New York ISO
Independent System Operator

NYISO's 2021 Comprehensive Area Review of Resource Adequacy

Covering the New York Control Area for the Study Period 2022 – 2026

Prepared by the NYISO for the NPCC

Final
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Caution and Disclaimer

Executive Summary

The New York Independent System Operator (NYISO) conducts an annual Area Review of Resource Adequacy of the New York State Bulk Power System (BPS) as required by the Northeast Power Coordinating Council (NPCC) and the New York State Reliability Council (NYSRC). The purpose of this assessment is to demonstrate conformance with the applicable NPCC resource adequacy planning requirements and NYSRC Reliability Rules.

This report represents the 2021 NYISO Comprehensive Area Review of Resource Adequacy ("2021 Comprehensive Review") and covers a five-year study period, *i.e.,* 2022 (study year 1) through 2026 (study year 5).

Major Findings

This 2021 Comprehensive Review demonstrates that the New York Control Area (NYCA) meets the NPCC resource adequacy criterion: *i.e.,* the NYCA's loss of load expectation (LOLE) of disconnecting firm load due to resource deficiencies is, on average, no more than one day in ten years, or 0.1 days/year, throughout the five-year study period. The results in this report are based on the study assumptions employed for resource adequacy evaluations in NYISO's 2020-2021 Reliability Planning Process and the NYISO's 2021 Q3 STAR. As described in Figure 1, these evaluations are conducted using the General Electric Multi-Area Reliability Simulation (MARS) software model.

Major Assumptions and Results

Figure 1 lists the major assumptions modeled in this review. **Figure 2** lists the Loss of Load Expectation (LOLE) results, while **Appendix A**: Resource Adequacy Model Assumptions.

Figure 1: Modeling Assumptions Highlights

Reliability Planning MARS Model Summary Assumptions	
Assumption	**Description**
Adequacy Criterion	NPCC and NYSRC Loss of Load Expectation (LOLE) requirement (LOLE no more than 0.1 days/year)
Reliability Model	GE MARS program (version 4.3.1796) For each modeled hour, the MARS program determines the resource adequacy and calculates an average loss of load expectation for the capability year for each of the seven load levels modeled. MARS uses this information to evaluate a probability weighted-average reliability indices (such as Loss of Load Expectation, LOLE) for each area.

Reliability Planning MARS Model Summary Assumptions	
Assumption	**Description**
Load Model	Based on the baseline load forecast from the NYISO's 2021 Load and Capacity Data Report (2021 Gold Book (GB). 11 New York zones are modeled. The 2021 GB baseline load forecast includes reductions for energy efficiency, codes and standards, distributed generation, behind-the-meter (BTM) photovoltaic (PV) solar, and energy storage, and increases to account for electric vehicles (EV), and non-EV electrification. For the resource adequacy load model, the deducted BTM solar MW was added back to the NYCA zonal loads, which then allows for a discrete modeling of the BTM solar resources as 5 years of 8,760 hourly shapes, randomly selected during MARS simulations.
Load Shapes	Used Multiple Load Shape MARS Feature. 8,760 hourly historical load shapes were used as base shapes for LFU bins: Bin 1: 2006 Bin 2: 2002 Bins 3-7: 2007 Energy and demand peak adjustments are performed on a seasonal basis.
Load Forecast Uncertainty (LFU)	The load forecast uncertainty (LFU) model captures the impacts of weather conditions on future loads. The LFU gives the MARS program information regarding seven load levels (three loads lower and three loads higher than the median peak) and their respective probabilities of occurrence. The LFU model is subdivided into five separate areas: New York City (Zone J), Long Island (Zone K), Zones H and I, Zones F and G, and the rest of New York State (Zones A-E).
Generating Capacity Additions	879 MW Nameplate wind and solar projects (based on 2021 reliability planning studies inclusion rules)
Generating Capacity Deactivations and Status Changes	2,666 MW (includes 1,575 MW generator status change due to DEC Peaker Rule, and Indian Point Unit 3). This MW value is the lower of CRIS and DMNC corresponding to the 2021 Gold Book Tables IV-5 and IV-6. *CRIS- Capacity Resource Interconnection Service; DMNC - Dependable Maximum Net Capability; DEC- Department of Environmental Conservation*
Unit Availability	Based on NERC GADS data (EFORd calculation) for thermal generation and on unit five-year historic production data (*e.g.,* wind, solar, run-of-river, landfill gas) *EFORd = Equivalent Forced Outage Rate demand*
Topology	A simplified bubble-and-pipe representation of the transmission system. Emergency transfer criteria and MW limits are used for the interfaces between NYISO zones.
Emergency Operating Procedures (EOPs)	EOPs reduce load during emergency conditions: e.g., operating reserves, Special Case Resources (SCR), manual voltage reduction, voltage curtailments, public appeals, external assistance.
External Control Areas	Load and capacity fixed through the study years. The top three summer peak load days of an external Control Area is modeled as coincident with the top three peak load days in the NYCA. EOPs are not represented for the external Control Area capacity models. External Areas adjusted to be between 0.1 and 0.15 days/year LOLE. Includes a limit of 3,500 MW on external control area emergency assistance to the NYCA.

Figure 2: NYCA LOLE Results

2021 Comprehensive Review NYCA LOLE Results					
Year	**2022**	**2023**	**2024**	**2025**	**2026**
Projected Resources* (MW)	40,742	40,343	40,165	39,890	39,890
Base Load Forecast					
NYCA Base Load Forecast** (MW)	32,353	32,380	32,211	32,140	32,076
LOLE Results	0.01	0.03	0.04	0.04	0.05
High Load Forecast					
NYCA High Load Forecast (MW)	32,709	32,971	33,035	33,156	33,307
LOLE Results	0.02	0.07	0.10	0.15	0.18

Notes:

*Projected capacity resources include NYCA Capacity, net purchases, and sales, full UDRs, and SCRs from the 2021 Gold Book. NYCA Capacity values are resources electrically internal to NYCA, proposed additions and re-ratings (e.g., uprates) that met the reliability planning inclusion rules, and proposed deactivations and status changes, including proposed retirements and mothballs. Capacity values reflect the lower of CRIS and DMNC values.

**NYCA baseline load values represent the baseline coincident summer peak demand forecast from the 2021 Gold Book.

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1. Introduction

The NPCC Directory 1 requires each of its five Areas (*i.e.*, New York, New England, Ontario Quebec, and Maritimes) to conduct a Comprehensive Review of Resource Adequacy at least once every three years. In subsequent years, each Area will conduct an Annual Interim Review of Resource Adequacy that will cover, at a minimum, the remaining years studied in the Comprehensive Review of Resource Adequacy.

The most recent NYISO Comprehensive Review was performed by NYISO in 2018 and covered the 2019 through 2023 study period. The 2018 Comprehensive Review was approved by the NPCC Reliability Coordinating Council (RCC) in December 2018. Two Interim Reviews followed, focusing on the remaining years from the study period[1].

This 2021 Comprehensive Review is based upon the NYISO's most recent reliability planning processes databases developed under Attachment Y of its Open Access Transmission Tariff (OATT) approved by the Federal Energy Regulatory Commission. Additional guidelines reside in the NYISO Reliability Planning Process Manual. Specifically, the results of this Comprehensive Review are from the 2021 reliability planning MARS databases, which are also used for the 2021 third quarter Short-Term Assessments of Reliability (2021 Q3 STAR). The NYISO does not perform a Reliability Needs Assessment (RNA in the odd years under the NYISO Reliability Planning Process (RPP). The 2020-2021 RPP started with the 2020 RNA, completed as of November 2020, and its assumptions are based on the 2020 Gold Book and CP-8 information. The 2020 RNA was followed by subsequent updates of the base case assumptions. These updates are captured in the Comprehensive Reliability Plan (CRP), which is the last phase of the 2020-2021 RPP cycle. The CRP is undergoing stakeholder review and the NYISO targets action by its Board of Directors in Q4 2021. A new RPP cycle will start in 2022 with the 2022 RNA, while the STARs will continue to be performed every quarter, in parallel.

This report follows the guidelines outlined in NPCC's Regional Reliability Reference Directory No. 1, Appendix D[2]. The NYISO submits the 2021 Comprehensive Review of Resource Adequacy, covering the study period 2022 through 2026, to satisfy NPCC requirements.

1.1. NYISO's Planning Processes

The New York Independent System Operator (NYISO) was formed in 1997 and commenced

[1] The NY Area Review of Resource Adequacy Reports are here: https://www.nyiso.com/planning-reliability-compliance
[2] https://www.npcc.org/Standards/Directories/Directory_1_TFCP_rev_20151001_GJD.pdf

operations in 1999. The NYISO is a not-for-profit organization that manages New York's bulk electricity grid, administers the state's competitive wholesale electricity markets, provides system and resource planning for state's bulk power system, and works to advance the technology serving the New York State power system. The organization is governed by an independent Board of Directors and a governance structure made up of committees with market participants and stakeholders. The NYISO owns no transmission facilities and is independent of and has no financial stake in any of its market participants or in the outcome of its wholesale electricity markets or planning processes.

The NYISO is also the regional Planning Coordinator for the New York Balancing Authority Area of the Northeast Power Coordinating Council. As the Planning Coordinator, the NYISO is responsible for conducting reliability studies and providing results to NPCC demonstrating that the New York bulk power system complies with NPCC reliability criteria as defined in NPCC's Regional Reliability Reference Directory No. 1, Design and Operation of the Bulk Power System.

The NYISO's Reliability Planning Process (RPP) and the Short-Term Reliability Process (STRP) are part of the NYISO's Comprehensive System Planning Process. Approved by the Federal Energy Regulatory Commission (FERC), these processes are contained in Attachment Y and Attachment FF of the NYISO's Open Access Transmission Tariff (OATT), respectively. The STRP also includes the Generation Deactivation Assessments. One of the NYISO's responsibilities is to prepare for the impact of expected changes in supply and demand of power on the reliable operation of the New York transmission system. The analyses, evaluations and forecasts produced by the NYISO's system and resource planning activities assist market participants, regulators, and policymakers as they plan for the future. One way the NYISO accomplishes this responsibility is through the Reliability Planning Process component of the CSPP. The New York Independent System Operator's (NYISO's) Comprehensive System Planning Process (CSPP) is comprised of four components:

1. Local Transmission Planning Process (LTPP),
2. Reliability Planning Process (RPP), along with parts of the Short-Term Reliability Process (STRP),
3. Economic Planning Process, and
4. Public Policy Transmission Planning Process (PPTPP).

The first component in the CSPP cycle is the LTPP. Under this process, the local Transmission Owners (TOs) perform transmission studies for their transmission districts according to all applicable criteria. This process produces the Local Transmission Owner Plans (LTPs), which feed into the NYISO's determination of system needs through the CSPP.

The second component in the CSPP cycle is the RPP, covering year 4 through year 10 following the year of starting the study, along with STRP, covering year 1 through year 5 following the start date of each quarterly Short-Term Assessment of Reliability (STAR). The requirements of the RPP are described in the Reliability Planning Process Manual and Attachment Y of the OATT.

Under the two-year process for conducting the RPP, the reliability of the New York State Bulk Power Transmission Facilities (BPTF) is assessed, any Reliability Needs are identified, market-based and regulated solutions to identified needs are proposed and evaluated for their viability and sufficiency to satisfy the identified needs. If necessary to satisfy a reliability need, the NYISO will select the more efficient or cost-effective regulated transmission solution to the identified needs. That regulated transmission solution is eligible for cost allocation and cost recovery by the NYISO. The RPP was originally developed and implemented in conjunction with stakeholders, was approved by FERC in December 2004, and was revised to conform to FERC Order Nos. 890 and 1000.

The RPP consists of two studies:

1. **The Reliability Needs Assessment (RNA):** The NYISO performs a biennial study in which it evaluates the resource and transmission adequacy, and the transmission system security, of the New York BPTF over its Study Period, encompassing years 4 through 10 following the year in which the RNA is conducted. Through this evaluation, the NYISO identifies Reliability Needs in accordance with applicable Reliability Criteria. This report is reviewed by NYISO stakeholders and approved by the Board of Directors.
2. **The Comprehensive Reliability Plan (CRP):** After the RNA is complete, the NYISO requests the submission of market-based solutions to satisfy any identified Reliability Needs. The NYISO also identifies a Responsible TO and requests that the TO submit a regulated backstop solution and that any interested entities submit alternative regulated solutions to address the identified Reliability Needs. The NYISO evaluates the viability and sufficiency of the proposed solutions to satisfy the identified Reliability Needs and evaluates and selects the more efficient or cost-effective transmission solution to resolve that need. In the event that market-based solutions do

not materialize to meet a Reliability Need in a timely manner, the NYISO triggers regulated solution(s) to satisfy the need. The NYISO develops the CRP for its Study Period that sets forth its findings regarding the proposed solutions. The CRP is reviewed by NYISO stakeholders and approved by the Board of Directors.

