Renewable Intermittency and The Importance of Dispatchable Generation in The Summer

New York Electric Market Case Review - July 2022

Report Date – October 2022

Key Insights

Proactively addressing the intermittent nature of most renewable generation in order to support the need for electric supply to be capable of meeting customer energy demand every hour of the day will allow electric customers to continue experiencing high levels of electric reliability during the clean energy transition. This will become increasingly important as New York increases its integration of intermittent renewable resources in the future. One critical action is to increase levels of 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 zero carbon resources available such as, among others, traditional hydro generation and continuing the availability of baseload nuclear facilities; increasing access to zero-carbon dispatchable supply by expanding the electric transmission system; using gas transmission and distribution systems to transport zero- or low-carbon fuels to conventional generation; or some combination of all these methods. Achieving commercial operation of new renewable resources prior to retiring dispatchable fossil fuel resources will also support continued high levels of reliability. The state, in consultation with the NYISO, the responsible Transmission Owner(s) and existing reliability entities, should provide guidance on the timing and sequencing of generation asset retirement decisions before any non-reversible actions occur to ensure reliability and public safety are maintained.

Maintaining Reliability Today

The responsibility for meeting 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 electric supply to customer demand. The NYISO is subject to reliability standards established by the North American Electric Reliability Corporation (NERC), the Northeast Power Coordinating Council (NPCC), and the New York State Reliability Council (NYSRC). The annual New York State Installed Reserve Margin (IRM) is established by the New York State Reliability Council (NYSRC) and implemented by the NYISO. NYISO sets the minimum amount of capacity necessary to be procured from supply resources to maintain the IRM threshold. However, intermittent renewable resources do not have the same performance and availability as existing baseload generators to maintain IRM; in other words, intermittent renewable resources do not provide a one-for-one replacement for existing fossil generators.

The existing portfolio of supply resources, which was built up over decades, includes a variety of resource types, including: natural gas-fueled plants (many with liquid fuel backup to enhance reliability), 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 economic to do so. With these supply resources and the

high voltage transmission system, the NYISO has an excellent history of meeting the supply needs of customers across the state.

Critically, most of the supply resources available to the NYISO today are dispatchable: they can be called on as needed and dispatched per instructions from the NYISO. Other resources, due to the inherent intermittency of their energy source, are not dispatchable, including wind turbines and solar photovoltaics. These intermittent resources will 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 become increasingly important as electrification increases in the transportation and heating sectors, making customers more dependent on reliable electric supply. And increasingly extreme weather events can worsen intermittency, including stronger storms impacting wind turbine availability, or heat waves reducing solar production,[1] putting increased pressure on these generation asset classes. Due to this confluence of changes, it will be critical to ensure that reliable electric supply resources in the future are ready to meet the increasing demand. This whitepaper reviews recent supply resource availability in July 2022 and its real-world impacts in New York during what is traditionally one of the warmest months of the year.

New York Electric Market Operations & Weather Conditions – July 2022

July 2022 was a period of sustained hot temperature conditions throughout New York State, and the Northeast United States. In fact, New York State, through Governor Hochul's press office, issued six weather-related statewide press releases. The press releases referenced drought conditions, severe storms and extreme heat risks, affecting all regions of the state. In addition, the National Weather Service website, under ***Observed Weather,*** provided additional granular information about the monthly weather conditions.

System Condition – Load / Supply Overview

The NYISO peak hourly load demand during July 2022 was 30,505 MW, which occurred on Wednesday, July 20 at 5:00 pm. This compares with the all-time summer peak load demand of 33,956 MW, which occurred on Friday, July 19, 2013, at 4:00 pm. On the peak day, July 20, 2022, the energy sendout was 606 GWh;[2] with wind and solar resources providing approximately 32 GWh or 5.3% of the generation supplied that day.

