New York ISO
Independent System Operator

Appendices

2022 Reliability Needs Assessment (RNA)

A Report from the New York Independent System Operator

Draft Report
For October 26, 2022
Management Committee

Table of Contents

List of Figures

Appendix A - 2022 Reliability Needs Assessment Glossary

The following glossary offers definitions and explanations of terms used in the Comprehensive Reliability Plan it appends, as well as references to additional source information published by the NYISO and other energy industry entities.

Annual Transmission Reliability Assessment (ATRA): An assessment, conducted by the NYISO staff in cooperation with Market Participants, to determine the System Upgrade Facilities required for each generation project and Class Year Transmission Project to interconnect to the New York State Transmission System in compliance with Applicable Reliability Standards and the NYISO Minimum Interconnection Standard. See NYISO OATT

Area Transmission Review (ATR): An annual report provided to the Northeast Power Coordinating Council Compliance Committee by the NYISO, in its role as Planning Coordinator, in regard to its Area Transmission Review. See NPCC.org

Baseline Forecast: Prepared for the NYISO Gold Book, baseline forecasts report the expected New York Control Area load and includes the projected impacts of energy efficiency programs, building codes and standards, distributed energy resources, behind-the-meter energy storage, behind-the-meter solar photovoltaic power, electric vehicle usage, and electrification of heating and other end uses. The baseline forecasts are used in the Reliability Needs Assessment Base Cases for determining Bulk Power Transmission Facilities Reliability Needs for the Reliability Needs Assessment Study Period.

Best Technology Available (BTA): Performance goal established by the New York State Department of Environmental Conservation for cooling water intake structures at proposed and existing electric generating plants with intake capacity greater than 20 million gallons per day. See DEC.NY.gov

New York State Bulk Power Transmission Facility (BPTF): Facilities identified as the New York State Bulk Power Transmission Facilities in the annual Area Transmission Review submitted to the Northeast Power Coordinating Council by the NYISO. See NYISO OATT

Clean Energy Standard (CES): New York State initiative requiring 70% of electricity consumed in the State to be produced from renewable sources by 2030. See NYSERDA.NY.gov

Climate Leadership and Community Protection Act (CLCPA): New York State statute enacted in 2019 to address and mitigate the effects of climate change. Among other requirements, the law mandates that; (1) 70% of energy consumed in New York State be sourced from renewable resources by 2030, (2) greenhouse gas emissions must be reduced by 40% by 2030, (3) the electric generation sector must be zero greenhouse gas emissions by 2040, and (4) greenhouse gas emissions across all sectors of the economy must be reduced by 85% by 2050. See CLIMATE.NY.gov

Contingencies: Actual or potential unexpected failure or outage of a system component such as a generator, transmission line, circuit breaker, switch, or other electrical element. A contingency also may include multiple components, which are related by situations leading to simultaneous component outages. See NYSRC.org

Dependable Maximum Net Capability (DMNC): Sustained maximum net output of a Generator, as demonstrated by the performance of a test or through actual operation, averaged over a continuous time period. See NYISO OATT

Disturbance: Severe oscillations or severe step changes of current, voltage and/or frequency usually caused by faults. See NYSRC.org

Electric System Planning Work Group (ESPWG): The stakeholder forum that provides Market Participant input on the NYISO's comprehensive system planning processes. See Committees at NYISO.com

Emergency Transfer Criteria: In the event that adequate facilities are not available to supply firm load within Normal Transfer Criteria, emergency transfer criteria may be invoked. Under emergency transfer criteria, transfers may be increased up to, but not exceed, emergency ratings and limits, as follows:

a. Pre-contingency line and equipment loadings may be operated up to LTE ratings for up to four (4) hours, provided the STE ratings are set appropriately. Otherwise, pre-contingency line and equipment loadings must be within normal ratings. Pre-contingency voltages and transmission interface flows must be within applicable pre-contingency voltage and stability limits.

b. Post-contingency line and equipment loadings within STE ratings. Post-contingency voltages and transmission interface flows within applicable post-contingency voltage and stability limits. See NYSRC.org

Fault: An electrical short circuit. See NYSRC.org

Federal Energy Regulatory Commission (FERC): The United States federal agency that regulates the transmission and wholesale sale of electricity and natural gas in interstate commerce.

FERC Form No. 715: Annual report by transmitting utilities on transmission planning, constraints, and available transmission capacity. See FERC.gov

Forced Outage: Unscheduled inability of a Market Participant's Generator to produce energy that does not meet the notification criteria to be classified as a scheduled outage or de-rate as established in NYISO Procedures. See NYISO.com

Gold Book: Annual NYISO publication, also known as the Load and Capacity Data Report. See Library/Reports at NYISO.com

Installed Capacity (ICAP): External or Internal Capacity that is made available pursuant to Tariff requirements and NYISO Procedures. See NYISO Services Tariff

Installed Capacity Requirement (ICR): The annual statewide requirement established by the New York State Reliability Council in order to provide resource adequacy in the New York Control Area. See NYSRC.org

Installed Reserve Margin (IRM): The amount of installed electric generation capacity above 100% of the forecasted peak electric demand that is required to meet New York State Reliability Council resource adequacy criteria.

Local Transmission Plan (LTP): The Local Transmission Owner Plan, developed by each Transmission Owner, which describes its respective plans that may be under consideration or finalized for its own Transmission District. See NYISO OATT

Local Transmission Planning Process (LTPP): The Local Planning Process conducted by each Transmission Owner for its own Transmission District. See NYISO OATT

Loss of Load Expectation (LOLE): A New York State Reliability Council resource adequacy criterion requiring that the probability (or risk) of the unplanned disconnecting of any firm load due to resource deficiencies shall be, on average, not more than once in ten years, expressed mathematically as 0.1 days per year. See NYSRC.org

- LOLE is generally defined as the expected (weighted average) number of days in a given period (e.g., one study year) when for at least one hour from that day the hourly demand is projected to exceed the zonal resources (event day). Within a day, if the zonal demand exceeds the resources in at least one hour of that day, this will be counted as one event day. The criterion is that the LOLE not exceed one day in 10 years, or LOLE < 0.1 days/year.
- LOLH is generally defined[1] as the expected number of hours per period (e.g., one study year) when a system's hourly demand is projected to exceed the zonal resources (event hour). Within an hour, if the zonal demand exceeds the resources, this will be counted as one event hour.
- EUE, also referred to as loss of energy expectation (LOEE), is generally defined[2] as the expected energy (MWh) per period (e.g., one study year) when the summation of the system's hourly demand is projected to exceed the zonal resources. Within an hour, if the zonal demand exceeds the resources, this deficit will be counted toward the system's EUE.

Market Monitoring Unit: The consulting or professional services firm, or other similar entity, responsible for carrying out the Core Market Monitoring Functions and other functions assigned to it in the NYISO's tariffs. . See NYISO OATT Attachment O

Market Participant: An entity, excluding the NYISO, that produces, transmits, sells, and/or purchases for resale unforced capacity, energy, or ancillary services in the wholesale market, including entities that buy or sell Transmission Congestion Contracts. See NYISO Services Tariff

Market Administration and Control Area Services Tariff (NYISO Services Tariff): The document addressing the Market Services and the Control Area Services provided by the NYISO, and the terms and conditions, regulated by the FERC, under which those services are provided.

New York Control Area (NYCA): The area under the electrical control of the NYISO, including the entire state of New York, divided into eleven load zones. See NYISO.com

New York State Department of Environmental Conservation (NYSDEC): The agency that implements the New York State Environmental Conservation Law, with some programs also governed by federal law.

New York Independent System Operator (NYISO): A not-for-profit organization that operates New York's bulk electricity grid, wholesale electricity markets and conducts interconnection and transmission planning.

NYISO Procedures (Manuals, Guides, Technical Bulletins): NYISO Manuals specify and explain the procedures and policies used to operate the bulk power system of the New York Control Area and to conduct wholesale electricity markets, consistent with the NYISO Tariffs and Agreements. NYISO Guides serve to assist users with information needed to participate in NYISO Administered Markets. NYISO Technical Bulletins explain changes to, and provide instruction for, NYISO processes and procedures. See NYISO.com

[1] NYSRC's "Resource Adequacy Metrics and their Application": https://www.nysrc.org/PDF/Reports/Resource%20Adequacy%20Metric%20Report%20Final%204-20-2020[6431].pdf

[2] NYSRC's "Resource Adequacy Metrics and their Application": https://www.nysrc.org/PDF/Reports/Resource%20Adequacy%20Metric%20Report%20Final%204-20-2020[6431].pdf

New York State Department of Public Service (NYDPS): The New York State agency that supports the New York State Public Service Commission. See DPS.NY.gov

New York State Energy Research and Development Authority (NYSERDA): The New York State public authority charged with conducting a multifaceted energy and environmental research and development program to meet New York State's diverse economic needs, including administering the state System Benefits Charge, Renewable Portfolio Standard, energy efficiency programs, the Clean Energy Fund, and the NY-Sun Initiative. See NYSERDA.NY.gov

New York State Public Service Commission (NYPSC): The decision-making body of the New York State Department of Public Service, which regulates the state's electric, gas, steam, telecommunications, and water utilities, oversees the cable industry, has the responsibility for setting rates and overseeing that safe and adequate service is provided by New York's utilities, and exercises jurisdiction over the siting of major gas and electric transmission facilities.

NY-Sun Initiative: A program run by NYSERDA for the purpose of obtaining more than 6,000 MW-DC of behind-the-meter solar photovoltaic systems by the end of 2023. See NYSERDA.NY.gov

New York State Reliability Council (NYSRC): A not-for-profit entity the mission of which is to annually establish the Installed Reserve Margin, and to promote and preserve the reliability of electric service on the New York State Power System by developing, maintaining, and updating the Reliability Rules with which the NYISO and all entities engaging in electric transmission, ancillary services, energy, and power transactions on the New York State Power System must comply. See NYSRC.org

Normal Transfer Criteria: Measures established, in accordance with the North American Electric Reliability Corporation, Northeast Power Coordinating Council, and the New York State Reliability Council's Reliability Rules, to determine that adequate facilities are available to supply firm load in the bulk power transmission system within applicable normal ratings and limits. See NYSRC.org

Normal Transfer Limit: The lowest limit based on the most restrictive of three maximum allowable transfers, calculated based on thermal, voltage, and stability testing, considering contingencies, ratings, and limits specified for normal conditions. See NYSRC.org

North American Electric Reliability Corporation (NERC): A not-for-profit international regulatory authority the mission of which is to assure the effective and efficient reduction of risks to the reliability and security of the grid. See NERC.com

Northeast Power Coordinating Council (NPCC): The entity to whom the North American Electric Reliability Corporation has delegated Electric Reliability Organization functions in the New York Control Area. See NYISO OATT

Open Access Transmission Tariff (OATT): The document setting forth the rates, terms, and conditions, accepted or approved by the FERC, under which the NYISO provides transmission service and conducts interconnection and transmission system planning.

Order No. 890: Order issued by the FERC in 2007 that amended the regulations and the *pro forma* open access transmission tariff to provide that transmission services and planning are provided on a basis that is just, reasonable and not unduly discriminatory or preferential. See FERC.gov

Order No. 1000: Order issued by the FERC in 2011 that amended the transmission planning and cost allocation requirements established in Order No. 890 to provide that Commission-jurisdictional services, including transmission planning, are provided at just and reasonable rates and on a basis that is just and reasonable and not unduly discriminatory or preferential. See FERC.gov

Outage: The forced or scheduled removal of generating capacity or a transmission line from service.

Peak Demand: The maximum instantaneous power demand, measured in megawatts (MW), and known as peak load, is usually measured, and averaged over an hourly interval. The peak hour is the hour during which the coincident usage was the highest across the entire New York Control Area in a given time period.

Queue Position: The order, in the NYISO's Interconnection Queue, of a valid Interconnection Request, Study Request, or Transmission Interconnection Application relative to all other pending Requests.
See NYISO OATT

Rating: The operational limits of an electric system, facility, or element under a set of specified conditions. Rating categories include Normal Rating, Long-Term Emergency (LTE) Rating, and Short-Term Emergency (STE) Rating, as follows:

1. **Normal Rating:** The capacity rating of a transmission facility that may be carried through consecutive twenty- four (24) hour load cycles.
2. **Long-Time Emergency (LTE) Rating:** The capacity rating of a transmission facility that can be carried through infrequent, non- consecutive four (4) hour periods.
3. **Short-Time Emergency (STE) Rating:** The capacity rating of a transmission facility that may be carried during very infrequent contingencies of fifteen (15) minutes or less duration.
(Source: NYSRC Reliability Rules). See NYSRC.org

Reasonably Available Control Technology for Major Facilities of Oxides of Nitrogen (NOx RACT): New York State Department of Environmental Conservation regulations for the control of emissions of nitrogen oxides (NOx) from fossil fuel-fired power plants. See DEC.ny.gov

Reactive Power: The portion of electric power that establishes and sustains the electric and magnetic fields of alternating-current equipment.

Reactive Power Resources: Facilities such as generators, high voltage transmission lines, synchronous condensers, capacitor banks, and static var compensators that provide reactive power.

Regional Greenhouse Gas Initiative (RGGI): A cooperative effort by a group of Northeast and Mid-Atlantic states to limit power sector greenhouse gas emissions using a market-based cap-and-trade approach. See RGGI.org

Reliability: The degree of performance of the bulk electric system that results in electricity being delivered to customers within accepted standards and in the amount desired, which can be addressed by considering the adequacy and security of the electric system:

1. **Adequacy:** The ability of the electric systems to supply the aggregate electrical demand and energy requirements of their customers at all times, taking into account scheduled and reasonably expected unscheduled outages of system elements. Note: Adequacy encompasses both generation and transmission.
2. **Security:** The ability of the electric system to withstand disturbances such as electric short circuits or unanticipated loss of system elements. The ability of the power system to withstand the loss of one or more elements without involuntarily disconnecting firm load. See NYSRC.org

Reliability Criteria: The electric power system planning and operating policies, standards, criteria, guidelines, procedures, and rules promulgated by the North American Electric Reliability Corporation, Northeast Power Coordinating Council, and the New York State Reliability Council. See NYISO OATT Attachment Y

Reliability Need: A condition identified by the NYISO as a violation or potential violation of one or more Reliability Criteria. See NYISO OATT Attachment Y

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

Reliability Needs Assessment (RNA) Study Period: The seven-year time period encompassing years four through ten following the year in which the RNA is conducted, which is used in the RNA and the Comprehensive Reliability Plan. See NYISO OATT Attachment Y

Reliability Planning Process (RPP): The process by which the NYISO determines, in the Reliability Needs Assessment, whether any Reliability Need(s) on the New York State Bulk Power Transmission Facilities will arise in the Study Period and addresses any identified Reliability Need(s) in the Comprehensive Reliability Plan. See NYISO OATT Attachment Y

Reliability Solutions: Potential solutions to reliability needs include the following:

1. **Alternative Regulated Solutions (ARS):** Regulated solutions submitted by a Transmission Owner or other developer in response to a solicitation for solutions to a Reliability Need identified in a Reliability Needs Assessment.

2. **Gap Solution:** A solution to a Reliability Need that is designed to be temporary and to strive to be compatible with permanent market-based proposals. The NYISO may call for a Gap Solution to an imminent threat to reliability of the Bulk Power Transmission Facilities if no market-based solutions, regulated backstop solutions, or alternative regulated solutions can meet the Reliability Needs in a timely manner.

3. **Market-Based Solution:** Investor-proposed project driven by market needs to meet future reliability requirements of the bulk electricity grid as outlined in the Reliability Needs Assessment. These can include generation, transmission, and demand response Programs.

4. **Regulated Backstop Solution:** Proposals are required of certain Transmission Owners to meet Reliability Needs as outlined in the Reliability Needs Assessment.

Those solutions can include generation, transmission, or demand response. Non-Transmission Owner developers may also submit regulated solutions. See NYISO OATT Attachment Y

Resource Adequacy: The ability of the electric systems to supply the aggregate electrical demand and energy requirements of their customers at all times, taking into account scheduled and reasonably expected unscheduled outages of system elements. Note: Adequacy encompasses both generation and transmission. See definition of Reliability.

Responsible Transmission Owner (Responsible TO): The Transmission Owner(s) designated by the NYISO to prepare a proposal for a regulated backstop solution to a Reliability Need or to proceed with a regulated solution to a Reliability Need. The Responsible Transmission Owner will normally be the Transmission Owner in whose Transmission District the ISO identifies a Reliability Need and/or that owns a transmission facility on which a Reliability Need arises. See NYISO OATT Attachment Y

Short-Term Assessment of Reliability (STAR): The NYISO's quarterly assessment, in coordination with the Responsible Transmission Owner(s), of whether a Short-Term Reliability Process Need will result from a Generator becoming Retired, entering into a Mothball Outage, or being unavailable due to an Installed Capacity Ineligible Forced Outage, or from other changes to the availability of Resources or to the New York State Transmission System. See NYISO OATT Attachment FF

Short-Term Reliability Process: The process by which the NYISO evaluates and addresses the reliability impacts resulting from both: (1) Generator Deactivation Reliability Need(s), and/or (2) other Reliability Needs on or affecting the Bulk Power Transmission Facilities that are identified in a Short-Term Assessment of Reliability. The Short-Term Reliability Process evaluates reliability needs in years one through five of the ten-year Study Period, with a focus on needs in years one through three. See NYISO OATT Attachment FF

Short-Term Reliability Process Need: A Generator Deactivation Reliability Need or a condition identified by the NYISO in a Short-Term Assessment of Reliability as a violation or potential violation of one or more Reliability Criteria on the Bulk Power Transmission Facilities. See NYISO OATT Attachment FF

Short-Term Reliability Process Solution: A solution to address a Short-Term Reliability Process Need, which may include (1) an Initiating Generator, (2) a solution proposed pursuant to the NYISO Services Tariff, or (3) a Generator identified by the NYISO pursuant to the NYISO Services Tariff. See NYISO OATT and NYISO Services Tariff

Short-Term Assessment of Reliability (STAR) Start Date: The date on which the NYISO next commences a STAR after issuing a written notice to a Market Participant indicating that the Generator Deactivation Notice for its Generator is complete. See NYISO OATT Attachment FF

Special Case Resource ("SCR"): Demand Side Resources the Load of which is capable of being interrupted upon demand 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 New York State Transmission System or the distribution system at the direction of the NYISO. See NYISO Services Tariff

Stability: The ability of an electric system to maintain a state of equilibrium during normal and abnormal system conditions or disturbances. See NYSRC.org

System & Resource Outlook (formerly "CARIS"): Biennial report produced by the NYISO, through which it summarizes the current assessments, evaluations, and plans in the biennial Comprehensive System Planning Process, produces a twenty-year projection of congestion on the New York State Transmission System, identifies, ranks, and groups congested elements, and assesses the potential benefits of addressing the identified congestion.

System Benefits Charge (SBC): An amount of money, charged to ratepayers on their electric bills, which is administered and allocated by the New York State Energy Research and Development Authority towards energy-efficiency programs, research and development initiatives, low-income energy programs, and environmental disclosure activities.

Transfer Capability: The measure of the ability of interconnected electrical systems to reliably move or transfer power from one area to another over all transmission facilities (or paths) between those areas under specified system conditions.

Transmission Constraints: Limitations on the ability of a transmission system to transfer electricity during normal or emergency system conditions.

Transmission Owner (TO): A public utility or authority that owns transmission facilities and provides Transmission Service under the NYISO Tariffs.

Transmission Security: The ability of the electric system to withstand disturbances such as electric short circuits or unanticipated loss of system elements. The ability of the power system to withstand the loss of one or more elements without involuntarily disconnecting firm load. See definition of Reliability.

Unforced Capacity: The measure by which Installed Capacity Suppliers will be rated to quantify the extent of their contribution to satisfy the New York Control Area Installed Capacity Requirement.
See NYISO Services Tariff

Unforced Capacity Deliverability Rights (UDRs): Rights, as measured in MWs, associated with (1) new incremental controllable transmission projects, and (2) new projects to increase the capability of existing controllable transmission projects that have UDRs, that provide a transmission interface to a Locality. which, under certain conditions, allow such Unforced Capacity to be treated as if it were located in the Locality, thereby contributing to an LSE's Locational Minimum Installed Capacity Requirement. When combined with Unforced Capacity which is located in an External Control Area or non-constrained NYCA region either by contract or ownership, and which is deliverable to the NYCA interface in the Locality in which the UDR transmission facility is electrically located, UDRs allow such Unforced Capacity to be treated as if it were located in the Locality, thereby contributing to an LSE's Locational Minimum Installed Capacity Requirement. To the extent the NYCA interface is with an External Control Area the Unforced Capacity associated with UDRs must be deliverable to the Interconnection Point. See NYISO Services Tariff

Weather Normalized: Adjustments made to normalize the impact of weather when making energy and peak demand forecasts. Using historical weather data, energy analysts can account for the influence of extreme weather conditions and adjust actual energy use and peak demand to estimate what would have happened if the hottest day or the coldest day had been the typical, or "normal," weather conditions. "Normal" is usually calculated by taking the average of the previous 20 years of weather data.

Zone: One of the eleven regions in the New York Control Area connected to each other by identified transmission interfaces and designated as Load Zones A-K.

Appendix B - The Reliability Planning Process

This appendix presents an overview of the NYISO's Reliability Planning Process (RPP).

This appendix presents an overview of the NYISO's Reliability Planning Process. A detailed discussion of the Reliability Planning Process, including applicable Reliability Criteria, is contained in NYISO Manual entitled: Reliability Planning Process Manual, which is posted on the NYISO's website[3].

The NYISO Reliability Planning Process is an integral part of the NYISO's overall Comprehensive System Planning Process (CSPP).

The CSPP is comprised of four components:

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

Under the LTPP, the local Transmission Owners (TOs) perform transmission studies for their transmission areas according to all applicable criteria. This process produces the Local Transmission Owner Plan (LTP), which feeds into the NYISO's determination of system needs through the CSPP. Links to the Local Transmission Owner Plans (LTPs) can be found on the NYISO's website[4].

The second component in the CSPP cycle is the RPP, covering year 4 through year 10 following the year of starting the study, in conjunction with the STRP, covering year 1 through year 5 following the STAR Start Date of the study. The RPP and STRP requirements are described in detail in the RPP Manual and Attachments Y and FF to the OATT, respectively. Under the biennial process for conducting the RPP, the reliability of the New York Bulk Power Transmission Facilities (BPTF) is assessed, any Reliability Needs are identified, solutions to identified needs are proposed and evaluated for their viability and sufficiency to satisfy the identified needs, and the more efficient or cost-effective transmission solution to the identified needs is selected by the NYISO.

During the Reliability Planning Process, the NYISO conducts the Reliability Needs Assessment (RNA) and Comprehensive Reliability Plan (CRP). The RNA evaluates the adequacy and security of the BPTFs over the RNA Study Period (i.e., years 4 through 10 following the year in which the RNA is conducted). In

[3] Link to RPP Manual: https://www.nyiso.com/documents/20142/2924447/rpp_mnl.pdf

[4] Link to LTPP: https://www.nyiso.com/documents/20142/3632262/Local-Transmission-Owner-Planning-Process-LTPP.pdf

identifying resource adequacy needs, the NYISO identifies the amount of resources in megawatts (MW, known as "compensatory MW") and the locations in which they are needed to meet those needs.

Following approval of the RNA by its Board of Directors and before NYISO issues a solicitation for regulated backstop, market-based, and alternative regulated solutions, the NYISO will request updated LTPs, NYPA transmission plans, and other status updates relevant to reducing, or eliminating, the Reliability Needs, as timely received from Market Participants, Developers, TOs, and other parties. Any such update must meet, in NYISO's determination, the RNA Base Case inclusion rules, as defined in Section 3 of the RPP Manual. If there are remaining Reliability Needs after these updates, the NYISO will request solutions for the remaining Reliability Needs. These solutions will be then undergoing the Viability and Sufficiency Assessments under the CRP, and if needed and as applicable, Transmission Evaluation and Selection. The CRP documents the solutions determined to be viable and sufficient to meet the identified Reliability Needs. The NYISO ranks any regulated transmission solutions submitted for the Board to consider for selection of the more efficient or cost-effective transmission project. If built, the selected transmission project would be eligible for cost allocation and recovery under the NYISO's tariff.

There are two different aspects to analyzing the BPTF's reliability in the RNA: adequacy and security. Adequacy is a planning and probabilistic concept. A system is adequate if the probability of having sufficient transmission and generation to meet expected demand is equal to or less than the system's standard, which is expressed as a loss of load expectation (LOLE). The New York State bulk power system is planned[5] to meet an LOLE that, at any given point in time, is less than or equal to an involuntary load disconnection that is not more frequent than once in every 10 years, or 0.1 days per year. This requirement also forms the basis of New York's installed reserve margin (IRM) resource adequacy requirement.

Security is an operating and deterministic concept. This means that possible events are identified as having significant adverse reliability consequences. The system is planned and operated so that the system can continue to serve load even if these events occur. Security requirements are sometimes referred to as N-1 or N-1-1. N is the number of system components. The analysis for the transmission security assessment is conducted in accordance with the NERC Reliability Standards, NPCC Transmission Design Criteria, and the NYSRC Reliability Rules. Contingency analysis is performed to assess the BPTF response to design criteria contingencies.

[5] NYSRC Reliability Rules: "The loss of load expectation (LOLE) of disconnecting firm load due to resource deficiencies shall be, on average, no more than 0.1 day per year. LOLE evaluations shall make do allowance for demand uncertainty, scheduled outages and deratings, forced outages and deratings, assistance over interconnections with neighboring control areas, NYS Transmission System emergency transfer capability, and capacity and/or load relief from available operating procedures."

For the RNA, over 1,000 design criteria contingencies are evaluated under N-1, N-1-0, and N-1-1 normal transfer criteria conditions to provide that the system is planned to meet all applicable reliability criteria. To evaluate the impact of a single event from the normal system condition (N-1), all design criteria contingences are evaluated including: single element, common structure, stuck breaker, generator, bus, HVDC contingencies, etc. An N-1 requirement means that the system can withstand single disturbance events (*e.g.*, generator, bus section, transmission circuit, breaker failure, double-circuit tower) without violating thermal, voltage and stability limits or before resulting in unplanned loss of service to consumers. An N-1 violation occurs when the system response following the contingency event does not meet the applicable criteria. For example, an N-1 thermal violation occurs when the power flow on branch or transformer is higher than the applicable post-contingency rating. N-1-0 and N-1-1 analysis evaluate the ability of the system to meet design criteria after a critical element has already been lost. For N-1-0 and N-1-1 analysis, single element contingencies are evaluated as the first level outage. An N-1-1 requirement means that the Reliability Criteria apply after any critical element such as a generator, a transmission circuit, a transformer, series or shunt compensating device, or a high voltage direct current (HVDC) pole has already been lost. For N-1-0 and N-1-1 analysis, generation and power flows can be adjusted between contingencies by the use of 10-minute operating reserve, phase angle regulator control, and HVDC control. Following such adjustments, a second single disturbance is analyzed. An N-1-0 violation occurs when the system cannot meet applicable reliability criteria after the first element is lost following system adjustments but prior to the occurrence of another event. An N-1-1 violation occurs when the system cannot meet applicable reliability criteria after the first element is lost following system adjustments and securing for all applicable second-level contingencies. Within the Con Edison service territory, the 345 kV transmission system along with specific portions of the 138 kV transmission system are designed for the occurrence of two non-simultaneous outages and a return to normal ratings (N-1-1-0). For N-1-1-0 analysis, after the second contingency occurs, system adjustments are allowed to secure the system back to normal ratings. The requirement to plan for the occurrence of a second contingency in the Con Edison transmission system is contained in the NYSRC Reliability Rules, Rule G.1.

Also included in the security concept is the transmission security margin or “tipping point” analysis. Transmission security margins are also included in this assessment is to identify plausible changes in conditions or assumptions that might adversely impact the reliability of the Bulk Power Transmission Facilities (BPTF) or “tip” the system into violation of a transmission security criterion. The transmission security margin is the ability to meet load plus losses and system reserve (*i.e.,* total capacity requirement) against the NYCA generation, interchanges, and temperature-based generation de-rates (total resources). This assessment is performed using a deterministic approach through a spreadsheet-based methods based on the RNA study assumptions. For this assessment, "tipping points" are evaluated for the statewide system margin as well as Lower Hudson Valley, New York City, and Long Island localities. For this evaluation, a BPTF Reliably Need is identified when the transmission security margin is less than zero for the statewide system margin or within the Lower Hudson Valley, New York City, and Long Island localities.

The Reliability Planning Process is anchored in the market-based philosophy of the NYISO and its Market Participants, which posits that market solutions should be the preferred choice to meet the identified Reliability Needs reported in the RNA. In the RNA, the reliability of the BPTFs is assessed accordance with existing NERC, NPCC, and the NYSRC criteria as they may change from time to time to identify Reliability Needs. Solutions to Reliability Needs are evaluated in CRP. These criteria and a description of the nature of long-term bulk power system planning are described in detail in the Reliability Planning Process Manual, and are briefly summarized below.

In the event that market-based solutions do not materialize to meet a Reliability Need in a timely manner, the NYISO designates the Responsible TO or Responsible TOs or developer of an alternative regulated solution to proceed with a regulated solution in order to maintain system reliability. Under the Reliability Planning Process, the NYISO also has an affirmative obligation to report historic congestion across the transmission system. In addition, the draft RNA is provided to the Market Monitoring Unit (MMU) for review and consideration of whether market rules changes are necessary to address an identified failure, if any, in one of the NYISO's competitive markets. If a market failure is identified as the reason for the lack of market-based solutions to a Reliability Need, the NYISO will explore appropriate changes in its market rules with its stakeholders and the MMU. The Reliability Planning Process does not substitute for the planning that each TO conducts to maintain the reliability of its own bulk and non-bulk power systems.

The NYISO does not license or construct projects to respond to identified Reliability Needs reported in the RNA. The ultimate approval of those projects lies with regulatory agencies such as the Federal Energy Regulatory Commission (FERC), the New York State Public Service Commission (NYPSC), environmental permitting agencies, and local governments. The NYISO monitors the progress and continued viability of proposed market and regulated projects to meet identified Reliability Needs and reports its findings to the Board.

The Short-Term Reliability Process (STRP) uses quarterly Short-Term Assessment of Reliability (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 by which the NYISO, Transmission Owners, Market Participants, Generator Owners, Developers, and other interested parties follow to plan 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 will assess a five-year period, with a particular focus on Short-Term Reliability Process Needs ("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,[6] needs that arise in years four or five of the assessment period may be addressed in either the STRP or longer-term Reliability Planning Process (RPP).

Each STAR looks out five years from its STAR Start Date. 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.

The third component of the CSPP is the Economic Planning Process, which 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 project's Load Serving Entity beneficiaries; 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.

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

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 on the BPTF driven by Public Policy Requirements. The NYISO then requests that interested entities submit proposed 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. 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.

Figure 1 summarizes the CSPP and Figure 2 summarizes the RPP process.

Figure 1: NYISO's Comprehensive System Planning Process (CSPP)

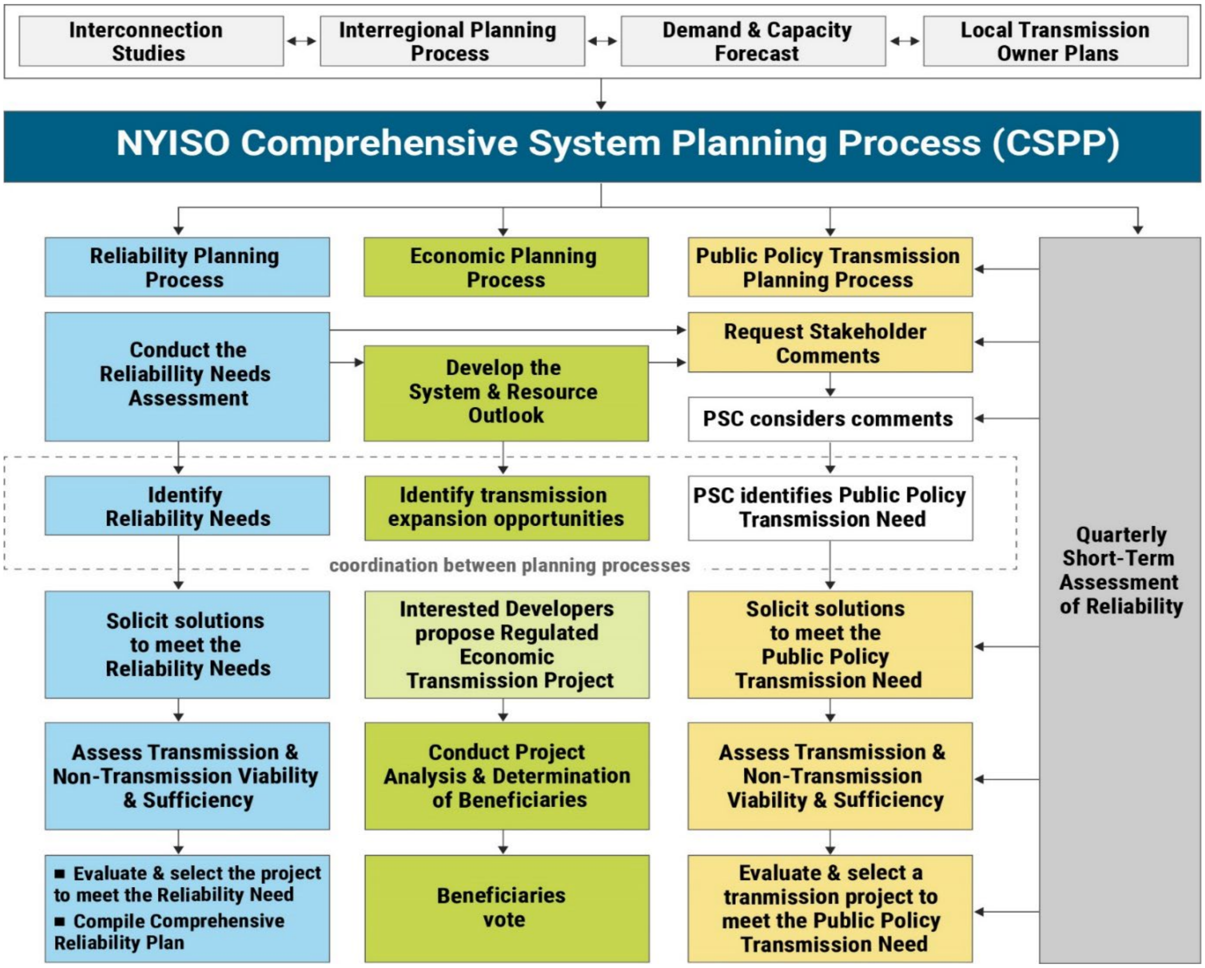
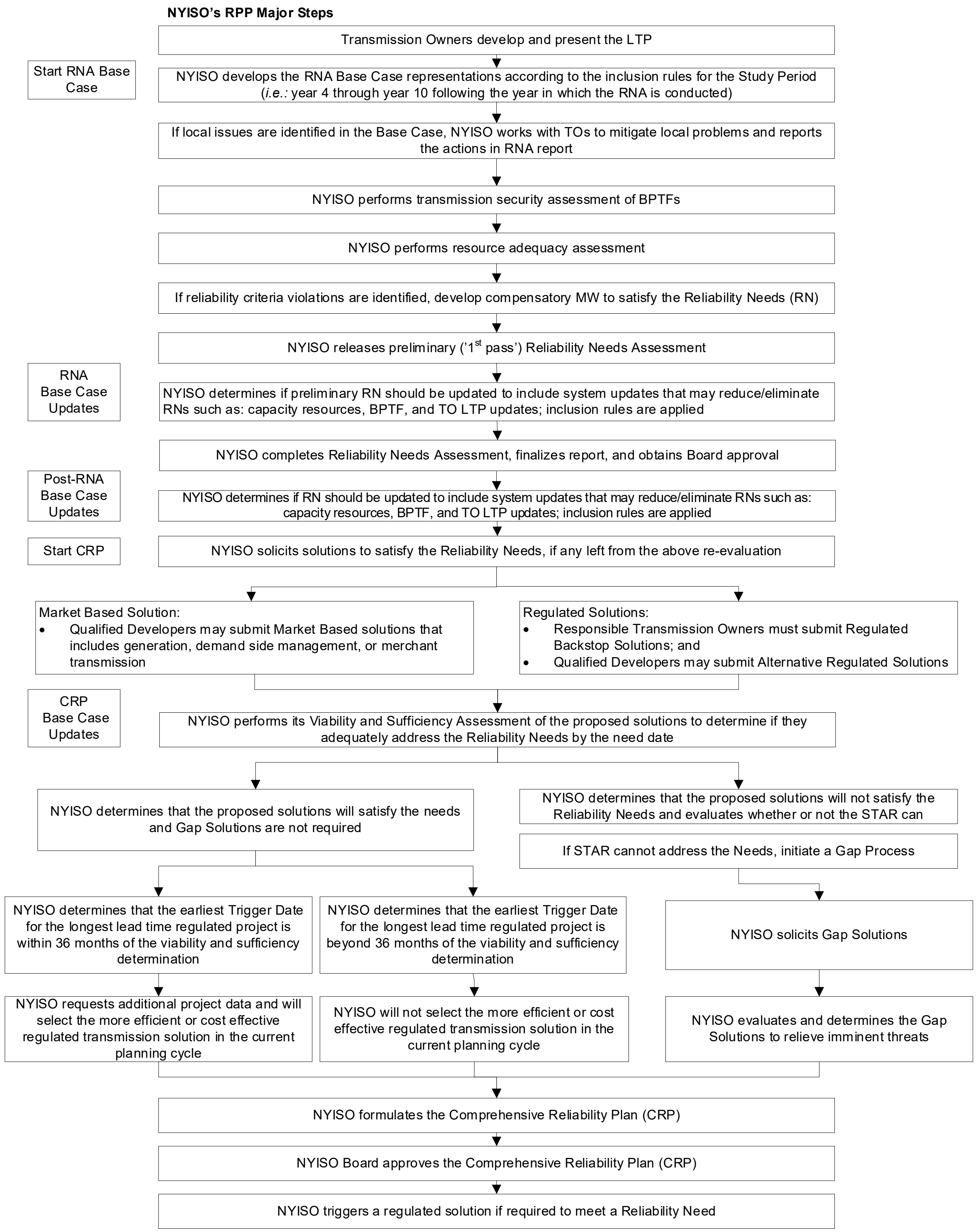


Figure 2: NYISO RPP



Notes:
* If an immediate threat to the reliability of the power system is identified, a Gap Solution outside of the normal RPP cycle may be requested by the NYISO Board.

Appendix C - Load and Energy Forecast 2022-2032

Historical Overview

In order to perform the 2022 RNA, forecasts of summer and winter peak demand and annual energy requirements were produced for the years 2022 - 2032. The New York Control Area (NYCA) is a summer peaking system and is expected to remain a summer peaking system over the study period. In considering longer-term trends, the NYISO may become a winter peaking system in the mid-2030s due to increasing electrification primarily via heat pumps and electric vehicles. Both summer and winter peaks show considerable year-to-year variability due to the influence of peak-producing weather conditions for the seasonal peaks. Annual energy is also influenced by weather conditions over the entire year. However, the resulting variation in annual energy levels is relatively lower.

Figure 3 below reports the NYCA historic seasonal peaks and annual energy growth since 2012. The table provides both actual results and weather-normalized results, together with annual average growth rates for each table entry. The growth rates are averaged over the period 2012 to 2021.

Figure 3: Historical Energy and Seasonal Peak Demand - Actual and Weather-Normalized

	Annual Energy - GWh		Summer Peak - MW		Winter Peak - MW		
Year	Actual	Weather Normalized	Actual	Weather Normalized	Winter	Actual	Weather Normalized
2012	162,840	163,458	32,439	33,106	2012-13	24,659	24,630
2013	163,514	163,473	33,956	33,502	2013-14	25,739	24,610
2014	160,026	160,576	29,782	33,291	2014-15	24,648	24,500
2015	161,572	159,884	31,139	33,226	2015-16	23,319	24,220
2016	160,798	159,169	32,075	33,225	2016-17	24,164	24,416
2017	156,370	156,795	29,699	32,914	2017-18	25,081	24,265
2018	161,114	158,445	31,861	32,512	2018-19	24,727	24,114
2019	155,832	155,848	30,397	32,357	2019-20	23,253	24,123
2020	150,198	150,310	30,660	31,723	2020-21	22,542	23,890
2021	151,978	152,147	30,919	31,528	2021-22	23,235	23,708
	-0.76%	-0.79%	-0.53%	-0.54%		-0.66%	-0.42%

Forecast Overview

Figure 4 below shows historical and forecast growth rates of annual energy for five different regions in New York and in total. The five regions are Zones A to E, Zones F and G, H and I, Zone J, and Zone K. Figure 5 shows historical and forecast growth rates of summer and winter peak demand for the same five regions. The corresponding load forecast uncertainty values for each of five regions are also included.

Figure 4: Annual Energy and Average Growth – Actual and Forecast

	Annual Energy - GWh					
Year	A to E	F&G	H&I	J	K	NYCA
2012	56,238	21,784	9,029	53,487	22,302	162,840
2013	56,899	21,995	9,190	53,316	22,114	163,514
2014	55,119	21,840	8,975	52,529	21,563	160,026
2015	54,548	22,487	9,146	53,485	21,906	161,572
2016	54,286	22,273	8,995	53,653	21,591	160,798
2017	52,938	21,492	8,859	52,266	20,815	156,370
2018	55,210	22,340	8,878	53,360	21,326	161,114
2019	53,089	21,403	8,792	52,003	20,545	155,832
2020	52,335	21,044	8,578	48,060	20,181	150,198
2021	53,119	21,089	8,665	48,832	20,273	151,978
2022	53,470	20,995	8,672	48,439	19,684	151,260
2023	55,216	20,607	8,651	48,240	19,406	152,120
2024	54,759	20,266	8,618	48,169	19,228	151,040
2025	53,870	19,801	8,513	47,626	18,950	148,760
2026	53,252	19,502	8,459	47,442	18,895	147,550
2027	52,838	19,353	8,437	47,317	19,025	146,970
2028	52,447	19,273	8,443	47,374	19,253	146,790
2029	52,248	19,349	8,505	47,795	19,643	147,540
2030	52,267	19,549	8,605	48,460	20,139	149,020
2031	52,748	19,934	8,759	49,407	20,742	151,590
2032	53,457	20,389	8,920	50,420	21,334	154,520

	Average Annual Growth - Percent					
Period	A to E	F&G	H&I	J	K	NYCA
2012-21	-0.63%	-0.36%	-0.46%	-1.01%	-1.05%	-0.76%
2022-32	0.00%	-0.29%	0.28%	0.40%	0.81%	0.21%
2012-16	-0.88%	0.56%	-0.09%	0.08%	-0.81%	-0.31%
2016-21	-0.43%	-1.09%	-0.74%	-1.87%	-1.25%	-1.12%
2022-27	-0.24%	-1.62%	-0.55%	-0.47%	-0.68%	-0.57%
2027-32	0.23%	1.05%	1.12%	1.28%	2.32%	1.01%

Figure 5: Actual and Forecast Seasonal Peak Demand and Average Growth, and LFU Multipliers

	Summer Coincident Peak - MW						Winter Coincident Peak - MW					
Year[1]	A to E	F&G	H&I	J	K	NYCA	A to E	F&G	H&I	J	K	NYCA
2012	9,932	4,630	2,046	10,722	5,109	32,439	8,885	3,462	1,457	7,456	3,399	24,659
2013	9,859	4,750	2,238	11,456	5,653	33,956	9,047	3,689	1,599	7,810	3,594	25,739
2014	8,212	4,069	1,917	10,567	5,017	29,782	8,789	3,481	1,491	7,481	3,406	24,648
2015	9,196	4,445	1,962	10,410	5,126	31,139	8,182	3,357	1,342	7,274	3,164	23,319
2016	9,437	4,451	2,028	10,990	5,169	32,075	8,534	3,416	1,447	7,482	3,285	24,164
2017	8,450	4,095	1,941	10,241	4,972	29,699	8,745	3,650	1,439	7,822	3,425	25,081
2018	8,985	4,568	2,024	10,890	5,394	31,861	8,504	3,684	1,475	7,674	3,390	24,727
2019	8,708	4,404	1,965	10,015	5,305	30,397	8,088	3,322	1,321	7,398	3,124	23,253
2020	8,967	4,551	2,018	9,798	5,326	30,660	8,019	3,337	1,354	6,689	3,143	22,542
2021	9,188	4,588	2,039	10,108	4,996	30,919	8,268	3,400	1,351	7,116	3,100	23,235
2022	9,320	4,631	1,998	10,760	5,056	31,765	8,557	3,479	1,334	7,356	3,167	23,893
2023	9,616	4,589	2,009	10,853	4,951	32,018	8,769	3,517	1,346	7,442	3,213	24,287
2024	9,522	4,551	1,998	10,837	4,870	31,778	8,855	3,553	1,349	7,495	3,229	24,481
2025	9,434	4,515	1,988	10,786	4,782	31,505	8,943	3,598	1,354	7,578	3,262	24,735
2026	9,349	4,485	1,981	10,778	4,746	31,339	9,037	3,652	1,365	7,725	3,319	25,098
2027	9,275	4,464	1,981	10,804	4,768	31,292	9,144	3,718	1,383	7,934	3,396	25,575
2028	9,205	4,455	1,987	10,864	4,806	31,317	9,266	3,800	1,406	8,208	3,491	26,171
2029	9,160	4,463	2,002	10,986	4,857	31,468	9,414	3,899	1,435	8,532	3,604	26,884
2030	9,133	4,482	2,022	11,140	4,907	31,684	9,599	4,019	1,470	8,894	3,737	27,719
2031	9,136	4,507	2,044	11,303	4,956	31,946	9,835	4,162	1,518	9,350	3,891	28,756
2032	9,163	4,539	2,064	11,441	5,007	32,214	10,113	4,321	1,574	9,897	4,049	29,954

	Average Annual Growth - Percent						Average Annual Growth - Percent					
Period	A to E	F&G	H&I	J	K	NYCA	A to E	F&G	H&I	J	K	NYCA
2012-21	-0.86%	-0.10%	-0.04%	-0.65%	-0.25%	-0.53%	-0.80%	-0.20%	-0.84%	-0.52%	-1.02%	-0.66%
2022-32	-0.17%	-0.20%	0.33%	0.62%	-0.10%	0.14%	1.68%	2.19%	1.67%	3.01%	2.49%	2.29%
2012-16	-1.27%	-0.98%	-0.22%	0.62%	0.29%	-0.28%	-1.00%	-0.33%	-0.17%	0.09%	-0.85%	-0.51%
2016-21	-0.53%	0.61%	0.11%	-1.66%	-0.68%	-0.73%	-0.63%	-0.09%	-1.36%	-1.00%	-1.15%	-0.78%
2022-27	-0.10%	-0.73%	-0.17%	0.08%	-1.17%	-0.30%	1.34%	1.34%	0.72%	1.52%	1.41%	1.37%
2027-32	-0.24%	0.33%	0.82%	1.15%	0.98%	0.58%	2.03%	3.05%	2.62%	4.52%	3.58%	3.21%

	Load Forecast Uncertainty Multipliers					Load Forecast Uncertainty Multipliers				
Bin	A to E	F&G	H&I	J	K	A to E	F&G	H&I	J	K
Bin 1	113.18%	111.42%	110.50%	109.10%	116.30%	110.29%	110.29%	110.29%	110.29%	110.29%
Bin 2	109.25%	108.20%	107.41%	105.78%	111.32%	106.26%	106.26%	106.26%	106.26%	106.26%
Bin 3	104.80%	104.14%	103.08%	102.05%	105.60%	102.65%	102.65%	102.65%	102.65%	102.65%
Bin 4	100.00%	99.46%	97.82%	97.98%	100.00%	99.37%	99.37%	99.37%	99.37%	99.37%
Bin 5	94.96%	94.28%	91.83%	93.60%	93.87%	96.32%	96.32%	96.32%	96.32%	96.32%
Bin 6	89.75%	88.67%	85.21%	88.90%	86.89%	93.46%	93.46%	93.46%	93.46%	93.46%
Bin 7	84.49%	82.72%	78.09%	83.89%	80.04%	90.74%	90.74%	90.74%	90.74%	90.74%

[1] Years listed reflect the NYISO capability year; For example, the year 2012 reflects the winter period spanning 2012-2013

Forecast Methodology

In addition to developing load forecasts for each of the load zones, the NYISO received and evaluated forecasts from all Transmission Owners, which are used in combination with the forecasts developed 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 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 and standards. Economic variables considered include Gross State Product (GSP), households, population, and commercial and industrial employment. Projected long-term weather trends from the NYISO Climate Change Impact Study Phase I 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. The incremental impacts of electric vehicle usage and other electrification are added to the forecast. The impacts of net electricity consumption of energy storage units due to charging and discharging are added to the energy forecasts, while the peak reducing impacts of behind-the-meter energy storage units are deducted from the peak forecasts. In the final stage, the NYISO aggregates load forecasts by Zone. The 2022 summer peak forecast is the 2022 ICAP forecast.

Forecast Results

Figure 6 through Figure 16 include information on the 2022 RNA baseline forecast specific to the 2022 RNA look-ahead period. Annual energy, summer, and winter peak forecasts and the corresponding average annual growth rates are provided for reference along with comparisons to the 2020 RNA baseline forecast (Gold Book forecasts). The peak demand-reducing impacts of installed behind-the-meter solar PV capacity are also summarized.

Figure 6: Gold Book Baseline Energy Forecast Growth Rates - 2022 to 2032

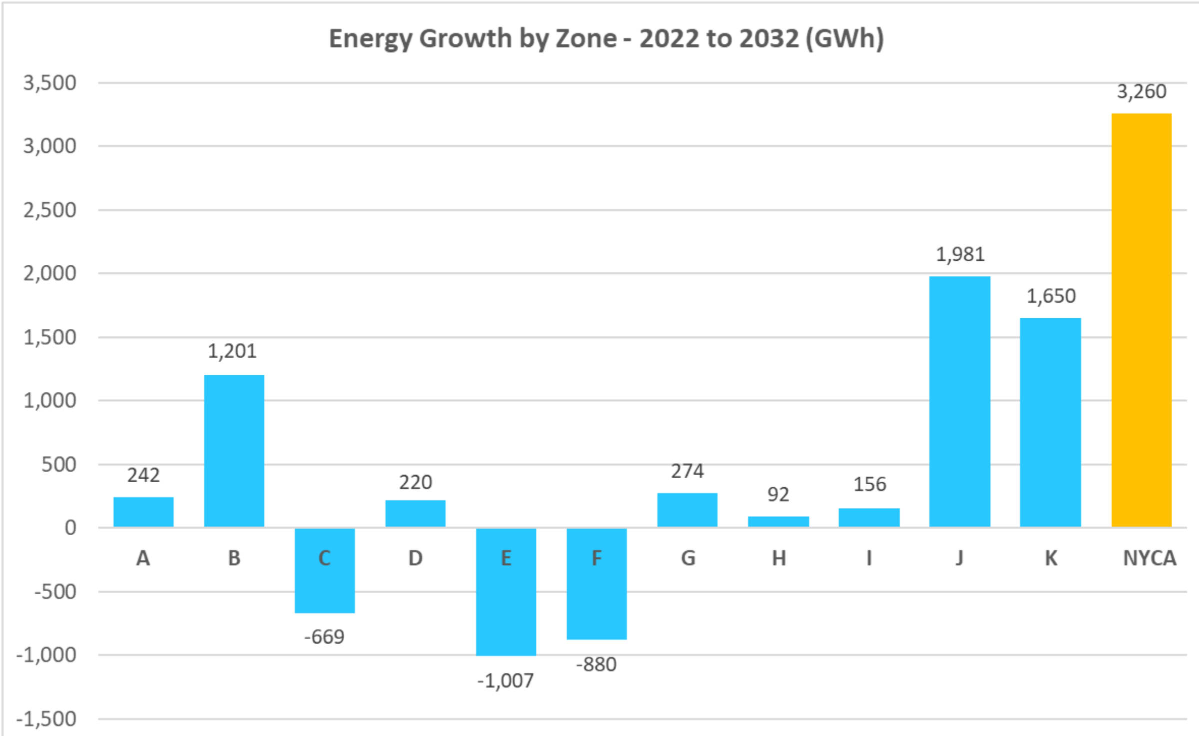


Figure 7: 2030 Energy Forecast Comparison between 2020 Gold Book and 2022 Gold Book

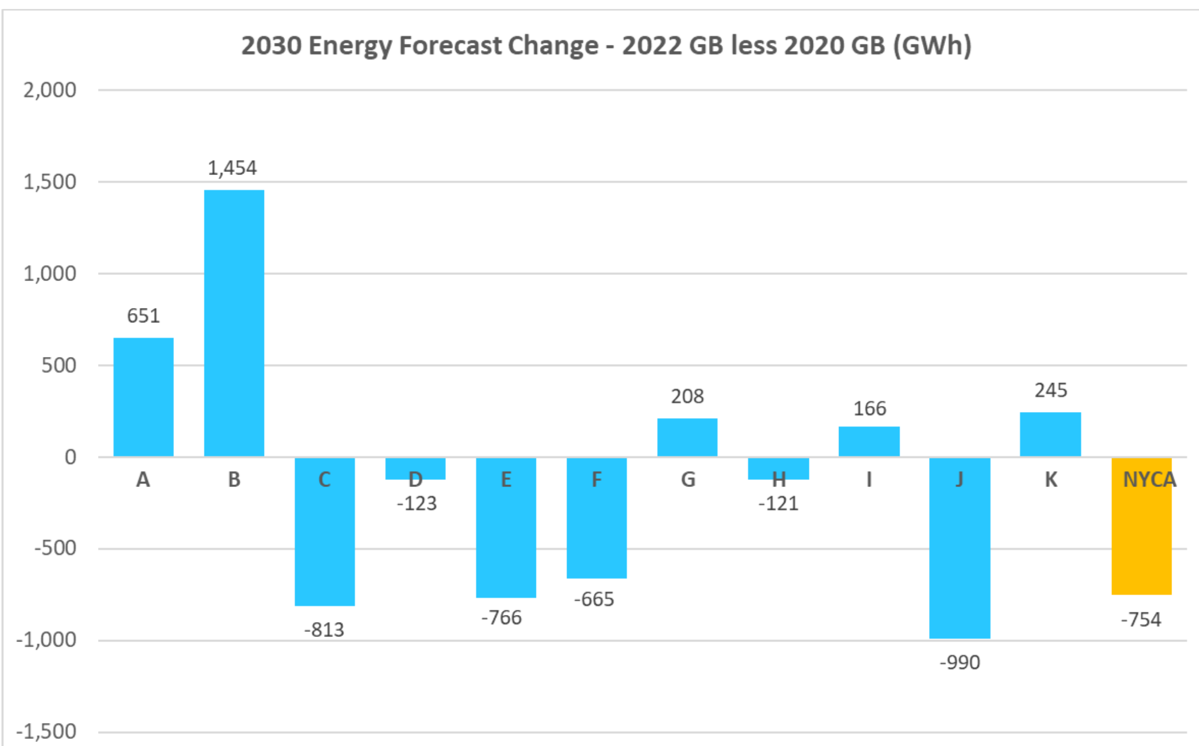


Figure 8: Gold Book Baseline Summer Coincident Peak Demand Forecast Growth Rates – 2022 to 2032

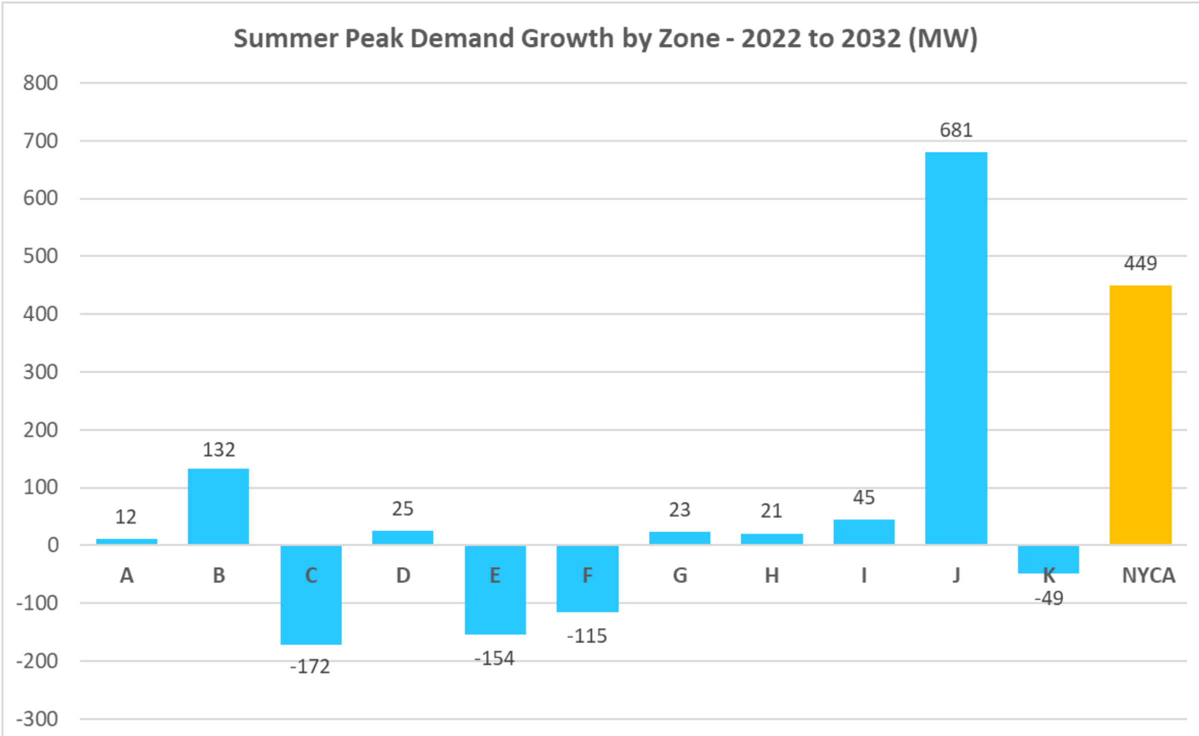


Figure 9: 2030 Summer Peak Forecast Comparison between 2020 Gold Book and 2022 Gold Book

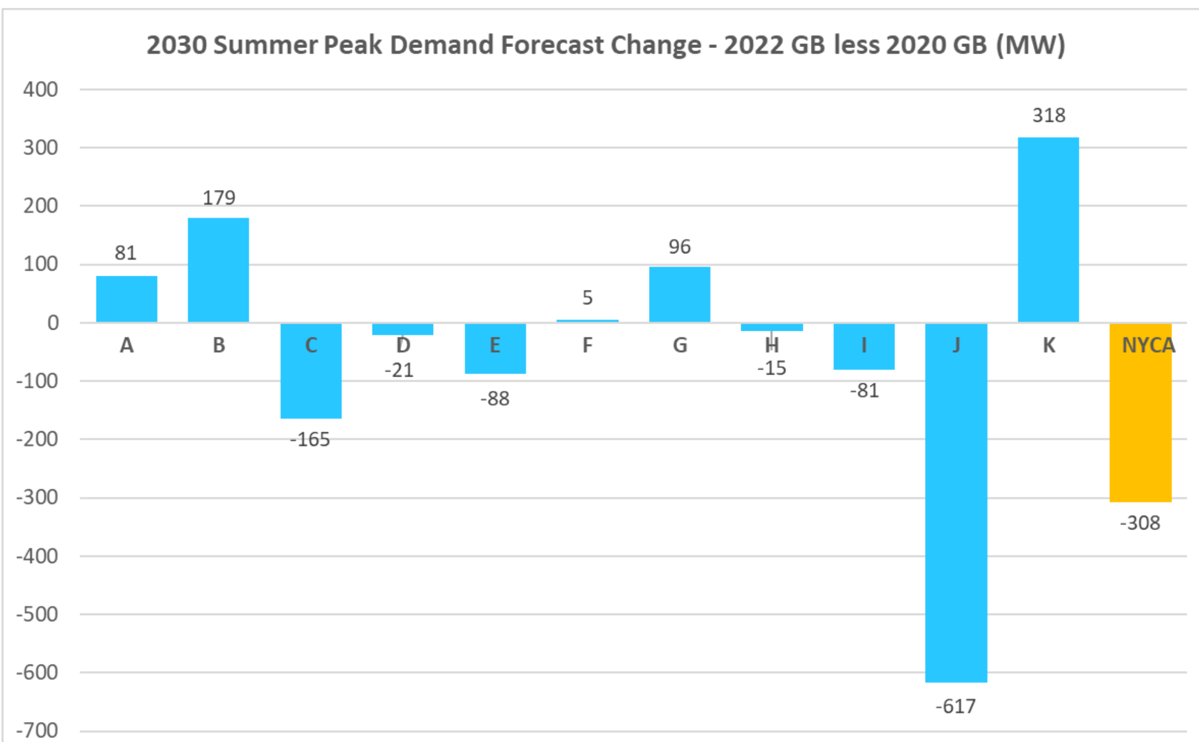


Figure 10: Annual Energy by Zone - Actual and 2022 Gold Book Baseline Forecast (GWh)

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA
2012	15,595	10,009	16,117	6,574	7,943	11,846	9,938	2,930	6,099	53,487	22,302	162,840
2013	15,790	9,981	16,368	6,448	8,312	12,030	9,965	2,986	6,204	53,316	22,114	163,514
2014	15,885	9,899	16,345	4,835	8,155	12,008	9,832	2,694	6,281	52,529	21,563	160,026
2015	15,761	9,906	16,299	4,441	8,141	12,422	10,065	2,847	6,299	53,485	21,906	161,572
2016	15,803	9,995	16,205	4,389	7,894	12,298	9,975	2,856	6,139	53,653	21,591	160,798
2017	15,261	9,775	15,819	4,322	7,761	11,823	9,669	2,883	5,976	52,266	20,815	156,370
2018	15,894	10,090	16,561	4,670	7,995	12,375	9,965	2,807	6,071	53,360	21,326	161,114
2019	14,872	9,715	15,809	4,825	7,868	11,829	9,574	2,816	5,976	52,003	20,545	155,832
2020	14,514	9,698	15,450	5,047	7,626	11,827	9,217	2,849	5,729	48,060	20,181	150,198
2021	14,731	9,797	15,560	5,415	7,616	11,827	9,262	2,884	5,781	48,832	20,273	151,978
2022	14,766	10,013	15,490	5,593	7,608	11,860	9,135	2,881	5,791	48,439	19,684	151,260
2023	15,141	10,915	15,819	5,944	7,397	11,597	9,010	2,885	5,766	48,240	19,406	152,120
2024	14,923	10,883	15,832	5,936	7,185	11,354	8,912	2,876	5,742	48,169	19,228	151,040
2025	14,751	10,816	15,458	5,911	6,934	11,050	8,751	2,841	5,672	47,626	18,950	148,760
2026	14,678	10,801	15,159	5,869	6,745	10,839	8,663	2,820	5,639	47,442	18,895	147,550
2027	14,623	10,826	14,937	5,849	6,603	10,703	8,650	2,821	5,616	47,317	19,025	146,970
2028	14,545	10,852	14,738	5,828	6,484	10,600	8,673	2,828	5,615	47,374	19,253	146,790
2029	14,532	10,870	14,612	5,813	6,421	10,578	8,771	2,847	5,658	47,795	19,643	147,540
2030	14,582	10,915	14,558	5,802	6,410	10,628	8,921	2,873	5,732	48,460	20,139	149,020
2031	14,763	11,046	14,651	5,805	6,483	10,784	9,150	2,920	5,839	49,407	20,742	151,590
2032	15,008	11,214	14,821	5,813	6,601	10,980	9,409	2,973	5,947	50,420	21,334	154,520

Figure 11: Summer Coincident Peak Demand by Zone - Actual and 2022 Gold Book Baseline Forecast (MW)

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA
2012	2,743	2,107	2,888	774	1,420	2,388	2,242	653	1,393	10,722	5,109	32,439
2013	2,549	2,030	2,921	819	1,540	2,392	2,358	721	1,517	11,456	5,653	33,956
2014	2,227	1,617	2,574	527	1,267	2,033	2,036	584	1,333	10,567	5,017	29,782
2015	2,632	1,926	2,705	557	1,376	2,294	2,151	617	1,345	10,410	5,126	31,139
2016	2,672	2,008	2,812	561	1,384	2,328	2,123	636	1,392	10,990	5,169	32,075
2017	2,439	1,800	2,557	502	1,152	2,032	2,063	607	1,334	10,241	4,972	29,699
2018	2,391	1,947	2,747	600	1,300	2,378	2,190	631	1,393	10,890	5,394	31,861
2019	2,367	1,841	2,592	603	1,305	2,224	2,180	652	1,313	10,015	5,305	30,397
2020	2,405	1,804	2,752	661	1,345	2,374	2,177	666	1,352	9,798	5,326	30,660
2021	2,611	1,918	2,705	588	1,366	2,352	2,236	686	1,353	10,108	4,996	30,919
2022	2,661	1,985	2,700	643	1,331	2,424	2,207	626	1,372	10,760	5,056	31,765
2023	2,726	2,125	2,775	687	1,303	2,390	2,199	630	1,379	10,853	4,951	32,018
2024	2,706	2,124	2,733	687	1,272	2,360	2,191	626	1,372	10,837	4,870	31,778
2025	2,691	2,122	2,691	686	1,244	2,332	2,183	623	1,365	10,786	4,782	31,505
2026	2,679	2,118	2,648	684	1,220	2,308	2,177	621	1,360	10,778	4,746	31,339
2027	2,669	2,116	2,609	681	1,200	2,290	2,174	621	1,360	10,804	4,768	31,292
2028	2,655	2,114	2,574	678	1,184	2,279	2,176	623	1,364	10,864	4,806	31,317
2029	2,653	2,108	2,549	675	1,175	2,278	2,185	627	1,375	10,986	4,857	31,468
2030	2,653	2,106	2,531	673	1,170	2,284	2,198	634	1,388	11,140	4,907	31,684
2031	2,660	2,110	2,524	670	1,172	2,294	2,213	641	1,403	11,303	4,956	31,946
2032	2,673	2,117	2,528	668	1,177	2,309	2,230	647	1,417	11,441	5,007	32,214

Figure 12: Winter Coincident Peak Demand by Zone - Actual and 2022 Gold Book Baseline Forecast (MW)

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA
2012-13	2,343	1,568	2,672	954	1,348	1,923	1,539	510	947	7,456	3,399	24,659
2013-14	2,358	1,645	2,781	848	1,415	1,989	1,700	625	974	7,810	3,594	25,739
2014-15	2,419	1,617	2,689	725	1,339	1,925	1,556	537	954	7,481	3,406	24,648
2015-16	2,253	1,486	2,469	667	1,307	1,861	1,496	453	889	7,274	3,164	23,319
2016-17	2,295	1,600	2,573	671	1,395	1,867	1,549	530	917	7,482	3,285	24,164
2017-18	2,313	1,533	2,766	735	1,398	2,012	1,638	506	933	7,822	3,425	25,081
2018-19	2,107	1,566	2,668	747	1,416	2,066	1,618	534	941	7,674	3,390	24,727
2019-20	2,100	1,460	2,482	741	1,305	1,854	1,468	479	842	7,398	3,124	23,253
2020-21	2,095	1,505	2,418	750	1,251	1,856	1,481	485	869	6,689	3,143	22,542
2021-22	2,120	1,507	2,512	846	1,283	1,894	1,506	491	860	7,116	3,100	23,235
2022-23	2,228	1,644	2,540	875	1,270	1,957	1,522	483	851	7,356	3,167	23,893
2023-24	2,264	1,669	2,674	880	1,282	1,972	1,545	487	859	7,442	3,213	24,287
2024-25	2,308	1,694	2,685	880	1,288	1,985	1,568	489	860	7,495	3,229	24,481
2025-26	2,353	1,720	2,694	880	1,296	2,003	1,595	490	864	7,578	3,262	24,735
2026-27	2,398	1,748	2,705	880	1,306	2,026	1,626	491	874	7,725	3,319	25,098
2027-28	2,443	1,781	2,720	880	1,320	2,056	1,662	495	888	7,934	3,396	25,575
2028-29	2,492	1,814	2,742	880	1,338	2,094	1,706	499	907	8,208	3,491	26,171
2029-30	2,550	1,848	2,772	882	1,362	2,140	1,759	506	929	8,532	3,604	26,884
2030-31	2,619	1,891	2,811	884	1,394	2,197	1,822	514	956	8,894	3,737	27,719
2031-32	2,703	1,944	2,868	887	1,433	2,266	1,896	526	992	9,350	3,891	28,756
2032-33	2,800	2,006	2,936	891	1,480	2,342	1,979	539	1,035	9,897	4,049	29,954

Figure 13: 2022 Gold Book Behind-the-Meter Solar PV Baseline Annual Energy Reductions by Zone (GWh)

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA
2022	463	235	590	56	537	679	604	67	99	391	914	4,635
2023	643	303	768	69	716	834	694	71	111	428	968	5,605
2024	861	368	942	78	886	987	770	86	129	469	1,040	6,616
2025	1,001	424	1,088	90	1,026	1,138	867	98	152	530	1,145	7,559
2026	1,147	480	1,242	102	1,165	1,295	962	110	174	594	1,261	8,532
2027	1,288	534	1,392	113	1,296	1,444	1,046	120	196	659	1,374	9,462
2028	1,414	580	1,525	123	1,410	1,574	1,112	131	215	735	1,479	10,298
2029	1,525	620	1,640	131	1,507	1,685	1,160	137	232	803	1,576	11,016
2030	1,604	646	1,722	137	1,572	1,763	1,193	142	245	858	1,656	11,538
2031	1,648	663	1,769	141	1,611	1,809	1,224	146	251	880	1,711	11,853
2032	1,683	676	1,807	144	1,641	1,846	1,249	148	256	898	1,760	12,108

Figure 14: 2022 RNA Base Case Annual Energy Forecast with BTM Solar PV Added Back (GWh)

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA
2022	15,229	10,248	16,080	5,649	8,145	12,539	9,739	2,948	5,890	48,830	20,598	155,895
2023	15,784	11,218	16,587	6,013	8,113	12,431	9,704	2,956	5,877	48,668	20,374	157,725
2024	15,784	11,251	16,774	6,014	8,071	12,341	9,682	2,962	5,871	48,638	20,268	157,656
2025	15,752	11,240	16,546	6,001	7,960	12,188	9,618	2,939	5,824	48,156	20,095	156,319
2026	15,825	11,281	16,401	5,971	7,910	12,134	9,625	2,930	5,813	48,036	20,156	156,082
2027	15,911	11,360	16,329	5,962	7,899	12,147	9,696	2,941	5,812	47,976	20,399	156,432
2028	15,959	11,432	16,263	5,951	7,894	12,174	9,785	2,959	5,830	48,109	20,732	157,088
2029	16,057	11,490	16,252	5,944	7,928	12,263	9,931	2,984	5,890	48,598	21,219	158,556
2030	16,186	11,561	16,280	5,939	7,982	12,391	10,114	3,015	5,977	49,318	21,795	160,558
2031	16,411	11,709	16,420	5,946	8,094	12,593	10,374	3,066	6,090	50,287	22,453	163,443
2032	16,691	11,890	16,628	5,957	8,242	12,826	10,658	3,121	6,203	51,318	23,094	166,628

Figure 15: 2022 Gold Book Behind-the-Meter Solar PV Baseline Summer Coincident Peak Demand Reductions by Zone (MW)

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA
2022	98	54	126	9	91	147	123	13	20	94	210	985
2023	127	67	153	10	112	170	133	13	21	96	211	1,113
2024	158	74	175	11	129	187	137	14	22	98	211	1,216
2025	174	81	192	12	142	203	146	15	25	105	219	1,314
2026	187	87	205	12	150	216	151	16	27	110	225	1,386
2027	194	89	211	13	155	223	152	17	28	113	226	1,421
2028	195	90	213	13	156	223	149	17	28	116	223	1,423
2029	197	90	212	12	156	222	145	16	28	118	220	1,416
2030	192	87	207	12	152	216	138	16	28	117	214	1,379
2031	184	83	197	12	144	205	131	15	27	112	205	1,315
2032	177	80	189	11	139	196	126	14	25	107	197	1,261

Figure 16: 2022 RNA Base Case Summer Coincident Peak Demand Forecast with BTM Solar PV Added Back (MW)

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA
2022	2,759	2,039	2,826	652	1,422	2,571	2,330	639	1,392	10,854	5,266	32,750
2023	2,853	2,192	2,928	697	1,415	2,560	2,332	643	1,400	10,949	5,162	33,131
2024	2,864	2,198	2,908	698	1,401	2,547	2,328	640	1,394	10,935	5,081	32,994
2025	2,865	2,203	2,883	698	1,386	2,535	2,329	638	1,390	10,891	5,001	32,819
2026	2,866	2,205	2,853	696	1,370	2,524	2,328	637	1,387	10,888	4,971	32,725
2027	2,863	2,205	2,820	694	1,355	2,513	2,326	638	1,388	10,917	4,994	32,713
2028	2,850	2,204	2,787	691	1,340	2,502	2,325	640	1,392	10,980	5,029	32,740
2029	2,850	2,198	2,761	687	1,331	2,500	2,330	643	1,403	11,104	5,077	32,884
2030	2,845	2,193	2,738	685	1,322	2,500	2,336	650	1,416	11,257	5,121	33,063
2031	2,844	2,193	2,721	682	1,316	2,499	2,344	656	1,430	11,415	5,161	33,261
2032	2,850	2,197	2,717	679	1,316	2,505	2,356	661	1,442	11,548	5,204	33,475

Appendix D - Resource Adequacy and Transmission System Security Base Case Assessments

The analysis performed during the Reliability Needs Assessment requires the development of RNA Base Cases for transmission security analysis and for resource adequacy analysis, in order to identify Reliability Criteria[7] violations leading to Reliability Needs, which are actionable via the solicitation for solutions process post-RNA (in the CRP).

