA will provide a detailed analysis of forecasted changes in supply and demand and the resources that may be necessary to maintain system reliability in the coming years.

As mentioned above and discussed in more detail under the Planning section of Power Trends, the NYISO will continue to execute our Short-Term Reliability Process (STAR) on a quarterly basis to prepare for the impact of expected changes in supply and demand on the grid.

As discussed further, the NYISO released the 2023-2032 Comprehensive Reliability Plan (CRP) in November 2023. The next biennial CRP, to be issued in late 2025, will incorporate the findings of the 2024 RNA and quarterly STAR reports.

Timely comprehensive system planning is essential to anticipating the need for investments that mitigate reliability risks on the grid. Expert system planning is also critical to achieving the objectives of a clean electric system. Equally essential is effective and efficient wholesale electricity market design.

The NYISO's wholesale electricity markets, grid operations, and planning responsibilities are regulated by FERC and, in certain aspects, by the NYPSC. Reliability standards and rules established by NERC and the Northeast Power Coordinating Council (NPCC) shape our operations, planning, and cybersecurity rules and practices. Given the unique aspects of the New York power system, and New York City's importance as an economic center for the nation, the New York State Reliability Council (NYSRC) was created to establish state-specific reliability rules.

Expert system planning is critical to achieving the objectives of a clean electric system. Equally essential is effective and efficient wholesale electricity market design.

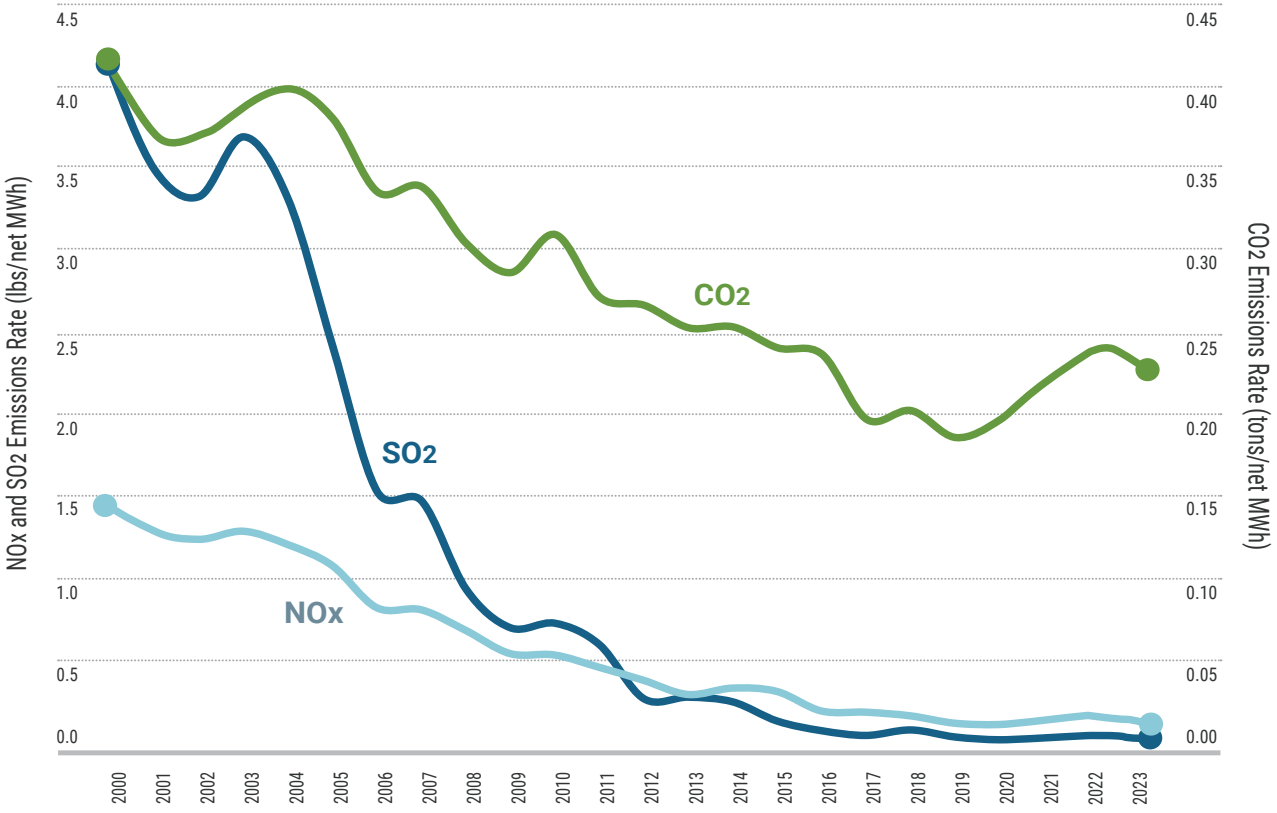
The power of competitive electric markets to attract necessary investment in the grid

Managing wholesale electric markets is a core responsibility for the NYISO. We are committed to administering and overseeing the competitive electricity markets as the most cost-effective way to attract and retain new resources to meet our reliability needs as we transition to a decarbonized grid.

For 25 years, competitive electricity markets have provided New Yorkers with reliable, least-cost power. Since 2000, the carbon dioxide emissions rate in the power sector decreased by 45%. Competitive markets produce real-time price signals that allow power suppliers to respond to the grid's changing needs. With ever-increasing intermittency, extreme weather, and demand from electrification and economic development, the balancing force of markets is essential.

Our market design team is hard at work developing new tools and programs to encourage investment in resources that are fast-ramping, flexible, dispatchable, and emissions-free — resource characteristics that are becoming increasingly important for grid reliability.

EMISSIONS RATES FROM ELECTRIC GENERATION IN NEW YORK: 2000-2023



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

Lessons Learned from the 2023 Canadian Wildfires and 2024 Solar Eclipse on Solar Generation

With each passing month, more solar generating capacity is installed throughout New York. As of April 2024, that total amount of solar capacity statewide is slightly more than 5,700 MW. Production from these resources is highly dependent on clear skies; and two events in the past year demonstrate the need for resources that can balance solar power intermittency.

In early June 2023, smoke from Canadian wildfires, driven by wind from a low-pressure system, swept across the state. On June 6, the NYISO forecasted 2,800 MW of peak solar energy production, but solar generation was 2,300 MW — or 18% less than expected. The challenge grew larger on June 7 when forecasts again called for approximately 2,800 MW of peak solar energy production but less than 2,100 MW, or about a 25% reduction, was produced. Forecasters adapted quickly and by June 8, with smoke still blanketing the region, solar forecasts were much more closely aligned with actual conditions.

The solar eclipse on April 8, 2024, while brief compared to the 2023 Canadian wildfire event, had a more significant impact on solar generation.

In the hours leading up to the eclipse, solar resources generated just over 3,000 MW. As the eclipse crossed New York, solar generation declined to just under 600 MW by 3:30 p.m. — an 80% reduction. Hydro-pumped storage, conventional hydro facilities, and fossil-fuel resources were dispatched to make up for the reduced solar generation during that period. By 4 p.m., solar generation ramped back up to just under 1,200 MW before declining again during the early evening hours. NYISO's operators-maintained system reliability through a sharp decline in solar generation, with actual generation levels landing close to pre-eclipse forecasts.

As solar capacity continues to expand in the coming years, events like these will continue to demonstrate how solar and other weather dependent resources introduce new challenges for our forecasting and operations teams. Continued collaboration with stakeholders, technological innovations, and investment in additional dispatchable resources and transmission infrastructure will ensure operators have the tools necessary to maintain reliability.

NYISO market design innovations underway include winter reliability capacity improvements; dynamic reserves to balance intermittency; advanced battery storage modeling; and carbon pricing. Each of these is discussed in detail under the Markets section of Power Trends.

While the pace of resources exiting and entering service is changing, the need for reliability services like the ability to respond quickly to changing system conditions has been essential for reliability and will be increasingly important as the grid transitions to resources more dependent intermittent technologies like on solar or wind.

Accurate forecasting is also vital for ensuring a safe, consistent flow of energy when and where it is needed. The intermittent nature of renewable energy sources highlights challenges to traditional forecasting methods.

Achieving the state's climate goals in an orderly fashion is a challenge given ever-changing market conditions, shifts in energy costs, emerging technologies, new policy measures, and economic and supply chain challenges. To get ahead of the uncertainty, leaders can develop decarbonization pathways based on various scenarios. Factoring reliability, resiliency, and affordability into any potential changes to the power system will be essential.

As the pace and scale of the state's energy transition accelerates, the collective efforts of all stakeholders must adapt. A careful and collaborative approach is important as we strive to meet the goals of the CLCPA and maintain a reliable grid. As residents and businesses across New York become more dependent on electricity to power our lives and livelihoods, the expectation for reliable electricity will also continue to grow.

Independence and Transparency

Regulatory and Reliability Organization Oversight

>The NYISO serves New Yorkers under the oversight of the **Federal Energy Regulatory Commission,** the **New York Public Service Commission,** the **North American Electric Reliability Corp.,** the **Northeast Power Coordinating Council,** and the **New York State Reliability Council.**

Shared Governance

>This process **engages suppliers, transmission owners, consumers, environmental and environmental justice interests, and state organizations** to facilitate the development of the rules and processes for a reliable and economically-efficient grid in New York.

Independence

>**The NYISO is transparent, open, and independent of its stakeholders.** We are a registered 501(c)3 not-for-profit corporation. NYISO and its directors, executives, and employees are prohibited from having financial interests in any company participating in New York wholesale competitive electricity markets.

Planning
for the Future Grid

Reliability planning process

The NYISO's mission of ensuring power system reliability and competitive markets for New York depends on the planning process. The NYISO's Comprehensive System Planning Process, focuses on the impacts of forecasted changes in supply and demand and the reliable operation of the power system. The Comprehensive System Planning Process has taken on even greater importance and complexity in recent years as the grid is impacted by a confluence of public policy mandates, advancing technology and more frequent extreme weather.

NYISO planners continuously study the electric system to identify and address changes that pose a risk to reliability. Planners conduct short-term and long-term assessments of reliability. They evaluate the system from an economic perspective, identifying investment opportunities that can support policy goals and improve the efficiency of the grid. Further, NYISO planners evaluate transmission expansion needs driven by public policies.

The NYISO's planning process functions in compliance with FERC-regulated tariffs and reliability standards established by NERC, NPCC, and the NYSRC. The NYISO's Reliability Planning Process includes biennial reliability planning reports focused on identifying and resolving reliability needs over a ten-year time horizon through the RNA and the CRP.

Planning Reports and Studies

> **Short-Term Assessment of Reliability (STAR):** Conducted every quarter to assess reliability needs within a five-year horizon to determine whether the grid will be able to supply enough power to meet demand.

> **Reliability Needs Assessment (RNA):** Evaluates the reliability of the New York bulk electric system considering forecasts of peak power demand, planned upgrades to the transmission system, and changes to the generation mix over the next ten years.

> **Comprehensive Reliability Plan (CRP):** integrates STAR reports and the most recent RNA, resolves any identified reliability needs and develops a ten-year reliability plan.

> **System and Resource Outlook (Outlook):** The Outlook will provide a comprehensive overview of system resources and transmission constraints throughout New York, highlighting opportunities for transmission investment driven by economics and public policy over a 20 year period.

In 2019, anticipating that the pace of change on the grid was increasing, the NYISO established a Short-Term Reliability Process in its federally regulated tariffs. Through this process, each quarter the NYISO issues a Short-Term Assessment of Reliability (STAR) report to identifies reliability needs that may arise over the next five years due to various changes to the grid such as generator deactivations, revised transmission plans, or updated electricity demand forecasts. Should a reliability need be identified in a STAR, the NYISO solicits for and selects solutions to address the need.

Short-Term Assessment of Reliability (STAR)

The STAR process focuses on identifying reliability needs that may occur within the next five years. In recognition of the rapidly changing power grid, the NYISO produces a STAR report on a quarterly basis. This approach provides timely opportunities to proactively identify reliability needs that may arise due to changes to the grid from generator deactivations, transmission availability, and updated electric demand forecasts.

In April 2023, the NYISO's STAR studied the period of January 15, 2023, through January 15, 2028, and warned that reliability margins in New York City could become deficient in 2025 due to several factors. The NYISO first identified rapidly declining reliability margins in its *2021-2030 Comprehensive Reliability Plan* and restated those concerns in its *2022 Reliability Needs Assessment.*

The *2023 Quarter 1 STAR* found that planned retirements of generators due to the peaker rule, electrification adoption, and extreme weather risks were having profound impacts on the electric system. The report also stated that the *2023 Quarter 2 STAR report* would likely identify a reliability need in New York City. Per regulatory oversight by the Federal Energy Regulatory Commission (FERC), the finding of a reliability need initiates a process administered by the NYISO to bring reliability margins back to acceptable operating levels.

The NYISO issued its *2023 Quarter 2 STAR* report on July 14, 2023, which identified the potential for electricity supply shortfalls in New York City beginning in the summer of 2025. The deficiency was estimated to be as great as 446 megawatts. The STAR quantified that a 446 MW deficiency could last for up to nine hours, warning that if not corrected shortfalls could lead to outages for extended periods of time on days when electricity demands are at their highest.

The report identified the need based on a deficient "transmission security margin." A transmission security analysis tests the grid's ability to withstand disturbances, such as electric short-circuits or unanticipated loss of system elements (such as a generator or a transmission line) that can risk the grid's ability to safely and reliably deliver electricity from where it is produced to where it is consumed.

The assessment covered a study period from April 15, 2023, through April 15, 2028. The report stated that the expected deficiency was primarily driven by an increase in electricity demand and a decrease in the availability of "peaker plants," which supply electricity during periods of high demand.

In 2019, the New York State Department of Environmental Conservation (DEC) took steps to limit nitrogen oxide (NOx) emissions and adopted what has become known as the "Peaker Rule." This resulted in 1,027 MW of affected peakers being deactivated or limited as of May 1, 2023, and an additional 590 MW of peakers expected to become unavailable by May of 2025. With the additional peakers unavailable, the bulk power transmission system will not be able to serve the forecasted demand securely and reliably under normal weather conditions. Extreme weather, which is often accompanied by increased demand for electricity, raises the risk of outages.

On August 4, 2023, following the identification of New York City's reliability need, NYISO initiated a process which called for solutions to address the deficiency. Throughout the process the NYISO explained that, absent viable or sufficient proposals, a potential outcome could include retaining peaker plants on a temporary basis that were otherwise scheduled for retirement while permanent solutions were developed. The NYISO received no solutions that could be installed by May 2025, or were sufficient to address the 446 MW deficiency.

