Renewable Intermittency and The Importance of Dispatchable Generation in The Winter

New York Electric Market Case Review - JANUARY 2022

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By The Utility Consultation Group[1]

Key Insights

The natural intermittency of renewable generation and the need for electric supply to meet customer energy demand every hour of the day can result in reliability issues if not proactively addressed. This will become increasingly important as the New York electric customer demand profile becomes winter peaking, as is expected to occur in the mid- 2030s. The state will need to use a wide variety of tools to address these issues, considering changes to the rules that govern the state's competitive wholesale energy markets, addition of new electric infrastructure to serve customers, and can mitigate the impacts of increasing winter electric peak demand from heating electrification by leveraging existing pipe networks to deliver low-carbon fuels and continue meeting a portion of New York's building heating load as a practical, reliable and cost-effective alternative to full electrification. In addition the state will need to increase access to zero-carbon dispatchable electric supply; this can be accomplished using a number of methods, including: increasing the amount of energy storage on the electric system; increasing the amount of dispatchable resources available such as traditional hydro generation; increasing access to zero-carbon dispatchable supply by expanding the electric transmission system; and using existing gas transmission and distribution systems to transport zero- or low-carbon fuels to conventional generation; or some combination of all these methods.

Maintaining Reliability Today

The responsibility for meeting the need for reliable electric supply in New York State belongs to the New York Independent System Operator (NYISO), a state-chartered non-profit entity that has operational control over the electric transmission in the state and dispatches generation resources at 5-minute intervals every hour of every day to match customer demand to electric supply. The existing portfolio of supply resources, which was built up over decades, includes a variety of resource types, including: natural gas-fired plants (many with liquid fuel backup), nuclear plants, large dispatchable hydro plants, smaller 'run of river' hydro plants, on-shore wind turbines, solar photovoltaic plants, energy storage (pumped hydro and, increasingly, chemical batteries like lithium ion), and transmission ties to neighboring regions that allow the NYISO to import out-of-state power when it is available and/or economic to do so. With these resources and the transmission system, the NYISO has an excellent history of meeting the supply needs

[1] The Utility Consultation Group (UCG) is a voluntary association of electric and gas utilities in New York State seeking to reliably and cost-effectively achieve the goals of the Climate Leadership and Community Protection Act. The participating utilities include: Consolidated Edison Company of New York, Inc.; Central Hudson Gas and Electric, Inc., The Municipal Electric Utilities Association of New York State; National Fuel Gas Distribution Corporation.; National Grid; New York State Electric and Gas, Inc.; Orange and Rockland Utilities, Inc.; and Rochester Gas and Electric, Inc.

of customers across the state. Critically, many of the resources available to the NYISO today are dispatchable: they can be called on as needed and dispatch per instructions from the NYISO. Some resources, however, due to the natural intermittency of their energy source, are not dispatchable, including wind turbines and solar photovoltaics. These non-dispatchable resources are expected to make up an increasing portion of the overall energy supply portfolio to meet the goals of the Climate Leadership and Community Protection Act (CLCPA). Reliable supply of electricity will grow increasingly important in the future as the state moves to expand electrification in transportation and heating sectors. And increasingly severe weather events, including stronger storms, longer, hotter heat waves, and cold snaps, will put increased pressure on both generation and transmission assets. Due to this confluence of changes, it will be critical to ensure that reliable electric supply in the future is ready to meet the increasing demand for it. This whitepaper is a case study that examines recent supply availability and its real-world impacts in New York during what is traditionally one of the coldest months of the year.

Electric Market Operations – January 2022– New York

January 2022 was a period of sustained cold temperature conditions throughout New York State, the Northeast United States and Canada. Reinforcing the severity of the monthly weather pattern, during January 2022, New York State issued ten (10) weather-related statewide press releases. The press releases revealed that no region of the state was spared from the extreme weather events and conditions. In addition, the National Weather Service website, under ***Observed Weather,*** provides additional granular information about the monthly weather conditions.