The power flow, transient stability, and short circuit system models are used for transmission security assessments. The power flow models are also for the development of the transfer limits impacts as input in the Multi-Area Reliability Simulation (MARS) topology ("bubble and pipe") model. The NYISO conducts comprehensive assessment of the transmission system through a series of steady-state power flow, transient stability, and short circuit studies, as well as scenarios to evaluate risks.

The NYISO uses GE-MARS models and performs probabilistic simulations to determine whether adequate resources would be available to meet the NYSRC and NPCC reliability criteria of Loss of Load Expectation (LOLE) of one day in ten years (0.1 event-days/year). The results identify whether or not there are LOLE violations. The MARS models were also used to evaluate variations to the Base Case assumptions to identify, through the development of appropriate scenarios, factors and issues that might adversely impact the reliability of the Bulk Power Transmission Facilities (BPTFs).

[7] As defined by the Reliability Councils: NERC (https://www.nerc.com/Pages/default.aspx), NPCC (https://www.npcc.org/), and NYSRC (https://www.nysrc.org/)

Summary of Proposed Generation and Transmission Assumptions

The NYISO develops various 2022 RNA Base Cases for both transmission security and resource adequacy. The base cases used to analyze the performance of the transmission system are stemming from the 2022 FERC 715 filing power flow case library. The load representation in the power flow model is the expected summer peak load forecast reported in the 2022 Gold Book Table 1-3a baseline forecast of coincident peak demand. The system representation external to the New York Control Area is the Eastern Interconnection Reliability Assessment Group (ERAG) Multiregional Modeling Working Group (MMWG) 2021 power flow model library.

For the resource adequacy evaluations, the models are developed starting with prior resource adequacy models and are updated with information from the 2022 Gold Book and historical data, with the application of the inclusion rules. Information on modeling of neighboring systems is based on the input received from the NPCC CP-8 working group.

The NYISO utilized the RNA Base Case inclusion rules to screen the projects and plans for inclusion or exclusion from the 2022 RNA Base Case. The NYISO bases its determination on the rules as set forth in Section 3 of the Reliability Planning Process (RPP) Manual. Specifically, the 2022 RNA Base Case does not include all projects currently listed on the NYISO's interconnection queue or those shown in the 2022 Gold Book. Rather, it includes only those which met the screening requirements, as shown in the Figure 17of the main report. The generation deactivation assumptions are reflected in Figure 18 of the main report. The firm transmission plans and TIP proposed projects included in the RNA Base Case are listed in Figure 20 in this appendix.

Additionally, the figures below summarize similar information from the load and capacity tables from the report, depicted in different ways. The minimum between proposed CRIS and ERIS MW is used aligning with the resource adequacy models assumptions.

Figure 17: Generation Additions by Year

Summer of Year	New Unit Additions	Zone	MW (Summer)	Total MW Additions
2022	Calverton Solar Energy Center	K	23	23
2022	Dog Corners Solar	C	20	43
2023	Ball Hill Wind	A	100	143
2023	Bluestone Wind	E	112	255
2023	Greene County 1	G	20	275
2023	Greene County 2	G	10	285
2023	Grissom Solar	F	20	305
2023	Janis Solar	C	20	325
2023	KCE NY6	A	20	345
2023	Puckett Solar	E	20	365
2023	Regan Solar	F	20	385
2023	Sky High Solar	C	20	405
2023	Skyline Solar	E	20	425
2023	Watkins Road Solar	E	20	445
2024	Albany County 1	F	20	465
2024	Albany County 2	F	20	485
2024	Bakerstand Solar	A	20	505
2024	Baron Winds	C	238	743
2024	Darby Solar	F	20	763
2024	East Point Solar	F	50	813
2024	Eight Point Wind Energy Center	B	102	915
2024	Excelsior Energy Center	A	280	1,195
2024	Flint Mine Solar	G	100	1,295
2024	High River Solar	F	90	1,385
2024	Martin Solar	A	20	1,405
2024	Number 3 Wind Energy	E	104	1,509
2024	Pattersonville	F	20	1,529
2024	Rock District Solar	F	20	1,549
2024	South Fork Wind Farm	K	96	1,645
2024	South Fork Wind Farm II	K	40	1,685
2024	Tayandenega Solar	F	20	1,705
2024	Ticonderoga Solar	F	20	1,725
2024	Trelina Solar Energy Center	C	80	1,805
2024	Watkins Glen Solar	C	50	1,855
2025	Mohawk Solar	F	91	1,945
2026	-	-	-	1,945
2027	-	-	-	1,945
2028	-	-	-	1,945
2029	-	-	-	1,945
2030	-	-	-	1,945
2031	-	-	-	1,945
2032	-	-	-	1,945

Figure 18: Deactivations and Peaker Rule Status Change by Year

Summer of Year	Retired/Not Available Unit	Zone	MW (Summer)	Total MW Removal
2022	Allegheny Cogen	B	62	62
2022	Madison County LF	E	2	64
2022	Nassau Energy Corporation	K	39	102
2022	Sithe Sterling	E	49	151
2022	Ravenswood 01	J	8	159
2022	Ravenswood 11	J	16	175
2023	74 St. GT 1 & 2	J	39	214
2023	Astoria GT 2-1, 2-2, 2-3, 2-4	J	142	356
2023	Astoria GT 3-1, 3-2, 3-3, 3-4	J	141	496
2023	Astoria GT 4-1, 4-2, 4-3, 4-4	J	138	634
2023	Gowanus 1-1 through 1-7	J	113	747
2023	Gowanus 4-1 through 4-8	J	135	882
2023	Hudson Ave 3	J	12	895
2023	Hudson Ave 5	J	15	910
2023	Zone G	G	38	948
2023	Zone J	J	30	978
2023	Zone K	K	130	1,107
2025	Zone G	G	0	1,107
2025	Zone J	J	596	1,704
2025	Zone K	K	0	1,704
2026	-	-	-	1,704
2027	-	-	-	1,704
2028	-	-	-	1,704
2029	-	-	-	1,704
2030	-	-	-	1,704
2031	-	-	-	1,704
2032	-	-	-	1,704

Additionally, the NYISO's Interconnection Queue has seen an unprecedented increase in the number of projects seeking interconnection service. The projects that are at a more advanced stage in the interconnection process are listed in the 2022 Gold Book Table IV and in Figure 19 and Figure 20 below. Those included in the 2020 and 2022 RNA Base Cases are highlighted.

Figure 19: Additional Proposed Generation Projects from the 2022 Gold Book

QUEUE POS.	OWNER / OPERATOR	STATION UNIT	ZONE	Proposed Date (M-YY)	REQUESTED CRIS (MW)	SUMMER (MW)
Completed Class Year Facilities Study						
678	LI Solar Generation, LLC	Calverton Solar Energy Center	K	Jun-22	22.9	22.9
422	NextEra Energy Resources, LLC	Eight Point Wind Enery Center	B	Sep-22	101.2	101.8
531	Invenergy Wind Development LLC	Number 3 Wind Energy	E	Oct-22	105.8	103.9
579	Bluestone Wind, LLC	Bluestone Wind	E	Oct-22	124.2	111.8
505	Ball Hill Wind Energy, LLC	Ball Hill Wind	A	Nov-22	100.0	100.0
618	High River Energy Center, LLC	High River Solar	F	Nov-22	90.0	90.0
619	East Point Energy Center, LLC	East Point Solar	F	Nov-22	50.0	50.0
721	Excelsior Energy Center, LLC	Excelsior Energy Center	A	Nov-22	280.0	280.0
519	Canisteo Wind Energy LLC	Canisteo Wind	C	Dec-22	290.7	290.7
535	Riverhead Solar 2 LLC	Riverhead Expansion	K	Dec-22	36.0	36.0
612	South Fork Wind, LLC	South Fork Wind Farm	K	Dec-22	96.0	96.0
683	KCE NY 2, LLC	KCE NY 2	G	Dec-22	200.0	200.0
695	South Fork Wind, LLC	South Fork Wind Farm II	K	Dec-22	40.0	40.0
704	Bear Ridge Solar, LLC	Bear Ridge Solar	A	Dec-22	100.0	100.0
706	High Brigde Wind, LLC	High Brigde Wind	E	Dec-22	100.8	100.8
596	Invenergy Wind Development LLC	Alle Catt II Wind	A	May-23	339.1	339.1
276	EDF Renewables Development, Inc.	Homer Solar Energy Center	C	Sep-23	90.0	90.0
637	Flint Mine Solar LLC	Flint Mine Solar	G	Sep-23	100.0	100.0
617	Watkins Glen Energy Center, LLC	Watkins Glen Solar	C	Nov-23	50.0	50.0
620	North Side Energy Center, LLC	North Side Solar	D	Nov-23	180.0	180.0
720	Trelina Solar Energy Center, LLC	Trelina Solar Energy Center	C	Nov-23	80.0	80.0
393	NRG Berrians East Development, LLC	Berrians East Replacement	J	Dec-23	508.0	431.0
396	Baron Winds, LLC	Baron Winds	C	Dec-23	300.0	238.4
591	SunEast Highview Solar LLC	Highview Solar	C	Dec-23	20.0	20.0
644	Hecate Energy Columbia County 1, LLC	Columbia County 1	F	Dec-23	60.0	60.0
746	Peconic River Energy Storage, LLC	North Street Energy Storage	K	Mar-24	150.0	150.0
495	Mohawk Solar LLC	Mohawk Solar	F	Nov-24	90.5	90.5
791	Danskammer Energy LLC	Danskammer Energy Center	G	Jan-25	88.9	595.5
737	Empire Offshore Wind LLC	El Sunset Park	J	Dec-26	816.0	816.0
Completed CRIS Requests						
430	HQUS	Cedar Rapids Transmission Upgrade	D	Oct-21	80.0	N/A
	BSC Owner LLC	Spring Creek Tower	J	N/A	8.0	N/A
	Energy Storage Resources, LLC	Eagle Energy Storage	J	N/A	20.0	N/A
	Strata Storage, LLC	Groundvault Energy Storage	J	N/A	12.5	N/A
	Strata Storage, LLC	Stillwell Energy Storage	J	N/A	10.0	N/A
	Strata Storage, LLC	Cleancar Energy Storage	J	N/A	15.0	N/A
	Hannacroix Solar Facility, LLC	Hannacroix Solar	G	N/A	3.2	N/A
	RWE Solar Development, LLC	Monsey 44-6	G	N/A	5.0	N/A
	RWE Solar Development, LLC	Monsey 44-2	G	N/A	5.0	N/A
	RWE Solar Development, LLC	Monsey 44-3	G	N/A	5.0	N/A
	RWE Solar Development, LLC	Cuddebackville Battery	G	N/A	10.0	N/A
	Yonkers Grid, LLC	Yonkers Grid	J	N/A	20.0	N/A
	King's Plaza Energy LLC	King's Plaza	J	N/A	6.0	N/A
	Port Jefferson Energy Storage, LLC	Port Jefferson Energy Storage	K	N/A	9.9	N/A
	Suffolk County Energy Storage, LLC	Suffork County Energy Storage	K	N/A	9.9	N/A

QUEUE POS.	OWNER / OPERATOR	STATION UNIT	ZONE	Proposed Date (M-YY)	REQUESTED CRIS (MW)	SUMMER (MW)
Class Year 2021						
577	Greene County Energy Properties, LLC	Greene County Energy	G	Jan-22	20.0	20.0
840	Hecate Grid Swiftsure LLC	Swiftsure Energy Storage	J	Jun-22	650.0	650.0
967	KCE NY 5 LLC	KCE NY 5	G	Oct-22	94.0	94.0
694	Sunset Hill Solar, LLC	Sunset Hill Solar	G	Nov-22	20.0	20.0
521	Invenergy NY, LLC	Bull Run II Wind	D	Dec-22	145.4	145.4
629	Silver Lake Solar, LLC	Silver Lake Solar	C	Dec-22	24.9	24.9
801	Prattsburgh Wind, LLC	Prattsburgh Wind Farm	C	Dec-22	147.0	147.0
925	Hecate Grid Clermont 1 LLC	Clermont 1	K	Dec-22	100.0	100.0
931	Hanwha Energy USA Holdings d/d/a/ 174 Power	Astoria Energy Storage	J	Dec-22	100.0	100.0
950	Orleans Solar LLC	Orleans Solar	B	Dec-22	200.0	200.0
774	EDF Renewables Development, Inc.	Tracy Solar Energy Centre	E	Jan-23	119.0	119.0
597	Hecate Energy Greene County 3 LLC	Greene County 3	G	Apr-23	20.0	20.0
779	Hecate Energy Gedney Hill LLC	Gedney Hill Solar	G	Apr-23	20.0	20.0
956	Holbrook Energy Storage	Holbrook Energy Storage	K	May-23	294.9	294.9
965	Yaphank Energy Storage, LLC	Yaphank Energy Storage	K	May-23	76.8	76.8
740	Oakdale Battery Storage LLC	Oakdale Battery Storage	C	Jun-23	120.0	120.0
815	Bayonne Energy Center, LLC	Bayonne Energy Center III	J	Jun-23	49.8	49.8
787	Levy Grid, LLC	Levy Grid, LLC	A	Sep-23	150.0	150.0
805	Osbow Hill Solar, LLC	Owbox Hill Solar	C	Sep-23	140.0	140.0
571	Heritage Renewables, LLC	Heritage Wind	A	Oct-23	200.1	200.1
710	Invenergy Solar Development North America LLC	Horseshoe Solar	B	Oct-23	180.0	180.0
716	EDF Renewables Development, Inc.	Moraine Solar	C	Oct-23	93.5	93.5
717	EDF Renewables Development, Inc.	Morris Ridge Solar Energy Center	C	Oct-23	177.0	177.0
995	Alabama Solar Park LLC	Alabama Solar Park LLC	B	Oct-23	130.0	130.0
783	ConnectGen Chautauqua County LLC	South Ripley Solar	A	Nov-23	270.0	270.0
880	Brookside Solar, LLC	Brookside Solar	D	Nov-23	100.0	100.0
881	New Breman Solar, LLC	New Breman Solar	E	Nov-23	100.0	100.0
882	Riverside Solar, LLC	Riverside Solar	E	Nov-23	100.0	100.0
883	North Park Energy, LLC	Garnet Energy Center	B	Nov-23	200.0	200.0
522	NYC Energy LLC	NYC Energy	J	Dec-23	79.9	79.9
709	Alder Creek Solar, LLC	Alder Creek Solar	E	Dec-23	165.0	165.0
777	Community Energy Solar, LLC	White Creek Solar	B	Dec-23	135.0	135.0
811	Hecate Energy Cider Solar LLC	Cider Solar	A	Dec-23	500.0	500.0
907	174 Power Global	Harlem River Yard	J	Dec-23	100.0	100.0
929	EDF Renewables Development, Inc.	Morris Ridge Battery Storage	C	Dec-23	83.0	83.0
953	Sugar Maple Solar, LLC	Sugar Maple Solar	E	Dec-23	125.0	125.0
954	Empire Solar, LLC	Empire Solar	A	Dec-23	125.0	125.0
878	Energy Storage Resources, LLC	Pirates Island	A	Jan-24	100.0	100.0
766	Sunrise Wind LLC	NY Wind Holbrook	K	May-24	880.0	880.0
822	Astoria Generating Company, LP	Narrows Generating Barge Battery Energy Sto	J	May-24	TBD	58.2
834	Astoria Generating Company, LP	Parking Lot Battery Energy Storage	J	May-24	TBD	79.0
835	Astoria Generating Company, LP	Dock Battery Energy Storage	J	May-24	TBD	56.3
864	Boralex US Development, LLC	NY38 Solar	E	Mar-24	TBD	120.0
987	Sunrise Wind LLC	NY Wind Holbrook 2	K	May-24	44.0	44.0
830	NRG Astoria Storage LLC	Astoria Energy Storage 2	J	Jun-24	79.9	79.9
942	KCE NY 21, LLC	KCE NY 21	K	Dec-24	60.0	60.0
994	KCE NY 22, LLC	KCE NY 22	K	Dec-24	90.0	90.0
700	Able Grid Energy Solutions, LLC	Robinson Grid	J	Jul-25	300.0	300.0
958	Empire Offshore Wind LLC	EI Oceanside	K	Dec-25	96.0	96.0
959	Empire Offshore Wind LLC	EI Oceanside 2	K	Dec-25	1,260.0	1,260.0

QUEUE POS.	OWNER / OPERATOR	STATION UNIT	ZONE	Proposed Date (M-YY)	REQUESTED CRIS (MW)	SUMMER (MW)
EDS 2021-01						
	Central Rivers Power US, LLC	C.H.I. (Dexter) Hydro	E	I/S	5.3	N/A
	Central Rivers Power US, LLC	Copenhagen Assoc.	E	I/S	4.2	N/A
	West Babylon Energy Storage, LLC	West Babylon (PAM-2019-77593)	K	N/A	9.9	N/A
Future Class Year Candidates						
745	Energy Storage Resources, LLC	Huckleberry Ridge Energy	G	Apr-22	TBD	100.0
697	Helix Ravenswood, LLC	Ravenswood Energy Storage 1	J	May-22	TBD	129.0
698	Helix Ravenswood, LLC	Ravenswood Energy Storage 2	J	May-22	TBD	129.0
778	Astoria Generating Company LP	Gowanus Gas Turbine Facility Repowering	J	May-22	TBD	549.0
803	Yonkers Grid, LLC	Yonkers Grid, LLC	I	Jun-22	TBD	100.0
974	KCE NY 19 LLC	KCE NY 19	G	Jun-22	TBD	80.0
718	Cortland Energy Center,LLC	Cortland Energy Center	C	Nov-22	TBD	50.0
719	East Ling Energy Center	East Light Energy Center	F	Nov-22	TBD	40.0
497	Invenergy Wind Development LLC	Bull Run	D	Dec-22	TBD	303.6
939	National Grid Generation LLC	Far Rockaway Battery Energy Storage	K	Dec-22	TBD	30.0
957	Holtsville Energy Storage	Holtsville Energy Storage	K	May-23	TBD	76.8
966	Suffolk County Energy Storage, LLC	Suffolk County Storage	K	May-23	TBD	40.3
520	EDP Renewables North America	Rolling Upland Wind	E	Nov-23	TBD	72.6
594	North Park Energy, LLC	NW Energy	C	Dec-23	TBD	60.0
624	Franklin Solar, LLC	Franklin Solar	D	Dec-23	TBD	150.0
825	Setauket Energy Storage, LLC	Setauket Energy Storage	K	Dec-23	TBD	76.9
668	North Bergen Liberty Generating, LLC	Liberty Generating Alternative	J	Feb-24	TBD	1,171.0
971	Savion, LLC	East Setauket Energy Storage	K	Mar-24	TBD	293.5
770	KCE NY 8 LLC	KCE NY 8a	G	Oct-24	TBD	20.0
857	EDF Renewables Development, Inc.	Columbia Solar Energy Center	E	Oct-24	TBD	350.0
858	EDF Renewables Development, Inc.	Genesee Road Solar Energy Center	A	Oct-24	TBD	350.0
859	EDF Renewables Development, Inc.	Ridge View Solar Energy Center	A	Oct-24	TBD	350.0
860	EDF Renewables Development, Inc.	Rosalen Solar Energy Center	E	Oct-24	TBD	350.0
686	Invenergy Solar Development North America LLC	Bull Run Solar Eneryg Center	D	Dec-24	TBD	170.0
738	Empire Offshore Wind LLC	El Melville	K	Dec-24	TBD	816.0
800	EDF Renewables Development, Inc.	Rich Road Solar Energy Center	E	Dec-24	TBD	240.0
693	Renovo Energy Center, LLC	Renovo Energy Center Uprate	C	Jun-25	TBD	515.0
526	Atlantic Wind, LLC	North Ridge Wind	D	Dec-25	TBD	100.0
560	Atlantic Wind, LLC	Deer River Wind	E	Dec-25	TBD	100.0
574	Atlantic Wind, LLC	Mad River Wind	E	Dec-25	TBD	450.0
680	Anbaric Development Partners, LLC	Long Island Offshore Wind	K	Dec-25	TBD	1,200.0
792	Anbaric Development Partners, LLC	Long Island Offshore Wind Connection	K	Dec-25	TBD	800.0
679	Anbaric Development Partners, LLC	New York City Offshore Wind	J	Dec-26	TBD	1,200.0
Other Non Class Year Generators (Small Generator)						
Interconnection Agreement Complete						
584	SunEast Dog Corners Solar LLC	Dog Corners Solar	C	Mar-22	20.0	20.0
769	New York Power Authority	North Country Energy Storage	D	Mar-22	N/A	20.0
670	SunEast Skyline Solar LLC	Skyline Solar	E	Apr-22	20.0	20.0
768	Janis Solar, LLC	Janis Solar	C	Apr-22	20.0	20.0
775	Puckett Solar, LLC (Conti)	Puckett Solar	E	Apr-22	20.0	20.0
682	Grissom Solar, LLC	Grissom Solar	F	Jun-22	20.0	20.0
748	Regan Solar, LLC	Regan Solar	F	Jun-22	20.0	20.0
735	ELP Stillwater Solar LLC	ELP Stillwater Solar	F	Sep-22	20.0	20.0
565	Tayandenega Solar, LLC	Tayandenega Solar	F	Oct-22	20.0	20.0
666	Martin Rd Solar LLC	Martin Rd Solar	A	Oct-22	20.0	20.0
667	Bakerstand Solar LLC	Bakerstand Solar	A	Oct-22	20.0	20.0

QUEUE POS.	OWNER / OPERATOR	STATION UNIT	ZONE	Proposed Date (M-YY)	REQUESTED CRIS (MW)	SUMMER (MW)
564	Rock District Solar, LLC	Rock District Solar	F	Dec-22	20.0	20.0
570	Hecate Energy, LLC	Albany County	F	Dec-22	20.0	20.0
598	Hecate Energy, LLC	Albany County II	F	Dec-22	20.0	20.0
638	Pattersonville Solar Facility, LLC	Pattersonville	F	Dec-22	20.0	20.0
730	Darby Solar, LLC	Darby Solar	F	Dec-22	20.0	20.0
572	Hecate Energy Greene 1 LLC	Greene County 1	G	Jan-23	20.0	20.0
573	Hecate Energy Greene 2 LLC	Greene County 2	G	Mar-23	10.0	10.0
590	Duke Energy Renewables Solar, LLC	Scipio Solar	C	May-23	N/A	20.0
592	Duke Energy Renewables Solar, LLC	Niagara Solar	B	May-23	N/A	20.0
545	Sky High Solar LLC	Sky High Solar	C	Jun-23	20.0	20.0
586	SunEast Watkins Road Solar LLC	Watkins Rd Solar	E	Jun-23	20.0	20.0
807	SunEast Hilltop Solar LLC	Hilltop Solar	F	Jul-23	20.0	20.0
581	SED NY Holdings LLC	Hills Solar	E	Aug-23	20.0	20.0
589	Duke Energy Renewables Solar, LLC	North Country Solar	E	Oct-23	N/A	15.0
848	SunEast Fairway Solar LLC	Fairway Solar	E	Oct-23	20.0	20.0
Facilities Study Complete						
575	Little Pond Solar, LLC	Little Pond Solar	G	Jul-23	20.0	20.0
487	LI Energy Storage System, LLC	Far Rockawary Battery Storage	K	Nov-24	20.0	20.0
759	KCE NY 6, LLC	KCE NY 6	A	Apr-22	20.0	20.0
833	Dolan Solar, LLC	Dolan Solar	F	Sep-23	20.0	20.0
828	SunEast Valley Solar LLC	Valley Solar	C	Jul-22	20.0	20.0
734	ELP Ticonderoga Solar, LLC	ELP Ticonderoga Solar	F	Aug-22	20.0	20.0
784	High Bridge Wind, LLC	High Bridge Wind	E	Sep-22	N/A	5.0
744	Granada Solar, LLC	Magruder Solar	G	Dec-22	20.0	20.0
855	Boralex US Development, LLC	NY13 Solar	F	Nov-23	19.9	19.9
Facilities Study In Progress						
804	KCE NY 10, LLC	KCE NY 10	A	Oct-22	20.0	20.0
832	Granada Solar, LLC	CS Hawthorn Solar	F	Dec-22	20.0	20.0
865	SED NY Holdings LLC	Flat Hill Solar	E	Feb-23	20.0	20.0
885	SED NY Holdings LLC	Grassy Knoll Solar	E	Feb-23	20.0	20.0
780	Hecate Energy Johnstown LLC	Johnstown Solar	F	Apr-23	N/A	20.0
863	Mitsubishi Hitachi Power Systems Americas, Inc.	Coverdale Solar	B	Oct-23	N/A	20.0
843	Sandy Creek Solar LLC	NY37 Solar	E	Nov-23	20.0	20.0
827	NRG Arthur Kill Storage LLC	Arthur Kill Energy Storage 1	J	Jun-24	15.0	15.0

Included in 2022 RNA Base Case

Included in 2020 RNA Base Case

The firm transmission plans included in the RNA Base Cases are listed in Figure 20 below.

Figure 20: Firm Transmission Plans and TIP Projects Included in 2022 RNA Base Case

Queue Number	Transmission Owner	Terminals		Line Length in Miles (1)	Expected In-Service Date/Yr Prior to		Nominal Voltage in kV		# of	Thermal Ratings		Project Description / Conductor Size
							Operating	Design	ckts	Summer	Winter	
					TIP Projects (19) (included in the 2022 RNA Base Case)							
430	National Grid	Dennison	Alcoa	3	In service	2021	115	115	1	1513	1851	954 ACSR. Alcoa-Dennison Line #12.
545A	NextEra Energy Transmission NY	Dysinger (New Station)	East Stolle (New Station)	20	S	2022	345	345	1	1356 MVA	1612 MVA	Western NY - Empire State Line Project
545A	NextEra Energy Transmission NY	Dysinger (New Station)	Dysinger (New Station)	PAR	S	2022	345	345	1	700 MVA	700 MVA	Western NY - Empire State Line Project
556	LSP/NGRID	Porter	Rotterdam	-71.8	S	2022	230	230	1	1066	1284	AC Transmission Project Segment A/1-795 ACSR/1-1431 ACSR/2-954 ACSS
556	LSP/NGRID	Porter	Rotterdam	-72.1	S	2022	230	230	1	1066	1284	AC Transmission Project Segment A/1-795 ACSR/1-1431 ACSR/2-954 ACSS
556	LSP/NGRID	Edic	New Scotland	-83.5	S	2022	345	345	1	2190	2718	AC Transmission Project Segment A/2-795 ACSR
556	NGRID	Rotterdam	New Scotland	-18.1	S	2022	115	230	1	1212	1284	AC Transmission Project Segment A/1-1033.5 ACSR/1-1192.5 ACSR
556	LSP/NGRID	Edic	Gordon Rd (New Station)	68.7	S	2022	345	345	1	3410	3709	AC Transmission Project Segment A/2-795 ACSR/2-954 ACSS
556	LSP/NGRID	Gordon Rd (New Station)	New Scotland	24.9	S	2022	345	345	1	2190	2718	AC Transmission Project Segment A/2-795 ACSR/2-954 ACSS
556	LSP	Gordon Rd (New Station)	Rotterdam	transformer	S	2022	345/230	345/230	2	478 MVA	478 MVA	AC Transmission Project Segment A
556	LSP/NGRID	Gordon Rd (New Station)	New Scotland	-24.9	S	2023	345	345	1	2190	2718	AC Transmission Project Segment A/2-795 ACSR/2-954 ACSS
556	LSP	Gordon Rd (New Station)	Princetown (New Station)	5.3	S	2023	345	345	1	3410	3709	AC Transmission Project Segment A/2-954 ACSS
556	LSP	Princetown (New Station)	New Scotland	20.1	S	2023	345	345	2	3410	3709	AC Transmission Project Segment A/2-954 ACSS
556	LSP/NGRID	Princetown (New Station)	New Scotland	19.8	S	2023	345	345	1	2190	2718	AC Transmission Project Segment A/2-795 ACSR
556	LSP/NYPA/NGRID	Edic	Princetown (New Station)	67	W	2023	345	345	2	3410	3709	AC Transmission Project Segment A/2-954 ACSS
556	NYPA	Edic	Marcy	1.4	W	2023	345	345	1	3150	3750	AC Transmission Project Segment A; Terminal Equipment Upgrades to existing line
556	NGRID	Rotterdam	Rotterdam	remove substation	S	2029	230	230	N/A	N/A	N/A	Rotterdam 230kV Substation Retirement
556	NGRID	Rotterdam	Eastover Rd	-23.8	S	2029	230	230	1	1114	1284	Rotterdam 230kV Substation Retirement, reconnect existing line
556	LSP	Gordon Rd (New Station)	Rotterdam	remove transformer	S	2029	345/230	345/230	2	478 MVA	478 MVA	Rotterdam 230kV Substation Retirement
556	NGRID	Gordon Rd (New Station)	Eastover Rd	23.8	S	2029	230	230	1	1114	1284	Rotterdam 230kV Substation Retirement; reconnect existing line
556	LSP	Gordon Rd (New Station)	Gordon Rd (New Station)	transformer	S	2029	345/230	345/230	1	478 MVA	478 MVA	Rotterdam 230kV Substation Retirement, reconnect transformer to existing line
556	LSP	Gordon Rd (New Station)	Rotterdam	transformer	S	2029	345/115	345/115	2	650 MVA	650 MVA	Rotterdam 230kV Substation Retirement
543	NGRID	Greenbush	Hudson	-26.4	W	2023	115	115	1	648	800	AC Transmission Project Segment B
543	NGRID	Hudson	Pleasant Valley	-39.2	W	2023	115	115	1	648	800	AC Transmission Project Segment B
543	NGRID	Schodack	Churchtown	-26.7	W	2023	115	115	1	937	1141	AC Transmission Project Segment B
543	NGRID	Churchtown	Pleasant Valley	-32.2	W	2023	115	115	1	806	978	AC Transmission Project Segment B
543	NGRID	Milan	Pleasant Valley	-16.8	W	2023	115	115	1	806	978	AC Transmission Project Segment B
543	NGRID	Lafarge	Pleasant Valley	-60.4	W	2023	115	115	1	584	708	AC Transmission Project Segment B
543	NGRID	North Catskill	Milan	-23.9	W	2023	115	115	1	937	1141	AC Transmission Project Segment B
543	O&R	Shoemaker, Middle	Sugarloaf, Chester	-12	W	2023	138	138	1	1098	1312	AC Transmission Project Segment B
543	NGRID	New Scotland	Alps	-30.6	W	2023	345	765	1	2015	2140	AC Transmission Project Segment B
543	New York Transco	Hudson	Churchtown	7.4	W	2023	115	115	1	648	798	AC Transmission Project Segment B
543	New York Transco	Churchtown	Pleasant Valley	32.2	W	2023	115	115	1	623	733	AC Transmission Project Segment B
543	NGRID	Lafarge	Churchtown	28.2	W	2023	115	115	1	582	708	AC Transmission Project Segment B
543	NGRID	North Catskill	Churchtown	8.4	W	2023	115	115	1	648	848	AC Transmission Project Segment B
543	New York Transco	Knickerbocker (New Station)	Pleasant Valley	55.1	W	2023	345	345	1	3836	4097	AC Transmission Project Segment B
543	New York Transco	Knickerbocker (New Station)	Knickerbocker (New Station)	series capacitor	W	2023	345	345	1	3836	4097	AC Transmission Project Segment B
543	NGRID	Knickerbocker (New Station)	New Scotland	12.4	W	2023	345	345	1	2381	3099	AC Transmission Project Segment B
543	NGRID	Knickerbocker (New Station)	Alps	18.1	W	2023	345	345	1	2552	3134	AC Transmission Project Segment B

Queue Number	Transmission Owner	Terminals		Line Length in Miles (1)	Expected In-Service Date/Yr Prior to		Nominal Voltage in kV		# of	Thermal Ratings		Project Description / Conductor Size
							Operating	Design	ckts	Summer	Winter	
TIP Projects (19) (included in the 2022 RNA Base Case)												
543	New York Transco	Rock Tavern	Sugarloaf	12	W	2023	115	115	1	1647	2018	AC Transmission Project Segment B; 1-1590 ACSR
543	New York Transco	Sugarloaf	Sugarloaf	Transformer	W	2023	138/115	138/115	---	1652	1652	AC Transmission Project Segment B
543	New York Transco	Van Wagner (New Station)	---	Cap Bank	W	2023	345	345	---	N/A	N/A	AC Transmission Project Segment B
543	NGRID	Athens	Pleasant Valley	-39.39	W	2023	345	345	1	2228	2718	Loop Line into new Van Wagner Substation/2-795 ACSR
543	NGRID	Leeds	Pleasant Valley	-39.34	W	2023	345	345	1	2228	2718	Loop Line into new Van Wagner Substation/2-795 ACSR
543	NGRID	Athens	Van Wagner (New Station)	38.65	W	2023	345	345	1	2228	2718	Loop Line into new Van Wagner Substation/2-795 ACSR
543	NGRID	Leeds	Van Wagner (New Station)	38.63	W	2023	345	345	1	2228	2718	Loop Line into new Van Wagner Substation/2-795 ACSR
543	New York Transco	Van Wagner (New Station)	Pleasant Valley	0.71	W	2023	345	345	1	3861	4087	Loop Line into new Van Wagner Substation/Reconductor w/2-795 ACSS
543	New York Transco	Van Wagner (New Station)	Pleasant Valley	0.71	W	2023	345	345	1	3861	4087	Loop Line into new Van Wagner Substation/Reconductor w/2-795 ACSS
543	New York Transco	Dover (New Station)	Dover (New Station)	Phase Shifter	W	2023	345	345	---	2510	2510	Loop Line 398 into new substation and install 2 x 750 MVAr PARs
543	ConEd	Cricket Valley	CT State Line	-3.46	W	2023	345	345	1	2220	2700	Loop Line into new Dover Substation/2-795 ACSS
543	ConEd	Cricket Valley	Dover (New Station)	0.3	W	2023	345	345	1	2220	2700	Loop Line into new Dover Substation/2-795 ACSS
543	ConEd	Dover (New Station)	CT State Line	3.13	W	2023	345	345	1	2220	2700	Loop Line into new Dover Substation/2-795 ACSS
1125	NYPA	Edic	Marcy	1.4	W	2025	345	345	1	4030	4880	SPCP Terminal Equipment Upgrades to existing line
1125	NYPA	Moses	Haverstock	2	W	2025	230	230	3	1089	1330	SPCP: Existing Moses - Adirondack (MA1), Moses - Adirondack (MA2), and Moses - Willis (MW2) 230 kV Lines to Haverstock Substation. 1 – 795 kcmil ACSR 26/7 "Drake"
1125	NYPA	Moses	Moses	SUB	W	2025	230	230	N/A	N/A	N/A	SPCP: Terminal Upgrades at Moses 230 kV Substation and Transformer T3 and MW-2 breaker positions interchanged
1125	NYPA	Haverstock 230 kV	Haverstock 345 kV	xfmr	W	2025	230/345	230/345	3	753	753	SPCP: Haverstock 230/345 kV xfmr-1, xfmr-2 and xfmr-3. Given Amp Ratings are for High Voltage side of xfmr.
1125	NYPA	Haverstock	Haverstock	SUB	W	2025	345	345	N/A	N/A	N/A	SPCP: Haverstock 345 kV Substation. New Shunt Capacitor Banks.
1125	NYPA	Haverstock	Adirondack	83.7	W	2025	345	345	2	2177	2663	SPCP: Existing Moses - Adirondack (MA1), Moses - Adirondack (MA2) 230kV lines to Haverstock Substation. Creating new Haverstock to Adirondack (HA1) and Haverstock to Adirondack (HA2) 345kV lines. 2 – 795 kcmil ACSR 26/7 "Drake"
1125	NYPA	Adirondack 115 kV	Adirondack 345 kV	xfmr	W	2025	115/345	115/345	1	192	221	SPCP: Adirondack 115/345 kV xfmr. Given Amp Ratings are for High Voltage side of xfmr.
1125	NYPA	Adirondack	Adirondack	SUB	W	2025	345	345	N/A	N/A	N/A	SPCP: Adirondack 345 kV Substation. New Shunt Capacitor Banks. New Shunt Reactor Banks.

Queue Number	Transmission Owner	Terminals		Line Length in Miles (1)	Expected In-Service Date/Yr Prior to		Nominal Voltage in kV Operating	Nominal Voltage in kV Design	# of ckts	Thermal Ratings Summer	Thermal Ratings Winter	Project Description / Conductor Size
TIP Projects (19) (included in the 2022 RNA Base Case)												
1125	NYPA	Haverstock	Willis	34.99	W	2025	345	345	2	3119	3660	SPCP: Existing Moses - Willis (MW1) and Moses - Willis (MW2) 230 kV Lines diverted to to Haverstock Substation. Creating Haverstock - Willis (HW1) and Haverstock - Willis (HW1) 345 kV Lines. 2 – 795 kcmil ACSS 26/7 "Drake"
1125	NYPA	Willis 345 kV	Willis 230 kV	xfmr	W	2025	345/230	345/230	2	2259	2259	SPCP: Willis 345/230 kV xfmr-1 and xfmr-2. Given Amp Ratings are for High Voltage side.
1125	NYPA	Willis	Willis	SUB	W	2025	230	230	N/A	N/A	N/A	SPCP: New Willis 345 kV Substation. New Shunt Capacitor Bank.
1125	NYPA	Willis	Patnode	8.65	W	2025	230	230	2	2078	2440	SPCP: Two Willis - Patnode 230 kV Lines. 1 – 1272 kcmil ACSS 45/7 "Bittern"
1125	NYPA	Willis	Ryan	6.59	W	2025	230	230	2	2078	2440	SPCP: Two Willis - Ryan 230 kV Lines. 1 – 1272 kcmil ACSS 45/7 "Bittern"
1125	NYPA	Ryan	Ryan	SUB	W	2025	230	230	N/A	N/A	N/A	SPCP: Terminal Upgrades at Ryan 230 kV Substation.
1125	NYPA	Patnode	Patnode	SUB	W	2025	230	230	N/A	N/A	N/A	SPCP: Terminal Upgrades at Patnode 230 kV Substation.
1125	NYPA	Willis (Existing)	Willis (New)	0.4	W	2025	230	230	2	2078	2440	SPCP: Two Willis (existing) - Willis (New) 230 kV Lines. 1 – 1272 kcmil ACSS 45/7 "Bittern"
1125	NYPA/NGRID	Adirondack	Austin Road	11.6	W	2025	345	345	1	3119	3660	SPCP: Adirondack - Austin Road Circuit-1 345 kV Line. 2 – 795 kcmil ACSS 26/7 "Drake"
1125	NYPA/NGRID	Adirondack	Marcy	52.6	W	2025	345	345	1	3119	3660	SPCP: Adirondack - Marcy Circuit-1 345 kV Line. 2 – 795 kcmil ACSS 26/7 "Drake"
1125	NGRID	Austin Road	Edic	42.5	W	2025	345	345	1	3119	3660	SPCP: Austin Road -Edic Circuit-1 345 kV Line. 2 – 795 kcmil ACSS 26/7 "Drake"
1125	NGRID	Rector Road	Austin Road	1	W	2025	230	230	1	1089	1330	SPCP: Rector Road - Austin Road Circuit-1 230 kV Line. 1 – 795 kcmil ACSR 26/7 "Drake"
1125	NGRID	Austin Road 230 kV	Austin Road 345 kV	Transformer	W	2025	230/345	230/345	1	753	753	SPCP: Austin Road 230/345 kV xfmr. Given Amp Ratings are for High Voltage side of xfmr.
1125	NGRID	Austin Road	Austin Road	Substation	W	2025	345	345	N/A	N/A	N/A	SPCP: Austin Road 345 kV Substation.
1125	NGRID	Edic	Edic	Substation	W	2025	345	345	N/A	N/A	N/A	SPCP: Terminal Upgrades at Edic 345 kV Substation. New Shunt Capacitor Bank.
1125	NGRID	Edic 345kV	Edic 230kV	Transformer	W	2025	345/230	345/230	1	N/A	N/A	SCSP: Remove Existing Transformer #2 345/230kV
1125	NYPA	Marcy	Marcy	SUB	W	2025	345	345	N/A	N/A	N/A	SPCP: Terminal Upgrades at Marcy 345 kV Substation.
1125	NGRID	Chases Lake	Chases Lake	Substation	W	2025	230	230	N/A	N/A	N/A	SPCP: Retire 230kV Substation.
1125	NYPA	Moses	Massena	Series Reactor	W	2025	230	230	2	3840	4560	SPCP: Install Series Reactors on Moses - Massena 230 kV Lines
1125	NYPA	Moses	Adirondack	-85.7	W	2025	230	230	2	N/A	N/A	SPCP: Retire Existing Moses - Adirondack MA1 and MA2 230 kV Lines
1125	NYPA	Moses	Willis	-36.99	W	2025	230	230	2	N/A	N/A	SPCP: Retire Existing Moses - Willis MW1 and MW2 230 kV Line
1125	NGRID	Adirondack	Porter	-54.41	W	2025	230	230	1	N/A	N/A	SPCP: Retire Existing Adirondack - Porter 230 kV Line
1125	NGRID	Adirondack	Chases Lake	-11.05	W	2025	230	230	1	N/A	N/A	SPCP: Retire Existing Adirondack - Chases Lake 230 kV Line
1125	NGRID	Chases Lake	Porter	-43.46	W	2025	230	230	1	N/A	N/A	SPCP: Retire Existing Chases Lake - Porter 230 kV Line
1125	NYPA	Willis	Patnode	-8.65	W	2025	230	230	1	N/A	N/A	SPCP: Retire Existing Willis - Patnode WPN1 230 kV Line.
1125	NYPA	Willis	Ryan	-6.59	W	2025	230	230	1	N/A	N/A	SPCP: Retire Existing Willis - Ryan WRY2 230 kV Line.
1125	NGRID	Edic	Porter	-0.39	W	2025	230	230	1	N/A	N/A	SPCP: Retire Existing Edic-Porter #17 230kV Line
1125	NGRID	Porter	Porter	Transformers	W	2025	230/115	230/115	2	N/A	N/A	SCSP: Remove Existing Transformers #1&2 230kV/115kV
1125	NGRID	Porter	Porter	Substation	W	2025	230	230	N/A	N/A	N/A	SPCP: Retire Porter 230kV substation

Queue Number	Transmission Owner	Terminals		Line Length in Miles (1)	Expected In-Service Date/Yr Prior to		Nominal Voltage in kV		# of ckts	Thermal Ratings		Project Description / Conductor Size
							Operating	Design		Summer	Winter	
Firm Plans (5) (included in the 2022 RNA Base Case)												
	CHGE	North Catskill	North Catskill	xfmr	In-Service	2021	115/69	115/69	1	560	726	Replace Transformer 5
	CHGE	Hurley Avenue	Leeds	nchronous series comp	W	2022	345	345	1	2336	2866	21% Compensation
	CHGE	Rock Tavern	Sugarloaf	12.1	W	2023	115	115	1	N/A	N/A	Retire SL Line
	CHGE	Kerhonkson	Kerhonkson	xfmr	W	2023	115/69	115/69	1	564	728	Add Transformer 3
	CHGE	Kerhonkson	Kerhonkson	xfmr	W	2023	115/69	115/69	1	564	728	Add Transformer 4
	CHGE	Sugarloaf	NY/NJ State Line	10.3	W	2024	115	115	2	N/A	N/A	Retire SD/SJ Lines
	CHGE	St. Pool	High Falls	5.69	W	2024	115	115	1	1010	1245	1-795 ACSR
	CHGE	High Falls	Kerhonkson	10.03	W	2024	115	115	1	1010	1245	1-795 ACSR
	CHGE	Modena	Galeville	4.62	W	2024	115	115	1	1010	1245	1-795 ACSR
	CHGE	Galeville	Kerhonkson	8.96	W	2024	115	115	1	1010	1245	1-795 ACSR
	CHGE	Hurley Ave	Saugerties	11.5	W	2025	69	115	1	1114	1359	1-795 ACSR
	CHGE	Saugerties	North Catskill	12.46	W	2024	69	115	1	1114	1359	1-795 ACSR
	CHGE	Knapps Corners	Spackenkill	2.36	W	2024	115	115	1	1280	1563	1-1033 ACSR
	ConEd	Hudson Ave East	Vinegar Hill Distribution Switching St	xfmrs/PARs/Feeders	S	2022	138/27	138/27		N/A	N/A	New Vinegar Hill Distribution Switching Station
	ConEd	Rainey	Rainey	xfmr	S	2023	345	345		N/A	N/A	Replacing xfmr 3W
	ConEd	Rainey	Corona	xfmr/PAR/Feeder	S	2023	345/138	345/138		N/A	N/A	New second PAR regulated feeder
	ConEd	Gowanus	Greenwood	xfmr/PAR/Feeder	S	2025	345/138	345/138		N/A	N/A	New PAR regulated feeder
	ConEd	Goethals	Fox Hills	xfmr/PAR/Feeder	S	2025	345/138	345/138		N/A	N/A	New PAR regulated feeder
	ConEd	Buchanan North	Buchanan North	Reconfiguration	S	2025	345	345		N/A	N/A	Reconfiguration (bus work related to decommissioning of Indian Point 2)
	ConEd	Mott Haven	Parkview	-	S	2026	345/138/13	345/138/13		N/A	N/A	Spare 345/138 kV xfmr at Mott Haven and a spare 138/13.8 kV xfmr at Parkview
	LIPA	Amagansett	Montauk	-13	In-Service	2021	23	23	1	577	657	750 kcmil CU
	LIPA	Amagansett	Navy Road	12.74	In-Service	2021	23	23	1	577	657	750 kcmil CU
	LIPA	Navy Road	Montauk	0.26	In-Service	2021	23	23	1	577	657	750 kcmil CU
	LIPA	Riverhead	Wildwood	10.63	In-Service	2021	138	138	1	1355	1436	1192ACSR
	LIPA	Riverhead	Canal	15.89	In-Service	2021	138	138	1	945	945	2368 KCMIL (1200 mm²) Copper XLPE
	LIPA	Barrett	Barrett	-	In-Service	2021	34.5	34.5	1	N/A	N/A	Barrett 34.5kV Bus Tie Reconfiguration
	LIPA	Round Swamp	Round Swamp	-	S	2022	69	69		N/A	N/A	New Round Swamp Road substation
	LIPA	Round Swamp	Plainview	1.93	S	2022	69	69	1	1217	1217	2500kcmil XLPE
	LIPA	Round Swamp	Ruland Rd	3.81	S	2022	69	69	1	1217	1217	2500kcmil XLPE
	NGRID	Oswego	Oswego	-	In-Service	2020	115	115		N/A	N/A	Rebuild of Oswego 115kV Station
	NGRID	Clay	Dewitt	10.24	In-Service	2021	115	115	1	220MVA	268MVA	Reconductor 4/0 CU to 795ACSR
	NGRID	Clay	Teall	12.75	In-Service	2021	115	115	1	220 MVA	268MVA	Reconductor 4/0 CU to 795ACSR

Queue Number	Transmission Owner	Terminals		Line Length in Miles (1)	Expected In-Service Date/Yr Prior to		Nominal Voltage in kV Operating	Nominal Voltage in kV Design	# of ckts	Thermal Ratings Summer	Thermal Ratings Winter	Project Description / Conductor Size
Firm Plans (5) (included in the 2022 RNA Base Case)												
	NGRID	Gardenville 230kV	Gardenville 115kV	xfmr	In-Service	2021	230/115	230/115	-	347 MVA	422 MVA	Replacement of 230/115kV TB#3 stepdown with larger unit
	NGRID	Huntley 115kV	Huntley 115kV	-	In-Service	2021	115	115	-	N/A	N/A	Rebuild of Huntley 115kV Station
	NGRID	Mortimer	Mortimer	xfmr	In-Service	2021	115	115		50MVA	50MVA	Replace Mortimer 115/69kV Transformer
	NGRID	Royal Ave	Royal Ave	-	In-Service	2021	115/13.2	115/13.2	-	-	-	Install new 115-13.2 kV distribution substation in Niagara Falls (Royal Ave)
	NGRID	Niagara	Packard	3.4	In-Service	2021	115	115	1	344MVA	449MVA	Replace 3.4 miles of 192 line
	NGRID	Volney	Clay	-	S	2022	115	115	1	1200 MVA	1474 MVA	Replace Terminal Equipment Line #6
	NGRID	Mountain	Lockport	0.08	S	2022	115	115	2	174MVA	199MVA	Mountain-Lockport 103/104 Bypass
	NGRID	South Oswego	Indeck (#6)	-	S	2022	115	115	1	-	-	Install High Speed Clearing on Line #6
	NGRID	Porter	Porter	-	S	2022	230	230		N/A	N/A	Porter 230kV upgrades
	NGRID	Watertown	Watertown		S	2022	115	115		N/A	N/A	New Distribution Station at Watertown
	NGRID	Golah	Golah	xfmr	S	2022	69	69		50MVA	50MVA	Replace Golah 69/34.5kV Transformer
	NGRID	Niagara	Packard	3.7	S	2022	115	115	1	344MVA	449MVA	Replace 3.7 miles of 191 line
	NGRID	Wolf Rd	Menands	1.34	S	2022	115	115	1	182 MVA	222 MVA	Reconductor 1.34 miles betw Wolf Rd-Everett tap (per EHI)
	NGRID	Volney	Clay	-	S	2022	115	115	1	1200 MVA	1474 MVA	Replace Terminal Equipment Line #6
	NGRID	Dunkirk	Dunkirk	-	S	2022	115	115	-	-	-	Rebuild Dunkirk Station/ Asset Separation.
	NGRID	Lockport	Mortimer	56.5	W	2022	115	115	3	-	-	Replace Cables Lockport-Mortimer #111, 113, 114
	NGRID	Niagara	Packard	3.7	W	2022	115	115	2	344MVA	449MVA	Replace 3.7 miles of 193 and 194 lines
	NGRID	Gardenville	Big Tree	6.3	W	2022	115	115	1	221MVA	221MVA	Gardenville-Arcade #151 Loop-in-and-out of NYSEG Big Tree
	NGRID	Big Tree	Arcade	28.6	W	2022	115	115	1	129MVA	156MVA	Gardenville-Arcade #151 Loop-in-and-out of NYSEG Big Tree
	NGRID	Seneca	Seneca	xfmr	W	2022	115/22	115/22		40MVA	40MVA	Seneca #5 xfmr asset replacement
	NGRID	Batavia	Batavia		W	2022	115	115				Batavia replace five OCB's
	NGRID	Kensington Terminal	Kensington Terminal	-	W	2022	115/23	115/23	-	50MVA	50MVA	Replace TR4 and TR5
	NGRID	Taylorville	Boonville	-	W	2022	115	115	1	584	708	Replace Station connections
	NGRID	Taylorville	Boonville	-	W	2022	115	115	1	584	708	Replace Station connections
	NGRID	Taylorville	Browns Falls	-	W	2022	115	115	1	569	708	Replace Station connections
	NGRID	Taylorville	Browns Falls	-	W	2022	115	115	1	584	702	Replace Station connections
	NGRID	Batavia	Batavia		W	2022	115	115				Batavia replace five OCB's.
	NGRID	Albany Steam	Albany Steam	-	W	2022	115	115				Replace NG's 115kV Breakers.
	NGRID	Mountain	Lockport		S	2023	115	115	2	847	1000	Reinsulating Mountain-Lockport 103/104
	NGRID	Maplewood	Menands	3	S	2023	115	115	1	220 MVA	239 MVA	Reconductor approx 3 miles of 115kV Maplewood – Menands #19
	NGRID	Maplewood	Reynolds	3	S	2023	115	115	1	217 MVA	265 MVA	Reconductor approx 3 miles of 115kV Maplewood – Reynolds Road #31

Queue Number	Transmission Owner	Terminals		Line Length in Miles (1)	Expected In-Service Date/Yr Prior to		Nominal Voltage in kV		# of ckts	Thermal Ratings		Project Description / Conductor Size
							Operating	Design	ckts	Summer	Winter	
				Firm Plans (5) (included in the 2022 RNA Base Case)								
	NGRID	Elm St	Elm St	-	S	2023	230/23	230/23	-	118MVA	133MVA	Replace TR2 as failure
	NGRID	Ridge	Ridge		S	2023				N/A	N/A	Ridge substation 34.5kV rebuild
	NGRID	Colton	Browns Falls	-	S	2023	115	115	1	629	764	Flat Rock station (mid-line) upgrades
	NGRID	Mountain	Lockport		S	2023	115	115	2	847	1000	Reinsulating Mountain-Lockport 103/104. .
	NGRID	Clay	Woodard		W	2023	115	115	1			Add 10.5mH reactor on line #17.
	NGRID/NYSEG	Mortimer	Station 56		W	2023	115	115	1	649	788	Mortimer-Pannell #24 Loop in-and-out of NYSEG's Station 56
	NGRID	Clay	Woodard		W	2023	115	115	1			Add 10.5mH reactor on line #17.
	NGRID	Cortland	Clarks Corners	0.2	S	2024	115	115	1	147MVA	170MVA	Replace 0.2 miles of 1(716) line and series equipment
	NGRID	Homer Hill	Homer Hill	-	S	2024	115	115	-	116MVA	141MVA	Homer Hill Replace five OCB
	NGRID	Packard	Huntley	9.1	W	2024	115	115	1	262MVA	275MVA	Walck-Huntley #133, Packard-Huntley #130 Reconductor
	NGRID	Walck	Huntley	9.1	W	2024	115	115	1	262MVA	275MVA	Walck-Huntley #133, Packard-Huntley #130 Reconductor
	NGRID	Station 56	Pannell		W	2024	115	115	1	649	788	Mortimer-Pannell #24 Loop in-and-out of NYSEG's Station 56
	NGRID	Clay	Wetzel	3.7	W	2024	115	115	1	220 MVA	220 MVA	Add a breaker at Clay and build approximately 2000 feet of 115kV to create radial line
	NGRID	Golah	Golah		S	2025				N/A	N/A	Golah substation rebuild
	NGRID	Malone	Malone	-	S	2025	115	115	-	753	753	Install PAR on Malone - Willis line 1-910
	NGRID	Oswego	Oswego	-	S	2026	345	345		N/A	N/A	Rebuild of Oswego 345kV Station (asset separation).
	NGRID	Gardenville	Dunkirk	20.5	S	2026	115	115	2	1105	1346	Replace 20.5 miles of 141 and 142 lines
	NGRID	Niagara	Gardenville	26.3	S	2026	115	115	1	275MVA	350MVA	Packard-Erie / Niagara-Garenville Reconfiguration
	NGRID	Packard	Gardenville	28.2	S	2026	115	115	2	168MVA	211 MVA	Packard-Gardenville Reactors, Packard-Erie / Niagara-Garenville Reconfiguration
	NGRID/NYSEG	Erie St	Gardenville	5.5	S	2026	115	115	1	139MVA	179MVA	Packard-Erie / Niagara-Garenville Reconfiguration, Gardenville add breakers
	NGRID	Lockport	Batavia	20	S	2026	115	115	1	646	784	Rebuild 20 miles of Lockport-Batavia 112
	NGRID	Packard	Packard		S	2026	115	115				Packard replace three OCB's
	NGRID	Oswego	Oswego	-	S	2026	345	345		N/A	N/A	Rebuild of Oswego 345kV Station (asset separation).
	NGRID	Rotterdam	Rotterdam	-	S	2026	115/69	115/69	-	67	76	Rebuild Rotterdam 69kV substation and add a 2nd 115/69kV Transformer
	NGRID	Rotterdam	Schoharie	0.93	S	2026	69	115	1	77	93	Rebuild 0.93mi double circuit Rotterdam-Schoharie / Schenectady International-Rotterdam
	NGRID	Schenectady International	Rotterdam	0.93	S	2026	69	115	1	69	84	Rebuild 0.93mi double circuit Rotterdam-Schoharie / Schenectady International-Rotterdam
	NGRID	Tar Hill	Tar Hill		S	2026	115	115				New station to replace Lighthouse Hill.
	NGRID	Inghams	Inghams	-	S	2026	115	115				Rebuild Inghams station, including rebuilding the PAR
	NGRID	Huntley	Lockport	1.2	W	2026	115	115	2	747	934	Rebuild 1.2 miles of (2) single circuit taps on Huntley-Lockport 36/37 at Ayer Rd

Queue Number	Transmission Owner	Terminals		Line Length in Miles (1)	Expected In-Service Date/Yr Prior to		Nominal Voltage in kV		# of ckts	Thermal Ratings		Project Description / Conductor Size
							Operating	Design	ckts	Summer	Winter	
Firm Plans (5) (included in the 2022 RNA Base Case)												
	NGRID	Oneida	Oneida	-	W	2026	115	115				115kV Oneida Station Rebuild & add Cap bank.
	NGRID	Brockport	Brockport	3.5	S	2027	115	115	2	648	650	Refurbish 111/113 3.5 mile single circuit taps to Brockport Station.
	NGRID	Brockport	Brockport	3.5	S	2027	115	115	2	648	650	Refurbish 111/113 3.5 mile single circuit taps to Brockport Station.
	NGRID	Pannell	Geneva		W	2027	115	115	2	755	940	Critical Road crossings replace on Pannell-Geneva 4/4A
	NGRID	Mortimer	Golah	9.7	W	2027	115	115	1	657	797	Refurbish 9.7 miles Single Circuit Wood H-Frames on Mortimer-Golah 110
	NGRID	Lockport	Lockport		W	2027				N/A	N/A	Rebuild of Lockport Substation and control house
	NGRID	Pannell	Geneva		W	2027	115	115	2	755	940	Critical Road crossings replace on Pannell-Geneva 4/4A.
	NGRID	Mortimer	Golah	9.7	W	2027	115	115	1	657	797	Refurbish 9.7 miles Single Circuit Wood H-Frames on Mortimer-Golah 110.
	NGRID	Mortimer	Mortimer	-	W	2027	115	115		N/A	N/A	Second 115kV Bus Tie Breaker at Mortimer Station
	NGRID	Mortimer	Pannell	15.7	S	2028	115	115	2	221MVA	270MVA	Reconductor existing Mortimer – Pannell 24 and 25 lines with 795 ACSR
	NGRID	SE Batavia	Golah	27.8	W	2028	115	115	1	648	846	Refurbish 27.8 miles Single Circuit Wood H-Frames on SE Batavia-Golah 119
	NGRID	SE Batavia	Golah	27.8	W	2028	115	115	1	648	846	Refurbish 27.8 miles Single Circuit Wood H-Frames on SE Batavia-Golah 119.
	NGRID	Gardenville	Homer Hill	37.5	S	2031	115	115	2	649	788	Refurbish 37.5 miles double circuit Gardenville-Homer Hill 151/152I
	NGRID	Gardenville	Homer Hill	37.5	S	2031	115	115	2	649	788	Refurbish 37.5 miles double circuit Gardenville-Homer Hill 151/152I
	NGRID	Huntley	Gardenville	23.4	W	2031	115	115	2	731	887	Refurbish 23.4 miles double circuit on Huntley-Gardenville 38/39.
	NGRID	Huntley	Gardenville	23.4	W	2031	115	115	2	731	887	Refurbish 23.4 miles double circuit on Huntley-Gardenville 38/39.
	NYPA	East Garden City	East Garden City	Shunt Reactor	In-Service	2021	345	345	1	N/A	N/A	Swap with the spare unit
580	NYPA/NGRID	STAMP	STAMP	Substation	W	2023	345/115	345/115		500 MVA	500 MVA	Load Interconnection.
566	NYPA	Moses	Adirondack	78	S	2023	230	345	2	1088	1329	Replace 78 miles of both Moses-Adirondack 1&2
	NYPA	Moses	Moses	uit Breakers Replaceme	W	2025	115/230	115/230		N/A	N/A	St. Lawrence Breaker Replacement 115 and 230 kV
	NYSEG	Willet	Willet	xfmr	In-Service	2021	115/34.5	115/34.5	1	39 MVA	44 MVA	Transformer #2
	NYSEG	Big Tree Road	Big Tree Road	Rebuild	W	2022	115	115				Station Rebuild
	NYSEG	Wood Street	Wood Street	xfmr	W	2022	345/115	345/115	1	327 MVA	378 MVA	Transformer #3
	NYSEG	Coddington	E. Ithaca (to Coddington)	8.07	S	2024	115	115	1	307 MVA	307 MVA	665 ACCR
	NYSEG	Fraser	Fraser	xfmr	S	2024	345/115	345/115	1	305 MVA	364 MVA	Transformer #2 and Station Reconfiguration
	NYSEG	Fraser 115	Fraser 115	Rebuild	S	2024	115	115		N/A	N/A	Station Rebuild to 4 bay BAAH
	NYSEG	Delhi	Delhi	Removal	S	2024	115	115		N/A	N/A	Remove 115 substation and terminate existing lines to Fraser 115 (short distance)

Queue Number	Transmission Owner	Terminals		Line Length in Miles (1)	Expected In-Service Date/Yr Prior to		Nominal Voltage in kV Operating	Nominal Voltage in kV Design	# of ckts	Thermal Ratings Summer	Thermal Ratings Winter	Project Description / Conductor Size
Firm Plans (5) (included in the 2022 RNA Base Case)												
	NYSEG	Erie Street Rebuild	Erie Street Rebuild	Rebuild	S	2026	115	115				Station Rebuild
	NYSEG	Gardenville	Gardenville	xfmr	S	2026	230/115	230/115	1	316 MVA	370 MVA	NYSEG Transformer #3 and Station Reconfiguration
	NYSEG	Meyer	Meyer	xfmr	W	2026	115/34.5	115/34.5	2	59.2MVA	66.9MVA	Transformer #2
	O & R/ConEd	Ladentown	Buchanan	-9.5	S	2023	345	345	1	3000	3211	2-2493 ACAR
	O & R/ConEd	Ladentown	Lovett 345 kV Station (New Station)	5.5	S	2023	345	345	1	3000	3211	2-2493 ACAR
	O & R/ConEd	Lovett 345 kV Station (New Station)	Buchanan	4	S	2024	345	345	1	3000	3211	2-2493 ACAR
	O & R	Lovett 345 kV Station (New Station)	Lovett	xfmr	S	2024	345/138	345/138	1	562 MVA	562 MVA	Transformer
	RGE	Station 262	Station 23	1.46	In-Service	2021	115	115	1	2008	2008	Underground Cable
	RGE	Station 33	Station 262	2.97	In-Service	2021	115	115	1	2008	2008	Underground Cable
	RGE	Station 262	Station 262	xfmr	In-Service	2018	115/34.5	115/34.5	1	58.8MVA	58.8MVA	Transformer
	RGE	Station 168	Mortimer (NG Trunk #2)	26.4	W	2023	115	115	1	145 MVA	176 MVA	Station 168 Reinforcement Project
	RGE	Station 168	Elbridge (NG Trunk # 6)	45.5	W	2023	115	115	1	145 MVA	176 MVA	Station 168 Reinforcement Project
	RGE	Station 127	Station 127	xfmr	W	2024	115/34.5	115/34.5	1	75MVA	75MVA	Transformer #2
	RGE	Station 418	Station 48	7.6	S	2026	115	115	1	175 MVA	225 MVA	New 115kV Line
	RGE	Station 33	Station 251 (Upgrade Line #942)		S	2026	115	115	1	400MVA	400MVA	Line Upgrade
	RGE	Station 33	Station 251 (Upgrade Line #943)		S	2026	115	115	1	400MVA	400MVA	Line Upgrade
	RGE	Station 82	Station 251 (Upgrade Line #902)		S	2028	115	115	1	400MVA	400MVA	Line Upgrade
	RGE	Mortimer	Station 251 (Upgrade Line #901)	1	S	2028	115	115	1	400MVA	400MVA	Line Upgrade

2022 RNA Assumptions Matrix

Below are the resource adequacy and the transmission adequacy assumptions matrices, which contain additional modeling details.