The NYISO has identified dual-fuel generators on the Gowanus 2 and 3 and Narrows 1 and 2 barges as the temporary solution for New York City's reliability need. Those generators will remain available for two years beyond the original deactivation date of May 1, 2025, per the DEC's Peaker Rule. The DEC's Peaker Rule allows the NYISO to temporarily retain peakers as a last resort if no other solutions are viable or sufficient by the time the reliability need is expected. While the electric system supports the health and safety for all New Yorkers and the state's economy, the NYISO is also cognizant of the impacts peaker plants have on surrounding communities. The NYISO stated in announcing the reliability need solution that peakers should only run when conditions require and should be deactivated when no longer necessary for reliability of the electric system.

Environmental Justice and a Just Transition

> Meeting environmental justice objectives is critical to the state's climate policies.

> The CLCPA charged the state's Climate Justice Working Group with the development of criteria to "identify disadvantaged communities to ensure that frontline and otherwise underserved communities benefit from the state's historic transition to cleaner, greener sources of energy, reduced pollution and cleaner air, and economic opportunities."[3]

> Part of a just transition is considering the impact on public health and safety if reliability is not maintained.

The CHPE project is expected to enter service in spring 2026, providing 1,250 megawatts of hydropower from Quebec to the New York City area. This will address the short-term reliability need and improve reliability margins; however, if this project experiences a significant delay or if demand exceeds expectations, the reliability deficiency could persist for the ten-year planning horizon.

The NYISO is not solely relying on the CHPE as a solution. Through the quarterly STAR studies, the NYISO will continue to evaluate the reliability of the electric system, assess the continued need for the peaker plants, and monitor the progress of the CHPE project.

The NYISO is working very closely with the DEC, the NYPSC and the New York State Energy Research and Development Authority (NYSERDA) to monitor and address the reliability need in New York City.

2023-2032 Comprehensive Reliability Plan (CRP)

The NYISO released the *2023-2032 CRP* in November 2023. The report, issued biennially, highlights growing risks to electric system reliability, including projected increases in peak demand due to electrification of the transportation and building sectors; additional generator deactivations; delayed implementation of planned infrastructure projects; and extreme weather. The *2023-2032 CRP* finds that if demand on the grid grows at a rate greater than the buildout of new generation and transmission, reliability deficiencies could arise within the CRP's ten-year planning period. Finally, the CRP sets forth a plan to maintain a reliable bulk electric grid based on expected changes and forecasted conditions over the ten-year planning period.

The CRP details how the advance of new technology and economic development is compounding the complexity of maintaining reliability as we transition to a decarbonized electric system. The combination of near-term growth in demand from data centers, semiconductor fabrication, and new manufacturing facilities highlights the challenges for grid planning over the next several years. The CRP finds that this increased demand is somewhat offset by energy efficiency initiatives and distributed behind-the-meter resources.

The CRP also shows that the early stages of the grid in transition are resulting in the retirement of fossil fuel generation faster than renewable resources are entering service. This trend has led to concerns over declining reliability margins across the state — an important element for grid reliability. Since the enactment of the CLCPA, more than twice the capacity of generation has deactivated than has been added to the system. The specific attributes of the generator retirements and resource additions also can impact system reliability. Should this trend continue, the CRP warns that additional reliability needs may be identified, both statewide and for localities.

In addition, state legislation enacted in 2023 will require the phase-out of the New York Power Authority's (NYPA) small natural gas-fueled plants located in New York City by December 31, 2030. The effect of phasing out of these plants is of particular concern because of the potential impact on already thin transmission security margins in New York City. The NYISO's preliminary assessment of the 2030 phaseout, impacting 517 MW of capacity, shows that the New York City transmission security margin would be deficient as early as 2031 without additional resources to take their place or delays in their retirement. The deficiency worsens to over 600 MW by 2033 when considering the higher range of

the demand forecasted and would be far worse without the CHPE project in service. The NYPA small natural gas-fueled plants phase-out will be further evaluated in the *2024 Reliability Needs Assessment* (discussed below).

The potential risks and resource needs identified in the CRP may be resolved by new capacity resources coming into service, construction of additional transmission facilities, increased energy efficiency, integration of distributed energy resources (DERs) and/or growth in demand response participation.

However, consistent with the recent STAR reports as discussed above, the plan also underscores the importance of the timely completion of planned transmission projects to maintain system reliability, especially the CHPE project. The CRP makes clear that without the CHPE project in service by May 2026 or other offsetting solutions, reliability margins within New York City would be deficient beginning in 2026.

The CRP emphasizes the need for additional transmission infrastructure to move renewable electricity from where we expect it will be sited to where it will be needed to serve demand. Building more generation to meet growing demand alone will be inadequate to meet the needs of a modern grid — we also need to move that electricity readily around the state as consumer demand dictates. While the CRP points out the challenge with electrifying homes, buildings, and the transportation sector, adding large, new energy-intensive load will require investments in major transmission infrastructure to keep the grid safe and reliable.

The CRP also examines challenges to grid reliability of the expected transition from a summer peaking system to a winter peaking system. The assessment finds that projected increases in demand, as discussed above, pose risks to summer-time reliability in the near term, which transitions to winter-time risks in the long term.

A winter peaking system introduces new reliability concerns, particularly around fuel availability for gas-fired generators. The ability of the New York generation fleet to serve the increased winter demand will be more challenging if faced with a natural gas shortage.

Based on a recent assessment of New York's fuel and energy security, the CRP states the following:

"The NYISO will need to rely significantly on dual-fuel generation resources to support winter system reliability into the next decade and changes to the resource mix may complicate system operations during multi-day cold snap conditions. The frequency and severity of projected potential loss of load events grow over the modeling time horizon as the generation mix evolves and the demand for electricity increases."

Additionally, the CRP identifies that the increased frequency of extreme weather events poses risks to reliability. The dangers of severe weather impacting the grid have been exemplified around the country in recent years, with Texas experiencing a brutal polar vortex in winter and California facing problems from extreme heat in summer. The report underscores that New York is not immune from such extreme weather, which could lead to greater electrical demand and more forced generator outages than previously accounted for in the NYISO's baseline forecasts. In consideration of these risk factors, the New York grid may be deficient in future years such that the transmission system could not fully serve the demand. Planning for the more extreme system conditions of heatwaves and cold snaps is currently beyond established design criteria.

Reliability Needs Assessment (RNA)

The RNA, also issued biennially, evaluates the reliability of the New York grid considering forecasts of peak power demand, planned expansions and/or upgrades to the transmission system, and changes to the generation mix over the next ten years. The RNA assesses an actionable "base case" set of assumptions, referred to as "baseline assessment," as well as various scenarios that are provided for information.

The 2024 RNA will evaluate grid reliability from 2028 to 2034 and will closely evaluate risk factors, such as winter system conditions, large industrial and other energy-intensive loads, and anticipated generator deactivations that could potentially lead to deficiencies in reliable electric service over the planning horizon.

Based on preliminary data, the upcoming RNA may identify actionable reliability needs driven by planned generator retirements outpacing new supply and growing demand from large microchip fabrication and data center loads. New assumptions regarding the unavailability of non-firm gas generation in the winter could compound the potential deficiencies.

Scenario analyses, such as resource and load variations, will be conducted to identify reliability risk factors as well as to inform potential solutions to any identified reliability needs. If reliability needs are identified, a solicitation for solutions must be issued in early 2025, and the NYISO will also coordinate with transmission owners to identify potential backstop solutions.

The following are notable study assumptions for the 2024 RNA:

- **Demand Forecast Changes:** Updated data shows a roughly 3,000 MW decrease in the ten-year winter peak forecast, mainly due to slower than previously observed transportation and heating electrification adoption. This results in roughly a five-year shift in the winter forecast. The increase in the summer peak appears unchanged from previous forecasts used in the 2023-2032 CRP and recent STAR reports.
- **Large Loads:** New microchip fabrication plants and data centers pose a unique challenge for planning the grid. The 2024 RNA will account for reliability challenges of large loads that have made progress in development. The large load forecast is the result of extensive outreach by the NYISO to the utilities, state agencies and parent companies of the projects to understand the likelihood, timing, and expected energy demands of the various projects.
- **NYPA Small Gas-Fueled Plants:** as noted previously, per state laws passed in 2023, the New York Power Authority is required to issue a plan in 2025 on the phase out by December 31, 2030, of its seven small natural gas peaker plants in New York City, (totaling 470 MW) and Long Island (totaling 47 MW). The 2024 RNA base case will assume these plants are unavailable beginning in 2031.

- **Natural Gas Unavailability:** A key winter reliability concern is the potential unavailability of natural gas fuel during cold snaps. On the coldest days, the natural gas distribution companies prioritize residential heating and other critical loads and limit the fuel available to generators without firm contracts. These coldest days also correspond to peak winter electric demand periods when the gas fleet is needed the most. The NYSRC recently established reliability rules that require the NYISO to plan for credible system conditions with anticipated winter peak load and limitations on the availability of generation with non-firm gas contracts. As a result of this new rule, the 2024 RNA base case will assume the unavailability of approximately 6,400 MW of gas-only generation primarily in eastern New York under winter peak conditions.
- **Generation and Transmission Projects:** As of the May, over 1,700 MW of planned offshore wind generation and approximately 900 MW of land-based renewable resources will tentatively be included in the 2024 RNA base case. The Champlain Hudson Power Express project and the Propel NY solution selected in response to the Long Island Public Policy Transmission Need will also be included, along with a variety of local transmission projects.

As reported in the 2023-2032 CRP, reliability margins will shrink in upcoming years. The following describes the types of actionable reliability needs that could potentially be identified in the 2024 RNA along with possible paths to address the needs:

- **New York City Deficiency:** The retirement of the NYPA small gas plants by the end of 2030 is expected to cause a deficiency within New York City starting in Summer 2031. As previously noted, NYPA is required to develop a compliance plan to ensure that these plants can be retired in a reliable manner. The NYISO is coordinating with NYPA on this issue. Possible solutions could include demand reductions beyond the baseline forecast, additional offshore wind and storage projects in New York City, competitive transmission projects, or transmission projects by Con Edison or NYPA.
- **Insufficient Resources Statewide:** Increased demand in both summer and winter, planned generator retirements, and availability limitations of non-firm gas during winter could all contribute to a statewide resource adequacy shortfall. Statewide resource adequacy deficiencies are more likely to be solved by resource additions or reductions in demand and less likely to be solved by transmission additions. For a winter-related need, a potential near-term market-based solution could include non-firm gas plants obtaining sufficient firm fuel supply.
- **Stressed Winter Peak System Conditions:** With increasing winter peak loads and consideration of limitations on the availability of non-firm gas, there may not be sufficient generation to serve forecasted demand for expected weather while maintaining required operating reserves and agreed upon power interchanges with neighboring systems. The NYISO will evaluate in the 2024 RNA if this would be an actionable reliability need.

System and Resource Outlook (the Outlook)

The Outlook is the NYISO's primary economic planning report that analyzes how changes in supply and demand will affect the grid of the future and what types of investments will be needed to enable achievement of state policy, principally the CLCPA. The Outlook examines a wide range of potential future system conditions and comparisons of possible pathways to a resource mix composed of increasing levels of clean energy resources. The Outlook is not intended to fully assess reliability like the RNA, but instead flag future operational needs to facilitate a more reliable and decarbonized system in New York. It also differs from the STAR, RNA, and CRP reports in that the Outlook evaluates the New York power system over a
20-year period.

The NYISO issued the very first Outlook in 2022. The *2021-2040 Outlook* compared several possible pathways to a cleaner resource mix. Under each scenario studied, that Outlook concluded that unprecedented levels of investment in Dispatchable Emission Free Resources (DEFRs) will be necessary to reliably deliver sufficient energy to meet future demand. As more wind, solar, and battery storage facilities are added to the grid, a new class of resources is required to ensure reliability with a larger share of intermittent resources connecting to the grid. DEFRs are a classification of emission-free resources that provide the reliability attributes of synchronous generation and can be dispatched to provide both energy and capacity over long durations. DEFRs must be developed and added to the system at scale to reliably serve demand when intermittent generation is unavailable. The lead time necessary for research, development, permitting, and construction of DEFR supply will require action well in advance of 2040 if state policy mandates under the CLCPA are to be achieved.

Furthermore, the report identified that extensive transmission investments will be necessary to deliver renewable energy to consumers and address new constraints that appear across the electric system resulting from significant new resource additions. Findings from the 2021-2040 Outlook supported utility system planning efforts and the Public Policy Transmission Planning Process for identifying transmission needs driven by public policy requirements. Without proper transmission investments, the Outlook noted the likely formation and/or increased magnitude of generation pockets where constraints on the transmission system are expected to limit the full potential of future renewable energy production.

The NYISO currently anticipates publishing an updated *2023-2042 Outlook* in July 2024, incorporating changes in load forecasts and expected system conditions. It will examine multiple scenarios to identify investment opportunities and potential resource mixes for achieving 2030 and 2040 policy mandates under the CLCPA.

Public policy transmission planning

As public policies continue to shape the grid of the future, the need to invest in the transmission system has never been greater. The good news is that a historic level of transmission investment is underway, with projects recently completed or under construction that will deliver more clean energy to consumers while enhancing grid reliability. However, to meet decarbonization goals, even more investment will be necessary as discussed in the Outlook.

To understand the process for how transmission is built in the state it is helpful to understand what's known as FERC Order 1000. On July 21, 2011, FERC directed regional transmission planners — including the NYISO — to consider transmission investment needs driven by federal, state, and local public policies in their planning processes. In New York, transmission needs driven by public policy requirements are identified by the NYPSC and the NYISO evaluates and selects the more efficient or cost-effective solutions to address those needs through a competitive, multi-step effort called the Public Policy Transmission Planning Process:

Step 1: The NYISO solicits proposals for transmission needs driven by public policy requirements from interested parties. These proposals, as well as any suggestions from the NYISO, are collected and provided to the NYPSC for consideration.

Step 2: The NYPSC considers and identifies proposed transmission needs. During this period, the NYPSC examines the public policy requirements and considers whether there are requirements driving the need for additional transmission investment. Consistent with state law, the NYPSC seeks public comment, and many parties, including the NYISO, actively participate in this part of the process.

Step 3: If the NYPSC identifies a specific transmission need for the power system, the NYISO requests and evaluates proposals from qualified developers. Following receipt of proposed solutions to a public policy transmission need identified by the NYPSC, the NYISO conducts a comparative evaluation of the solutions based on their ability to satisfy the needs identified by the NYPSC and other criteria aimed at identifying the more efficient or cost-effective solution. The NYISO's evaluation is performed transparently with continuous input from stakeholders and developers through its governance process.

Step 4: Based upon results of the NYISO's evaluation and input from stakeholders, the NYISO Board of Directors may select the more efficient or cost-effective solution. Following selection, the designated developers will proceed with the development and construction of the project.