System Condition – Load / Supply Overview

The NYISO peak hourly load demand during January 2022 was 23,237 MW, which occurred on Tuesday, January 11th at 5:00 pm. This compares with the all-time winter peak load demand of 25,738 MW, which occurred on Tuesday, January 7, 2014, at 6:00 pm. Energy prices were high throughout New York and neighboring RTOs/ISOs (New England, PJM, Hydro/Quebec/Ontario) due to higher electric demand driven by the sustained winter weather and higher commodity (fuel) prices. Importantly, this was the first winter since the mid-1970's where the Indian Point nuclear facility Units 2 & 3 were not in operation as they were retired in Spring of 2020 and 2021, respectively. The Indian Point supply reduction of 2000MW of baseload generation supply was replaced by other generation resources in the system, such as wind, solar, natural gas, and oil. Hydro and nuclear resources are normally considered baseload generation that are dispatched daily throughout the year.

As **Figure 1** illustrates, the State's generation supply in January 2022 was dominated by dual fuel (oil/natural gas), nuclear, hydro, and natural gas facilities. Wind and other renewable resources accounted for only approximately 5% of total generation within New York State during the month.

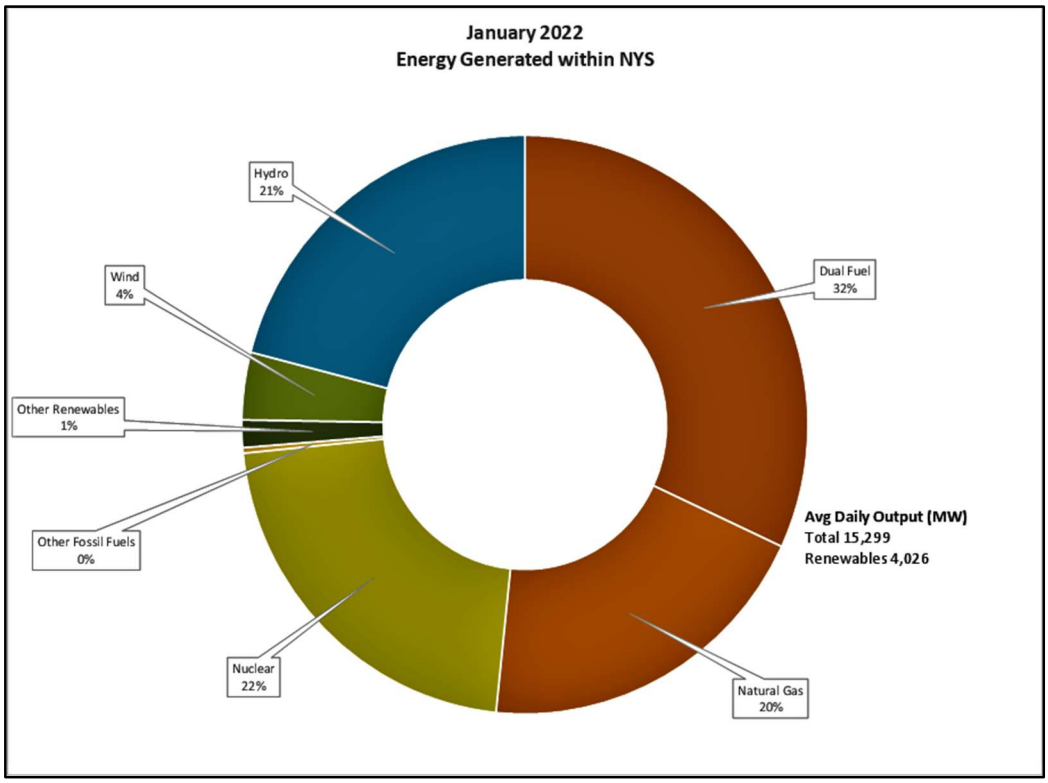


Figure 1: Graph showing generation mix by resource type and percentage within New York State.

The daily real-time fuel mix cart and supporting historical files are available here - https://www.nyiso.com/real-time-dashboard

Daily Intermittent Resource Wind Performance – January 2022

The chart below, **Figure 2**, illustrates the daily wind generation levels by NYISO zone. The NYISO reported low wind generation levels, below 5 GWhs per day, on eight (8) of the thirty-one (31) days in January 2022, including multi-day periods on January 2 & 3 and January 13, 14 and 15. This equates to 25% of the days for the January 2022 period experiencing low wind generation. The NYISO average daily demand sendout was 451 GWh/day in January 2022 per the January 2022 Market Operations Report, therefore, on days where wind generation was 5 GWhs or less; the wind contribution was only approximately 1.1% based of the average daily demand sendout.