Assumptions Matrix for Resource Adequacy Assessment

#	Parameter	2020 RNA *(2020 GB)* Study Period: 2024 (y4) -2030 (y10)	2021-2030 CRP and 2021 Q2 STAR (*2020 GB updated as applicable)* Study Period: 2024-2030 and 2021(y1) -2025 (y5), respectively	2022 RNA (2022 Gold Book) Study Period: y4 (2026)-y10 (2032)	2022 RNA Outlook Scenario *Based on the 2021 Outlook Policy Case – Scenario 2 (S2) for Study Year 2030*
Key Assumptions and Reports					
1	**Links to Key Assumptions Presentations and Final Reports**	2020 RNA Report and Appendices, final as of November 2020:	2021-2030 CRP Report, final as of December 2, 2021. 2021-2030 CRP Appendices	March 1 **TPAS/ESPWG**: preliminary schedule March 24 **LFTF/ESPWG/TPAS:** Load Forecast, New Load Shapes, Scenarios April 1 TPAS/ESPWG: resource adequacy assumptions matrix, including preliminary topology, Inclusion Rules application April 21 LFTF: load forecast uncertainty presentation (LFU) April 26 **ESPWG/TPAS:** updated inclusion rules, updated scenarios, updated schedule May 5 TPAS/ESPWG and May 23 ESPWG/TPAS: RPP Manual and modeling improvements June 23 OC: RPP Manual redline for OC approval **July 1 TPAS/ESPWG:** 2022 RNA 1st pass results presentation [link], assumptions matrix [link] [link] August 1 TPAS/ESPWG: 2022 RNA Scenarios Results, Base Case updated results, as available August 23 ESPWG/TPAS: Draft 1 Report, Policy Case Scenario S2 for 2030 resource adequacy results, transmission security updated conclusion September 1 TPAS/ESPWG: Draft 2 RNA Report and Draft 1 Appendices September 19 ESPWG/TPAS: Draft 3 RNA Report excerpts and Draft 2 Appendices October 3 TPAS/ESPWG: Draft 4 RNA Report and Draft 3 Appendices, findings presentation October 13 OC: Draft RNA for vote	July 14, 2022 ESPWG/TPAS: The 2021 Outlook Draft Report and Appendices July 26, 2022 ESPWG/TPAS: updated 2021 Outlook Appendix August 17, 2022 BIC: updated 2021 Outlook Report and Appendices August 23 ESPWG/TPAS: Policy Case Scenario 2 for 2030 resource adequacy results presentation

<table>
<tr><th>#</th><th>Parameter</th><th>2020 RNA

(2020 GB)

Study Period: 2024 (y4) -2030 (y10)</th><th>2021-2030 CRP
and
2021 Q2 STAR
(2020 GB updated as applicable)

Study Period: 2024-2030
and 2021(y1) -2025 (y5), respectively</th><th>2022 RNA

(2022 Gold Book)

Study Period: y4 (2026)-y10 (2032)</th><th>2022 RNA
Outlook Scenario

Based on the 2021 Outlook Policy Case – Scenario 2 (S2) for Study Year 2030</th></tr>
<tr><td colspan="4">Load Parameters</td><td></td><td></td></tr>
<tr><td>1</td><td>Peak Load Forecast</td><td>Adjusted 2020 Gold Book NYCA baseline peak load forecast.

The GB 2020 baseline peak load forecast includes the impact (reduction) of behind-the-meter (BtM) solar at the time of NYCA peak. 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.</td><td>Adjusted NYCA baseline peak load forecast based on the November 19, 2020 Load Forecast Update.
Reference: Nov 19, 2020 ESPWG/LFTF/TPAS presentation: [link]

Same method.</td><td>Adjusted 2022 Gold Book NYCA baseline peak load forecast. It includes five large loads from the NYISO interconnection queue, with forecasted impacts.

The GB 2022 baseline peak load forecast includes the impact (reduction) of behind-the-meter (BtM) solar at the time of NYCA peak. For the BtM Solar adjustment, gross load forecasts that include the impact of the BtM generation will be used for the 2022 RNA, as provided by the Demand Forecasting Team which then allows for a discrete modeling of the BtM solar resources using 5 years of inverter data.</td><td>The forecast is based on the Climate Action Council Draft Scoping Plan Strategic Use of Low Carbon Fuels Scenario.

<table><tr><th>Annual Energy</th><th>Summer Peak</th><th>Winter Peak</th></tr><tr><td>GWh</td><td colspan="2">MW</td></tr><tr><td>164,256</td><td>30,070</td><td>25,892</td></tr></table></td></tr>
<tr><td>2</td><td>Load Shapes

(Multiple Load Shapes)</td><td>Used Multiple Load Shape MARS Feature

8,760-hour historical load shapes were used as base shapes for LFU bins:
Load Bin 1: 2006
Load Bin 2: 2002
Load Bins 3-7: 2007

Peak adjustments on a seasonal basis to meet peak forecasts, while maintaining the energy target

For the BtM Solar adjustment, the BtM shape is added back to account for the impact of the BtM generation on both on-peak and off-peak hours. Calculated an average 8,760h MW shape based on the 5 years of historical production data to determine gross load forecast values.</td><td>Same</td><td>New Load Shapes (see March 24 LFTF/ESPWG):
Used Multiple Load Shape MARS Feature

8,760-hour historical gross load shapes were used as base shapes for LFU bins:
Load Bins 1 and 2: 2013
Load Bins 3 and 4: 2018
Load Bins 5 to 7: 2017

Peak adjustments on a seasonal basis to meet peak forecasts, while maintaining the energy target.

For the BtM Solar adjustment, gross load forecasts that include the impact of the BtM generation will be used for the 2022 RNA, as provided by the Demand Forecasting Team</td><td>Single year load shape that includes BtM taken directly from the Outlook Scenario 2 Case original load (losses not included)</td></tr>
</table>

#	Parameter	2020 RNA *(2020 GB)* Study Period: 2024 (y4) -2030 (y10)	2021-2030 CRP and 2021 Q2 STAR *(2020 GB updated as applicable)* Study Period: 2024-2030 and 2021(y1) -2025 (y5), respectively	2022 RNA (2022 Gold Book) Study Period: y4 (2026)-y10 (2032)	2022 RNA Outlook Scenario *Based on the 2021 Outlook Policy Case – Scenario 2 (S2) for Study Year 2030*
3	Load Forecast Uncertainty (LFU) The LFU model captures the impacts of weather conditions on future loads.	2020 LFU Updated via Load Forecast Task Force (LFTF) process. Reference: April 13, 2020, LFTF presentation: [link]	Same	Same method Updated LFU values, *(as presented at the April 21, 2022 LFTF)*	Same as 2022 RNA Base Case
Generation Parameters					
1	**Existing** Generating Unit Capacities (*e.g., thermal units, large hydro)*	2020 Gold Book values. Use summer min (DMNC vs. CRIS). Use winter min (DMNC vs. CRIS). Adjusted for RNA inclusion rules. Note: Units with CRIS rights and 0 DMNC are modeled at 0 MW	Same	Same method	Same as the 2022 RNA Base Case
2	**Proposed New Units Inclusion** Determination	GB2020 with Inclusion Rules Applied	Same method	Same method *See April 26, 2022 TPAS/ESPWG*	Off-shore wind, land-based wind, utility scale PV and energy storage added to align with the Outlook Scenario 2 Case Renewable Resources mix
3	Retirement, Mothballed Units, IIFO	GB2020 with Inclusion Rules Applied	Same method	Same method *See April 26, 2022 TPAS/ESPWG*	Units that are retired in 2022 RNA Base Case. Additionally, all units retired or derated to align with the Outlook Scenario 2 Case assumptions
4	Forced and Partial Outage Rates (*e.g., thermal units, large hydro)*	Five-year (2015-2019) GADS data for each unit represented. Those units with less than five years – use representative data. Transition Rates representing the Equivalent Forced Outage Rates (EFORd) during demand periods over the most recent five-year period. For new units or units that are in service for less than three years, NERC 5-year class average EFORd data are used.	Same	Same method	Same as the 2022 RNA Base Case
5	Planned Outages	Based on schedules received by the NYISO and adjusted for history	Same	Same method with updated data	Same as the 2022 RNA Base Case

#	Parameter	2020 RNA *(2020 GB)* Study Period: 2024 (y4) -2030 (y10)	2021-2030 CRP and 2021 Q2 STAR (*2020 GB updated as applicable)* Study Period: 2024-2030 and 2021(y1) -2025 (y5), respectively	2022 RNA (2022 Gold Book) Study Period: y4 (2026)-y10 (2032)	2022 RNA Outlook Scenario *Based on the 2021 Outlook Policy Case – Scenario 2 (S2) for Study Year 2030*
6	Fixed and Unplanned Maintenance	Scheduled maintenance from operations. Unplanned maintenance based on GADS data average maintenance time – average time in weeks is modeled.	Same	Same method	Same as the 2022 RNA Base Case
7	Summer Maintenance	None	None	None	Same as the 2022 RNA Base Case
8	Combustion Turbine Derates	Derate based on temperature correction curves For new units: used data for a unit of same type in same zone, or neighboring zone data.	Same	Same method	Same as the 2022 RNA Base Case
8	Existing Landfill Gas (LFG) Plants	Actual hourly plant output over the period 2015-2019. Program randomly selects an LFG shape of hourly production over the 2015-2019 for each model replication. Probabilistic model is incorporated based on five years of input shapes, with one shape per replication randomly selected in the Monte Carlo process.	Same	Same method	Same as the 2022 RNA Base Case
9	Existing **Wind** Units (>5 years of data)	Actual hourly plant output over the period 2015-2019. Probabilistic model is incorporated based on five years of input shapes with one shape per replication being randomly selected in Monte Carlo process.	Same	Same method	8,760 hourly shapes based on output profile from the Outlook Scenario 2 Case. Notes: 1. The Outlook Scenario 2 Case output profile captures curtailments observed in the Outlook MAPS simulations 2. The Outlook Scenario 2 Case wind shape input based on 2009 weather year NREL data.

#	Parameter	2020 RNA *(2020 GB)* Study Period: 2024 (y4) -2030 (y10)	2021-2030 CRP and 2021 Q2 STAR (*2020 GB updated as applicable)* Study Period: 2024-2030 and 2021(y1) -2025 (y5), respectively	2022 RNA (2022 Gold Book) Study Period: y4 (2026)-y10 (2032)	2022 RNA Outlook Scenario *Based on the 2021 Outlook Policy Case – Scenario 2 (S2) for Study Year 2030*
10	Existing **Wind** Units (<5 years of data)	For existing data, the actual hourly plant output over the period 2016-2020 is used. For missing data, the nameplate normalized average of units in the same load zone is scaled by the unit's nameplate rating.	Same	Same method	8,760 hourly shapes based on output profile from the Outlook Scenario 2 Case. Notes: 1. The Outlook Scenario 2 Case output profile captures curtailments observed in the Outlook MAPS simulations 2. The Outlook Scenario 2 Case wind shape input based on 2009 weather year NREL data.
11a	Proposed **Land based Wind** Units	Inclusion Rules Applied to determine the generator status. The nameplate normalized average of units in the same load zone is scaled by the unit's nameplate rating.	Same	Same method	8,760 hourly shapes based on output profile from the Outlook Scenario 2 Case. Notes: 1. The Outlook Scenario 2 Case output profile captures curtailments observed in the Outlook MAPS simulations 2. The Outlook Scenario 2 Case wind shape input based on 2009 weather year NREL data.
11b	Proposed **Offshore Wind** Units	None passed inclusion rules	Same	Inclusion Rules Applied to determine the generator status. Power curves based on 2008-2012 NREL from 3 different sites: NY Harbor, LI Shore, LI East, and GE updates of the NREL curves reflecting derates.	8,760 hourly shapes based on output profile from the Outlook Scenario 2 Case. Notes: 1. The Outlook Scenario 2 Case output profile captures curtailments observed in the Outlook MAPS simulations 2. The Outlook Scenario 2 Case wind shape input based on 2009 weather year NREL data.

#	Parameter	2020 RNA *(2020 GB)* Study Period: 2024 (y4) -2030 (y10)	2021-2030 CRP and 2021 Q2 STAR (*2020 GB updated as applicable)* Study Period: 2024-2030 and 2021(y1) -2025 (y5), respectively	2022 RNA (2022 Gold Book) Study Period: y4 (2026)-y10 (2032)	2022 RNA Outlook Scenario *Based on the 2021 Outlook Policy Case – Scenario 2 (S2) for Study Year 2030*
12a	Existing **Utility-scale Solar Resources**	Inclusion Rules Applied to determine the generator status. Probabilistic model chooses from 5 years of production data output shapes covering the period 2015-2019 (one shape per replication is randomly selected in Monte Carlo process.)	Same	Same method	8,760 hourly shapes based on output profile from the Outlook Scenario 2 Case. Notes: 1. The Outlook Scenario 2 Case output profile captures curtailments observed in the Outlook MAPS simulations 2. The Outlook Scenario 2 Case solar shape input based on 2006 weather year NREL data.
12b	Proposed **Utility-scale Solar Resources**	Inclusion Rules Applied to determine the generator status. The nameplate normalized average of units in the same load zone is scaled by the unit's nameplate rating.	Same	Same method	8,760 hourly shapes based on output profile from the Outlook Scenario 2 Case. Notes: 1. The Outlook Scenario 2 Case output profile captures curtailments observed in the Outlook MAPS simulations 2. The Outlook Scenario 2 Case solar shape input based on 2006 weather year NREL data.
13	Projected **BtM Solar Resources**	Will use 5-year of inverter production data and apply the Gold Book energy forecast. Probabilistic model is incorporated based on five years of input shapes with one shape per replication being randomly selected in Monte Carlo process. **Reference**: April 6, 2020 TPAS/ESPWG meeting materials	Same method	**Supply side:** Five years of 8,760 hourly MW profiles based on sampled inverter data The MARS random shape mechanism is used: one 8,760 hourly shape (of five) is randomly picked for each replication year. Similar with the past planning modeling and aligns with the method used for wind, utility solar, landfill gas, and run-of-river facilities. **Load side:** Gross load forecasts will be used for the 2022 RNA, as provided by the forecasting group.	8,760 hourly shapes based on output profile from the Outlook Scenario 2 Case. Notes: The underlying BTM PV shapes used in the S2 forecast were from the Climate Impact Study Phase I [link]. They were modified to align with the projected BTM PV capacity from the Integration Analysis. [link]

#	Parameter	2020 RNA *(2020 GB)* Study Period: 2024 (y4) -2030 (y10)	2021-2030 CRP and 2021 Q2 STAR *(2020 GB updated as applicable)* Study Period: 2024-2030 and 2021(y1) -2025 (y5), respectively	2022 RNA (2022 Gold Book) Study Period: y4 (2026)-y10 (2032)	2022 RNA Outlook Scenario *Based on the 2021 Outlook Policy Case – Scenario 2 (S2) for Study Year 2030*
14	Existing **BTM-NG Program**	These are former load modifiers to sell capacity into the ICAP market. Modeled as cogen type 1 (or type 2 as applicable) unit in MARS. Unit capacity set to CRIS value, load modeled with weekly pattern that can change monthly.	Same	Same method	Same as the 2022 RNA Base Case
15	Existing **Small Hydro** Resources (e.g., run-of-river)	Actual hourly plant output over the past 5 years period (i.e., 2015-2019). Program randomly selects a hydro shape of hourly production over the 5-year window for each model replication. The randomly selected shape is multiplied by their current nameplate rating.	Same	Same method	Same as the 2022 RNA Base Case
16	Existing **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 (2015-2019). Methodology consistent with thermal unit transition rates.	Same	Same method	Same as the 2022 RNA Base Case
17	Proposed front-of-meter **Battery Storage**	None passed inclusion rules Behind-the-meter impacts at peak demand are captured in the baseline load forecast.	Same	GE MARS ES model is used. Units are given a maximum capacity, maximum stored energy, and a dispatch window.	Nameplate and location of Energy Storage units from the Outlook Scenario 2 Case used along with the GE MARS ES Model

#	Parameter	2020 RNA *(2020 GB)* Study Period: 2024 (y4) -2030 (y10)	2021-2030 CRP and 2021 Q2 STAR *(2020 GB updated as applicable)* Study Period: 2024-2030 and 2021(y1) -2025 (y5), respectively	2022 RNA (2022 Gold Book) Study Period: y4 (2026)-y10 (2032)	2022 RNA Outlook Scenario *Based on the 2021 Outlook Policy Case – Scenario 2 (S2) for Study Year 2030*
18	Existing Energy Limited Resources (**ELRs**)	N/A	Existing gens' elections were made by August 1st of each year and are incorporated into the model as hourly shapes consistent with operational capabilities. Resource output is aligned with the NYISO's peak load window when most loss-of-load events are expected to occur.	New method: GE developed MARS functionality to be used for ELRs. Resource output is aligned with the NYISO's peak load window when most loss-of-load events are expected to occur.	Same as the 2022 RNA Base Case
Transaction – Imports/ Exports					
1	Capacity Purchases	Grandfathered Rights and other awarded long-term rights Modeled using MARS explicit contracts feature.	Same	Same method	Same as the 2022 RNA Base Case except for CHPE and CPNY CHPE/CPNY - Modeled output shape from the Outlook Scenario 2 Case, includes curtailments See HQ section for more additional information
2	Capacity Sales	These are long-term contracts filed with FERC. Modeled using MARS explicit contracts feature. Contracts sold from ROS (Zones: A-F). ROS ties to external pool are derated by sales MW amount	Same	Same method	Same as the 2022 RNA Base Case
3	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	Same	Same method	Same as the 2022 RNA Base Case

#	Parameter	2020 RNA *(2020 GB)* Study Period: 2024 (y4) -2030 (y10)	2021-2030 CRP and 2021 Q2 STAR *(2020 GB updated as applicable)* Study Period: 2024-2030 and 2021(y1) -2025 (y5), respectively	2022 RNA (2022 Gold Book) Study Period: y4 (2026)-y10 (2032)	2022 RNA Outlook Scenario *Based on the 2021 Outlook Policy Case – Scenario 2 (S2) for Study Year 2030*
4	UDRs	Updated with most recent elections/awards information (VFT, HTP, Neptune, CSC)	Same	Same method Added CHPE HTP (from Hydro Quebec into Zone J) at 1250 MW (summer) starting 2026	Same as the 2022 RNA Base Case
5	External Deliverability Rights (EDRs)	**Cedars Uprate 80 MW**. Increased the HQ to D by 80 MW. Note: The Cedar bubble has been removed and its corresponding MW was reflected in HQ to D limit. References: 1. March 16, 2020 ESPWG/TPAS 2. April 6, 2020 TPAS/ESPWG	Same	Same	Not modeled (see HQ section for additional information)
6	Wheel-Through Contract	**300 MW HQ through NYISO to ISO-NE.** Modeled as firm contract. Reduced the transfer limit from HQ to NYISO by 300 MW and increased the transfer limit from NYISO to ISO-NE by 300 MW.	Same	Same	Same as the 2022 RNA Base Case
MARS Topology: a simplified bubble-and-pipe representation of the transmission system					
1	Interface Limits	Developed by review of previous studies and specific analysis during the RNA study process.	Same	Same method	Same as the 2022 RNA Base Case
2	New Transmission	Based on TO- provided firm plans (via Gold Book 2020 process) and proposed merchant transmission; inclusion rules applied.	Same	Same method	Same as the 2022 RNA Base Case
3	AC Cable Forced Outage Rates	All existing cable transition rates updated with data received from ConEd and PSEG-LIPA to reflect most recent five-year history.	Same	Same method	Same as the 2022 RNA Base Case
4	UDR unavailability	Five-year history of forced outages	Same	Same method	Same as the 2022 RNA Base Case

#	Parameter	2020 RNA *(2020 GB)* Study Period: 2024 (y4) -2030 (y10)	2021-2030 CRP and 2021 Q2 STAR (*2020 GB updated as applicable)* Study Period: 2024-2030 and 2021(y1) -2025 (y5), respectively	2022 RNA (2022 Gold Book) Study Period: y4 (2026)-y10 (2032)	2022 RNA Outlook Scenario *Based on the 2021 Outlook Policy Case – Scenario 2 (S2) for Study Year 2030*
5	Other		Topology changes implemented due to the Post-RNA (CRP) Base Case updates [link]: 1. ConEdison's LTP updates January 23, 2021 ESPWG [link] 2. Status change of seven ConEdison Series Reactors proposed as backstop solution to the 2020 Q3 STAR needs solicitation: [link] 3. 2021 Q2 STAR key assumptions: [link]	Preliminary topology below Topology changes summary, as compared with the 2021 -2030 CRP MARS topology: 1. Dysinger East and Group A limits decreased to reflect Large Loads in western NY (as forecasted in the 2022 Gold Book Table I-14 [link] 2. West Central reverse emergency thermal limits increased mainly due to a rating increase on a limiting element – also as identified in the 2022 Operating Study 3. Ontario – NY updated per input from Ontario ISO 4. Added 1,250 MW (May through October) related with the HVDC from Quebec to New York City (Champlain Hudson project) starting 2026 5. Updated Long Island limits per PSEG-Long Island's input 6. Updated UPNY-ConEd to align with around 300 MW smaller delta associated in the 2021 Operations UPNY-ConEd Voltage Study with the status of the M51, M52, 71, 72 Series Rectors (assumed in service for this RNA)	Same as the 2022 RNA Base Case

#	Parameter	2020 RNA *(2020 GB)* Study Period: 2024 (y4) -2030 (y10)	2021-2030 CRP and 2021 Q2 STAR (*2020 GB updated as applicable)* Study Period: 2024-2030 and 2021(y1) -2025 (y5), respectively	2022 RNA (2022 Gold Book) Study Period: y4 (2026)-y10 (2032)	2022 RNA Outlook Scenario *Based on the 2021 Outlook Policy Case – Scenario 2 (S2) for Study Year 2030*
Emergency Operating Procedures (EOPs): Special Case Resources (SCRs) (Load and Generator) 5% Manual Voltage Reduction 30-Minute Operating Reserve to Zero 5% Remote Controlled Voltage Reduction Voluntary Load Curtailment Public Appeals Emergency Assistance from External Areas 10-Minute Operating Reserve to Zero					
1	Special Case Resources (SCR)	SCRs sold for the program discounted to historic availability ("effective capacity"). Monthly variation based on historical experience. Summer values calculated from the latest available July registrations, held constant for all years of study. **15 calls/year** Note: also, combined the two SCR steps (generation and load zonal MW)	Same method Based on the July 2020 SCR enrollment	Same method Based on the July 2022 SCR enrollment	Same as the 2022 RNA Base Case
2	EDRP Resources	Not modeled: the values are less than 2 MW.	Same	Same	Same as the 2022 RNA Base Case
3	Operating Reserves	655 MW 30-min reserve to zero 1,310 MW 10-min reserve to zero	Same	Updated per NYISO's recommendation (approved at the May 4, 2022 NYSRC ICS [link]) to maintain (or no longer deplete/use) 350 MW of the 1,310 MW 10-min operating reserve at the applicable EOP step. Therefore, the 10-min operating reserve MARS EOP step will use, as needed each MARS replication: 960 MW (=1,310 MW – 350 MW)	Same as the 2022 RNA Base Case
4	Other EOPs *e.g., manual voltage reduction, voltage curtailments, public appeals, external assistance, as listed above*	Based on TO information, measured data, and NYISO forecasts	Same Used 2020 elections, as available	Same method Used 2022 elections, as available	Same as the 2022 RNA Base Case

#	Parameter	2020 RNA *(2020 GB)* Study Period: 2024 (y4) -2030 (y10)	2021-2030 CRP and 2021 Q2 STAR (*2020 GB updated as applicable)* Study Period: 2024-2030 and 2021(y1) -2025 (y5), respectively	2022 RNA (2022 Gold Book) Study Period: y4 (2026)-y10 (2032)	2022 RNA Outlook Scenario *Based on the 2021 Outlook Policy Case – Scenario 2 (S2) for Study Year 2030*
External Control Areas • The top three summer peak load days of an external Control Area is modeled as coincident with the NYCA top three peak load days. • Load and capacity fixed through the study years. • 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 • Implemented a statewide emergency assistance (from the neighboring systems) limit of 3500 MW					
1	PJM	Simplified model: The 5 PJM MARS areas (bubbles) were consolidated into one	Same	Same method	Same as the 2022 RNA Base Case
2	ISONE	Simplified model: The 8 ISO-NE MARS areas (bubbles) were consolidated into one	Same	Same method	Same as the 2022 RNA Base Case
3	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.	Same	Same method	HQ bubble not modeled for consistency with the Outlook. Imports from HQ modeled as injections based upon usage profile from MAPS analysis. No flows between HQ and IESO or ISONE.
4	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.	Same	Same method	Same as the 2022 RNA Base Case
5	Reserve Sharing	All NPCC Control Areas indicate that they will share reserves **equally** among all members before sharing with PJM.	Same	Same method	Same as the 2022 RNA Base Case
6	NYCA Emergency Assistance Limit	Implemented a statewide limit of **3,500 MW**	Same	Same	Same as the 2022 RNA Base Case

#	Parameter	2020 RNA *(2020 GB)* Study Period: 2024 (y4) -2030 (y10)	2021-2030 CRP and 2021 Q2 STAR (*2020 GB updated as applicable)* Study Period: 2024-2030 and 2021(y1) -2025 (y5), respectively	2022 RNA (2022 Gold Book) Study Period: y4 (2026)-y10 (2032)	2022 RNA Outlook Scenario *Based on the 2021 Outlook Policy Case – Scenario 2 (S2) for Study Year 2030*
Miscellaneous					
1	MARS Model Version	3.29.1499	3.30.1531	4.10.2035	Same as the 2022 RNA Base Case

Assumptions Matrix for Transmission Security Assessment

Parameter	2022 RNA Transmission Security Studies Modeling Assumptions	Source
Load Forecast	The 2022 Gold Book publishes the baseline coincident peak load forecasts (summer and winter) including the impact (reduction) of behind-the-meter (BtM) generation (solar, non-solar, and storage adjustments) at the time of NYCA peak as well as energy efficiency and codes & standards. The midday light load forecast utilizes the BtM solar generation from the 2022 Gold Book Table 1-9d and includes expected load during the midday light load hour.	2022 Gold Book
Load Model	ConEd: voltage varying Rest of NYCA: constant power	2022 FERC 715 filing
System Representation	Per updates received through the annual database update process (subject to RNA base case inclusion rules)	NYISO RAD Manual, 2022 FERC 715 filing
Inter-area Interchange Schedules	Consistent with ERAG MMWG interchange schedule	2022 FERC 715 filing, MMWG
Inter-area Controllable Tie Schedules	Consistent with applicable tariffs and known firm contracts or rights	2022 FERC 715 filing
In-City Series Reactors	Consistent with Con Edison series reactor status in their 2021 Local Transmission Plan update presented at the November 19, 2021 ESPWG/TPAS [here]. 2021-2023 Series Reactor Status • 71, 72, M51, M52 are bypassed • 41, 42, Y49 are in-service Post-2023 Series Reactor Status • 71, 72, M51, M52 are in-service • 41, 42, Y49 are bypassed	2022 FERC 715 filing, Con Edison protocol
SVCs, FACTS	Set at zero pre-contingency; allowed to adjust post-contingency	NYISO T&D Manual
Transformer & PAR taps	Taps allowed to adjust pre-contingency; fixed post-contingency	2022 FERC 715 filing
Switched Shunts	Allowed to adjust pre-contingency; fixed post-contingency	2022 FERC 715 filing

Parameter	2022 RNA Transmission Security Studies Modeling Assumptions	Source
Fault Current analysis settings	Per Fault Current Assessment Guideline	NYISO Fault Current Assessment Guideline
Thermal Generation (includes fossil and nuclear) Unavailability	The impact of thermal generation unavailability is captured in the transmission security margin calculations (aka "tipping points") and incorporates the NERC five-year class-average forced outage rate values (EFORd).	NERC Generating Unit Statistical Brochures, most recently available Brochure 4 [here]. Reference May 5, 2022 TPAS/ESPWG meeting materials [here] and May 23, 2022 ESPWG meeting materials [here].
Wind Generation	Dispatch land-based wind (LBW) generation and off-shore wind (OSW) generation to the following percentage of nameplate capacity: LBW • Summer 5% • Winter 10% • Light load 10% OSW • Summer 10% • Winter 15% • Light load 15%	Reference May 5, 2022 TPAS/ESPWG meeting materials [here] and May 23, 2022 ESPWG meeting materials [here].
Solar Generation	BtM solar reductions in load forecast are included in the Gold Book (Table I-9d) along with nameplate capacity (Table I-9a). Utility-scale solar resources are dispatched at the same factor as the BtM solar resources for a given transmission security case.	Reference May 5, 2022 TPAS/ESPWG meeting materials [here] and May 23, 2022 ESPWG meeting materials [here].
Hydro Generation	Large hydro and pumped storage are dispatchable up to the stated seasonal capabilities published in the Gold Book. Run-of-river hydro are fixed at their 5-year average based on GADS data (roughly 50% of the capability stated in the Gold Book).	Reference May 5, 2022 TPAS/ESPWG meeting materials [here] and May 23, 2022 ESPWG meeting materials [here].
Battery Storage	As the starting point in transmission security analysis utility-scale battery storage resources are modeled at 0 MW output. If a potential transmission security reliability need is observed, post-processing analysis is performed to understand the nature of the need and how the characteristics of the battery storage resources may address the need. BtM storage resources are netted with load consistent with the forecasts published in the Gold Book.	2022 Gold Book Reference May 5, 2022 TPAS/ESPWG meeting materials [here] and May 23, 2022 ESPWG meeting materials [here].

2022 RNA Base Case MARS Models – Additional Details

The NYISO conducts its resource adequacy analysis using the GE-MARS software package, which performs probabilistic simulations of outages of capacity and select transmission resources. The program employs a sequential Monte Carlo simulation method and calculates expected values of reliability indices such as LOLE (event-days/year) and includes load, generation, and transmission representation. Additional modeling details and links to various stakeholders' presentations are in the assumptions matrix, which is included in this appendix. In determining the reliability of a system, there are several types of randomly occurring events that are taken into consideration. Among these are the forced outages of generation and transmission, and deviations from the forecasted loads.

Summary of major MARS model changes (as compared with the 2021-2030 CRP):

- Modeled new load shapes for the seven MARS load bins: the 2002, 2006 and 2006 historical load shapes were replaced by the 2013, 2017, 2018 shapes; As presented at the March 24 LFTF/ESPWG/TPAS: [link] [link];
- Maintained (*i.e.,* no longer depleting) 350 MW of the 1,310 MW 10-min operating reserves as part of the MARS emergency operating procedure steps (EOP) and as presented at the May 5, 2022 ESPWG/TPAS [link];
- Added 1,250 MW HVDC from Quebec to New York City (Champlain Hudson project) starting 2026 (*i.e.,* 1,250 MW May through October, 0 MW November through April);
- Reflected an increase in Moses South limits (from 2,650 MW to 3,500 MW) due to the Q1125 Northern Path project starting 2026;
- Using GE developed MARS functionality for Energy Limited Resources (ELRs);
    - Resource output is aligned with the NYISO's peak load window when most loss-of-load events are expected to occur;
- Large loads forecast and updated impacts reflected in the Dysinger East and Group A MARS limits (as reflected in the MARS topology from the posted assumptions matrix);
    - Large loads are forecasted in the 2022 Gold Book Table I-14 [link]
- West Central reverse emergency thermal limits increased mainly due to a rating increase on a limiting element; also identified in the 2022 Operating Study.
- Ontario – NY updated with input from Ontario ISO

- Updated Long Island limits with input from PSEG-Long Island
- Updated UPNY-ConEd (from to reflect a smaller delta associated in the 2021 Operations UPNY-ConEd Voltage Study with the status of the M51, M52, 71, 72 Series Rectors (assumed in service for this RNA and as presented at the April 1 ESPWG)

Generation Model

The NYISO models the generation system in GE-MARS using several types of units. Thermal unit considerations include: random forced outages as determined by Generator Availability Data System (GADS) — calculated EFORd and the Monte Carlo draw, scheduled and unplanned maintenance, and thermal derates (minimum between CRIS and DMNC MW from the 2022 Gold Book is used for both summer and winter). Renewable resource units (*i.e.,* both utility and behind the meter solar PV, wind, run-of-river hydro and landfill gas) are modeled using five years of historical production data. Co-generation units are also modeled using a capacity and load profile for each unit.

Load Model

The load model in the NYISO GE-MARS model consists of historical load shapes and load forecast uncertainty (LFU). The NYISO uses three historical load shapes (8,760 hourly MW) in the GE-MARS model in seven different load levels using a normal distribution. The load shapes are adjusted on a seasonal (summer and winter) basis to meet peak forecasts while maintaining the energy target from the 2022 Gold Book. The load forecast includes five large loads from the NYISO interconnection queue with forecasted impacts. The GB 2022 baseline peak load forecast also includes the impact (reduction) of behind-the-meter (BtM) solar at the time of the NYCA peak. For the BtM solar adjustment, gross load forecasts that include the impact of the BtM generation will be used for the 2022 RNA, which then allows for a discrete modeling of the BtM solar resources using 5 years of inverter data. LFU is applied to every hour of these historical shapes and each hour of the seven load levels is run through the GE-MARS model for each replication for resources availability evaluations.

An important change is that the historical shapes used in the past (2002 for bin 2, 2006 for bin 1, and 2007 for bin 3 through 7) were replaced by 2013, 2017, 2018 based on detailed analysis performed by the NYISO.[8] The load bin distribution in MARS is below:

- Load Bins 1 and 2: 2013
  - 2013 had a hot summer peak day and a steep load shape and was selected to represent

[8] The changes to the historical shapes were presented at the March 24, 2022 LFTF/TPAS/ESPWG and available at: https://www.nyiso.com/documents/20142/29418084/07%20LFU%20Phase%202_Recommendation.pdf and https://www.nyiso.com/documents/20142/29418084/08%20MARS_PlanningModel-NewLoadShapes.pdf.

LFU Bins 1 and 2. Years with significantly hot peak-producing weather (analogous to Bin 1 and Bin 2 LFU temperatures) have fairly steep load duration curves.

- Load Bins 3 and 4: 2018
  - 2018 had fairly average peak-producing weather and a relatively flat load shape. And was selected to represent Bins 3 and 4. Bin 4 represents the expected (average) weather and load level.
- Load Bins 5 to 7: 2017
  - 2017 had a cool summer peak day and a relatively flat load shape. 2017 is selected to represent Bins 5 through 7, which represent summers with milder than expected peak weather conditions.

External Areas Model

The NYISO models the four external Control Areas interconnected to the NYCA (ISO-New England, PJM, Ontario, and Quebec). The transfer limits between the NYCA and the external areas are set in collaboration with the NPCC CP-8 Working Group. Additionally, the probabilistic model used in the RNA to assess resource adequacy employs a number of methods aimed at preventing the NYISO's overreliance on support from the external Control Areas. These include imposing a limit of 3,500 MW to the total emergency assistance from all neighbors, modeling simultaneous peak days, and modeling the long-term purchases and sales with neighboring control areas. Furthermore, the external areas are kept within a Loss of Load Expectation (LOLE) range of 0.10 to 0.15 event-days/year throughout Study Period.

Additionally, various grandfathered or firm contracts and Unforced Deliverability Rights (UDRs) links with the neighboring systems are generally modeled using the "contracts" feature in MARS.

Emergency Operating Procedures (EOPs)

The New York model evaluates the need to implement in sequential order a number of emergency operating procedures such as operating reserves, Special Case Resources (SCRs), manual voltage reduction, public appeals, 10-minute reserve, 30-minute reserve, emergency assistance from external areas.

A change was implemented for this RNA to maintained (*i.e.,* no longer deplete) 350 MW of the 1,310 MW 10-min operating reserves as part of the MARS EOPs and as presented at the May 5, 2022, ESPWG/TPAS[9].

[9] Details were presented at the May 5, 2022 ESPWG/TPAS and available at: https://www.nyiso.com/documents/20142/30451285/08_Reliability_Practices_TPAS-ESPWG_2022-05-05.pdf .

MARS Topology

The NYISO models the amount of power that could be transferred during emergency conditions across the system in GE-MARS using interface transfer limits applied to the connections between the NYCA 11 Areas ("bubble-and-pipe" model), and with the four neighboring systems (Ontario, Quebec, New England, and PJM). No generation pockets in Zone J and Zone K are modeled in detail in MARS.

The internal transfer limits modeled are the summer emergency ratings derived from the RNA power flow cases discussed above.

The emergency transfer criteria limits used for the MARS topology model are developed from an assessment of analysis of the 2022 RNA power flow base cases and review of analysis performed for other planning and operations studies. The NYISO performed analyses of the RNA Base Cases to determine emergency thermal transfer limits for the key interfaces used in the MARS resource adequacy analysis. Figure 21 below reports the emergency thermal transfer limits for the RNA base system conditions.

Figure 21: Emergency Thermal Transfer Limits (MW)

Interface	SY 2027	
	Topology MW	
Dysinger East	2100	1
Moses South	3500	2
Central East MARS	3925	3
I to J	4400	4
West Central Reverse	2275	5

	Limiting Facility	Rating	Contingency
1	Niagara - Dysinger 345 kV	1685	Niagara - Dysinger 345 kV
2	Higley - Browns Falls 115 kV	135	L/O Chateauguay–Massena–Marcy 765 kV (S:HQ-NY_LOG05)
3	New Scotland - Knickerbocker 345 kV	1423	Pre-disturbance
4	Mott Haven - Rainey 345 kV	785	Pre-disturbance
5	Sorrell Hill - Geres Lock 115 kV	147	L/O Elbridge - Lafaytte - Oswego 345 kV (OS - EL - LFYTE 345 17)

Figure 22, Figure 23 and Figure 24 provide the thermal and voltage emergency transfer limits for the major NYCA interfaces. The 2021-2030 CRP transfer limits are for comparison purposes.

Figure 22: Transmission System Thermal Emergency Transfer Limits

Interface	2022 RNA						2021 - 2030 CRP				
	For information only			Study Years 2026-2032			Study Years: 2021-2030				
	2023	2024	2025	2026	2027	2032	2023	2024	2025	2026	2030
Dysinger East	2150	2100	2100	2100	2100	2100	2200	2200	2200	2200	2200
Central East MARS	2500	4500	4500	4500	4500	4500	4450	4925	4925	4925	4925
E to G (Marcy South)	1750	2300	2300	2300	2300	2300	1750	2300	2300	2300	2300
F to G	3475	5400	5400	5400	5400	5400	3475	5400	5400	5400	5400
UPNY-SENY MARS	5250	7150	7150	7150	7150	7150	5250	7150	7150	7150	7150
I to J	4400	4400	4400	4400	4400	4400	4400	4400	4400	4400	4400
I to K (Y49/Y50)	1293	1293	1293	1293	1293	1293	1293	1293	1293	1293	1293
I to J & K	5693	5693	5693	5693	5693	5693	5693	5693	5693	5693	5693

Note: Black font values: power flow evaluations were re-performed under the applicable study processes

Figure 23: Transmission System Voltage Emergency Transfer Limits

Interface	2022 RNA						2021 - 2030 CRP				
	For information only			Study Years 2026-2032			Study Years: 2021-2030				
	2023	2024	2025	2026	2027	2032	2023	2024	2025	2026	2031
Dysinger East	2350	2300	2200	2150	2100	2100	2850	2850	2850	2850	2850
Central East MARS	2645	3925	3925	3925	3925	3925	3100	3925	3925	3925	3925
Central East Group	4260	5650	5650	5650	5650	5650	5000	5650	5650	5650	5650
UPNY-ConEd	6675	7050	7050	7050	7050	7050	6250	6625	6625	6625	6625

Black font values: power flow evaluations were re-performed under the applicable study processes

Figure 24: Transmission System Base Case Emergency Transfer Limits

Interface	2022 RNA						2021-2030 CRP				
	For information only			Study Years 2026-2032			Study Years: 2021 - 2030				
	2023	2024	2025	2026	2027	2032	2023	2024	2025	2026	2031
Dysinger East	2150 T	2100 T	2100 T	2100 T	2100 T	2100 T	2200 T	2200 T	2200 T	2200 T	2200 T
Central East MARS	2645 V	3925 V	3925 V	3925 V	3925 V	3925 V	3100 V	3925 V	3925 V	3925 V	3925 V
Central East Group	4260 V	5650 V	5650 V	5650 V	5650 V	5650 V	5000 V	5650 V	5650 V	5650 V	5650 V
E to G (Marcy South)	1750 T	2300 T	2300 T	2300 T	2300 T	2300 T	1750 T	2300 T	2300 T	2300 T	2300 T
F to G	3475 T	5400 T	5400 T	5400 T	5400 T	5400 T	3475 T	5400 T	5400 T	5400 T	5400 T
UPNY-SENY MARS	5250 T	7150 T	7150 T	7150 T	7150 T	7150 T	5250 T	7150 T	7150 T	7150 T	7150 T
UPNY-ConEd	6675 V	7050 V	7050 V	7050 V	7050 V	7050 V	6250 V	6625 V	6625 V	6625 V	6625 V
I to J	4400 T	4400 T	4400 T	4400 T	4400 T	4400 T	4400 T	4400 T	4400 T	4400 T	4400 T
LI PSW	1293 T	1293 T	1293 T	1293 T	1293 T	1293 T	1293 T	1293 T	1293 T	1293 T	1293 T
I to J & K	5693 T	5693 T	5693 T	5693 T	5693 T	5693 V	5693 T	5693 T	5693 T	5693 T	5693 T

Notes:
Black font values: power flow evaluations were re-performed under the applicable study processes
T - Thermal, V - Voltage

Key observations, as comparing with the 2021-2030 Comprehensive Reliability Plan (CRP) Base Cases, are below.

The NYISO modeled a gradual decrease in the thermal transfer limit for Dysinger East of 50 MW in the year 2023 and a subsequent decrease of 100 MW for years 2024-2032. Similar decreases in Zone A group of 50 MW in 2023, 150 MW in 2024, and 200 MW in the subsequent years 2025-2032 are also observed. This is mainly due to the Western New York large loads as forecasted in the 2022 Gold Book.

There is a decrease of 455 MW and 255 MW respectively, modeled only for study year 2023 in Central East MARS and Central East Group voltage limits due to Porter-Rotterdam (30 and 31) line outages and Segment A project construction.

Comparing the transfer limits modeled for study year 2023 through 2032 to the CRP, there is an apparent delta increase of 425 MW on the UPNY-Con Ed voltage limit for the 2022 RNA. Otherwise, there is an overall negative effect (decrease in the limits) associated with the switching of the 4 series reactors on the M51, M52, 71, 72 cables in service (as compared with them being off service). However, the apparent 425 MW relative delta increase from the CRP models to this 2022 RNA is implemented solely to apply the insights from an updated 2021 Operations Study,[10] which identified a smaller (-350 MW) delta decrease due to the series reactors in service (as compared with them being off service). The UPNY-Con Ed voltage limits are updated as such to align with the 2021 Operating Study. Additionally, the series reactors on the 41 and 42 cables are assumed to be in-service starting from summer 2025.

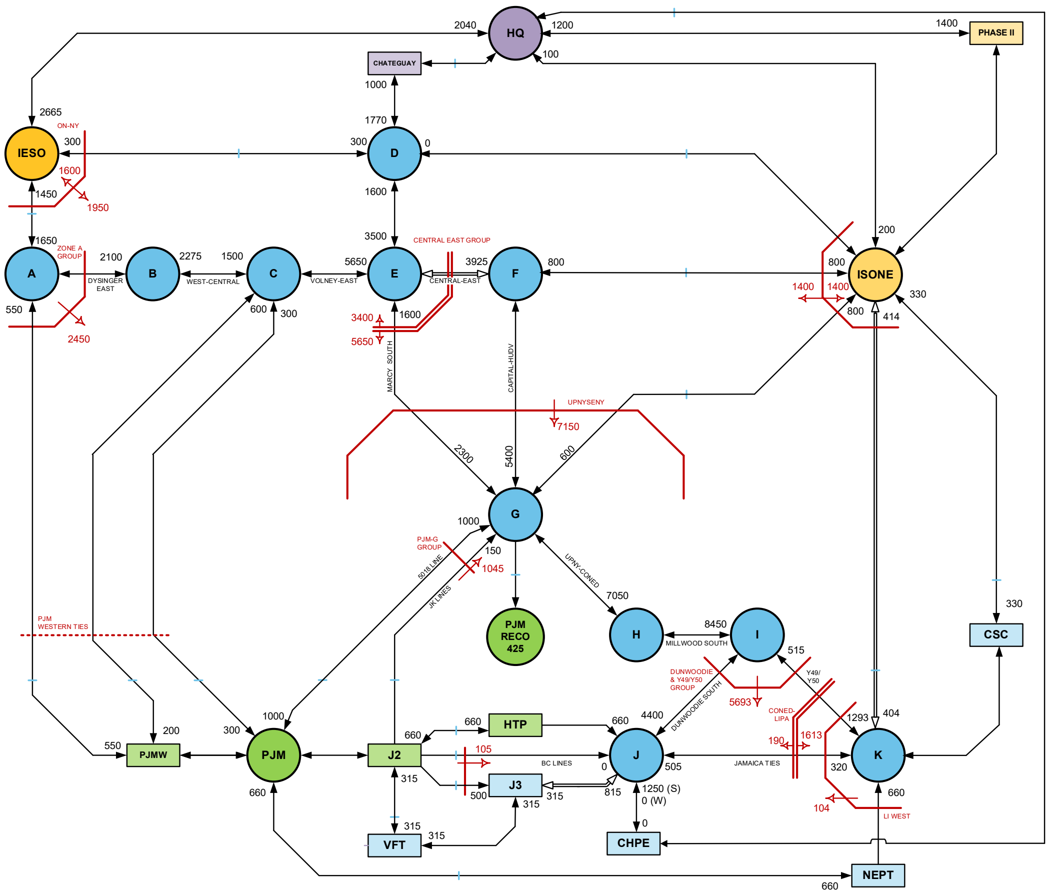
There is an increase of 675 MW in West Central reverse limit starting from year 2023 as shown in the topology diagram Figure 26. This change is due to an increase in the emergency rating for the limiting element Farmington – Hamilton 115 kV, as provided by National Grid.

There is an 850 MW increase in the thermal limits for Moses South as shown in topology diagram Figure 25 starting from study year 2026 associated with the inclusion of the Smart Path Connect Project, Q1125 (target Commercial Operating Date - COD - is December 2025).

The topology used in the GE-MARS model for the 2022 RNA Base Case (study years 2026-2032) is represented in Figure 25.

[10] May 12, *2022 SOAS Operations presentation on the delta from the 2020 UPNY-ConEd Voltage study to 2021 UPNY-ConEd Voltage study,* available at https://www.nyiso.com/documents/20142/30625526/11_Comparison%20of%20UPNY-ConEd%20Votlage%20Study%20Results.pdf.

Figure 25: 2022 RNA Topology Years 4-10 (2026 -2032)



Notes

1. PJM to NY emergency assistance (EA) assumption for calculating the PJM-NY Western ties, PJM-G Group, and ABC Line Group flow distribution limit: 1500MW

2. NYCA EA simultaneous import limit: 3,500 MW

3. External areas representation based upon information received from the NPCC CP-8 WG

Legend

- Interface
- Unidirectional Interface
- Interface w/ Dynamic Ratings
- Interface Group
- Interface Group w/ Dynamic Ratings
- Monitoring Interface Group
- NYCA EA Interface Group Marker
- xx "Dummy Bubble" i.e. no load

NOTE: An interface is considered to not have a MW limitation if no number is specified

Topology for 2022 RNA Base Case: RNA Study Years 4-10 (2026-2032)
Dynamic Limits and Groupings Information

Interface Group	Limit	Flow Equation
LI_WEST	134	(K to I&J) - 0.13*(K_NEPT)

Central East Voltage Limits, Oswego Complex Units

Depends On:	9MILP1, 9MILP2, FPNUC1, STHIND, OS05, OS06			
Units	E_to_F		E_to_FG	
Available	Fwd	Rev	Fwd	Rev
6	3925	1999	5650	3400
5	3875	1999	5575	3400
4	3815	1999	5490	3400
3	3710	1999	5335	3400
2	3595	1999	5160	3400
Otherwise	3470	1999	4960	3400

Staten Island Import Limits, AK and Linden CoGen Units

Unit Availability				J_to_J3	
AK02	AK03	LINCOG1	LINCOG2	Fwd	Rev
A	A	A	A	315	425
U	A	A	A	315	700
A	A	U	A	315	750
A	A	A	U	315	750
Otherwise				315	815

Depends On:	NPRTS1-4	
Units	LI_NE	
Available	Norwalk to K	K to Norwalk
4	260	414
Otherwise	404	414

Depends On:	Barrett1 and 2	
Units	SY2026-2032 ConEd-LIPA	
Available	IJ to K	K to IJ
2	1613	190
1	1613	190
0	1613	8

PJM-NY JOA Flow Distribution (Jan 31, 2017 filing)	RECO Load Deliveries	PJM-NY Emergency Assistance
PJM-NY Western Ties	20%	46%
5018 Line	80%	32%
JK Lines	0%	15%
A Line	0%	7%
BC Lines	0%	0%

Additionally, for informational purposes, Figure 26,

Figure 27 and Figure 28 represent the topology for the initial 3 study years (2023, 2024, 2025) preceding the 2022 RNA Study Period.

Figure 26: 2022 RNA Topology Year 1 (2023)

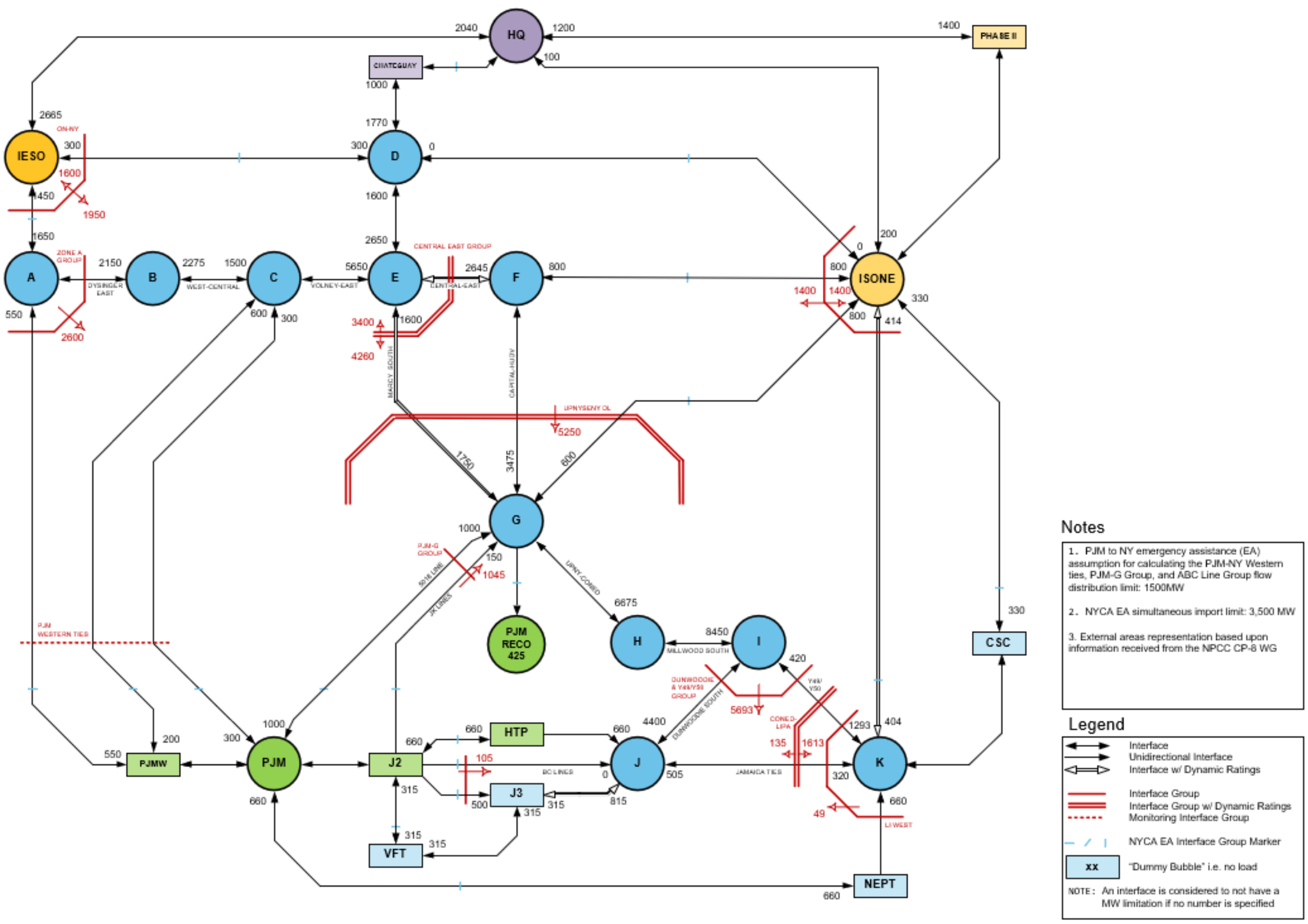


Figure 27: 2022 RNA Topology Year 2 (2024)

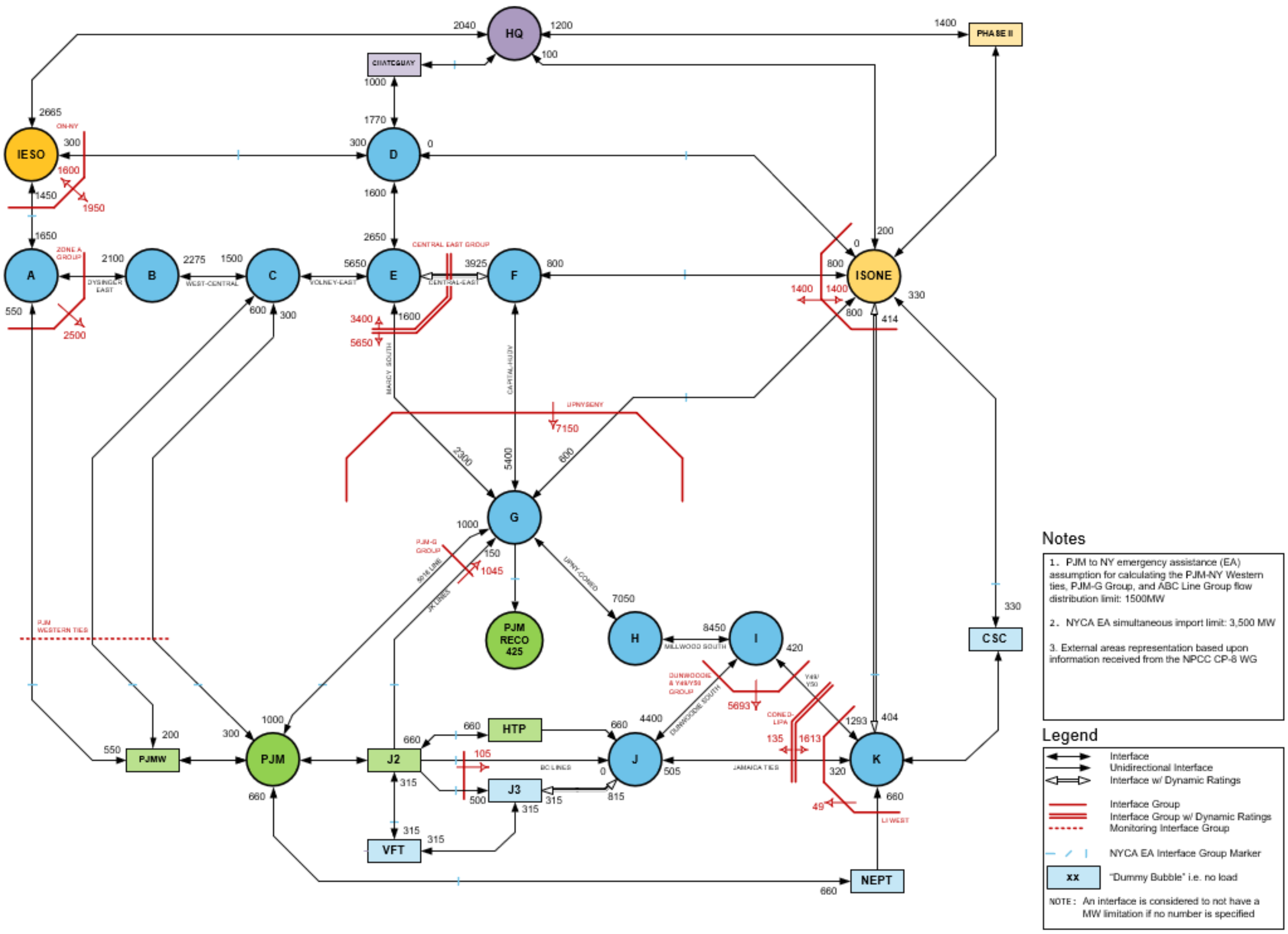
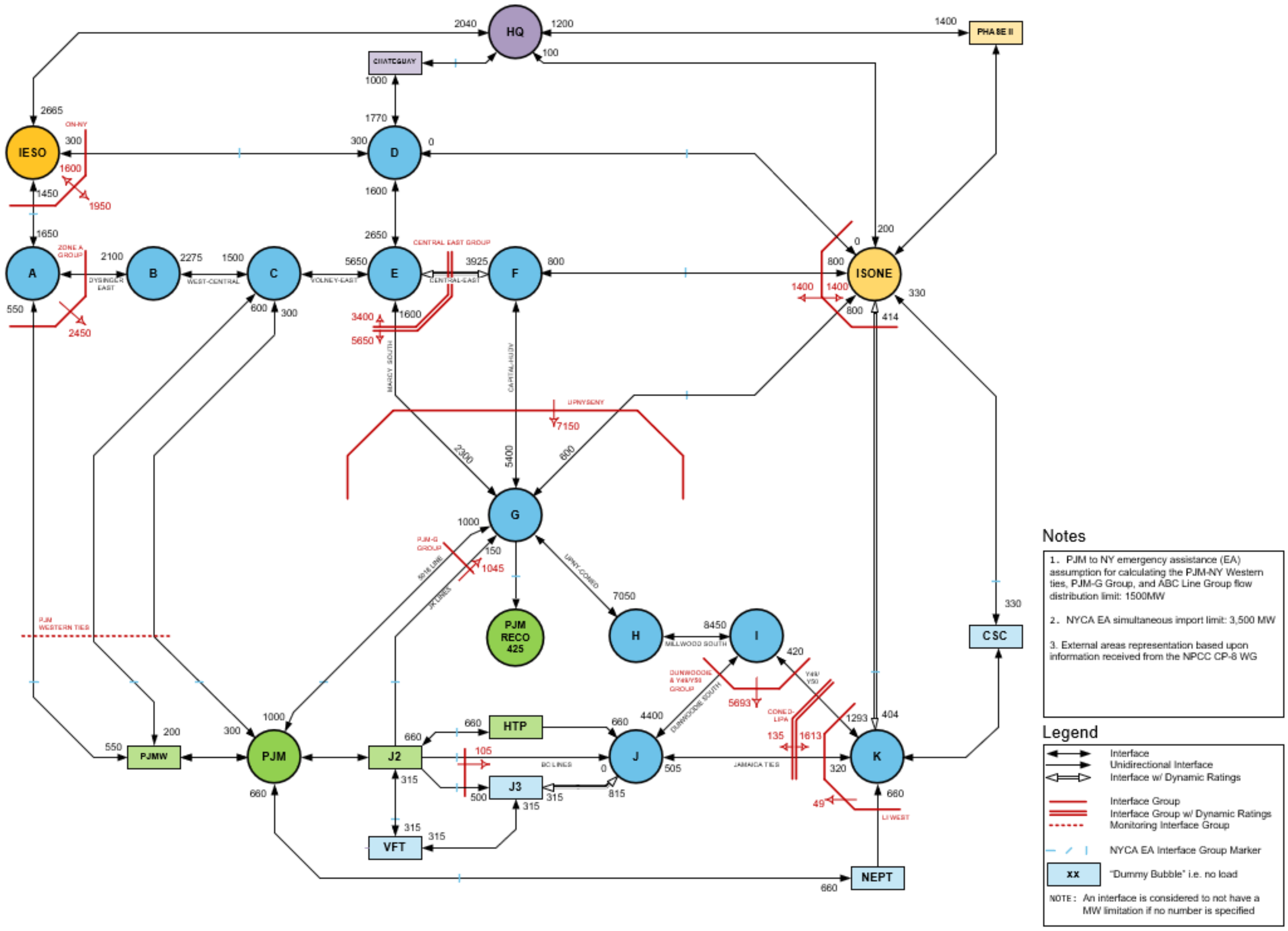


Figure 28: 2022 RNA Topology Year 3 (2025)



RNA Base Case MARS Event Analysis

Loss of Load Expectation (LOLE, in days/year) is generally defined as the expected (weighted average) number of days in a given time period (*e.g.,* one study year) when at least one hour from that day, the hourly demand (for each of the seven load bins and per replication) is projected to exceed the zonal resources capacity (event day) in any of the seven load bins. Within a day, if the zonal demand exceeds the resources in at least one hour of that day (could be anywhere from hour 1 to 24, consecutive or not), this will be counted as one event day for the respective load bin and replication. The NYISO currently simulates 2,000 replications per study year and load level (seven load bins) for a total of 14,000 replications per study year. Weighted average is based on load bin probability, total bin event days, and total number of replications. NYSRC's and NPCC's LOLE criterion is that the NYCA LOLE does not exceed one day in 10 years, or LOLE < 0.1 days/year.