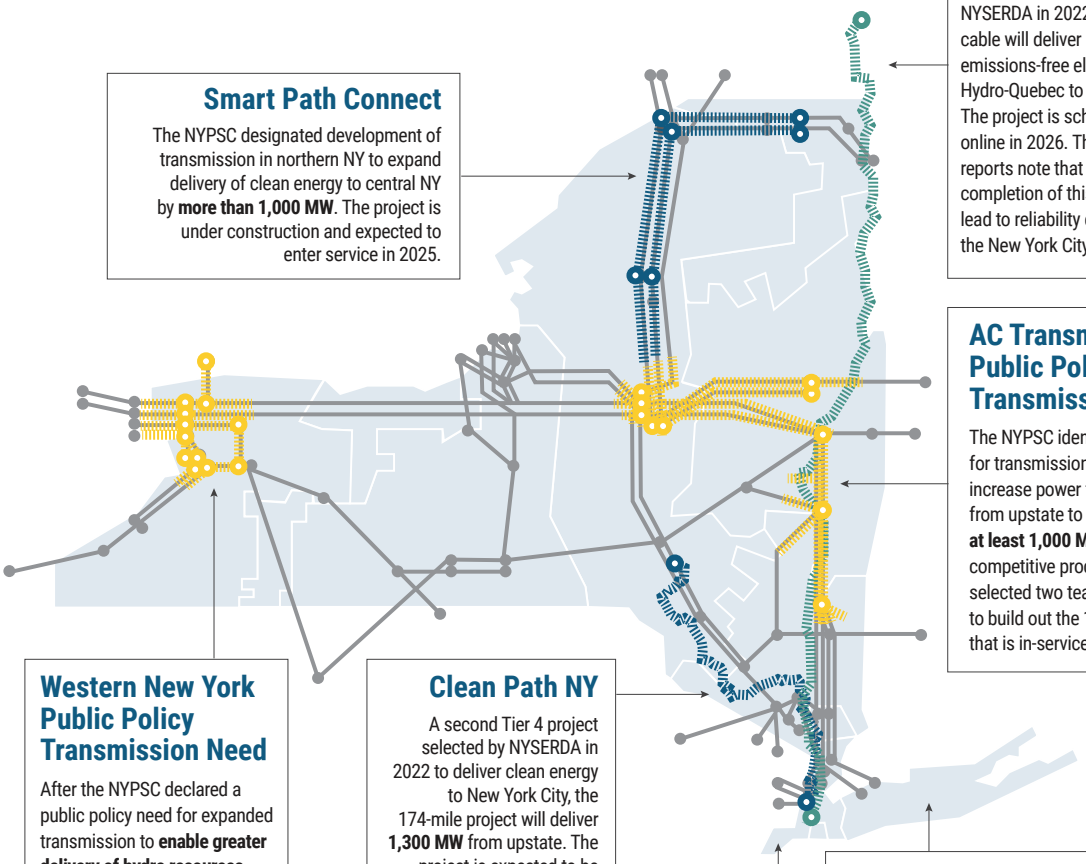
In recent years, the NYPSC has identified five transmission investment needs being driven by state policy. The first, located in western New York, was completed in 2022 and expanded the delivery of emissions free hydropower to consumers across the state.

Two additional projects in the Mohawk and Hudson Valley regions primarily completed construction in 2023 to increase the power flowing from upstate generators to downstate consumers by more than 1,000 MW. Together, these three projects represent the largest investment in transmission infrastructure in New York State in more than 30 years.

The fourth transmission need identified by the NYPSC sought to deliver future offshore wind energy from Long Island to New York City and the rest of the state. The NYISO issued a solicitation for proposals to address this need, and the NYISO's Board of Directors selected, in June 2023, the Propel NY solution submitted by the New York Power Authority and New York Transco LLC. The project will deliver at least 3,000 MW from offshore wind projects — advancing the state closer to its goal of 9,000 MW of offshore wind capacity by 2035.

In March 2024, the first of what is expected to be several offshore wind farms interconnecting to Long Island's power grid commenced operation. The 12-turbine, 130 MW South Fork wind project is about 35 miles off the coast of Montauk where it will supply a portion of the grid that is heavily reliant on fossil fuels. As new offshore wind projects begin to inject energy into Long Island, the Propel NY project, which is expected to be in service in 2030, will provide expanded transmission capability to reduce the prospect that offshore wind production will be curtailed.

NEW TRANSMISSION PROJECTS IN NEW YORK STATE



Champlain Hudson Power Express (CHPE)

Awarded a Tier 4 REC contract by NYSERDA in 2022, the 339-mile cable will deliver **1,250 MW** of emissions-free electricity from Hydro-Quebec to New York City. The project is scheduled to come online in 2026. The NYISO reliability reports note that any delays in the completion of this project could lead to reliability challenges in the New York City area.

Smart Path Connect

The NYPSC designated development of transmission in northern NY to expand delivery of clean energy to central NY by **more than 1,000 MW**. The project is under construction and expected to enter service in 2025.

AC Transmission Public Policy Transmission Need

The NYPSC identified the need for transmission investment to increase power flow of energy from upstate to downstate by **at least 1,000 MW.** Through a competitive process, the NYISO selected two teams of developers to build out the 150-mile project that is in-service.

Western New York Public Policy Transmission Need

After the NYPSC declared a public policy need for expanded transmission to **enable greater delivery of hydro resources** from Niagara, the NYISO selected a 20-mile, $181 million project through an extensive, competitive process. The project is in-service.

Clean Path NY

A second Tier 4 project selected by NYSERDA in 2022 to deliver clean energy to New York City, the 174-mile project will deliver **1,300 MW** from upstate. The project is expected to be in-service in 2027.

NYC Public Policy Transmission Need

In June 2023, the NYPSC identified a need to expand the state's transmission system to **deliver energy from offshore wind resources to New York City.**

Long Island Public Policy Transmission Need

In 2021, the NYPSC identified a need to expand the transmission capability between Long Island, NYC, and the rest of the state by **at least 3,000 MW** to support the CLCPA's offshore wind requirements. Expanded transmission is needed to move offshore wind energy from Long Island to the rest of NY. The NYISO Board of Directors selected a solution in June 2023.

In June 2023, the NYPSC identified a fifth transmission need driven by a public policy requirement to support the injection of offshore wind generation into New York City. The NYPSC directed that proposed solutions to address the minimum requirement of this need to inject approximately 4,800 MW of incremental offshore wind generation into New York City must demonstrate their ability to be in service by January 1, 2033, to support the CLCPA's timeframe for offshore wind.

The NYISO has been working with New York State Department of Public Service staff, NYSERDA, stakeholders, and interested parties, including hosting technical conferences, in advance of its solicitation for solutions to this new public policy transmission need.

Additional transmission investment

There are several additional transmission development efforts underway that are driven by state policies but are not part of the NYISO's Public Policy Transmission Planning Process. For instance, the Smart Path Connect Transmission Project (Smart Path) is under construction pursuant to New York State's Accelerated Renewable Energy Growth and Community Benefit Act, which enabled the NYPSC to authorize the development of the project. Smart Path is intended to increase delivery of renewable energy from northern New York and Canada to consumers. Further, two "Tier 4" transmission projects are under development. In 2020, the NYPSC established a new Tier 4 Renewable Energy Credit (REC) product as part of its Clean Energy Standard for resources that can deliver qualified renewable energy into New York City. Following a competitive solicitation process administered by NYSERDA, the NYPSC approved contracts with two projects, the CHPE project to deliver Canadian hydropower directly to Queens, and the second is known as Clean Path NY, which proposes to deliver renewable energy from upstate New York directly into New York City. CHPE is currently under construction, with a projected in-service date in 2026. The Clean Path NY project is in the latter stages of the interconnection process and is awaiting Article VII certification from the NYPSC, a required predicate to commencing construction of the project.

Interregional transmission for offshore wind investment

In June 2023, New York State joined seven regional states in calling on the U.S. Department of Energy (DOE) to support the formation of a "Northeast States Collaborative on Interregional Transmission" for the DOE and the states to "work in partnership to explore opportunities for increased interconnectivity, including for offshore wind, between our regions." The request added that the three regional transmission organizations (ISO-New England, PJM Interconnection, and the NYISO) "could be invited to participate as additional technical support to the Collaborative. As…they are uniquely positioned to help identify cost-effective options for increasing transfer capability and have been coordinating on planning for many years."[4] The three regions continue to work with the regional states and the DOE to explore cost-effective opportunities to deliver new clean energy supply to the region.

New York has seen the most significant investment in new transmission in decades through the NYISO's Public Policy Transmission Planning Process.

Interconnection planning

There has been an unprecedented increase in the number of projects seeking to connect to the bulk power system since the passage of the CLCPA in 2019. As the grids evolves, it also requires careful coordination and thorough analysis to safely and reliably connect new resources to the system. Through the interconnection process, as required by the Federal Energy Regulatory Commission, the NYISO seeks to balance the demands of open access to the electric system with grid reliability while protecting customers from undue costs.

Through the NYISO's interconnection process, major generation, transmission, and load projects are studied to assess the reliability impact they may have on the electric system. The interconnection process is coordinated by the NYISO but requires significant involvement by both the electric utilities and developers. Each party has an important role to play, and success of the process depends on coordination and timely delivery of information by all participants.

Transparent and robust rules for reliably connecting to the grid provide essential information for developers. Working closely with developers and affected utilities, studies identify necessary system upgrades and estimated costs to allow new resource developers to make informed investment decisions. Costs identified as necessary to maintain reliability are borne by developers and not consumers under the NYISO's interconnection process. If electric system upgrades are found to be necessary to maintain reliability, project developers, not consumers, are required to pay for investments identified through the process.

In August 2018, the NYISO's interconnection queue hosted 174 proposals. The queue at that time included 26 proposals representing more than 8,400 megawatts of fossil fuel-based generation. In 2024 the queue contains more than 520 proposals, with more than 117,000 megawatts of proposed clean energy supply resources. It is important to keep in mind that not all proposals in the interconnection queue are destined to enter commercial operations. Developers often submit multiple proposals with multiple proposed points of interconnection for what is intended ultimately to be one project. However, our planning team must still perform analyses of each submitted proposal as required by FERC.

In 2023, the NYISO was pleased to announce that 27 new wind, solar, energy storage and transmission expansion projects totaling 7,452 megawatts completed their final interconnection study, or "Class Year," bringing them closer to commercial operation. A Class Year is a group of projects seeking to connect to the transmission system within the same relative time horizon that have also met necessary milestones through the NYISO's legally mandated evaluation process.

The NYISO must also perform a rigorous analysis of large load projects, like major manufacturing facilities, that will draw substantial amounts of power from the grid. Since 2018, the number of load-related interconnection requests grew from just one project with a proposed 500-megawatt load to ten requests in early 2024, totaling 1,846 megawatts.

In anticipation that state policies would drive an influx of new interconnection requests, the NYISO worked with stakeholders to implement a comprehensive redesign of the interconnection study process in 2019, offering greater flexibility and expedited study options to developers.

To make the Class Year process more efficient and encourage the development of renewable energy, the NYISO is pursuing further reforms under three broad categories:

- Improved and more transparent communication with developers;
- Efficient administration and coordination between parties; and
- A revised scope and structure of the interconnection process to make the Class Year Study and entire process more efficient.

In addition to these enhancements, the NYISO has worked with stakeholders, asset owners, and developers in response to FERC Order 2023. The order, while sweeping in nature, leverages many of the concepts already included in the NYISO's interconnection rules.

Even with these new rules and improvements in place, it remains true that multiple factors outside the scope of the NYISO's control can impact whether a project elects to move forward with the interconnection process, including the status of siting and other regulatory matters, investment risks, and supply-chain concerns. These factors can result in developers electing to defer or drop out of the process, even after the final interconnection studies have been completed and interconnection costs have been allocated and accepted.

7,452 MW

of new wind, solar, energy storage, and transmission expansion projects completed their final interconnection study in 2023

To address the increase in projects seeking to connect to the grid, the NYISO is working with stakeholders to implement further improvements to the interconnection study process. Additional engineers and project management staff have been hired to support existing engineers who are currently shouldering the increased workload. Additional staff will also help manage timelines and customer service functions. Focus groups with developers are ongoing to identify additional areas for enhancements. New technology is also being developed that will create transparency and efficiencies in managing demands for applicants as well as NYISO staff.

Enhancing and Improving the Interconnection Process to Connect More Clean Energy

Recognizing the importance of the CLCPA, we've improved the interconnection process to help advance clean energy projects in New York.

NYISO commenced a comprehensive and substantial interconnection queue reform effort in January 2023 to address the unprecedented number of projects seeking to interconnect.

Following the issuance of FERC Order 2023, the NYISO worked with stakeholders to fashion a reform proposal to address the Commission's directives and goals.

FERC's reform efforts focused on three areas: 1) implement a "first-ready, first-served" cluster study process; 2) increase the speed of queue processing; and 3) incorporate technological advancements into the interconnection process. The NYISO held more than a dozen stakeholder meetings to discuss details of its compliance proposal.

Among the key elements of the NYISO's proposal are:

- Transitioning directly into a new "first-ready, first served" cluster study process with the option of a transition cluster study open to all interconnection customers.
- Incorporating several reforms intended to speed queue processing, including limiting project modifications, requirements for projects to prove commercial readiness, and physical readiness.
- Establishing a rolling pre-application window for customers, an enhanced scope for customer engagement, and incorporating small generating facilities into the cluster study process.

In 2023, our team completed reliability studies for 60 projects with an average completion time of 132 days – a 200% improvement.

We continue to add additional professionals to our interconnection team to address the increasing workload and customer service needs.

We've also launched an improved technology platform to streamline submissions, improve transparency and access to information and help answer common interconnection questions. We're also engaging with customer focus groups to discuss and develop additional functions and improvements.