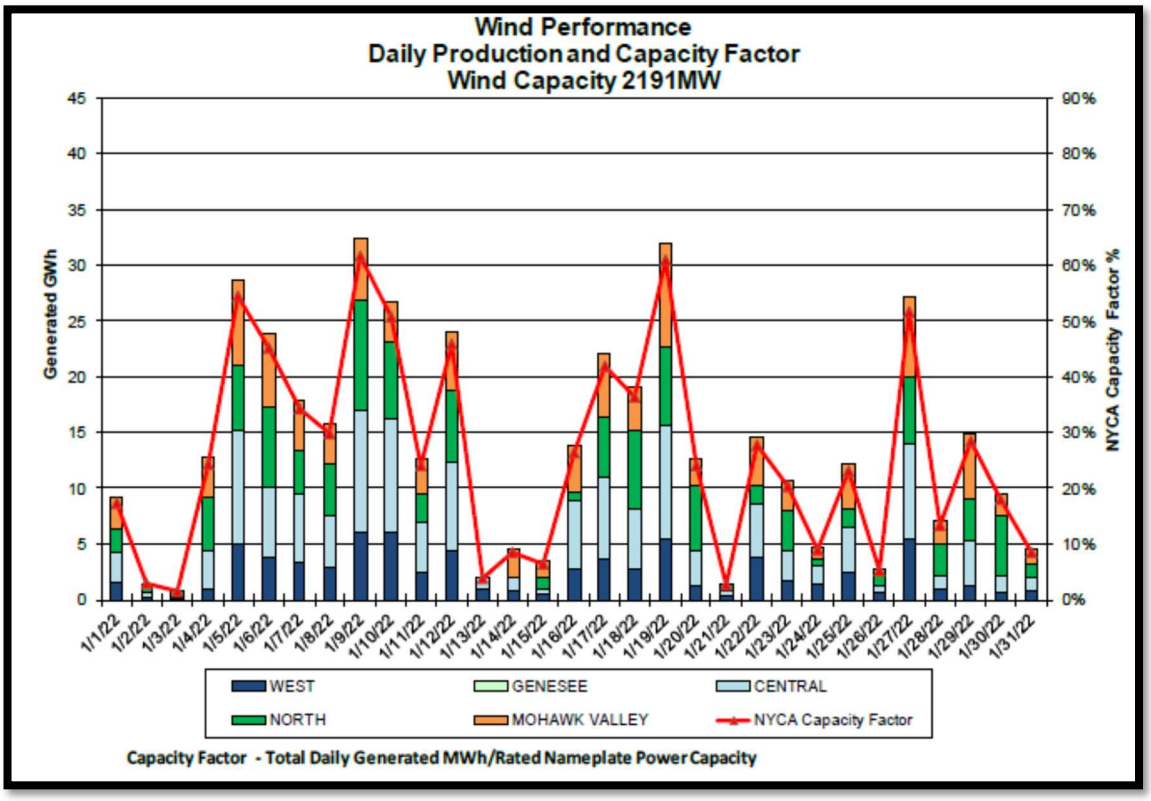


Figure 2: Wind performance by region in NYS for January 2022.

Source – NYISO January Operations Report presented at the February 16, 2022, Business Issues Committee Working Group

Daily Intermittent Resource Solar Performance – January 2022

Figure 3 below illustrates similar information about daily production of Behind the Meter (BTM) solar generation during the January 2022 period. Solar generation experienced low production during the month including a consecutive three-day period, January 1-3, where total daily production was equal to or less than 2 GWh. In total, solar production was 2 GWh or less during eight (8) days during January or approximately 25% of the month. NYISO average daily demand sendout was 451 GWh/day in January 2022 per the January 2022 Market Operations Report, therefore, on days where solar generation was 2 GWhs or less; the solar contribution was only approximately .04% based on the average daily demand sendout.