For each study year and in a single MARS replication, the zonal MW hourly margins (MW surplus or deficit) are calculated for each bin using load forecast uncertainty (LFU) applied load, forced outage calculations, hourly shape values (*i.e.,* wind, solar, run-of-river hydro, landfill gas), contracts and interface flows. In instances where there is a deficit in any area, emergency operating procedures (EOPs) steps are completed until either the deficits are gone, or there are no more EOP steps to call. Once all of this is completed MARS calculates the reliability indices (LOLE, LOLH, LOEE) for the replication. This occurs concurrently across all load levels simultaneously: MARS lumps them all together in a weighted sum to get a single value for each replication.

NYCA LOLE (days/ year) = $\frac{1}{N}\sum_{i=1}^{7} D_i\, P_i$

NYCA LOLH (hour/ year) = $\frac{1}{N}\sum_{i=1}^{7} H_i\, P_i$

NYCA EUE (MWh) = $\frac{1}{N}\sum_{i=1}^{7} E_i\, P_i$

where, $\boldsymbol{D_i}$ is the **event days** for bin i for the study year
$\mathbf{H_i}$ is the **event hours** for bin i
$\mathbf{E_i}$ is the MW deficit for bin i
$\mathbf{P_i}$ is the **probability of occurring of bin i** which is the LFU probability data
N is the total number of **replications** e.g., 2000

The below figures provide additional insight into how the LOLE bin and month distribution for the RNA Base Case, study year 2032. Additional details on load forecast uncertainty (LFU) and MARS load bins are under the April 21, 2022 Load Forecast Task Force presentation [link]

Observations:

- The NYCA LOLE is below its 0.1 event-days/year criterion throughout the Study Years (0.022 event -days/year in 2032). This is mainly due to the net resources included in this RNA Base Case being higher as comparing with the CRP base cases. Additionally, the Champlain Hudson Transmission Partners (CHPE) 1,250 MW HVDC project from Hydro Quebec to Astoria Annex 345 kV in Zone J and the NYPA/National Grid’s Northern New York Priority Transmission Project projects are also included starting 2026.
- Summer season and using the new (2013, 2017, 2918) historical shapes: the MARS events for the Base Case study year 2032 are distributed in June, July (the most), August, and September in the afternoon hours, with most events in load bins 1 through 3and some events in bins 4 through 6.
- Winter season and using the new (2013, 2017, 2918) historical shapes: there are events observed in January in bin 1 (and some in bin 2). Below is a table showing a comparison of the distribution of summer versus winter forecasts between the 2022 Gold Book and 2020 Gold Book. While the NYCA forecast is still a summer peak, there are additional zones getting closer, or being at the winter peak, throughout the study period.

Figure 29: 2022 vs 2020 Non-Coincident Peak Summer and Winter

2022 Gold Book Non-Coincident Peak Season - Within 5% Considered Both as Peak											
Year	A	B	C	D	E	F	G	H	I	J	K
2022	S	S	S	W	S	S	S	S	S	S	S
2023	S	S	S	W	B	S	S	S	S	S	S
2024	S	S	B	W	B	S	S	S	S	S	S
2025	S	S	B	W	B	S	S	S	S	S	S
2026	S	S	B	W	B	S	S	S	S	S	S
2027	S	S	B	W	W	S	S	S	S	S	S
2028	S	S	B	W	W	S	S	S	S	S	S
2029	S	S	W	W	W	S	S	S	S	S	S
2030	S	S	W	W	W	B	S	S	S	S	S
2031	B	S	W	W	W	B	S	S	S	S	S
2032	B	S	W	W	W	B	S	S	S	S	S

2020 Gold Book Non-Coincident Peak Season - Within 5% Considered Both as Peak											
Year	A	B	C	D	E	F	G	H	I	J	K
2022	S	S	S	W	B	S	S	S	S	S	S
2023	S	S	S	W	B	S	S	S	S	S	S
2024	S	S	S	W	B	S	S	S	S	S	S
2025	S	S	S	W	B	S	S	S	S	S	S
2026	S	S	S	W	B	S	S	S	S	S	S
2027	S	S	S	W	B	S	S	S	S	S	S
2028	S	S	S	W	W	S	S	S	S	S	S
2029	S	S	S	W	W	S	S	S	S	S	S
2030	S	S	S	W	W	S	S	S	S	S	S
2031	S	S	S	W	W	S	S	S	S	S	S
2032	S	S	S	W	W	S	S	S	S	S	S

S-Summer W-Winter B - Both (The peaks are within 5% of each other)

Figure 30: 2022 (top) vs 2021-2030 CRP Base Case, Study Year 10 Bin and Month LOLE Distributions

LOLE (dy/yr)

Month	1	2	3	4	5	6	7	Total
Jan	0.0039	0.0005						0.0043
Feb								
Mar	0.0001	0.0002			0.0002	0.0001		0.0006
Apr								
May								
Jun			0.0001					0.0001
Jul	0.0087	0.0057	0.0001					0.0146
Aug			0.0016	0.0006				0.0021
Sep			0.0001	0.0002				0.0003
Oct								
Nov			0.0001					0.0001
Dec								
Annual	0.0126	0.0064	0.0021	0.0008	0.0002	0.0001		0.0222

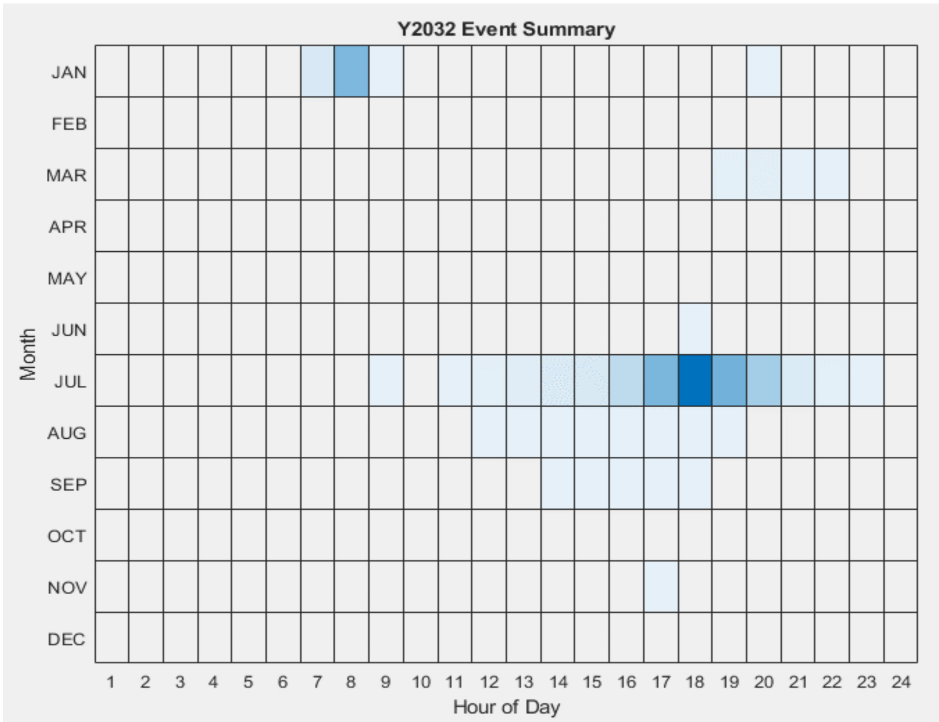
Load Level

LOLE (dy/yr)

Month	1	2	3	4	5	6	7	Total
Jan								
Feb								
Mar								
Apr								
May								
Jun	0.0000	0.0002	0.0002	0.0002				0.0006
Jul	0.0138	0.0145	0.0002					0.0286
Aug	0.0036	0.0289	0.0024	0.0002				0.0351
Sep								
Oct								
Nov	0.0000							0.0000
Dec								
Annual	0.0174	0.0437	0.0029	0.0004				0.0644

Load Level

Figure 31: 2022 (top) vs 2021-2030 CRP Base Case Study Year 10 Event Summary Hour of Day and Month Distribution



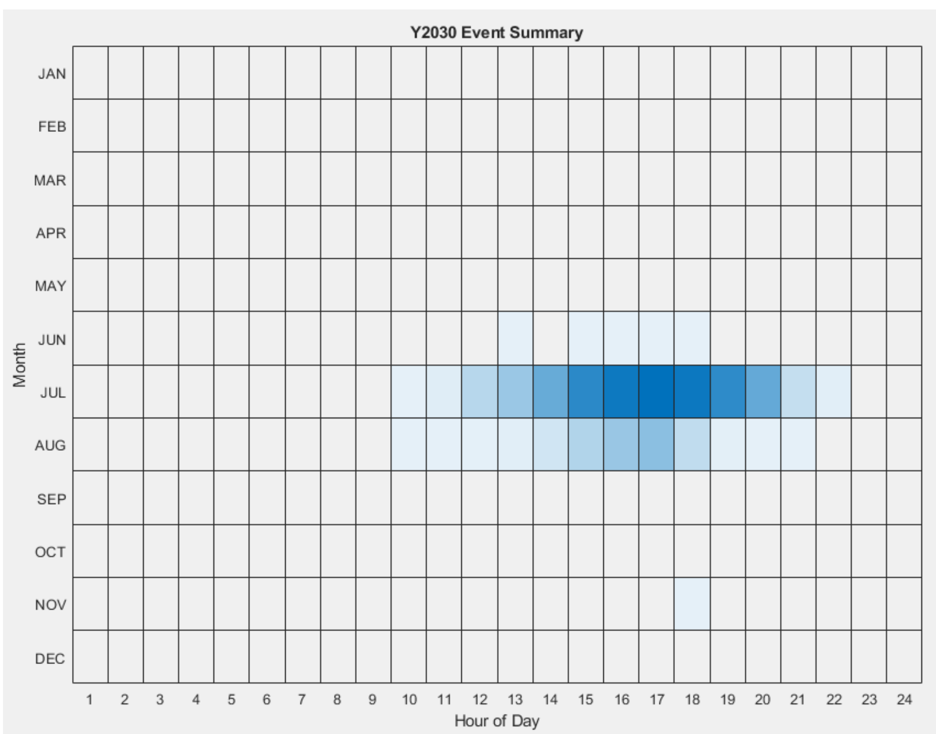
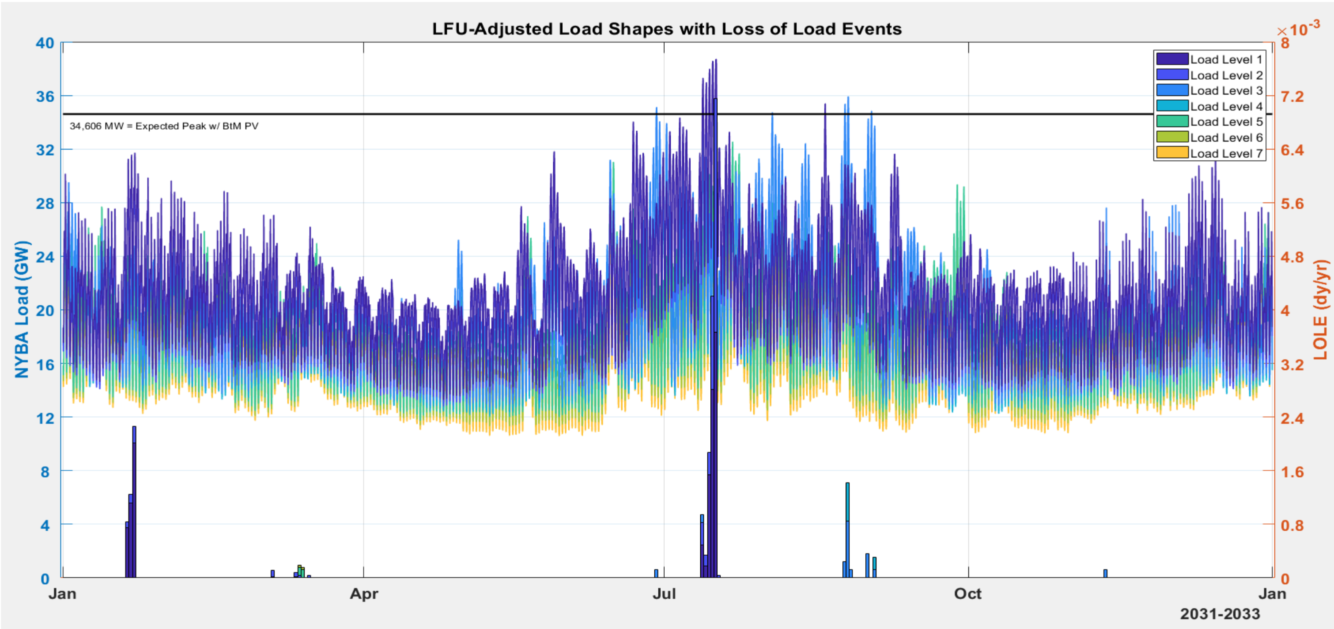
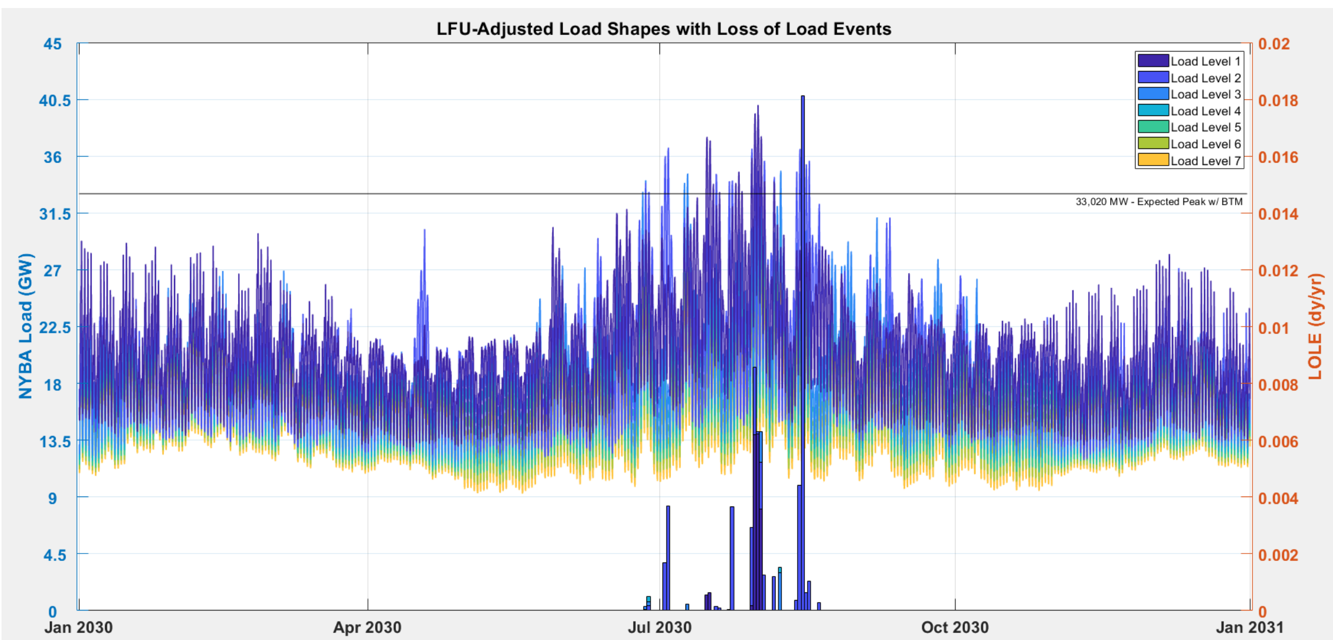


Figure 32: 2022 (top) vs 2021-2030 CRP Base Case Study Year 10 LFU-Adjusted Load Shapes vs Load Events





2022 RNA Short Circuit Assessment

Figure 33 below provides the results of NYISO's short circuit screening test for year 5 (2027) of the Study Period. Individual Breaker Analysis (IBA) is required for any breakers the ratings of which were exceeded by the maximum bus fault current. Either NYISO or the responsible Transmission Owner performed the analyses.

Figure 33: 2022 RNA Fault Current Analysis Summary Table for 2027 System Representation

Substation	Nominal Voltage (kV)	LCB FOR RNA	Owner	2027 Ozone Case			Breaker(s) Overdutied
				Maximum Bus Fault Current (kA)	Percent of Breaker Duty	IBA Required	
ACADEMY	345	63.0	Con Ed	31.6	50%	N	N
AES SOMERSET	345	40.0	NYSEG	16.5	41%	N	N
ALPS	345	39.0	N. Grid	20.4	52%	N	N
ASTE-ERG	138	63.0	Con Ed	53.7	85%	N	N
ASTE-WRG	138	63.0	Con Ed	53.7	85%	N	N
ASTORIA ANNEX	345	63.0	NYPA	52.4	83%	N	N
ASTORIA W-N	138	63.0	Con Ed	43.5	69%	N	N
ASTORIA W-S	138	63.0	Con Ed	43.5	69%	N	N
ATHENS	345	49.0	N. Grid	35.3	72%	N	N
BARRETT1	138	63.0	LIPA	50.3	80%	N	N
BARRETT2	138	63.0	LIPA	50.4	80%	N	N
BAYONNE	345	50.0	Con Ed	42.1	84%	N	N
BOONVILLE	115	23.0	N. Grid	10.7	47%	N	N
BOWLINE 2	345	40.0	O&R	26.6	66%	N	N
BOWLINE1	345	40.0	O&R	26.7	67%	N	N
BRKHAVEN	138	63.0	LIPA	26.6	42%	N	N
BUCH138	138	40.0	Con Ed	15.7	39%	N	N
BUCHANAN N	345	63.0	Con Ed	24.5	39%	N	N
BUCHANAN S	345	63.0	Con Ed	35.6	57%	N	N
C.ISLIP	138	63.0	LIPA	27.8	44%	N	N
CANANDAIGUA	230	40.0	NYSEG	8.5	21%	N	N
CARLE PL	138	63.0	LIPA	40.4	64%	N	N
CHAS_LAKE345	345	50.0	N. Grid	14.0	28%	N	N
CHURCHTOWN	115	40.0	NYSEG	9.6	24%	N	N
CLARKS CNRS	345	40.0	NYSEG	11.7	29%	N	N
CLARKS CNRS	115	40.0	NYSEG	17.6	44%	N	N
CLAY	345	49.0	N. Grid	33.6	68%	N	N
CLAY	115	45.0	N. Grid	38.0	84%	N	N
COOPERS CRN	345	40.0	NYSEG	19.1	48%	N	N
COOPERS CRN4	115	22.6	NYSEG	15.0	66%	N	N

Substation	Nominal Voltage (kV)	LCB FOR RNA	Owner	2027 Ozone Case			Breaker(s) Overdutied
				Maximum Bus Fault Current (kA)	Percent of Breaker Duty	IBA Required	
COOPERS CRN8	115	23.1	NYSEG	15.0	65%	N	N
CORONA-N	138	63.0	Con Ed	53.8	85%	N	N
CORONA-S	138	63.0	Con Ed	53.8	85%	N	N
CRICKET VLLY	345	63.0	Con Ed	35.7	57%	N	N
DEWITT	345	39.0	N. Grid	18.9	48%	N	N
DEWITT	115	39.0	N. Grid	29.4	75%	N	N
DOLSON AVE	345	63.0	NYPA	20.8	33%	N	N
DOVER	345	63.0	N. Grid	35.1	56%	N	N
DUFFY AVE	345	58.6	LIPA	8.4	14%	N	N
DULEY	230	40.0	NYPA	8.4	21%	N	N
DUN NO	138	40.0	Con Ed	35.0	88%	N	N
DUN NO S6	138	63.0	Con Ed	29.5	47%	N	N
DUN SO	138	40.0	Con Ed	31.9	80%	N	N
DUN SO N7	138	63.0	Con Ed	27.6	44%	N	N
DUNKIRK	230	33.0	N. Grid	7.7	23%	N	N
DUNWOODIE	345	63.0	Con Ed	48.4	77%	N	N
E FISHKILL	115	40.0	CH	24.4	61%	N	N
E FISHKILL	345	63.0	CH	43.6	69%	N	N
E13 ST	138	63.0	Con Ed	49.7	79%	N	N
E13ST 45	345	63.0	Con Ed	52.5	83%	N	N
E13ST 46	345	63.0	Con Ed	52.5	83%	N	N
E13ST 47	345	63.0	Con Ed	53.0	84%	N	N
E13ST 48	345	63.0	Con Ed	52.5	83%	N	N
EASTOVER	230	49.0	N. Grid	12.4	25%	N	N
EASTOVER N	115	49.0	N. Grid	26.6	54%	N	N
EASTVIEW	138	63.0	Con Ed	36.8	58%	N	N
EDIC	345	39.0	N. Grid	37.8	97%	N	N
EGC PAR	345	63.0	NYPA	24.8	39%	N	N
EGC-1	138	80.0	LIPA	70.1	88%	N	N
EGC-2	138	80.0	LIPA	70.1	88%	N	N
ELBRIDGE	345	40.0	N. Grid	16.0	40%	N	N
ELBRIDGE D	115	49.0	N. Grid	26.1	53%	N	N
ELWOOD 1	138	63.0	LIPA	38.8	62%	N	N
ELWOOD 2	138	63.0	LIPA	38.7	61%	N	N
FARRAGUT	345	63.0	Con Ed	59.0	94%	N	N
FITZPATRICK	345	37.0	NYPA	40.9	111%	Y[1]	N
FIVE MILE RD	345	49.0	N. Grid	7.6	15%	N	N

Substation	Nominal Voltage (kV)	LCB FOR RNA	Owner	2027 Ozone Case			Breaker(s) Overdutied
				Maximum Bus Fault Current (kA)	Percent of Breaker Duty	IBA Required	
FIVE MILE RD	115	49.0	N. Grid	14.1	29%	N	N
FRASER	115	40.0	NYSEG	19.4	48%	N	N
FRASER	345	40.0	NYSEG	19.6	49%	N	N
FREEPORT	138	63.0	LIPA	35.3	56%	N	N
FRESH KILLS	138	40.0	Con Ed	36.8	92%	N	N
FRESH KILLS	345	63.0	Con Ed	39.5	63%	N	N
GARDENVILLE	115	63.0	N. Grid	33.9	54%	N	N
GARDENVILLE1	230	31.0	N. Grid	18.1	58%	N	N
GILBOA 345	345	50.0	NYPA	25.6	51%	N	N
GLNWD NO	138	63.0	LIPA	42.8	68%	N	N
GLNWD SO	138	63.0	LIPA	42.5	68%	N	N
GORDON RD	345	63.0	N. Grid	24.4	39%	N	N
GOTHLS	345	63.0	Con Ed	45.4	72%	N	N
GOWANUS	345	63.0	Con Ed	54.7	87%	N	N
GREENLWN	138	63.0	LIPA	29.3	46%	N	N
HAUPAGUE	138	63.0	LIPA	21.8	35%	N	N
HIGH SHELDON	230	40.0	NYSEG	10.0	25%	N	N
HILLSIDE #4	115	21.1	NYSEG	19.2	91%	N	N
HILLSIDE #8	115	22.0	NYSEG	19.2	87%	N	N
HILLSIDE 230	230	35.9	NYSEG	14.6	41%	N	N
HOLBROOK	138	63.0	LIPA	47.2	75%	N	N
HOLTSGT-NYPA	138	63.0	LIPA	43.9	70%	N	N
HUNTLEY 68	230	30.0	N. Grid	16.6	55%	N	N
HUNTLEY 70	230	50.0	N. Grid	16.6	33%	N	N
HURLEY	345	40.0	CH	18.9	47%	N	N
HURLEY AVE	115	40.0	CH	16.8	42%	N	N
INDEPENDENCE	345	44.0	N. Grid	38.8	88%	N	N
JAMAICA	138	63.0	Con Ed	49.1	78%	N	N
KNICKERBOCKER	345	63.0	N. Grid	28.7	46%	N	N
LADENTOWN	345	63.0	O&R	38.3	61%	N	N
LAFAYETTE	345	40.0	N. Grid	17.8	44%	N	N
LCST GRV	138	63.0	LIPA	39.3	62%	N	N
LEEDS	345	37.0	N. Grid	36.1	98%	N	N
LHH WHITE	115	23.0	N. Grid	11.8	51%	N	N
LKSUCS P	138	63.0	LIPA	31.8	51%	N	N
LOVETT	138	40.0	O&R	29.0	73%	N	N
LOVETT 345	345	63.0	O&R	34.5	55%	N	N
MARCY 345	345	63.0	NYPA	36.4	58%	N	N

Substation	Nominal Voltage (kV)	LCB FOR RNA	Owner	2027 Ozone Case			Breaker(s) Overdutied
				Maximum Bus Fault Current (kA)	Percent of Breaker Duty	IBA Required	
MARCY 765	765	63.0	NYPA	10.1	16%	N	N
MASSENA 765	765	63.0	NYPA	7.0	11%	N	N
MEYER	230	40.0	NYSEG	8.3	21%	N	N
MEYER	115	18.9	NYSEG	11.7	62%	N	N
MIDDLETOWN TP	345	50.0	O&R	19.1	38%	N	N
MILLR PL	138	63.0	LIPA	14.6	23%	N	N
MILLWOOD	345	63.0	Con Ed	42.9	68%	N	N
MILLWOOD 138	138	40.0	Con Ed	19.4	49%	N	N
MOTT HAVEN	138	50.0	Con Ed	13.8	28%	N	N
MOTT HAVEN	138	50.0	Con Ed	13.8	28%	N	N
MOTT HAVEN	138	50.0	Con Ed	13.8	28%	N	N
MOTT HAVEN	138	50.0	Con Ed	13.8	28%	N	N
MOTT HAVEN	345	63.0	Con Ed	48.7	77%	N	N
NEWBRID	138	80.0	LIPA	68.4	85%	N	N
NEWBRIDG	345	56.0	LIPA	8.6	15%	N	N
NIAGARA 345	345	63.0	NYPA	32.8	52%	N	N
NIAGRA E 115	115	63.0	NYPA	36.2	57%	N	N
NIAGRA E 230	230	63.0	NYPA	53.1	84%	N	N
NIAGRA W 115	115	42.2	NYPA	29.2	69%	N	N
NIAGRA W 230	230	63.0	NYPA	53.1	84%	N	N
NMP#1	345	50.0	N. Grid	42.5	85%	N	N
NMP#2	345	50.0	N. Grid	43.3	87%	N	N
NRTHPRT1	138	63.0	LIPA	60.4	96%	N	N
NRTHPRT1-2	138	63.0	LIPA	60.4	96%	N	N
NRTHPRT2	138	63.0	LIPA	60.4	96%	N	N
NRTHPRT3	138	63.0	LIPA	46.0	73%	N	N
NRTHPRT4	138	63.0	LIPA	46.0	73%	N	N
NSCOT 33K	345	39.0	N. Grid	38.7	99%	N	N
NSCOT 77K	345	50.0	N. Grid	38.4	77%	N	N
NSCOT 99K	345	39.0	N. Grid	38.5	99%	N	N
NSCOT33	115	49.0	N. Grid	47.1	96%	N	N
NSCOT77	115	48.0	N. Grid	47.0	98%	N	N
NSCOT99	115	49.0	N. Grid	47.1	96%	N	N
OAKDALE	115	40.0	NYSEG	26.3	66%	N	N
OAKDALE 345	345	40.0	NYSEG	12.8	32%	N	N
OAKWOOD	138	63.0	LIPA	27.9	44%	N	N
ONEIDA EAST	115	23.0	N. Grid	12.1	53%	N	N
ONEIDA WEST	115	23.0	N. Grid	12.1	53%	N	N

Substation	Nominal Voltage (kV)	LCB FOR RNA	Owner	2027 Ozone Case			Breaker(s) Overdutied
				Maximum Bus Fault Current (kA)	Percent of Breaker Duty	IBA Required	
OSWEGO	345	44.0	N. Grid	32.5	74%	N	N
OSWEGO M3	115	40.0	N. Grid	21.2	53%	N	N
PACKARD 2&3	230	49.0	N. Grid	38.4	78%	N	N
PACKARD 4&5	230	49.0	N. Grid	38.4	78%	N	N
PACKARD 6	230	49.0	N. Grid	38.5	79%	N	N
PACKARD NRTH	115	62.0	N. Grid	28.5	46%	N	N
PACKARD STH	115	58.0	N. Grid	25.6	44%	N	N
PARK TR1	138	63.0	Con Ed	16.8	27%	N	N
PARK TR2	138	63.0	Con Ed	17.0	27%	N	N
PATNODE	230	63.0	NYPA	12.5	20%	N	N
PILGRIM	138	63.0	LIPA	58.6	93%	N	N
PL VILLE	345	63.0	Con Ed	21.7	34%	N	N
PL VILLW	345	63.0	Con Ed	21.9	35%	N	N
PLATTSBURGH	115	20.3	NYPA	18.1	89%	N	N
PLEASANT VAL	115	37.9	CH	24.8	66%	N	N
PLTVLLEY	345	63.0	Con Ed	50.1	80%	N	N
PORTER	115	59.0	N. Grid	28.0	47%	N	N
PRINCETOWN	345	63.0	N. Grid	30.0	48%	N	N
PT JEFF	138	63.0	LIPA	31.7	50%	N	N
Q396BRNPSU	230	40.0	NYSEG	7.5	19%	N	N
Q505_POI	230	50.0	N. Grid	6.9	14%	N	N
Q545A_DYSING	345	50.0	TransCo	21.4	43%	N	N
Q545A_ESTSTO	345	50.0	TransCo	8.7	17%	N	N
Q545A_PAR	345	50.0	TransCo	9.3	19%	N	N
Q546_230_TRA	230	40.0	N. Grid	7.9	20%	N	N
Q631/Q887AA	345	63.0	NYPA	49.5	79%	N	N
Q721POI	230	40.0	NYPA	14.4	36%	N	N
RAINEY	345	63.0	Con Ed	56.8	90%	N	N
RAMAPO	345	63.0	Con Ed	43.4	69%	N	N
REYNOLDS	345	39.0	N. Grid	16.5	42%	N	N
REYNOLDS RD	115	63.0	N. Grid	41.6	66%	N	N
RIVERHD	138	63.0	LIPA	20.7	33%	N	N
RNKNKOMA	138	63.0	LIPA	36.0	57%	N	N
ROBINSON RD.	230	43.1	NYSEG	13.5	31%	N	N
ROBINSON RD.	115	37.9	NYSEG	17.2	45%	N	N
ROCK TAV	115	40.0	CH	28.9	72%	N	N
ROCK TAVERN	345	63.0	CH	33.9	54%	N	N
ROSETON	345	63.0	CH	38.0	60%	N	N

Substation	Nominal Voltage (kV)	LCB FOR RNA	Owner	2027 Ozone Case			Breaker(s) Overdutied
				Maximum Bus Fault Current (kA)	Percent of Breaker Duty	IBA Required	
ROSLYN	138	63.0	LIPA	29.6	47%	N	N
ROTTERDAM66H	230	39.0	N. Grid	21.5	55%	N	N
ROTTERDAM77H	230	23.0	N. Grid	21.5	93%	N	N
ROTTERDAM99H	230	23.0	N. Grid	21.6	94%	N	N
RULND RD	138	63.0	LIPA	44.8	71%	N	N
RYAN	230	40.0	NYPA	13.4	33%	N	N
S OSWEGO	115	37.0	N. Grid	20.8	56%	N	N
S RIPLEY	230	40.0	N. Grid	4.2	11%	N	N
S013A	115	37.6	RGE	25.4	67%	N	N
S080 345kV	345	40.0	RGE	18.0	45%	N	N
S080 922	115	40.0	RGE	16.3	41%	N	N
S082 B2	115	40.0	RGE	36.0	90%	N	N
S082 B3	115	40.0	RGE	35.9	90%	N	N
S122	345	40.0	RGE	17.1	43%	N	N
S122 B1	115	50.0	RGE	32.0	64%	N	N
S255	345	63.0	RGE	18.0	28%	N	N
S255	115	40.0	RGE	22.0	55%	N	N
SCHUYLER	115	23.0	N. Grid	13.5	59%	N	N
SCRIBA	345	54.0	N. Grid	46.1	85%	N	N
SCRIBA C	115	40.0	N. Grid	10.5	26%	N	N
SCRIBA D	115	40.0	N. Grid	10.5	26%	N	N
SHORE RD	345	63.0	LIPA	26.9	43%	N	N
SHORE RD1	138	63.0	LIPA	46.4	74%	N	N
SHORE RD2	138	63.0	LIPA	46.4	74%	N	N
SHOREHAM1	138	63.0	LIPA	26.9	43%	N	N
SHOREHAM2	138	63.0	LIPA	26.9	43%	N	N
SILLS RD1	138	63.0	LIPA	31.4	50%	N	N
SMAH	138	40.0	RECO	26.1	65%	N	N
SPRAINBROOK	345	63.0	Con Ed	49.5	79%	N	N
ST LAWRENCE 115	115	50.0	NYPA	37.6	75%	N	N
ST LAWRENCE 230	230	32.4	NYPA	32.2	99%	N	N
STOLLE ROAD	345	40.0	NYSEG	8.6	22%	N	N
STOLLE ROAD	230	40.0	NYSEG	13.0	33%	N	N
STOLLE ROAD	115	23.9	NYSEG	19.1	80%	N	N
STONEYRIDGE	230	40.0	NYSEG	8.0	20%	N	N
STONY CREEK	230	40.0	NYSEG	9.0	22%	N	N
SUGLF 345TAP	345	63.0	CH	25.5	41%	N	N
SYOSSET	138	63.0	LIPA	33.9	54%	N	N

Substation	Nominal Voltage (kV)	LCB FOR RNA	Owner	2027 Ozone Case			Breaker(s) Overdutied
				Maximum Bus Fault Current (kA)	Percent of Breaker Duty	IBA Required	
TEALL A	115	39.0	N. Grid	26.8	69%	N	N
TEALL B	115	39.0	N. Grid	26.8	69%	N	N
TERMINAL	115	23.0	N. Grid	14.3	62%	N	N
VALLEY	115	39.0	N. Grid	8.4	22%	N	N
VAN WAGNER	345	63.0	N. Grid	48.4	77%	N	N
VERNON-E	138	63.0	Con Ed	45.8	73%	N	N
VERNON-W	138	63.0	Con Ed	33.2	53%	N	N
VLY STRM1	138	63.0	LIPA	57.0	90%	N	N
VLY STRM2	138	63.0	LIPA	57.2	91%	N	N
VOLNEY	345	45.0	N. Grid	36.5	81%	N	N
W 49 ST	345	63.0	Con Ed	49.3	78%	N	N
WADNGRV1	138	63.0	LIPA	25.0	40%	N	N
WATERCURE230	230	40.0	NYSEG	14.5	36%	N	N
WATERCURE345	345	40.0	NYSEG	9.5	24%	N	N
WATKINS	115	39.0	N. Grid	8.4	22%	N	N
WETHERSFIELD	230	40.0	NYSEG	8.8	22%	N	N
WHAV	138	40.0	O&R	29.7	74%	N	N
WILDWOOD	138	63.0	LIPA	26.4	42%	N	N
WILLIS 230	230	40.0	NYPA	16.7	42%	N	N
WOOD ST.	115	40.0	NYSEG	19.8	49%	N	N
WOODARD	115	23.0	N. Grid	12.2	53%	N	N
YAHNUNDASIS	115	16.0	N. Grid	6.4	40%	N	N

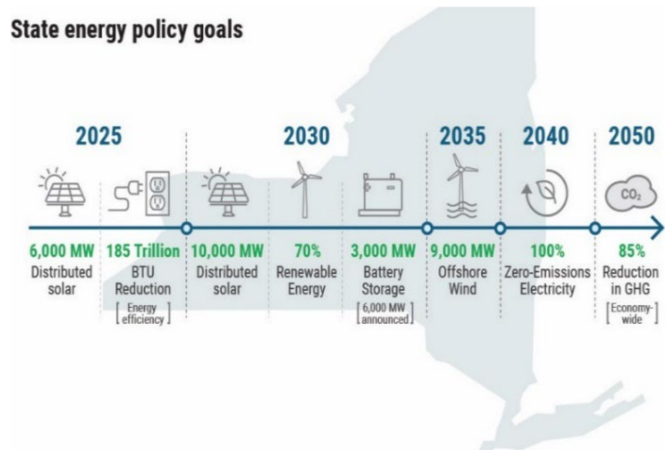
Appendix E - Road to 2040 – 70 x 30 Policy Case Scenario

The NYISO performed a scenario by building upon the findings from the *2021-2040 System & Resource Outloo*k (the "Outlook") Policy Case and focusing on system reliability aspects such as resource adequacy.

Climate Leadership and Community Protection Act (CLCPA) Background

The Climate Leadership and Community Protection Act (CLCPA), which was signed into law in 2019, mandates that New York consumers be served by 70% renewable energy by 2030 (70 x 30). The CLCPA includes specific technology-based targets, such as:

- 185 trillion BTU reduction (energy-efficiency) by 2025
- 6,000 MW of distributed solar PV by 2025
- 10,000 MW distributed solar by 2030
- 3,000 MW of energy storage by 2030
- 70% renewable energy by 2030
- 9,000 MW of offshore wind by 2035
- 100% zero-emissions electricity by 2040
- 85% reduction in Greenhouse Gas Emissions by 2050



Background of the Policy Case

Assumptions in the Outlook Policy Case reflect the federal, state, and local policies that impact the New York power system. Examples of policies modeled in this case include the 70 x 30 renewable mandate and the 2040 zero-emissions directive.

The suite of analyses in the Outlook provided a wide range of potential future system conditions and affords the ability to compare possible pathways to the future resource mix. Through the projection of future transmission congestion utilizing complex hourly production cost simulations, the NYISO did: (1) identify regions of New York where renewable generation "pockets" are expected to continue or form anew, (2) quantify the extent to which those pockets limit delivery of renewable energy to consumers, and (3) present information for stakeholders to identify potential transmission opportunities that may provide economic and operational benefits. In addition, the NYISO utilized the simulations to investigate and assess future system performance including ramping, reserves, and cycling of conventional thermal generators. These analyses inform reliability studies, including this *2022 Reliability Needs Assessment* (RNA), via using the results for 2030 from the Outlook Policy Case Scenario 2.

Given the significant uncertainty that exists surrounding the path to achieving policy objectives, the NYISO has modeled capacity expansion in the Economic Planning Process to evaluate many alternative paths to achieving the renewable resource buildout. The capacity expansion model optimizes future generation buildout to minimize capital and operating costs while also achieving each specific policy modeled (*e.g.,* 70 x 30 and zero-emissions by 2040 targets).

The capacity expansion optimization was limited to the NYCA system only, and does not include imports or exports, except that the contributions from Tier 4 projects are included as soon as the projects are assumed to be in-service. Due to the CLCPA requirement of a zero-emissions grid by 2040, the NYISO modeled all fossil-fueled generation as retired by that time. Existing zero-emitting generation, such as nuclear, hydro, land-based wind, and utility-scale solar generation, remains operational in the system through 2040.

The key input assumptions that drive the types and quantities of resource addition and replacement in the capacity expansion analysis are peak demand forecast, energy demand forecast, capital, operation, and maintenance cost associated with each technology, age of the existing fossil-fueled and nuclear fleet, and energy output from existing resources. The details are included in the *Outlook Report* and its Appendices C and D.

In addition to generation expansion, the capacity expansion optimization allows for generator retirements when their deactivation does not trigger a reliability need. The resulting retirement decisions from the capacity expansion scenarios are then translated to the production cost model. The higher resolution production cost models enable a deeper evaluation of the transmission and operational challenges related to adopting high levels of intermittent renewable generation. In addition, Scenario 2 includes an age-based retirement criteria that retires steam turbines at 62 years and gas turbines at 47 years of age, based on industry trends for the age at which 95% of the specified generation type historically retires.

System Resource Mix Scenarios from the Outlook

The NYISO uses a capacity expansion model to estimate possible system resource mixes over the next 20 years.[11] In the Outlook Policy Case, two specific generation buildout scenarios were selected from the multitude of capacity expansion simulations performed to reasonably bound impacts and formulate a

[11] The capacity expansion results in this study do not endorse outcomes under any specific set of assumptions. Instead, the results inform future transmission and generation planning.[12] Climate Change Phase II is available at: https://www.nyiso.com/documents/20142/16884550/NYISO-Climate-Impact-Study-Phase1-Report.pdf.

detailed nodal production cost simulation model.

- **Scenario 1 (S1)** utilizes industry data and NYISO load forecasts, representing a future with high demand (57,144 MW winter peak and 208,679 GWh energy demand in 2040) and assumes less restrictions in renewable generation buildout options.
- **Scenario 2 (S2)** utilizes various assumptions more closely aligned with the Climate Action Council Integration Analysis and represents a future with a moderate peak but a higher overall energy demand (42,301 MW winter peak and 235,731 GWh energy demand in 2040).

For this RNA resource adequacy scenario, the NYISO uses the Outlook Policy Case Scenario 2 results from 2030. Historical zonal capacity by type is shown in Figure 35 for comparison to the Policy Case results for Scenario 1 and Scenario 2, which are provided in Figure 36.

Projected resource mixes for Scenario 2 are provided in Figure 34.

Figure 34: Outlook Policy Case Scenario 2 Capacity Expansion Results

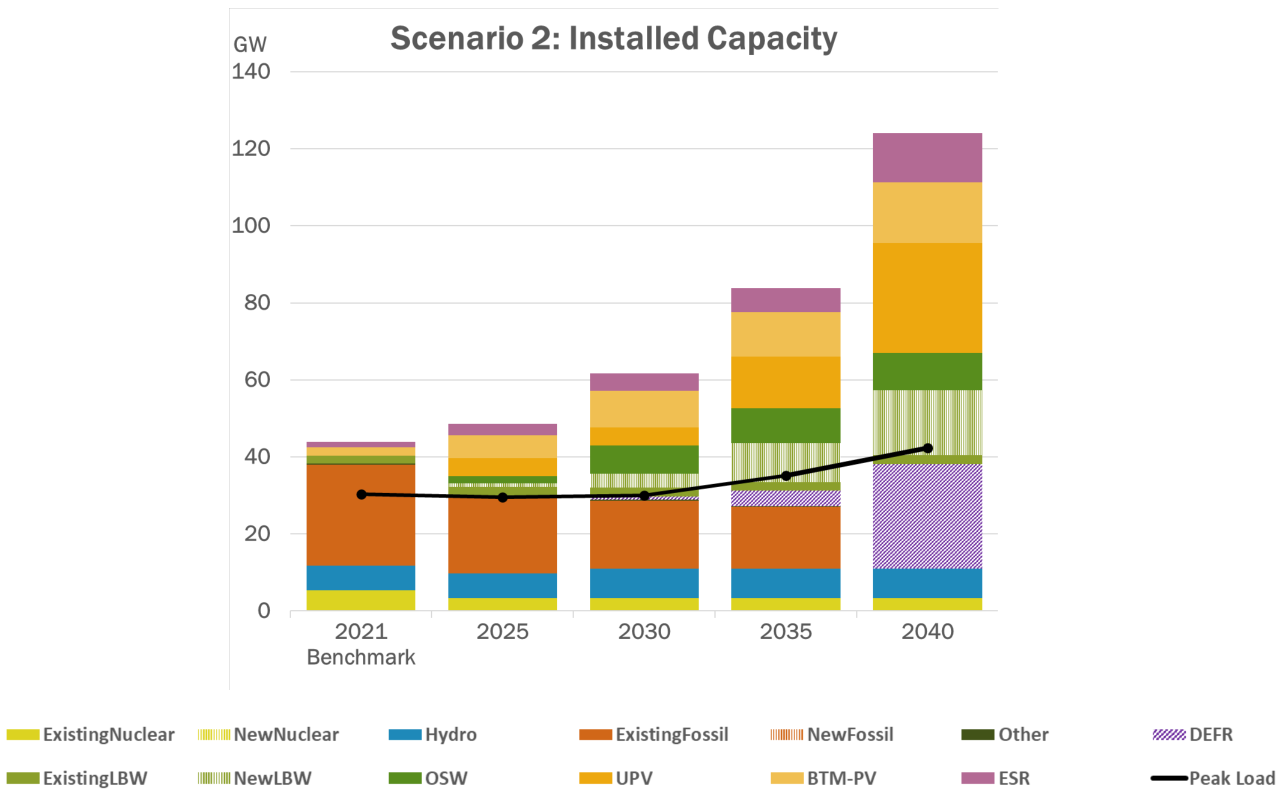


Figure 35: 2021 Actual Installed Capacity By Zone

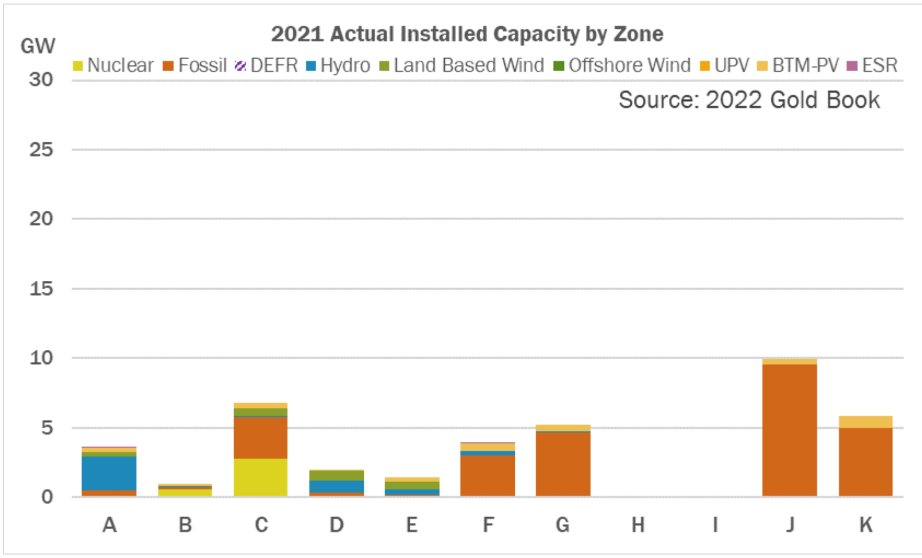
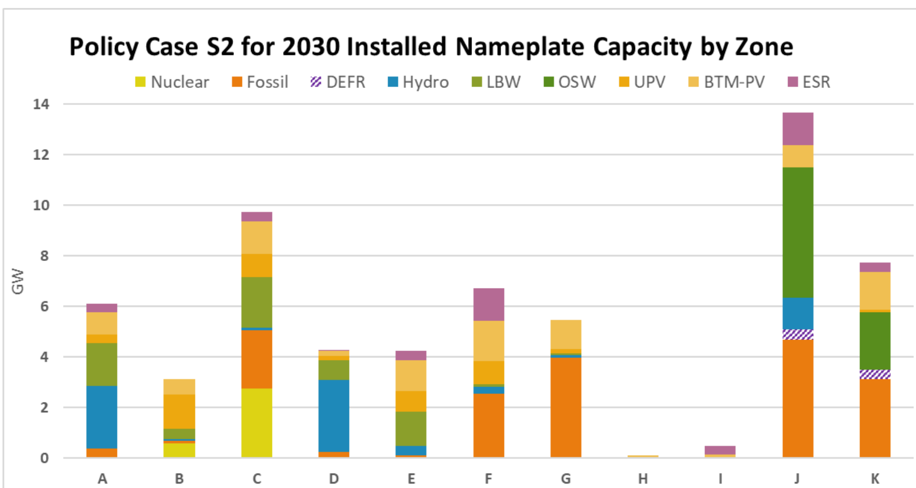


Figure 36: Outlook Policy Case Scenario 2 Installed Nameplate Capacity by Zone - 2030



Policy Case Scenario Assumptions

This RNA policy case scenario builds upon the findings from the 2021-2040 Outlook Policy Case Scenario 2 for year 2030 and provides further insight focusing on system reliability aspects such as resource adequacy.

The scenario consists of developing a MARS model to study the potential reliability impact of a certain renewable energy mix and load levels assumptions and augments the insights from the Outlook by adding the resource adequacy aspects. However, this scenario is not intended to define the specific steps that must be taken to achieve the policy goals. As policymakers advance on the implementation plan of CLCPA, this scenario is only intended to help provide insight into the resource adequacy reliability impacts of one load shape and its corresponding renewable resources mix in 2030, which is in addition to the congestion and curtailment insights gained in the Outlook.

An understanding of the key modeling assumptions and approaches is necessary as their selection may have major impact on the results. To help readers understand the scope of this assessment, considerations that are outside of the scope of this analysis are described below:

1. **Percentage of renewable energy relative to end-use energy:** This scenario does not define the formula to calculate the percentage of renewable energy relative to end-use energy, (*i.e.,* how to account for 70% renewable energy by 2030 or 70 x 30 target). Rather, several potential renewable build-out levels were defined and modeled in the Outlook study for corresponding load levels to approximate the potential future resource mix in 2030. One of them, *i.e.,* the Policy Case Scenario 2 for year 2030, was used in this study,

2. **Renewable mix modeling**

    a) **Siting and sizing:** Specific to the Policy Case, the NYISO's Interconnection Queue was one of many sources of information in guiding the process of translating the generation expansion results from the capacity expansion model at a zonal level into discrete generators at the nodal level in system modeling. Additional information on the generator placement process for the Policy Case is provided in Appendix E.3 of the Outlook Report.

    b) **Operational constraints:** Renewable resources are modeled as 8,760 hourly resource MW shapes for the resource adequacy MARS simulations. These generation profiles are synthetically generated resource shapes constructed using publicly available data and tools. This deterministic modeling approach will not capture the uncertainty involved with particular renewable resources.

Also, this analysis does not consider potential reliability impacts due to:

a) Changes on the transmission system limits as a result of the resource additions or subtractions;

b) Unit commitment, ramp rate constraints, and other production cost modeling techniques; or

c) Sub-hourly variation in renewable generation.

3. **Transmission system modeling:** This scenario is not an interconnection-level assessment of the renewable buildouts and does not review detailed engineering requirements, capacity deliverability, or impact to the New York system reserve margin. No other change is implemented, as compared with the 2022 RNA Base Case topology, to reflect the impacts of any modification

simulated in the scenarios, such as the addition of renewable resources, or the removal of fossil-fueled units.

4. **External area representation:** As the neighboring regions develop their own plans to achieve higher renewable generation penetration, those regions' demand, generation supply, and transmission system may change. Imports from Hydro Quebec are modeled as injections based upon usage profile from MAPS analysis. No flows between HQ and IESO or ISONE are modeled. The 1,250 MW HVDC CHPE from Hydro Quebec into New York City is modeled as an output shape from the Outlook Policy Case Scenario 2, which includes curtailments.

   If the neighboring areas increase their renewable generation, it is possible that the renewable curtailment amounts assumed in the NYCA from this scenario may be underestimated.

Load Assumptions

The same 8,760 hourly MW shape from the Outlook Policy Case Scenario 2 for 2030 scenario is used for the resource adequacy modeling for each of the seven probabilistic load bins. The load forecast uncertainty from the 2022 RNA Base Cases is applied. The assumed forecasts are shown in the Figure 37 below, with BtM solar forecast added back.

Figure 37: 2030 Policy Case: Demand Forecasts

Annual Energy	Summer Peak	Winter Peak
GWh	MW	
164,256	30,070	25,892

Figure 38: 2030 Policy Case Summer Energy and Peak Demand Forecast Zonal Distribution

2030 Outlook S2 Energy Details	A	B	C	D	E	F	G	H	I	J	K	NYCA
Net Load Energy (GWh)	14,547	9,438	14,955	4,802	6,305	10,183	7,732	2,632	5,769	53,937	19,518	149,817
+ BtM-PV Energy (GWh)	1,277	899	1,866	332	2,067	2,433	1,870	192	225	1,217	2,060	14,439
Total Energy (GWh)	15,824	10,337	16,821	5,134	8,372	12,616	9,602	2,824	5,993	55,155	21,578	164,256

2030 Outlook S2 Peak Details	A	B	C	D	E	F	G	H	I	J	K	NYCA
Net Load Peak (MW)	2,319	1,499	2,348	769	907	1,795	1,537	535	1,178	9,867	3,989	26,743
+ BtM-PV at NYCA Peak (MW)	293	208	429	79	475	562	432	45	51	280	475	3,327
Total Load Peak (MW)	2,612	1,706	2,777	847	1,382	2,357	1,969	579	1,229	10,147	4,464	30,070

Note: *Non-coincident zonal peak

Coincident peak demand is the projected zonal load during the date and hour of the NYCA system-wide peak. The NYCA coincident peak typically occurs in late afternoon during July or August. Non-coincident peak demand is the projected maximum load for each individual zone across a year or season.

Renewable Mix Assumptions

The NYISO assumed a renewable resource mix distributed across the state by zone, corresponding to the load modeled in the Outlook Policy Case Scenario 2 for 2030. This RNA scenario models the same zonal renewable resource distribution.

Additional modeling details, by type:

- **Land-based wind (LBW):** Hourly dispatch profiles (MWh shapes) are applied from the Outlook Policy Case Scenario 2 for 2030 simulation output, including curtailments observed in the production simulation. The Outlook used the 2009 weather year National Renewable Energy Laboratory (NREL) data as input.
- **Off-shore wind (OSW):** Hourly dispatch profiles (MWh shapes) are applied from the Outlook Policy Case Scenario 2 for 2030 simulation output, including curtailments observed in the production simulation, for each of the two load shapes. The Outlook used the 2009 weather year NREL data as input.
- **Utility-scale Solar PV (UPV):** Hourly dispatch profiles (MWh shapes) are applied from the Outlook Policy Case Scenario 2 for 2030 simulation output, including curtailments observed in the production simulation, for each of the two load shapes. The Outlook used the 2006 weather year NREL data as input.
- **Behind-the-Meter PV (BtM PV):** Hourly dispatch profile (MWh shapes) are applied from the Outlook Policy Case Scenario 2 for 2030 simulation output. The underlying BtM PV shapes used in the Outlook Scenario 2 forecast were from the *Climate Impact Study Phase II.* [12] They were modified to align with the projected BtM PV capacity from Berkley's Lab Integration Analysis.[13]

Storage Assumptions

The MARS Energy Storage (ES) model was used, with the energy storage nameplate by zone summary provided from the Outlook data. If a zone had more than 100 MW of energy storage nameplate, the units were split into approximately 100 MW increments. All energy storage units have four hours of full capability, consistent with the Outlook Policy Case Scenario 2 assumptions.

This scenario assumes the same zonal MW distribution modeled in the Outlook Policy Case, as shown in the Figure 36 above. In these simulations, the energy storage units discharge their power when the system is deficient and recharge their energy when the system has an excess of capacity. Units are modeled with a maximum energy discharge per day of four times their maximum hourly discharge value. This paradigm allows the unit to discharge fully in four hours, or for longer if not at full

[12] Climate Change Phase II is available at: https://www.nyiso.com/documents/20142/16884550/NYISO-Climate-Impact-Study-Phase1-Report.pdf.

[13] Berkley's Lab Integration Analysis is available at: https://climate.ny.gov/-/media/Project/Climate/Files/IA-Tech-Supplement-Annex-1-Input-Assumptions.xlsx.

discharge.

Contracts and External Areas

This scenario models PJM, Ontario and ISO-NE systems using same method as the 2022 RNA Base Case.

Hydro Quebec (HQ) is modeled as an import (*i.e.*, no generation or load). All contracts currently tied to HQ (*i.e.*, HQ Wheel and HQ Import) were removed. All ties to and from HQ set to 0. The following HQ contracts are modeled as shapes from the Outlook output data:

- Champlain Hudson Power Express (CHPE)
- HQ Import (including Cedars)

Transmission

This scenario is not an interconnection-level assessment of the renewable buildouts and does not review detailed engineering requirements, capacity deliverability, or impact to the New York system reserve margin. No other change was implemented, as compared with the 2022 RNA Base Case topology, to reflect the impacts of any modification simulated in the scenarios.

This scenario includes two significant proposed HVDC projects that have received awards under NYSERDA's Tier 4 REC program, of which one— CHPE—is also included in the 2022 RNA Base Case. Both projects are reflected in the MARS model using the Outlook Policy Case 8,760 hourly MW flow.

- 1,250 MW Champlain Hudson Power Express project,[14] jointly developed by Transmission Developers, Inc. and Hydro-Québec, is a 375-mile submarine and underground HVDC transmission project delivering power from Québec, Canada to New York City.
- 1,300 MW Clean Path New York (CPNY) project,[15] jointly developed by Forward Power (a joint venture of Invenergy and EnergyRe) and the New York Power Authority, is a 174-mile underground and submarine HVDC transmission line from Fraser substation in upstate New York to New York City.

Dispatchable Emissions-Free Resources (DEFRs)

The Outlook Policy Case Scenario 2 modeled 819 MW installed capacity of DEFRs for 2030; however, in the output data, only a single unit was dispatched by the production simulation program and for only 50 MWh. Therefore, for the purposes of this reliability analysis no DEFRs are modeled in this RNA 2030 policy case scenario.

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[14] Additional details of the Champlain Hudson Power Express project are available at https://chpexpress.com/.

[15] Additional details of the Clean Path New York project are available at https://www.cleanpathny.com/.

Policy Case Analysis and Findings

GE's MARS program is used for resource adequacy analysis of this 2030 policy case scenario. The GE-MARS tool employs a sequential Monte Carlo simulation method, and calculates, on an area and system basis, standard reliability indices such as daily and hourly LOLE (days/year and hours/year). New MARS cases were developed based on the assumptions described above, and sensitivities were performed to better understand the impact of various factors.

The following describe two major steps employed for this scenario:

- Step 1: Modeling the renewable mix corresponding to the Outlook Policy Case for 2030 load level;
- Step 2: Removing capacity by using two methods:
    a. removing generic "perfect capacity" resources from each zone until the LOLE 0.1 days/year criterion is reached, and
    b. removing fossil capacity by age.

Step 1: Renewable Mix on the Outlook Policy Case for 2030 Load Levels

Model the Outlook's Policy Case Scenario 2 for 2030 load levels along with their corresponding renewable resources mix output and calculate the NYCA LOLE.

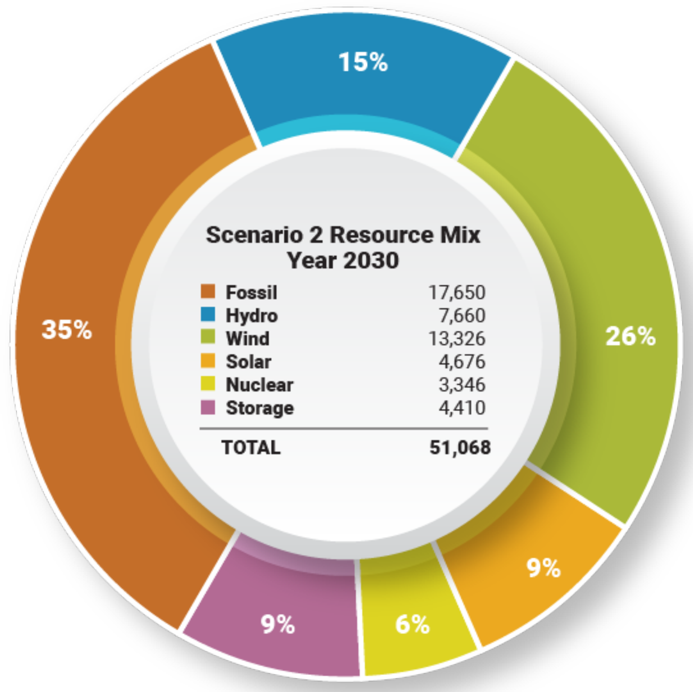
Initial resource adequacy simulations show that the modeled system is well below the 0.1 days/year criterion, at NYCA LOLE of 0.008 event-days/year as shown in Figure 39 below. This result occurs because large amounts of additional renewable generation are modeled in this scenario, while still retaining some of the existing fossil fuel generators. This, in turn, leads to a surplus of available generation for resource adequacy purposes. In addition, the transmission system model (MARS topology) is not revised to reflect the potential impacts of increasing the penetration of renewable resources.

Figure 39: 2030 Policy Case: Resource Adequacy Results

NYCA Metric	Value
LOLE (days/year)	0.008
LOLH (hours/year)	0.020
EUE (MWH/year)	3.264

Figure 40 below shows the resource mix with the renewables added.

Figure 40: 2030 Policy Case: Resource Mix before Capacity Removal



Policy Case Zonal Resource Adequacy Margins

Additional simulations are performed to gauge the sensitivity of the system to capacity removal. A Zonal Resource Adequacy Margin (ZRAM) analysis: identifies the amounts of generic "perfect capacity" resources that can be removed from a single zone while still meeting the LOLE criterion. "Perfect capacity" is capacity that is not derated (*e.g.,* due to ambient temperature or unit unavailability caused by factors such as equipment failures or lack of fuel), not subject to energy duration limitations (*i.e.*, available at maximum capacity every hour of the study year) and not tested for transmission security or interface impacts. Actual resources would need to be larger in order to achieve the same impact as perfect-capacity resources.

Figure 41: 2030 Policy Case: Zonal Resource Adequacy Margins

Study Year 2030	NYCA LOLE	Zone A	Zone B	Zone C	Zone D	Zone E	Zone F	Zone G	Zone H	Zone I	Zone J	Zone K
Base Case	0.006	-850	-850	-2,325	-1,925	-2,525	-2,525	-2,525	-2,175	-2,175	-1,450	-750
Policy Case S2	0.008	-2,300	-2,300	-2,700	-1,150	-2,700	-2,725	-2,750	-2,700	-2,700	-1,900	-450

Notes:

- Negative numbers indicate the amount of MW that can be removed from a zone (one zone at a time in this case) without causing a violation. For instance, NYCA LOLE reaches 0.1 days/year when 450 MW of "perfect capacity" is removed from Zone K in the Policy Case, and 750 MW in the 2022 RNA Base Case.

- The generation pockets in Zone J and Zone K are not modeled in detail in MARS, and the values identified here may be larger as a result.

The ZRAM analysis results show that while the NYCA LOLE for the Outlook Scenario 2 case is below its 0.1 days/year criterion, removing 450 MW of perfect capacity in Zone K (or 1,900 MW in Zone J or 1,150 in Zone D) can lead to resource adequacy violations.

Age-Based Retirement Analysis

An age-based retirement analysis was also performed, where fossil units are removed from the model, starting with the oldest, until the New York system is at its LOLE criteria. This age-based approach is a simple analytical approach as a proxy to represent unit retirements that may occur as surplus resources increase. In reality, many factors will affect specific generator status decisions.

Figure 42: 2030 Policy Case: Fossil Removal by Age

	Total Thermal Capacity Left (MW)				Total Thermal Capacity Removed (MW)					
Cases (Age >=)	Zone J	Zone K	Other Zones	Total	Zone J	Zone K	Other Zones	Total	Total**	NYCA LOLE
2022 RNA Base	8,755	4,946	11,688	25,389	0	0	0	0	-	-
Outlook S2 Base	4,848	3,145	9,657	17,650	3,907	1,801	2,031	7,739	0	0.01
62	4,848	2,737	9,635	17,220	3,907	2,209	2,053	8,169	430	0.04
61*	4,848	2,499	9,635	16,982	3,907	2,447	2,053	8,407	668	0.10
61	4,848	2,341	9,616	16,805	3,907	2,605	2,072	8,584	845	0.19

*A special evaluation of Case 61 where the marginal unit was derated, instead of fully removed, to obtain an LOLE of close to 0.1 days/year

** Total removal compared to the Outlook S2 Case

Both the Outlook Policy Case and this RNA already reflect proposed deactivations and status changes such as the impact of the DEC Peaker Rule. The Outlook Policy Case Scenario 2 also already includes an age-based retirement criteria that retires steam turbines at 62 years and gas turbines at 47 years of age, based on industry trends for the age at which 95% of the specified generation type historically retires.

In the age-based analysis, the total capacity will reduce by 845 MW if generators at least 61 years old are removed. This reduction will cause the NYCA to exceed the LOLE criterion. Further analysis shows that the LOLE can be brought closer to the 0.1 days/year criterion by derating the capacity of the marginal unit (Case 61*), which identifies that the NYCA will exceed the LOLE criterion once 668 MW out of 17,650 MW of total statewide fossil generation have been removed from the system, of which 646 MW is from

Zone K. The age-based fossil removal method has the effect to primarily remove the units from Zones K, accelerating the rate of LOLE reaching its criterion violation. Because Zone K is driving the LOLE at criterion, and not upstate generation, additional fossil generation can be removed from the upstate zones without affecting the LOLE at criterion.

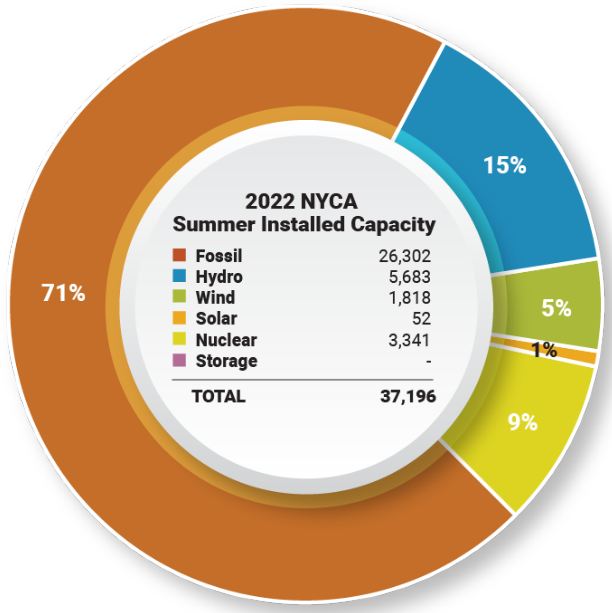
This age-based scenario shows that approximately 17,000 MW must be retained to have an adequate system. For different conditions such as higher load, or different zonal resources and types, this value can be higher.