Energy prices were high throughout New York and neighboring RTOs/ISOs (New England, PJM,) due to regional higher electric demand driven by the sustained hot weather and higher commodity (fuel) prices.[3] Thunderstorm Alerts were declared in New York for 29.9 hours during the month, and Special Case Resources (SCRs) were activated in Zone F on July 19 and 20.[4]

[1] *See, e.g.*, *Solar Panels are Feeling the Heat Too: How Heatwave Temperatures are Hampering Solar Power*; available at: https://www.euronews.com/next/2022/07/18/solar-panels-feel-the-heat-too-how-higher-temperatures-are-undermining-solar-power#:~:text=High%20temperatures%20can%20decrease%20the,%2C%20according%20to%20Solar.com.

[2] July 20, 2022 Peak Sendout is available in the August 17, 2022 Business Issues Committee Meeting Minutes

[3] July 2022 NYISO Market Operations Report

[4] July 2022 NYISO Operations Report

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

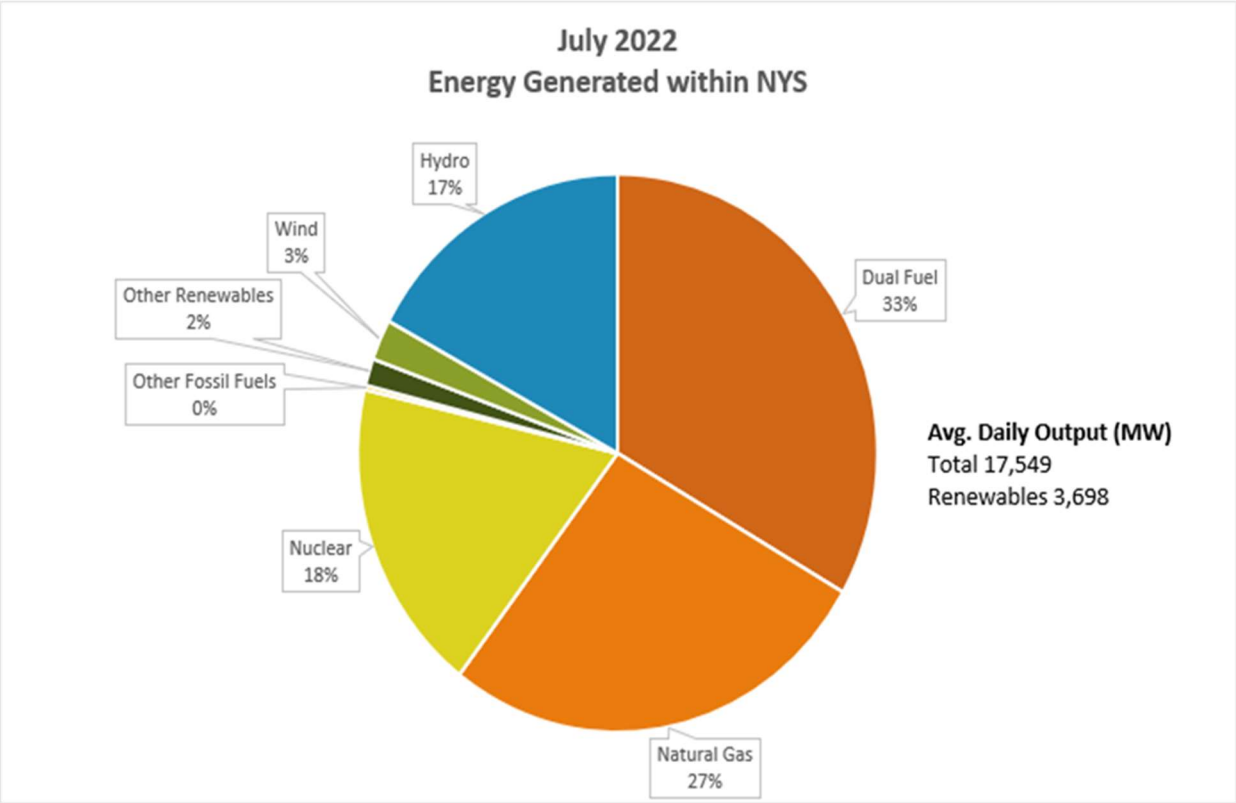


Figure 1: Energy generated in July 2022 by resource type and percentage within New York State

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

Daily Intermittent Resource Wind Performance – July 2022

Figure 2, below, illustrates the daily wind generation levels by NYISO zone.[5] The NYISO reported low wind generation levels, below 5 GWh per day, on eleven (11) days in July 2022, including a five-day wind lull period from July 13-17. This equates to 35% of the days in July 2022 experiencing low wind generation. The NYISO average daily demand sendout was 509 GWh/day per the July 2022 Market Operations Report, therefore, on days where wind generation was 5 GWh or less; the wind contribution was only approximately 1% of the average daily demand sendout.