The STRP uses quarterly STAR studies to assess the reliability impacts of Generator deactivations on both Bulk Power Transmission Facilities (BPTF) and non-BPTF (local) transmission facilities, in coordination with the Responsible Transmission Owner(s). The STAR is also used by the NYISO, in coordination with the Responsible Transmission Owner(s), to assess the reliability impacts on the BPTF of system changes that are not related to a Generator deactivation. These changes may include adjustments to load forecasts, delays in completion of planned upgrades, long duration transmission facility outages and other system topology changes. Section 38 of the NYISO OATT describes the process that the NYISO, Transmission Owners, Market Participants, Generator Owners, Developers, and other interested parties follow to meet Generator Deactivation Reliability Needs affecting the New York State Transmission System and other Reliability Needs affecting the BPTF (collectively, Short-Term Reliability Needs).

Each STAR assesses a five-year period, with a particular focus on Short-Term Reliability Process Needs that are expected to arise in the first three years of the study period. The STRP is the sole venue for addressing Generator Deactivation Reliability Needs on the non-BPTF, and for BPTF needs that arise in the first three years of the assessment period. With one exception,[3] needs that arise in years four or five of the assessment period may be addressed in either the STRP or in the longer-term Reliability Planning Process (RPP).

The STRP concludes if a STAR does not identify a need or if the NYISO determines that all identified needs will be addressed in the RPP. Should a STAR identify a need to be addressed in the STRP, the NYISO would request the submission of market-based solutions to satisfy the need along with a Responsible Transmission Owner STRP solution. The NYISO evaluates the viability and sufficiency of the proposed solutions to satisfy the identified needs and selects a solution to address the need. The NYISO reviews the results of the solution or combination of solutions (including an explanation regarding the solution that is selected) with stakeholders and posts a Short-Term Reliability Process Report detailing the determination with stakeholders.

[3] Generator Deactivation Reliability Needs that arise on local facilities, not on the BPTF, must always be addressed in the STRP.

The third component of the CSPP is the Economic Planning Process. The Economic Planning Process commences within each two-year planning cycle using the most recent base case of the Reliability Planning Process and Short-Term Reliability Process, as appropriate. The EPP is the process by which the ISO: (1) develops the System & Resource Outlook and identifies current and future congestion on the New York State Transmission System; (2) evaluates in an Economic Transmission Project Evaluation any Regulated Economic Transmission Project proposals to address any constraint(s) on the BPTFs identified in the Economic Planning Process, which transmission projects are eligible for cost allocation and cost recovery under the ISO OATT if approved by a vote of the beneficiary Load Serving Entity that would pay for the project; and (3) conducts any Requested Economic Planning Studies. In conducting the process, the ISO will analyze a base case and scenarios that are developed in consultation with stakeholders.

The fourth component of the CSPP is the Public Policy Transmission Planning Process. Under this process interested entities propose, and the New York State Public Service Commission (NYPSC) identifies, transmission needs driven by Public Policy Requirements. The NYISO then establishes baseline study cases, holds a technical conference, and requests that interested entities submit proposed transmission and non-transmission solutions to the identified Public Policy Transmission Need. The NYISO evaluates the viability and sufficiency of the proposed solutions to satisfy the identified Public Policy Transmission Need. The NYISO then evaluates and may select the more efficient or cost-effective transmission solution to the identified need. A selected transmission solution is eligible for cost allocation and cost recovery under the NYISO’s tariffs. The NYISO develops the Public Policy Transmission Planning Report that sets forth its findings regarding the proposed solutions. This report is reviewed by NYISO stakeholders and approved by the Board of Directors.

In concert with these four components, interregional planning is conducted with NYISO's neighboring control areas in the United States and Canada under the Northeastern ISO/RTO Planning Coordination Protocol. The NYISO participates in interregional planning and may consider Interregional Transmission Projects in its regional planning processes.

In addition, the NYISO may request Gap Solutions outside of its normal planning cycle if there appears to be an imminent threat to the reliability of the Bulk Power Transmission System arising from causes other than deactivating generation. The NYISO works with the responsible Transmission Owners and the New York Department of Public Service to select and implement a Gap Solution.

Additionally, NYISO provides significant support to the New York State Reliability Council (NYSRC), which conducts an annual Installed Reserve Margin (IRM) study. This study determines the IRM for the upcoming Capability Year (May 1 through April 30th). The IRM is used to quantify the capacity required to meet the Northeast Power Coordinating Council (NPCC) and NYSRC resource adequacy criterion of a Loss of Load Expectation (LOLE) of no greater than 0.1 days per year.

The NYISO performs an annual study to identify the Locational Minimum Installed Capacity Requirements (LCRs) for the upcoming capability year. On October 5, 2018, Federal Energy Regulatory Commission (FERC) accepted proposed revisions for determining LCRs. The new methodology utilizes an economic optimization algorithm to minimize the total cost of capacity for the New York Balancing Area (NYBA).

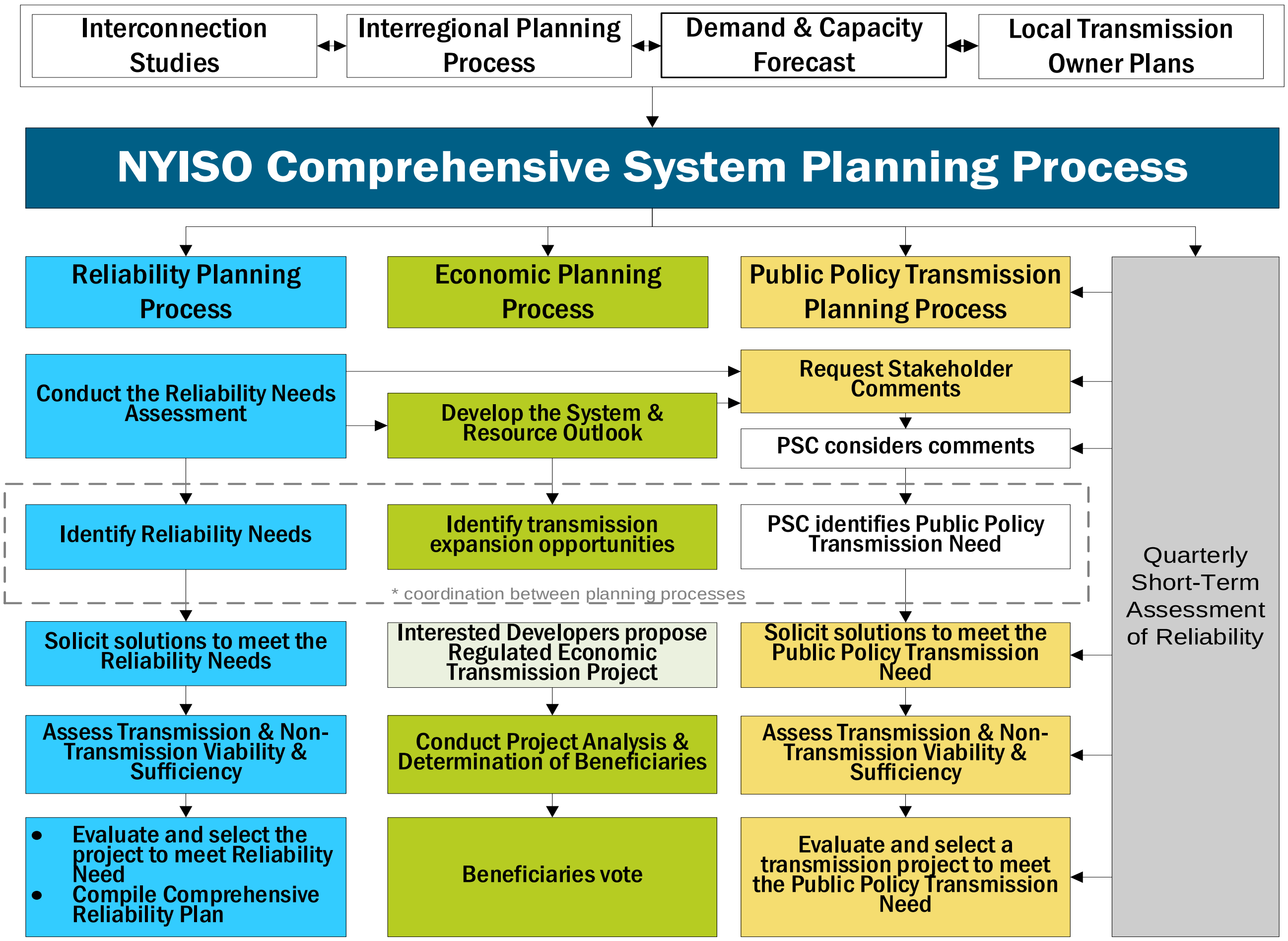
The NYISO establishes installed capacity (ICAP) requirements for the Load Serving Entities (LSEs), including locational ICAP requirements.

For reference, below are several links to various reports and information:

- Link to various NYISO Planning Studies (Reliability, Economic, Public Policy): https://www.nyiso.com/cspp.
    - The latest 2020 Reliability Needs Assessment (RNA) Report is here: https://www.nyiso.com/documents/20142/2248793/2020-RNAReport-Nov2020.pdf
    - The quarterly STAR/STRP Reports are here: https://www.nyiso.com/short-term-reliability-process
- Link to the NYSRC's IRM Reports: https://www.nysrc.org/NYSRC_NYCA_ICR_Reports.html
- Link to the NYISO's LCR Reports (under Reference Documents – LCR Calculation Process): https://www.nyiso.com/installed-capacity-market
- Link to the 2021 NYISO Load and Capacity Data report (the 2021 Gold Book): https://www.nyiso.com/documents/20142/2226333/2021-Gold-Book-Final-Public.pdf
- Link to the 2021 NYISO's Power Trends: https://www.nyiso.com/documents/20142/2223020/2021-Power-Trends-Report.pdf

The NYISO Comprehensive System Planning Process (CSPP) is illustrated in **Figure 3.**

Figure 3: NYISO's Comprehensive Planning Process



1.2. Previous Comprehensive Review

The Reliability Coordinating Committee (RCC) approved the 2018 New York Comprehensive Review of Resource Adequacy in December 2018. The findings of that review demonstrated that New York would meet the NPCC Resource Adequacy Design Criterion for the study period under the base case load and resource conditions described in the report.

1.3. Comparison of Load and Resources with Previous Comprehensive Review

1.3.1. Demand Forecast Background

The baseline peak load forecast, along with the scenario high load forecast from the NYISO's 2021 Load and Capacity Data Report (the 2021 Gold Book) are used for NYISO's reliability planning processes, as well as for this report. The load forecasts are based on information obtained from the New York State Department of Public Service (DPS), the New York State Energy Research and Development Authority (NYSERDA), state power authorities, Transmission Owners, the U.S. Census Bureau, and the U.S. Energy Information Administration. The baseline and scenario load forecasts reflect a combination of information provided by Transmission Owners for their respective service territories and load forecasts prepared by the NYISO.

The NYISO employs a multi-stage process to develop load forecasts for each of the eleven zones within the NYCA. In the first stage, baseline energy and peak models are built based on projections of end-use intensities and economic variables. End-use intensities modeled include those for lighting, refrigeration, cooking, heating, cooling, and other plug loads. Appliance end-use intensities are generally defined as the product of saturation levels (average number of units per household or commercial square foot) and efficiency levels (energy usage per unit or a similar measure). End-use intensities specific to New York are estimated from appliance saturation and efficiency levels in both the residential and commercial sectors. These intensities include the projected impacts of energy efficiency programs and improved codes & standards. Economic variables considered include Gross Domestic Product (GDP), households, population, and commercial and industrial employment. Projected long-term weather trends from the NYISO *Climate Change Impact Study Phase I* [4] are included in the end-use models. In the second stage, the incremental impacts of additional policy-based energy efficiency, behind-the-meter solar PV and distributed generation are deducted from the forecast; and the incremental impacts of electric vehicle usage and other electrification are added to the forecast. The impacts of net electricity consumption of energy storage resources due to charging and discharging are added to the energy forecasts, while the peak-reducing impacts of behind-the-meter energy storage resources are deducted from the peak forecasts. In the final stage, the NYISO aggregates load forecasts by zone.

Scenario (low and high) load forecasts are included in NYISO's 2021 Gold Book to reflect the increasing uncertainty in forecasting future energy usage across the state. The high load scenario

[4] NYISO Climate Change Impact Study Phase I: https://www.nyiso.com/documents/20142/10773574/NYISO-Climate-Impact-Study-Phase1-Report.pdf

forecast reflects faster adoption of electric vehicles and other electrification, and slower adoption of behind-the-meter solar PV and energy efficiency measures. The low load scenario forecast from the Gold Book reflects full adoption of behind-the-meter solar PV and energy efficiency policy measures in accordance with state mandates, and slower adoption of electric vehicles and other electrification. The baseline forecast reflects the expected implementation rates of these programs and technologies. The CLCPA Case load forecast from the NYISO *Climate Change Impact Study Phase I*, completed in December 2019, is included for reference.