If the peak load from the Outlook Policy Case Scenario 1 materializes, additional existing fossil generation will need to be retained to maintain reliability of the system. Additional fossil generation may also be needed to provide other reliability services such as black start, voltage support, governor response, etc.

This finding, however, is sensitive to location. The age-based fossil removal method has the effect of primarily removing the units from Long Island (Zone K) which is already near its limit in the model, thus accelerating the rate of LOLE reaching its criterion violation. Because Zone K (and not upstate generation) is driving the LOLE at criterion, additional fossil generation could be removed from the upstate zones without affecting the LOLE at criterion.

Figure 43 and Figure 44 below show the resulting resources mixes for the state, New York City (Zone J) and Long Island (Zone K), respectively. All generation percentages are calculated based on nameplate rating.

Figure 43: 2030 Policy Case: NYCA Resource Mix after the Age-Based Fossil Removal



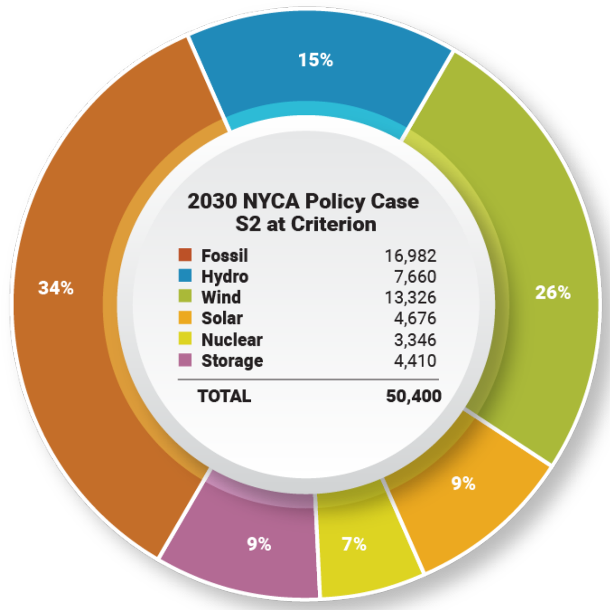
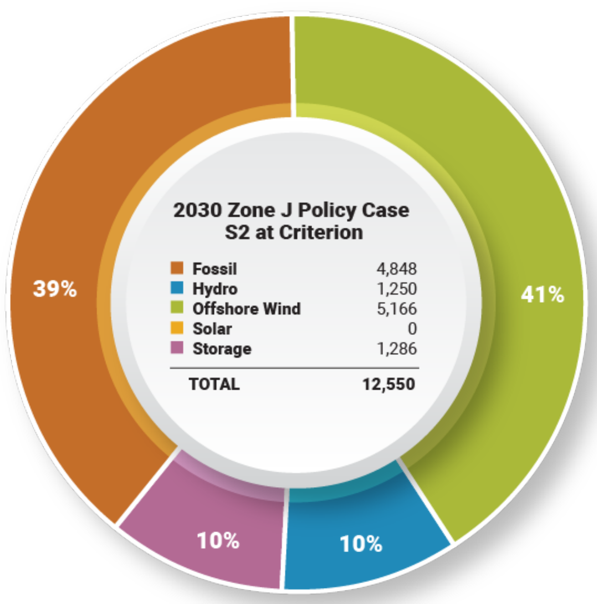


Figure 44: 2030 Policy Case: New York City (Zone J) and Long Island (Zone K) Resource Mix at Criterion



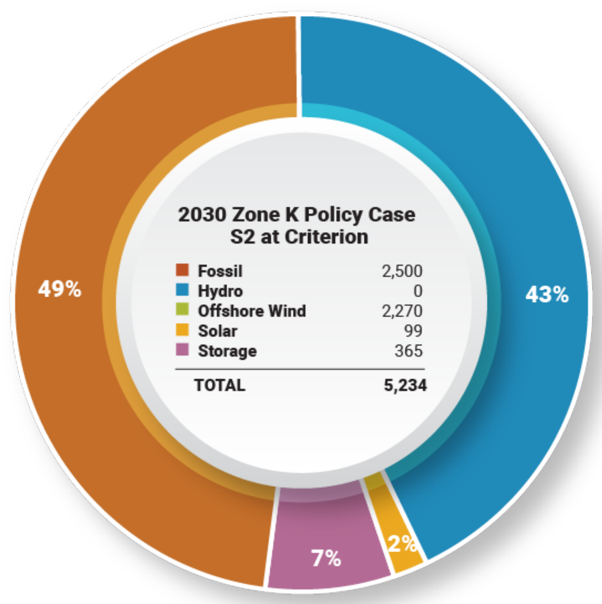


Figure 45 shows a comparison between the total installed capacity and unforced capacity for the scenario case when the system is close to LOLE criterion. After removal of fossil generation to bring the model to criterion, the remaining resources result in a statewide installed capacity margin of 188.5%, equivalent to an unforced capacity margin of 135.8%.

Figure 45: 2030 Policy Case: Load and Capacity Totals, ICAP vs. UCAP

NYCA Totals	Outlook S2 Y2030 (ICAP)	Outlook S2 Y2030 (UCAP)
Load (net of BtM Solar)	**26,743**	**26,743**
*Capacity from 2022 RNA Base Case**	37,625	32,670
Outlook Renewable Additions (*offshore & land-based wind, utility solar)* *	13,805	4,521
HQ Imports	3,035	3,035
Outlook Storage Additions	3,005	2,254
Outlook Thermal Removals*	6,402	5,616
Total capacity in the Outlook S2 model before age-based capacity removal*	51,068	36,864
Age-based capacity removed to get to 0.1 LOLE ("model at criterion")	668	548
Total capacity ("model at criterion")	**50,400**	**36,316**
Capacity/ Load Ratio	**188.5%**	**135.8%**
Zone J Totals		
Load (net of BtM Solar)	**9,867**	**9,867**
Total capacity in Outlook S2 Case*	12,550	8,182
Total thermal units in Outlook S2 model before age-based capacity	4,848	4,546
Age-based capacity removed to get to 0.1 LOLE ("model at criterion")	0	0
Total capacity ("model at criterion")	**12,550**	**8,182**
Capacity/Load Ratio	**127.2%**	**82.9%**
Zone K Totals		
Load (net of BtM Solar)	**3,989**	**3,989**
Total capacity in Outlook S2 Case*	5,880	3,776
Total thermal units in Outlook S2 model before age-based capacity	3,145	2,857
Age-based capacity removed to get to 0.1 LOLE ("model at criterion")*	646	527
Total capacity ("model at criterion")	**5,234**	**3,249**
Capacity/Load Ratio	**131.2%**	**81.4%**

Note: *Renewable UCAP calculated based on average 13:00 to 18:00 hourly output during June, July and August. Thermal UCAP calculated based on MARS unit availability (eford) data. Thermal generator capacities are the minimum of CRIS and DMNC.

Appendix F - Transmission Security Margins (Tipping Points)

Introduction

The purpose of this assessment is to identify plausible changes in conditions or assumptions that might adversely impact the reliability of the Bulk Power Transmission Facilities (BPTF) or "tip" the system into violation of a transmission security criterion. This assessment is performed using a deterministic approach through a spreadsheet-based method using input from the 2022 Load and Capacity Data Report (Gold Book) and the projects that meet the 2022 RNA base case inclusion rules. At the May 5, 2022[16] and May 23, 2022[17] joint meetings of the Transmission Planning Advisory Subcommittee and the Electric System Planning Working Group (TPAS/ESPWG), the NYISO discussed with stakeholders several enhancements to the reliability planning practices. The proposed changes to reliability planning practices include: (1) modeling intermittent resources according to their expected availability coincident with the represented system condition, (2) accounting for the availability of thermal generation based on NERC class average five-year outage rate data in transmission security assessments, (3) the ability to identify reliability needs through the spreadsheet-based method of calculating transmission security margins (a.k.a. "tipping points") within the Lower Hudson Valley (Zones G-J), New York City (Zone J), and Long Island (Zone K) localities, as well as other enhancements to reliability planning practices. At its June 23, 2022, meeting, the Operating Committee approved revisions to the Reliability Planning Process Manual that reflect these enhancements. For this assessment, the margins are evaluated statewide as well as Lower Hudson Valley, New York City, and Long Island localities.

A BPTF reliability need is identified when the transmission security margin under expected weather conditions in the Lower Hudson Valley, New York City, and Long Island localities are less than zero or when the statewide system margin is less than zero. Additional details regarding the impact of heatwave, extreme heatwave, or other scenario conditions are provided for informational purposes.

[16] https://www.nyiso.com/documents/20142/30451285/08_Reliability_Practices_TPAS-ESPWG_2022-05-05.pdf/

[17] https://www.nyiso.com/documents/20142/30860639/04%20Response%20to%20SHQuestions%20and%20Feedback%20on%202022%20RNA%202022%20Quarter%202%20STAR.pdf/

New York Control Area (NYCA) Tipping Points

The statewide system margin for the New York is evaluated under baseline expected weather for summer and winter conditions with normal transfer criteria. Under current applicable reliability rules and procedures, a Reliability Need would be identified when the statewide margin is negative for the base case assumptions (*i.e.*, baseline expected weather, normal transfer criteria). The statewide system margin is the ability to meet the forecasted load and largest loss-of-source contingency (*i.e.,* total capacity requirement) against the NYCA generation (including derates) and external area interchanges. The NYCA generation (from line-item A) is comprised of the existing generation plus additions of future generation resources that meet the reliability planning process base case inclusion rules, as well as the removal of deactivating generation and peaker units. Consistent with current transmission planning practices for transmission security, the NYISO assumed the following: (1) land-based wind generation is assumed at a 5% of nameplate output and off-shore wind is assumed at 10% of nameplate output, (2) run-of-river hydro is reduced consistent with its average capacity factor, and (3) wholesale solar generation is dispatched based on the ratio of behind-the-meter solar generation ("BtM-PV") BtM solar nameplate capacity and BtM-PV peak reductions stated in the 2022 Gold Book. Derates for thermal resources based on their NERC five-year class average EFORd are also included.[18] Additionally, the NYCA generation includes the Oswego export limit with all lines in service.

As transmission security analysis represents discrete snapshots in time of various credible combinations of system conditions, when reliability needs are identified only the magnitude of the need is identified (*e.g.*, a thermal overload expressed in terms of percentage of the applicable rating) under those system conditions. Additional details are required to fully describe the nature of the need such as evaluating the hourly load shape and its impact on the need. For example, in the 2020 Reliability Needs Assessment[19], there is information detailing various contingency combinations resulting in thermal overloads (*see, e.g.*, 2020 RNA Figure 26) within New York City. To fully describe the nature of these needs, load-duration curves were developed (*see, e.g.*, 2020 RNA Figure 27) for the transmission load areas in which needs were observed.

To describe the nature of the statewide system margins under expected summer peak, heatwave, and extreme heatwave conditions more fully, load shapes are developed to reflect the expected behavior of the load over 24 hours on the summer peak day for the 10-year study horizon. Details of the load shapes are provided later in this appendix. For this assessment load shapes were not developed past 2032 and have only been developed for the summer condition.

[18] NERC five-year class average EFORd data
[19] 2020 Reliability Needs Assessment

Baseline peak forecasts and load shapes assume expected (approximately average) peak day weather. The heatwave and extreme heatwave conditions are defined by the 90th and 99th percentile summer peak forecasts documented in the Gold Book, respectively. The baseline and percentile summer peak forecasts utilize a cumulative temperature and humidity index, which reflects a weighted average of weather conditions on the peak day and the two preceding days and is based on the historical distribution of peak-day weather. The peak load forecasts incorporate the projected impacts of increasing temperature trends throughout the forecast horizon. In general, a heatwave (1-in-10-year or 90/10) has a statewide average maximum temperature of 95 degrees Fahrenheit. An extreme heatwave (1-in-100-year or 99/1) has a statewide average maximum temperature of 98 degrees Fahrenheit.

As shown in **Figure 46**, under summer peak baseline expected weather load, normal transfer criteria, the statewide system margin (line-item I) ranges between 845 MW in 2023 to 1,341 MW in 2032. The annual fluctuations are driven by the decreases in NYCA generation (line-item A) and in the load forecast (line-item F). An additional sensitivity evaluation shown in **Figure 46** is the impact of maintaining the full operating reserve within the NYCA (line-item K). The statewide system margin with full operating reserve is deficient in the first few years (2023 through 2025) under summer peak conditions until the CHPE project enters service.[20]

Utilizing the load shapes for the baseline expected weather summer peak day (**Figure 128**), the statewide system margin for each hour utilizing normal transfer criteria is shown in **Figure 47**. The statewide system margins for each hour are created by using the load forecast for each hour in the margin calculation (*e.g.*, **Figure 46** line-item F) with additional adjustments in NYCA generation to account for the appropriate derate for solar generation and energy limited resources in each hour (*e.g.*, **Figure 46** line-item B). All other values in the margin calculations are held constant. A graphical representation of the hourly margin for years 2023, 2025, 2027, and 2032 is shown in **Figure 48**. These years are selected due to the DEC Peaker Rule impacts in 2023 and 2025 along with the year 5 representation (2027) and the last year of the RNA study period (2032). For all years in the 10-year study horizon, there are no observed deficiencies considering the statewide coincident peak day load shape.

It is possible for other combinations of events, such as a 1-in-10-year heatwave[21] (“heatwave”) or 1-in-100-year extreme heatwave[22] (“extreme heatwave”) to result in a deficient statewide system margin. **Figure 49** shows the statewide system margin for heatwave condition under the assumption that the system is using emergency transfer criteria. Although system transmission security is not currently

[20] The CHPE project is currently planned to enter service in December 2025.
[21] The load forecast utilized for the heatwave condition is the 90th percentile (or 90/10) expected load forecast.
[22] The load forecast utilized for the extreme heatwave condition is the 99th percentile (or 99/1) expected load forecast.

designed under these conditions, **Figure 49** shows that insufficient margin exists for in the first few years (2023 through 2025) under summer peak conditions until the CHPE project is in-service (line-item J). In 2023, the system is deficient by 485 MW, which reduces in 2024 to 159 MW. This reduction is primarily due to decreasing load forecast. In 2025, the deficiency moves down to 392 MW primarily due to a decrease in NYCA generation. In 2026, with CHPE in service, the margin returns positive to 1,024 MW. However, by 2032 the margin is extremely narrow at 22 MW. Additionally, **Figure 49** also shows the statewide system margin with full operating reserve under heatwave conditions (line-item L). Under this sensitivity there is insufficient margin for all study years.

Utilizing the load shape for the 1-in-10-year heatwave (**Figure 133**), the statewide system margin for each hour utilizing emergency transfer criteria is shown in **Figure 50**. Under the 1-in-10-year heatwave conditions, the deficiency for the 1-in-10-year heatwave peak day in 2023 shown in **Figure 49** at the statewide coincident peak hour is 485 MW. **Figure 50** shows that the system is deficient in four hours with a total deficiency in the 24-hour period of 1,856 MWh. In 2024, the deficiency of 159 MW is only for one hour. In 2025, the deficiency lasts for three hours (921 MWh). For years 2026 through 2032 the margin curve for each day remains sufficient. **Figure 51** provides a graphical representation of the statewide system margin curve for heatwave conditions for the heatwave peak day in summers 2023, 2025, 2027, and 2032.

For the statewide system margin in a 1-in-100-year extreme heatwave, **Figure 52** shows that there is insufficient statewide system margin as early as 2023 by 2,394 MW (line-item J). The insufficient margin has improvement with the inclusion of the CHPE project, improving to a deficiency of 841 MW in 2026. However, by 2032 the margins are deficient by 1,881 MW. These issues are exacerbated with consideration of operating reserve (line-item L).

Utilizing the load shape for the 1-in-100-year extreme heatwave (**Figure 138**), the statewide system margin for each hour utilizing emergency transfer criteria is shown in **Figure 53**. Under the 1-in-100-year extreme heatwave conditions, the deficiency for the extreme heatwave day in summer 2023 shown in **Figure 52** as 2,394 MW is seen over ten hours (15,505 MWh). With the in-service status of CHPE in December 2025, the deficiency observed for the extreme heatwave day in summer 2026 improves to four hours (2,277 MWh). By 2032, the extreme heatwave days deficiency increases to seven hours (8,250 MWh). **Figure 54** provides a graphical representation of the statewide system margin curve for heatwave conditions for the peak day in years 2023, 2025, 2027, and 2032.

Figure 55 shows the statewide system margin under winter peak baseline expected weather load condition using normal transfer criteria. For winter peak, the statewide system margin ranges from 9,800

MW in winter 2023-24 to 4,102 MW in winter 2032-33. Under the additional sensitivity evaluation of maintaining the full operating reserve in the NYCA shown in **Figure 55** all years are also shown to be sufficient.

Cold snap and extreme cold snap conditions are defined by the 90th and 99th percentile Gold Book winter peak forecasts, respectively. The baseline and percentile winter peak forecasts utilize the historical distribution of winter peak day temperature. In general, a cold snap (1-in-10-year or 90/10) reflects a statewide daily average temperature of 6 degrees Fahrenheit. An extreme cold snap (1-in-100-year or 99/1) reflects a statewide daily average temperature of 0 degrees Fahrenheit.

Figure 56 shows the statewide system margin in a 1-in-10-year cold snap ("cold snap") utilizing emergency transfer criteria.[23] Under this condition the margin is sufficient for all study years (line-item J) and ranges from 9,038 MW in winter 2023-24 to 3,048 MW in winter 2032-33. Additionally, **Figure 56** shows the statewide system margin with full operating reserve which is also sufficient for all study years.

Figure 57 shows the statewide system margin in a 1-in-100-year extreme cold snap ("extreme cold snap") utilizing emergency transfer criteria.[24] Under this condition the margin is sufficient for all study years (line-item J) and ranges from 7,722 MW in winter 2023-24 to 1,424 MW in winter 2032-33. Additionally, **Figure 57** shows the statewide system margin with full operating reserve which is also sufficient for all study years (line-item L).

Figure 58 provides a summary of the summer peak statewide system margins under expected weather, heatwave, and extreme heatwave conditions. **Figure 59** provides a summary of the winter peak statewide system margins under expected weather, cold snap, and extreme cold snap conditions. While **Figure 58** and **Figure 59** provide a summary of the statewide system margin through the 10-year horizon, the 2022 Gold Book provides the forecast details through year 2052.

Figure 60 provides a summary of the statewide system margins (summer and winter) under baseline expected weather conditions through 2052 to quantify the future year margins beyond the RNA horizon. These margins assume that no resource additions beyond what is included in the RNA are added to the system. These margins are an extension of the total resources in the last year of the RNA horizon (*i.e.,* **Figure 46** shows the total resources for summer 2032 at 34,865 MW and **Figure 55** shows the total resources for winter 2032-33 at 35,366 MW) through 2052 and do not consider future generator deactivations or additions. As seen in **Figure 60,** the statewide system margin is extremely narrow by

[23] The load forecast utilized for the cold snap condition is the winter 90th percentile (or 90/10) expected load forecast.
[24] The load forecast utilized for the extreme cold snap condition is the winter 99th percentile (or 99/1) expected load forecast.

winter 2035-36 with a margin of 63 MW and is deficient in winter 2036-37 by 1,422 MW. By winter 2052-53, the observed deficiency is 10,491 MW. Under expected summer conditions the system is extremely narrow by 2037 with a margin of 28 MW and is deficient in summer 2038 by 195 MW. By summer 2052, the observed deficiency in summer is 2,052 MW. Anticipated generation additions to meet CLCPA goals, such as those discussed in the System & Resource Outlook Policy Scenario 2 will have a significant impact on the ability to maintain sufficient margin.

Figure 46: Statewide System Margin (Summer Peak - Baseline Expected Weather, Normal Transfer Criteria)

Line	Item	Summer Peak - Baseline Expected Summer Weather, Normal Transfer Criteria (MW)									
		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
A	NYCA Generation (1)	38,147	38,832	38,323	38,323	38,323	38,323	38,323	38,323	38,323	38,323
B	NYCA Generation Derates (2)	(5,818)	(6,434)	(6,458)	(6,471)	(6,485)	(6,498)	(6,511)	(6,525)	(6,538)	(6,552)
C	Temperature Based Generation Derates	0	0	0	0	0	0	0	0	0	0
D	External Area Interchanges (3)	1,844	1,844	1,844	3,094	3,094	3,094	3,094	3,094	3,094	3,094
E	**Total Resources (A+B+C+D)**	34,173	34,242	33,709	34,945	34,932	34,919	34,905	34,892	34,878	34,865
F	Load Forecast	(32,018)	(31,778)	(31,505)	(31,339)	(31,292)	(31,317)	(31,468)	(31,684)	(31,946)	(32,214)
G	Largest Loss-of-Source Contingency	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)
H	**Total Capability Requirement (F+G)**	(33,328)	(33,088)	(32,815)	(32,649)	(32,602)	(32,627)	(32,778)	(32,994)	(33,256)	(33,524)
I	**Statewide System Margin (E+H)**	845	1,154	894	2,296	2,330	2,292	2,127	1,898	1,622	1,341
J	Operating Reserve	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)
K	**Statewide System Margin with Full Operating Reserve (I+J) (4)**	(465)	(156)	(416)	986	1,020	982	817	588	312	31

Notes:

1. Reflects the 2022 Gold Book existing summer capacity plus projected additions and deactivations.
2. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 5% of the total nameplate, off-shore wind at 10% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
3. Interchanges are based on ERAG MMWG values.
4. For informational purposes.

Figure 47: Statewide System Margin (Hourly) (Summer Peak - Baseline Expected Weather, Normal Transfer Criteria)

Summer Peak - Baseline Expected Summer Weather, Normal Transfer Criteria (MW)										
Statewide System Margin										
Hour	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
HB0	7,367	7,411	6,899	8,104	8,011	7,878	7,659	7,364	7,021	6,678
HB1	7,277	7,331	6,829	8,047	7,971	7,857	7,661	7,398	7,089	6,781
HB2	8,055	8,113	7,616	8,843	8,779	8,679	8,504	8,266	7,989	7,713
HB3	8,487	8,549	8,059	9,296	9,243	9,158	9,000	8,788	8,540	8,293
HB4	8,518	8,587	8,107	9,356	9,319	9,254	9,119	8,940	8,731	8,523
HB5	8,003	8,092	7,629	8,898	8,879	8,831	8,713	8,551	8,357	8,160
HB6	7,000	7,174	6,788	8,129	8,174	8,187	8,121	7,999	7,837	7,659
HB7	6,677	6,998	6,735	8,183	8,329	8,430	8,437	8,366	8,233	8,075
HB8	5,598	6,058	5,902	7,435	7,655	7,818	7,866	7,809	7,662	7,480
HB9	4,622	5,208	5,145	6,753	7,042	7,265	7,361	7,332	7,198	7,018
HB10	3,456	4,153	4,176	5,854	6,209	6,489	6,633	6,636	6,520	6,351
HB11	2,427	3,202	3,286	5,017	5,423	5,753	5,940	5,983	5,900	5,759
HB12	1,636	2,451	2,573	4,327	4,755	5,105	5,308	5,373	5,311	5,193
HB13	1,355	1,572	1,687	3,430	3,847	4,190	4,383	4,448	4,396	4,291
HB14	1,635	1,777	1,831	3,279	3,637	3,926	3,267	3,293	3,217	3,098
HB15	1,257	1,292	1,263	2,868	3,150	3,369	2,967	2,940	2,827	2,681
HB16	1,075	1,565	862	2,387	2,588	2,732	2,149	2,067	1,915	1,739
HB17	845	1,154	894	2,296	2,379	2,411	2,308	2,241	2,024	1,793
HB18	428	1,236	903	2,242	2,330	2,292	2,127	1,898	1,622	1,341
HB19	358	1,665	1,258	2,540	2,510	2,437	2,249	2,000	1,709	1,416
HB20	803	906	1,054	2,551	2,504	2,417	2,807	2,550	2,249	1,949
HB21	1,640	1,735	1,284	2,539	2,488	2,396	2,678	2,418	2,114	1,807
HB22	2,700	2,775	2,299	3,533	3,461	3,347	3,938	3,653	3,317	2,980
HB23	4,406	4,468	3,969	5,187	5,105	4,981	4,767	4,472	4,127	3,780

Figure 48: Statewide System Margin Hourly Curve (Summer Peak - Baseline Expected Weather, Normal Transfer Criteria)

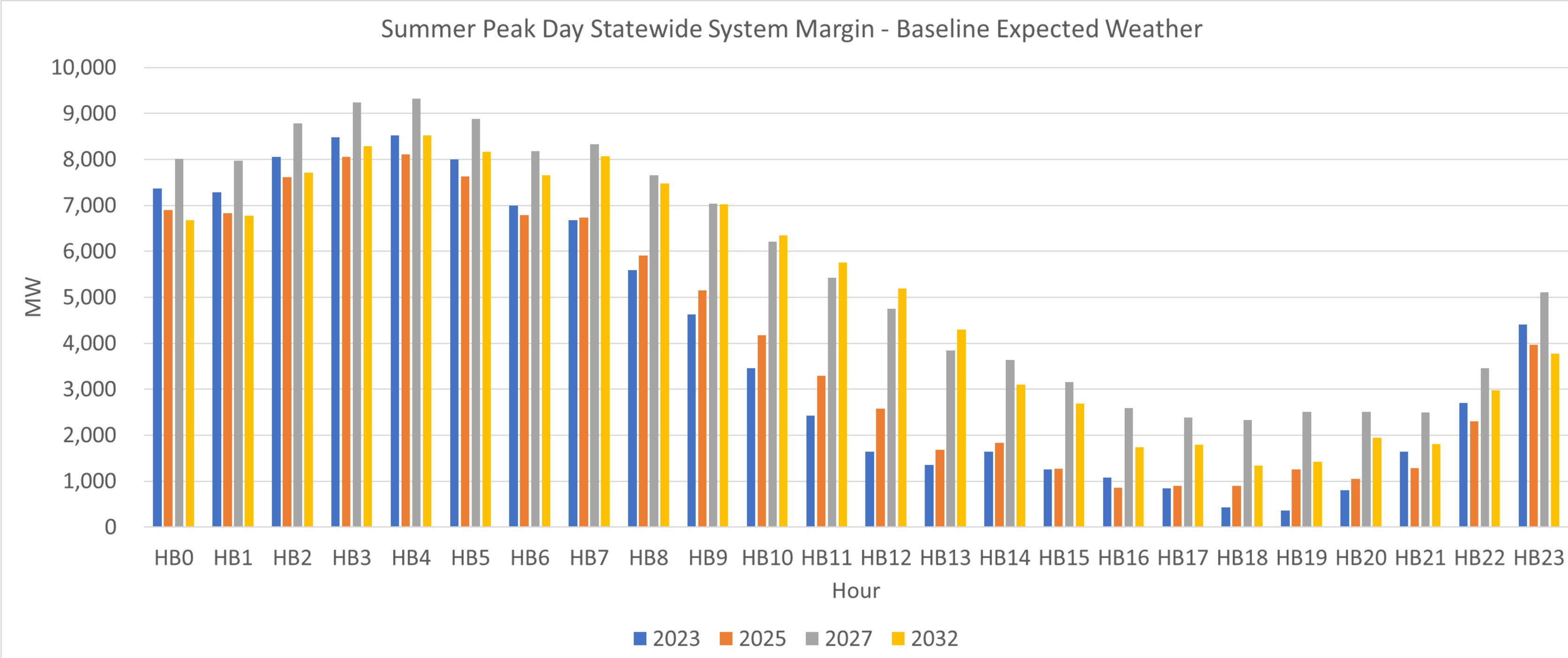


Figure 49: Statewide System Margin (1-in-10-Year Heatwave, Emergency Transfer Criteria)

Line	Item	Summer Peak - 1-in-10-Year Heatwave, Emergency Transfer Criteria (MW)									
		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
A	NYCA Generation (1)	38,147	38,832	38,323	38,323	38,323	38,323	38,323	38,323	38,323	38,323
B	NYCA Generation Derates (2)	(5,818)	(6,434)	(6,458)	(6,471)	(6,485)	(6,498)	(6,511)	(6,525)	(6,538)	(6,552)
C	Temperature Based Generation Derates	(193)	(193)	(184)	(184)	(184)	(184)	(184)	(184)	(184)	(184)
D	External Area Interchanges (3)	1,844	1,844	1,844	3,094	3,094	3,094	3,094	3,094	3,094	3,094
E	SCRs (4), (5)	860	860	860	860	860	860	860	860	860	860
F	**Total Resources (A+B+C+D+E)**	34,841	34,909	34,385	35,622	35,608	35,595	35,582	35,568	35,555	35,541
G	Load Forecast	(34,016)	(33,758)	(33,467)	(33,288)	(33,238)	(33,263)	(33,422)	(33,649)	(33,926)	(34,209)
H	Largest Loss-of-Source Contingency	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)
I	**Total Capability Requirement (G+H)**	(35,326)	(35,068)	(34,777)	(34,598)	(34,548)	(34,573)	(34,732)	(34,959)	(35,236)	(35,519)
J	**Statewide System Margin (F+I)**	(485)	(159)	(392)	1,024	1,060	1,022	850	609	319	22
K	Operating Reserve	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)
L	**Statewide System Margin with Full Operating Reserve (J+K)**	(1,795)	(1,469)	(1,702)	(286)	(250)	(288)	(460)	(701)	(991)	(1,288)

Notes:

1. Reflects the 2022 Gold Book existing summer capacity plus projected additions and deactivations.
2. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 5% of the total nameplate, off-shore wind at 10% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
3. Interchanges are based on ERAG MMWG values.
4. SCRs are not applied for transmission security analysis of normal operations, but are included for emergency operations.
5. Includes a de-rate of 364 MW for SCRs.

Figure 50: Statewide System Margin (Hourly) (1-in-10-Year Heatwave, Emergency Transfer Criteria)

Summary Peak - Heatwave, Emergency Transfer Criteria (MW)										
Statewide System Margin										
Hour	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
HB0	5,147	5,199	4,702	5,911	5,793	5,623	5,367	5,051	4,698	4,346
HB1	5,181	5,240	4,753	5,975	5,874	5,722	5,489	5,203	4,885	4,568
HB2	6,002	6,069	5,592	6,826	6,740	6,607	6,397	6,141	5,859	5,577
HB3	6,482	6,554	6,084	7,329	7,254	7,136	6,944	6,715	6,462	6,210
HB4	6,549	6,629	6,167	7,424	7,364	7,265	7,096	6,899	6,685	6,471
HB5	5,999	6,104	5,666	6,949	6,913	6,838	6,691	6,517	6,325	6,128
HB6	4,900	5,091	4,729	6,084	6,113	6,098	6,002	5,869	5,706	5,529
HB7	4,564	4,881	4,623	6,065	6,173	6,227	6,184	6,082	5,929	5,750
HB8	3,590	4,043	3,888	5,410	5,590	5,700	5,696	5,603	5,433	5,227
HB9	2,714	3,292	3,230	4,826	5,074	5,244	5,287	5,221	5,062	4,858
HB10	1,722	2,407	2,426	4,088	4,398	4,622	4,708	4,671	4,526	4,329
HB11	1,092	1,850	1,925	3,634	3,989	4,256	4,381	4,377	4,260	4,085
HB12	542	1,337	1,446	3,177	3,546	3,824	3,953	3,962	3,861	3,704
HB13	460	660	767	2,489	2,844	3,108	3,222	3,229	3,138	2,995
HB14	607	739	792	2,227	2,523	2,733	1,993	1,964	1,852	1,698
HB15	32	67	48	1,649	1,873	2,013	1,531	1,455	1,313	1,139
HB16	(165)	330	(363)	1,160	1,300	1,360	692	557	376	172
HB17	(485)	(159)	(392)	1,024	1,060	1,022	850	745	514	270
HB18	(683)	141	(167)	1,183	1,224	1,115	879	609	319	22
HB19	(523)	799	415	1,707	1,634	1,496	1,243	957	651	344
HB20	51	168	336	1,841	1,755	1,609	1,939	1,648	1,335	1,020
HB21	1,031	1,124	677	1,923	1,823	1,665	1,881	1,577	1,247	914
HB22	2,282	2,349	1,869	3,088	2,967	2,789	3,315	2,985	2,620	2,253
HB23	4,174	4,220	3,713	4,912	4,781	4,596	4,321	3,982	3,604	3,225

Figure 51: Statewide System Margin Hourly Curve (1-in-10-Year Heatwave, Emergency Transfer Criteria)

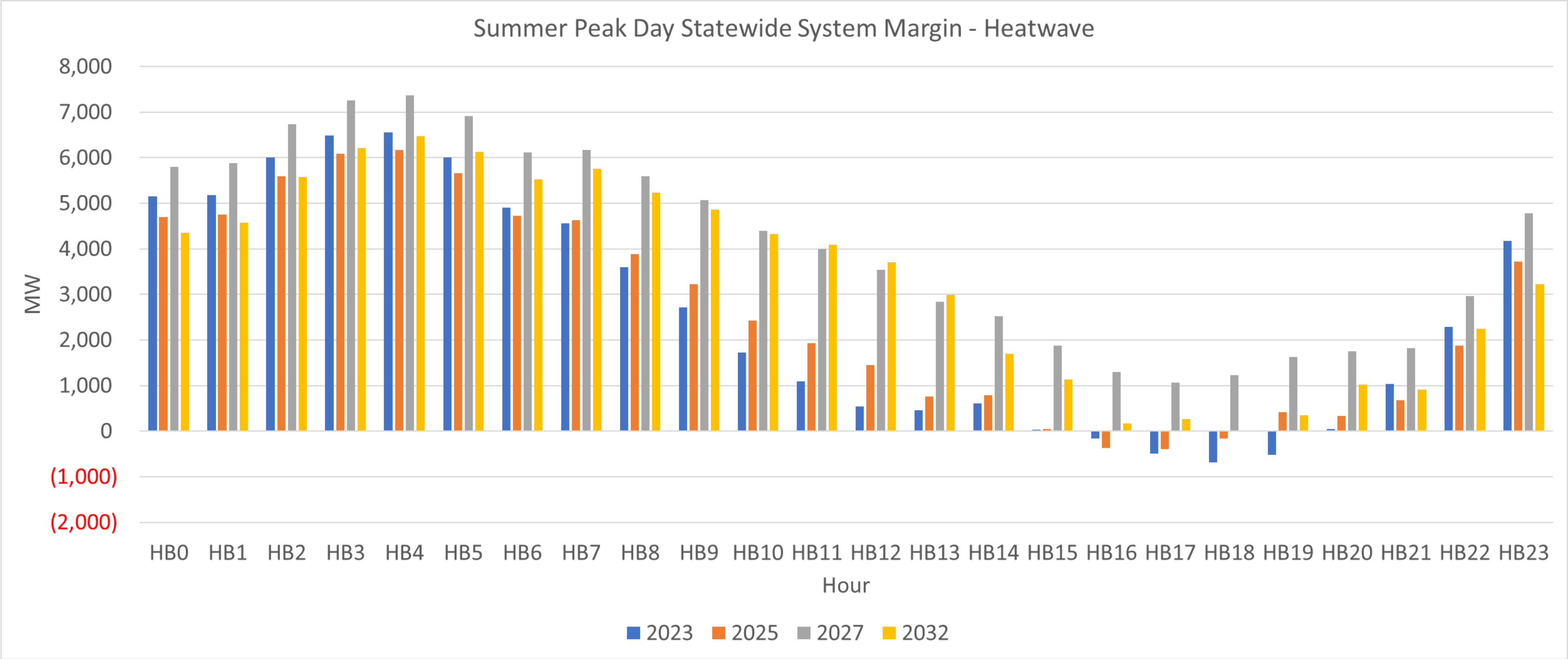


Figure 52: Statewide System Margin (1-in-100-Year Extreme Heatwave, Emergency Transfer Criteria)

Line	Item	Summer Peak - 1-in-100-Year Extreme Heatwave, Emergency Transfer Criteria (MW)									
		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
A	NYCA Generation (1)	38,147	38,832	38,323	38,323	38,323	38,323	38,323	38,323	38,323	38,323
B	NYCA Generation Derates (2)	(5,818)	(6,434)	(6,458)	(6,471)	(6,485)	(6,498)	(6,511)	(6,525)	(6,538)	(6,552)
C	Temperature Based Generation Derates	(405)	(405)	(386)	(386)	(386)	(386)	(386)	(386)	(386)	(386)
D	External Area Interchanges (3)	1,844	1,844	1,844	3,094	3,094	3,094	3,094	3,094	3,094	3,094
E	SCRs (4), (5)	860	860	860	860	860	860	860	860	860	860
F	**Total Resources (A+B+C+D+E)**	34,629	34,697	34,183	35,420	35,406	35,393	35,380	35,366	35,353	35,339
G	Load Forecast	(35,713)	(35,443)	(35,138)	(34,951)	(34,897)	(34,921)	(35,088)	(35,326)	(35,617)	(35,910)
H	Largest Loss-of-Source Contingency	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)
I	**Total Capability Requirement (G+H)**	(37,023)	(36,753)	(36,448)	(36,261)	(36,207)	(36,231)	(36,398)	(36,636)	(36,927)	(37,220)
J	**Statewide System Margin (F+I)**	(2,394)	(2,056)	(2,265)	(841)	(801)	(838)	(1,018)	(1,270)	(1,574)	(1,881)
K	Operating Reserve	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)
L	**Statewide System Margin with Full Operating Reserve (J+K)**	(3,704)	(3,366)	(3,575)	(2,151)	(2,111)	(2,148)	(2,328)	(2,580)	(2,884)	(3,191)

Notes:

1. Reflects the 2022 Gold Book existing summer capacity plus projected additions and deactivations.
2. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 5% of the total nameplate, off-shore wind at 10% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
3. Interchanges are based on ERAG MMWG values.
4. SCRs are not applied for transmission security analysis of normal operations, but are included for emergency operations.
5. Includes a de-rate of 364 MW for SCRs.

Figure 53: Statewide System Margin (Hourly) (1-in-100-Year Extreme Heatwave, Emergency Transfer Criteria)

Summer Peak - 1-in-100-Year Extreme Heatwave, Emergency Transfer Criteria (MW)										
Statewide System Margin										
Hour	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
HB0	4,086	4,144	3,664	4,877	4,762	4,592	4,332	4,011	3,650	3,293
HB1	4,120	4,185	3,715	4,941	4,843	4,691	4,454	4,163	3,837	3,515
HB2	4,941	5,014	4,554	5,792	5,709	5,576	5,362	5,101	4,811	4,524
HB3	5,421	5,499	5,046	6,295	6,223	6,105	5,909	5,675	5,414	5,157
HB4	5,488	5,574	5,129	6,390	6,333	6,234	6,061	5,859	5,637	5,418
HB5	4,938	5,049	4,628	5,915	5,882	5,807	5,656	5,477	5,277	5,075
HB6	3,839	4,036	3,691	5,050	5,082	5,067	4,967	4,829	4,658	4,476
HB7	3,503	3,826	3,585	5,031	5,142	5,196	5,149	5,042	4,881	4,697
HB8	2,529	2,988	2,850	4,376	4,559	4,669	4,661	4,563	4,385	4,174
HB9	1,653	2,237	2,192	3,792	4,043	4,213	4,252	4,181	4,014	3,805
HB10	661	1,352	1,388	3,054	3,367	3,591	3,673	3,631	3,478	3,276
HB11	31	795	887	2,600	2,958	3,225	3,346	3,337	3,212	3,032
HB12	(688)	114	241	1,977	2,349	2,627	2,752	2,754	2,644	2,481
HB13	(940)	(732)	(605)	1,123	1,481	1,745	1,854	1,853	1,752	1,602
HB14	(962)	(821)	(746)	694	994	1,204	458	421	298	136
HB15	(1,707)	(1,662)	(1,658)	(49)	178	319	(170)	(257)	(411)	(594)
HB16	(2,074)	(1,567)	(2,236)	(705)	(561)	(500)	(1,176)	(1,322)	(1,517)	(1,731)
HB17	(2,394)	(2,056)	(2,265)	(841)	(801)	(838)	(1,018)	(1,134)	(1,379)	(1,633)
HB18	(2,592)	(1,756)	(2,040)	(682)	(637)	(745)	(989)	(1,270)	(1,574)	(1,881)
HB19	(2,262)	(930)	(1,291)	9	(61)	(198)	(458)	(755)	(1,073)	(1,389)
HB20	(1,518)	(1,392)	(1,202)	308	226	80	404	105	(219)	(542)
HB21	(369)	(268)	(695)	557	460	302	513	201	(139)	(479)
HB22	1,052	1,126	664	1,888	1,770	1,592	2,114	1,777	1,403	1,030
HB23	3,113	3,165	2,675	3,878	3,750	3,565	3,286	2,942	2,556	2,172

Figure 54: Statewide System Margin Hourly Curve (1-in-100-Year Extreme Heatwave, Emergency Transfer Criteria)

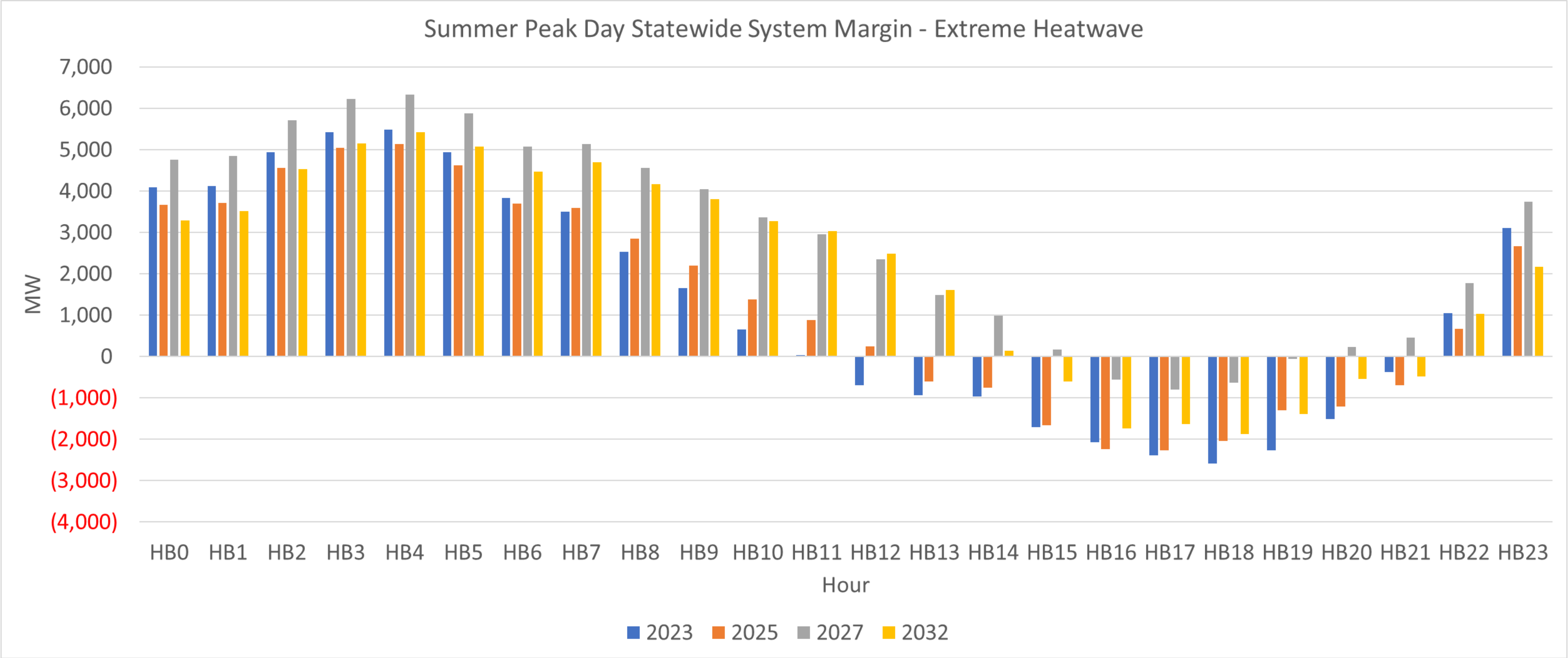


Figure 55: Statewide System Margin (Winter Peak - Baseline Expected Weather, Normal Transfer Criteria)

Line	Item	Winter Peak - Baseline Expected Winter Weather, Normal Transfer Criteria (MW)									
		2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33
A	NYCA Generation (1)	41,102	41,192	41,158	41,158	41,158	41,158	41,158	41,158	41,158	41,158
B	NYCA Generation Derates (2)	(6,973)	(7,064)	(7,061)	(7,061)	(7,061)	(7,061)	(7,061)	(7,061)	(7,061)	(7,061)
C	Temperature Based Generation Derates	0	0	0	0	0	0	0	0	0	0
D	External Area Interchanges (3)	1,268	1,268	1,268	1,268	1,268	1,268	1,268	1,268	1,268	1,268
E	**Total Resources (A+B+C+D)**	35,397	35,397	35,366	35,366	35,366	35,366	35,366	35,366	35,366	35,366
F	Load Forecast	(24,287)	(24,481)	(24,735)	(25,098)	(25,575)	(26,171)	(26,884)	(27,719)	(28,756)	(29,954)
G	Largest Loss-of-Source Contingency	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)
H	**Total Capability Requirement (F+G)**	(25,597)	(25,791)	(26,045)	(26,408)	(26,885)	(27,481)	(28,194)	(29,029)	(30,066)	(31,264)
I	**Statewide System Margin (E+H)**	9,800	9,606	9,321	8,958	8,481	7,885	7,172	6,337	5,300	4,102
J	Operating Reserve	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)
K	**Statewide System Margin with Full Operating Reserve (I+J) (4)**	8,490	8,296	8,011	7,648	7,171	6,575	5,862	5,027	3,990	2,792

Notes:

1. Reflects the 2022 Gold Book existing winter capacity plus projected additions and deactivations.
2. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 10% of the total nameplate, off-shore wind at 15% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). For winter the expected solar PV output at peak is 0 MW. Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
3. Interchanges are based on ERAG MMWG values.
4. For informational purposes.

Figure 56: Statewide System Margin (1-in-10-Year Cold Snap, Emergency Transfer Criteria)

Line	Item	Winter Peak - 1-in-10-Year Cold Snap, Emergency Transfer Criteria (MW)									
		2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33
A	NYCA Generation (1)	41,192	41,192	41,158	41,158	41,158	41,158	41,158	41,158	41,158	41,158
B	NYCA Generation Derates (2)	(7,064)	(7,064)	(7,061)	(7,061)	(7,061)	(7,061)	(7,061)	(7,061)	(7,061)	(7,061)
C	Temperature Based Generation Derates	0	0	0	0	0	0	0	0	0	0
D	External Area Interchanges (3)	1,268	1,268	1,268	1,268	1,268	1,268	1,268	1,268	1,268	1,268
E	SCRs (4), (5)	486	486	486	486	486	486	486	486	486	486
F	**Total Resources (A+B+C+D+E)**	35,883	35,883	35,852	35,852	35,852	35,852	35,852	35,852	35,852	35,852
G	Load Forecast	(25,535)	(25,739)	(26,007)	(26,388)	(26,891)	(27,518)	(28,266)	(29,144)	(30,237)	(31,494)
H	Largest Loss-of-Source Contingency	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)
I	**Total Capability Requirement (G+H)**	(26,845)	(27,049)	(27,317)	(27,698)	(28,201)	(28,828)	(29,576)	(30,454)	(31,547)	(32,804)
J	**Statewide System Margin (F+I)**	9,038	8,834	8,535	8,154	7,651	7,024	6,276	5,398	4,305	3,048
K	Operating Reserve	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)
L	**Statewide System Margin with Full Operating Reserve (J+K)**	7,728	7,524	7,225	6,844	6,341	5,714	4,966	4,088	2,995	1,738

Notes:

1. Reflects the 2022 Gold Book existing winter capacity plus projected additions and deactivations.
2. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 10% of the total nameplate, off-shore wind at 15% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). For winter the expected solar PV output at peak is 0 MW. Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
3. Interchanges are based on ERAG MMWG values.
4. SCRs are not applied for transmission security analysis of normal operations, but are included for emergency operations.
5. Includes a de-rate of 211 MW for SCRs.

Figure 57: Statewide System Margin (1-in-100-Year Extreme Cold Snap, Emergency Transfer Criteria)

Line	Item	Winter Peak - 1-in-100-Year Extreme Cold Snap, Emergency Transfer Criteria (MW)									
		2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33
A	NYCA Generation (1)	41,192	41,192	41,158	41,158	41,158	41,158	41,158	41,158	41,158	41,158
B	NYCA Generation Derates (2)	(7,064)	(7,064)	(7,061)	(7,061)	(7,061)	(7,061)	(7,061)	(7,061)	(7,061)	(7,061)
C	Temperature Based Generation Derates	0	0	0	0	0	0	0	0	0	0
D	External Area Interchanges (3)	1,268	1,268	1,268	1,268	1,268	1,268	1,268	1,268	1,268	1,268
E	SCRs (4), (5)	486	486	486	486	486	486	486	486	486	486
F	**Total Resources (A+B+C+D+E)**	35,883	35,883	35,852	35,852	35,852	35,852	35,852	35,852	35,852	35,852
G	Load Forecast	(26,851)	(27,069)	(27,351)	(27,750)	(28,276)	(28,936)	(29,723)	(30,647)	(31,794)	(33,118)
H	Largest Loss-of-Source Contingency	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)
I	**Total Capability Requirement (G+H)**	(28,161)	(28,379)	(28,661)	(29,060)	(29,586)	(30,246)	(31,033)	(31,957)	(33,104)	(34,428)
J	**Statewide System Margin (F+I)**	7,722	7,504	7,191	6,792	6,266	5,606	4,819	3,895	2,748	1,424
K	Operating Reserve	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)
L	**Statewide System Margin with Full Operating Reserve (J+K)**	6,412	6,194	5,881	5,482	4,956	4,296	3,509	2,585	1,438	114

Notes:

1. Reflects the 2022 Gold Book existing winter capacity plus projected additions and deactivations.
2. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 10% of the total nameplate, off-shore wind at 15% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). For winter the expected solar PV output at peak is 0 MW. Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
3. Interchanges are based on ERAG MMWG values.
4. SCRs are not applied for transmission security analysis of normal operations, but are included for emergency operations.
5. Includes a de-rate of 211 MW for SCRs.

Figure 58: Summary of Statewide System Margin – Summer

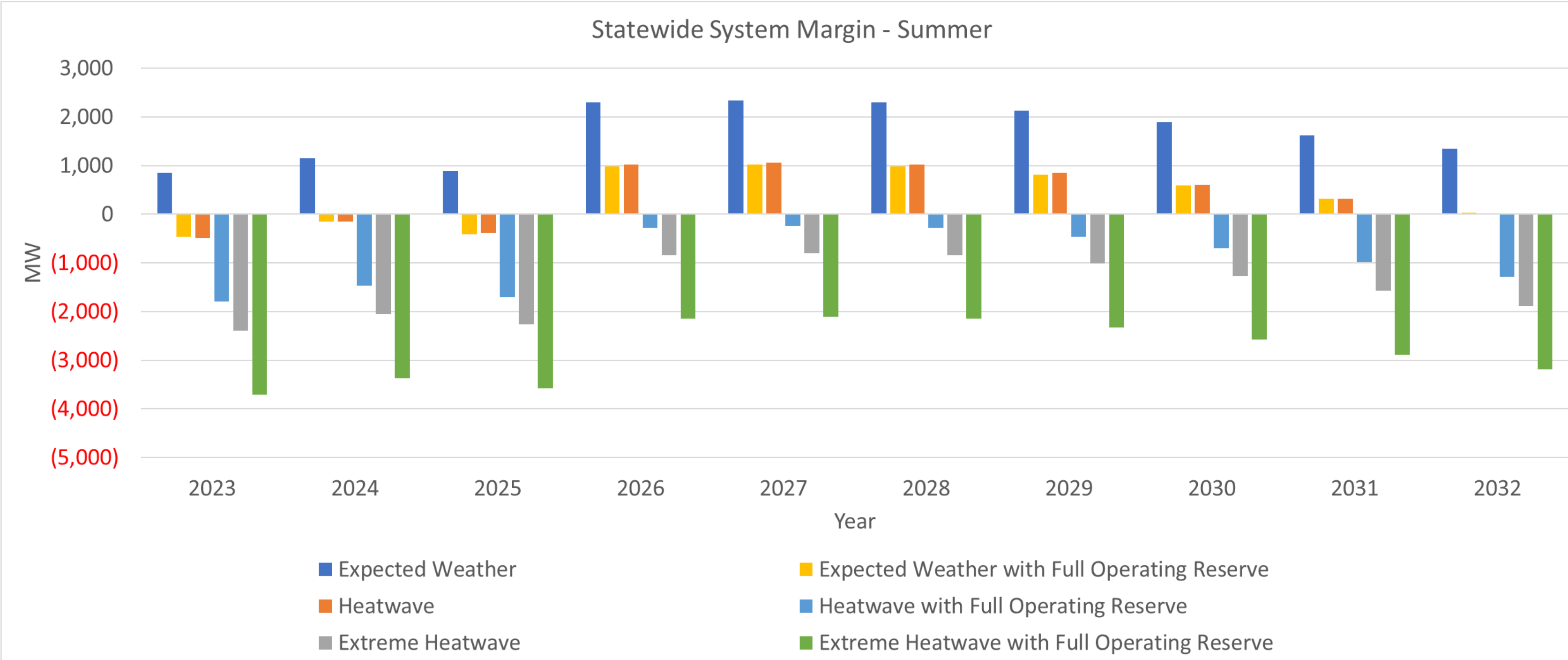


Figure 59: Summary of Statewide System Margin – Winter

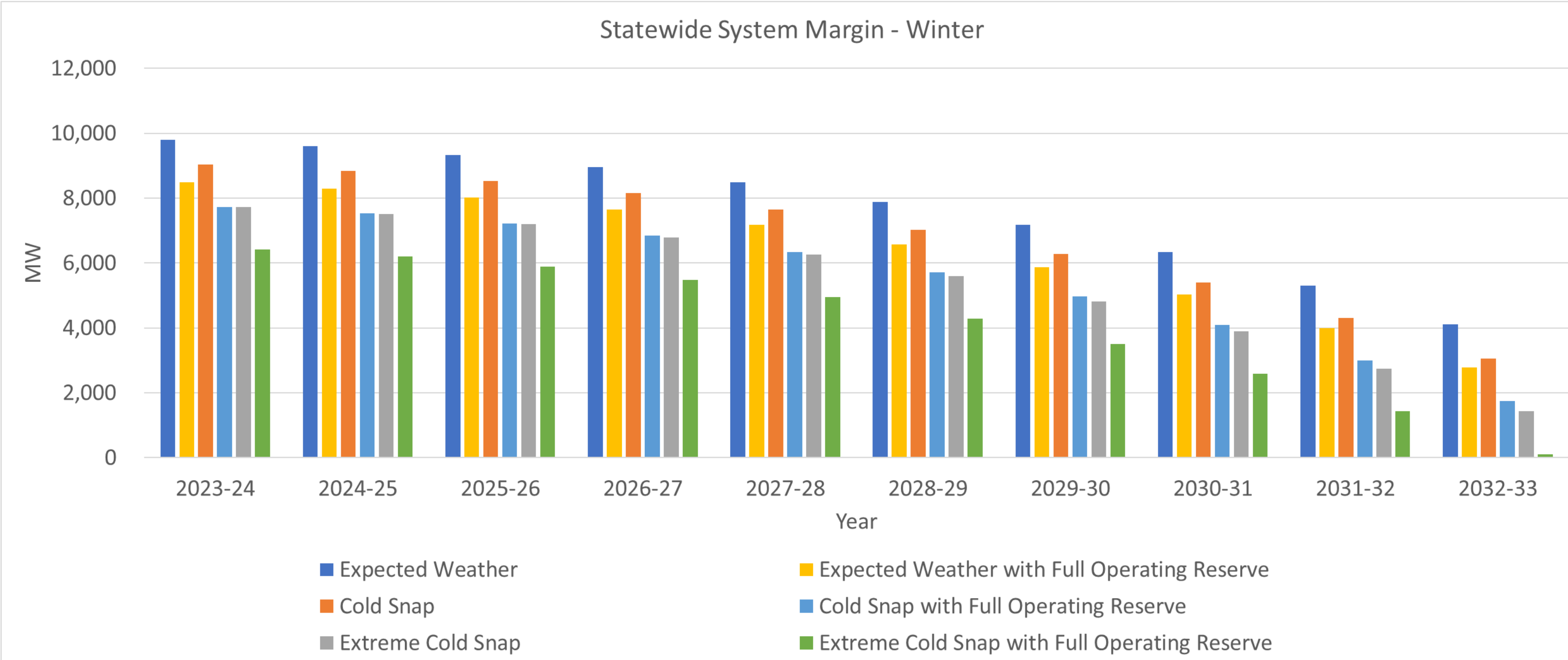
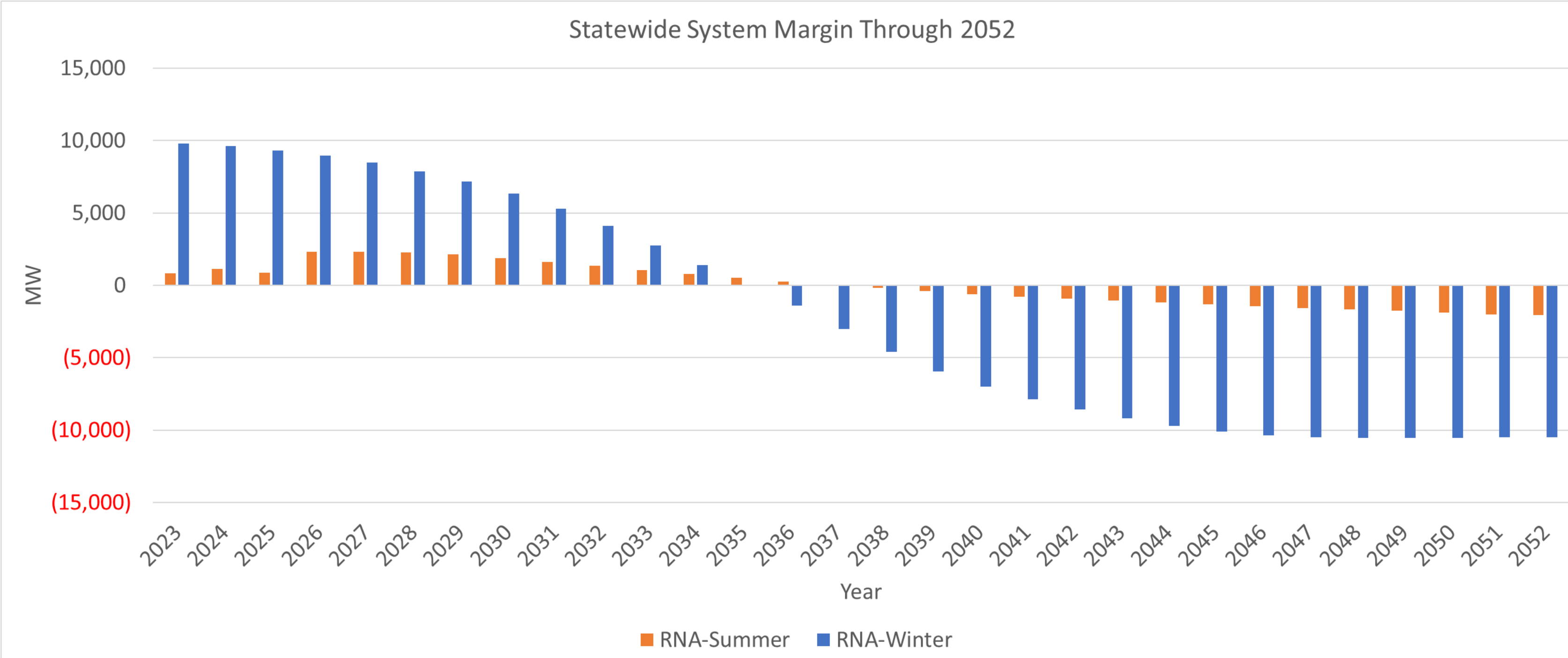


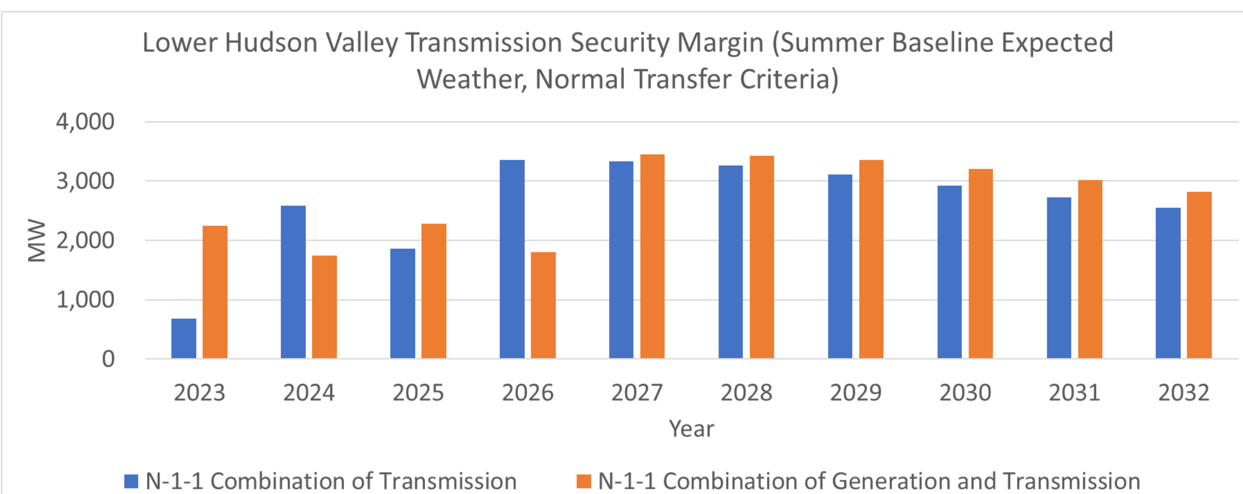
Figure 60: Summary of Statewide System Margins for Baseline Expected Weather, Normal Transfer Criteria Through 2052



Lower Hudson Valley (Zones G-J) Tipping Points

The Lower Hudson Valley, or southeastern New York (SENY) region, is comprised of Zones G-J and includes the electrical connections to the RECO load in PJM. To determine the transmission security margin for this area, the most limiting combination of two non-simultaneous contingency events (N-1-1) to the transmission security margin was determined. Design criteria N-1-1 combinations include various combinations of losses of generation and transmission. As the system changes the limiting contingency combination may also change. **Figure 61** shows how the summer transmission security margin changes through time in consideration of the planned transmission system changes which impact the most limiting contingency combination for the year being evaluated. In summer 2023 (prior to the completion of the Segment B public policy project) the most limiting contingency combination to the transmission security margin under peak load conditions is the loss of Leeds-Pleasant Valley (92) 345 kV followed by the loss of Dolson — Rock Tavern (DART44) 345 kV and Coopers Corners – Rock Tavern (CCRT34). In summer 2024 and 2025 the contingency combination changes to the loss of Ravenswood 3 followed by the loss of Pleasant Valley-Wood St. 345 kV (F30/F31). Starting in summer 2026 (following the inclusion of the CHPE project in winter 2025), the limiting contingency combination changes again to the loss of Knickerbocker – Pleasant Valley 345 kV followed by the loss of Athens-Van Wagner 345 kV and one of the Athens gas/steam combinations. The limiting contingency combination for winter also changes through time in consideration of the planned transmission system changes. In winter 2023-24, the limiting contingency combination is the loss of Pleasant Valley-Millwood (F31/W81) 345 kV followed by the loss of E. Fishkill-Wood St. (F38/F39) 345 kV. Starting in winter 2024-25, the limiting contingency combination is the loss of Ravenswood 3 followed by the loss of Pleasant Valley-Wood St. 345 kV (F30/F31).

Figure 61: Lower Hudson Valley Transmission Security Margin (Summer Baseline Peak Forecast – Expected Weather)



As transmission security analysis represents discrete snapshots in time of various credible combinations of system conditions, when reliability needs are identified only the magnitude of the need can be identified under those system conditions. Additional details are required to fully describe the nature of the need such as evaluating the hourly load shape and its impact on the need. To describe the nature of the Lower Hudson Valley transmission security margin, load shapes are developed the Zone G, H, I, and J components of the statewide load shape. Details of the load shapes are provided later in this appendix. For this assessment load shapes were not developed past 2032 and limited to the summer conditions.

Figure 62 shows the calculation of the Lower Hudson Valley transmission security margin for baseline expected weather, expected load conditions for summer for the statewide coincident peak hour with normal transfer criteria. The Lower Hudson Valley transmission security margin is sufficient for the 10-year horizon (line-item O). The transmission security margin coincident with the statewide system peak ranges from 676 MW in summer 2023 to 2,546 MW in summer 2032. Considering the summer baseline peak load transmission security margin, the lower Hudson Valley would require several additional outages beyond design criteria to have a deficient transmission security margin.

The load shapes for the Lower Hudson Valley show the contributions of Zones G, H, I, (**Figure 130**) and J (**Figure 131**) towards the statewide curve (which represents the statewide coincident peak) for each hour of the day. Utilizing the load shapes for the baseline expected weather summer peak day, the Lower Hudson Valley transmission security margin for each hour utilizing normal transfer criteria is shown in **Figure 63**. The Lower Hudson Valley transmission security margins for each hour are created by using the load forecast for each hour in the margin calculation (*i.e.*, **Figure 62** line-item A) with additional adjustments to account for the appropriate derate for solar generation and energy limited resources in each hour (*i.e.*, **Figure 62** line-item K). All other values in the margin calculations are held constant. A graphical representation of the hourly margin for the Lower Hudson Valley for the peak day in years 2023, 2025, 2027, and 2032 is provided in **Figure 64**. For all years in the 10-year study horizon, there are no observed deficiencies considering the load shapes under baseline expected load, normal transfer criteria for the Lower Hudson Valley.