[5] Figure 2 indicates installed wind capacity of 2,191 MW, approximately 5% of installed generation capacity in the New York Control Area.

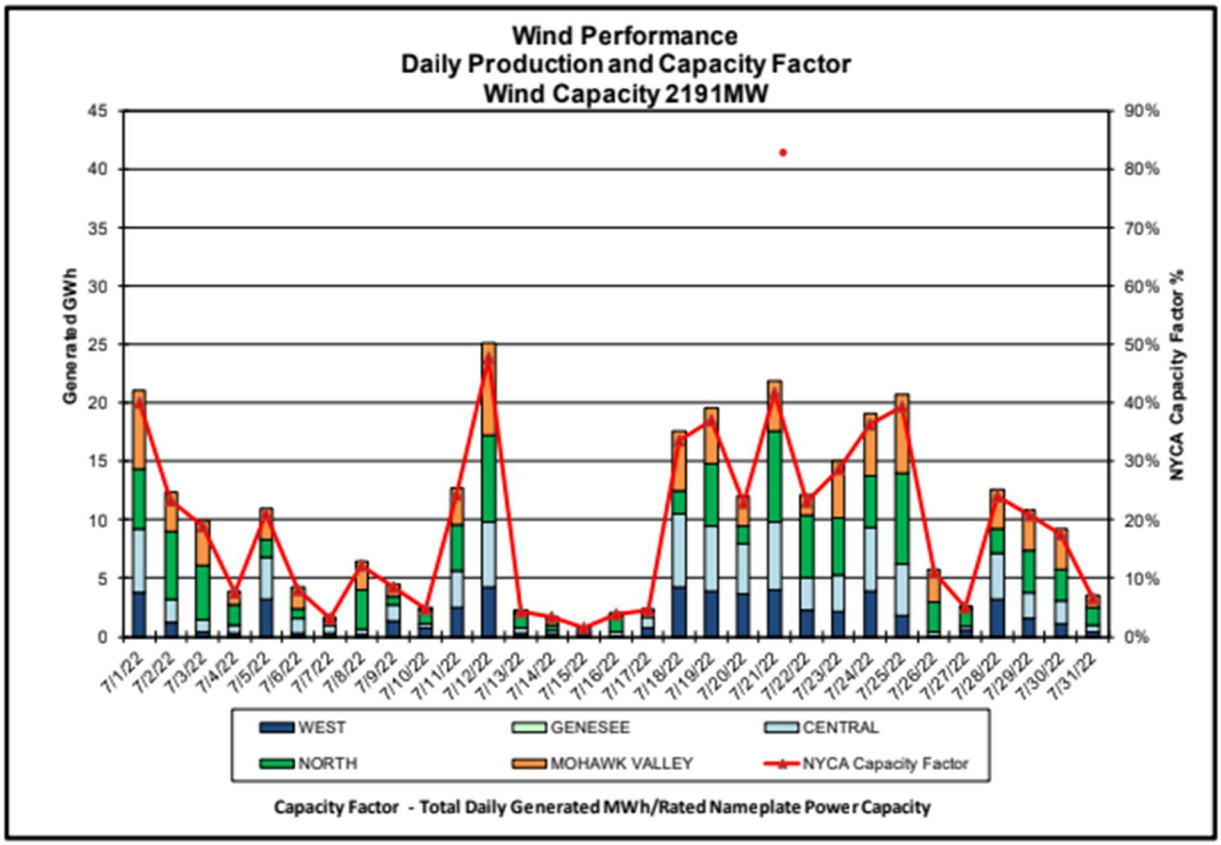


Figure 2: Wind performance by region in NYS for July 2022.