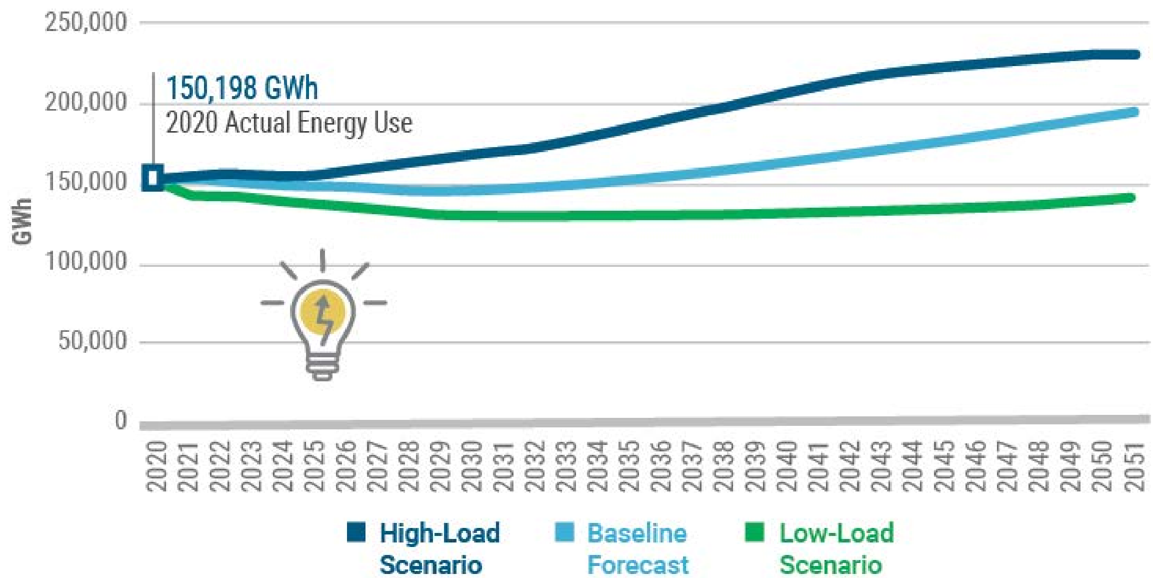
The baseline and scenario energy forecasts also differ in their economic assumptions. The baseline energy forecast reflects the expected rate of economic recovery from the COVID-19 induced recession and assumes typical economic growth over the long-term horizon. The high load scenario energy forecast reflects a stronger recovery and assumes somewhat higher than typical economic growth over the remainder of the forecast horizon. The low load scenario energy forecast reflects a slower economic recovery and assumes somewhat lower than typical economic growth in the long run.

Over the first 20 years of the forecast, the energy growth rate in the 2021 baseline forecast is lower than the rate published in the 2020 Gold Book. The lower forecasted growth in energy usage can be attributed primarily to increased projected load reductions due to energy efficiency programs, increased load reductions due to stronger projected growth in behind-the-meter solar PV, and continuing economic impacts caused by the COVID-19 recession. Over the final ten years of the forecast, the energy growth rate in the 2021 baseline forecast is significantly higher than the rate published in the 2020 Gold Book. The higher forecasted growth in energy usage can be attributed primarily to the increasing impacts of electric vehicle usage, space heating electrification, and electrification of other end uses. On aggregate, the energy growth rate over the thirty years in the 2021 baseline forecast is slightly higher than the rate published in the 2020 *Gold Book*.

Over the course of the forecast horizon, significant load-reducing impacts occur due to energy efficiency initiatives and the growth of distributed behind-the-meter energy resources, such as solar PV. Much of these impacts are due to New York State's energy policies and programs, including the 2019 Climate Leadership and Community Protection Act (CLCPA), the 2020 Accelerated Renewable Energy Growth and Community Benefit Act (AREA), the Clean Energy Standard ("CE), the Clean Energy Fund (CEF), the NY-SUN initiative, the energy storage initiative, and other programs developed as part of the Reforming the Energy Vision (REV) proceedings.

Figure 4 represents three energy forecasts through 2051 developed by the NYISO. The baseline scenario reflects the expected influence of energy efficiency and behind-the-meter resources, as well as the expected rate of near-term economic recovery and long-term economic growth. Behind-the-meter (BTM) generally refers to supply technologies that are installed at one's home or business, or in some cases, connected to a local utility's distribution system. While near-term load is expected to decline, the figure points to longer-term load growth that will be driven largely by electrification. The high-load scenario evaluated conditions with higher adoption rates for electrification and reduced adoption of energy efficiency measures and BTM solar. The low-load scenario models increased adoption of energy efficiency measures, which have the effect of reducing demand on the transmission system.

Figure 4: Electric Energy Usage - Actual and Forecast: 2020-2051 (GWh)



Source: 2021 Power Trends

Figure 5: 2020 New York Control Area (NYCA) Seasonal Load Shapes (Average)

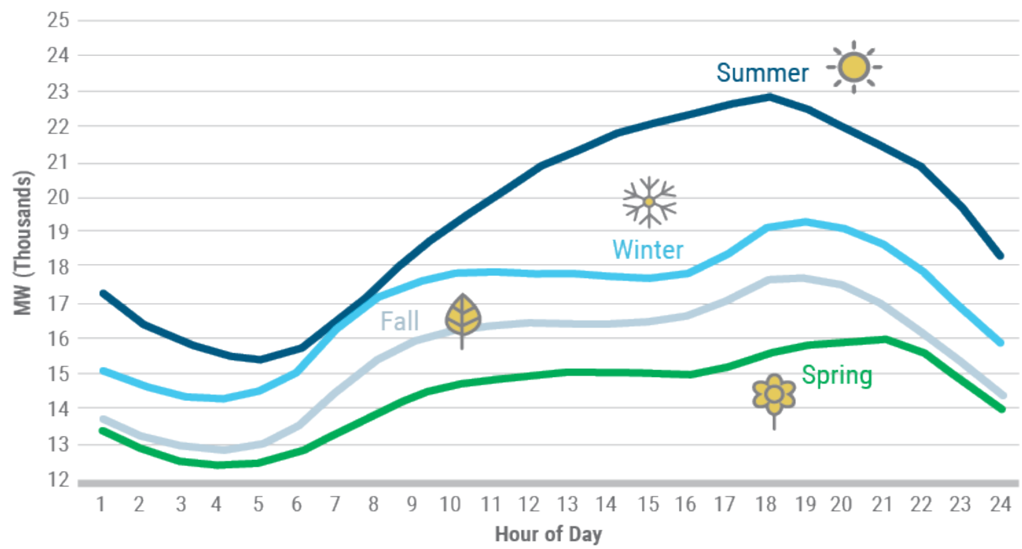
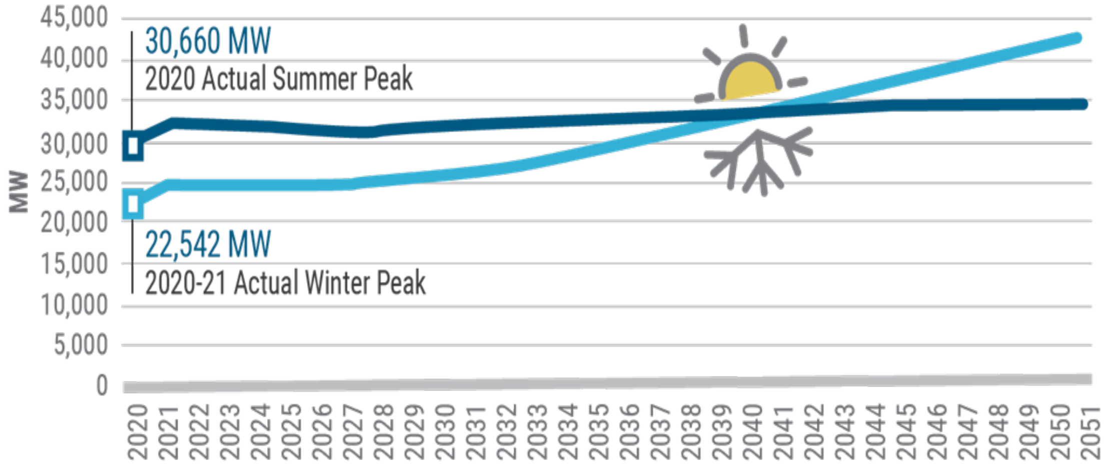


Figure 6: Electric Summer & Winter Peak Demand: 2020-2051



Source: 2021 Power Trends

1.3.2. COVID-19 Impact

The economic and behavioral changes stemming from the COVID-19 pandemic caused large differences in 2020 load levels and load shapes relative to a typical year. Annual energy usage across the state was more than 4,100 GWh below the pre-COVID expected baseline forecast developed in early 2020. The largest impacts were seen in April and May during the height of the initial lockdown period, with usage across the NYCA more than 8% below expected. These effects tapered off into the summer and fall, with smaller deviations relative to expected. The largest load reductions have consistently been in New York City (Zone J), being an urban area with a large share of commercial load.

1.3.3. Resources

The 2021 resource adequacy reliability base case models as generation resources the existing generation, adjusted for the unit proposed deactivations and status changes, along with the new resource additions that met the reliability planning base case inclusion rules set forth in Section 3 of the Reliability Planning Process Manual. The capacity and baseline load forecasts are summarized in **Figure 7** below. The capacity also includes the NYCA net purchases and sales, the Unforced Deliverability Rights (UDRs), and the Special Capacity Resources (SCRs)[5]. The baseline peak load is the coincident summer peak forecast from the 2021 Gold Book. A comparison with the prior Comprehensive Review assumptions is also provided below, and shows that Capacity resources trend lower, mainly due to the impacts of the Department of Energy Conservation (DEC) peaker rule affecting units in Zones J and K.

Figure 7: Comparison of Peak Load Forecasts and Capacity Resources from Previous Review

Comparison of Peak Load Forecasts (MW) and Capacity Resources (MW) with the 2018 Comprehensive Review					
Year	**2022**	**2023**	**2024**	**2025**	**2026**
2021 Comprehensive Review – Capacity Resources*	40,742	40,343	40,165	39,890	39,890
2018 Comprehensive Review – Capacity Resources*	41,500	41,500	-	-	-
Delta	-759	-1,157	N/A	N/A	N/A
2021 Comprehensive Review – Baseline Load Forecast**	32,353	32,380	32,211	32,140	32,076
2018 Comprehensive Review – Baseline Load Forecast**	32,339	32,284	-	-	-
Delta	14	96	N/A	N/A	N/A

Notes:

*Projected capacity resources include NYCA Capacity, net purchases and sales, full UDRs, and SCRs from the 2021 Gold Book. NYCA Capacity values are resources electrically internal to NYCA, proposed additions and re-ratings (uprates, etc.) that met the reliability planning inclusion rules, and proposed deactivations and status changes (including proposed retirements and mothballs). Capacity values reflect the lesser of CRIS and DMNC values.

**NYCA baseline load values represent baseline coincident summer peak demand forecast from the 2021 Gold Book.

[5] Special Case Resources, SCRs, are Demand Side Resources whose Load is capable of being interrupted at the direction of the NYISO, and/or Demand Side Resources that have a Local Generator, which is not visible to the NYISO's Market Information System and is rated 100 kW or higher, that can be operated to reduce Load from the NYS Transmission System and/or the distribution system at the direction of the NYISO. Small customer aggregations may also qualify as SCRs. The Unforced Capacity of a SCR corresponds to its pledged amount of Load reduction as adjusted by historical performance factors (i.e., test and event performance) and as increased by the Transmission District loss factor, as calculated in accordance with Section 4.12.2.1 to the ICAP Manual

2. Resource Adequacy Criterion

2.1. NPCC and NYSRC Criteria

The NYISO adheres to the NPCC resource adequacy criterion[6], which reads:

"R4. Each Planning Coordinator or Resource Planner shall probabilistically evaluate resource adequacy of its Planning Coordinator Area portion of the bulk power system to demonstrate that the loss of load expectation (LOLE) of disconnecting firm load due to resource deficiencies is, on average, no more than 0.1 days per year.

> *R4.1 Make due allowances for demand uncertainty, scheduled outages and deratings, forced outages and deratings, assistance over interconnections with neighboring Planning Coordinator Areas, transmission transfer capabilities, and capacity and/or load relief from available operating procedures."*

The NYISO also adheres to the New York State Reliability Council (NYSRC) resource adequacy criterion[7] (A.1-R1), which reads:

"A.1: Establishing NYCA Installed Reserve Margin Requirements

R1. The NYSRC shall annually perform and document an analysis to calculate the NYCA Installed Reserve Margin (IRM) requirement for the following Capability Year. The IRM analysis shall:

> *R1.1 Probabilistically establish the IRM requirement for the NYCA such that the loss of load expectation (LOLE) of disconnecting firm load due to resource deficiencies shall be, on average, no more than 0.1 days per year. This evaluation shall make due allowances for demand uncertainty, scheduled outages and deratings, forced outages and deratings, assistance over interconnections with neighboring control areas, emergency NYS Transmission System transfer capability, and capacity and/or load relief from available operating procedures."*

The NYSRC LOLE criterion is consistent with the NPCC LOLE criterion.