Wholesale Electricity Markets

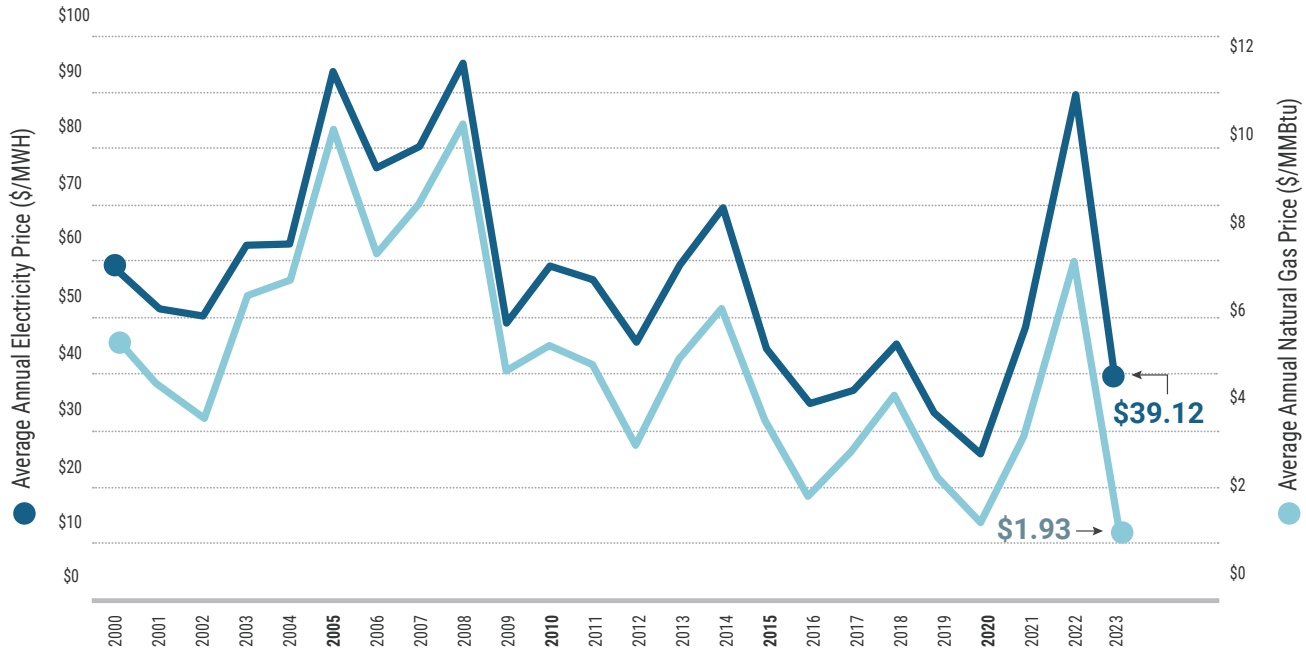
Attracting needed grid reliability resources while protecting consumers

Maintaining a reliable energy system requires that enough power generating capacity is installed system-wide to meet projected electricity demand and reliability requirements.

For the past 25 years, competitive wholesale electricity markets in New York have supported the reliable, efficient operation of the grid. Furthermore, as investors looked for opportunities to develop new resources to supply the grid, electricity markets ensured that the risk of those investments remained entirely on the developer an investor, rather than on ratepayers and taxpayers.

An added benefit of wholesale electricity markets is that competition among resources rewards economic efficiency. Historically, this has resulted in cleaner and more efficient supply coming onto the grid and displacing older, less efficient supply.

AVERAGE ANNUAL NATURAL GAS AND WHOLESALE ELECTRICITY PRICES IN NEW YORK: 2000-2023



Wholesale electricity markets use price signals to attract and retain enough supply in the most beneficial locations on the system to provide needed reliability services. Today's grid consists largely of dispatchable resources that respond quickly to system needs. To ensure markets continue to attract the investment necessary for the grid of the future, we are taking numerous steps to evolve and enhance market designs.

However, long before the 2019 CLCPA was passed into law, our market design team worked to implement rules that increase participation of storage, solar, and wind on the grid. These market innovations, including a draft plan to integrate a social cost of carbon into wholesale energy prices, are ways in which markets can create incentives in support of both reliability and clean energy goals.

New York represents the 8th largest economy in the world. Powering our economy requires continuous innovation and maintaining a continuous balance of electric power. As New York continues its transition toward a decarbonized electric grid, wholesale electricity markets will continue to be the foundation of delivering energy reliably.

Protecting Consumers

> The NYISO has a team of engineers and economists that review market performance to make sure that prices reflect market conditions, such as fuel costs to produce energy. The NYISO can modify market participant offers if they do not meet competitive market rules that require that offers appropriately reflect supplier's costs.

> An independent market monitor evaluates the performance of the NYISO's markets each day to make sure market outcomes reflect strict market rules driving competition to serve customers. The market rules and how they are administered are also subject to review by the independent market monitor to make sure our market design is as efficient as possible.

> FERC's Office of Enforcement and the New York State Department of Public Service are active in evaluating markets and how they are administered. FERC can issue penalties to entities that violate wholesale market rules.

Competitive electric markets benefit consumers and system reliability

To meet the complex needs of managing the energy grid, we operate multiple wholesale competitive electricity markets that work together to achieve a reliable and efficient system.

The costs to procure adequate capacity for projected peak demand levels and to produce electricity in the precise quantities needed by the grid in real-time are all included within the cost of wholesale electricity, but the NYISO manages a separate market for each to support their different purposes.

Each of the NYISO-administered markets are interdependent, and facilitate a different piece of the reliability puzzle:

- The Capacity Market secures commitments from supply resources to be available to meet seasonal and annual resource adequacy requirements.
- The Energy Market secures electricity production to meet demand in real-time.
- The Ancillary Services Market secures flexibility services from suppliers to maintain balance in response to changing conditions on the electrical grid.

Wholesale market price signals guide investment decisions and performance but the rules that guide these markets continue to evolve to reflect the changing needs that clean energy policies and technologies are introducing to the grid. For instance, the ability of supply resources to rapidly increase or decrease their output levels, known as ramping capability, will become increasingly valuable as more wind and solar resources enter operation.

We are further examining emerging needs through various planning initiatives. Modeling future grid scenarios as discussed in the Planning section of Power Trends, helps us identify challenges that may arise as more weather-dependent resources connect to the system. Doing so helps to define the specific characteristics of services the grid will need to maintain reliability. From this work we can modify electricity markets and ensure they attract and retain the resources needed to support reliability through the transition to a clean energy grid.

Transitioning to the clean energy grid of the future will require unprecedented investment in new supply resources. Competitive markets support and encourage continuous gains in efficiency and innovation. Inefficient producers are replaced by new, cost-effective, and cleaner technology.

Market-based price signals are transparent and stimulate necessary infrastructure investment to meet renewable and decarbonization goals, energy conservation, and demand response. Finally, markets ensure that the risk of these investments remains with the investor, rather than consumers, as opposed to taxpayer and ratepayer funds used to finance investments.

Policy Incentives

> **State Renewable Energy Credits (RECs), Offshore Renewable Energy Credits (ORECs), Zero-Emissions Certificates (ZECs) and other publicly directed investment incentives** seek to achieve environmental goals by awarding out-of-market payments to policy-mandated clean energy resources. These include land-based and offshore wind, solar, storage, existing nuclear generation, and certain kinds of distributed resources. Funded through ratepayer assessments, these incentives reward clean energy production, but are limited in their ability to incentivize production in response to system reliability needs. The NYISO-administered wholesale electricity markets complement these incentives by selecting the least-cost mix of supply to serve consumer demand and maintain grid reliability. Markets reward resources for the reliability services they provide, when and where needed.

Energy Market

The energy market provides a fundamental platform for utilities, large consumers, retail energy providers, and other load serving entities to purchase electricity in the NYISO marketplace. Put simply, the energy market provides a means for load serving entities to satisfy the immediate power needs of the customers they serve.

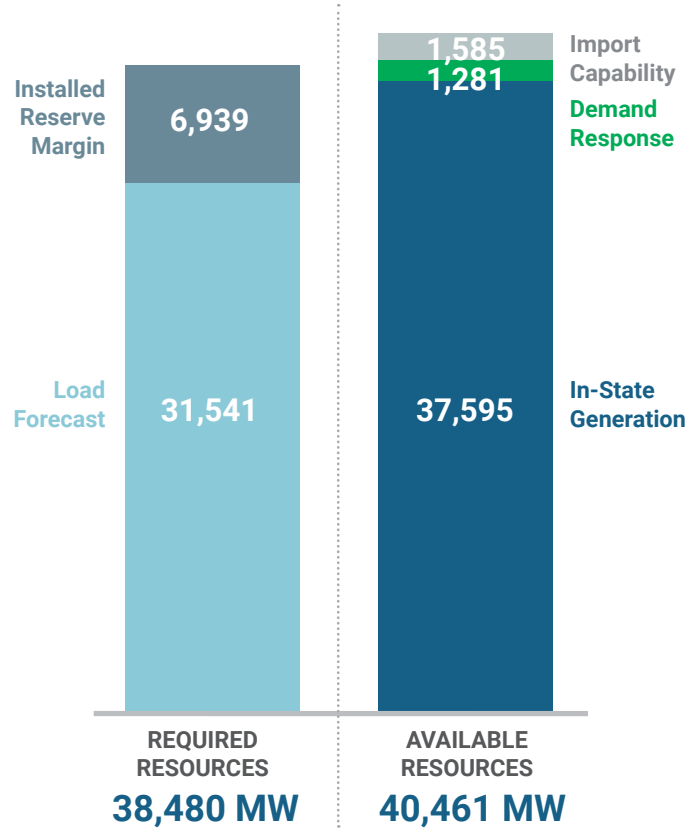
While some electricity is bought and sold directly between suppliers and utilities, much of the electricity consumed in New York is procured through the wholesale electricity markets. In these markets, suppliers compete to offer electric supply and ancillary services necessary to maintain reliability.

Every five minutes, every day, these markets select the least-cost mix of supply to meet changing electricity demand across the state, all while adhering to strict reliability standards. After being selected in these auctions, suppliers deliver their services to the marketplace. Several factors influence which suppliers are selected for their services, including location, cost, and the amount of electricity flowing across the grid.

Capacity Market

Our highest priority is to maintain reliability of the electric system, and in keeping with our mission, we operate the capacity market to meet resource adequacy requirements and other reliability requirements. The capacity market acts as a transparent and cost-effective mechanism to avoid the danger of service interruptions and outages.

STATEWIDE RESOURCE AVAILABILITY: SUMMER 2024



Strict reliability rules require extra capacity to be available in excess of expected peak demand, so demand can be met reliably even when unforeseen events occur like transmission or generation outages, or additional demand from hotter than expected weather. This requirement to maintain extra supply among the pool of resources interconnected to the grid is called the Installed Reserve Margin (IRM). The IRM is set annually by the NYSRC, with approval by FERC and the NYPSC, based on reliability rules, annual peak demand projections, grid constraints, and the makeup of the supply mix anticipated to meet demand. Developing the IRM is an extensive study process that unfolds over much of the year to align requirements with reliability needs.

The IRM is based on updated load, resource, and transmission models. It is derived by engineers, meteorologists, and economists, using strict reliability rules, engagement with industry stakeholders,

and oversight from regulators. Inputs include information from NYISO such as changes in forecasted demand, supply performance capabilities, and transmission system constraints.

Not every region in the U.S. uses this mechanism to support reliability for customers. For example, Texas and California do not operate capacity markets. Due to a multitude of factors including the challenges of coordinating the pace of renewable energy integration with the retirement of fossil resources, both states are beginning to consider capacity market-like structures to address reliability going forward. For example, in 2022, the grid operator in California, CAISO, extended special contracts through the end of 2023 with a handful of fossil-fuel power plants that were scheduled to retire. This type of contract is only utilized in scenarios where concerns about availability of supply are very high, and the risk of capacity shortages is significant.

NYISO Shared Governance

> The NYISO and its stakeholders utilize a shared governance process to establish wholesale market rules and processes associated with grid planning and operations.

> This process engages suppliers, transmission owners, consumers, environmental and environmental justice interests, and state organizations to facilitate the development of the rules and processes for a reliable and economically efficient grid in New York.

Rather than relying on this approach, which is meant for last-resort scenarios, the NYISO's capacity market provides built-in security to the marketplace for energy. The NYISO's capacity market ensures that supply is not only available, but also that the cost of that supply is as competitive as possible for the benefit of consumers.

Ancillary Services Market

Ancillary services refer to functions that help grid operators maintain a reliable electricity system by maintaining the proper flow and direction of electricity. These increasingly essential grid services address imbalances between supply and demand, avoid power system interruptions, and help the system recover after a power system event. Ancillary services can include the following structures:

- Synchronized regulation corrects for changes in electrical imbalances that might affect the stability of the power system every six seconds.
- Operating (or contingency) reserves are used to respond to an unexpected outage of a system component, such as a generator, transmission line, circuit breaker, switch, or other electrical element.
- Flexibility reserves are an emerging concept for addressing variability and uncertainty on longer timescales than operating reserves and regulation service.

The NYISO is working with stakeholders via our transparent shared governance process to expand ancillary services products to better support reliable grid operations and help to balance the intermittent nature of the anticipated renewable generation fleet. These products will help signal and procure the grid reliability attributes, at the lowest cost to consumers, that will become increasingly important in balancing weather-dependent resources to achieve a reliable grid, attributes that were previously provided by fossil fuel generators.

In a clean energy grid of the future, a premium attribute of energy supply will be its flexibility. We are working on several market innovations that will attract flexible resources that perform when needed and reward those resources that can support balancing grid supply and demand. With ever-increasing intermittency, extreme weather, and demand from electrification and economic development, the economic force of markets is essential for maintaining reliability.

First in the Nation DER Integration

> DERs, including solar, energy storage technologies, and microgrids are generally installed to supply customers directly, which impacts the amount of demand that must be supplied by the bulk power grid that the NYISO operates. In April 2024, the NYISO launched a first-in-the-nation program to integrate DER aggregations into the wholesale electric markets. The new rules allow DERs of 10 kilowatts or more to participate in aggregations that will provide reliability and other important services to the electric grid. The rules effectively enable multiple resources to be dispatched in a coordinated manner to encourage flexible supply and demand to respond to dynamic grid conditions. In approving the rules, FERC Chairman Willie Phillips and Commissioner Allison Clements noted that, "…NYISO has been at the forefront of developing a participation model for DERs and seeking to implement that model expeditiously."[5] The NYISO forecasts distributed generation in the state to more than double by 2040 as the state pursues its renewable and decarbonization objectives.

Market enhancements currently underway

The NYISO's wholesale electricity markets continuously evolve to address changing system needs and capture the benefits of new technologies entering the grid, all while supporting reliability. Through ongoing, effective engagement with stakeholders and policymakers, the NYISO continues to prepare the wholesale electricity markets of today for the needs of consumers tomorrow.

Winter reliability capacity enhancements

More than half of New York's generating capacity relies on fossil fuels to produce electricity. The prospect of a winter-peaking system introduces new reliability challenges, driven by the challenges to secure fuel on the coldest days. Proper price signals must be designed to encourage participation from supply resources with firm fuel supply arrangements. We are working with stakeholders to identify the emerging winter risks and determine what market changes may be needed to compensate suppliers for meeting these needs.

Dynamic reserves to balance intermittency

Operating reserves ensure sufficient supply to meet changing conditions in real-time, such as unplanned generator or transmission outages. Historically this need was solved by identifying fixed, system-wide reserve requirements. As renewable capacity grows and supply to the grid is more susceptible to changing weather conditions, establishing dynamic reserve requirements will support renewable energy integration by more accurately accounting for uncertainty and procuring this additional reserve at the lowest cost to consumers. Development of initial design requirements are anticipated through 2026 and discussions will continue with stakeholders thereafter.