Source – NYISO July Operations Report presented at the August 18, 2022, Operating Committee Working Group

Daily Intermittent Resource Solar Performance – July 2022

Figure 3 below illustrates similar information about daily production of Behind the Meter (BTM) solar generation for the July 2022 period. Solar generation was as high as 23 GWh on July 9, and as low as approximately 8 GWh on July 18. In total, solar production exceeded 20 GWh or more on twelve days (12) days during July or approximately 39% of the month. It ranged from 10 GWh to 20 GWh during seventeen (17) days or approximately 55% of the month and was less than 10 GWh for two (2) days. Maximum daily BTM solar generation in the month (23 GWh on July 9) was approximately 4.6% of the NYISO average daily sendout. On days where solar generation was less than 20 GWh, the solar contribution was approximately 4% of the average daily demand sendout.

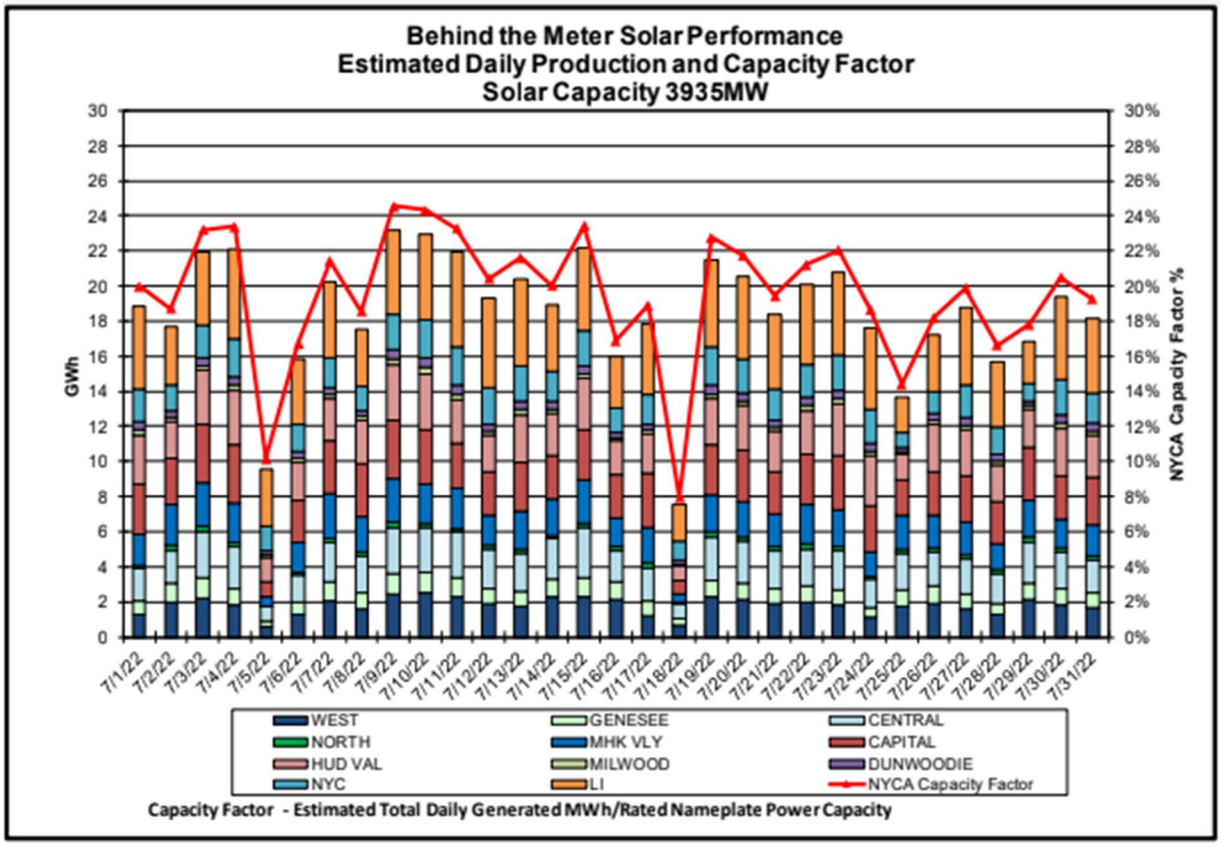


Figure 3: Behind the Meter solar performance for various NYS regions in July 2022.