It is possible for other combinations of events, such as a 1-in-10-year heatwave or 1-in-100-year extreme heatwave to result in a deficient transmission security margin. **Figure 65** shows that the Lower Hudson Valley transmission security margin for the statewide coincident peak hour under the 1-in-10-year heatwave condition with the assumption that the system is using emergency transfer criteria. The transmission security margin under 1-in-10-year heatwave condition is sufficient for all years. The margins range from 864 MW in summer 2023 to 2,611 MW in summer 2032. The load shapes for the Lower Hudson Valley under heatwave conditions are shown in **Figure 135** (Zones G, H, and I) and **Figure 136** (Zone J). Utilizing the Lower Hudson Valley load-duration heatwave curves, the transmission security margin for each hour utilizing emergency transfer criteria is shown in **Figure 66**. For all years in the 10-year horizon, there are no observed transmission security margin deficiencies in consideration the heatwave load duration curves for the Lower Hudson Valley with emergency transfer criteria. A graphical representation of the hourly margin for the Lower Hudson Valley for the peak day in years 2023, 2025, 2027, and 2032 heatwave, emergency transfer criteria conditions is provided in **Figure 67**.

Under the 1-in-100-year extreme heatwave shown in

Figure 68 which also assumes the use of emergency transfer criteria, the margin is sufficient at the statewide coincident peak hour. **Figure 68** shows that the margin is sufficient and ranges from 23 MW in summer 2023 to 1,750 MW in summer 2032. The load shapes for the Lower Hudson Valley under extreme heatwave conditions are shown in **Figure 140** (Zones G, H, I, and J) and **Figure 141** (Zone J). Utilizing the Lower Hudson Valley load-duration extreme heatwave curves, the transmission security margin for each hour utilizing emergency transfer criteria is shown in **Figure 69**. In summer 2023, the hourly load of the Lower Hudson Valley does not peak coincident with the statewide coincident peak. The contributions of Zones G-J towards the statewide coincident peak are the largest in hour beginning 16, while the statewide coincident peak occurs in hour beginning 17. As such, under extreme heatwave conditions, **Figure 69** shows that the system would be deficient in summer 2023 by 18 MW for 1 hour during the extreme heatwave day. All other hours of the 10-year horizon for the peak day are shown to be sufficient. **Figure 70** provides a graphical representation of the hourly transmission security margin for the peak day in years

2023, 2025, 2027, and 2032.

Figure 71 shows the Lower Hudson Valley transmission security margin under winter peak baseline expected weather load conditions. For winter peak, the margin is sufficient for all years and ranges from 8,307 MW in winter 2023-24 to 4,847 MW in winter 2032-33 (line-item O). Considering the winter baseline peak load transmission security margin, multiple outages in the lower Hudson Valley would be required to show a deficient transmission security margin.

Figure 72 shows the Lower Hudson Valley transmission security margin in a 1-in-10-year cold snap with emergency transfer criteria. Under this condition the margin is sufficient for all study years and ranges from 8,385 MW in winter 2023-24 to 5,079 MW in winter 2032-33 (line-item P). The 1-in-100-year extreme cold snap shown in **Figure 73** (also assuming emergency transfer criteria) shows sufficient margin for all study years ranging from 7,813 MW in winter 2023-24 to 4,338 in winter 2032-33 (line-item P).

Figure 74 provides are summary of the summer peak Lower Hudson Valley transmission security margins under expected summer weather, heatwave, and extreme heatwave conditions. **Figure 75** provides a summary of the winter peak Lower Hudson Valley transmission security margins under expected winter weather, cold snap, and extreme cold snap conditions.

While **Figure 74** and **Figure 75** provide a summary of the margins through the 10-year horizon, the 2022 Gold Book provides the forecast details through year 2052. **Figure 76** provides a summary of the Lower Hudson Valley transmission security margins (summer and winter) under baseline expected weather conditions, normal transfer criteria through 2052 to quantify the future year margins beyond the 10-year horizon. These margins are an extension of the total resources in the last year of the RNA horizon (*i.e.*, **Figure 62** shows the total resources for summer 2032 at 13,569 MW and **Figure 71** shows the total resources for winter 2032-33 at 13,694 MW) through 2052. As seen in **Figure 76**, the Lower Hudson Valley transmission security margin is deficient in winter 2038-39 by 227 MW. By 2052-53, this deficiency grows to 3,202 MW. Under summer peak, the margins remain sufficient for all years. By 2052, the summer margin is 921 MW. Anticipated generation additions to meet CLCPA goals, such as those discussed in the System & Resource Outlook Policy Case Scenario 2, will have a significant impact on the ability to maintain sufficient margin.

Figure 62: Lower Hudson Valley Transmission Security Margin (Summer Peak – Baseline Expected Weather, Normal Transfer Criteria)

Summer Peak - Baseline Expected Weather, Normal Transfer Criteria (MW)											
Line	**Item**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
A	G-J Load Forecast	(15,061)	(15,026)	(14,957)	(14,936)	(14,959)	(15,027)	(15,173)	(15,360)	(15,560)	(15,735)
B	RECO Load	(394)	(394)	(394)	(394)	(394)	(394)	(394)	(394)	(397)	(397)
C	**Total Load (A+B)**	(15,455)	(15,420)	(15,351)	(15,330)	(15,353)	(15,421)	(15,567)	(15,754)	(15,957)	(16,132)
D	UPNY-SENY Limit (3)	3,200	5,725	5,725	5,025	5,025	5,025	5,025	5,025	5,025	5,025
E	ABC PARs to J	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)
F	K - SENY	95	95	95	95	95	95	95	95	95	95
G	**Total SENY AC Import (D+E+F)**	3,284	5,809	5,809	5,109	5,109	5,109	5,109	5,109	5,109	5,109
H	Loss of Source Contingency	0	(980)	(980)	0	0	0	0	0	0	0
I	**Resource Need (C+G+H)**	(12,171)	(10,591)	(10,522)	(10,221)	(10,244)	(10,312)	(10,458)	(10,645)	(10,848)	(11,023)
J	G-J Generation (1)	13,584	13,684	13,084	13,084	13,084	13,084	13,084	13,084	13,084	13,084
K	G-J Generation Derates (2)	(1,051)	(1,131)	(1,071)	(1,072)	(1,074)	(1,076)	(1,077)	(1,079)	(1,080)	(1,080)
L	Temperature Based Generation Derates	0	0	0	0	0	0	0	0	0	0
M	Net ICAP External Imports	315	315	315	1,565	1,565	1,565	1,565	1,565	1,565	1,565
N	**Total Resources Available (J+K+L+M)**	12,847	12,868	12,328	13,577	13,575	13,573	13,571	13,570	13,569	13,569
O	**Transmission Security Margin (I+N)**	676	2,277	1,806	3,356	3,331	3,261	3,113	2,925	2,721	2,546

Notes:

1. Reflects the 2022 Gold Book existing summer capacity plus projected additions and deactivations.
2. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 5% of the total nameplate, off-shore wind at 10% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
3. Limits in 2022 and 2023 are based on limits from the summer peak 2023 representations evaluated in the post-2020 RNA updates. Limits for 2024 and 2025 are based on the summer peak 2025 representations evaluated in the post-2020 RNA updates. Limits for 2026 through 2032 are based on the summer peak 2032 represenations evalauted in the 2022 RNA.

Figure 63: Lower Hudson Valley Transmission Security Margin (Hourly) (Summer Peak – Baseline Expected Weather, Normal Transfer Criteria)

Summer Peak - Baseline Expected Summer Weather, Normal Transfer Criteria (MW)										
G-J Transmission Security Margin										
Hour	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
HB0	5,152	6,703	6,204	7,714	7,558	7,464	7,295	7,077	6,840	6,637
HB1	5,679	7,232	6,740	8,256	8,109	8,024	7,863	7,662	7,440	7,251
HB2	6,061	7,619	7,129	8,648	8,506	8,427	8,274	8,084	7,877	7,702
HB3	6,293	7,852	7,363	8,888	8,750	8,680	8,535	8,355	8,159	7,994
HB4	6,332	7,894	7,412	8,942	8,810	8,748	8,612	8,449	8,268	8,116
HB5	6,082	7,646	7,162	8,696	8,567	8,504	8,372	8,209	8,031	7,881
HB6	5,494	7,071	6,600	8,148	8,028	7,977	7,855	7,698	7,526	7,378
HB7	4,632	6,238	5,792	7,364	7,265	7,236	7,127	6,980	6,814	6,669
HB8	3,826	5,461	5,027	6,611	6,523	6,500	6,392	6,239	6,060	5,902
HB9	3,146	4,804	4,384	5,980	5,904	5,888	5,787	5,636	5,456	5,294
HB10	2,547	4,229	3,819	5,431	5,367	5,362	5,271	5,124	4,944	4,785
HB11	2,066	3,766	3,369	4,992	4,939	4,949	4,870	4,735	4,568	4,416
HB12	1,656	3,365	2,974	4,604	4,559	4,575	4,504	4,380	4,222	4,084
HB13	1,317	3,023	2,629	4,257	4,213	4,227	4,160	4,042	3,891	3,760
HB14	1,102	2,794	2,388	4,001	3,942	3,947	3,871	3,745	3,593	3,460
HB15	895	2,563	2,137	3,732	3,657	3,645	3,553	3,417	3,257	3,116
HB16	654	2,294	1,851	3,428	3,336	3,308	3,202	3,054	2,886	2,738
HB17	676	2,277	1,806	3,356	3,233	3,179	3,047	2,874	2,684	2,517
HB18	828	2,409	1,928	3,461	3,331	3,261	3,113	2,925	2,721	2,546
HB19	1,129	2,691	2,202	3,722	3,577	3,497	3,340	3,143	2,932	2,745
HB20	1,474	3,029	2,537	4,056	3,907	3,823	3,663	3,464	3,244	3,056
HB21	1,917	3,477	2,985	4,508	4,362	4,279	4,120	3,918	3,697	3,508
HB22	2,649	4,208	3,715	5,235	5,083	4,997	4,829	4,616	4,382	4,181
HB23	3,503	5,062	4,570	6,088	5,937	5,847	5,679	5,462	5,227	5,022

Figure 64: Lower Hudson Valley Transmission Security Margin Hourly Curve (Summer Peak – Baseline Expected Weather, Normal Transfer Criteria)

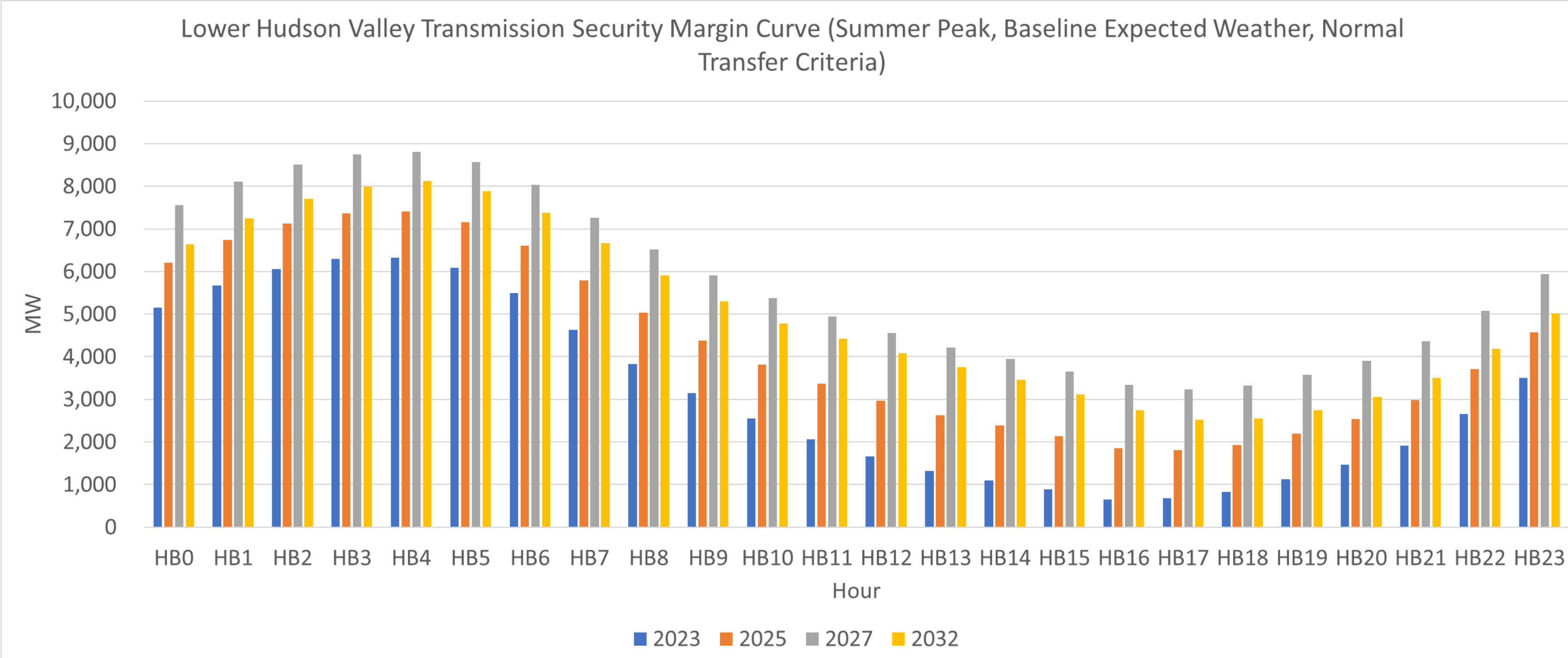


Figure 65: Lower Hudson Valley Transmission Security Margin (1-in-10-Year Heatwave, Emergency Transfer Criteria)

Summer Peak - 1-in-10-Year Heatwave, Emergency Transfer Criteria (MW)											
Line	**Item**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
A	G-J Load Forecast	(15,813)	(15,776)	(15,703)	(15,681)	(15,705)	(15,776)	(15,929)	(16,125)	(16,335)	(16,518)
B	RECO Load	(424)	(424)	(424)	(424)	(424)	(424)	(424)	(424)	(427)	(427)
C	**Total Load (A+B)**	(16,237)	(16,200)	(16,127)	(16,105)	(16,129)	(16,200)	(16,353)	(16,549)	(16,762)	(16,945)
D	UPNY-SENY Limit (5)	3,925	5,450	5,450	5,650	5,650	5,650	5,650	5,650	5,650	5,650
E	ABC PARs to J	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)
F	K - SENY	155	155	155	155	155	155	155	155	155	155
G	**Total SENY AC Import (D+E+F)**	4,069	5,594	5,594	5,794	5,794	5,794	5,794	5,794	5,794	5,794
H	Loss of Source Contingency	0	0	0	0	0	0	0	0	0	0
I	**Resource Need (C+G+H)**	(12,168)	(10,606)	(10,533)	(10,311)	(10,335)	(10,406)	(10,559)	(10,755)	(10,968)	(11,151)
J	G-J Generation (1)	13,584	13,684	13,084	13,084	13,084	13,084	13,084	13,084	13,084	13,084
K	G-J Generation Derates (2)	(1,051)	(1,131)	(1,071)	(1,072)	(1,074)	(1,076)	(1,077)	(1,079)	(1,080)	(1,080)
L	Temperature Based Generation Derates	(87)	(87)	(78)	(78)	(78)	(78)	(78)	(78)	(78)	(78)
M	Net ICAP External Imports	315	315	315	1,565	1,565	1,565	1,565	1,565	1,565	1,565
N	SCRs (3), (4)	271	271	271	271	271	271	271	271	271	271
O	**Total Resources Available (J+K+L+M+N)**	13,031	13,052	12,521	13,769	13,768	13,766	13,764	13,763	13,762	13,762
P	**Transmission Security Margin (I+O)**	864	2,446	1,988	3,459	3,434	3,360	3,206	3,008	2,794	2,611

Notes:

1. Reflects the 2022 Gold Book existing summer capacity plus projected additions and deactivations.
2. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 5% of the total nameplate, off-shore wind at 10% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
3. SCRs are not applied for transmission security analysis of normal operations, but are included for emergency operations.
4. Includes a de-rate of 226 MW for SCRs.
5. Limits in 2022 and 2023 are based on limits from the summer peak 2023 representations evaluated in the post-2020 RNA updates. Limits for 2024 and 2025 are based on the summer peak 2025 representations evaluated in the post-2020 RNA updates. Limits for 2026 through 2032 are based on the summer peak 2032 represenations evalauted in the 2022 RNA.

Figure 66: Lower Hudson Valley Transmission Security Margin (Hourly) (1-in-10-Year Heatwave, Emergency Transfer Criteria)

Summer Peak - Heatwave, Emergency Transfer Criteria (MW)										
G-J Transmission Security Margin										
Hour	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
HB0	4,722	6,256	5,773	7,205	7,022	6,907	6,712	6,474	6,223	6,011
HB1	5,309	6,844	6,368	7,806	7,633	7,526	7,338	7,116	6,881	6,682
HB2	5,713	7,256	6,784	8,226	8,059	7,960	7,781	7,572	7,354	7,170
HB3	5,972	7,515	7,044	8,493	8,330	8,240	8,069	7,871	7,663	7,489
HB4	6,031	7,578	7,113	8,567	8,409	8,327	8,165	7,983	7,789	7,628
HB5	5,763	7,314	6,849	8,309	8,156	8,075	7,919	7,740	7,552	7,395
HB6	5,118	6,678	6,222	7,693	7,547	7,475	7,327	7,151	6,967	6,812
HB7	4,235	5,810	5,367	6,849	6,710	6,648	6,499	6,321	6,132	5,968
HB8	3,471	5,071	4,633	6,122	5,991	5,929	5,778	5,591	5,388	5,209
HB9	2,836	4,455	4,029	5,528	5,407	5,350	5,205	5,019	4,813	4,631
HB10	2,322	3,962	3,544	5,056	4,946	4,897	4,759	4,575	4,367	4,186
HB11	2,037	3,696	3,290	4,811	4,712	4,677	4,550	4,377	4,180	4,003
HB12	1,749	3,417	3,013	4,542	4,450	4,418	4,295	4,130	3,941	3,776
HB13	1,548	3,215	2,812	4,342	4,278	4,246	4,131	3,941	3,761	3,605
HB14	1,310	2,967	2,557	4,076	4,023	3,987	3,867	3,639	3,461	3,305
HB15	1,049	2,688	2,264	3,769	3,730	3,683	3,552	3,285	3,102	2,944
HB16	842	2,456	2,017	3,506	3,476	3,416	3,275	2,963	2,775	2,611
HB17	864	2,446	1,988	3,459	3,434	3,360	3,206	2,845	2,644	2,469
HB18	1,121	2,685	2,217	3,672	3,641	3,553	3,384	3,008	2,794	2,611
HB19	1,493	3,039	2,564	4,006	3,937	3,840	3,662	3,314	3,093	2,898
HB20	1,862	3,400	2,922	4,363	4,267	4,165	3,984	3,668	3,438	3,243
HB21	2,331	3,868	3,383	4,821	4,698	4,590	4,403	4,111	3,875	3,671
HB22	3,110	4,643	4,154	5,587	5,433	5,319	5,119	4,849	4,598	4,380
HB23	4,011	5,542	5,052	6,481	6,302	6,182	5,981	5,740	5,486	5,263

Figure 67: Lower Hudson Valley Transmission Security Margin Hourly Curve (1-in-10-Year Heatwave, Emergency Transfer Criteria)

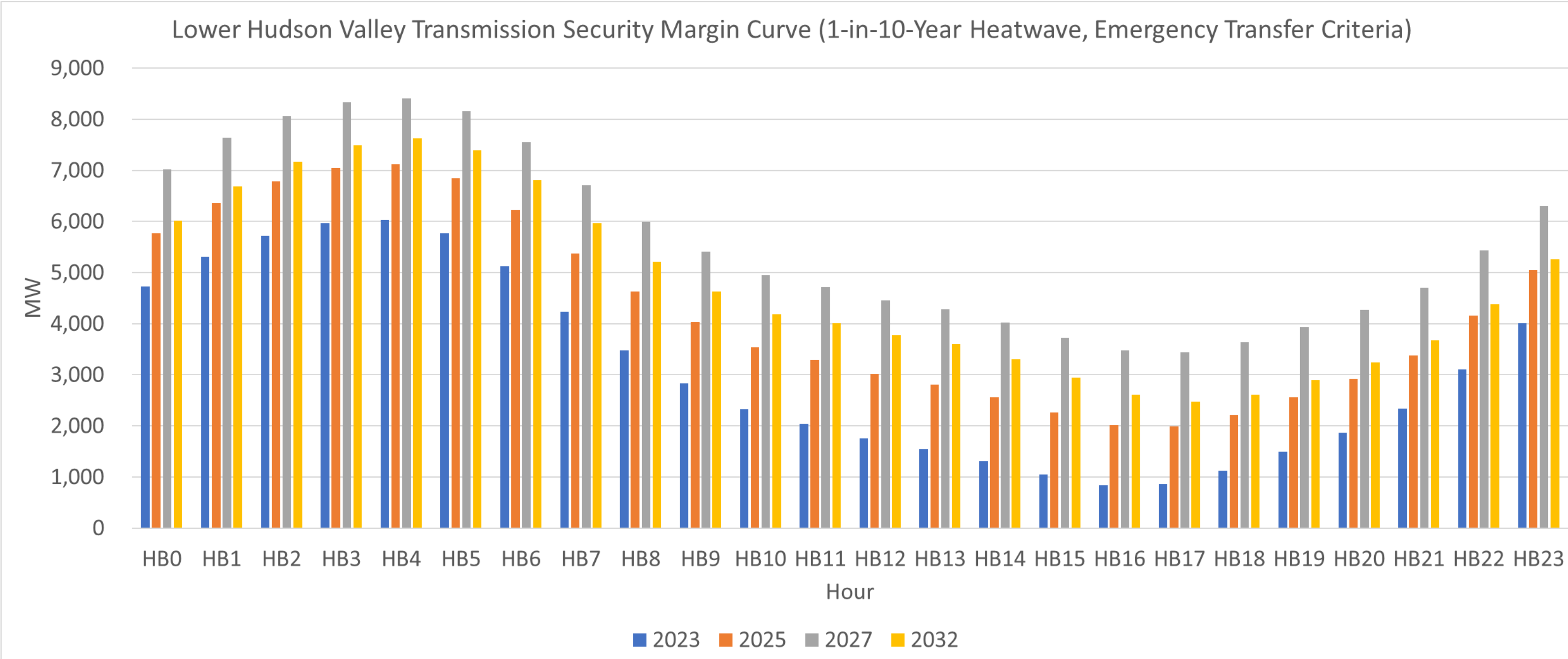


Figure 68: Lower Hudson Valley Transmission Security Margin (1-in-100-Year Extreme Heatwave, Emergency Transfer Criteria)

Summer Peak - 1-in-100-Year Extreme Heatwave, Emergency Transfer Criteria (MW)											
Line	**Item**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
A	G-J Load Forecast	(16,532)	(16,493)	(16,418)	(16,395)	(16,420)	(16,493)	(16,653)	(16,857)	(17,077)	(17,267)
B	RECO Load	(448)	(448)	(448)	(448)	(448)	(448)	(448)	(448)	(451)	(451)
C	**Total Load (A+B)**	(16,980)	(16,941)	(16,866)	(16,843)	(16,868)	(16,941)	(17,101)	(17,305)	(17,528)	(17,718)
D	UPNY-SENY Limit (5)	3,925	5,450	5,450	5,650	5,650	5,650	5,650	5,650	5,650	5,650
E	ABC PARs to J	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)
F	K - SENY	155	155	155	155	155	155	155	155	155	155
G	**Total SENY AC Import (D+E+F)**	4,069	5,594	5,594	5,794	5,794	5,794	5,794	5,794	5,794	5,794
H	Loss of Source Contingency	0	0	0	0	0	0	0	0	0	0
I	**Resource Need (C+G+H)**	(12,911)	(11,347)	(11,272)	(11,049)	(11,074)	(11,147)	(11,307)	(11,511)	(11,734)	(11,924)
J	G-J Generation (1)	13,584	13,684	13,084	13,084	13,084	13,084	13,084	13,084	13,084	13,084
K	G-J Generation Derates (2)	(1,051)	(1,131)	(1,071)	(1,072)	(1,074)	(1,076)	(1,077)	(1,079)	(1,080)	(1,080)
L	Temperature Based Generation Derates	(184)	(184)	(165)	(165)	(165)	(165)	(165)	(165)	(165)	(165)
M	Net ICAP External Imports	315	315	315	1,565	1,565	1,565	1,565	1,565	1,565	1,565
N	SCRs (3), (4)	271	271	271	271	271	271	271	271	271	271
O	**Total Resources Available (J+K+L+M+N)**	12,934	12,955	12,434	13,682	13,681	13,679	13,677	13,676	13,675	13,675
P	**Transmission Security Margin (I+O)**	23	1,608	1,162	2,634	2,607	2,532	2,370	2,165	1,940	1,750

Notes:

1. Reflects the 2022 Gold Book existing summer capacity plus projected additions and deactivations.
2. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 5% of the total nameplate, off-shore wind at 10% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
3. SCRs are not applied for transmission security analysis of normal operations, but are included for emergency operations.
4. Includes a de-rate of 226 MW for SCRs.
5. Limits in 2022 and 2023 are based on limits from the summer peak 2023 representations evaluated in the post-2020 RNA updates. Limits for 2024 and 2025 are based on the summer peak 2025 representations evaluated in the post-2020 RNA updates. Limits for 2026 through 2032 are based on the summer peak 2032 represenations evalauted in the 2022 RNA.

Figure 69: Lower Hudson Valley Transmission Security Margin (Hourly) (1-in-100-Year Extreme Heatwave, Emergency Transfer Criteria)

Summary Peak - 1-in-100-Year Extreme Heatwave, Emergency Transfer Criteria (MW)										
G-J Transmission Security Margin										
Hour	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
HB0	4,198	5,735	5,266	6,700	6,515	6,398	6,199	5,956	5,699	5,483
HB1	4,786	6,324	5,862	7,302	7,126	7,017	6,825	6,598	6,356	6,154
HB2	5,191	6,736	6,279	7,723	7,552	7,452	7,268	7,054	6,829	6,642
HB3	5,450	6,997	6,540	7,991	7,824	7,733	7,558	7,354	7,139	6,961
HB4	5,511	7,060	6,610	8,066	7,905	7,821	7,654	7,467	7,266	7,100
HB5	5,243	6,796	6,345	7,807	7,650	7,568	7,407	7,221	7,027	6,865
HB6	4,592	6,154	5,712	7,184	7,034	6,960	6,806	6,624	6,432	6,272
HB7	3,706	5,282	4,850	6,333	6,188	6,123	5,968	5,784	5,586	5,417
HB8	2,938	4,537	4,111	5,599	5,462	5,396	5,239	5,045	4,833	4,650
HB9	2,302	3,919	3,505	5,001	4,875	4,813	4,660	4,467	4,253	4,065
HB10	1,789	3,427	3,018	4,528	4,411	4,358	4,212	4,021	3,805	3,619
HB11	1,506	3,162	2,764	4,283	4,177	4,137	4,003	3,822	3,618	3,435
HB12	1,137	2,802	2,408	3,934	3,834	3,796	3,665	3,489	3,291	3,120
HB13	873	2,537	2,145	3,670	3,600	3,561	3,437	3,235	3,043	2,881
HB14	573	2,227	1,828	3,343	3,284	3,243	3,114	2,872	2,682	2,519
HB15	250	1,888	1,473	2,977	2,932	2,880	2,740	2,457	2,266	2,099
HB16	(18)	1,597	1,168	2,657	2,624	2,560	2,410	2,082	1,883	1,709
HB17	23	1,608	1,162	2,634	2,607	2,532	2,370	1,993	1,781	1,598
HB18	281	1,849	1,396	2,851	2,821	2,732	2,556	2,165	1,940	1,750
HB19	720	2,269	1,809	3,254	3,185	3,087	2,904	2,541	2,312	2,110
HB20	1,152	2,695	2,231	3,673	3,578	3,475	3,288	2,961	2,725	2,523
HB21	1,683	3,223	2,753	4,193	4,069	3,960	3,768	3,468	3,223	3,015
HB22	2,520	4,057	3,583	5,017	4,862	4,746	4,543	4,265	4,007	3,786
HB23	3,483	5,016	4,541	5,972	5,791	5,670	5,465	5,219	4,959	4,733

Figure 70: Lower Hudson Valley Transmission Security Margin Hourly Curve (1-in-100-Year Extreme Heatwave, Emergency Transfer Criteria)

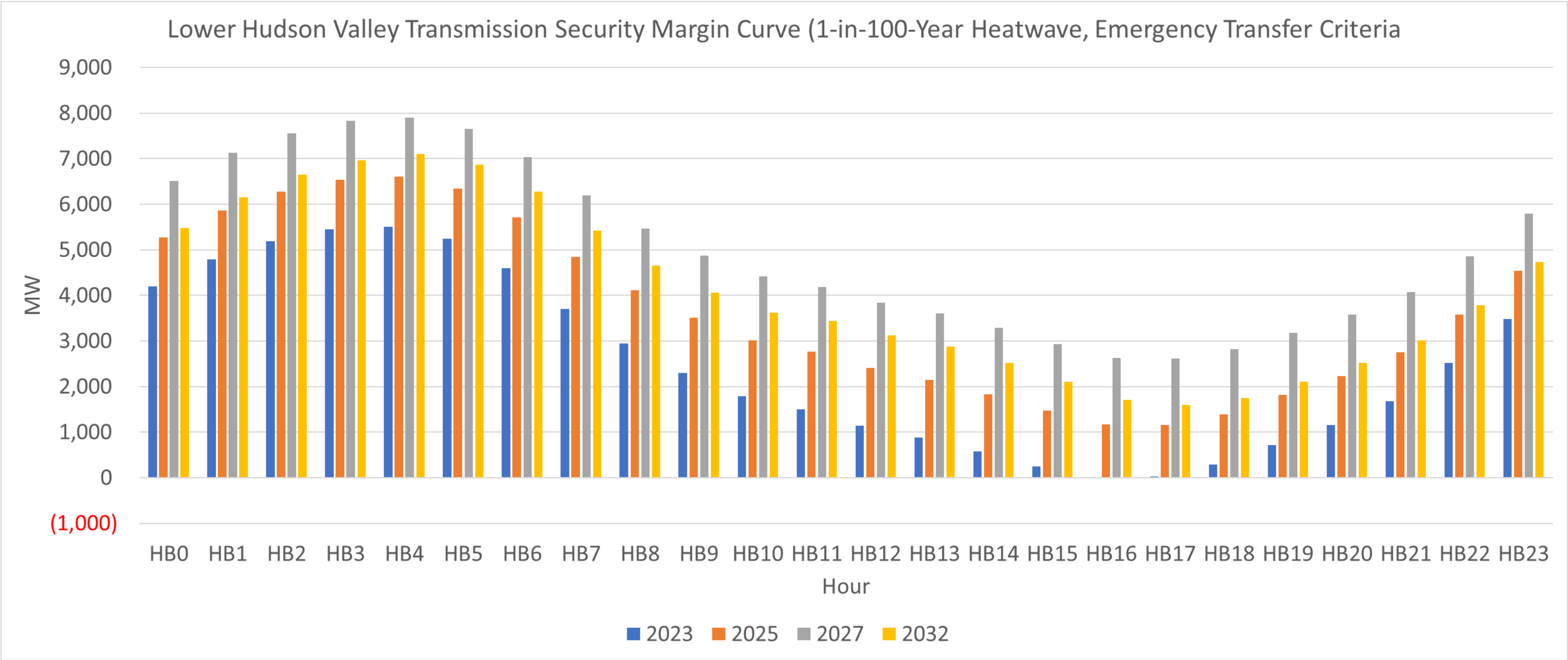


Figure 71: Lower Hudson Valley Transmission Security Margin (Winter Peak – Baseline Expected Weather, Normal Transfer Criteria)

Winter Peak - Baseline Expected Weather, Normal Transfer Criteria (MW)											
Line	**Item**	**2023-24**	**2024-25**	**2025-26**	**2026-27**	**2027-28**	**2028-29**	**2029-30**	**2030-31**	**2031-32**	**2032-33**
A	G-J Load Forecast	(10,333)	(10,412)	(10,527)	(10,716)	(10,979)	(11,320)	(11,726)	(12,186)	(12,764)	(13,450)
B	RECO Load	(219)	(219)	(219)	(219)	(219)	(219)	(219)	(219)	(216)	(216)
C	**Total Load (A+B)**	(10,552)	(10,631)	(10,746)	(10,935)	(11,198)	(11,539)	(11,945)	(12,405)	(12,980)	(13,666)
D	UPNY-SENY Limit (3), (4)	5,050	5,725	5,725	5,725	5,725	5,725	5,725	5,725	5,725	5,725
E	ABC PARs to J	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)
F	K - SENY (4)	95	95	95	95	95	95	95	95	95	95
G	**Total SENY AC Import (D+E+F)**	5,134	5,809	5,809	5,809	5,809	5,809	5,809	5,809	5,809	5,809
H	Loss of Source Contingency	0	(990)	(990)	(990)	(990)	(990)	(990)	(990)	(990)	(990)
I	**Resource Need (C+G+H)**	(5,418)	(5,812)	(5,927)	(6,116)	(6,379)	(6,720)	(7,126)	(7,586)	(8,161)	(8,847)
J	G-J Generation (1)	14,622	14,622	14,588	14,588	14,588	14,588	14,588	14,588	14,588	14,588
K	G-J Generation Derates (2)	(1,212)	(1,212)	(1,209)	(1,209)	(1,209)	(1,209)	(1,209)	(1,209)	(1,209)	(1,209)
L	Temperature Based Generation Derates	0	0	0	0	0	0	0	0	0	0
M	Net ICAP External Imports	315	315	315	315	315	315	315	315	315	315
N	**Total Resources Available (J+K+L+M)**	13,725	13,725	13,694	13,694	13,694	13,694	13,694	13,694	13,694	13,694
O	**Transmission Security Margin (I+N)**	8,307	7,913	7,767	7,578	7,315	6,974	6,568	6,108	5,533	4,847

Notes:

1. Reflects the 2022 Gold Book existing winter capacity plus projected additions and deactivations.
2. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 10% of the total nameplate, off-shore wind at 15% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). For winter the expected solar PV output at peak is 0 MW. Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
3. Limits in 2022 and 2023 are based on limits from the summer peak 2023 representations evaluated in the post-2020 RNA updates. Limits for 2024 and 2025 are based on the summer peak 2025 representations evaluated in the post-2020 RNA updates. Limits for 2026 through 2032 are based also based on the summer peak 2025 representations evaluated in the post-2020 RNA analysis which does not include the impact of CHPE.
4. As a conservative winter peak assumption these limits utilize the summer values.

Figure 72: Lower Hudson Valley Transmission Security Margin (1-in-10-Year Cold Snap, Emergency Transfer Criteria)

Winter Peak - 1-in-10-Year Cold Snap, Emergency Transfer Criteria (MW)											
Line	**Item**	**2023-24**	**2024-25**	**2025-26**	**2026-27**	**2027-28**	**2028-29**	**2029-30**	**2030-31**	**2031-32**	**2032-33**
A	G-J Load Forecast	(10,864)	(10,947)	(11,068)	(11,267)	(11,543)	(11,903)	(12,329)	(12,812)	(13,421)	(14,142)
B	RECO Load	(230)	(230)	(230)	(230)	(230)	(230)	(230)	(230)	(227)	(227)
C	**Total Load (A+B)**	(11,094)	(11,177)	(11,298)	(11,497)	(11,773)	(12,133)	(12,559)	(13,042)	(13,648)	(14,369)
D	UPNY-SENY Limit (5), (6)	5,450	5,450	5,450	5,450	5,450	5,450	5,450	5,450	5,450	5,450
E	ABC PARs to J	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)
F	K - SENY (6)	155	155	155	155	155	155	155	155	155	155
G	**Total SENY AC Import (D+E+F)**	5,594	5,594	5,594	5,594	5,594	5,594	5,594	5,594	5,594	5,594
H	Loss of Source Contingency	0	0	0	0	0	0	0	0	0	0
I	**Resource Need (C+G+H)**	(5,500)	(5,583)	(5,704)	(5,903)	(6,179)	(6,539)	(6,965)	(7,448)	(8,054)	(8,775)
J	G-J Generation (1)	14,622	14,622	14,588	14,588	14,588	14,588	14,588	14,588	14,588	14,588
K	G-J Generation Derates (2)	(1,212)	(1,212)	(1,209)	(1,209)	(1,209)	(1,209)	(1,209)	(1,209)	(1,209)	(1,209)
L	Temperature Based Generation Derates	0	0	0	0	0	0	0	0	0	0
M	Net ICAP External Imports	315	315	315	315	315	315	315	315	315	315
N	SCRs (3), (4)	160	160	160	160	160	160	160	160	160	160
O	**Total Resources Available (J+K+L+M+N)**	13,885	13,885	13,854	13,854	13,854	13,854	13,854	13,854	13,854	13,854
P	**Transmission Security Margin (I+O)**	8,385	8,302	8,150	7,951	7,675	7,315	6,889	6,406	5,800	5,079

Notes:

1. Reflects the 2022 Gold Book existing winter capacity plus projected additions and deactivations.
2. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 10% of the total nameplate, off-shore wind at 15% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). For winter the expected solar PV output at peak is 0 MW. Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
3. SCRs are not applied for transmission security analysis of normal operations, but are included for emergency operations.
4. Includes a de-rate of 133 MW for SCRs.
5. Limits in 2022 and 2023 are based on limits from the summer peak 2023 representations evaluated in the post-2020 RNA updates. Limits for 2024 and 2025 are based on the summer peak 2025 representations evaluated in the post-2020 RNA updates. Limits for 2026 through 2032 are based also based on the summer peak 2025 representations evaluated in the post-2020 RNA analysis which does not include the impact of CHPE.
6. As a conservative winter peak assumption these limits utilize the summer values.

Figure 73: Lower Hudson Valley Transmission Security Margin (1-in-100-year Extreme Cold Snap, Emergency Transfer Criteria)

Winter Peak - 1-in-100-Year Extreme Cold Snap, Emergency Transfer Criteria (MW)											
Line	**Item**	**2023-24**	**2024-25**	**2025-26**	**2026-27**	**2027-28**	**2028-29**	**2029-30**	**2030-31**	**2031-32**	**2032-33**
A	G-J Load Forecast	(11,424)	(11,513)	(11,640)	(11,848)	(12,139)	(12,516)	(12,964)	(13,473)	(14,113)	(14,871)
B	RECO Load	(242)	(242)	(242)	(242)	(242)	(242)	(242)	(242)	(239)	(239)
C	**Total Load (A+B)**	(11,666)	(11,755)	(11,882)	(12,090)	(12,381)	(12,758)	(13,206)	(13,715)	(14,352)	(15,110)
D	UPNY-SENY Limit (5), (6)	5,450	5,450	5,450	5,450	5,450	5,450	5,450	5,450	5,450	5,450
E	ABC PARs to J	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)
F	K - SENY (6)	155	155	155	155	155	155	155	155	155	155
G	**Total SENY AC Import (D+E+F)**	5,594	5,594	5,594	5,594	5,594	5,594	5,594	5,594	5,594	5,594
H	Loss of Source Contingency	0	0	0	0	0	0	0	0	0	0
I	**Resource Need (C+G+H)**	(6,072)	(6,161)	(6,288)	(6,496)	(6,787)	(7,164)	(7,612)	(8,121)	(8,758)	(9,516)
J	G-J Generation (1)	14,622	14,622	14,588	14,588	14,588	14,588	14,588	14,588	14,588	14,588
K	G-J Generation Derates (2)	(1,212)	(1,212)	(1,209)	(1,209)	(1,209)	(1,209)	(1,209)	(1,209)	(1,209)	(1,209)
L	Temperature Based Generation Derates	0	0	0	0	0	0	0	0	0	0
M	Net ICAP External Imports	315	315	315	315	315	315	315	315	315	315
N	SCRs (3), (4)	160	160	160	160	160	160	160	160	160	160
O	**Total Resources Available (J+K+L+M+N)**	13,885	13,885	13,854	13,854	13,854	13,854	13,854	13,854	13,854	13,854
P	**Transmission Security Margin (I+O)**	7,813	7,724	7,566	7,358	7,067	6,690	6,242	5,733	5,096	4,338

Notes:

1. Reflects the 2022 Gold Book existing winter capacity plus projected additions and deactivations.
2. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 10% of the total nameplate, off-shore wind at 15% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). For winter the expected solar PV output at peak is 0 MW. Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
3. SCRs are not applied for transmission security analysis of normal operations, but are included for emergency operations.
4. Includes a de-rate of 133 MW for SCRs.
5. Limits in 2022 and 2023 are based on limits from the summer peak 2023 representations evaluated in the post-2020 RNA updates. Limits for 2024 and 2025 are based on the summer peak 2025 representations evaluated in the post-2020 RNA updates. Limits for 2026 through 2032 are based also based on the summer peak 2025 representations evaluated in the post-2020 RNA analysis which does not include the impact of CHPE.
6. As a conservative winter peak assumption these limits utilize the summer values.

Figure 74: Summary of Lower Hudson Valley Summer Transmission Security Margin – Summer

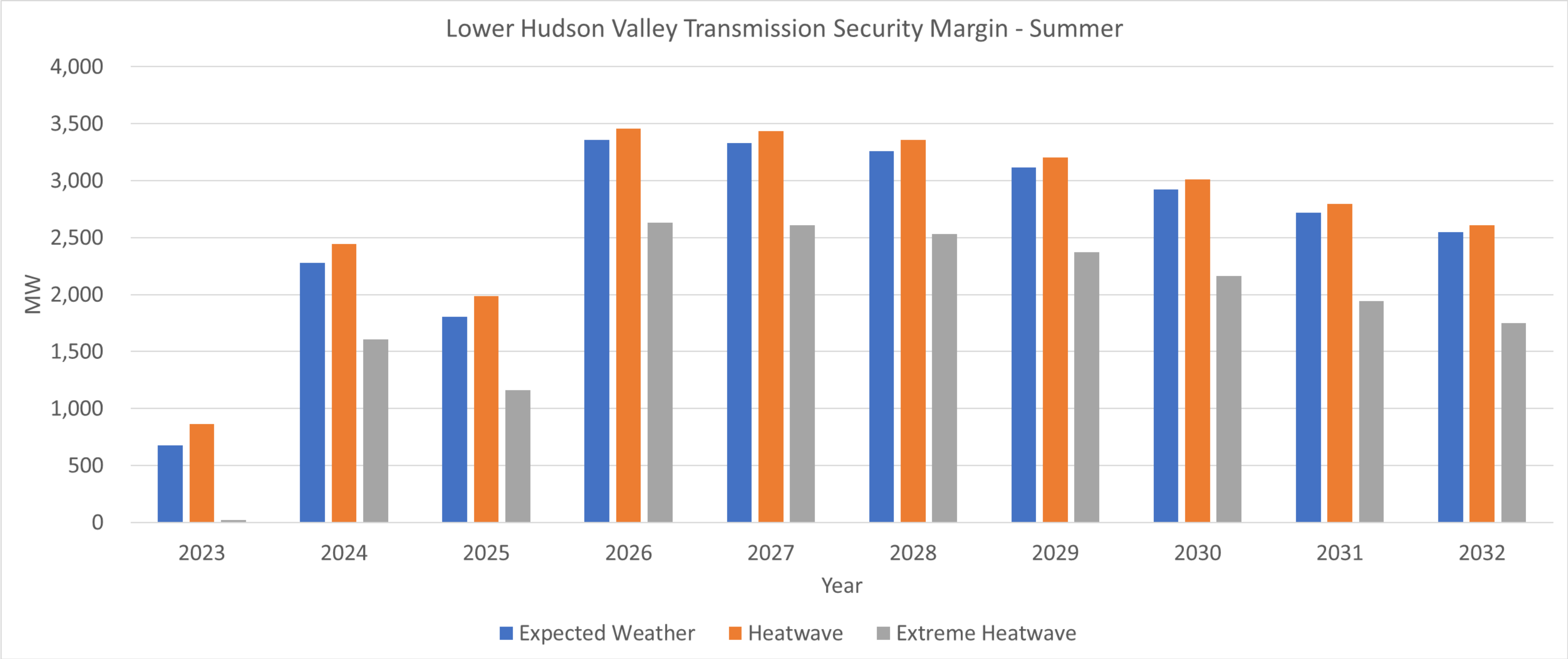


Figure 75: Summary of Lower Hudson Valley Summer Transmission Security Margin – Winter

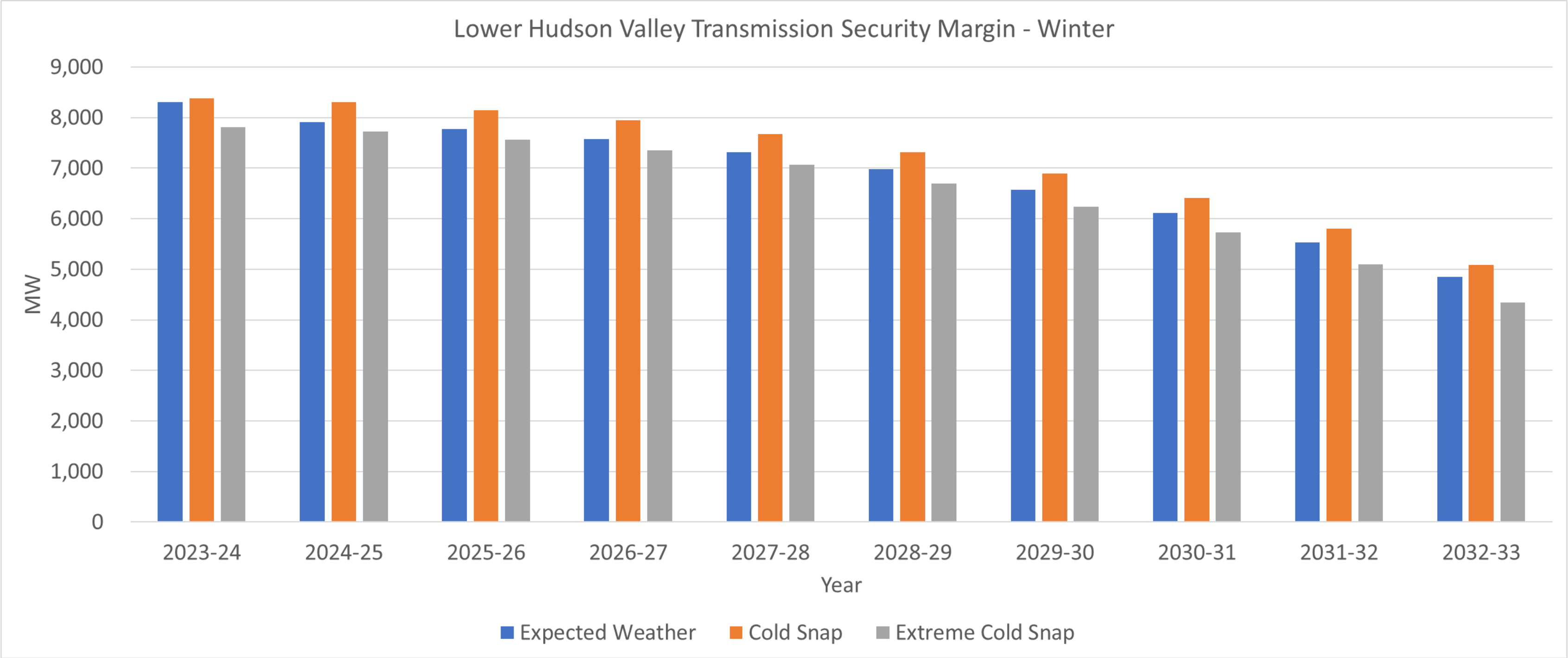
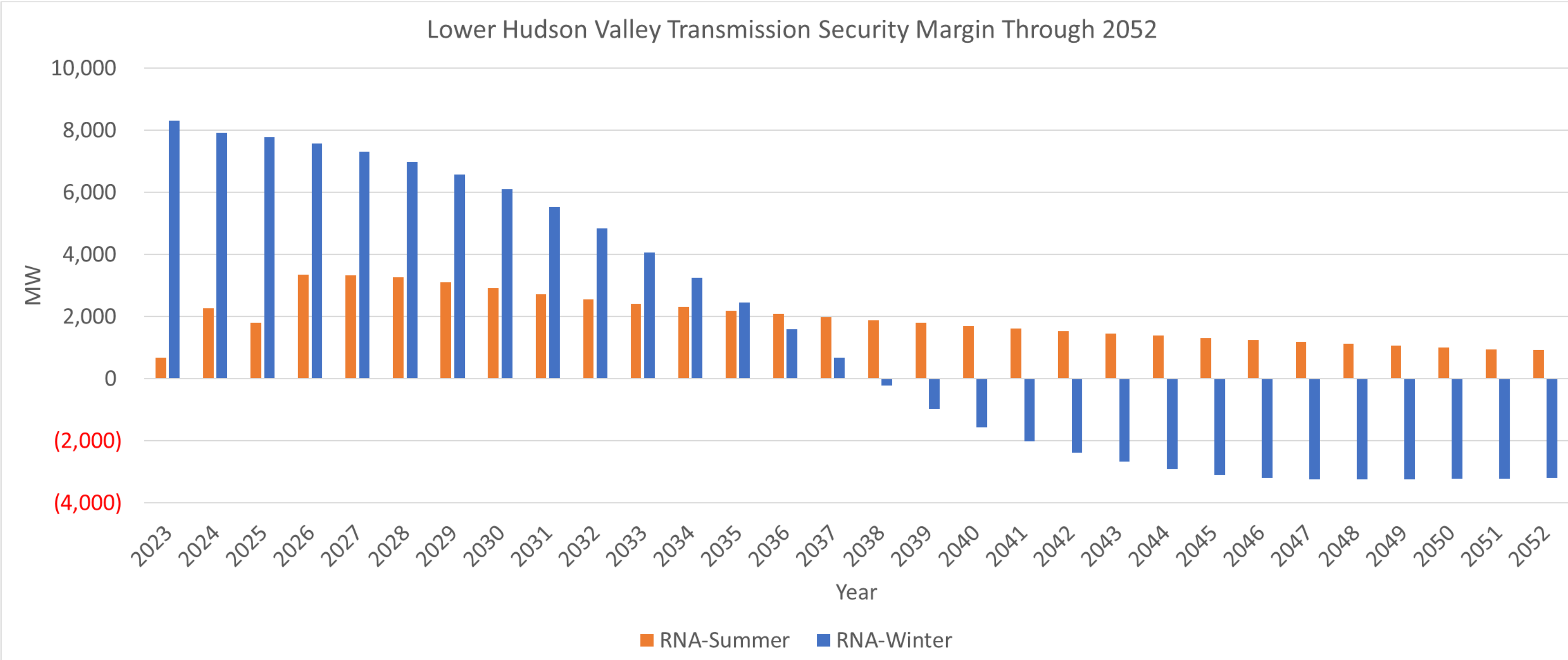


Figure 76: Summary of Lower Hudson Valley Summer Transmission Security Margins for Baseline Expected Weather, Normal Transfer Criteria Through 2052

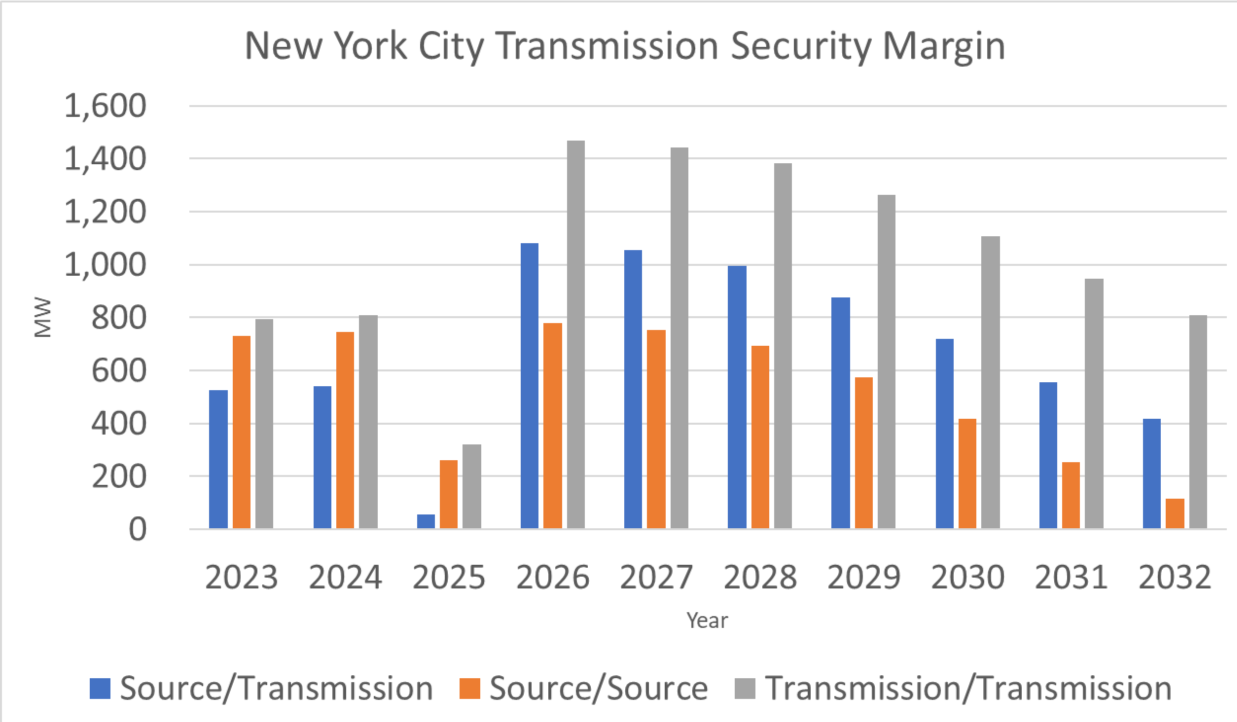


New York City (Zone J) Tipping Points

Within the Con Edison service territory, the 345 kV transmission system along with specific portions of the 138 kV transmission system are designed for the occurrence of two non-simultaneous contingencies and a return to normal (N-1-1-0).[25] Design criteria N-1-1-0 combinations include various combinations of the loss of generation and transmission facilities. As the system changes, the limiting contingency combination may also change. **Figure 77** shows how the summer transmission security margin changes through time in consideration of the planned transmission system changes, which impact the most limiting contingency combination for the year being evaluated. In the summer 2023, 2024, and 2025, the most limiting N-1-1-0 contingency combination is the loss of Ravenswood 3 followed by the loss of Mott Haven – Rainey 345 kV (Q12). Starting in summer 2026, the limiting contingency combination changes to the loss of CHPE followed by the loss of Ravenswood 3. Other contingency combinations result in changing the power flowing into Zone J from other NYCA zones. For example, in considering the possible combinations of N-1-1-0 events, these can include a mix of generation and transmission, two transmission events, or two generation events. **Figure 77** shows the transmission security margin for the contingency combinations of: Ravenswood 3 and Mott Haven — Rainey (Q12) 345 kV, Ravenswood 3 and Bayonne Energy Center (for years 2023 through 2025) or CHPE and Ravenswood 3 (years 2026 through 2032), and Sprain Brook-W. 49th St. 345 kV (M51 and M52). As seen in **Figure 77**, the selecting an interface flow with the lowest value (3,191 MW for the loss of M51/M52) does not result in the smallest transmission security margin. The limiting contingency combination for all winters is the loss of Ravenswood 3 followed by the loss of Mott Haven – Rainey 345 kV (Q12). This is due to the assumption that following the in-service status of CHPE in December 2025, its schedule is 0 MW for the winter seasons.

[25] Con Edison, TP-7100-18 Transmission Planning Criteria, dated August 2019.

Figure 77: Impact of Contingency Combination on Zone J Transmission Security Margin



As transmission security analysis represents discrete snapshots in time of various credible combinations of system conditions, when reliability needs are identified only the magnitude of the need can be identified under those system conditions. Additional details are required to fully describe the nature of the need such as evaluating the hourly load shape and its impact on the need. To describe the nature of the New York City transmission security margin, load shapes are developed for the Zone J component of the statewide load shape. Details of the load shapes are provided later in this appendix. For this assessment, load shapes are not developed past 2032 and only developed for the summer conditions.

Figure 78 shows the calculation of the New York City transmission security margin at the statewide coincident peak hour for baseline expected weather, expected load conditions for summer with normal transfer criteria. The New York City transmission security margin coincident with the statewide system peak ranges from 526 MW in summer 2023 to 117 MW by summer 2032 (line-item L).

The narrowest margin in New York City in the 10-year horizon for the summer peak expected load, normal transfer criteria conditions is 54 MW, which is observed in summer 2025. With this narrow margin, it is feasible for a small increase in expected load forecast to cause the system to be deficient. For example, with a margin of 54 MW, a forecast change of about 0.5% in New York City would cause a deficiency. The

2022 Quarter 2 STAR,[26] which used the 2021 Gold Book forecast, showed that under baseline expected load conditions with normal transfer criteria and the unavailability of thermal generation there would be a deficiency of 190 MW in year 2025.

The load shapes for New York City show the contribution of Zone J (**Figure 131**) towards the statewide curve (which represents the statewide coincident peak) for each hour of the day. Utilizing the load shape for the baseline expected weather summer peak day, the New York City transmission security margin for each hour is shown in **Figure 79**. The hourly margins are created by using the load forecast for each hour in the margin calculation (*i.e.*, **Figure 78** line-item A) with additional adjustments to account for the appropriate derate for solar generation and energy limited resources in each hour (*i.e.*, **Figure 78** line item H). All other values in the margin calculations are held constant. For all years in the 10-year study horizon, **Figure 79** shows that there are no observed deficiencies in consideration of the load shapes under baseline expected load, normal transfer criteria for New York City. However, the Zone J load during the system peak day does not necessarily peak during the same hour as the NYCA as a whole. In summer 2025, the Zone J peak hour is 16 while the statewide peak is hour 17. As such, the New York City margin for summer 2025 is 15 MW. Similarly, in 2032, the hourly margins are as narrow as 50 MW. A graphical representation of the New York City transmission security margin curve for summer peak baseline expected weather for the peak day in years 2023, 2025, 2027, and 2032 is provided **Figure 80**.

It is possible for other combinations of events, such as 1-in-10-year heatwaves and 1-in-100-year extreme heatwaves, to result in a deficient transmission security margin. **Figure 81** shows the New York City transmission security margin for the statewide coincident peak hour under the 1-in-10-year heatwave condition with the assumption that the system is using emergency transfer criteria. As seen in **Figure 81**, the margin is sufficient for summer 2023 or 2024; however, the margin is deficient in summer 2025 by 249 MW (line-item M). Starting in summer 2026 with CHPE in-service, the margins are sufficient through summer 2030. In summer 2031 the system is deficient by 71 MW with increased deficiency in summer 2032 to 215 MW due to the increased load. The load shapes for Zone J under a heatwave is provided in **Figure 136**. Utilizing the New York City load-duration heatwave curve, the transmission security margin for each hour utilizing emergency transfer criteria is shown in **Figure 82**. As shown in **Figure 82**, the deficiency in summer 2025 is observed over seven hours (988 MWh). While **Figure 81** does not show the system to be deficient in year 2030, the load shape results in a two-hour deficiency (163 MWh) as seen in **Figure 82**. This is due to the Zone J load component of the statewide 1-in-10-year summer peak day having less of a contribution to the load in hour beginning 18 as compared to hours beginning 16 and 17.

[26] The quarterly Short-Term Reliability Process (STAR) reports are available on the NYISO's website at https://www.nyiso.com/short-term-reliability-process.

In 2032, the MWh deficiency is observed over 8 hours (1,483 MWh). **Figure 83** provides a graphical representation of the New York City transmission security margin curve for the 1-in-10-year heatwave for the peak day in years 2023, 2025, 2027, and 2032.

The 1-in-100-year extreme heatwave transmission security margin in **Figure 84** shows that the transmission security margin is deficient for all years in the 10-year horizon (line-item M). As shown in **Figure 85**, in summer 2023 the 1-in-100-year peak day is deficient over 6 hours (1,472 MWh). In 2025, the deficiency increases to 5,352 MWh over 11 hours. In 2027, the deficiency is only observed for 3 hours (377 MWh). By 2032, the deficiency increases to 12 hours (6,850 MWh). **Figure 86** provides a graphical representation of the New York City transmission security margin curve for the 1-in-100-year extreme heatwave for the peak day in years 2023, 2025, 2027, and 2032.

In addition to heatwave or extreme heatwave conditions, other changes to the transmission system may result in a deficient transmission security margin. Considering the summer baseline peak load transmission security margin, several different single generator outages, or combinations of generator outages within New York City beyond those included in the RNA Base Case assumptions could result in a deficient transmission security margin. Details of specific generator impacts on the New York City transmission security margin are shown in **Figure 87**. In summer 2023, there are eight different units (or combinations of units) listed that could result in an insufficient transmission security margin. By 2025, the amount of units (or combination of units) that can result in insufficient margins increases to 33. These values reduce to three units (or combination of units) starting in summer 2026 with the in-service status of CHPE. However, by 2032, there are 22 units that could cause the margins to be deficient.

Figure 88 shows the New York City transmission security margin under winter peak baseline expected weather load conditions with normal transfer criteria. For winter peak, the margins are sufficient for all years and ranges from 4,571 MW in winter 2023-24 to 2,086 in winter 2032-33 (line-item L). Considering the winter baseline peak load transmission security margin, multiple outages in New York City would be required to show a deficient transmission security margin.

Figure 89 shows the New York City transmission security margin in a 1-in-10-year cold snap with emergency transfer criteria. Under this condition the margins are sufficient for all years and ranges from 4,316 MW in winter 2023-24 to 1,705 MW in winter 2032-33. Similarly, **Figure 90** shows the New York City transmission security margins for the 1-in-100-year extreme cold snap with emergency transfer criteria. The margin under this condition is sufficient for all years and ranges from 3,913 MW in winter 2023-24 to 1,168 MW in winter 2032-33.

Figure 91 provides a summary of the summer peak New York City transmission security margins under expected summer weather, heatwave, and extreme heatwave conditions. **Figure 92** provides a summary of the winter peak New York City transmission security margins under expected winter weather, cold snap, and extreme cold snap conditions.

While **Figure 91** and **Figure 92** provide a summary of the margins through the 10-year horizon, the 2022 Gold Book provides the forecast details through year 2052. **Figure 93** provides a summary of the New York City transmission security margins (summer and winter) under baseline expected weather, normal transfer criteria through 2052 to quantify the future year margins beyond the 10-year horizon. These margins are an extension of the total resources of the last year of the RNA horizon (*i.e.*, **Figure 78** shows the total resources for summer 2032 at 9,178 MW and **Figure 88** shows the total resources for winter 2032-33 at 9,080 MW) through 2052. As seen in **Figure 93**, the New York City transmission security margin for the summer peak day is extremely narrow in summer 2033 at 21 MW and is deficient in summer 2034 by 52 MW. By 2052, the summer deficiency grows to 1,095 MW. For winter peak, the New York City transmission security margin is deficient in winter 2036-37 by 543 MW. This deficiency grows to 4,023 MW by winter 2052-53. Anticipated generation additions to meet CLCPA goals, such as those discussed in the System & Resource Outlook Policy Scenario 2, will have a significant impact on the ability to maintain sufficient margin.

Figure 78: New York City Transmission Security Margin (Summer Peak – Baseline Expected Weather, Normal Transfer Criteria)

Summer Peak - Baseline Expected Weather, Normal Transfer Criteria (MW)											
Line	**Item**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
A	**Zone J Load Forecast**	(10,853)	(10,837)	(10,786)	(10,778)	(10,804)	(10,864)	(10,986)	(11,140)	(11,303)	(11,441)
B	I+K to J (3)	3,904	3,904	3,904	4,622	4,622	4,622	4,622	4,622	4,622	4,622
C	ABC PARs to J	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)
D	**Total J AC Import (B+C)**	3,893	3,893	3,893	4,611	4,611	4,611	4,611	4,611	4,611	4,611
E	Loss of Source Contingency	(980)	(980)	(980)	(2,230)	(2,230)	(2,230)	(2,230)	(2,230)	(2,230)	(2,230)
F	**Resource Need (A+D+E)**	(7,940)	(7,924)	(7,873)	(8,397)	(8,423)	(8,483)	(8,605)	(8,759)	(8,922)	(9,060)
G	J Generation (1)	8,796	8,796	8,197	8,197	8,197	8,197	8,197	8,197	8,197	8,197
H	J Generation Derates (2)	(645)	(645)	(584)	(584)	(584)	(584)	(584)	(584)	(584)	(584)
I	Temperature Based Generation Derates	0	0	0	0	0	0	0	0	0	0
J	Net ICAP External Imports	315	315	315	1,565	1,565	1,565	1,565	1,565	1,565	1,565
K	**Total Resources Available (H+I+J)**	8,466	8,466	7,928	9,178	9,178	9,178	9,178	9,178	9,178	9,178
L	**Transmission Security Margin (F+K)**	526	542	54	780	754	694	572	418	255	117

Notes:

1. Reflects the 2022 Gold Book existing summer capacity plus projected additions and deactivations.
2. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 5% of the total nameplate, off-shore wind at 10% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
3. Limits in 2022 and 2023 are based on limits from the summer peak 2023 representations evaluated in the post-2020 RNA updates. Limits for 2024 and 2025 are based on the summer peak 2025 representations evaluated in the post-2020 RNA updates. Limits for 2026 through 2032 are based on the summer peak 2032 represenations evalauted in the 2022 RNA.