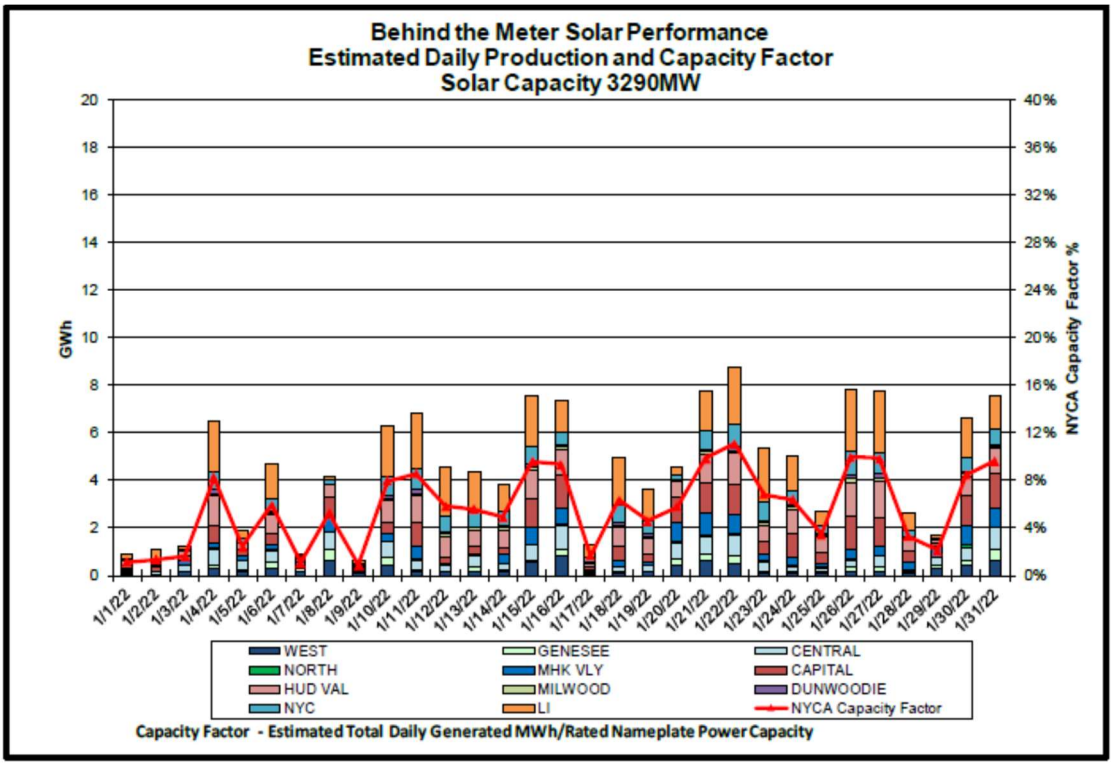


Figure 3: Behind the Meter solar performance for various NYS regions in January 2022.

Source – NYISO January Operations Report presented at the February 16, 2022, Business Issues Committee Working Group

Combined Wind & Solar Intermittent Generation - January 2022

Figure 4 illustrates the combined wind and solar generation of 10 GWh or less occurred on seven (7) of the thirty-one (31) days; approximately 22% of the days in the January 2022 period. In addition, consecutive day low combined generation was experienced on January 2 & 3, and January 13-14, respectively. NYISO average daily demand sendout was 451 GWh/day in January 2022 per the January 2022 Market Operations Report, therefore, on days where combined wind & solar generation was 10 GWhs or less; the combined wind & solar contribution was only approximately 2.2% based on the average daily demand sendout.