Advanced storage modeling

Coordinating the growing fleet of storage resources requires advanced modeling techniques in day-ahead and real-time markets, and improved tools for grid operators to manage capabilities so that these resources are deployed at the most effective times to meet New York's reliability needs. Efforts are

underway with stakeholders to develop these capabilities so that storage resources, which act as both load and supply and have limited-duration capabilities, are utilized in an optimal manner.

We anticipate deployment of enhanced tools in 2027, in advance of the state's 2030 goals calling for 6,000 MW of storage capacity.

Carbon pricing

Economists widely agree that one of the most effective means of decarbonizing the power grid is to integrate the cost of carbon dioxide emissions into the cost of energy. Several years ago, we worked with stakeholders to develop a carbon pricing proposal that would incorporate a cost of carbon dioxide emissions in the electricity markets we administer, rewarding investment in clean energy while promoting efficiency improvements to fossil-fuel plants. Numerous studies confirm the proposal's ability to assist meeting the state's goals faster and more cost-effectively while maintaining grid reliability.

As New York progresses towards the mandates established by the CLCPA, competitive electricity markets offer a powerful means to drive needed energy infrastructure investment in support of reliability. While state incentives may continue to attract investment in clean energy generation, electricity markets will continue to attract the capabilities necessary to balance the availability of intermittent resources and ensure that the clean energy grid is also a reliable grid.

Our market design team continues to work with stakeholders to define and implement various market enhancements and has been a leader in defining and implementing structures that expand integration of decarbonized solutions.

New York Cap and Invest

> In 2023, the New York State Department of Environmental Conservation (DEC) and the New York State Research and Development Authority (NYSERDA) opened proceedings related to the New York Cap and Invest (NYCI) Program, which is being designed to "reduce harmful climate-altering greenhouse gas emissions, improve public health, and help combat climate change while advancing environmental justice and investing in disadvantaged communities statewide." DEC and NYSERDA sought comments early in 2024 on the various components of the NYCI Program.

> The NYISO offered comments on the NYCI Program proposal, suggesting that programs must be designed to "reflect the necessity of maintaining the reliability of the electric system, including safeguards to deal with unplanned circumstances during the transition."

> NYISO's comments went on to explain that reflecting the cost of greenhouse gas emissions and public policy mandates in wholesale electricity markets would support new resource development needed to achieve CLCPA mandates, signal where on the system new resources would have the most benefit, and efficiently maintain electric system reliability.

> Several approaches, or combinations of approaches, could be used to reflect emissions costs in wholesale electricity markets. NYCI allowance costs could flow into wholesale electricity markets through generator offers. Alternatively, the State and the NYISO could work together to implement a carbon price in the NYISO-administered wholesale electricity markets. The NYISO developed a carbon pricing design several years ago with its stakeholders, which could be reevaluated and used to reflect the cost of carbon dioxide emissions in the wholesale markets as a step to achieving the CLCPA mandates.

On the Horizon

Next steps for the grid in transition

The NYISO's nearly 600 employees share a common mission: maintain grid reliability, deliver electricity at the least cost through our wholesale markets, plan for an effective and efficient transition to a clean energy grid, and serve as an independent and authoritative source of information for policymakers, regulators, investors, stakeholders, market participants, and the public.

Every minute, every hour, every day, highly skilled grid operators support reliability and resilience. Through sophisticated modeling and expertise, NYISO grid planners support reliability and enable record levels of new transmission and supply development. The NYISO's innovative wholesale market design continues to lead the way in supporting reliability and cost efficiency.

The NYISO's role as an independent, authoritative source of information is essential. As we move towards a zero-emissions grid, it is critical to understand how the growth of intermittent resources and risks stemming from extreme weather, both in the summer and winter, will impact the ability to maintain reliability of the New York electric system.

Addressing the pace of change as we transition from the grid of today to a clean energy grid of the future is the focus of all elements of the NYISO. Balancing the transition in the mix of supply through effective planning that identifies and mitigates reliability risks, supports needed transmission investment to access supply, and more efficiently coordinates interconnection of new clean supply is at the forefront of the NYISO's work.

Public policies seeking to electrify building heating and cooking appliances, as well as expand electric vehicle adoption to reduce emissions, are changing consumption patterns, and emphasizing the importance of grid reliability. This shift is expected to grow electric demand in winter, making the cold-weather months the highest-demand period of the year by the mid-2030s.

For the NYISO, our stakeholders, developers, and policymakers, there are key near-term milestones as the grid transitions, which will both influence and reflect the policy, economic, and technological landscape before us.

These include:

- **July 2024:** NYISO issues second quarter Short-Term Assessment of Reliability (STAR) report
- **Summer 2024:** NYISO issues new edition of the System and Resource Outlook study.
- **October 2024:** NYISO issues third quarter Short-Term Assessment of Reliability (STAR) report which will evaluate the changing mix of supply, transmission capability, and forecasted demand over the next five years.
- **Fourth quarter 2024:** NYISO issues the 2024 Reliability Needs Assessment (RNA).

As policymakers seek widespread change in how energy is produced and consumed, the NYISO is providing critical data and information on the reliability implications of current and new policies. The NYISO will continue to actively engage with stakeholders and policymakers on the path to a reliable and lower emissions grid for New York.

The NYISO's leadership in developing innovative market design enhancements demonstrates our focus on innovation. The expertise of our grid operations is unrivaled, and the importance of the skilled and authoritative system planning work done by the NYISO demonstrates the value of our independence. That success also demonstrates our ability to work across all sectors and interested parties to build consensus that supports reliability, consumer interests, climate policies and new technologies that will help build the grid of the future.

Information for Policymakers

Through expert system operations, planning, and wholesale electricity market design, the NYISO is working to identify the reliability needs of the future grid envisioned by New York's nation-leading climate policy goals. We will continue to engage policymakers and our stakeholders to design and implement the operations, planning and market enhancements necessary for the grid in transition, consistent with our mission and vision.

Learn more about the issues currently impacting New York's grid and the NYISO's role in this transition:

Planning for Reliability

> Grid in Transition
> Addressing Transmission Needs
> Interconnection Process
> Planning Process

Wholesale Electricity Markets

> Competitive Wholesale Electricity Markets
> How Markets Can Support Climate Goals
> Electricity Prices in New York

Independence and Transparency

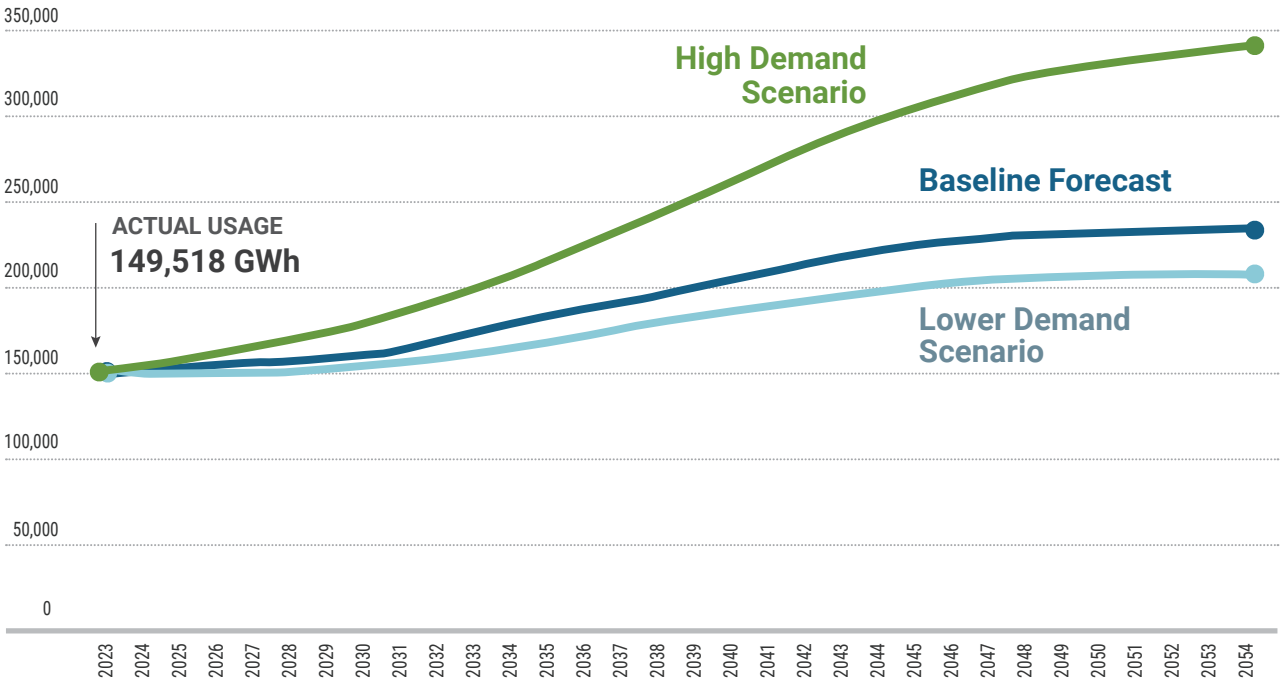
> History
> Regulatory and Reliability Organization Oversight
> Independence

Appendix

NYISO by the numbers

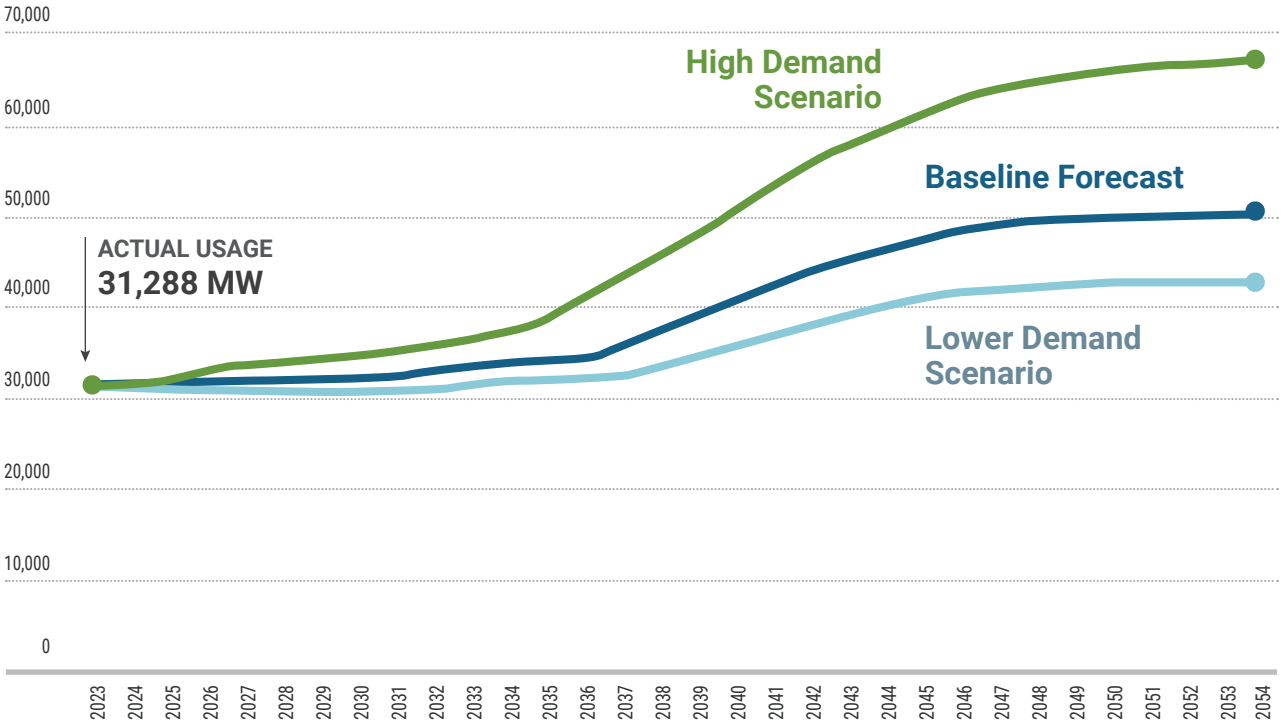
Demand Trends

ACTUAL AND FORECAST LOAD (GWH): 2023-2054



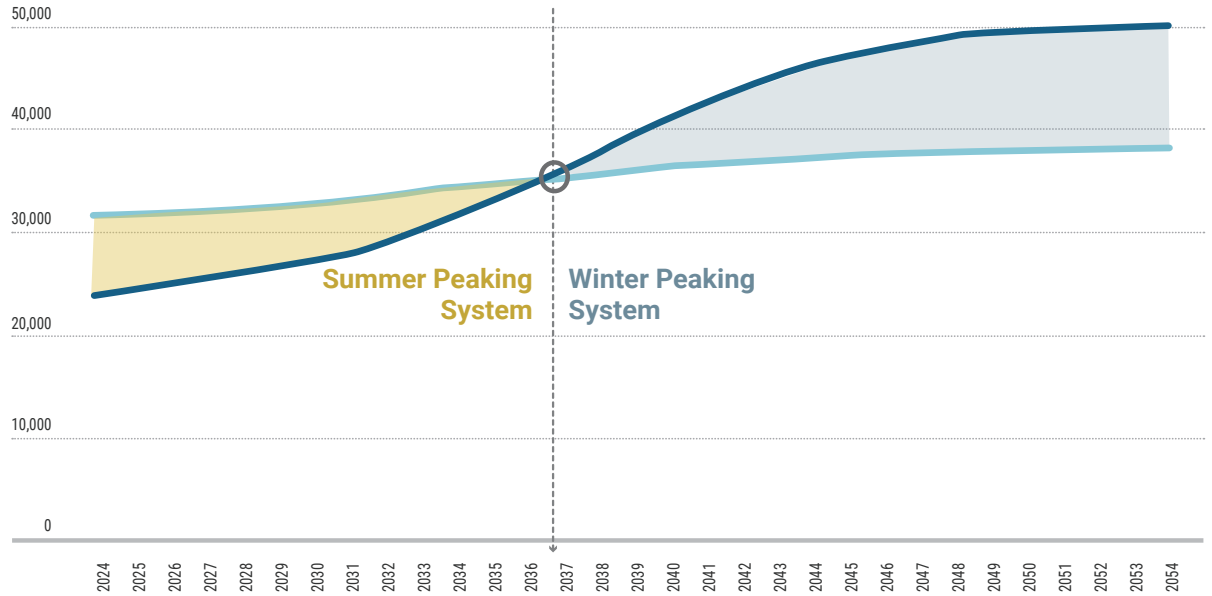
> This figure presents three scenario forecasts: a baseline forecast that the NYISO assumes is the most likely outcome based on current observations and assumptions, and two scenarios that include differing assumptions about key inputs in the forecast, including economic activity and the adoption of electrification. These High-Demand and Low-Demand scenarios provide bounds around the baseline forecast. For example, the Lower Demand Scenario assumes slower economic activity and lower saturation of electric heating. The Higher Demand Scenario assumes greater economic activity and a greater saturation of electric heating.