Figure 79: New York City Transmission Security Margin (Hourly) (Summer Peak – Baseline Expected Weather, Normal Transfer Criteria)

Summer Peak - Baseline Expected Summer Weather, Normal Transfer Criteria (MW)										
J Transmission Security Margin										
Hour	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
HB0	3,485	3,491	2,993	3,703	3,561	3,490	3,357	3,188	3,010	2,860
HB1	3,842	3,849	3,356	4,069	3,933	3,868	3,740	3,581	3,413	3,271
HB2	4,104	4,113	3,620	4,335	4,202	4,140	4,017	3,865	3,705	3,570
HB3	4,253	4,262	3,771	4,488	4,357	4,300	4,181	4,034	3,880	3,751
HB4	4,264	4,275	3,787	4,507	4,379	4,326	4,211	4,073	3,926	3,805
HB5	4,063	4,072	3,580	4,300	4,171	4,115	4,001	3,860	3,713	3,590
HB6	3,587	3,598	3,110	3,833	3,705	3,653	3,542	3,403	3,257	3,132
HB7	2,917	2,937	2,460	3,194	3,077	3,035	2,932	2,799	2,658	2,535
HB8	2,299	2,324	1,849	2,587	2,472	2,432	2,328	2,193	2,043	1,912
HB9	1,807	1,834	1,363	2,103	1,992	1,954	1,853	1,719	1,568	1,433
HB10	1,413	1,444	976	1,723	1,616	1,582	1,486	1,353	1,202	1,069
HB11	1,133	1,169	706	1,458	1,356	1,331	1,241	1,115	970	840
HB12	917	955	496	1,253	1,155	1,135	1,051	931	793	672
HB13	756	795	336	1,092	997	975	893	779	646	530
HB14	688	724	261	1,012	911	886	800	681	547	431
HB15	597	628	157	901	794	761	667	542	404	284
HB16	464	491	15	752	640	600	499	368	226	102
HB17	526	542	54	780	653	600	486	340	185	50
HB18	646	659	168	887	754	694	572	418	255	117
HB19	836	845	351	1,065	928	862	733	574	407	263
HB20	1,065	1,072	576	1,291	1,152	1,084	953	791	620	474
HB21	1,317	1,328	833	1,551	1,414	1,348	1,220	1,058	886	741
HB22	1,752	1,763	1,270	1,985	1,846	1,779	1,646	1,480	1,302	1,152
HB23	2,309	2,321	1,829	2,544	2,407	2,339	2,208	2,041	1,865	1,713

Figure 80: New York City Transmission Security Margin Hourly Curve (Summer Peak – Baseline Expected Weather, Normal Transfer Criteria)

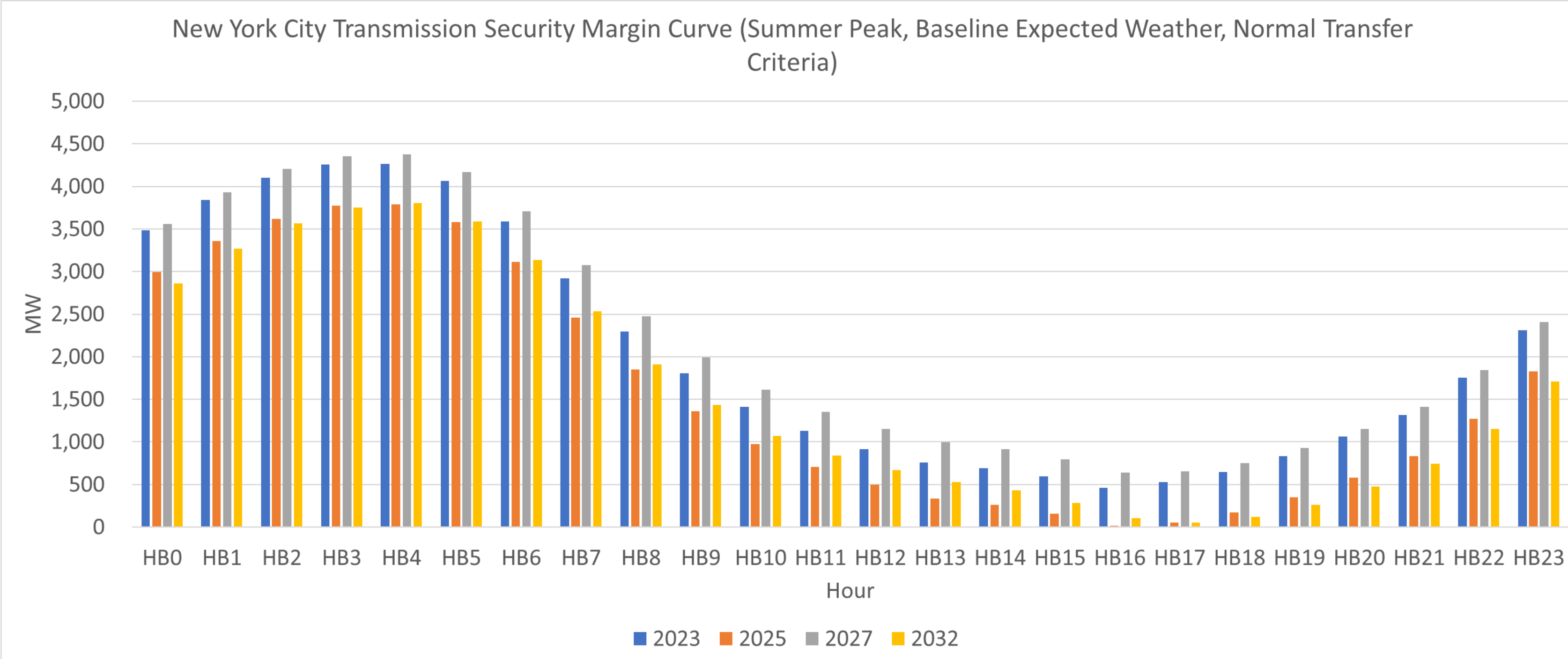


Figure 81: New York City Transmission Security Margin (1-in-10-Year Heatwave, Emergency Transfer Criteria)

Summer Peak - 1-in-10-Year Heatwave, Emergency Transfer Criteria (MW)											
Line	**Item**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
A	**Zone J Load Forecast**	(11,324)	(11,308)	(11,254)	(11,246)	(11,273)	(11,336)	(11,463)	(11,624)	(11,794)	(11,938)
B	I+K to J (5)	3,904	3,904	3,904	4,622	4,622	4,622	4,622	4,622	4,622	4,622
C	ABC PARs to J	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)
D	**Total J Import (B+C)**	3,893	3,893	3,893	4,611	4,611	4,611	4,611	4,611	4,611	4,611
E	Loss of Source Contingency	(980)	(980)	(980)	(2,230)	(2,230)	(2,230)	(2,230)	(2,230)	(2,230)	(2,230)
F	**Resource Need (A+D+E)**	(8,411)	(8,395)	(8,341)	(8,865)	(8,892)	(8,955)	(9,082)	(9,243)	(9,413)	(9,557)
G	J Generation (1)	8,796	8,796	8,197	8,197	8,197	8,197	8,197	8,197	8,197	8,197
H	J Generation Derates (2)	(645)	(645)	(584)	(584)	(584)	(584)	(584)	(584)	(584)	(584)
I	Temperature Based Generation Derates	(64)	(64)	(55)	(55)	(55)	(55)	(55)	(55)	(55)	(55)
J	Net ICAP External Imports	315	315	315	1,565	1,565	1,565	1,565	1,565	1,565	1,565
K	SCRs (3), (4)	219	219	219	219	219	219	219	219	219	219
L	**Total Resources Available (G+H+I+J+K)**	8,621	8,621	8,092	9,342	9,342	9,342	9,342	9,342	9,342	9,342
M	**Transmission Security Margin (F+L)**	210	226	(249)	477	450	387	260	99	(71)	(215)

Notes:

1. Reflects the 2022 Gold Book existing summer capacity plus projected additions and deactivations.
2. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 5% of the total nameplate, off-shore wind at 10% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
3. SCRs are not applied for transmission security analysis of normal operations, but are included for emergency operations.
4. Includes a de-rate of 198 MW for SCRs.
5. Limits in 2022 and 2023 are based on limits from the summer peak 2023 representations evaluated in the post-2020 RNA updates. Limits for 2024 and 2025 are based on the summer peak 2025 representations evaluated in the post-2020 RNA updates. Limits for 2026 through 2032 are based on the summer peak 2032 represenations evalauted in the 2022 RNA.

Figure 82: New York City Transmission Security Margin (Hourly) (1-in-10-Year Heatwave, Emergency Transfer Criteria)

Summary Peak - Heatwave, Emergency Transfer Criteria (MW)										
J Transmission Security Margin										
Hour	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
HB0	2,618	2,627	2,144	2,857	2,692	2,604	2,451	2,266	2,078	1,921
HB1	3,016	3,024	2,547	3,262	3,103	3,021	2,872	2,696	2,518	2,369
HB2	3,291	3,303	2,827	3,545	3,390	3,312	3,169	3,002	2,832	2,690
HB3	3,456	3,469	2,995	3,715	3,561	3,489	3,349	3,187	3,022	2,887
HB4	3,480	3,495	3,023	3,746	3,595	3,526	3,389	3,235	3,077	2,948
HB5	3,264	3,278	2,803	3,527	3,376	3,306	3,172	3,016	2,860	2,730
HB6	2,740	2,752	2,278	3,003	2,850	2,780	2,647	2,491	2,334	2,202
HB7	2,054	2,063	1,589	2,314	2,161	2,091	1,954	1,795	1,635	1,495
HB8	1,467	1,478	1,001	1,725	1,571	1,498	1,359	1,195	1,025	877
HB9	1,012	1,022	547	1,270	1,120	1,047	909	746	574	422
HB10	689	701	227	954	806	736	601	438	264	112
HB11	563	581	111	843	701	639	510	352	185	34
HB12	443	463	(3)	735	597	538	413	260	98	(45)
HB13	402	426	(37)	702	596	538	419	241	86	(50)
HB14	336	360	(103)	634	547	493	374	162	8	(126)
HB15	224	246	(221)	514	449	391	270	23	(131)	(265)
HB16	132	153	(317)	414	369	309	184	(100)	(257)	(393)
HB17	210	226	(249)	477	450	387	260	(63)	(225)	(367)
HB18	406	420	(56)	663	632	563	430	99	(71)	(215)
HB19	632	643	164	878	821	747	606	304	130	(19)
HB20	863	872	390	1,105	1,023	944	802	529	353	200
HB21	1,117	1,126	641	1,353	1,244	1,162	1,015	771	588	433
HB22	1,568	1,576	1,089	1,798	1,663	1,575	1,420	1,203	1,013	850
HB23	2,144	2,150	1,663	2,371	2,213	2,122	1,967	1,781	1,591	1,426

Figure 83: New York City Transmission Security Margin Hourly Curve (1-in-10-Year Heatwave, Emergency Transfer Criteria)

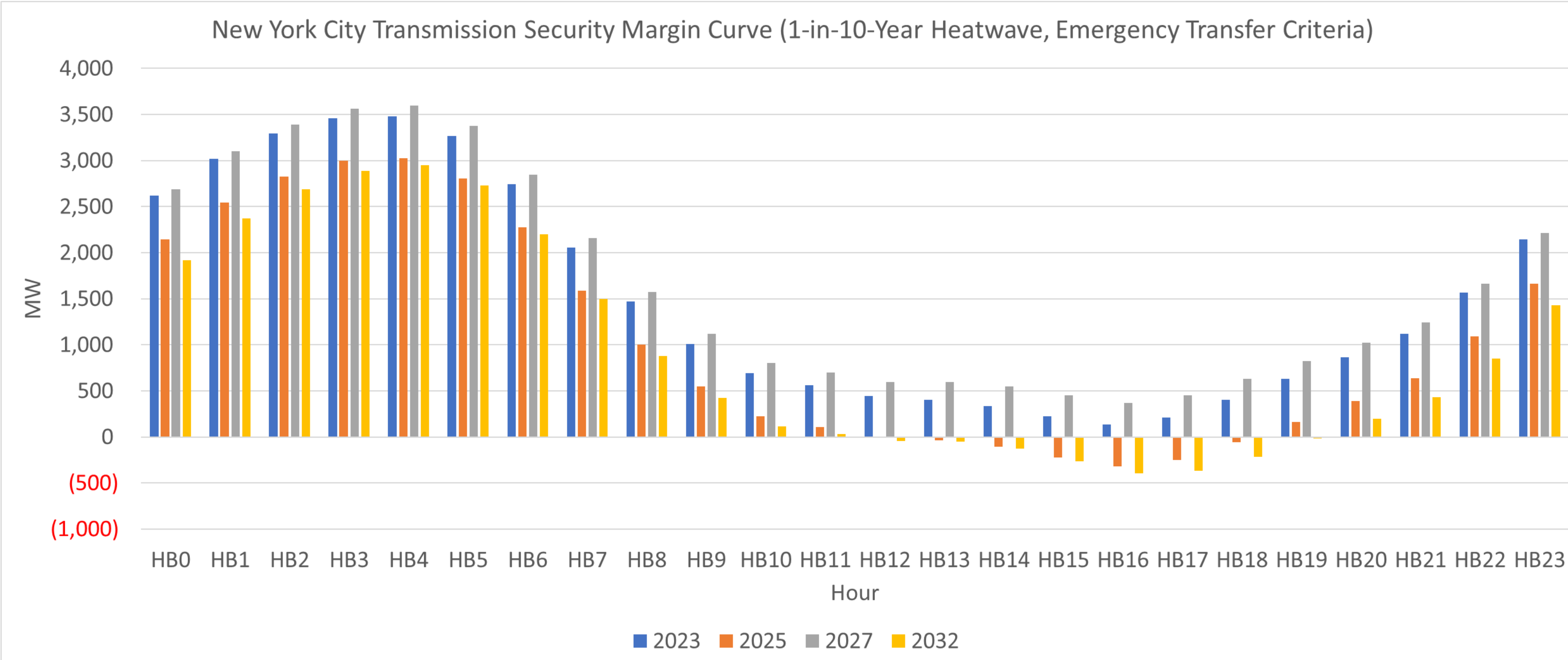


Figure 84: New York City Transmission Security Margin (1-in-100-Year Extreme Heatwave, Emergency Transfer Criteria)

Summer Peak - 1-in-100-Year Extreme Heatwave, Emergency Transfer Criteria (MW)											
Line	**Item**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
A	**Zone J Load Forecast**	(11,802)	(11,785)	(11,729)	(11,721)	(11,749)	(11,814)	(11,947)	(12,114)	(12,292)	(12,442)
B	I+K to J (5)	3,904	3,904	3,904	4,622	4,622	4,622	4,622	4,622	4,622	4,622
C	ABC PARs to J	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)
D	**Total J Import (B+C)**	3,893	3,893	3,893	4,611	4,611	4,611	4,611	4,611	4,611	4,611
E	Loss of Source Contingency	(980)	(980)	(980)	(2,230)	(2,230)	(2,230)	(2,230)	(2,230)	(2,230)	(2,230)
F	**Resource Need (A+D+E)**	(8,889)	(8,872)	(8,816)	(9,340)	(9,368)	(9,433)	(9,566)	(9,733)	(9,911)	(10,061)
G	J Generation (1)	8,796	8,796	8,197	8,197	8,197	8,197	8,197	8,197	8,197	8,197
H	J Generation Derates (2)	(645)	(645)	(584)	(584)	(584)	(584)	(584)	(584)	(584)	(584)
I	Temperature Based Generation Derates	(135)	(135)	(116)	(116)	(116)	(116)	(116)	(116)	(116)	(116)
J	Net ICAP External Imports	315	315	315	1,565	1,565	1,565	1,565	1,565	1,565	1,565
K	SCRs (3), (4)	219	219	219	219	219	219	219	219	219	219
L	**Total Resources Available (G+H+I+J+K)**	8,550	8,550	8,031	9,281	9,281	9,281	9,281	9,281	9,281	9,281
M	**Transmission Security Margin (F+L)**	(339)	(322)	(785)	(59)	(87)	(152)	(285)	(452)	(630)	(780)

Notes:

1. Reflects the 2022 Gold Book existing summer capacity plus projected additions and deactivations.
2. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 5% of the total nameplate, off-shore wind at 10% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
3. SCRs are not applied for transmission security analysis of normal operations, but are included for emergency operations.
4. Includes a de-rate of 198 MW for SCRs.
5. Limits in 2022 and 2023 are based on limits from the summer peak 2023 representations evaluated in the post-2020 RNA updates. Limits for 2024 and 2025 are based on the summer peak 2025 representations evaluated in the post-2020 RNA updates. Limits for 2026 through 2032 are based on the summer peak 2032 represenations evalauted in the 2022 RNA.

Figure 85: New York City Transmission Security Margin (Hourly) (1-in-100-Year Extreme Heatwave, Emergency Transfer Criteria)

Summary Peak - 1-in-100-Year Extreme Heatwave, Emergency Transfer Criteria (MW)										
J Transmission Security Margin										
Hour	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
HB0	2,247	2,257	1,788	2,503	2,335	2,246	2,090	1,901	1,708	1,548
HB1	2,643	2,654	2,190	2,907	2,745	2,662	2,509	2,329	2,146	1,994
HB2	2,918	2,932	2,470	3,190	3,031	2,952	2,805	2,633	2,458	2,314
HB3	3,083	3,097	2,637	3,359	3,202	3,128	2,985	2,817	2,648	2,508
HB4	3,107	3,124	2,665	3,390	3,235	3,165	3,024	2,865	2,701	2,569
HB5	2,890	2,905	2,444	3,169	3,015	2,942	2,804	2,643	2,481	2,348
HB6	2,362	2,375	1,913	2,638	2,481	2,409	2,270	2,109	1,945	1,809
HB7	1,672	1,681	1,218	1,942	1,784	1,710	1,569	1,404	1,236	1,093
HB8	1,083	1,092	625	1,347	1,188	1,111	966	797	620	468
HB9	628	635	170	891	734	657	513	343	164	8
HB10	307	316	(149)	576	421	346	204	34	(146)	(302)
HB11	185	200	(262)	467	318	251	115	(49)	(223)	(378)
HB12	9	25	(433)	301	155	90	(43)	(203)	(374)	(522)
HB13	(67)	(48)	(503)	233	118	55	(72)	(260)	(424)	(567)
HB14	(168)	(147)	(602)	132	38	(21)	(149)	(372)	(535)	(675)
HB15	(315)	(295)	(752)	(20)	(90)	(153)	(283)	(542)	(705)	(847)
HB16	(442)	(421)	(880)	(152)	(199)	(263)	(396)	(693)	(860)	(1,003)
HB17	(339)	(322)	(785)	(59)	(87)	(152)	(285)	(622)	(794)	(941)
HB18	(142)	(125)	(588)	132	101	32	(108)	(452)	(630)	(780)
HB19	122	136	(329)	386	330	255	109	(204)	(385)	(540)
HB20	391	402	(65)	651	569	489	341	60	(123)	(280)
HB21	678	690	217	933	822	739	588	336	147	(11)
HB22	1,161	1,170	696	1,408	1,270	1,182	1,024	801	606	440
HB23	1,771	1,779	1,305	2,016	1,855	1,763	1,605	1,415	1,221	1,053

Figure 86: New York City Transmission Security Margin Hourly Curve (1-in-100-Year Extreme Heatwave, Emergency Transfer Criteria)

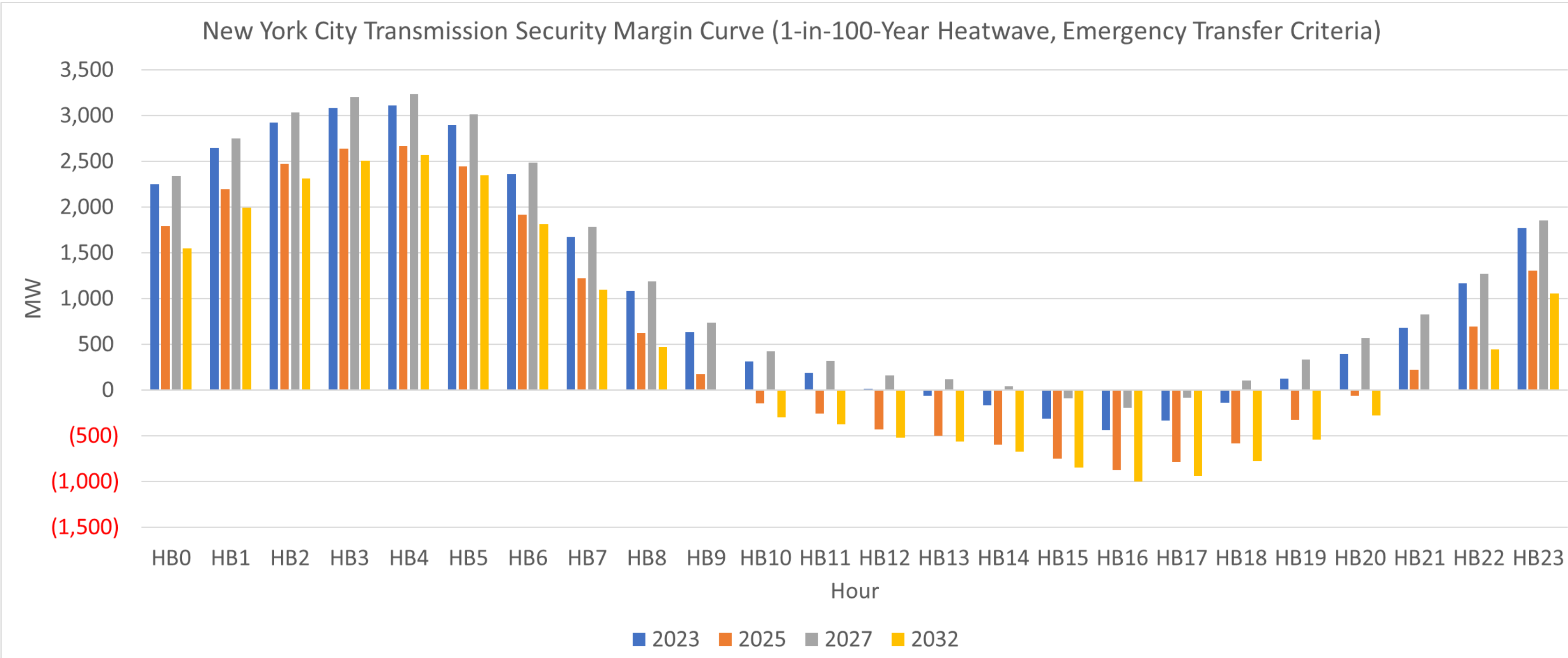


Figure 87: Impact of Generator Outages on New York City Transmission Security Margin (Summer Peak – Baseline Expected Weather, Normal Transfer Criteria)

New York City Transmission Security Margin (MW)											
Year		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
New York City Transmission Security Margin (Summer Peak - Baseline Expected Weather, Normal Transfer Criteria)		526	542	54	780	754	694	572	418	255	117
Unit Name	Summer DMNC	Transmission Security Margin Less Summer DMNC									
Astoria 2, 3, and 5	918.8	(393)	(377)	(864)	(138)	(164)	(224)	(346)	(500)	(663)	(801)
Arthur Kill ST 2 and ST 3	860.1	(334)	(318)	(806)	(80)	(106)	(166)	(288)	(442)	(605)	(743)
Linden Cogen	790.8	(265)	(249)	(736)	(10)	(36)	(96)	(218)	(372)	(535)	(673)
Ravenswood ST 01 and ST 02	749.8	(224)	(208)	(695)	31	5	(55)	(177)	(331)	(494)	(632)
East River 1, 2, 6, and 7	638.8	(113)	(97)	(584)	142	116	56	(66)	(220)	(383)	(521)
Bayonne (all units)	607.8	(82)	(66)	(553)	173	147	87	(35)	(189)	(352)	(490)
Astoria East Energy - CC1 & CC2	584.4	(58)	(42)	(530)	196	170	110	(12)	(166)	(329)	(467)
Astoria Energy 2 - CC3 & CC4	571.2	(45)	(29)	(517)	209	183	123	1	(153)	(316)	(454)
Arthur Kill ST 3	520.1	6	22	(466)	260	234	174	52	(102)	(265)	(403)
Astoria CC 1 & 2	479.8	46	62	(425)	301	275	215	93	(61)	(224)	(362)
Ravenswood ST 02	377.5	149	165	(323)	403	377	317	195	41	(122)	(260)
Astoria 5	375.1	151	167	(321)	405	379	319	197	43	(120)	(258)
Ravenswood ST 01	372.3	154	170	(318)	408	382	322	200	46	(117)	(255)
Astoria 3	371.3	155	171	(317)	409	383	323	201	47	(116)	(254)
Arthur Kill ST 2	340.0	186	202	(286)	440	414	354	232	78	(85)	(223)
Brooklyn Navy Yard	256.9	269	285	(202)	524	498	438	316	162	(1)	(139)
Ravenswood CC 04	232.5	294	310	(178)	548	522	462	340	186	23	(115)
East River 7	184.8	341	357	(130)	596	570	510	388	234	71	(67)
Astoria 2	172.4	354	370	(118)	608	582	522	400	246	83	(55)
East River 1	155.8	370	386	(101)	625	599	539	417	263	100	(38)
East River 2	152.9	373	389	(98)	628	602	542	420	266	103	(35)
East River 6	145.3	381	397	(91)	635	609	549	427	273	110	(28)
KIAC JFK GT 1 & GT2	105.5	421	437	(51)	675	649	589	467	313	150	12
Bayonne EC CTG10	62.6	463	479	(8)	718	692	632	510	356	193	55
Bayonne EC CTG4	61.8	464	480	(7)	719	693	633	511	357	194	56
Bayonne EC CTG9	61.3	465	481	(7)	719	693	633	511	357	194	56
Bayonne EC CTG1	61.1	465	481	(7)	719	693	633	511	357	194	56
Bayonne EC CTG8	61.0	465	481	(7)	719	693	633	511	357	194	56
Bayonne EC CTG5	60.7	465	481	(6)	720	694	634	512	358	195	57
Bayonne EC CTG7	60.6	465	481	(6)	720	694	634	512	358	195	57
Bayonne EC CTG2	60.0	466	482	(6)	720	694	634	512	358	195	57
Bayonne EC CTG6	59.5	467	483	(5)	721	695	635	513	359	196	58
Bayonne EC CTG3	59.2	467	483	(5)	721	695	635	513	359	196	58
KIAC_JFK_GT1	53.4	473	489	1	727	701	641	519	365	202	64
KIAC_JFK_GT2	52.1	474	490	2	728	702	642	520	366	203	65
Kent	46.0	480	496	8	734	708	648	526	372	209	71
Pouch	45.2	481	497	9	735	709	649	527	373	210	72
Gowanus 5	40.0	486	502	14	740	714	654	532	378	215	77
Harlem River 2	40.0	486	502	14	740	714	654	532	378	215	77
Hellgate 2	40.0	486	502	14	740	714	654	532	378	215	77
Vernon Blvd 2	40.0	486	502	14	740	714	654	532	378	215	77
Gowanus 6	39.9	486	502	15	741	715	655	533	379	216	78
Harlem River 1	39.9	486	502	15	741	715	655	533	379	216	78
Hellgate 1	39.9	486	502	15	741	715	655	533	379	216	78
Vernon Blvd 3	39.9	486	502	15	741	715	655	533	379	216	78
Arthur Kill Cogen	9.0	517	533	45	771	745	685	563	409	246	108

Figure 88: New York City Transmission Security Margin (Winter Peak – Baseline Expected Weather, Normal Transfer Criteria)

Winter Peak - Baseline Expected Weather, Normal Transfer Criteria (MW)											
Line	**Item**	**2023-24**	**2024-25**	**2025-26**	**2026-27**	**2027-28**	**2028-29**	**2029-30**	**2030-31**	**2031-32**	**2032-33**
A	**Zone J Load Forecast**	(7,442)	(7,495)	(7,578)	(7,725)	(7,934)	(8,208)	(8,532)	(8,894)	(9,350)	(9,897)
B	I+K to J (3), (4)	3,904	3,904	3,904	3,904	3,904	3,904	3,904	3,904	3,904	3,904
C	ABC PARs to J	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)
D	**Total J AC Import (B+C)**	3,893	3,893	3,893	3,893	3,893	3,893	3,893	3,893	3,893	3,893
E	Loss of Source Contingency	(990)	(990)	(990)	(990)	(990)	(990)	(990)	(990)	(990)	(990)
F	**Resource Need (A+D+E)**	(4,539)	(4,592)	(4,675)	(4,822)	(5,031)	(5,305)	(5,629)	(5,991)	(6,447)	(6,994)
G	J Generation (1)	9,481	9,481	9,447	9,447	9,447	9,447	9,447	9,447	9,447	9,447
H	J Generation Derates (2)	(686)	(686)	(682)	(682)	(682)	(682)	(682)	(682)	(682)	(682)
I	Temperature Based Generation Derates	0	0	0	0	0	0	0	0	0	0
J	Net ICAP External Imports	315	315	315	315	315	315	315	315	315	315
K	**Total Resources Available (G+H+I+J)**	9,110	9,110	9,080	9,080	9,080	9,080	9,080	9,080	9,080	9,080
L	**Transmission Security Margin (F+K)**	4,571	4,518	4,405	4,258	4,049	3,775	3,451	3,089	2,633	2,086

Notes:

1. Reflects the 2022 Gold Book existing winter capacity plus projected additions and deactivations.
2. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 10% of the total nameplate, off-shore wind at 15% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). For winter the expected solar PV output at peak is 0 MW. Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
3. Limits in 2022 and 2023 are based on limits from the summer peak 2023 representations evaluated in the post-2020 RNA updates. Limits for 2024 and 2025 are based on the summer peak 2025 representations evaluated in the post-2020 RNA updates. Limits for 2026 through 2032 are based also based on the summer peak 2025 representations evaluated in the post-2020 RNA analysis which does not include the impact of CHPE.
4. As a conservative winter peak assumption these limits utilize the summer values.

Figure 89: New York City Transmission Security Margin (1-in-10-Year Cold Snap, Emergency Transfer Criteria)

Winter Peak - 1-in-10-Year Cold Snap, Emergency Transfer Criteria (MW)											
Line	**Item**	**2023-24**	**2024-25**	**2025-26**	**2026-27**	**2027-28**	**2028-29**	**2029-30**	**2030-31**	**2031-32**	**2032-33**
A	**Zone J Load Forecast**	(7,825)	(7,880)	(7,968)	(8,122)	(8,342)	(8,630)	(8,971)	(9,351)	(9,831)	(10,406)
B	I+K to J (5), (6)	3,904	3,904	3,904	3,904	3,904	3,904	3,904	3,904	3,904	3,904
C	ABC PARs to J	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)
D	**Total J Import (B+C)**	3,893	3,893	3,893	3,893	3,893	3,893	3,893	3,893	3,893	3,893
E	Loss of Source Contingency	(990)	(990)	(990)	(990)	(990)	(990)	(990)	(990)	(990)	(990)
F	**Resource Need (A+D+E)**	(4,922)	(4,977)	(5,065)	(5,219)	(5,439)	(5,727)	(6,068)	(6,448)	(6,928)	(7,503)
G	J Generation (1)	9,481	9,481	9,447	9,447	9,447	9,447	9,447	9,447	9,447	9,447
H	J Generation Derates (2)	(686)	(686)	(682)	(682)	(682)	(682)	(682)	(682)	(682)	(682)
I	Temperature Based Generation Derates	0	0	0	0	0	0	0	0	0	0
J	Net ICAP External Imports	315	315	315	315	315	315	315	315	315	315
K	SCRs (3), (4)	128	128	128	128	128	128	128	128	128	128
L	**Total Resources Available (G+H+I+J+K)**	9,238	9,238	9,208	9,208	9,208	9,208	9,208	9,208	9,208	9,208
M	**Transmission Security Margin (F+L)**	4,316	4,261	4,143	3,989	3,769	3,481	3,140	2,760	2,280	1,705

Notes:

1. Reflects the 2022 Gold Book existing winter capacity plus projected additions and deactivations.
2. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 10% of the total nameplate, off-shore wind at 15% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). For winter the expected solar PV output at peak is 0 MW. Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
3. SCRs are not applied for transmission security analysis of normal operations, but are included for emergency operations.
4. Includes a de-rate of 116 MW for SCRs.
5. Limits in 2022 and 2023 are based on limits from the summer peak 2023 representations evaluated in the post-2020 RNA updates. Limits for 2024 and 2025 are based on the summer peak 2025 representations evaluated in the post-2020 RNA updates. Limits for 2026 through 2032 are based also based on the summer peak 2025 representations evaluated in the post-2020 RNA analysis which does not include the impact of CHPE.
6. As a conservative winter peak assumption these limits utilize the summer values.

Figure 90: New York City Transmission Security Margin (1-in-100-year Extreme Cold Snap, Emergency Transfer Criteria)

Winter Peak - 1-in-100-Year Extreme Cold Snap, Emergency Transfer Criteria (MW)											
Line	**Item**	**2023-24**	**2024-25**	**2025-26**	**2026-27**	**2027-28**	**2028-29**	**2029-30**	**2030-31**	**2031-32**	**2032-33**
A	**Zone J Load Forecast**	(8,228)	(8,287)	(8,379)	(8,541)	(8,772)	(9,075)	(9,433)	(9,834)	(10,338)	(10,943)
B	I+K to J (5), (6)	3,904	3,904	3,904	3,904	3,904	3,904	3,904	3,904	3,904	3,904
C	ABC PARs to J	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)
D	**Total J Import (B+C)**	3,893	3,893	3,893	3,893	3,893	3,893	3,893	3,893	3,893	3,893
E	Loss of Source Contingency	(990)	(990)	(990)	(990)	(990)	(990)	(990)	(990)	(990)	(990)
F	**Resource Need (A+D+E)**	(5,325)	(5,384)	(5,476)	(5,638)	(5,869)	(6,172)	(6,530)	(6,931)	(7,435)	(8,040)
G	J Generation (1)	9,481	9,481	9,447	9,447	9,447	9,447	9,447	9,447	9,447	9,447
H	J Generation Derates (2)	(686)	(686)	(682)	(682)	(682)	(682)	(682)	(682)	(682)	(682)
I	Temperature Based Generation Derates	0	0	0	0	0	0	0	0	0	0
J	Net ICAP External Imports	315	315	315	315	315	315	315	315	315	315
K	SCRs (3), (4)	128	128	128	128	128	128	128	128	128	128
L	**Total Resources Available (G+H+I+J+K)**	9,238	9,238	9,208	9,208	9,208	9,208	9,208	9,208	9,208	9,208
M	**Transmission Security Margin (F+L)**	3,913	3,854	3,732	3,570	3,339	3,036	2,678	2,277	1,773	1,168

Notes:

1. Reflects the 2022 Gold Book existing winter capacity plus projected additions and deactivations.
2. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 10% of the total nameplate, off-shore wind at 15% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). For winter the expected solar PV output at peak is 0 MW. Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
3. SCRs are not applied for transmission security analysis of normal operations, but are included for emergency operations.
4. Includes a de-rate of 116 MW for SCRs.
5. Limits in 2022 and 2023 are based on limits from the summer peak 2023 representations evaluated in the post-2020 RNA updates. Limits for 2024 and 2025 are based on the summer peak 2025 representations evaluated in the post-2020 RNA updates. Limits for 2026 through 2032 are based also based on the summer peak 2025 representations evaluated in the post-2020 RNA analysis which does not include the impact of CHPE.
6. As a conservative winter peak assumption these limits utilize the summer values.

Figure 91: Summary of New York City Summer Transmission Security Margin – Summer

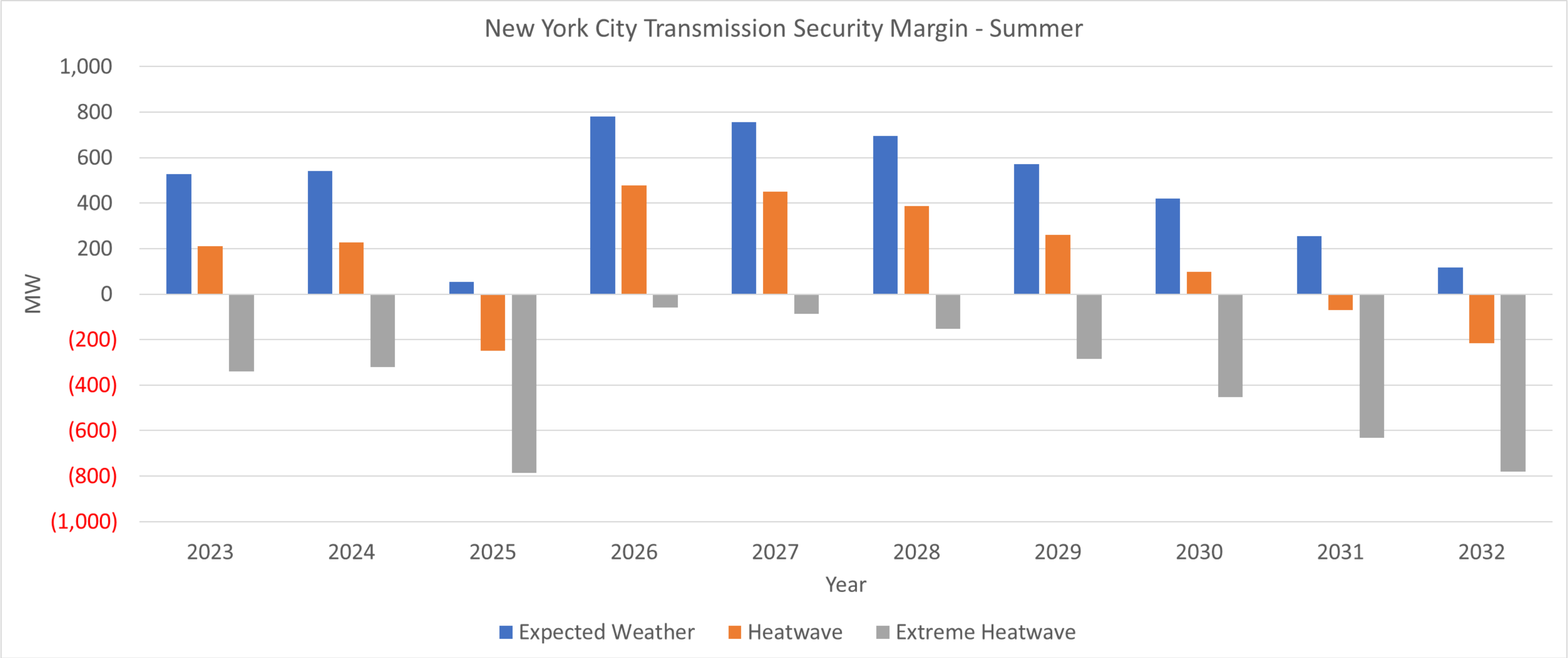


Figure 92: Summary of New York City Summer Transmission Security Margin – Winter

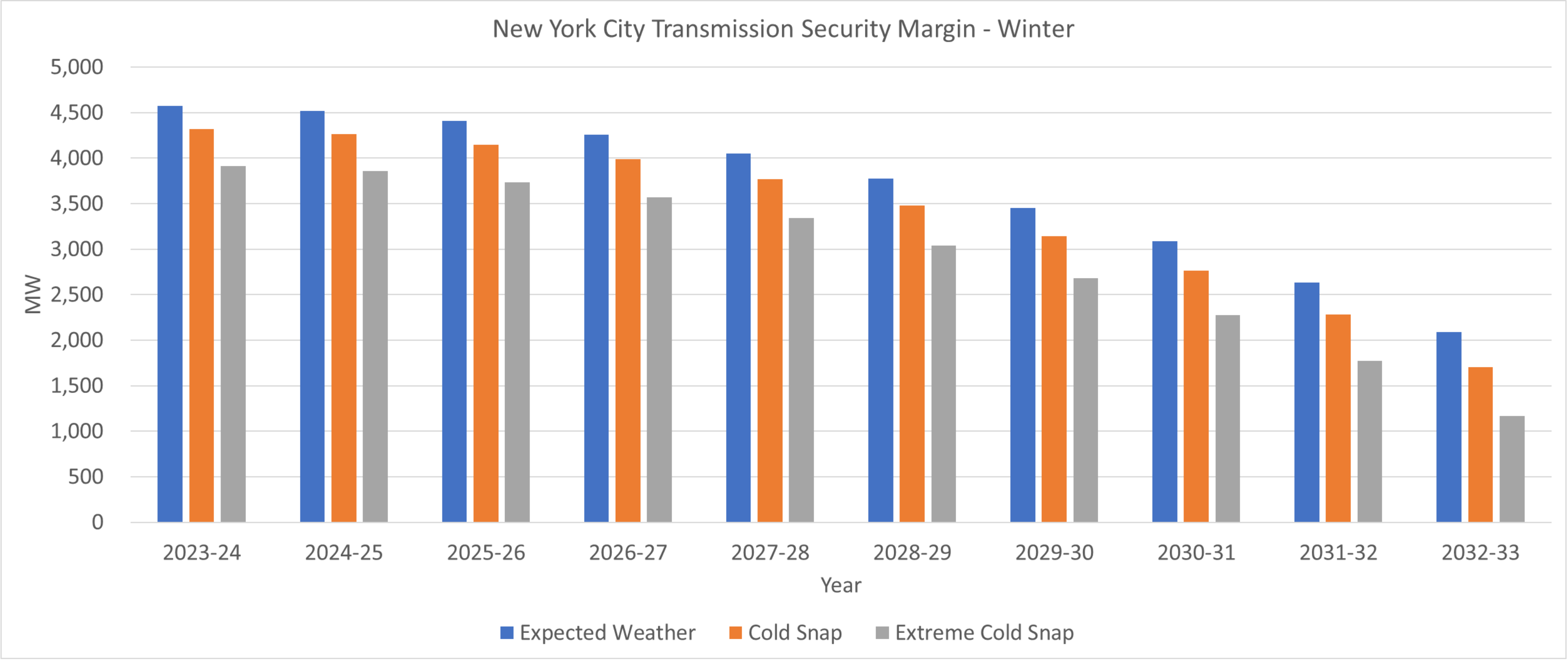
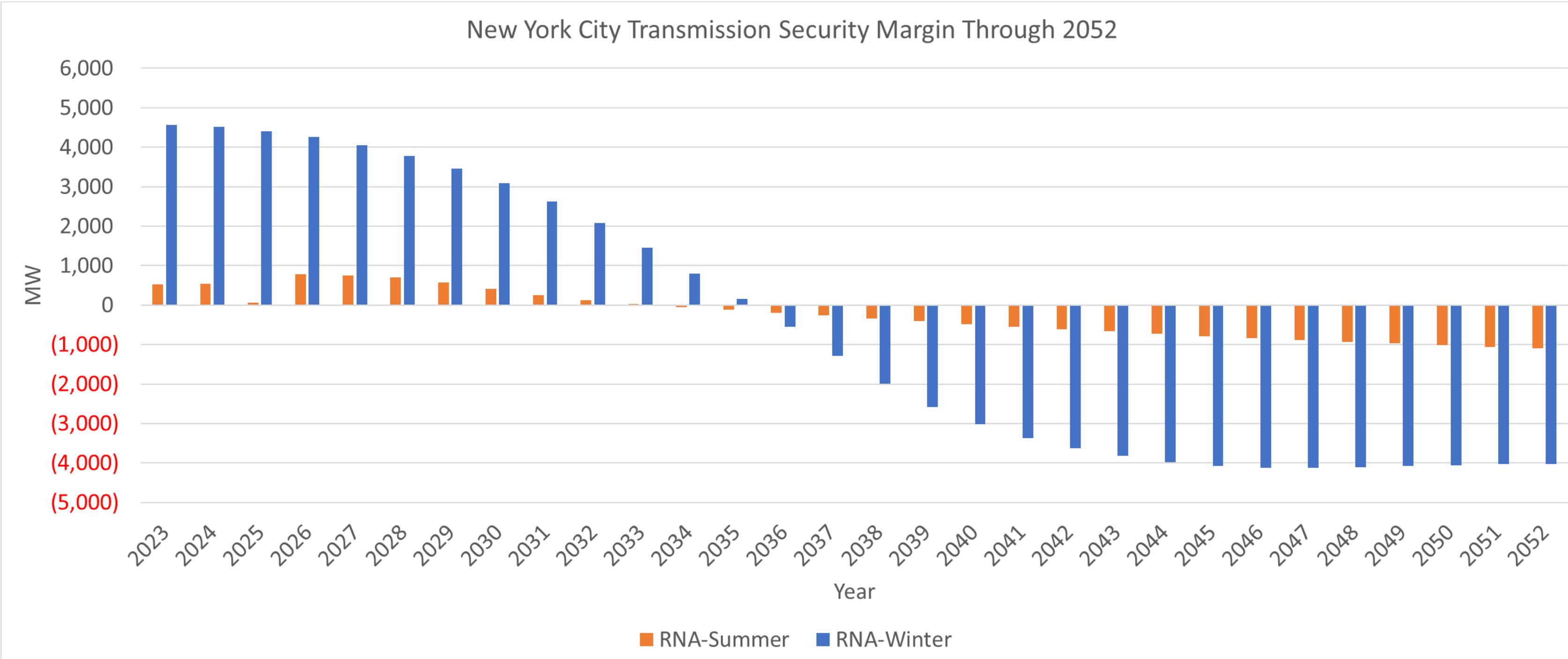


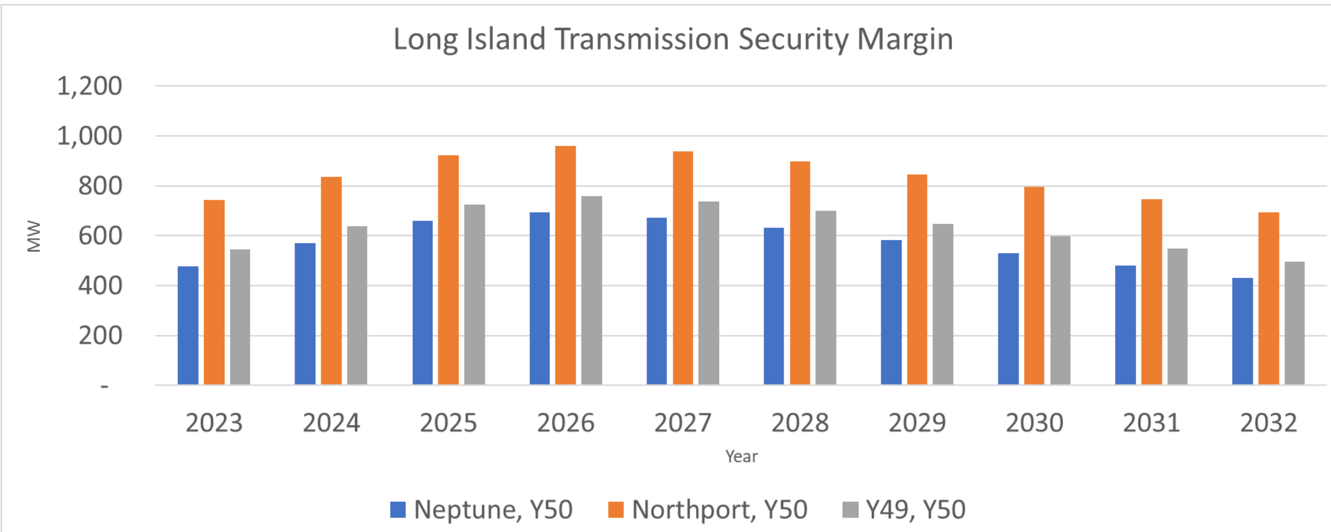
Figure 93: Summary of New York City Summer Transmission Security Margins for Baseline Expected Weather, Normal Transfer Criteria Through 2052



Long Island (Zone K) Tipping Points

Within the PSEG Long Island service territory, the BPTF system (primarily comprised of 138 kV transmission) is designed for N-1-1. As shown in **Figure 94,** the most limiting N-1-1 combination for the transmission security margin under normal conditions is the outage of Neptune HVDC (660 MW) followed by securing for the loss of Dunwoodie — Shore Road 345 kV (Y50) for all evaluated years.

Figure 94: Impact of Contingency Combination on Zone K Transmission Security Margin



As transmission security analysis represents discrete snapshots in time of various credible combinations of system conditions, when reliability needs are identified only the magnitude of the need can be identified under those system conditions. Additional details are required to fully describe the nature of the need such as evaluating the hourly load shape and its impact on the need. To describe the nature of the Long Island transmission security margin, load shapes are developed for the Zone K component of the statewide load shape. Details of the load shapes are provided later in this appendix. For this assessment load shapes were not developed past 2032 and have only been developed for the summer conditions.

Figure 95 shows the calculation of the Long Island transmission security margin at the statewide coincident peak hour for baseline expected weather, expected load conditions for summer. The Long Island transmission security margin ranges from 478 MW in summer 2023 to 430 MW in summer 2032 (*see* line-item L). The narrowest transmission security margin in the 10-year horizon is 430 MW in summer 2032. The load shapes for Long Island show the contribution of Zone K (**Figure 132**) towards the statewide curve (which represents the statewide coincident peak) for each hour of the day. Utilizing the load shape for the baseline expected weather summer peak day, the Long Island transmission security margin for each hour is shown in **Figure 96**. The hourly margins are created by using the load forecast for each hour in the margin calculation (*i.e.*, placing each hour into **Figure 95** line-item A) with additional adjustments to account for the appropriate derate for solar generation and energy limited resources in each hour (*i.e.*, **Figure 95** line-item H). All other values in the margin calculations are held constant. For all years in the 10-year study horizon, **Figure 96** shows that there are no observed deficiencies considering the load shapes under baseline expected load, normal transfer criteria for Long Island. A graphical representation of the Long Island transmission security margin cure for summer peak baseline expected weather, normal transfer criteria for the peak day in years 2023, 2025, 2027 and 2032 is shown in **Figure 97**.

It is possible for other combinations of events such as 1-in-10-year heatwaves and 1-in-100-year extreme heatwaves to have a deficient transmission security margin. **Figure 98** shows the Long Island transmission security margin for the statewide coincident peak hour under the 1-in-10-year heatwave condition with the assumption that the system is using emergency transfer criteria. As seen in **Figure 98**, the system is sufficient under these conditions within the 10-year study horizon and ranges from 701 MW in summer 2023 to 649 MW in summer 2032 (*see* line-item M). The load shapes for Zone K under heatwave conditions is provided in **Figure 137**. Additionally, the hourly margins in **Figure 99** show that for each hour of the heatwave day the margins are sufficient. A graphical representation of the Long Island transmission security margins for the 1-in-10-year heatwave day with emergency transfer criteria for the peak day in years 2023, 2025, 2027 and 2032 is shown in **Figure 100**.

The 1-in-100-year extreme heatwave transmission security margin is shown in **Figure 101**. These margins assume that the system is using emergency transfer criteria. Under this condition the margin is sufficient for all years in the 10-year study horizon and ranges from 355 MW in summer 2023 to 299 MW in summer 2032 (*see* line-item M). Additionally, the hourly margins in **Figure 102** show that for each hour the margins are sufficient for the extreme heatwave day. The load shapes for Zone K under an extreme heatwave is provided in **Figure 142**. A graphical representation of the Long Island transmission security margins for the 1-in-100-year extreme heatwave day with emergency transfer criteria for the peak day in years 2023, 2025, 2027, and 2032 is shown in **Figure 103**.

In addition to heatwave or extreme heatwave conditions, other changes to the transmission system may plausibly result in deficient margins. Considering the summer baseline peak load transmission security margin, limited combinations of single generator outages, or combinations of generator outages within Long Island beyond those included in the RNA Base Case assumptions could result in deficient transmission security margins. Details of specific generator impacts on the Long Island transmission security margin are shown in **Figure 104**. In summer 2023, there are two different units (or combinations of units) listed that could result in a deficient transmission security margin. Starting in 2024, only one combination of units could result in a deficient transmission security margin.

Figure 105 shows the Long Island transmission security margin under winter peak baseline expected weather conditions. For winter peak, the margin ranges from 2,638 MW in winter 2023-24 to 1,802 MW in winter 2032-33. Considering the winter baseline peak load transmission security margin, multiple outages in Long Island would be required to have a deficient margin.

Figure 106 shows Long Island transmission security margin in a 1-in-10-year cold snap. Under this system condition the transmission security margins for all years are sufficient and range from 3,103 MW in winter 2023-24 to 2,224 MW in winter 2032-33. Similarly, **Figure 107** shows the transmission security margins for Long Island with a 1-in-100-year extreme cold snap (with emergency transfer criteria) is sufficient with the margin ranging from 2,929 MW in winter 2023-24 to 2,004 MW in winter 2032-33.

Figure 108 provides a summary of the summer peak Long Island transmission security margins under expected summer weather, heatwave, and extreme heatwave conditions. **Figure 109** provides a summary of the winter peak Long Island transmission security margins under expected winter weather, cold snap, and extreme cold snap conditions.

While **Figure 108** and **Figure 109** provide a summary of the margins through the 10-year horizon, the 2022 Gold Book provides the forecast details through year 2052. **Figure 110** provides a summary of the Long Island transmission security margins (summer and winter) under baseline expected weather, normal transfer criteria through 2052 to quantify the future year margins beyond the 10-year horizon. These margins are an extension of the total resources of the last year of the RNA horizon (*i.e.*, **Figure 95** shows the total resources for summer 2032 at 5,168 MW and **Figure 105** shows the total resources for winter 2032-33 at 5,582 MW) through 2052. As seen in **Figure 110**, the Long Island transmission security margin is deficient by 5 MW in summer 2049. By 2052, Long Island is deficient by 80 MW in summer. Within Long Island, the margins remain sufficient through winter 2052-53. Anticipated generation additions to meet CLCPA goals, such as those discussed in the System & Resource Outlook Policy Scenario 2, will have a significant impact on the ability to maintain sufficient margin.

Figure 95: Long Island Transmission Security Margin (Summer Peak – Baseline Expected Weather, Normal Transfer Criteria)

Summer Peak - Baseline Expected Weather, Normal Transfer Criteria (MW)											
Line	**Item**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
A	**Zone K Load Forecast**	(4,951)	(4,870)	(4,782)	(4,746)	(4,768)	(4,806)	(4,857)	(4,907)	(4,956)	(5,007)
B	I+J to K	929	929	929	929	929	929	929	929	929	929
C	New England Import (NNC)	0	0	0	0	0	0	0	0	0	0
D	**Total K AC Import (B+C)**	929	929	929	929	929	929	929	929	929	929
E	Loss of Source Contingency	(660)	(660)	(660)	(660)	(660)	(660)	(660)	(660)	(660)	(660)
F	**Resource Need (A+D+E)**	(4,682)	(4,601)	(4,513)	(4,477)	(4,499)	(4,537)	(4,588)	(4,638)	(4,687)	(4,738)
G	K Generation (1)	4,970	5,106	5,106	5,106	5,106	5,106	5,106	5,106	5,106	5,106
H	K Generation Derates (2)	(470)	(593)	(594)	(594)	(595)	(596)	(597)	(597)	(598)	(598)
I	Temperature Based Generation Derates	0	0	0	0	0	0	0	0	0	0
J	Net ICAP External Imports	660	660	660	660	660	660	660	660	660	660
K	**Total Resources Available (H+I+J)**	5,160	5,172	5,172	5,171	5,171	5,170	5,169	5,169	5,168	5,168
L	**Transmission Security Margin (F+K)**	478	571	659	694	672	633	581	531	481	430

Notes:

1. Reflects the 2022 Gold Book existing summer capacity plus projected additions and deactivations.
2. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 5% of the total nameplate, off-shore wind at 10% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).

Figure 96: Long Island Transmission Security Margin (Hourly) (Summer Peak – Baseline Expected Weather, Normal Transfer Criteria)

Summer Peak - Baseline Expected Summer Weather, Normal Transfer Criteria (MW)										
K Transmission Security Margin										
Hour	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
HB0	2,536	2,619	2,692	2,711	2,638	2,590	2,529	2,467	2,405	2,337
HB1	2,747	2,830	2,905	2,924	2,855	2,810	2,751	2,693	2,637	2,574
HB2	2,898	2,981	3,057	3,079	3,010	2,967	2,911	2,856	2,804	2,747
HB3	2,989	3,073	3,150	3,173	3,105	3,064	3,011	2,959	2,910	2,859
HB4	3,010	3,097	3,174	3,198	3,132	3,095	3,043	2,996	2,953	2,911
HB5	2,965	3,052	3,131	3,157	3,094	3,057	3,008	2,963	2,922	2,879
HB6	2,862	2,953	3,040	3,074	3,017	2,988	2,944	2,904	2,868	2,830
HB7	2,605	2,705	2,802	2,849	2,804	2,786	2,752	2,719	2,687	2,652
HB8	2,299	2,406	2,510	2,568	2,532	2,520	2,492	2,461	2,428	2,389
HB9	1,991	2,104	2,217	2,282	2,254	2,249	2,228	2,201	2,170	2,132
HB10	1,665	1,782	1,902	1,976	1,956	1,959	1,943	1,921	1,893	1,858
HB11	1,357	1,478	1,605	1,684	1,671	1,681	1,671	1,653	1,632	1,600
HB12	1,099	1,221	1,349	1,432	1,420	1,432	1,425	1,411	1,393	1,367
HB13	903	1,025	1,151	1,230	1,219	1,228	1,221	1,207	1,190	1,167
HB14	752	870	988	1,059	1,039	1,041	1,027	1,010	989	963
HB15	613	725	834	894	864	856	835	809	783	754
HB16	489	593	693	744	702	686	655	623	590	556
HB17	478	571	659	694	639	610	567	523	481	436
HB18	536	624	706	733	672	633	581	531	481	430
HB19	707	793	868	891	822	778	722	667	614	557
HB20	903	987	1,062	1,084	1,014	970	911	855	801	741
HB21	1,163	1,249	1,325	1,348	1,279	1,235	1,178	1,121	1,065	1,004
HB22	1,547	1,632	1,707	1,729	1,657	1,610	1,552	1,491	1,431	1,364
HB23	1,940	2,025	2,101	2,122	2,050	2,004	1,944	1,883	1,821	1,751

Figure 97: Long Island Transmission Security Margin Hourly Curve (Summer Peak – Baseline Expected Weather, Normal Transfer Criteria)

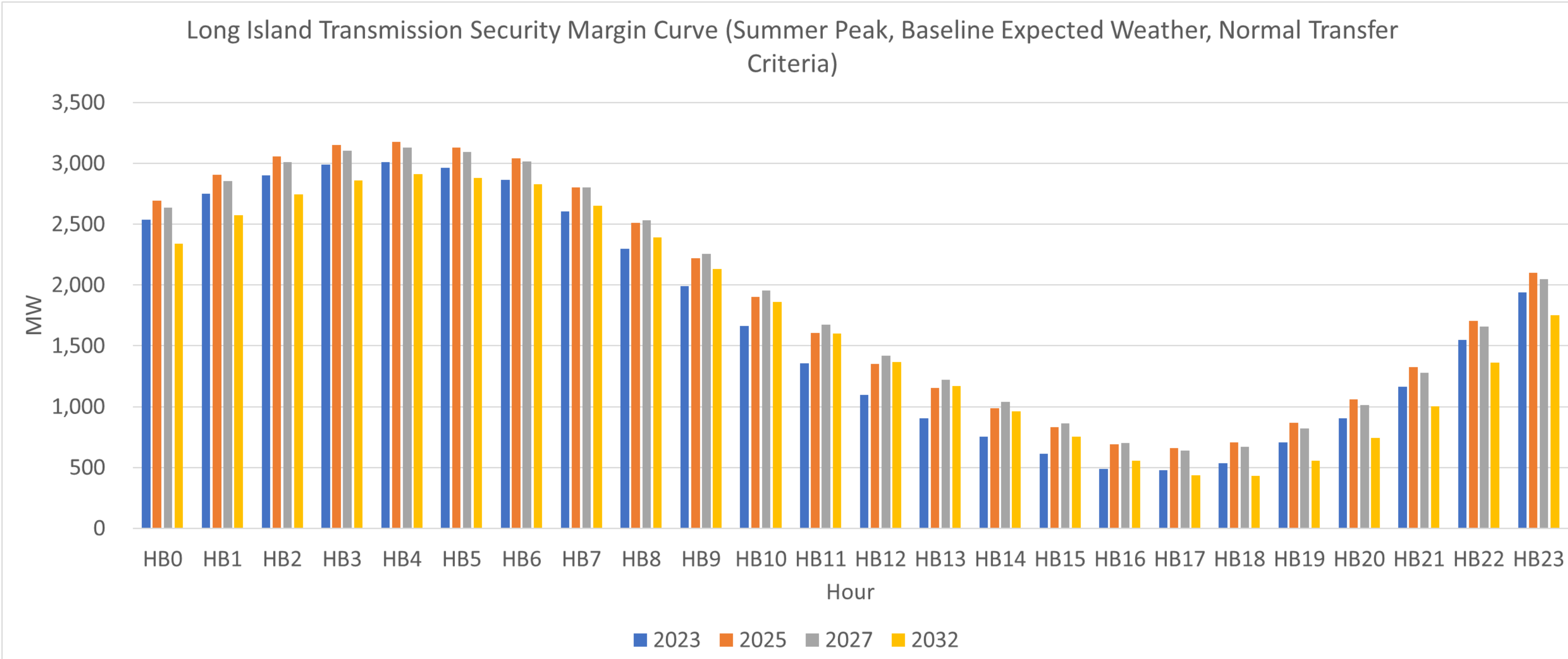


Figure 98: Long Island Transmission Security Margin (1-in-10-Year Heatwave, Emergency Transfer Criteria)

Summer Peak - 1-in-10-Year Heatwave, Emergency Transfer Criteria (MW)											
Line	**Item**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
A	**Zone K Load Forecast**	(5,331)	(5,243)	(5,149)	(5,110)	(5,134)	(5,174)	(5,229)	(5,283)	(5,336)	(5,391)
B	I+J to K	887	887	887	887	887	887	887	887	887	887
C	New England Import (NNC)	0	0	0	0	0	0	0	0	0	0
D	**Total K AC Import (B+C)**	887	887	887	887	887	887	887	887	887	887
E	Loss of Source Contingency	0	0	0	0	0	0	0	0	0	0
F	**Resource Need (A+D+E)**	(4,444)	(4,356)	(4,262)	(4,223)	(4,247)	(4,287)	(4,342)	(4,396)	(4,449)	(4,504)
G	K Generation (1)	4,970	5,106	5,106	5,106	5,106	5,106	5,106	5,106	5,106	5,106
H	K Generation Derates (2)	(470)	(593)	(594)	(594)	(595)	(596)	(597)	(597)	(598)	(598)
I	Temperature Based Generation Derates	(33)	(33)	(33)	(33)	(33)	(33)	(33)	(33)	(33)	(33)
J	Net ICAP External Imports	660	660	660	660	660	660	660	660	660	660
K	SCRs (3), (4)	18	18	18	18	18	18	18	18	18	18
L	**Total Resources Available (G+H+I+J+K)**	5,145	5,157	5,157	5,156	5,156	5,155	5,154	5,153	5,153	5,153
M	**Transmission Security Margin (F+L)**	701	801	895	933	909	868	812	757	704	649

Notes:

1. Reflects the 2022 Gold Book existing summer capacity plus projected additions and deactivations.
2. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 5% of the total nameplate, off-shore wind at 10% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
3. SCRs are not applied for transmission security analysis of normal operations, but are included for emergency operations.
4. Includes a de-rate of 16 MW for SCRs.