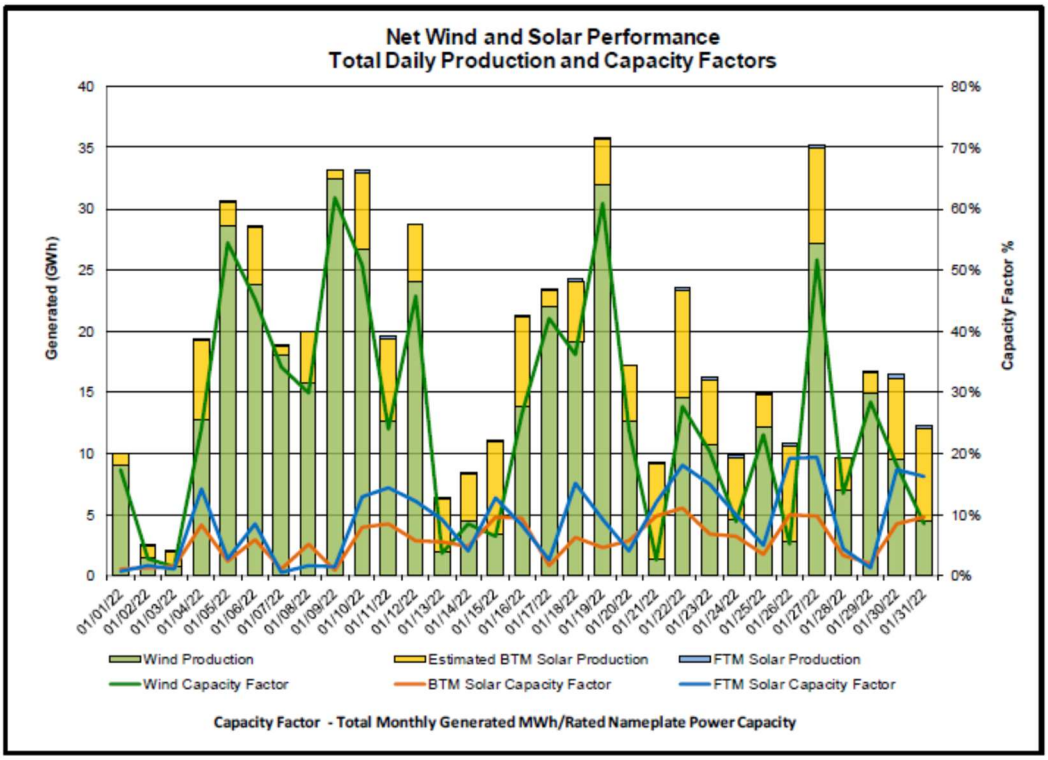


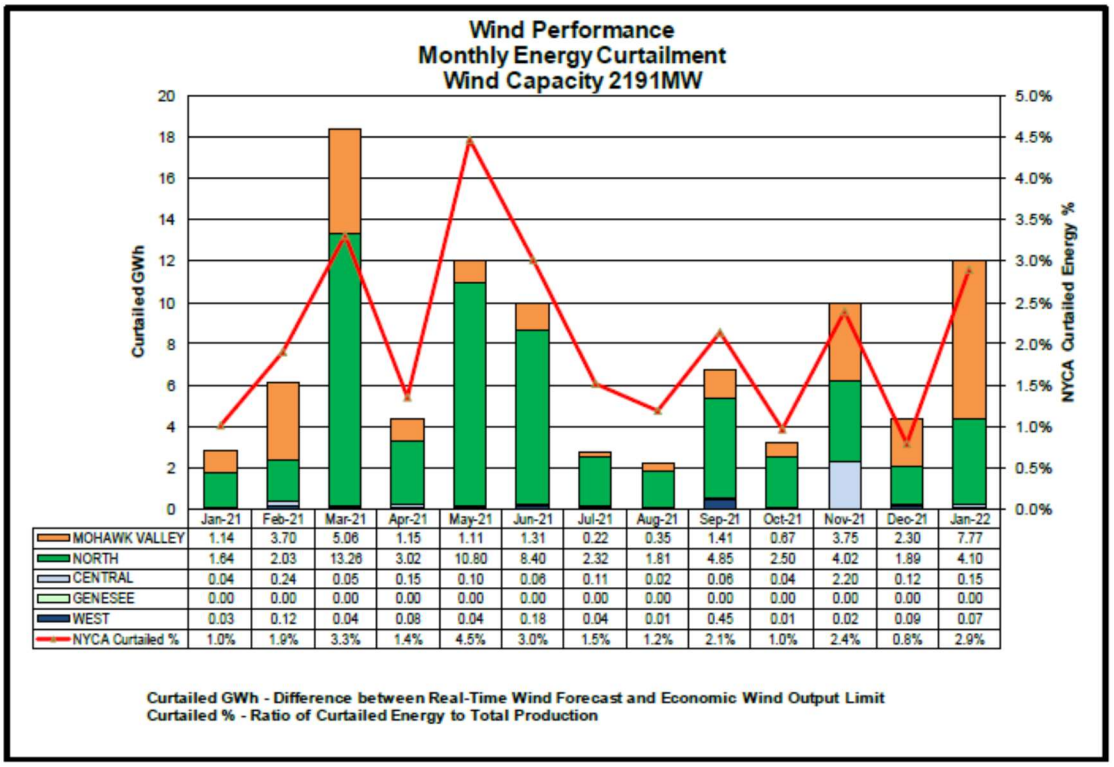
Figure 4: Graph showing net wind and solar performance for January 2022 in NYS.