ACTUAL AND FORECAST ANNUAL PEAK DEMAND (MW): 2023-2054



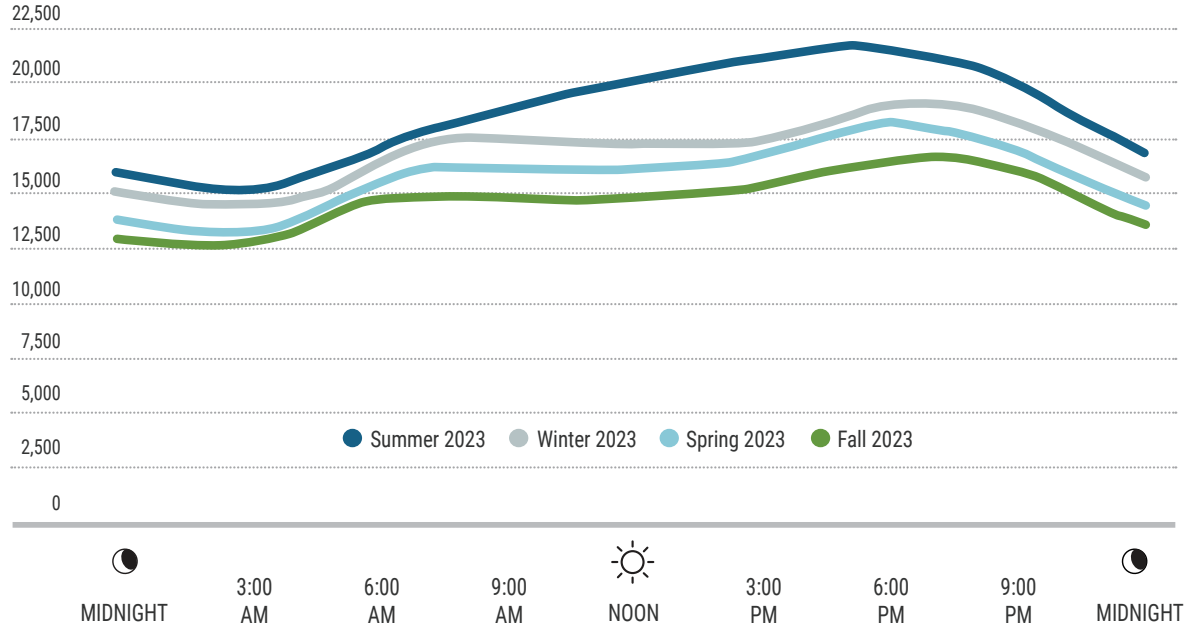
> This figure presents three scenario forecasts, a baseline forecast that the NYISO assumes is the most likely outcome based on current observations and assumptions, and two additional scenarios that include differing assumptions about key inputs, such as the rate of electrification adoption and economic activity, providing lower and upper bounds around the baseline forecast. For example, the Lower Demand Scenario assumes slower economic growth, lower electric vehicle sales, and lower saturation of residential electric heating. The Higher Demand Scenario reflects faster growth of plug-in vehicles, a greater degree of unmanaged charging that can contribute to higher peaks, and significantly greater saturation of residential electric heating.

SUMMER AND WINTER PEAK DEMAND FORECASTS (MW): 2024-2054



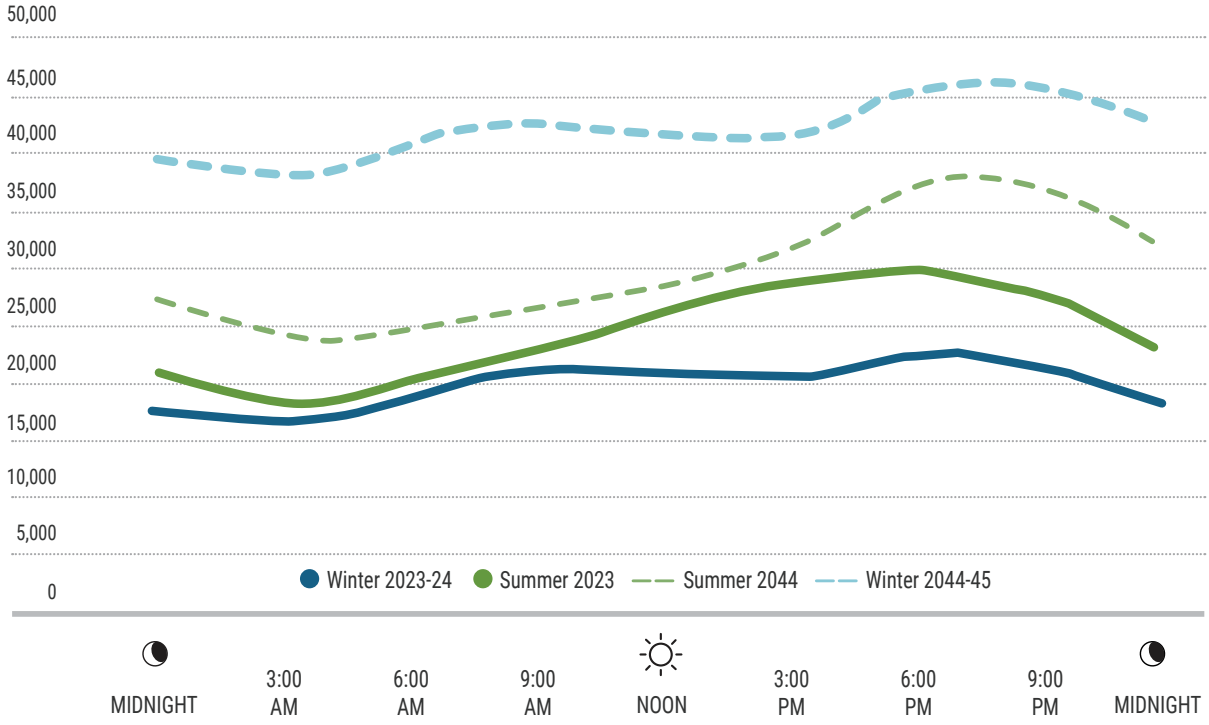
> Electrification of the transportation and building sectors will drive winter peak demand higher in the future. The exact timing the transition to winter peaking will depend heavily on the adoption of residential electric heat. A winter-peaking system introduces new challenges to reliability planning, including the need for greater focus on fuel security.

SEASONAL HOURLY DEMAND PATTERNS (MW): 2023



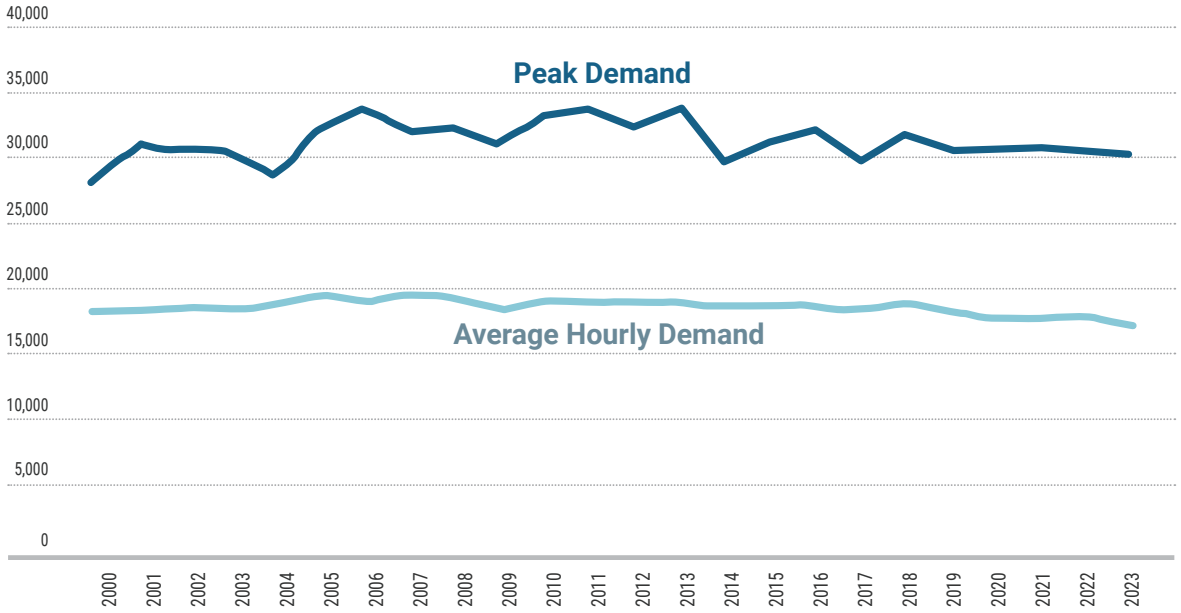
> Demand for energy fluctuates throughout the day as well as throughout the year. Currently, a summer-peaking state, New York's electricity consumption is driven by air conditioning use during the summer months. The grid needs sufficient supply resources to meet summer peak demand periods even though demand throughout much of the year is significantly lower.

PROJECTED VS. CURRENT SEASONAL LOADS (MW)

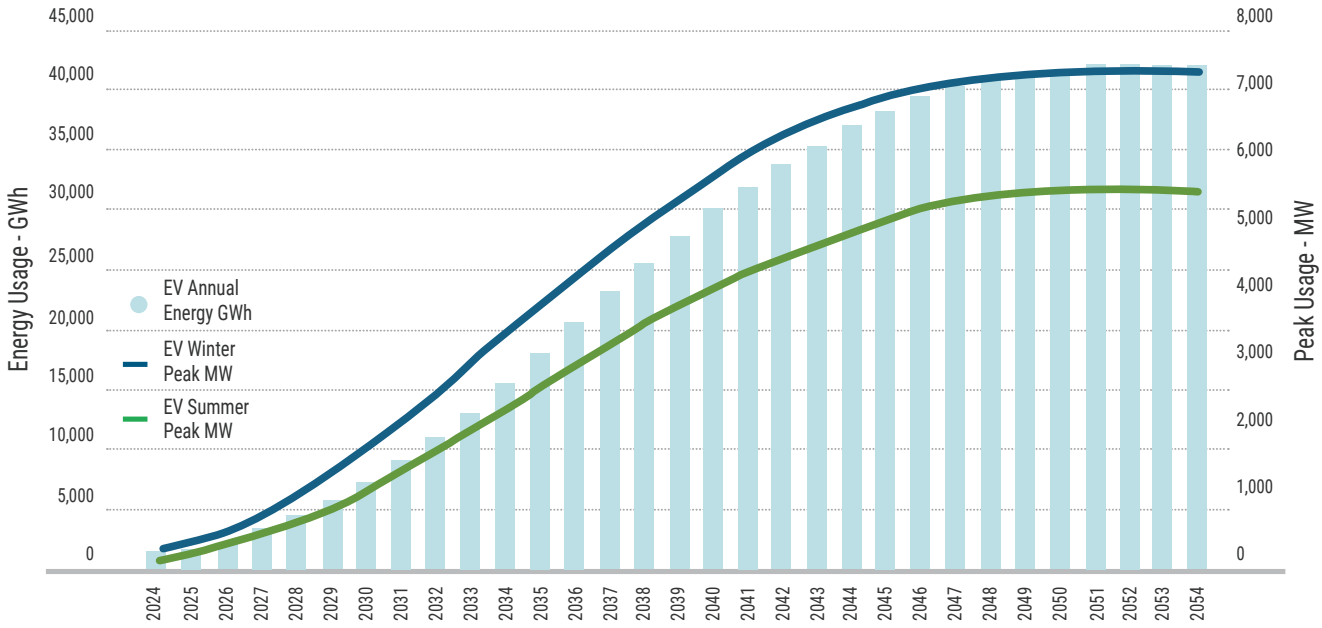


> This figure shows the average hourly demand for peak days in the summer 2023 and winter 2023-24 as well as projected high-demand days 20 years in the future. Electrification will contribute to increased demand, with winter demand expected to roughly double. Summer demand will also grow, but to a lesser degree as demand associated with cooling is largely already electrified. Summer peaks are expected to occur later in the day with the continued growth of behind-the-meter solar resources.

PEAK DEMAND VS. AVERAGE DEMAND: 2000-2023



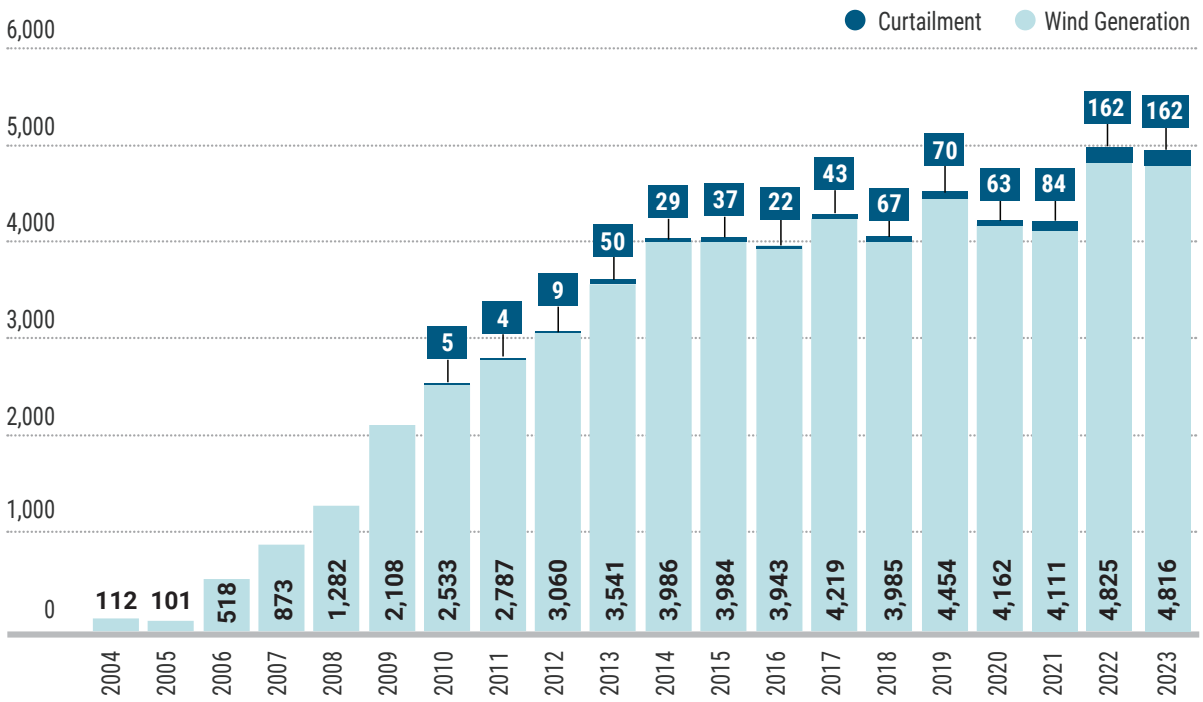
ELECTRIC VEHICLE ENERGY AND PEAK IMPACTS: 2024-2054



> Electric vehicle adoption will contribute significantly to demand for electricity in the coming years. The actual impact will depend heavily on the degree to which electric vehicle owners employ “managed charging” practices that utilize grid prices or conditions to avoid charging vehicles during periods of peak demand. The impact of electric vehicles on peak demand is expected to be greater in the winter than the summer, largely due to the timing of the peak hour, which occurs later in the day during winter months.