Source – NYISO July Operations Report presented at the August 18, 2022, Operating Committee Working Group

Combined Wind & Solar Intermittent Generation - July 2022

Figure 4, below, illustrates the combined wind and solar generation for July 2022. Solar generation was higher than wind generation on most days during the month. The maximum combined wind and solar generation occurred on July 12 (approximately 45 GWh), which was 8.8% of the daily average sendout. For twenty (20) of the thirty-one (31) days of the month, combined wind and solar generation contributed 30 GWh or less, compared to the average daily demand sendout was 509 GWh/day in July (*i.e.*, less than 6% of the average daily sendout).

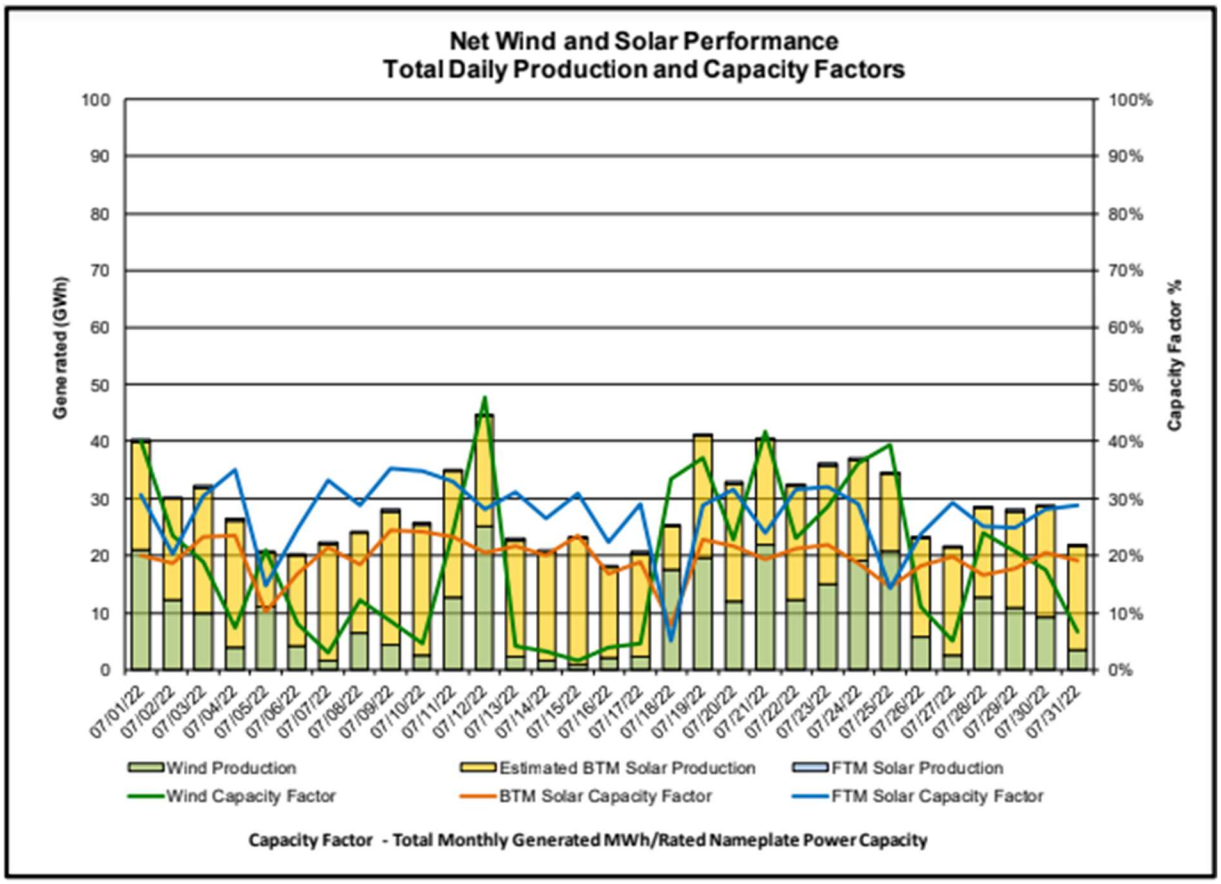


Figure 4: Graph showing net wind and solar performance for July 2022 in NYS.