In addition, NYSRC imposes Installed Capacity Requirements on NYCA Load Serving Entities (LSE) (A.2-R2), as follows:

"A.2: Establishing Load Serving Entity Installed Capacity Requirements

> *R1. The NYISO shall annually establish Load Serving Entity (LSE) installed capacity (ICAP) requirements, including Locational Capacity Requirements (LCRs), in accordance with NYSRC rules and NYISO tariffs..."*

[6] NPCC Directory #1: https://www.npcc.org/Standards/Directories/Directory_1_TFCP_rev_20151001_GJD.pdf

[7] NYSRC Reliability Rules, rev. 45: https://www.nysrc.org/NYSRCReliabilityRulesComplianceMonitoring.html

2.2. Application of the Criteria

The NYISO evaluates the Reliability Criteria (as promulgated by NERC, NPCC, and NYSRC) of the New York State Bulk Power Transmission Facilities in its Reliability Planning Process (RPP) and also in its Short-Term Reliability Process (STRP), pursuant to Attachments Y and FF of the NYISO OATT. NYISO's reliability processes are described in **Section 1.1 NYISO Planning Processes** above.

The NYISO conducts the resource adequacy analysis and compares the results against the NPCC and NYSRC resource adequacy LOLE criterion described in this **Section 2** above. The NYISO uses the GE MARS software package, which performs a probabilistic simulation of outages and availability of capacity and select transmission resources. The NYISO models the transmission system in MARS using interface transfer limits applied to the connections between the MARS areas. Additional model details are in the **Appendix A Assumptions Matrix.**

The NYISO developed the system representations for PJM, Ontario, New England, and Hydro Quebec modeled in the 2021 base cases from the NPCC CP-8 WG. To avoid overdependence on emergency assistance from the external areas, the emergency operating procedure data is removed from the model for each external area. In addition, the capacity of the external areas was further modified such that the LOLE value of each external area was set at a minimum value of 0.10 and capped at a value of 0.15 through year 10. Also, an overall NYCA emergency assistance limit is employed. Deviations from the forecasted loads are captured using a load forecast uncertainty (LFU) model.

The internal transfer limits modeled are the summer emergency ratings derived from the RNA power flow cases. The NYISO developed external transfer limits from the NPCC CP-8 Summer Assessment MARS database with changes based upon the RNA Base Case assumptions.

Emergency operating procedures (EOP) are also modeled in both the RNA and the IRM studies; these are aimed at either reducing load or increasing capacity.

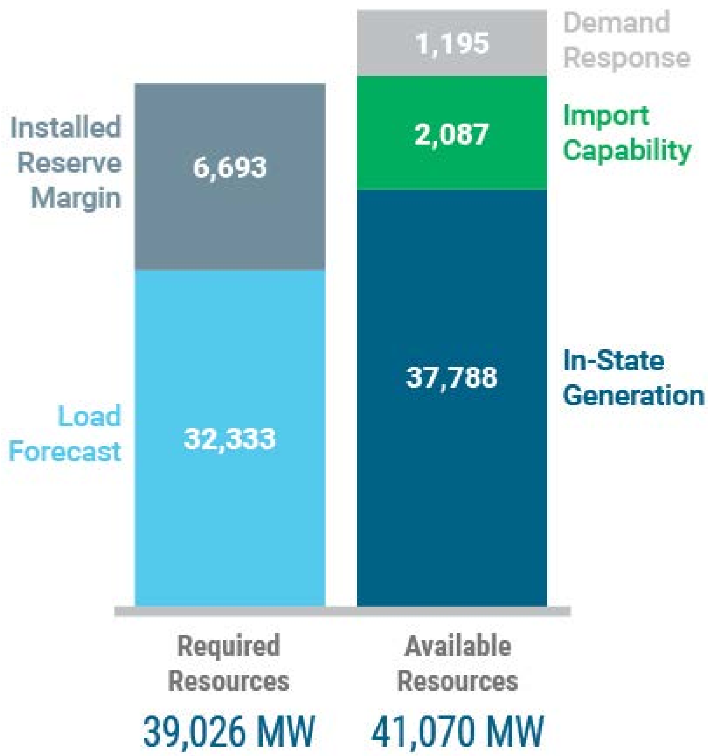
2.3. Capacity Resources to Meet Criteria

New York requires load serving entities to procure capacity for their loads equal to their peak demand plus an Installed Reserve Margin (IRM), as established yearly by NYSRC. The IRM requirement represents a percentage of capacity above peak load forecast and is approved annually by the New York State Reliability Council (NYSRC).

The current approved Installed Reserve Margin[8] requirement for the May 1, 2021, through April 30, 2022, Capability Year is 20.7% of the forecasted NYCA summer peak load. This value is based upon an annual Installed Reserve Margin study report adopted by the NYSRC[9] completed in December 2020. All values in the IRM calculation are based upon full Installed Capacity (ICAP) MW values of resources, and it is identified based on annual probabilistic assessments and models for the upcoming capability year, using General Electric's MARS program.

Figure 8 shows the statewide resource requirement (20.7% IRM) vs availability for summer 2021.

Figure 8: Statewide Resource Availability: Summer 2021



Source: 2021 NYISO's Power Trends

2.4. NPCC vs NYSRC LOLE Criterion

The New York State Reliability Council LOLE criterion is the same as the NPCC LOLE criterion. Details in Section 2.1 above.

[8] Capitalized terms are defined in the NYISO's Tariffs, Agreements and Procedures.

[9] https://www.nysrc.org/NYSRC_NYCA_ICR_Reports.html

3. Resource Adequacy Assessments

3.1. Baseline Load Forecast Results

Assessment results for the baseline load forecast are summarized in **Figure 9**, and are based on the NYISO's 2021 reliability planning databases and assumptions. The results indicate that no LOLE violations arise during the five-year study period of this Comprehensive Review.

Figure 9 also summarizes the amount of excess capacity resources during the study period. Should the current capability year (*i.e.,* May 1, 2021, through April 30, 2022) IRM requirement of 20.7% be constant over the five-year study period, the NYCA would have a minimum excess capacity of 1,097 MW under base load forecast to meet the current Installed Reserve Margin requirement. Given that NPCC and NYSRC establish resource adequacy criteria, no separate planning reserve margin criterion is applicable in New York.

Figure 9: Baseline Load Forecast Results

Baseline Load Forecast Results					
Study Year	2022	2023	2024	2025	2026
Baseline MW Load Forecast*	**32,353**	**32,380**	**32,211**	**32,140**	**32,076**
Resources corresponding to an 20.7% (2021-2022) IRM, and extended*** to outer years (MW)	39,050	39,083	38,879	38,793	38,716
Projected MW Resources** *(meeting the 2021 Q3 STAR inclusion rules)*	**40,742**	**40,343**	**40,165**	**39,890**	**39,890**
Delta MW Resources	1,692	1,260	1,287	1,097	1,174
Projected Resources divided by Baseline Load	126%	125%	125%	124%	124%
LOLE Results	**0.01**	**0.03**	**0.04**	**0.04**	**0.05**

Notes:

*NYCA load values represent baseline coincident summer peak demand.

**Projected capacity resources include NYCA Capacity, net purchases and sales, full UDRs, and SCRs from the 2021 Gold Book. NYCA Capacity values are resources electrically internal to NYCA, proposed additions and re-ratings (uprates, etc.) that met the reliability planning inclusion rules, and proposed deactivations and status changes (including proposed retirements and mothballs). Capacity values reflect the lesser of CRIS and DMNC values.

***The NYSRC determines the IRM for the following Capability Year only (i.e., during 2021, the IRM study process will determine the IRM for the May 1, 2022, through April 30, 2023, Capability Year). Extending the assumption for the outer years is for information purposes only, as requested by NPCC. Given that NPCC and NYSRC establish resource adequacy criteria, no separate planning reserve margin criterion is applicable in New York.

3.2. High Load Forecast Scenario Results

The baseline scenario reflects the expected influence of energy efficiency and behind-the-meter resources, as well as the expected rate of near-term economic recovery and long-term economic growth.

The high-load scenario evaluated conditions with higher adoption rates for electrification and reduced adoption of energy efficiency measures and BTM solar. This results in a 1,231 MW higher peak load in 2026, as comparing with the baseline forecast, as shown in **Figure 10**. **Figure 11** contains the LOLE results for the high load scenario.

Figure 10: High Load (Topline) vs. Baseline Summer Peak Forecast

Year	High Load	Baseline Load	Delta
2022	32,709	32,353	356
2023	32,971	32,380	591
2024	33,035	32,211	824
2025	33,156	32,140	1,016
2026	33,307	32,076	1,231

Figure 11. High Load (Topline) Forecast Scenario Results

	High Load Scenario Results					
	Year	2022	2023	2024	2025	2026
a	High Load Forecast* (MW)	32,709	32,971	33,035	33,156	33,307
b	Resources corresponding to an 20.7% (2021-2022) IRM, and extended*** to outer years (MW)	39,480	39,796	39,873	40,019	40,202
c	Projected Resources** (MW)	40,742	40,343	40,165	39,890	39,890
	Delta (b-c) (MW)	1,262	547	292	-129	-312
	LOLE Results	0.02	0.07	0.10	0.15	0.18

Notes:

*NYCA load values represent the high load scenario summer peak demand.

**Projected capacity resources include NYCA Capacity, net purchases, and sales, full UDRs, and SCRs from the 2021 Gold Book. NYCA Capacity values are resources electrically internal to NYCA, proposed additions and re-ratings (uprates, etc.) that met the reliability planning inclusion rules, and proposed deactivations and status changes (including proposed retirements and mothballs). Capacity values reflect the lesser of CRIS and DMNC values.

***The NYSRC determines the IRM for the **following Capability Year only** (*i.e.*, during 2021, the IRM study process will determine the

IRM for the May 1, 2022, through April 30, 2023, Capability Year). Extending the assumption for the outer years is **for information purposes only, as requested by NPCC.** Given that NPCC and NYSRC establish resource adequacy criteria, no separate planning reserve margin criterion is applicable in New York.

3.3. Impact of Load and Resource Uncertainties

Uncertainty exists relative to forecasting NYCA loads for any given year. This uncertainty[10] is incorporated in the base case model by using a load forecast probability distribution that is sensitive to different weather and economic conditions, as well as load multipliers.

Also, a number of recent state policies and initiatives and Department of Environmental Conservation rulemakings are underway that have the potential to significantly change the resource mix in the New York Control Area. These include the 2019 CLCPA and the Department of Conservation (DEC) regulations such as the peaker rule (additional details in the Regulatory Activities Section), which can lead to a system with less fossil generation (synchronous generation with high inertia and availability) and more reliant upon on intermittent and energy limited resources. The increasing potential for extreme weather further highlights the need for sufficient resources to resource adequacy. Inverter-based technologies used for generation units such as wind, solar, battery storage can also affect impacts the reliability of the system, due to decreased inertia, increased sensitivity to small voltage, frequency and current changes, and increased complexity related to system protection controls and interactions. These challenges also create potential opportunities for services provided by grid-forming power electronics. The geographical distribution of solar, wind, distributed generation, storage units also impact the system events and reliability. Additionally, the system load is changing from a static demand to a demand that can play an active role in the operation of the system (e.g., demand management programs participation), with increased coordination complexity and increased interactions between various entities.

The NYISO will continue to monitor these and other developments to determine whether changing system resources and conditions could impact the reliability of the Bulk Power Transmission Facilities.

Only existing resources and those that have met certain inclusion rules in the NYISO's reliability planning procedures are modeled in the assessment. Existing resources are those listed in the 2021 Load and Capacity Data Report (2021 Gold Book). The figures below list generating units that met criteria for inclusion in the 2021 NYISO's reliability planning assessments.

[10] Link to the May 24, 2021 LFTF presentation on LFU: https://www.nyiso.com/documents/20142/21707507/04%20LFU_IRM_2022.pdf

Figure 12: Additions Assumed in the 2021 Comprehensive Review

					Study Year 1 = 2022
Queue #	**Project Name**	**Type or Zone**	**CRIS Request**	**Summer MW**	**Included in the 2021 Study From Beginning of**
Proposed Transmission Additions, other than Local Transmission Owner Plans (LTPs)					
0545A	Empire State Line	Western NY PPTPP	n/a/	n/a	Study Year 1
0543	Segment B Knickerbocker-Pleasant Valley 345 kV	ACPPTPP	n/a/	n/a	Study Year 3
0556	Segment A Double Circuit		n/a/	n/a	Study Year 3
0430	Cedar Rapids Transmission Upgrade	Developer Proposed Upgrade	n/a/	n/a	Study Year 1
SDU	Leeds-Hurley SDU	System Deliverability Upgrades (SDU)	n/a	n/a	Study Year 1
Proposed Generation Additions with CRIS Rights					
0387	Cassadaga Wind	A	126.5	126.5	Study Year 1
0396	Baron Winds	C	238.4	238.4	Study Year 2
0422	Eight Point Wind Energy Center	C	101.8	101.8	Study Year 1
0505	Ball Hill Wind	A	107.2	107.2	Study Year 2
0546	Roaring Brook Wind	E	78.0	78.0	Study Year 1
0531	Number 3 Wind Energy	E	103.9	103.9	Study Year 2
0678	Calverton Solar Energy Center	K	22.9	22.9	Study Year 1
0565	Tayandenega Solar	F	20.0	20.0	Study Year 1
0584	Dog Corners Solar	C	20.0	20.0	Study Year 1
0586	Watkins Road Solar	E	20.0	20.0	Study Year 2
670	Skyline Solar	E	20.0	20.0	Study Year 1
0768	Janis Solar	C	20.0	20.0	Study Year 1
		Total MW generation	**879**	**879**	