Supply Demands

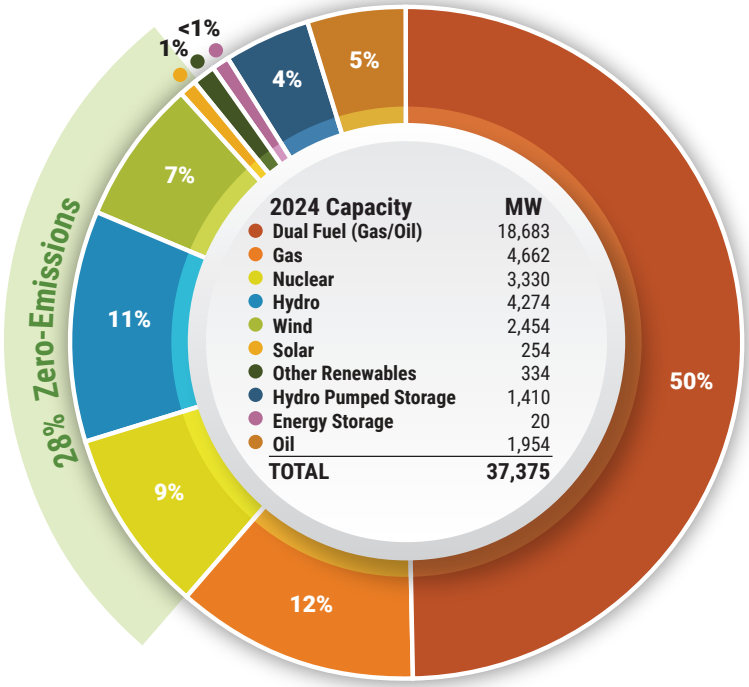
WIND GENERATION AND CURTAILMENT (GWH): 2004-2023



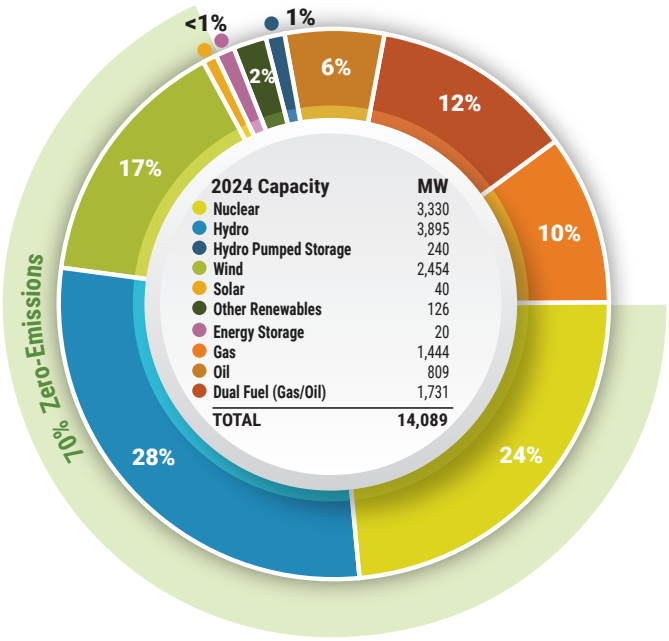
> Ongoing transmission upgrades contributed to curtailment of wind resources in 2023. Much of the curtailment was concentrated in NYISO Zones D and E and impacted by ongoing construction work on the Smart Path Connect Transmission Project and the AC Transmission Public Policy Transmission Need upgrades from the Mohawk Valley to the lower Hudson Valley.

SUMMER 2024 INSTALLED CAPACITY (MW) BY FUEL SOURCE (STATEWIDE, UPSTATE, AND DOWNSTATE NEW YORK)

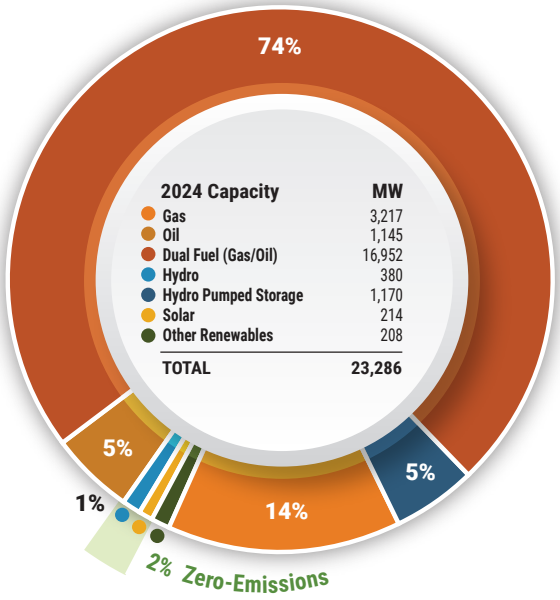
NYCA Summer Installed Capacity



Upstate Summer Installed Capacity (Zones A-E)

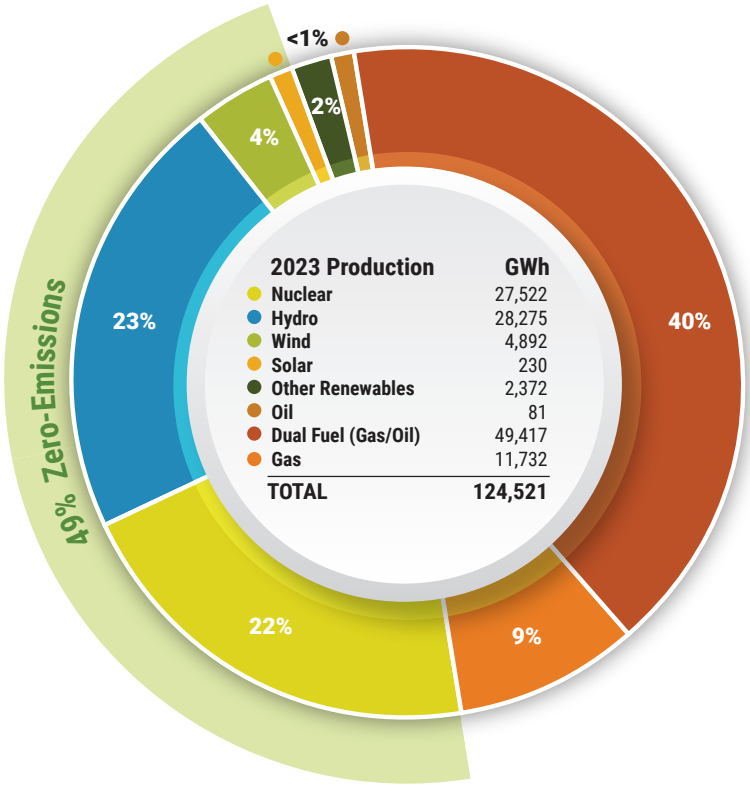


Downstate Summer Installed Capacity (Zones F-K)

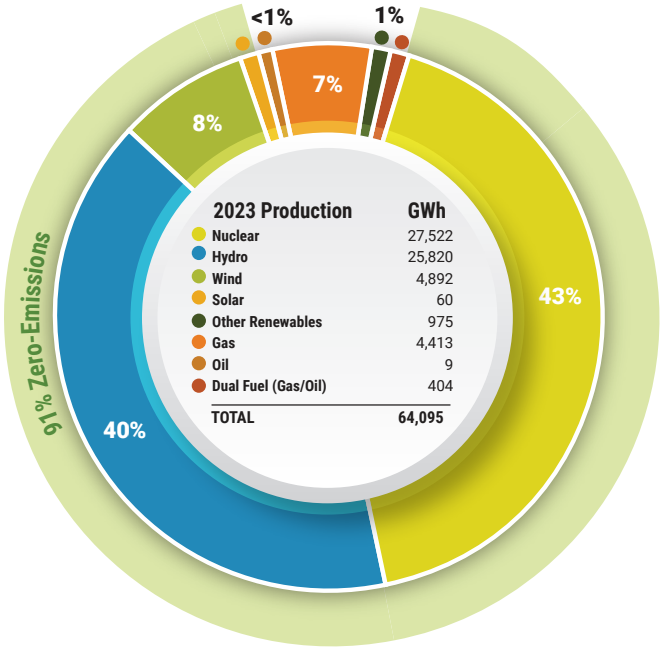


2023 ENERGY PRODUCTION (GWH) BY FUEL SOURCE (STATEWIDE, UPSTATE, AND DOWNSTATE NEW YORK)

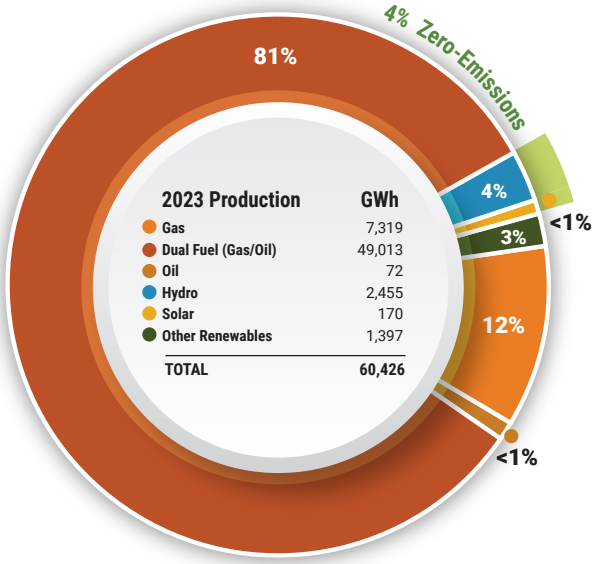
NYCA Energy Production



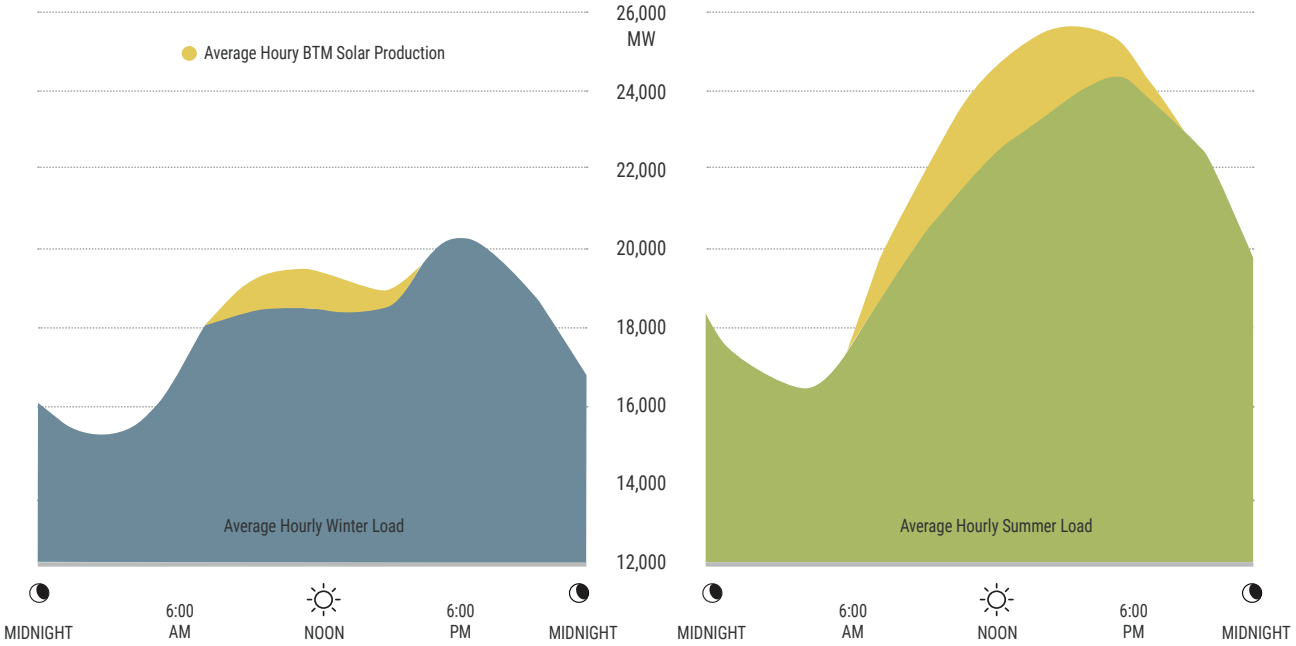
Upstate Energy (Zones A-E)



Downstate Energy (Zones F-K)