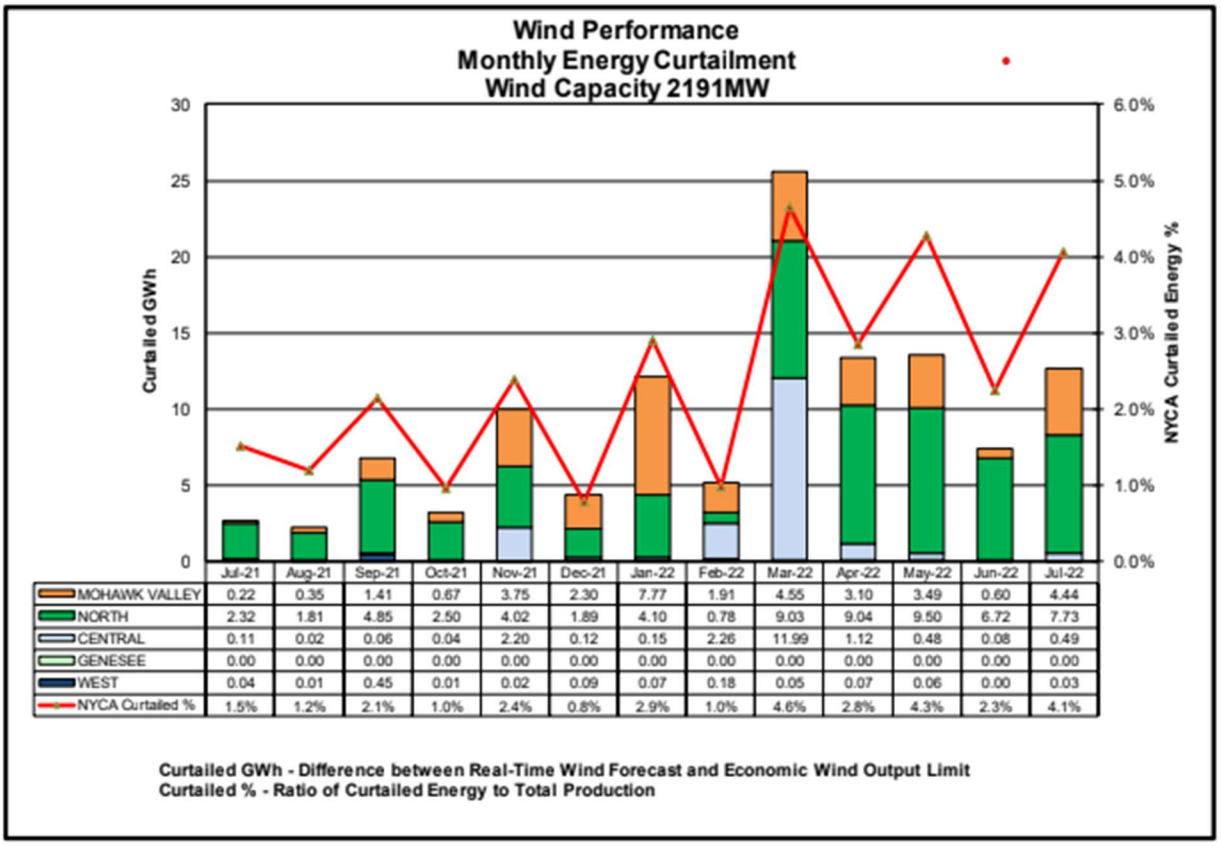
Source – NYISO July *Operations Report presented at the* August *18, 2022,* Operating *Committee Working Group*

The combined performance statistics provide a real-time indicator of the variability of intermittent resources. A core reliability and public safety question for ensuring that customer energy demand can be met is: in the future, what resources will be available and utilized during periods of low wind and solar generation? During July 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 renewable generation intermittency, there is a long-term need for dispatchable emissions free resources (DEFRs) that can be paired with a larger amount of intermittent renewable resources to meet customer load reliably.