CRIS = Capacity Resource Interconnection Service

blue font - inlcuded in the 2018 Comprehensive Review

Figure 13: Generation Deactivations Assumed in the 2021 Comprehensive Review

2021 Gold Book Table Refference	Owner/Operator	Plant Name	Zone	CRIS	Status	2021 GB Target Date	2021 Comprehensive Review Status
Table IV-3: Deactivated[0] Units with Unexpired CRIS Rights Not Listed in Existing Capacity Table III-2	International Paper Company	Ticonderoga	F	7.6	SCR Program	05/01/2017	SCR program
	Helix Ravenswood, LLC	Ravenswood 2-1	J	40.4	I	04/01/2018	out
		Ravenswood 2-2	J	37.6	I	04/01/2018	
		Ravenswood 2-3	J	39.2	I	04/01/2018	
		Ravenswood 2-4	J	39.8	I	04/01/2018	
		Ravenswood 3-1	J	40.5	I	04/01/2018	
		Ravenswood 3-2	J	38.1	I	04/01/2018	
		Ravenswood 3-4	J	35.8	I	04/01/2018	
	Exelon Generation Company LLC	Monroe Livingston	B	2.4	R	09/01/2019	out
	Innovative Energy Systems, Inc.	Steuben County LF	C	3.2	R	09/01/2019	out
	Consolidated Edison Co. of NY, Inc	Hudson Ave 4	J	13.9	R	09/10/2019	out
	New York State Elec. & Gas Corp.	Auburn - State St	C	5.8	R	10/01/2019	out
	Cayuga Operating Company, LLC	Cayuga 1	C	154.1	R	06/04/2020	out
		Cayuga 2	C	154.7	R	06/04/2020	out
	Albany Energy LLC	Albany LFGE	F	4.5	I	07/01/2020	out
Table IV-4: Deactivated Units Listed in Existing Capacity Table III-2	Somerset Operating Company, LLC	Somerset	A	686.5	R	03/12/2020	out
	Entergy Nuclear Power Marketing, LLC	Indian Point 2	H	1027.0	R	04/30/2020	out
	Astoria Generating Company L.P.	Gowanus 1-8	J	16.1	peaker rule	02/01/2021	out
TABLE IV-5: Notices of Proposed Deactivations as of March 15, 2020	National Grid	West Babylon 4	K	49.0	1	12/12/2020	out
	Long Island Power Authority	Glenwood GT 01	K	14.6	1	02/28/2021	out
	Entergy Nuclear Power Marketing, LLC	Indian Point 3	H	1040.4	1	04/30/2021	out
TABLE IV-6: Proposed Status Change to Comply with DEC Peaker Rule (1)	Central Hudson Gas & Elec. Corp.	Coxsackie GT	G	21.6	2	05/01/2023	out
	Central Hudson Gas & Elec. Corp.	South Cairo	G	19.8	2	05/01/2023	out
	Consolidated Edison Co. of NY, Inc.	74 St. GT 1 & 2	J	39.1	2	05/01/2023	out
	NRG Power Marketing, LLC	Astoria GT 2-1, 2-2, 2-3, 2-4	J	165.8	2	05/01/2023	out
	NRG Power Marketing, LLC	Astoria GT 3-1, 3-2, 3-3, 3-4	J	170.7	2	05/01/2023	out
	NRG Power Marketing, LLC	Astoria GT 4-1, 4-2, 4-3, 4-4	J	167.9	2	05/01/2023	out
	Astoria Generating Company, L.P.	Gowanus 1-1 through 1-7	J	122.6	3	05/01/2023	out
	Astoria Generating Company, L.P.	Gowanus 4-1 through 4-8	J	140.1	3	05/01/2023	out
	Consolidated Edison Co. of NY, Inc.	Hudson Ave 3	J	16.0	2	05/01/2023	out
	Consolidated Edison Co. of NY, Inc.	Hudson Ave 5	J	15.1	2	05/01/2023	out
	Helix Ravenswood, LLC	Ravenswood 01	J	8.8	2	05/01/2023	out
	Helix Ravenswood, LLC	Ravenswood 10	J	21.2	2	05/01/2023	out
	Helix Ravenswood, LLC	Ravenswood 11	J	20.2	2	05/01/2023	out
	National Grid	Northport GT	K	13.8	2	05/01/2023	out
	National Grid	Port Jefferson GT 01	K	14.1	2	05/01/2023	out
	Consolidated Edison Co. of NY, Inc.	59 St. GT 1	J	15.4	2	05/01/2025	out
	NRG Power Marketing, LLC	Arthur Kill GT 1	J	16.5	2	05/01/2025	out
	Astoria Generating Company, L.P.	Astoria GT 01	J	15.7	3	05/01/2025	out
	Astoria Generating Company, L.P.	Gowanus 2-1 through 2-8	J	152.8	3	05/01/2025	out
	Astoria Generating Company, L.P.	Gowanus 3-1 through 3-8	J	146.8	3	05/01/2025	out
	Astoria Generating Company, L.P.	Narrows 1-1 through 2-8	J	309.1	3	05/01/2025	out
	Long Island Power Authority	Glenwood GT3	K	54.7	2	05/01/2023	out
	Long Island Power Authority	Shoreham 1	K	48.9	2	05/01/2023	out
	Long Island Power Authority	Shoreham 2	K	18.5	2	05/01/2023	out
			Total CRIS	**2,839**			

Notes:

blue font - status "out-of-service" in the 2018 Comprehensive Review

0. Approximate date of generator status change; not necessarily the date the generator became CRIS-inactive.

1. Units listed in Table IV-5 have provided a notice to the NYSPSC and/or have a completed Generator Deactivation Notice with the NYISO.

2. These units have indicated they will be out of service as noted in their compliance plans in response to the DEC peaker rule.

3. These units have indicated they will be out of service during the ozone season (May through September) in their compliance plans in response to the DEC peaker rule.

CRIS - Capacity Resource Interconnection Services

M = Mothball Outage per MST Section 5.18; R = retired or retired as defined in the MST; I = ICAP Ineligible Forced Outage per MST Section 5.18.

3.4. Summary of Past Resource Adequacy Studies

The NYISO is currently undertaking the 2020-2021 Reliability Planning Process (RPP) cycle, with the 2020 Reliability Needs Assessment (RNA) completed as of November 2020, and with the Comprehensive Reliability Plan (CRP) in progress. While the 2020 RNA identified LOLE violations starting with the study year 2027, the process allows for subsequent updates, before solicitation for solutions. With the subsequent updates (e.g., load forecast updates and local transmission plans updates) it concluded that there are no Loss of Load Event (LOLE) violations for the entire RNA study period 2024-2030. This conclusion will be captured in the Comprehensive Reliability Plan (CRP), to be published in Q4 of 2021. Scenarios are also performed in the RNA and the CRP, such as higher load forecast, 70% of energy from renewable resources by 2030 ('70x30'), zonal capacity at the reliability margin, and a status-quo case without the proposed projects.

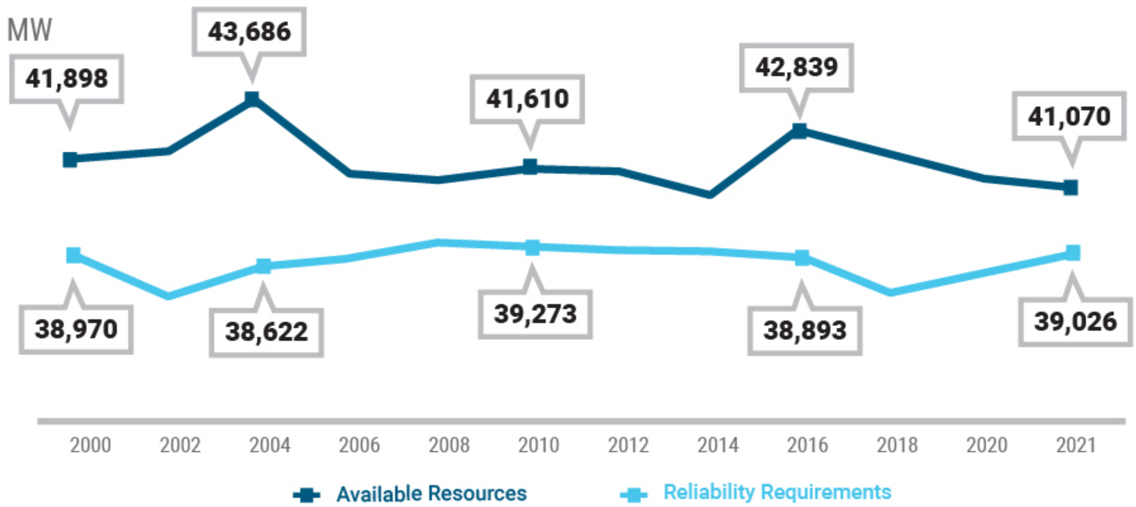
Additionally, under NYISO's Short Term Reliability Process (STRP), the NYISO re-assesses the system on a quarterly basis, from both transmission security and resource adequacy perspectives. For the 2021 Q1 and the Q2 Short Term Reliability Assessments (STAR) the NYISO determined that the New York LOLE continued to be below its criterion of 0.1 days/year.

The 2021 Q2 STAR report was completed on July 14, 2021, and identified no Needs. The 2021 Q3 STAR started on July 15, 2021, and targets October 15, 2021 for completion; its assumptions are the same with this Comprehensive Review's assumptions. The STARs also evaluate the proposed deactivations of generators with a complete Generation Deactivation Notice, or generation in an installed capacity payment ineligible forced outage (IIFO) or otherwise becoming unavailable.

The IRM for the current capability year (i.e., May 1st, 2021, through April 30th, 2022) is 20.7% of the NYCA baseline forecasted peak load and has varied historically from 15% to 20.7%. All values in the IRM calculation are based upon full installed capacity values of resources. Using the IRM determined by the NYSRC, the NYISO establishes locational capacity requirements for certain regions of the state for which minimum levels of capacity must be procured to maintain resource adequacy. The NYISO calculates Locational Minimum Installed Capacity Requirements ("LCRs") for the localities of New York City (Load Zone J), Long Island (Load Zone K), and the Zones G-J Locality that encompasses the lower Hudson Valley (Load Zones G, H, I and J). The LCRs for the 2021-2022 Capability Year are 80.3% for Zone J, 102.9% for Zone K, and 87.6% for Zones G-J.

Figure 14 shows the MW requirement as compared to available resources through time, based on the available resources assumptions calculations from the NYISO's Gold Books.

Figure 14: Available Resources & Reliability Requirements : 2010-2021



4. Resource Capacity Mix

From a statewide perspective, New York has a relatively diverse mix of generation resources. However, New York's grid is characterized by regional differences whereby the downstate supply mix is less diverse than the upstate supply mix.

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

Intermittent supply resources like wind and solar are expected to be a larger contributor to serving load in the future, helping to reduce emissions from the electric sector. Coordinating supply with demand will become increasingly complex because the supply produced by intermittent resources is dependent upon availability of solar and wind energy.

The CLCPA calls for a significant increase in BTM solar resources, totaling 6,000 MW by 2025. Currently, more than 2,500 MW of BTM solar capacity is installed throughout the state. BTM solar resources supply electricity on-site or locally through distribution networks. In doing so, they reduce the amount of load served by the bulk power system. As the number of BTM solar resources increases, uncertainty in load forecasts also increases. BTM resources displace energy that was traditionally supplied by the grid. However, displacement is not the same as elimination, and the energy provided by many BTM resources is not continuous. When those intermittent resources are unavailable to produce energy, the grid must still provide energy to those homes and businesses. To reduce uncertainty due to the effects of greater participation of solar resources on the grid, the NYISO implemented solar forecasting tools to provide day-ahead and real-time estimates of BTM solar production. Understanding the contribution of these resources throughout the day helps grid operators dispatch generation on the bulk power system more efficiently.

The CLCPA also calls for the addition of 3,000 MW of storage by 2030. Energy storage resources may be interconnected to the transmission system, distribution system, or a customer's premises to supply energy. The NYISO considers customer-sited and certain distribution system storage resources to be behind-the-meter, meaning they work to reduce demand on the transmission system rather than supply it. When connected to the transmission or distribution system, storage resources can inject energy directly into the grid in response to competitive wholesale market price signals. However, storage has the added flexibility to withdraw energy in response to low prices or system balancing needs.