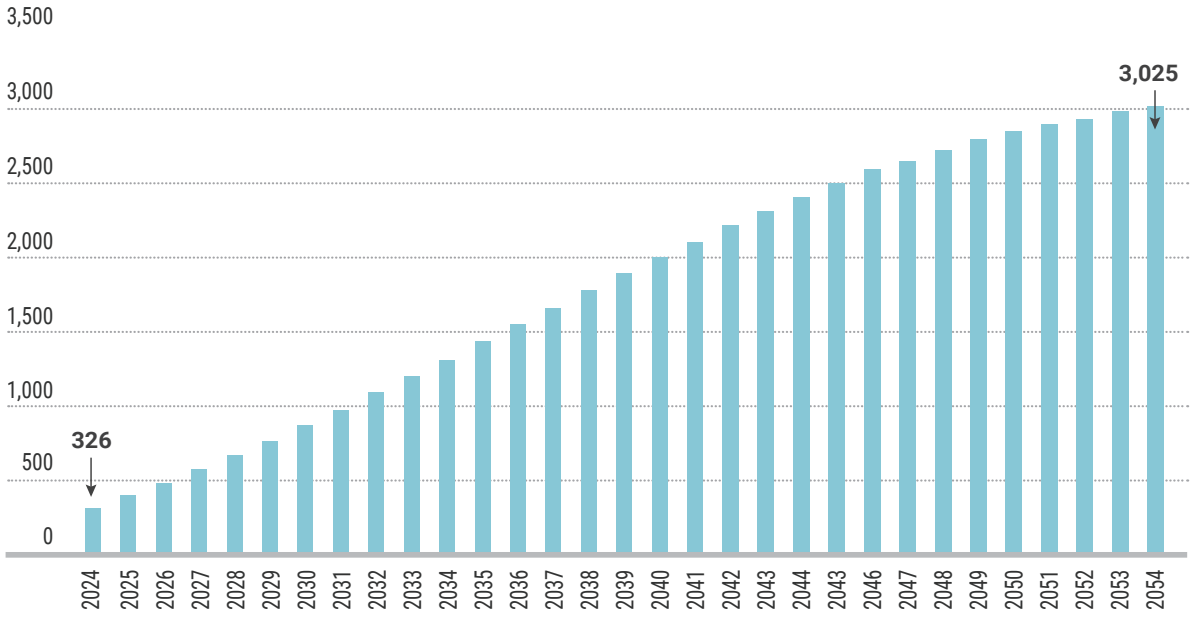


SUMMER AND WINTER BEHIND-THE-METER SOLAR PERFORMANCE



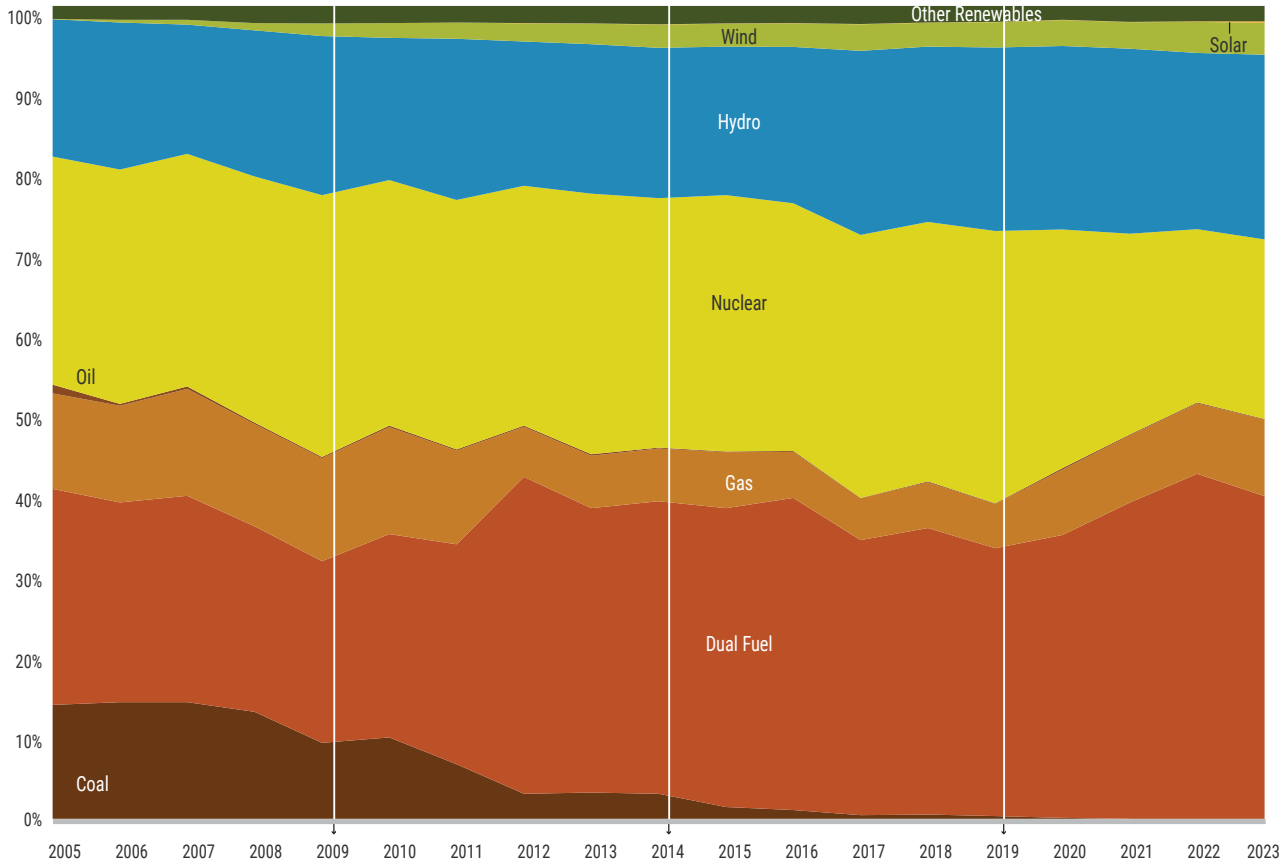
> Behind-the-meter solar resources contribute directly to load, reducing the amount of energy that must be supplied to customers by the bulk power system. In the summer months, these solar resources reduce the level of peak demand. In the winter, peak demand occurs after sunset.

ENERGY STORAGE NAMEPLATE CAPACITY - BTM STORAGE ONLY (MW): 2024-2054



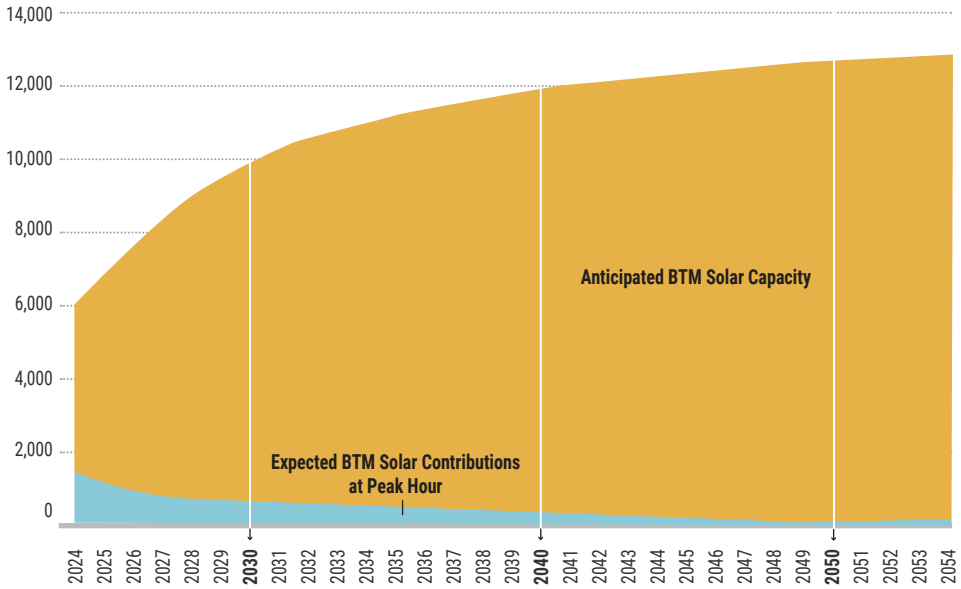
> Behind-the-meter storage resources will play a significant role in meeting New York's objective of 3,000 MW of storage resources by 2030. By supplying customers directly, these resources can reduce demand levels on the grid during peak hours. These reductions are offset by increased demand in other hours when storage is charging.

HISTORICAL GENERATING CAPACITY FUEL MIX IN NEW YORK STATE: 2005-2023



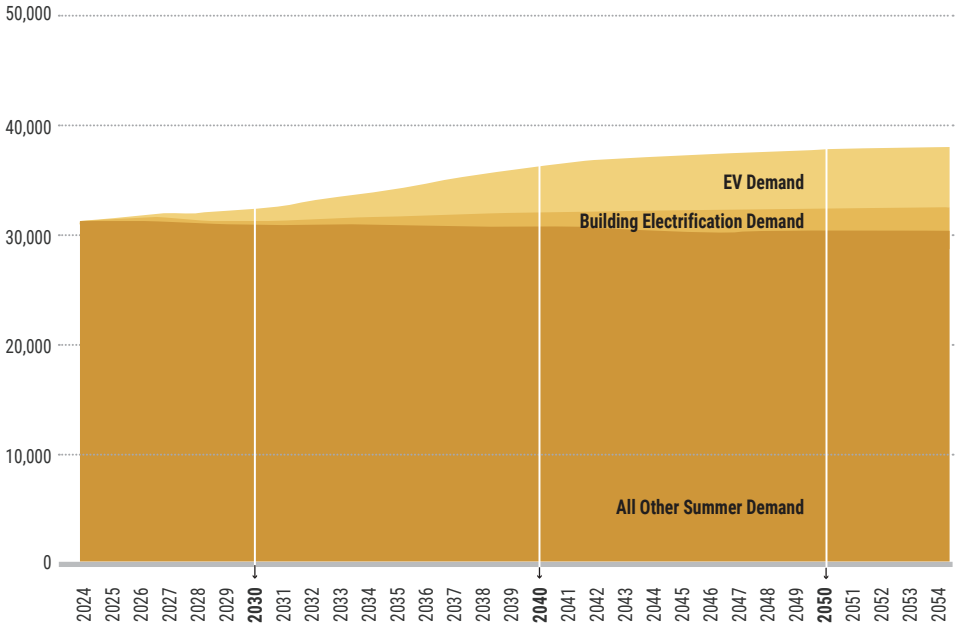
> The fuel mix of the resources powering New York's grid has become cleaner over time, including the elimination of coal-fired power plants, the growth of wind, and the emergence of solar.

BTM SOLAR CAPACITY VS. EXPECTED CONTRIBUTION TO SUMMER PEAK DEMAND HOUR (MW)



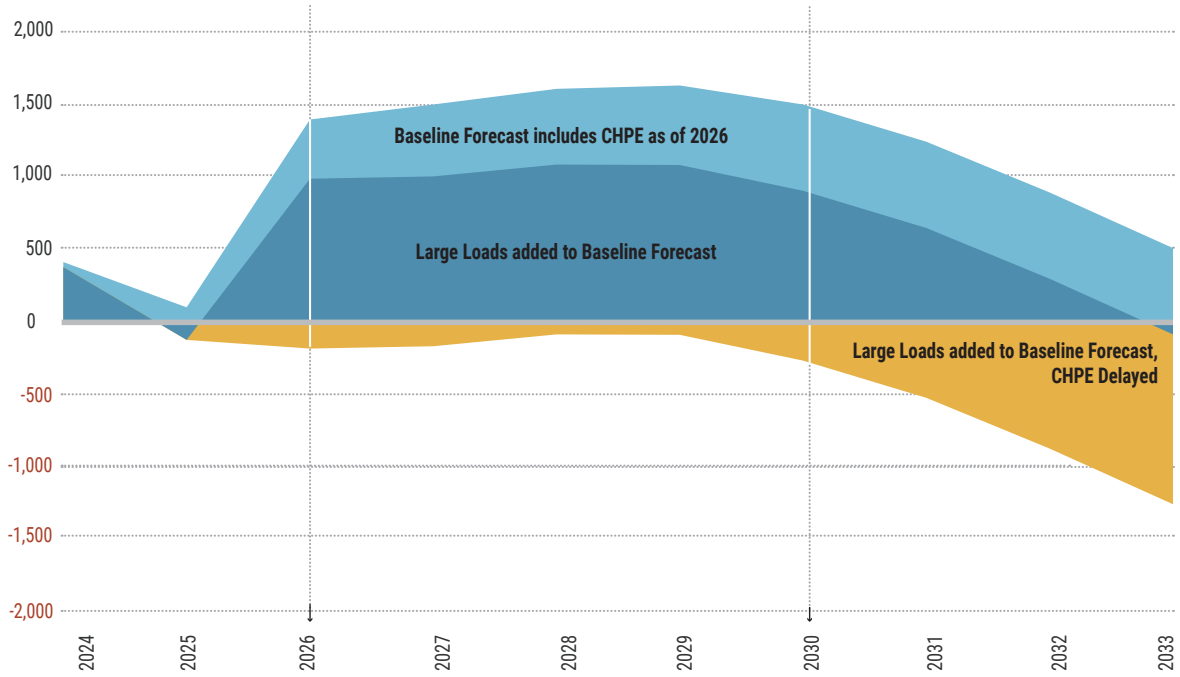
> One implication of the growth of behind-the-meter solar resources is that they will contribute to summer peak demand hours shifting to later in the evening. As a result, as more behind-the-meter solar is installed, it will contribute less energy in support of peak demand hours in the future.

EXPECTED IMPACT OF ELECTRIFICATION ON STATEWIDE SUMMER PEAK DEMAND (MW)



> While electrification will drive growth in winter peak demand, summer peak demand is not expected to grow as significantly, due largely to the saturation of electric-based air conditioning for cooling needs.

STATEWIDE RELIABILITY MARGIN – SUMMER, EXPECTED WEATHER



> Baseline forecasts from the 2023-2032 Comprehensive Reliability Plan indicate that the grid is expected to remain reliable, though reliability margins are thinning towards the end of the ten-year study period. The potential addition of large load projects will erode reliability margins further without new supply added to the system. Further, maintaining positive reliability margins is contingent upon the completion of the Champlain Hudson Power Express transmission project from Canada to New York City.

Glossary

Definitions and explanations of terms and phrases

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

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

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

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

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

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

Climate Leadership and Community Protection Act (CLCPA): A law that requires New York to reduce economy-wide greenhouse gas emissions 40% by 2030 and no less than 85% by 2050 from 1990 levels. The law establishes technology-specific mandates for deploying clean energy technologies as well as a Climate Action Council charged with developing a scoping plan of recommendations to meet these targets.

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 the NYISO's Reliability Planning Process.

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

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

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

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

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

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

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

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

Installed Capacity (ICAP): the capability of a qualifying generator or load facility to supply and/or reduce demand when directed by the NYISO.

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

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

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

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

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

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

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

New York 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.

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

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

Peakers: Peaking power plants, also known as peaker plants or just "peakers," are power plants that generally run only during periods of high demand — known as peak demand — for electricity.

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

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

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

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

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

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

Endnotes

1 Federal Energy Regulatory Commission, North American Electric Reliability Corp., Elliott Report: Complete Electricity Standards, Implement Gas Reliability Rules, Sept. 21, 2022

2 ibid.

3 Climate Justice Working Group, New York's Climate Leadership and Community Protection Act, 2024

4 Federal Energy Regulatory Commission, Order Accepting Tarriff Revisions, April 15, 2024

5 Northeast States Collaborative on Interregional Transmission, Letter to DOE Grid Deployment Office, June 16, 2023

About the ISO

The NYISO is subject to the oversight of the Federal Energy Regulatory Commission and regulated in certain aspects by the New York State Public Service Commission. NYISO operations are also overseen by electric system reliability regulators, including the North American Electric Reliability Corporation, Northeast Power Coordinating Council, and the New York State Reliability Council.

The NYISO is governed by an independent 10-member Board of Directors. The members of the NYISO's Board of Directors have backgrounds in electricity systems, finance, information technology, communications, and public service. The NYISO is unaffiliated with any market participant or government entity. 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 engages stakeholders in a robust and transparent shared governance process that involves representation from a variety of interests, including transmission owners, generator owners, public authorities and municipal utilities, large and small consumers, and environmental advocates. Through open engagement and consensus building with stakeholders, rules and procedures address our wholesale electricity markets, system planning, and grid operations are developed.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