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

Substantial infrastructure investment on both the distribution and transmission (bulk power) systems also will be necessary, in order to interconnect new renewable energy resources throughout the New York State electric grid and deliver that energy to customers. During July 2022 about 12.7 GWh or 4% of renewable wind generation was curtailed due to transmission system constraints. **Figure 5, below,** provides an annual snapshot demonstrating that each month in the past year experienced some level of

renewable energy curtailment. The renewable resource requirements under the CLCPA are far greater than the current renewable energy supply portfolio and curtailments of these resources will only increase unless the distribution and transmission buildout is carefully coordinated and sequenced with increased access to zero carbon dispatchable supply resources and other important CLCPA initiatives.[6] Additionally, utilities will need to provide access to both 'on ramps' to interconnect new renewable generation as well as sufficient 'off ramps' in order to deliver that energy to customers. These local transmission and distribution investments will be critical to mitigating curtailments.



	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21	Jan-22	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22
MOHAWK VALLEY	0.22	0.35	1.41	0.67	3.75	2.30	7.77	1.91	4.55	3.10	3.49	0.60	4.44
NORTH	2.32	1.81	4.85	2.50	4.02	1.89	4.10	0.78	9.03	9.04	9.50	6.72	7.73
CENTRAL	0.11	0.02	0.06	0.04	2.20	0.12	0.15	2.26	11.99	1.12	0.48	0.08	0.49
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	0.04	0.01	0.45	0.01	0.02	0.09	0.07	0.18	0.05	0.07	0.06	0.00	0.03
NYCA Curtailed %	1.5%	1.2%	2.1%	1.0%	2.4%	0.8%	2.9%	1.0%	4.6%	2.8%	4.3%	2.3%	4.1%

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

Source – NYISO July Operations Report presented at the August 18, 2022, Operating Committee Working Group

[6] *See* NYISO's *2021-2040 System & Resource Outlook (The Outlook)*, Draft Report (Aug. 31, 2022), p. 6 ("[t]he contracted renewable project portfolio will exacerbate existing transmission congestion and will encounter new local transmission constraints throughout New York State. . . . A major impact of the transmission constraints is that larger amounts of renewable generation experience curtailment"); available at: https://www.nyiso.com/documents/20142/32976598/2021-2040_System_Resource_Outlook_Report_v19_MC.pdf/c638407b-65f9-fe53-4314-9ddce613378f.

Considerations – Going Forward

- During July 2022, the New York Electric Grid depended on dual fuel, natural gas, hydro, and nuclear facilities to provide approximately 95% of its generation supply needs. Wind and solar accounted for approximately 5%, with solar resources outperforming wind resources on 23 of the 31 days. Further, there was a five-day period, July 13-17, where daily wind production was low at less than 5 GWh, or about 1% of the energy needs of customers at the time.
- The real-life observed availability of intermittent generation in July 2022 underscores the importance of implementing the CLCPA transition in an orderly manner to ensure system reliability and public safety are maintained so that customer energy demand can be met every hour of the day. Coordinated optimization of the electric and gas energy systems and maintaining flexibility in technology development, combined with a decarbonization of the fuels transported in the gas system, will facilitate meeting CLCPA requirements while supporting continued high levels of energy reliability.
- As demonstrated in July 2022, intermittent generation can sometimes be minimally available for consecutive multiple day periods. DEFRs will be necessary on a MW-to-MW basis, compared to load, to cover both in-day and extended day supply shortfalls.
- Resource diversity mitigates the risk that the unavailability of a particular fuel impacts reliability. The existing portfolio of electric supply has significant resource diversity, supporting existing high levels of reliability even during high demand periods. Supporting resource diversity, applying the principle of resource diversity to the intermittent renewable generation mix (e.g. the diversity of solar, on-shore wind and off-shore wind), increasing investment in adequate transmission and distribution, and providing access to ample DEFRs 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 modular nuclear facilities). Addressing these limitations and achieving the benefits of resource 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.