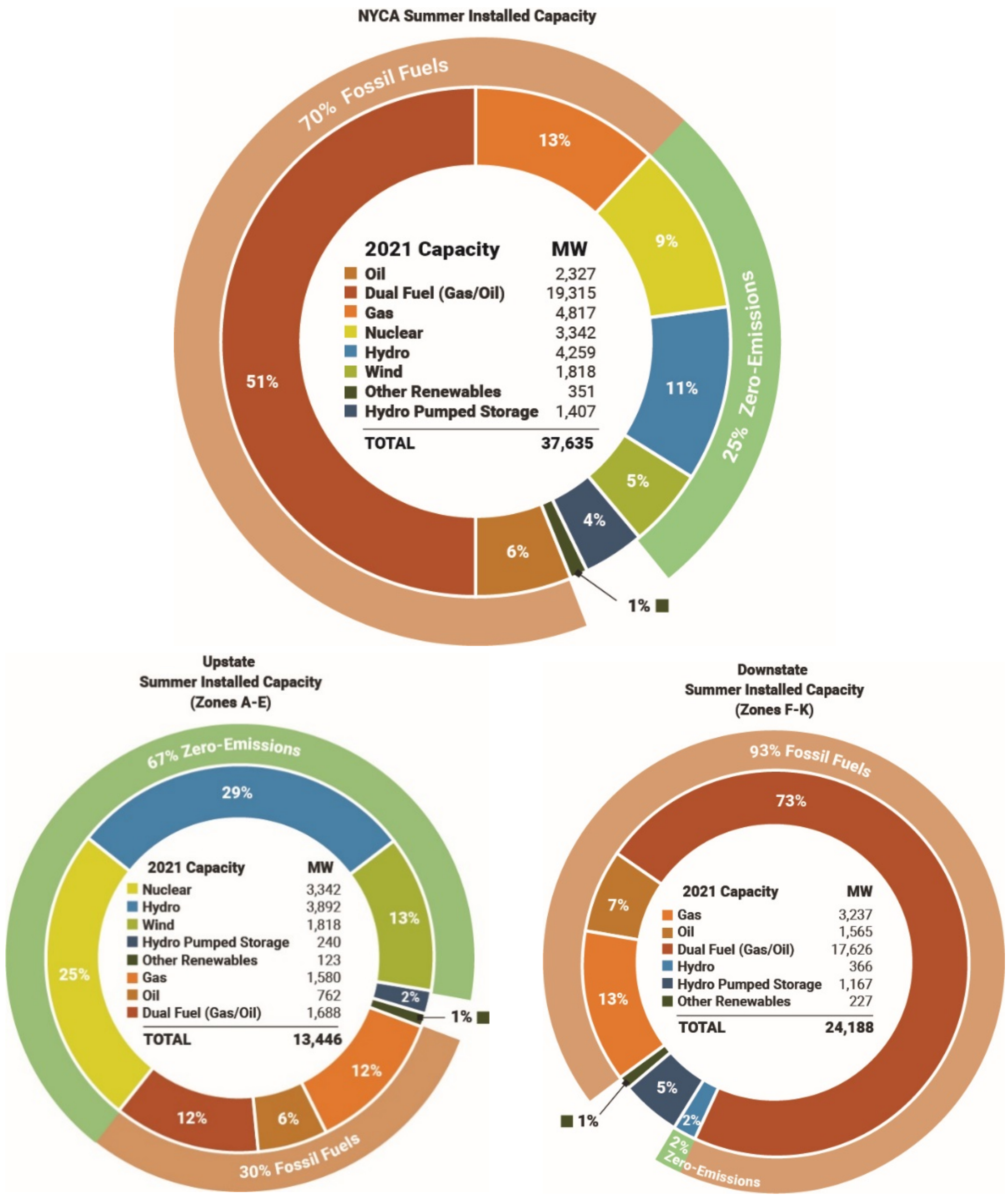
To maintain reliability, bulk power system operators will require a full portfolio of resources that can be dispatched in response to any change in real-time operating conditions. The ability to dispatch resources to reliably meet ever-changing grid conditions and serve New York's electric consumers will always be paramount.

On January 9, 2017, Entergy and New York State announced an agreement to close Indian Point units 2 and 3 in 2020 and 2021, respectively. The NYISO evaluated the proposed deactivation as part of the required generator deactivation assessments it performs for proposed generator retirements. Based on the study's assumptions, the NYISO concluded that the proposed Indian Point deactivation did not result in a reliability need. Subsequent reliability planning studies have not altered this outlook. On April 30, 2020, Indian Point unit 2 deactivated. Indian Point unit 3 deactivated in April 2021. Additionally, the 685 MW coal plant in western NY, Kintigh-Somerset, retired as of March 2020.

The 1,020 MW Cricket Valley Energy Center combined cycle plant entered service in 2020 (CPV Valley entered service in 2018).

Figure 15 shows New York statewide generating capacity by fuel source (2021).

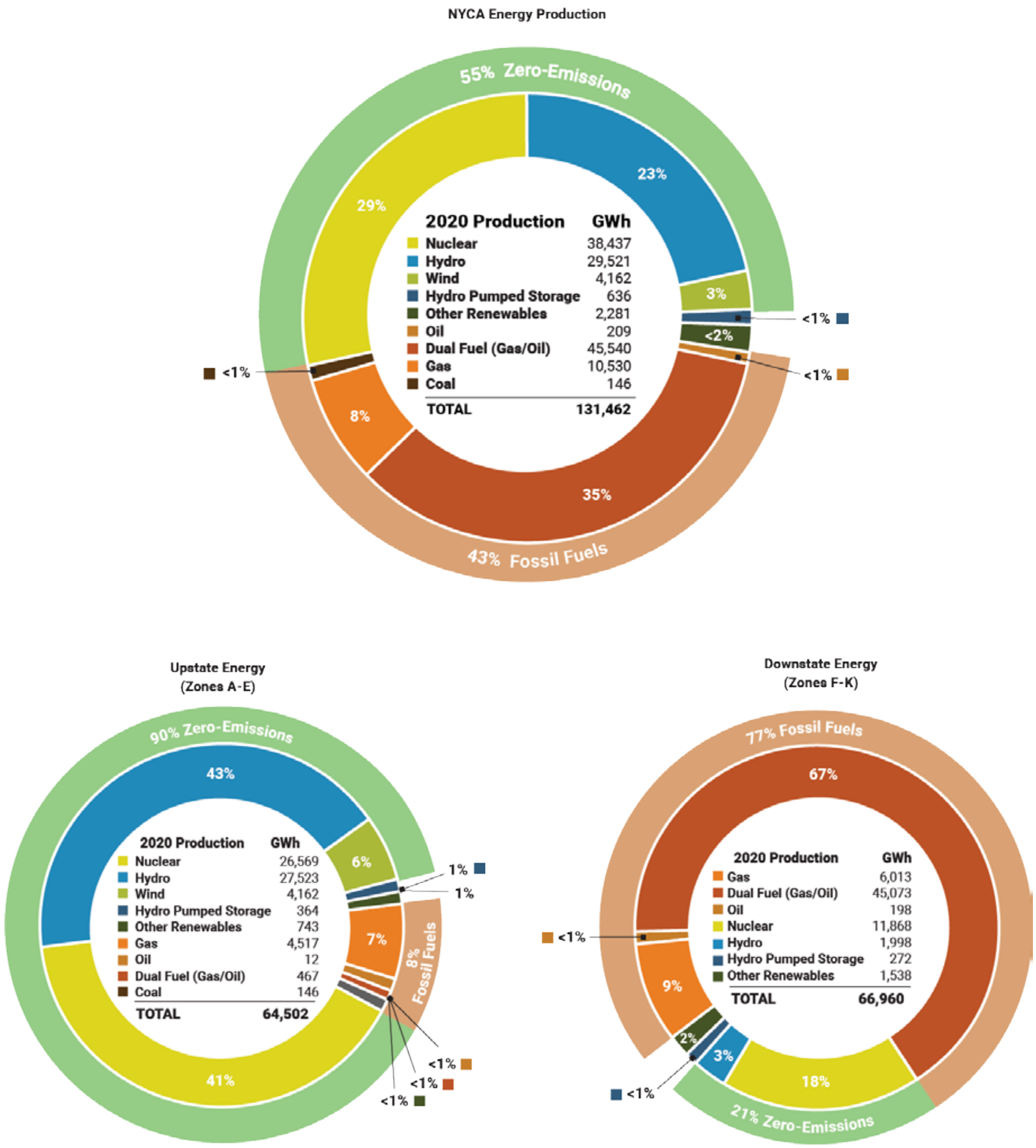
Figure 15: Summer Installed Capacity (MW) by Fuel Source – Statewide, Upstate, & Downstate New York: 2021



4.1.1. 2020 NYCA Energy Production

Figure 16 provides information on the production of electricity, by fuel type, in 2020.

Figure 16: Energy Production by Fuel Source (GWh) – Statewide, Upstate, & Downstate New York: 2020



5. Regulatory Policy Activities

Federal, state, and local government regulatory programs may impact the operation and reliability of the New York BPTF. Compliance with state and federal regulatory initiatives such as DEC's peaker rule, may require investment by the owners of New York's existing thermal power plants. If the owners of those plants have to make considerable investments, the cost of these investments could impact whether they remain available in the NYISO's markets and therefore potentially affect the reliability of the BPTF.

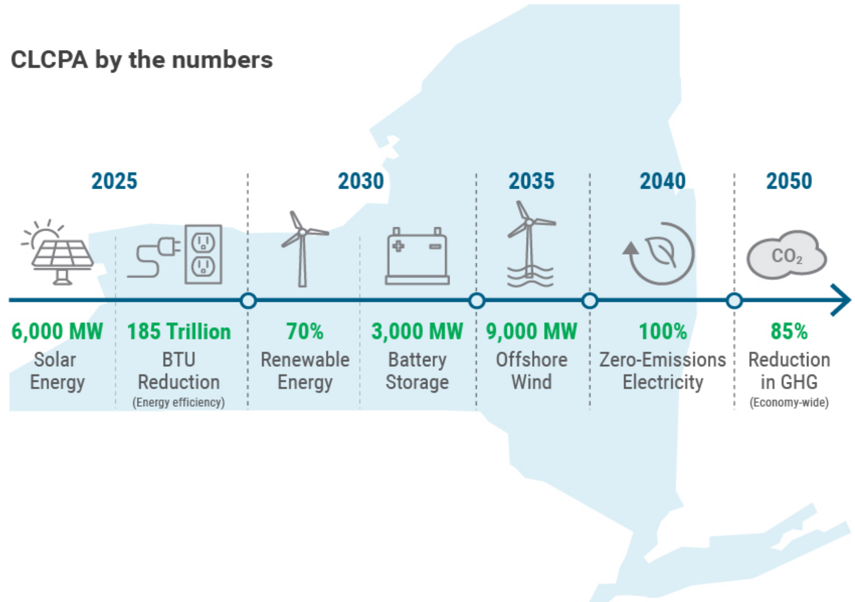
5.1. DEC Peaker Rule Summary

In December 2019, the DEC issued requirements to reduce emissions of nitrogen oxides, smog-forming pollutants, from peaking generation units.

The Peaker Rule, which phases in compliance obligations between 2023 and 2025, will affect approximately 3,300 MW of simple-cycle turbines located mainly in the lower Hudson Valley, New York City and Long Island. The rule required affected unit owners to submit compliance plans to the DEC by March 2020. The compliance plans indicated that approximately 1,500 MW of capability will be unavailable during the summer of 2025. Approximately 800 MW of those generators will be unavailable in 2023. Importantly, the Peaker Rule allows the NYISO to designate resources that are needed to sustain reliability on the grid to continue operation on a temporary basis beyond 2023 and 2025 until alternative reliability solutions can be implemented.

The NYISO assessed the reliability implications of these compliance plans in its *2020 Reliability Needs Assessment* (RNA) and quarterly *Short-Term Assessments of Reliability*. The reliability studies identified both transmission security and resource adequacy needs starting in 2023 in the New York City region driven by the unavailability of the affected units. As discussed further, the NYISO worked with the local transmission owner, Con Edison, and other stakeholders, to identify transmission solutions that will resolve all of these identified reliability needs.

5.2. CLCPA Summary



New York State's Climate Leadership and Climate Protection Act (CLCPA) was adopted in 2019, accelerating penetration of intermittent resources and inverter-based technology. Dispatchable, emissions-free, and flexible resources are needed to balance the system. These future resources must be significant in capacity and have attributes such as ability to come on-line quickly, stay online for as much as needed, maintain system's balance and stability, and adapt to meet rapid, steep ramping needs.

5.2.1. Climate Action Council (CAC)

The New York State CAC is a 22-member committee that is preparing a Scoping Plan to achieve the emissions reductions called for by the CLCPA. The CAC established and oversees sector-specific advisory panels and working groups, and works in consultation with the state's Climate Justice Working Group and the Environmental Justice Advisory Group.

5.3. NYS Accelerated Renewable Energy Growth and Community Benefit Act (AREA)

The Accelerated Renewable Energy Growth and Community Benefit Act (AREA) seeks to accelerate siting and construction of large-scale clean energy projects. The act provides an accelerated path for permitting and constructing renewable energy projects by establishing a new Office of Renewable Energy Siting (ORES) within the New York State Department of State to oversee permitting approval for renewable generators larger than 25 MW. Renewable generators between 20 and 25 MW, usually subject to a local environmental review, can opt into this state-administered process, as can eligible renewable projects currently in the Article 10 process. Pursuant to the act, ORES issued new regulations and standards for siting renewable facilities in March 2021. The siting process under these regulations requires ORES to act upon applications within one year, or six months if the applicant is seeking to locate on certain former commercial or industrial sites.

AREA also authorized the New York Power Authority (NYPA) to undertake the development of transmission investments needed to achieve CLCPA targets. The New York PSC utilized this authority to authorize NYPA to pursue construction of its proposed Northern New York transmission expansion project. The project will increase the capacity of transmission lines in northern New York.

AREA also directed the New York State Department of Public Service (DPS), in consultation with NYSERDA, NYPA, the Long Island Power Authority (LIPA), the investor-owned utilities, and the NYISO to conduct a comprehensive study to identify cost-effective distribution and local and bulk power system upgrades to support the state's climate and clean energy policies.