Source – NYISO January Operations Report presented at the February 16, 2022, Business Issues Committee Working Group

The combined performance statistics provide a real-time indicator of the variability of intermittent resources. A core reliability and public safety question is: in the future, what resources will be available and utilized during low periods of wind and solar generation? During January 2022, the production gap in New York was filled by increased output from natural gas and fuel oil generation, and/or energy imports from neighboring control areas. Due to this intermittency variability, there is a long-term need for MW – to - MW backup requirement of a dispatchable generation resource.

Need for Enhanced Distribution and Transmission Expansion - Renewable Energy Curtailment – January 2022

Substantial infrastructure investment on both the distribution and transmission (bulk power) systems will be necessary. This need will be created by the proposed increased electrification of the building heat and transportation sectors, and the need to interconnect new renewable energy resources throughout the New York State electric grid. During January 2022 about 12 GWhs or 3% of renewable generation was curtailed due to system constraints. More importantly, **Figure 5** also provides an annual snapshot demonstrating that each month in the past year experienced some level of renewable energy curtailment. The renewable requirements in the CLCPA are far more aggressive than the current renewable energy supply portfolio. Curtailments of these resources will only become more pronounced unless the distribution and transmission buildout is carefully coordinated and sequenced with increased access to zero carbon dispatchable resources and other important CLCPA initiatives.



	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21	Jan-22
MOHAWK VALLEY	1.14	3.70	5.06	1.15	1.11	1.31	0.22	0.35	1.41	0.67	3.75	2.30	7.77
NORTH	1.64	2.03	13.26	3.02	10.80	8.40	2.32	1.81	4.85	2.50	4.02	1.89	4.10
CENTRAL	0.04	0.24	0.05	0.15	0.10	0.06	0.11	0.02	0.06	0.04	2.20	0.12	0.15
GENESEE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WEST	0.03	0.12	0.04	0.08	0.04	0.18	0.04	0.01	0.45	0.01	0.02	0.09	0.07
NYCA Curtailed %	1.0%	1.9%	3.3%	1.4%	4.5%	3.0%	1.5%	1.2%	2.1%	1.0%	2.4%	0.8%	2.9%

Figure 5: Graph showing monthly energy curtailment over the 2022 calendar year for NYS.

Source – NYISO January Operations Report presented at the February 16, 2022, Business Issues Committee Working Group

Considerations – Going Forward

- The real-life observed availability of intermittent generation in January 2022 underscores the importance of implementing the CLCPA transition in a measured manner to ensure system reliability and public safety are maintained. Coordinated optimization of the electric and gas energy systems and maintaining flexibility in technology development will facilitate meeting CLCPA requirements while supporting continued high levels of energy reliability.
- As demonstrated in January 2022, intermittent generation can sometimes be only minimally available for consecutive multiple day periods. Dispatchable backup resources will be necessary on a MW-to-MW basis to cover both in-day and extended day supply shortfalls.
- Resource diversity mitigates the risk that the unavailability of a particular resource type impacts reliability. The existing portfolio of electric supply has significant resource diversity, supporting existing high levels of reliability. Supporting resource diversity, increasing investment in adequate transmission and distribution, and providing access to ample dispatchable backup generation are all critical actions that will ensure system reliability and public safety are maintained.
- While many forms of zero-carbon dispatchable electric supply exist, all come with limitations, including cost, physical space requirements, technology maturity, or policy preferences that would limit use (e.g., new nuclear facilities). Addressing these limitations

and achieving the benefits of fuel diversity in the future will require technology research and development. A zero-carbon future can most reliably be achieved by allowing all technology options to be considered, including use of the existing gas system to transport low- and no-carbon energy.

- New York is expected to become a winter peaking electric grid in the mid-2030's per multiple NYISO reports performed by the Brattle Group and Analysis Group, as well as the CLCPA Draft Scoping Plan. This transition to a winter peaking system is driven heavily by the electrification of the transportation and building sectors and will result in a need for additional generation supply capable of reliably operating during future winter periods.