The Initial Power Grid Study, delivered by the DPS and NYSERDA in January 2021, concluded that the public policy transmission projects already approved by the NYISO and the PSC, together with the NYPA priority projects, position the state to achieve the 70 by 30 renewable energy requirement of the CLCPA. The report indicated that additional transmission would be needed after 2030 to move toward the goal of a zero-emission electric system by 2040. Finally, the report indicated that transmission upgrades would be needed to facilitate delivery of the 9,000 MW of offshore wind capacity called for in the CLCPA. Based on the constraints observed in its 2019 CARIS 70 by 30 scenario, the NYISO informed the PSC that additional transmission is needed to reach the 2030 requirements as well as the 2040 target.

Additionally, a new Public Policy Transmission Project Process was initiated by Public Service Commission in 2021 and is in progress. This process has the goal to add at least one bulk transmission intertie cable to increase the export capability of the LIPA-Con Edison interface, to ensure that the full output from at least 3,000 MW of offshore wind is deliverable from Long Island to the rest of the state, with associated local transmission facilities. The NYISO established base cases, held technical conferences, and solicited transmission and other solutions to the offshore wind need, which are due on October 11, 2021.

The following regulatory programs — each at various points in the development and implementation — are summarized in the **Figure 17** below.

5.4. Summary of Regulatory Programs

A number of recent state policies and initiatives, along with various Department of Environmental Conservation (DEC) rulemakings are underway that have the potential to significantly change the generation resource mix in the New York Control Area. These include the Climate Leadership and Community Protection Act[11] (CLCPA), the New York State Department of Environmental Conservation (DEC) peaker rule[12], the NYS Accelerated Renewable Energy Growth and Community Benefit Act (AREA), the Clean Energy Standard, the Offshore Wind Master Plan, the Large-Scale Renewable Program, and the Zero Emission Credits Program for the James A. FitzPatrick, R.E Ginna and Nine Mile Point nuclear power plants. NYS Accelerated Renewable Energy Growth and Community Benefit Act (AREA) AREA was enacted in April 2020 and seeks to accelerate siting and construction of large-scale clean energy projects. AREA also authorized the New York Power Authority (NYPA) to undertake the development of transmission investments needed to achieve CLCPA targets. The New York PSC utilized this authority to authorize NYPA to pursue construction of its proposed Northern New York transmission expansion project. The project will increase the capacity of transmission lines in northern New York. Also, the NYISO's interconnection process contains many proposed transmission projects in various stages of development.

Additionally, a new Public Policy Transmission Project Process was initiated by Public Service Commission in 2021 and is in progress. This process has the goal to add at least one bulk transmission intertie cable to increase the export capability of the LIPA-Con Edison interface, to ensure that the full output from at least 3,000 MW of offshore wind is deliverable from Long Island to the rest of the state, with associated local transmission facilities.

There have been several significant developments that are shaping how the New York electric grid of the future will develop. Part of the changes are climate related, which will drive temperatures higher and result in higher load. Part of the changes are due to state policies in response to climate change. The Climate Leadership and Community Protection Act (CLCPA), enacted in 2019, requires an economy-wide approach to addressing climate change and decarbonization.[13] This includes sweeping mandates to deliver 70% of New York energy from

[11] On July 18, 2019, the CLCPA was signed into law, codifying a number of measures.

[12] DEC Peaker Rule details here: https://www.dec.ny.gov/regulations/116131.html

[13] 2019 Laws of New York, ch. 106. The CLCPA requires that seventy percent of energy consumed in New York State be produced by renewable resources by 2030. By 2040 energy consumed must be completely emissions free.

renewable resources by 2030 and 100% emissions-free electricity supply by 2040 while promoting electrification in other sectors of the economy. Understanding the impacts due to these two driving changes on the generation, transmission, and load components of the bulk electric system is critical to understanding the challenges in the coming year. The NYISO performed a number of scenarios in the 2020 RNA, including several that model the potential reliability impacts of implementing 70% renewable energy by 2030 (70 x 30) and the 100% emissions-free electricity (100 x 40) as required by the CLCPA.

6. Mechanisms to Mitigate Risk

6.1. Baseline System Considerations

The baseline findings reflect the base case assumptions, which were set in accordance with NYISO's procedures.

There are, however, risk factors that could adversely affect the system reliability over the planning horizon. If any of these factors materialize, the NYISO will assess the potential impacts and, if necessary, perform an evaluation to determine whether the NYISO should solicit solutions under the applicable processes, as required. The risk factors include:

1. Changes to System Resources

Substantial uncertainties exist in the next five to ten years that will impact the system resources. These uncertainties include, but are not limited to:

a) If expected generation projects are not built, a system deficiency may occur. The base cases include approximately 880 MW of assumed generation additions in various planning stages, and approximately 2,600 MW of assumed generation deactivated (includes the status changes due to the DEC's peaker rule, and Indian Point 3), or not available during the summer peak.

b) If additional generating units become unavailable or deactivate beyond those units already planned for, the reliability of the New York Control Area (NYCA) could be adversely affected. There are numerous risk factors related to the continued viability, compliance with emissions requirements, and operation of aging generating units. Depending on the units affected, the NYISO may need to take actions through its Short-Term Reliability Process and RPP to maintain reliability. The scenarios performed as part of the NYISO's 2020 RNA and in the 2021-2030 CRP[14] indicated that the deactivation of additional generators could lead to reliability needs.

c) Capacity resources could decide to offer into markets in other regions and, therefore, some of the capability of those resources may not be available to the NYCA. Accordingly, the NYISO will continue to monitor imports, exports, generation, and other infrastructure.

[14] Link to the August 18, 2021, ESPWG CRP presentation: https://www.nyiso.com/documents/20142/23873690/02%202021-2030_CRP.pdf

2. Completion of Public Policy Transmission Plans

There are several public policy transmission developments in progress that will increase the system capability to transport power, and are included in this assessment's assumptions, as well as in the 2020 RNA/CRP and the recent STARs:

- The Western NY Public Policy Transmission Project (the Empire State Line Proposal 1, Q545A), developed by NextEra Energy Transmission New York, Inc., was selected by the NYISO Board in October 2017 and was included in the reliability plan starting with the 2018 RNA. This project includes a new 345 kV circuit and phase angle regulator (PAR) that will alleviate constraints in the Niagara area. The planned in-service date for this project is summer 2022.
- The solutions to the AC Transmission Public Policy Transmission Needs were reflected in the 2020 RNA base case and are now included in this reliability plan. As part of the NYISO's Public Policy Transmission Planning Process, the New York State Public Service Commission (PSC) identified the need to expand the state's transmission capability to deliver additional power from generating facilities located in upstate New York, including important renewable resources, to the population centers located downstate. On April 8, 2019, the NYISO Board of Directors selected the Double-Circuit project (Q556) proposed jointly by LS Power Grid New York and the New York Power Authority as the more efficient or cost-effective transmission solution to address Segment A. The Board also selected the New York Energy Solution project (Q543) proposed jointly by Niagara Mohawk Power Corporation d/b/a National Grid and the New York Transco, LLC as the more efficient or cost-effective transmission solution to address Segment B. The planned in-service date for the Segment A and Segment B projects is winter 2023.

As these transmission projects enter service, reliability of the New York grid will improve. If the projects were to be delayed for any reason, there would be an increased risk to grid reliability.

3. Completion of Local Transmission Owner Plans

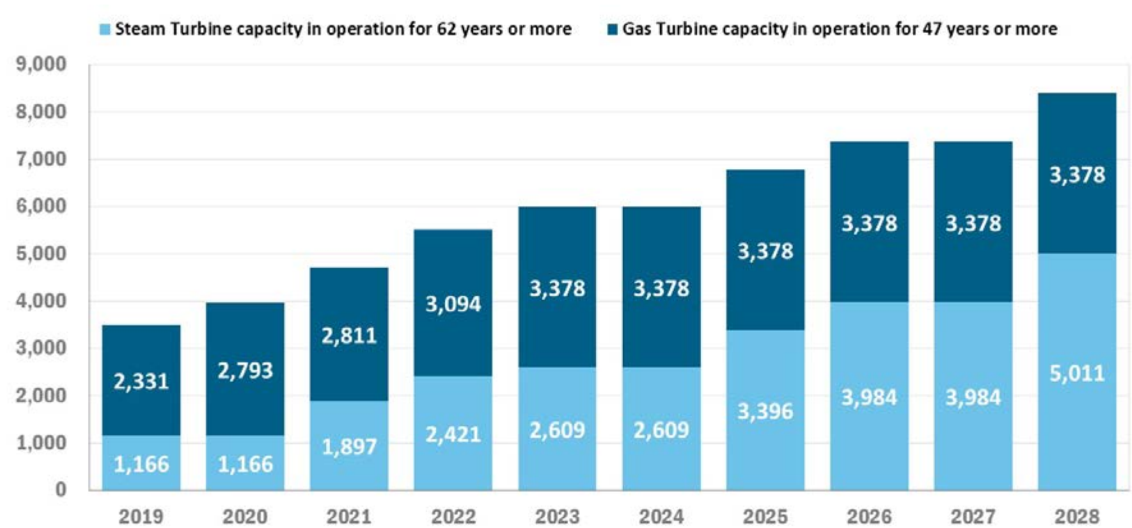
The local transmission owner plans (LTPs) are an important part of the overall Comprehensive System Planning Process and the findings of this assessment.

The 2020 RNA identified transmission security criteria violations, as well as resource adequacy violations. The process allows for subsequent updates, which included three projects in Con Edison: a new 345/138 kV PAR controlled 138 kV Rainey — Corona feeder, a new 345/138 kV PAR controlled 138 kV Gowanus — Greenwood feeder, and a new 345/138 kV PAR controlled 138 kV Goethals — Fox Hills feeder. These are included in the plan. The NYISO will continue to track the timely entry into service of these and other projects that have been identified to relieve reliability violations.

4. Changes to System Performance

As generators age and experience more frequent and longer duration outages, the costs to maintain the assets increase. This may drive aging generation into retirement. A growing amount of New York's gas-turbine and fossil fuel-fired steam-turbine capacity is reaching an age at which, nationally, a vast majority of similar capacity has been deactivated. As shown in **Figure 18** by 2028 more than 8,300 MW of gas-turbine and steam-turbine based capacity in New York will reach an age beyond which 95% of these types of generators have deactivated.

Figure 17: Cumulative NYCA Nameplate Capacity MW Past the Age When 95% of Similar Units Have Retired



Source: https://www.nyiso.com/documents/20142/2223020/2019-Power-Trends-Report.pdf

5. Changes to System Load Level

A higher-than-studied load level could expose the system to potential reliability issues, necessitating interim operating procedures up to and including measures such as load shedding in some localized areas of the state. This assessment includes a high load scenario, and under this scenario, there are LOLE violations as soon as 2025 under a NYCA load forecast that is 1,000 MW higher. In study year 2024, the NYCA is at the 0.1 days/year LOLE criterion, under an 825 MW higher NYCA load forecast.

Additionally, in conducting a resource adequacy scenario in the 2020 RNA with a high load forecast, approximately 2,400 MW higher than the 2020 Gold Book baseline forecast, the NYISO found that the LOLE would exceed criteria two years earlier. However, the NYISO is forecasting a decrease in energy usage during 2021 through 2030 period, which can be attributed in part to the increasing impact of energy efficiency initiatives and increasing amounts of behind the meter solar generation. Conversely, significant load-increasing impacts are forecasted due to electric vehicle usage and other electrification (*i.e.,* conversion of home heating, cooking, water heating and other end-uses from fossil-fuel based systems to electric systems). The relative behind-the–meter-solar impact on peak load declines over time as the New York summer peak is expected to shift further into the evening, when solar resources are unavailable. New York is projected to become a winter peaking system in future decades due to electrification, primarily via heat pumps and electric vehicles.

In the past decade, energy provided by the bulk grid has decreased, while energy production from distributed energy resources (DERs), such as solar, has increased. These DERs are beginning to displace energy that was traditionally supplied by conventional generation through the regional electricity grid. The energy provided by many DERs is not continuous, but intermittent, and less visible to the NYISO markets and operations.

The NYISO will continue to report on energy usage and peak demand trends in its annual Load and Capacity Data Report (Gold Book) and other reports.

6. Extreme Weather

The dangers of severe weather impacting the grid have been exemplified around the country in the past year, with Texas experiencing a brutal polar vortex in February and California facing problems from extreme heat last summer. In New York, the frigid[15] winter of 2013-14 offered a number of lessons that continue to serve energy reliability today. In the end, New York suffered no electric customer outages from the polar vortex of 2014. In fact, it strengthened our reliability by enabling us to prepare the NYISO for the next cold wave. Since then, a number of resilience measures were instituted, including:

- **Improved** operator awareness of fuel inventories and replacement fuel schedules, including a web-based application for generators;
- **Changes** to our tariff to increase the amount of reserve power available;
- **Expanded** generator site visits to review preparations for cold conditions;
- **Reduced** the number of generators that can be scheduled offline for maintenance; and
- **Improved** outreach and coordination with the gas delivery industry, including operator awareness of the natural gas pipeline availability.

[15] The vortex hit in earnest in early January 2014. On Jan 7, the high in Central Park was 4 degrees F, breaking a low record set in 1896.

6.2. Safeguards to the Comprehensive Reliability Plan

The work of the NYISO is distinct from the role that the Texas and California grid operators play in their regions. Primary among those differences are the NYISO's capacity markets and planning functions. For instance:

1. New York has an Installed Capacity Market

A main part of the NYISO's mission is to manage the operation of the grid in New York and administer the wholesale electricity markets by which power and grid reliability services are bought and sold. One important grid reliability service – resource adequacy – is bought and sold through the Installed Capacity (ICAP) market. This is a major difference between the NYISO markets and those of Texas and California.

Resource adequacy promotes reliability by making sure that enough generating capability is available to meet grid demand at peak times of electricity consumption. The NYISO's capacity market offers a forum for buying and selling capacity through competitive auctions. Auctions are conducted monthly and for the summer and winter seasons. Consumers benefit from competitive auctions that minimize consumer costs. Investors in new technologies benefit from transparent locational pricing. Existing suppliers benefit from investment signals that reward units for maintaining or upgrading their performance. Our centralized capacity market offers price transparency to spur competition and drive costs down for maintaining resource adequacy. The capacity market also includes specific rules to incent performance and availability of resources when system needs are expected to be greatest as well as stiff penalties for non-performance. Texas and California lack capacity markets.

In addition, the NYISO's planning processes include generator deactivation studies and periodic assessments of both resource adequacy and transmission system needs to identify risks to reliability, and to act if necessary.

2. New York has Regional Coordination

California, like the NYISO, imports energy from several neighboring states. Texas, however, generally does not. In New York, both energy and capacity are imported from and exported to neighboring regions, benefiting reliability in the region, and strengthening market competition. Resources importing capacity services into New York must meet strict market rules, just like resources located within the state, to be eligible to serve New York consumers.

3. New York has a Diverse Fuel Mix

In New York, the electricity that comes out of the wall of your business or home originates from many different sources. According to our recent Power Trends report, in 2019 a third of New York's energy production was from dual-fuel generators that run primarily on natural gas but have the ability to use other fuels as well. Another third came from nuclear energy, and nearly a quarter came from hydropower.

In comparison, accounts of the incidents in California point to the state reducing fossil fuel and nuclear generating capability, leaving the state with fewer resources to balance the grid on days when there is reduced wind or clouds obscuring the sun. As CAISO's report to the governor said, "[I]n transitioning to a reliable, clean and affordable resource mix, resource planning targets have not kept pace to lead to sufficient resources that can be relied upon to meet demand in the early evening hours."

The NYISO followed closely the events in the south-central states related to cold weather-related outages. On February 17, 2021, the Federal Energy Regulatory Commission (FERC) and the Northeast Electric Reliability Council (NERC) announced that they will open a joint inquiry into the operations of the bulk power system during the extreme winter weather conditions that were experienced by the Midwest and south-central states. FERC and NERC indicated that they would work with other federal agencies, states, and utilities to review the performance of the bulk power system and determine what further investigation is appropriate.

For the past decade, wind and solar energy resources have played an increasingly important role in New York and their participation is expected to grow as the NYISO market rules evolve to address these new technologies. We have developed forecasting tools that accurately predict the levels of production from these resources, maximizing their reliability, economic, and environmental benefits. Studies such as the Reliability Needs Assessment, the "70 x 30 Scenario" in our Congestion Assessment and Resource Integration Study (CARIS), and our Climate Change Study show that wind and solar growth would require a diverse portfolio of resources to keep the grid in balance when nature does not cooperate.

4. Clear Accountability for Non-Performance of Supply Resources

Our markets in New York help to drive out costlier, and often dirtier energy suppliers through economic competition. The NYISO coordinates with New York State to address reliability needs caused by generator deactivations. We also have a mandatory notice period for units seeking to deactivate to prepare for any potential reliability concerns.

Reliability rules require that New York carry enough capacity to meet peak demand levels, as well as additional resources to provide a margin of reliability safety for certain conditions. Grid planners develop models that depict what would happen to the grid if we lost the use of certain energy resources due to weather, fuel constraints, transmission outages, or other system conditions. This allows the NYISO to be ready for contingencies, including the potential loss of some of our largest supply resources.

In California, the role of resource management is shared between the independent system operator and the state. According to media accounts of outages last summer, the CAISO was unaware that certain energy resources were shut down, reducing the options of where to get electricity. As CAISO noted in its report to the governor, "the existing resource planning processes are not designed to fully address an extreme heat storm like the one experienced in mid-August."

As the NYISO continues working on the grid of the future, it operates under the most stringent reliability rules in the nation. The NYISO's long-range reliability planning requires it to examine scenarios such as extreme weather events and unexpected transmission failures to maintain reliability. Its independent structure and shared governance process give all members of the energy sector a say in decisions affecting our markets.

As the energy grid changes, we continue doing what we do best to make sure the energy grid in New York State stays reliable.

5. Natural Gas Coordination

While the environmental rules, such as the DEC Peaker Rule, mainly target emissions from the natural gas peaker plants, New York's reliance on natural gas as the primary fuel for electric generation continues to justify vigilance regarding the status of the natural gas system. The NYISO is actively involved in natural gas/electric coordination efforts with New York State and federal regulators, pipeline owners, generator owners, local distribution companies, and neighboring ISOs and Regional Transmission Operators (RTOs).

The NYISO's efforts with respect to gas supply assurance focus on: (1) improving communication and coordination between the gas and electric sectors; (2) annual, weekly and, when conditions warrant, *ad hoc* generator surveys of fuel supplies to enhance awareness in the control room and provide electric system reliability benefits; and (3) addressing the electric system reliability impact of the sudden catastrophic loss of gas.

Appendices

Appendix A: Resource Adequacy Model Assumptions

#	Parameter	2021 Comprehensive Review Study Period: 2022 (y1) - 2026 (y5)
Load Parameters		
1	Peak Load Forecast	Based on the baseline load forecast from the NYISO's 2021 Load and Capacity Data Report (2021 Gold Book, or 2021 GB). Eleven NYCA zones are modeled. The 2021 GB baseline load forecast includes reductions for energy efficiency, codes and standards, distributed generation, behind-the-meter (BtM) photovoltaic (PV) solar, and energy storage, and increases to account for electric vehicles (EV), and non-EV electrification. For the resource adequacy load model, the deducted BtM solar MW was added back to the NYCA zonal loads, which then allows for a discrete modeling of the BtM solar resources as 5x8760h shapes, randomly picked during MARS simulations
2	Load Shape (Multiple Load Shape)	Used Multiple Load Shape MARS Feature 8760 h historical load shapes were used as base shapes for LFU bins: Bin 1: 2006 Bin 2: 2002 Bins 3-7: 2007 Energy and deman peak adjustments are being performed on a seasonal basis.
3	Load Forecast Uncertainty (LFU)	The load forecast uncertainty (LFU) model captures the impacts of weather conditions on future loads. The LFU gives the MARS program information regarding seven load levels (three loads lower and three loads higher than the median peak) and their respective probabilities of occurrence. The LFU model is subdivided into five separate areas: New York City (Zone J), Long Island (Zone K), Zones H and I, Zones F and G, and the rest of New York State (Zones A-E). .
Generation Parameters		
4	Existing Generating Unit Capacities	2021 Gold Book values. Used summer min (DMNC vs. CRIS). Used winter min (DMNC vs CRIS). Adjusted for reliability planning inclusion rules from the NYISO's RPP Manual
5	Proposed New Units	GB2021 with inclusion rules applied
6	Proposed Deactivations	GB2021 with inclusion rules applied
7	Forced and Partial Outage Rates for Thermal Units	Past five-year (2016-2020) GADS data for each thermal unit represented. Those units with less than five years – used class average data from GADS. Transition Rates representing the Equivalent Forced Outage Rates (EFORd) during demand periods over the most recent five-year period
8	Planned Outages	Based on schedules received by the NYISO and adjusted for history
9	Summer Maintenance	Nominal MW
10	Combustion Turbine Derates	Derate based on temperature correction curves

#	Parameter	2021 Comprehensive Review Study Period: 2022 (y1) - 2026 (y5)
11	Landfill Gas Plants (LFG)	Actual hourly plant output over the past 5 years period. Program randomly selects a LFG shape of hourly MW production for each simulated replication year.
12	Existing Wind Units (>5 years of data)	Actual hourly plant output over the past five years (2016-2020) Probabilistic model is incorporated based on five years of input shapes with one shape per replication being randomly selected in the MARS Monte Carlo simulations.
13	Existing Wind Units (<5 years of data)	For existing data, the actual hourly plant output over the past 5 year period is used. For missing data, the nameplate normalized average of units in the same load zone is scaled by the unit's nameplate.
14	Proposed Wind Units	Inclusion Rules Applied to determine the generating unit status. The nameplate normalized average of units in the same load zone is scaled by the unit's nameplate.
15	Utility-scale Solar Resources	Probabilistic model chooses from the past 5 years of production MW data output hourly shapes. One shape per replication is randomly selected in Monte Carlo process.
16	Behind-the-Meter (BtM) Solar	The large projection of increasing retail (BtM) solar installations over the 10- year period required a discrete model with some level of detailed hourly performance. Actual hourly production MW data over the past five years (2016-2020) is used. Probabilistic model is incorporated based on five years of input shapes with one shape per replication being randomly selected in the MARS Monte Carlo simulations.
17	BTM-NG Program	These are former load modifiers to sell capacity into the ICAP market. Modeled as cogen type 2 unit in MARS. Unit capacity set to CRIS value, load modeled with weekly pattern that can change monthly.

#	Parameter	2021 Comprehensive Review Study Period: 2022 (y1) - 2026 (y5)
18	Small Hydro Resources	Actual hourly plant output over the past 5 years period. Program randomly selects an annual shape of hourly production for each simulated replication year.
19	Large Hydro	Probabilistic Model based on 5- years of GADS data. Transition Rates representing the Equivalent Forced Outage Rates (EFORd) during demand periods over the most recent five-year period. Methodology consistent with thermal unit transition rates.
20	Capacity Purchases	Grandfathered Rights and other awarded long-term rights Modeled using MARS explicit contracts feature.
Transaction - Imports / Exports		
21	Capacity Sales	These are long-term contracts filed with FERC. Modeled using MARS explicit contracts feature. Contracts sold from Rest of State ROS (Zones: A-F). ROS ties to external pool are derated by sales MW amount
22	FCM Sales	Model sales for known years Modeled using MARS explicit contracts feature. Contracts sold from ROS (Zones: A-F). ROS ties to external pool are derated by sales MW amount
23	UDRs	Updated with most recent elections/awards information (VFT, HTP, Neptune, CSC)
Topology		
24	Interface Limits	Developed by review of previous studies and specific analysis during the RNA study process
25	New Transmission	Based on TO- provided firm plans (via the Gold Book process) and proposed merchant transmission; inclusion rules applied
26	AC Cable Forced Outage Rates	All existing cable transition rates updated with info received from ConEd and PSEG-LIPA to reflect most recent five-year history
27	UDR unavailability	Five-year history of forced outages

#	Parameter	2021 Comprehensive Review Study Period: 2022 (y1) - 2026 (y5)
Emergency Operating Procedures		
28	Special Case Resources	2021 Gold Book with effective capacity modeled SCRs sold for the program each summer, discounted to historic availability ('effective capacity'), and held constant for all study years.
29	EDRP Resources	2021 Gold Book with effective capacity modeled Those sold for the program discounted to historic availability and held constant for all study years.
30	Other EOPs	Based on TO information, measured data, and NYISO forecasts
External Control Areas		
31	PJM	As per RNA Procedure External model (load, capacity, topology) provided by PJM/NPCC CP-8 WG. PJM is a 5-zone model. LOLE of pool adjusted to be between 0.10 and 0.15 days per year by adjusting capacity pro-rata in all areas.
32	ISONE	As per RNA Procedure External model (load, capacity, topology) provided by PJM/NPCC CP-8 WG. LOLE of pool adjusted to be between 0.10 and 0.15 days per year by adjusting capacity pro-rata in all areas.
33	HQ	As per RNA Procedure External model (load, capacity, topology) provided by PJM/NPCC CP-8 WG. LOLE of pool adjusted to be between 0.10 and 0.15 days per year by adjusting capacity pro-rata in all areas.
34	IESO	As per RNA Procedure External model (load, capacity, topology) provided by PJM/NPCC CP-8 WG. LOLE of pool adjusted to be between 0.10 and 0.15 days per year by adjusting capacity pro-rata in all areas.
35	Reserve Sharing	All NPCC Control Areas indicate that they will share reserves equally among all members before sharing with PJM.
36	NYCA Emergency Assistance Limit	Implemented a statewide limit of 3500 MW
Miscellaneous		
37	MARS Model Version	Version 4.2.1765

Weighted average Equivalent Demand Forced Outage Rate (EFORd, or equivalent) values for 2022:

Unit Type	Five-Year Weighted Average
Petroleum	13.0%
Natural Gas and Other Gases	6.0%
Nuclear	2.2%
Hydro	0.9%
Pumped Storage	5.1%
Biomass	4.9%