Figure 99: Long Island Transmission Security Margin (Hourly) (1-in-10-Year Heatwave, Emergency Transfer Criteria)

Summer Peak - Heatwave, Emergency Transfer Criteria (MW)										
K Transmission Security Margin										
Hour	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
HB0	2,766	2,859	2,942	2,964	2,880	2,824	2,754	2,686	2,620	2,548
HB1	3,002	3,095	3,180	3,202	3,122	3,069	3,000	2,936	2,877	2,810
HB2	3,166	3,259	3,346	3,372	3,292	3,241	3,176	3,115	3,060	3,000
HB3	3,268	3,362	3,450	3,477	3,398	3,349	3,287	3,230	3,178	3,123
HB4	3,296	3,393	3,480	3,508	3,432	3,387	3,326	3,273	3,227	3,182
HB5	3,249	3,346	3,436	3,467	3,394	3,350	3,293	3,243	3,200	3,154
HB6	3,136	3,236	3,334	3,373	3,306	3,270	3,217	3,173	3,134	3,094
HB7	2,869	2,975	3,080	3,129	3,072	3,044	3,000	2,960	2,923	2,883
HB8	2,562	2,673	2,783	2,842	2,794	2,771	2,733	2,694	2,656	2,612
HB9	2,251	2,368	2,486	2,551	2,511	2,495	2,463	2,428	2,393	2,350
HB10	1,934	2,053	2,176	2,249	2,216	2,208	2,180	2,150	2,117	2,077
HB11	1,671	1,791	1,919	1,996	1,970	1,967	1,945	1,918	1,891	1,853
HB12	1,439	1,561	1,688	1,768	1,742	1,741	1,720	1,695	1,671	1,638
HB13	1,256	1,377	1,502	1,579	1,563	1,557	1,536	1,502	1,478	1,448
HB14	1,068	1,186	1,305	1,374	1,358	1,345	1,316	1,270	1,243	1,210
HB15	881	996	1,108	1,168	1,149	1,127	1,091	1,028	996	962
HB16	739	847	951	1,002	980	950	903	823	785	745
HB17	701	801	895	933	909	868	813	714	669	620
HB18	794	889	977	1,006	977	927	862	757	704	649
HB19	1,019	1,111	1,192	1,217	1,173	1,118	1,051	951	896	835
HB20	1,253	1,342	1,423	1,447	1,393	1,340	1,271	1,181	1,124	1,061
HB21	1,553	1,642	1,720	1,742	1,682	1,627	1,559	1,476	1,415	1,349
HB22	1,983	2,070	2,146	2,167	2,094	2,037	1,969	1,892	1,826	1,754
HB23	2,420	2,506	2,582	2,601	2,521	2,465	2,396	2,328	2,261	2,185

Figure 100: Long Island Transmission Security Margin Hourly Curve (1-in-10-Year Heatwave, Emergency Transfer Criteria)

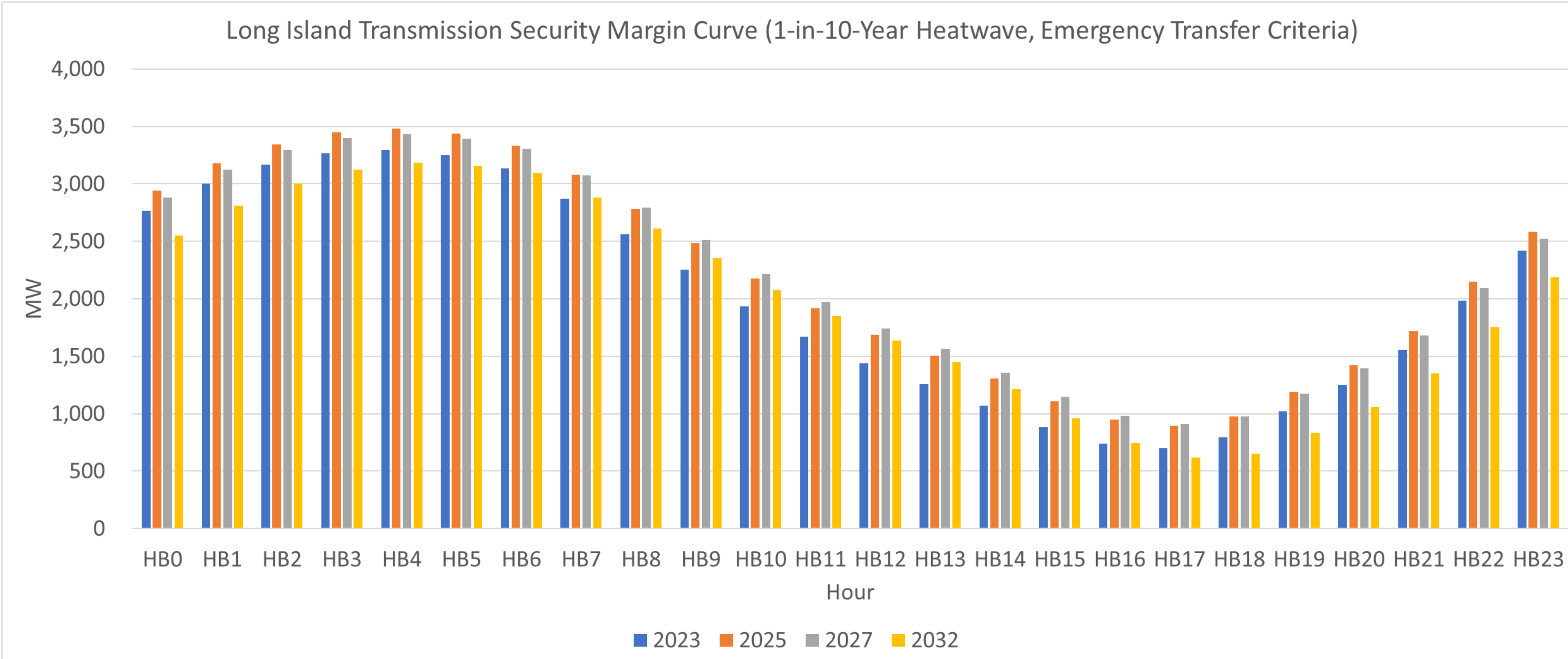


Figure 101: Long Island Transmission Security Margin (1-in-100-Year Extreme Heatwave, Emergency Transfer Criteria)

Summary Peak - 1-in-100-Year Extreme Heatwave, Emergency Transfer Criteria (MW)											
Line	**Item**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
A	**Zone K Load Forecast**	(5,640)	(5,548)	(5,448)	(5,407)	(5,432)	(5,475)	(5,533)	(5,590)	(5,646)	(5,704)
B	I+J to K	887	887	887	887	887	887	887	887	887	887
C	New England Import (NNC)	0	0	0	0	0	0	0	0	0	0
D	**Total K AC Import (B+C)**	887	887	887	887	887	887	887	887	887	887
E	Loss of Source Contingency	0	0	0	0	0	0	0	0	0	0
F	**Resource Need (A+D+E)**	(4,753)	(4,661)	(4,561)	(4,520)	(4,545)	(4,588)	(4,646)	(4,703)	(4,759)	(4,817)
G	K Generation (1)	4,970	5,106	5,106	5,106	5,106	5,106	5,106	5,106	5,106	5,106
H	K Generation Derates (2)	(470)	(593)	(594)	(594)	(595)	(596)	(597)	(597)	(598)	(598)
I	Temperature Based Generation Derates	(70)	(70)	(70)	(70)	(70)	(70)	(70)	(70)	(70)	(70)
J	Net ICAP External Imports	660	660	660	660	660	660	660	660	660	660
K	SCRs (3), (4)	18	18	18	18	18	18	18	18	18	18
L	**Total Resources Available (G+H+I+J+K)**	5,108	5,120	5,120	5,119	5,119	5,118	5,117	5,116	5,116	5,116
M	**Transmission Security Margin (F+L)**	355	459	559	599	574	530	471	413	357	299

Notes:

1. Reflects the 2022 Gold Book existing summer capacity plus projected additions and deactivations.
2. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 5% of the total nameplate, off-shore wind at 10% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
3. SCRs are not applied for transmission security analysis of normal operations, but are included for emergency operations.
4. Includes a de-rate of 16 MW for SCRs.

Figure 102: Long Island Transmission Security Margin (Hourly) (1-in-100-Year Extreme Heatwave, Emergency Transfer Criteria)

Summer Peak - 1-in-100-Year Extreme Heatwave, Emergency Transfer Criteria (MW)										
K Transmission Security Margin										
Hour	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
HB0	2,620	2,715	2,802	2,826	2,740	2,682	2,610	2,541	2,474	2,400
HB1	2,859	2,954	3,043	3,067	2,985	2,930	2,860	2,794	2,733	2,664
HB2	3,024	3,121	3,211	3,239	3,157	3,105	3,038	2,975	2,919	2,856
HB3	3,128	3,226	3,317	3,346	3,265	3,214	3,151	3,092	3,038	2,982
HB4	3,156	3,257	3,348	3,378	3,299	3,253	3,190	3,136	3,088	3,042
HB5	3,110	3,211	3,305	3,337	3,262	3,216	3,157	3,106	3,061	3,014
HB6	2,999	3,102	3,203	3,243	3,174	3,136	3,082	3,036	2,996	2,955
HB7	2,728	2,837	2,945	2,996	2,937	2,908	2,862	2,820	2,782	2,741
HB8	2,417	2,530	2,643	2,704	2,654	2,630	2,589	2,549	2,510	2,465
HB9	2,101	2,220	2,341	2,407	2,365	2,348	2,315	2,279	2,241	2,197
HB10	1,779	1,900	2,025	2,099	2,065	2,055	2,026	1,994	1,960	1,918
HB11	1,511	1,633	1,763	1,841	1,813	1,810	1,786	1,757	1,729	1,690
HB12	1,251	1,374	1,504	1,585	1,557	1,554	1,531	1,505	1,478	1,445
HB13	1,029	1,154	1,282	1,360	1,342	1,334	1,310	1,273	1,248	1,216
HB14	805	926	1,048	1,119	1,100	1,085	1,053	1,004	975	940
HB15	580	698	814	876	856	831	793	725	690	653
HB16	402	514	622	676	652	618	570	485	443	401
HB17	355	459	559	599	574	530	472	368	320	267
HB18	449	549	642	675	644	590	524	413	357	299
HB19	714	810	896	924	878	821	753	649	590	526
HB20	987	1,080	1,165	1,192	1,137	1,081	1,011	917	858	791
HB21	1,325	1,418	1,500	1,525	1,462	1,406	1,336	1,250	1,188	1,119
HB22	1,793	1,884	1,963	1,986	1,912	1,854	1,784	1,704	1,637	1,562
HB23	2,268	2,356	2,436	2,456	2,374	2,318	2,247	2,177	2,109	2,032

Figure 103: Long Island Transmission Security Margin Hourly Curve (1-in-100-Year Extreme Heatwave, Emergency Transfer Criteria)

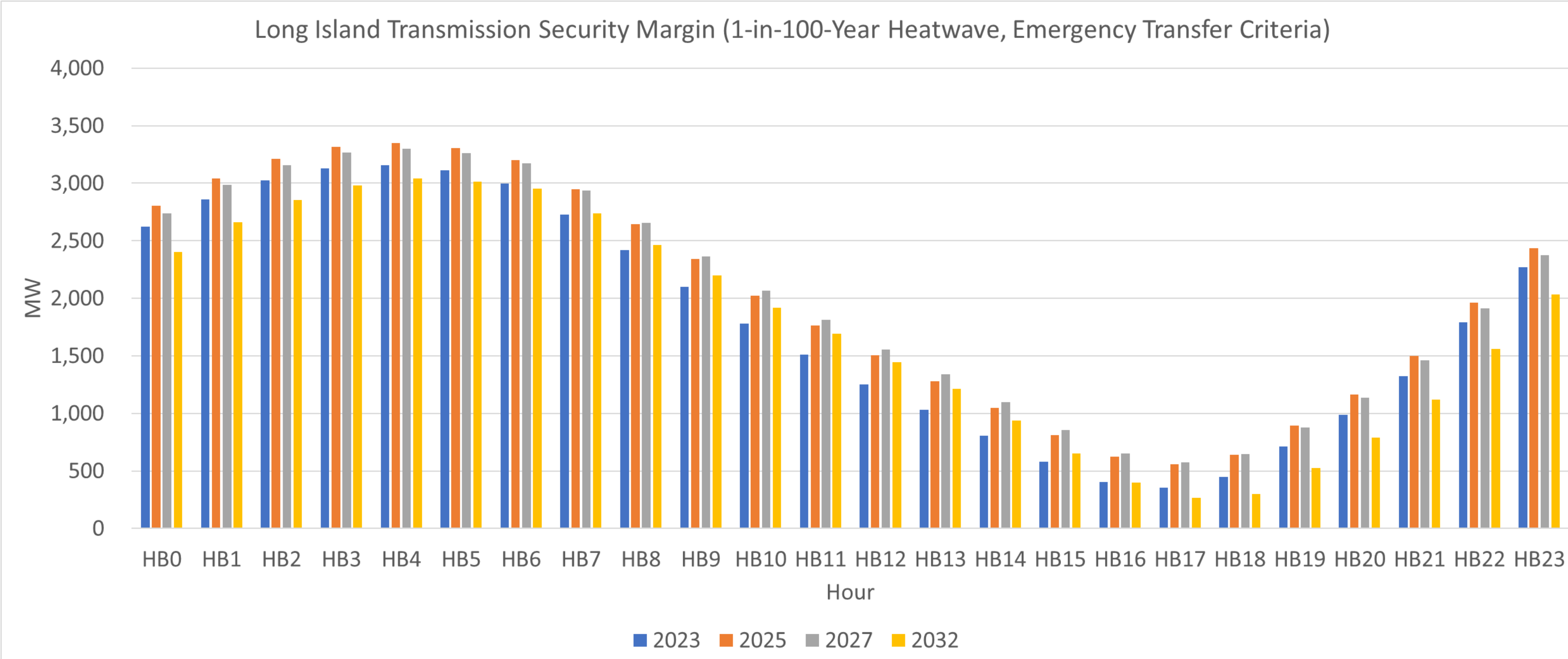


Figure 104: Impact of Generator Outages on Long Island Transmission Security Margin (Summer Peak – Baseline Expected Weather, Normal Transfer Criteria)

Long Island Transmission Security Margin (MW)											
Year		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Summer Peak - Baseline Expected Weather, Normal Transfer Criteria Transmission Security Margin with Generation Unavailability (Line Item O)		478	571	659	694	672	633	581	531	481	430
Unit Name	Summer DMNC	Adjusted Transmission Security Margin (Line Item O minus each generator)									
Northport 1, 2, 3, and 4	1,567.9	(1,090)	(997)	(909)	(874)	(896)	(935)	(987)	(1,037)	(1,087)	(1,138)
Holtsville (all units)	529.9	(52)	41	129	164	142	103	51	1	(49)	(100)
Northport 2	398.2	80	173	261	296	273	234	183	132	83	32
Northport 3	397.0	81	174	262	297	275	236	184	134	84	33
Northport 1	394.7	83	177	264	300	277	238	186	136	86	35
Barrett ST 01 and ST 02	383.0	95	188	276	311	289	250	198	148	98	47
Northport 4	378.0	100	193	281	316	294	255	203	153	103	52
Port Jefferson 3 and 4	377.2	101	194	282	317	294	255	204	153	104	53
Caithness_CC_1	310.1	168	261	349	384	362	323	271	220	171	120
Barrett 03 through 12	231.6	246	340	427	463	440	401	349	299	249	198
Wading River 1, 2, and 3	224.5	253	347	434	470	447	408	357	306	256	205
Barrett ST 02	193.0	285	378	466	501	479	440	388	338	288	237
Barrett ST 01	190.0	288	381	469	504	482	443	391	341	291	240
Port Jefferson 4	188.7	289	383	470	506	483	444	392	342	292	241
Port Jefferson 3	188.5	289	383	470	506	483	444	393	342	292	241
Flynn	141.5	336	430	517	553	530	491	440	389	339	288
Glenwood GT 02, 04, and 05	126.3	352	445	532	568	545	506	455	404	355	304
Far Rockaway GT1 and GT 2	109.7	368	462	549	585	562	523	471	421	371	320
Freeport CT 1 and CT 2	85.2	393	486	574	609	586	547	496	445	396	345
Shoreham GT3 and GT 4	84.9	393	486	574	609	587	548	496	446	396	345
Pilgrim GT 1 and GT 2	84.5	393	487	574	610	587	548	497	446	396	345
Port Jefferson GT 02 and GT 03	80.7	397	491	578	614	591	552	500	450	400	349
Wading River 1	75.6	402	496	583	619	596	557	505	455	405	354
Wading River 3	74.9	403	496	584	619	597	558	506	456	406	355
Bethpage 3	74.8	403	497	584	619	597	558	506	456	406	355
Hempstead (RR)	74.2	404	497	585	620	597	558	507	456	407	356
Wading River 2	74.0	404	497	585	620	598	559	507	457	407	356
Pinelawn Power 1	72.2	406	499	587	622	599	560	509	458	409	358

Figure 105: Long Island Transmission Security Margin (Winter Peak – Baseline Expected Weather, Normal Transfer Criteria)

Winter Peak - Baseline Expected Weather, Normal Transfer Criteria (MW)											
Line	**Item**	**2023-24**	**2024-25**	**2025-26**	**2026-27**	**2027-28**	**2028-29**	**2029-30**	**2030-31**	**2031-32**	**2032-33**
A	**Zone K Load Forecast**	(3,213)	(3,229)	(3,262)	(3,319)	(3,396)	(3,491)	(3,604)	(3,737)	(3,891)	(4,049)
B	I+J to K (3), (4)	929	929	929	929	929	929	929	929	929	929
C	New England Import (NNC)	0	0	0	0	0	0	0	0	0	0
D	**Total K AC Import (B+C)**	929	929	929	929	929	929	929	929	929	929
E	Loss of Source Contingency	(660)	(660)	(660)	(660)	(660)	(660)	(660)	(660)	(660)	(660)
F	**Resource Need (A+D+E)**	(2,944)	(2,960)	(2,993)	(3,050)	(3,127)	(3,222)	(3,335)	(3,468)	(3,622)	(3,780)
G	K Generation (1)	5,559	5,559	5,559	5,559	5,559	5,559	5,559	5,559	5,559	5,559
H	K Generation Derates (2)	(637)	(637)	(637)	(637)	(637)	(637)	(637)	(637)	(637)	(637)
I	Temperature Based Generation Derates	0	0	0	0	0	0	0	0	0	0
J	Net ICAP External Imports	660	660	660	660	660	660	660	660	660	660
K	**Total Resources Available (G+H+I+J)**	5,582	5,582	5,582	5,582	5,582	5,582	5,582	5,582	5,582	5,582
L	**Transmission Security Margin (F+K)**	2,638	2,622	2,589	2,532	2,455	2,360	2,247	2,114	1,960	1,802

Notes:

1. Reflects the 2022 Gold Book existing winter capacity plus projected additions and deactivations.
2. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 10% of the total nameplate, off-shore wind at 15% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). For winter the expected solar PV output at peak is 0 MW. Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
3. Limits in 2022 and 2023 are based on limits from the summer peak 2023 representations evaluated in the post-2020 RNA updates. Limits for 2024 and 2025 are based on the summer peak 2025 representations evaluated in the post-2020 RNA updates. Limits for 2026 through 2032 are based also based on the summer peak 2025 representations evaluated in the post-2020 RNA analysis which does not include the impact of CHPE.
4. As a conservative winter peak assumption these limits utilize the summer values.

Figure 106: Long Island Transmission Security Margin (1-in-10-Year Cold Snap, Emergency Transfer Criteria)

Winter Peak - 1-in-10-Year Cold Snap, Emergency Transfer Criteria (MW)											
Line	**Item**	**2023-24**	**2024-25**	**2025-26**	**2026-27**	**2027-28**	**2028-29**	**2029-30**	**2030-31**	**2031-32**	**2032-33**
A	**Zone K Load Forecast**	(3,378)	(3,395)	(3,430)	(3,490)	(3,571)	(3,671)	(3,789)	(3,929)	(4,091)	(4,257)
B	I+J to K (5), (6)	887	887	887	887	887	887	887	887	887	887
C	New England Import (NNC)	0	0	0	0	0	0	0	0	0	0
D	**Total K AC Import (B+C)**	887	887	887	887	887	887	887	887	887	887
E	Loss of Source Contingency	0	0	0	0	0	0	0	0	0	0
F	**Resource Need (A+D+E)**	(2,491)	(2,508)	(2,543)	(2,603)	(2,684)	(2,784)	(2,902)	(3,042)	(3,204)	(3,370)
G	K Generation (1)	5,559	5,559	5,559	5,559	5,559	5,559	5,559	5,559	5,559	5,559
H	K Generation Derates (2)	(637)	(637)	(637)	(637)	(637)	(637)	(637)	(637)	(637)	(637)
I	Temperature Based Generation Derates	0	0	0	0	0	0	0	0	0	0
J	Net ICAP External Imports	660	660	660	660	660	660	660	660	660	660
K	SCRs (3), (4)	12	12	12	12	12	12	12	12	12	12
L	**Total Resources Available (G+H+I+J+K)**	5,594	5,594	5,594	5,594	5,594	5,594	5,594	5,594	5,594	5,594
M	**Transmission Security Margin (F+L)**	3,103	3,086	3,051	2,991	2,910	2,810	2,692	2,552	2,390	2,224

Notes:

1. Reflects the 2022 Gold Book existing winter capacity plus projected additions and deactivations.
2. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 10% of the total nameplate, off-shore wind at 15% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). For winter the expected solar PV output at peak is 0 MW. Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
3. SCRs are not applied for transmission security analysis of normal operations, but are included for emergency operations.
4. Includes a de-rate of 10 MW for SCRs.
5. Limits in 2022 and 2023 are based on limits from the summer peak 2023 representations evaluated in the post-2020 RNA updates. Limits for 2024 and 2025 are based on the summer peak 2025 representations evaluated in the post-2020 RNA updates. Limits for 2026 through 2032 are based also based on the summer peak 2025 representations evaluated in the post-2020 RNA analysis which does not include the impact of CHPE.
6. As a conservative winter peak assumption these limits utilize the summer values.

Figure 107: Long Island Transmission Security Margin (1-in-100-year Extreme Cold Snap, Emergency Transfer Criteria)

Winter Peak - 1-in-100-Year Extreme Cold Snap, Emergency Transfer Criteria (MW)											
Line	**Item**	**2023-24**	**2024-25**	**2025-26**	**2026-27**	**2027-28**	**2028-29**	**2029-30**	**2030-31**	**2031-32**	**2032-33**
A	**Zone K Load Forecast**	(3,552)	(3,570)	(3,607)	(3,670)	(3,755)	(3,860)	(3,985)	(4,132)	(4,302)	(4,477)
B	I+J to K (5), (6)	887	887	887	887	887	887	887	887	887	887
C	New England Import (NNC)	0	0	0	0	0	0	0	0	0	0
D	**Total K AC Import (B+C)**	887	887	887	887	887	887	887	887	887	887
E	Loss of Source Contingency	0	0	0	0	0	0	0	0	0	0
F	**Resource Need (A+D+E)**	(2,665)	(2,683)	(2,720)	(2,783)	(2,868)	(2,973)	(3,098)	(3,245)	(3,415)	(3,590)
G	K Generation (1)	5,559	5,559	5,559	5,559	5,559	5,559	5,559	5,559	5,559	5,559
H	K Generation Derates (2)	(637)	(637)	(637)	(637)	(637)	(637)	(637)	(637)	(637)	(637)
I	Temperature Based Generation Derates	0	0	0	0	0	0	0	0	0	0
J	Net ICAP External Imports	660	660	660	660	660	660	660	660	660	660
K	SCRs (3), (4)	12	12	12	12	12	12	12	12	12	12
L	**Total Resources Available (G+H+I+J+K)**	5,594	5,594	5,594	5,594	5,594	5,594	5,594	5,594	5,594	5,594
M	**Transmission Security Margin (F+L)**	2,929	2,911	2,874	2,811	2,726	2,621	2,496	2,349	2,179	2,004

Notes:

1. Reflects the 2022 Gold Book existing winter capacity plus projected additions and deactivations.
2. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 10% of the total nameplate, off-shore wind at 15% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). For winter the expected solar PV output at peak is 0 MW. Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
3. SCRs are not applied for transmission security analysis of normal operations, but are included for emergency operations.
4. Includes a de-rate of 10 MW for SCRs.
5. Limits in 2022 and 2023 are based on limits from the summer peak 2023 representations evaluated in the post-2020 RNA updates. Limits for 2024 and 2025 are based on the summer peak 2025 representations evaluated in the post-2020 RNA updates. Limits for 2026 through 2032 are based also based on the summer peak 2025 representations evaluated in the post-2020 RNA analysis which does not include the impact of CHPE.
6. As a conservative winter peak assumption these limits utilize the summer values.

Figure 108: Summary of Long Island Summer Transmission Security Margin – Summer

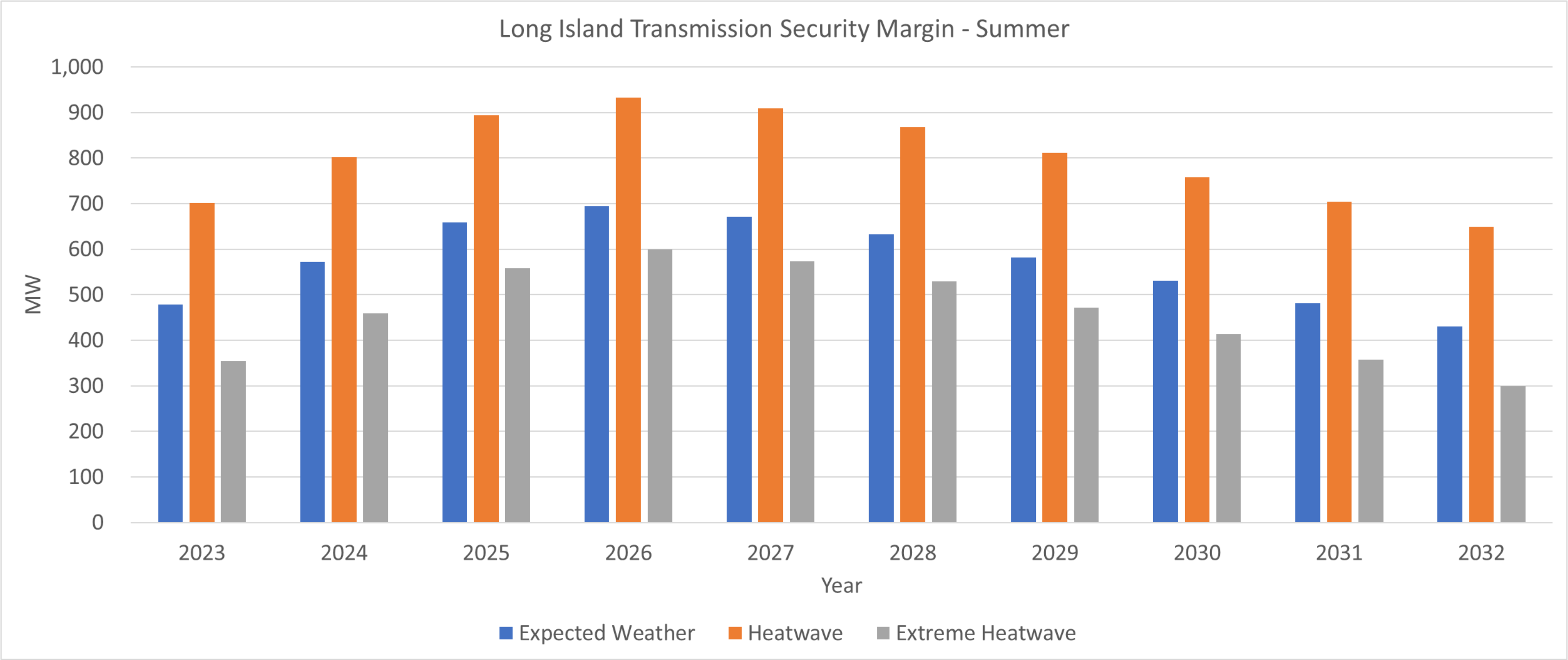


Figure 109: Summary of Long Island Summer Transmission Security Margin – Winter

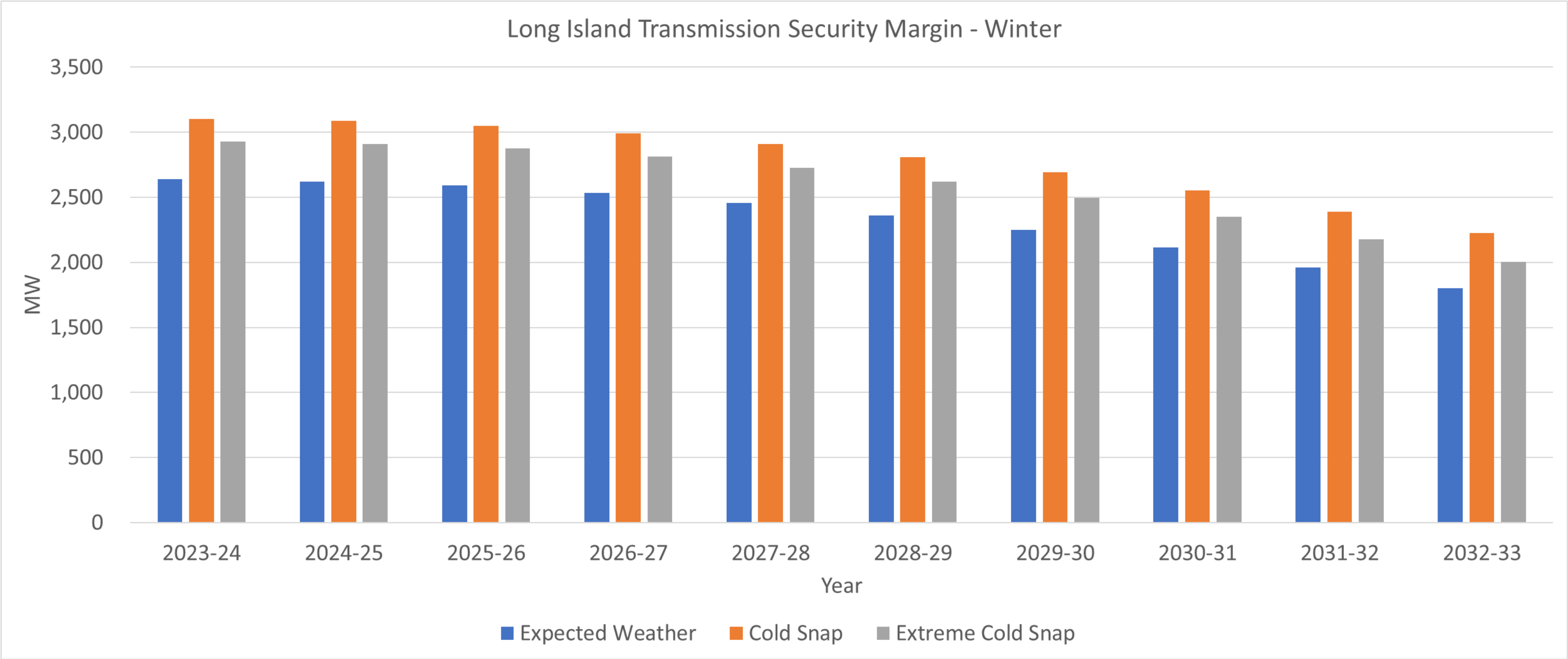
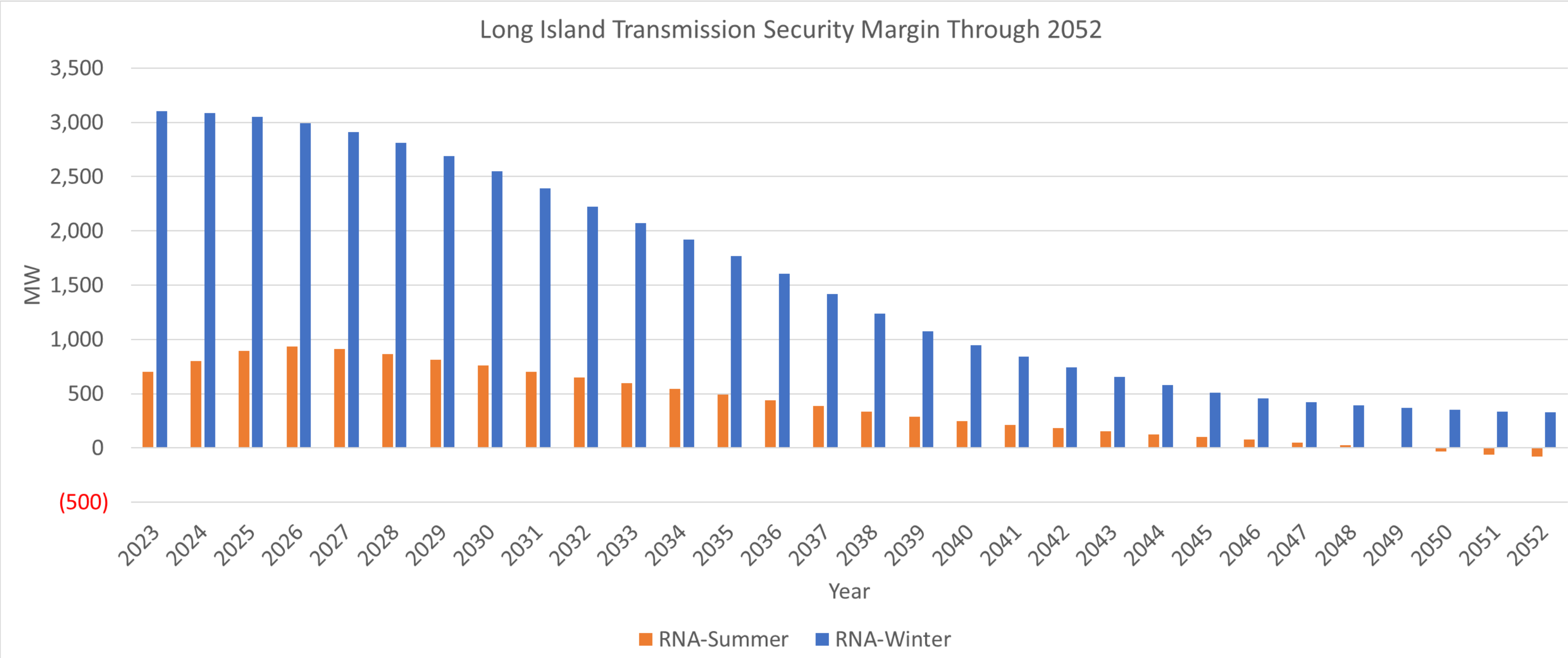


Figure 110: Summary of Long Island Summer Transmission Security Margins for Baseline Expected Weather, Normal Transfer Criteria Through 2052



Loss of Gas Fuel Supply Extreme System Condition Tipping Point Analysis

Natural gas fired generation in the NYCA is supplied by various networks of major gas pipelines. From a statewide perspective, New York has a relatively diverse mix of generation resources. Details of the fuel mix in New York State are outlined in the 2022 Gold Book, as well as the 2022 Power Trends Report.[27]

The study conditions for evaluating the impact of the loss of gas fuel supply are identified in NPCC Directory #1 and the NYSRC Reliability Rules as an extreme system condition. Extreme system conditions are beyond design criteria conditions and are meant to evaluate the robustness of the system. However, efforts are underway nationally, regionally, and locally to review the established design criteria and conditions in consideration of heatwave, cold snaps, and other system conditions. For instance, FERC issued a Notice of Proposed Rulemaking in 2022 to "address reliability concerns pertaining to transmission system planning for extreme heat or cold weather events that impact the Reliable Operation of the Bulk-Power System."[28] In response to this NOPR, the NYISO supported the Commission's guidance to NERC and the industry at large that will help stakeholders plan for, and develop responses to, extreme heat and cold weather events.[29] Locally, the NYSRC has established goals to identify actions to preserve NYCA reliability for extreme weather events and other extreme system conditions.[30]

Even prior to the 2022 initiative, the Analysis Group conducted an assessment in 2019 of the fuel and energy security in New York to examine the fuel and energy security of the New York electric grid.[31] Following this report, the NYISO has continued to evaluate and update stakeholders regarding the key factors that could impact fuel and energy security in New York.[32] The NYISO identified a 2023 project, Enhancing Fuel and Energy Security, has been established to refresh the assumptions from the 2019 fuel and energy security report to assess emerging operational and grid reliability concerns.[33] At the nationwide level, NERC identified a project, entitled Project 2022-03 Energy Assurance with Energy-Constrained Resources, that proposes to address several energy

[27] Power Trends 2022

[28] Transmission System Planning Performance Requirements for Extreme Weather, *Notice of Proposed Rulemaking,* Docket No. RM22-10-000 (June 16, 2022).

[29] NYISO comments to RM22-10-000 are found here

[30] A copy of the NYSRC 2022 goals is available here.

[31] Analysis Group, Final Report on Fuel and Energy Security In New York State, An Assessment of Winter Operational Risks for a Power System in Transition (November 2019), which is available here.

[32] One example is the 2021-2022 Fuel & Energy Security Update that the NYISO presented at its Installed Capacity Working Group in June of 2022, which is available at here.

[33] Additional details on the 2023 Enhancing Fuel and Energy Security project are available here.

assurance concerns related to both the operations and planning time horizons.[34]

For the transmission security margin evaluation of gas shortage conditions, all gas-only units within the NYCA are assumed unavailable with consideration of firm gas fuel contracts. Dual-fuel units with duct-burn capability are also assumed to be unavailable. This assessment assumes the remaining units have available fuel for the peak period.

In the Area Transmission Review (ATR) assessments conducted by the NYISO, an evaluation of the loss of gas fuel supply is conducted using the winter peak demand level. In the 2020 Comprehensive ATR, the NYISO evaluated the extreme system condition of a natural gas fuel shortage using the winter baseline expected weather forecast with normal transfer criteria.[35] The 2020 Comprehensive ATR found no thermal or voltage violations. However, there were dynamic stability issues observed around the Oswego area. Due to these dynamic stability issues, the NYISO conducted an evaluation to better understand the nature of the issue and found that reduced clearing times, as well as additional dynamic reactive capability in the local area, address the stability issues.

Utilizing the winter system conditions evaluated for the transmission security margins under winter peak for baseline, cold snap, and extreme cold snaps the statewide system margin as well as the Lower Hudson Valley, New York City, and Long Island localities can be evaluated for the extreme scenario of a shortage of gas fuel supply. This shortage impacts approximately 6,350 MW of gas generation throughout the NYCA. This value is consistent with the 2021-22 Winter Assessment & Winter Preparedness review, which included an extreme scenario showing the impact of a reduction of 6,350 MW for gas units and duct burn capabilities.[36] For the statewide system margin, **Figure 111** shows that the statewide system margin is sufficient under the extreme scenario of the loss of gas fuel supply under winter peak baseline expected weather through 2030-31. However, the system would be deficient by 743 MW in winter 2031-32 and the deficiency increases to 1,941 MW by winter 2032-33 (see line-item J). **Figure 112** shows that under a cold snap the system would be deficient as early as 2030-31 by 645 MW (see line-item K). By winter 2032-33, the deficiency would increase to 2,995 MW. **Figure 113** shows that under an extreme

[34] Additional details on NERC's Project 2022-03 Energy Assurance with Energy-Constrained Resources are available here.

[35] The 2020 Comprehensive Area Transmission Review of the New York State Bulk Power Transmission System (Study Year 2025) is available here.

[36] The 2021-22 Winter Assessment & Winter Preparedness review was presented to stakeholders at the November 12, 2021 Operating Committee meeting (which is available here). The winter capacity assessment extreme scenarios on slide 7 shows a gas and duct burner reduction of -8,834 MW with an add back of units with firm gas contracts of 2,484 MW. This results in a total gas reduction of -6,350 MW.

cold snap, the system is deficient starting in winter 2028-29 by 437 MW (see line-item K). By winter 2032-33, the deficiency increases to 4,619 MW. Figure 114 provides a graphical representation of the of the statewide system margin under baseline expected load, cold snap, and extreme cold snap conditions with gas units being available (as shown in the margin details in Figure 55) plus the impact of a shortage of gas fuel supply.

Figure 115 shows the impact of a shortage of gas fuel supply on the Lower Hudson Valley winter transmission security margin under baseline expected weather conditions. **Figure 116** shows the margins under cold snap conditions. **Figure 117** shows the margins under extreme cold snap conditions. Within the Lower Hudson Valley locality, gas unavailability impacts approximately 2,690 MW of gas generation. Under baseline expected load for winter as well as cold snap and extreme cold snap conditions the margins are sufficient for all years. **Figure 118** provides a graphical representation of the Lower Hudson Valley transmission security margin with gas units being available (as shown in the margin details of **Figure 75**) plus the impact of a shortage of gas fuel supply.

Figure 119 shows the impact of a shortage of gas fuel supply on the New York City winter transmission security margin under baseline expected weather conditions. Within the New York City locality, gas unavailability impacts approximately 2,130 MW of gas generation. Under baseline expected weather, normal transfer criteria conditions the margins are sufficient for all years (*see* line-item M). Under a 1-in-10-year cold snap, **Figure 120** shows that the system would be deficient in winter 2032-33 by 285 MW (*see* line-item N). Under a 1-in-100-year extreme cold snap showin in **Figure 121**, the system would be deficient in winter 2031-32 by 217 MW which increases to 822 MW in winter 2032-33 (*see* line-item N). **Figure 122** provides a graphical representation of the New York City transmission security margin with gas units being available (as shown in the margin details in Figure 92) plus the impact of a shortage of gas fuel supply.

Figure 123 shows the impact of a shortage of gas fuel supply on the Long Island winter transmission security margin under baseline expected weather conditions. **Figure 124** shows the margins under cold snap conditions. **Figure 125** shows the margins under cold snap conditions. Within the Long Island locality, gas unavailability impacts approximately 400 MW of gas generation. As shown in these figures the margins are sufficient for baseline expected weather, cold snap, and extreme cold snap conditions. **Figure 126** provides a graphical representation of the Long Island transmission security margin with gas units being available (as shown in the margin details in **Figure 109**) plus the impact of a shortage of gas fuel supply.

Figure 111: Extreme System Condition – Winter Peak Statewide System Margin with A Shortage of Gas Fuel Supply

Line	Item	Winter Peak, Shortage of Gas Fuel Supply - Baseline Expected Winter Weather, Normal Transfer Criteria (MW)									
		2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33
A	NYCA Generation (1)	41,102	41,192	41,158	41,158	41,158	41,158	41,158	41,158	41,158	41,158
B	Shortage of Gas Fuel Supply (2)	(6,387)	(6,387)	(6,353)	(6,353)	(6,353)	(6,353)	(6,353)	(6,353)	(6,353)	(6,353)
C	NYCA Generation Derates (3)	(6,660)	(6,750)	(6,751)	(6,751)	(6,751)	(6,751)	(6,751)	(6,751)	(6,751)	(6,751)
D	Temperature Based Generation Derates	0	0	0	0	0	0	0	0	0	0
E	External Area Interchanges (4)	1,268	1,268	1,268	1,268	1,268	1,268	1,268	1,268	1,268	1,268
F	**Total Resources (A+B+C+D+E)**	29,323	29,323	29,323	29,323	29,323	29,323	29,323	29,323	29,323	29,323
G	Load Forecast	(24,287)	(24,481)	(24,735)	(25,098)	(25,575)	(26,171)	(26,884)	(27,719)	(28,756)	(29,954)
H	Largest Loss-of-Source Contingency	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)
I	**Total Capability Requirement (G+H)**	(25,597)	(25,791)	(26,045)	(26,408)	(26,885)	(27,481)	(28,194)	(29,029)	(30,066)	(31,264)
J	**Statewide System Margin (F+I)**	3,726	3,532	3,278	2,915	2,438	1,842	1,129	294	(743)	(1,941)

Notes:

1. Reflects the 2022 Gold Book existing winter capacity plus projected additions and deactivations.
2. Includes all gas only units that do not have a firm gas contract. All includes reductions in units with duct burner capabilities. Duct burner derates on dual fual combined cycle units with non-firm gas account for approximately 170 MW of derated capacity.
3. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 10% of the total nameplate, off-shore wind at 15% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). For winter the expected solar PV output at peak is 0 MW. Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
4. Interchanges are based on ERAG MMWG values.

Figure 112: Extreme System Condition – Winter Peak Statewide System Margin (1-in-10-Year Cold Snap, Emergency Transfer Criteria) with A Shortage of Gas Fuel Supply

Line	Item	Winter Peak, Shortage of Gas Fuel Supply - 1-in-10-Year Cold Snap, Emergency Transfer Criteria (MW)									
		2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33
A	NYCA Generation (1)	41,102	41,192	41,158	41,158	41,158	41,158	41,158	41,158	41,158	41,158
B	Shortage of Gas Fuel Supply (2)	(6,387)	(6,387)	(6,353)	(6,353)	(6,353)	(6,353)	(6,353)	(6,353)	(6,353)	(6,353)
C	NYCA Generation Derates (3)	(6,660)	(6,750)	(6,751)	(6,751)	(6,751)	(6,751)	(6,751)	(6,751)	(6,751)	(6,751)
D	Temperature Based Generation Derates	0	0	0	0	0	0	0	0	0	0
E	External Area Interchanges (4)	1,268	1,268	1,268	1,268	1,268	1,268	1,268	1,268	1,268	1,268
F	SCRs (5), (6)	486	486	486	486	486	486	486	486	486	486
G	**Total Resources (A+B+C+D+E+F)**	29,809	29,809	29,809	29,809	29,809	29,809	29,809	29,809	29,809	29,809
H	Load Forecast	(25,535)	(25,739)	(26,007)	(26,388)	(26,891)	(27,518)	(28,266)	(29,144)	(30,237)	(31,494)
I	Largest Loss-of-Source Contingency	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)
J	**Total Capability Requirement (H+I)**	(26,845)	(27,049)	(27,317)	(27,698)	(28,201)	(28,828)	(29,576)	(30,454)	(31,547)	(32,804)
K	**Statewide System Margin (G+K)**	2,964	2,760	2,492	2,111	1,608	981	233	(645)	(1,738)	(2,995)

Notes:

1. Reflects the 2022 Gold Book existing winter capacity plus projected additions and deactivations.
2. Includes all gas only units that do not have a firm gas contract. All includes reductions in units with duct burner capabilities. Duct burner derates on dual fual combined cycle units with non-firm gas account for approximately 170 MW of derated capacity.
3. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 10% of the total nameplate, off-shore wind at 15% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). For winter the expected solar PV output at peak is 0 MW. Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
4. Interchanges are based on ERAG MMWG values.
5. SCRs are not applied for transmission security analysis of normal operations, but are included for emergency operations.
6. Includes a de-rate of 211 MW for SCRs.

Figure 113: Extreme System Condition – Winter Peak Statewide System Margin (1-in-100-Year Extreme Cold Snap, Emergency Transfer Criteria) with A Shortage of Gas Fuel Supply

Line	Item	Winter Peak, Shortage of Gas Fuel Supply - 1-in-100-Year Extreme Cold Snap, Emergency Transfer Criteria (MW)									
		2023-24	**2024-25**	**2025-26**	**2026-27**	**2027-28**	**2028-29**	**2029-30**	**2030-31**	**2031-32**	**2032-33**
A	NYCA Generation (1)	41,102	41,192	41,158	41,158	41,158	41,158	41,158	41,158	41,158	41,158
B	Shortage of Gas Fuel Supply (2)	(6,387)	(6,387)	(6,353)	(6,353)	(6,353)	(6,353)	(6,353)	(6,353)	(6,353)	(6,353)
C	NYCA Generation Derates (3)	(6,660)	(6,750)	(6,751)	(6,751)	(6,751)	(6,751)	(6,751)	(6,751)	(6,751)	(6,751)
D	Temperature Based Generation Derates	0	0	0	0	0	0	0	0	0	0
E	External Area Interchanges (4)	1,268	1,268	1,268	1,268	1,268	1,268	1,268	1,268	1,268	1,268
F	SCRs (5), (6)	486	486	486	486	486	486	486	486	486	486
G	**Total Resources (A+B+C+D+E+F)**	29,809	29,809	29,809	29,809	29,809	29,809	29,809	29,809	29,809	29,809
H	Load Forecast	(26,851)	(27,069)	(27,351)	(27,750)	(28,276)	(28,936)	(29,723)	(30,647)	(31,794)	(33,118)
I	Largest Loss-of-Source Contingency	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)	(1,310)
J	**Total Capability Requirement (H+I)**	(28,161)	(28,379)	(28,661)	(29,060)	(29,586)	(30,246)	(31,033)	(31,957)	(33,104)	(34,428)
K	**Statewide System Margin (G+K)**	1,648	1,430	1,148	749	223	(437)	(1,224)	(2,148)	(3,295)	(4,619)

Notes:

1. Reflects the 2022 Gold Book existing winter capacity plus projected additions and deactivations.
2. Includes all gas only units that do not have a firm gas contract. All includes reductions in units with duct burner capabilities. Duct burner derates on dual fual combined cycle units with non-firm gas account for approximately 170 MW of derated capacity.
3. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 10% of the total nameplate, off-shore wind at 15% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). For winter the expected solar PV output at peak is 0 MW. Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
4. Interchanges are based on ERAG MMWG values.
5. SCRs are not applied for transmission security analysis of normal operations, but are included for emergency operations.
6. Includes a de-rate of 211 MW for SCRs.

Figure 114: Extreme System Condition – Summary of Winter Peak Statewide System Margin with A Shortage of Gas Fuel Supply

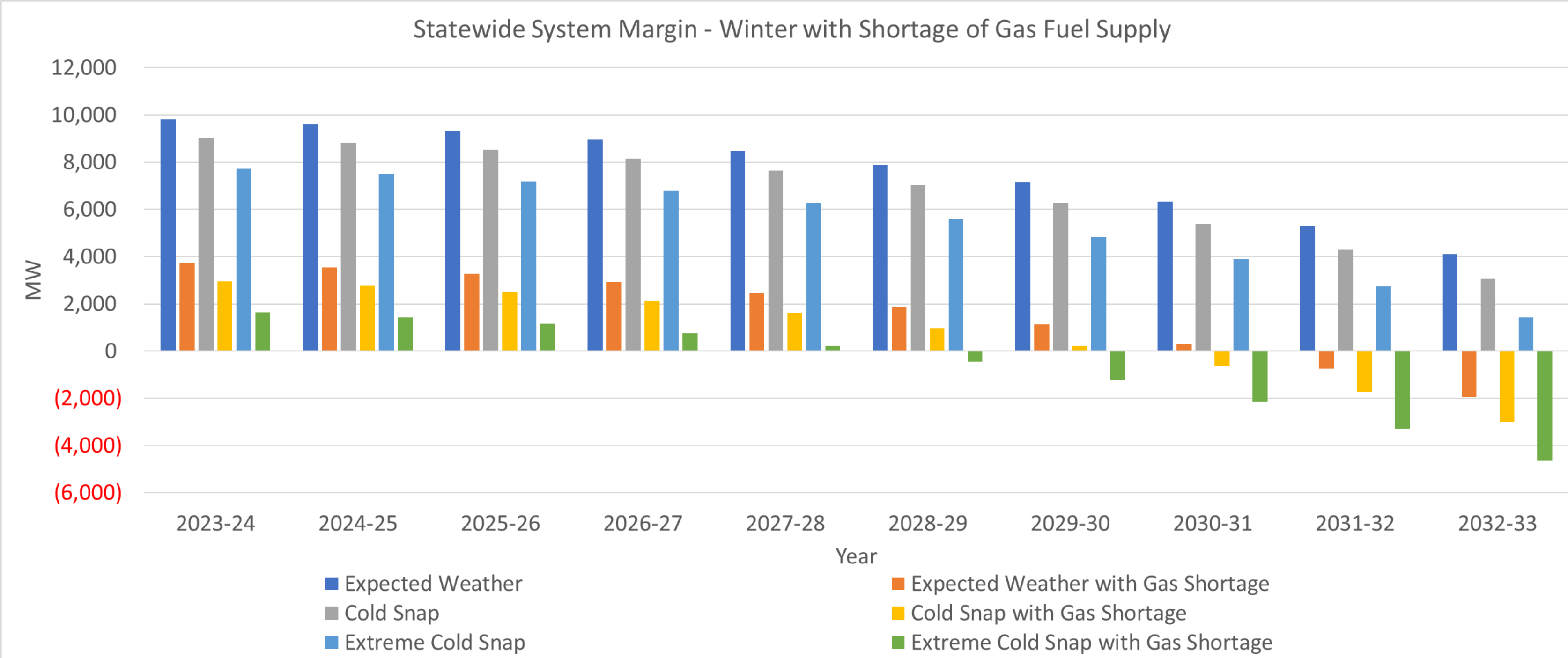


Figure 115: Extreme System Condition – Winter Peak Lower Hudson Valley Transmission Security Margin with A Shortage of Gas Fuel Supply

Winter Peak, Shortage of Gas Fuel Supply - Baseline Expected Weather, Normal Transfer Criteria (MW)											
Line	**Item**	**2023-24**	**2024-25**	**2025-26**	**2026-27**	**2027-28**	**2028-29**	**2029-30**	**2030-31**	**2031-32**	**2032-33**
A	G-J Load Forecast	(10,333)	(10,412)	(10,527)	(10,716)	(10,979)	(11,320)	(11,726)	(12,186)	(12,764)	(13,450)
B	RECO Load	(219)	(219)	(219)	(219)	(219)	(219)	(219)	(219)	(216)	(216)
C	**Total Load (A+B)**	(10,552)	(10,631)	(10,746)	(10,935)	(11,198)	(11,539)	(11,945)	(12,405)	(12,980)	(13,666)
D	UPNY-SENY Limit (4), (5)	5,050	5,725	5,725	5,725	5,725	5,725	5,725	5,725	5,725	5,725
E	ABC PARs to J	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)
F	K - SENY (4)	95	95	95	95	95	95	95	95	95	95
G	**Total SENY AC Import (D+E+F)**	5,134	5,809	5,809	5,809	5,809	5,809	5,809	5,809	5,809	5,809
H	Loss of Source Contingency	0	(990)	(990)	(990)	(990)	(990)	(990)	(990)	(990)	(990)
I	**Resource Need (C+G+H)**	(5,418)	(5,812)	(5,927)	(6,116)	(6,379)	(6,720)	(7,126)	(7,586)	(8,161)	(8,847)
J	G-J Generation (1)	14,622	14,622	14,588	14,588	14,588	14,588	14,588	14,588	14,588	14,588
K	Shortage of Gas Fuel Supply (2)	(2,721)	(2,721)	(2,687)	(2,687)	(2,687)	(2,687)	(2,687)	(2,687)	(2,687)	(2,687)
L	G-J Generation Derates (3)	(1,035)	(1,035)	(1,035)	(1,035)	(1,035)	(1,035)	(1,035)	(1,035)	(1,035)	(1,035)
M	Temperature Based Generation Derates	0	0	0	0	0	0	0	0	0	0
N	Net ICAP External Imports	315	315	315	315	315	315	315	315	315	315
O	**Total Resources Available (J+K+L+M+N)**	11,181	11,181	11,181	11,181	11,181	11,181	11,181	11,181	11,181	11,181
P	**Transmission Security Margin (I+O)**	5,763	5,369	5,254	5,065	4,802	4,461	4,055	3,595	3,020	2,334

Notes:

1. Reflects the 2022 Gold Book existing winter capacity plus projected additions and deactivations.
2. Includes all gas only units that do not have a firm gas contract. All includes reductions in units with duct burner capabilities. Duct burner derates on dual fual combined cycle units with non-firm gas account for approximately 250 MW of derated capacity.
3. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 10% of the total nameplate, off-shore wind at 15% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). For winter the expected solar PV output at peak is 0 MW. Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
4. Limits in 2022 and 2023 are based on limits from the summer peak 2023 representations evaluated in the post-2020 RNA updates. Limits for 2024 and 2025 are based on the summer peak 2025 representations evaluated in the post-2020 RNA updates. Limits for 2026 through 2032 are based also based on the summer peak 2025 representations evaluated in the post-2020 RNA analysis which does not include the impact of CHPE.
5. As a conservative winter peak assumption these limits utilize the summer values.

Figure 116: Extreme System Condition – Winter Peak Lower Hudson Valley Transmission Security Margin (1-in-10-Year Cold Snap, Emergency Transfer Criteria) with A Shortage of Gas Fuel Supply

Winter Peak, Shortage of Gas Fuel Supply - 1-in-10-Year Cold Snap, Emergency Transfer Criteria (MW)											
Line	**Item**	**2023-24**	**2024-25**	**2025-26**	**2026-27**	**2027-28**	**2028-29**	**2029-30**	**2030-31**	**2031-32**	**2032-33**
A	G-J Load Forecast	(10,864)	(10,947)	(11,068)	(11,267)	(11,543)	(11,903)	(12,329)	(12,812)	(13,421)	(14,142)
B	RECO Load	(230)	(230)	(230)	(230)	(230)	(230)	(230)	(230)	(227)	(227)
C	**Total Load (A+B)**	(11,094)	(11,177)	(11,298)	(11,497)	(11,773)	(12,133)	(12,559)	(13,042)	(13,648)	(14,369)
D	UPNY-SENY Limit (6), (7)	5,450	5,450	5,450	5,450	5,450	5,450	5,450	5,450	5,450	5,450
E	ABC PARs to J	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)
F	K - SENY (6)	155	155	155	155	155	155	155	155	155	155
G	**Total SENY AC Import (D+E+F)**	5,594	5,594	5,594	5,594	5,594	5,594	5,594	5,594	5,594	5,594
H	Loss of Source Contingency	0	0	0	0	0	0	0	0	0	0
I	**Resource Need (C+G+H)**	(5,500)	(5,583)	(5,704)	(5,903)	(6,179)	(6,539)	(6,965)	(7,448)	(8,054)	(8,775)
J	G-J Generation (1)	14,622	14,622	14,588	14,588	14,588	14,588	14,588	14,588	14,588	14,588
K	Shortage of Gas Fuel Supply (2)	(2,721)	(2,721)	(2,687)	(2,687)	(2,687)	(2,687)	(2,687)	(2,687)	(2,687)	(2,687)
L	G-J Generation Derates (3)	(1,035)	(1,035)	(1,035)	(1,035)	(1,035)	(1,035)	(1,035)	(1,035)	(1,035)	(1,035)
M	Temperature Based Generation Derates	0	0	0	0	0	0	0	0	0	0
N	Net ICAP External Imports	315	315	315	315	315	315	315	315	315	315
O	SCRs (4), (5)	160	160	160	160	160	160	160	160	160	160
P	**Total Resources Available (J+K+L+M+N+O)**	11,341	11,341	11,341	11,341	11,341	11,341	11,341	11,341	11,341	11,341
Q	**Transmission Security Margin (I+P)**	5,841	5,758	5,636	5,437	5,161	4,801	4,375	3,892	3,287	2,566

Notes:

1. Reflects the 2022 Gold Book existing winter capacity plus projected additions and deactivations.
2. Includes all gas only units that do not have a firm gas contract. All includes reductions in units with duct burner capabilities. Duct burner derates on dual fual combined cycle units with non-firm gas account for approximately 250 MW of derated capacity.
3. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 10% of the total nameplate, off-shore wind at 15% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). For winter the expected solar PV output at peak is 0 MW. Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
4. SCRs are not applied for transmission security analysis of normal operations, but are included for emergency operations.
5. Includes a de-rate of 133 MW for SCRs.
6. Limits in 2022 and 2023 are based on limits from the summer peak 2023 representations evaluated in the post-2020 RNA updates. Limits for 2024 and 2025 are based on the summer peak 2025 representations evaluated in the post-2020 RNA updates. Limits for 2026 through 2032 are based also based on the summer peak 2025 representations evaluated in the post-2020 RNA analysis which does not include the impact of CHPE.
7. As a conservative winter peak assumption these limits utilize the summer values.

Figure 117: Extreme System Condition – Winter Peak Lower Hudson Valley Transmission Security Margin (1-in-100-Year Extreme Cold Snap, Emergency Transfer Criteria) with A Shortage of Gas Fuel Supply

Winter Peak, Shortage of Gas Fuel Supply - 1-in-100-Year Extreme Cold Snap, Emergency Transfer Criteria (MW)											
Line	**Item**	**2023-24**	**2024-25**	**2025-26**	**2026-27**	**2027-28**	**2028-29**	**2029-30**	**2030-31**	**2031-32**	**2032-33**
A	G-J Load Forecast	(11,424)	(11,513)	(11,640)	(11,848)	(12,139)	(12,516)	(12,964)	(13,473)	(14,113)	(14,871)
B	RECO Load	(242)	(242)	(242)	(242)	(242)	(242)	(242)	(242)	(239)	(239)
C	**Total Load (A+B)**	(11,666)	(11,755)	(11,882)	(12,090)	(12,381)	(12,758)	(13,206)	(13,715)	(14,352)	(15,110)
D	UPNY-SENY Limit (6), (7)	5,450	5,450	5,450	5,450	5,450	5,450	5,450	5,450	5,450	5,450
E	ABC PARs to J	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)
F	K - SENY (6)	155	155	155	155	155	155	155	155	155	155
G	**Total SENY AC Import (D+E+F)**	5,594	5,594	5,594	5,594	5,594	5,594	5,594	5,594	5,594	5,594
H	Loss of Source Contingency	0	0	0	0	0	0	0	0	0	0
I	**Resource Need (C+G+H)**	(6,072)	(6,161)	(6,288)	(6,496)	(6,787)	(7,164)	(7,612)	(8,121)	(8,758)	(9,516)
J	G-J Generation (1)	14,622	14,622	14,588	14,588	14,588	14,588	14,588	14,588	14,588	14,588
K	Shortage of Gas Fuel Supply (2)	(2,721)	(2,721)	(2,687)	(2,687)	(2,687)	(2,687)	(2,687)	(2,687)	(2,687)	(2,687)
L	G-J Generation Derates (3)	(1,035)	(1,035)	(1,035)	(1,035)	(1,035)	(1,035)	(1,035)	(1,035)	(1,035)	(1,035)
M	Temperature Based Generation Derates	0	0	0	0	0	0	0	0	0	0
N	Net ICAP External Imports	315	315	315	315	315	315	315	315	315	315
O	SCRs (4), (5)	160	160	160	160	160	160	160	160	160	160
P	**Total Resources Available (J+K+L+M+N+O)**	11,341	11,341	11,341	11,341	11,341	11,341	11,341	11,341	11,341	11,341
Q	**Transmission Security Margin (I+P)**	5,269	5,180	5,053	4,845	4,554	4,177	3,729	3,220	2,583	1,825

Notes:

1. Reflects the 2022 Gold Book existing winter capacity plus projected additions and deactivations.
2. Includes all gas only units that do not have a firm gas contract. All includes reductions in units with duct burner capabilities. Duct burner derates on dual fual combined cycle units with non-firm gas account for approximately 250 MW of derated capacity.
3. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 10% of the total nameplate, off-shore wind at 15% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). For winter the expected solar PV output at peak is 0 MW. Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
4. SCRs are not applied for transmission security analysis of normal operations, but are included for emergency operations.
5. Includes a de-rate of 133 MW for SCRs.
6. Limits in 2022 and 2023 are based on limits from the summer peak 2023 representations evaluated in the post-2020 RNA updates. Limits for 2024 and 2025 are based on the summer peak 2025 representations evaluated in the post-2020 RNA updates. Limits for 2026 through 2032 are based also based on the summer peak 2025 representations evaluated in the post-2020 RNA analysis which does not include the impact of CHPE.
7. As a conservative winter peak assumption these limits utilize the summer values.

Figure 118: Extreme System Condition – Summary of Winter Peak Lower Hudson Valley Transmission Security Margin with A Shortage of Gas Fuel Supply

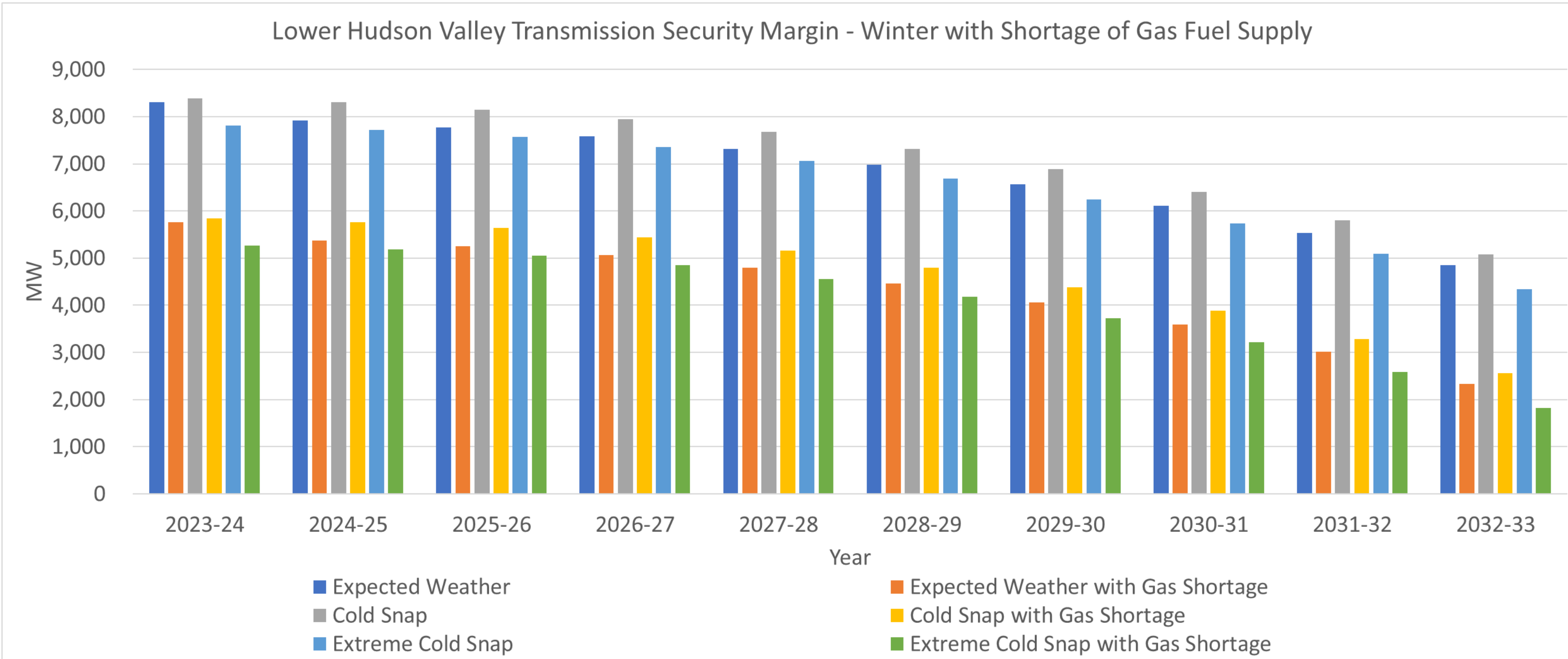


Figure 119: Extreme System Condition – Winter Peak New York City Transmission Security Margin with A Shortage of Gas Fuel Supply

Winter Peak, Shortage of Gas Fuel Supply - Baseline Expected Weather, Normal Transfer Criteria (MW)											
Line	**Item**	**2023-24**	**2024-25**	**2025-26**	**2026-27**	**2027-28**	**2028-29**	**2029-30**	**2030-31**	**2031-32**	**2032-33**
A	**Zone J Load Forecast**	(7,442)	(7,495)	(7,578)	(7,725)	(7,934)	(8,208)	(8,532)	(8,894)	(9,350)	(9,897)
B	I+K to J (4), (5)	3,904	3,904	3,904	3,904	3,904	3,904	3,904	3,904	3,904	3,904
C	ABC PARs to J	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)
D	**Total J AC Import (B+C)**	3,893	3,893	3,893	3,893	3,893	3,893	3,893	3,893	3,893	3,893
E	Loss of Source Contingency	(990)	(990)	(990)	(990)	(990)	(990)	(990)	(990)	(990)	(990)
F	**Resource Need (A+D+E)**	(4,539)	(4,592)	(4,675)	(4,822)	(5,031)	(5,305)	(5,629)	(5,991)	(6,447)	(6,994)
G	J Generation (1)	9,481	9,481	9,447	9,447	9,447	9,447	9,447	9,447	9,447	9,447
H	Shortage of Gas Fuel Supply (2)	(2,164)	(2,164)	(2,130)	(2,130)	(2,130)	(2,130)	(2,130)	(2,130)	(2,130)	(2,130)
I	J Generation Derates (3)	(543)	(543)	(542)	(542)	(542)	(542)	(542)	(542)	(542)	(542)
J	Temperature Based Generation Derates	0	0	0	0	0	0	0	0	0	0
K	Net ICAP External Imports	315	315	315	315	315	315	315	315	315	315
L	**Total Resources Available (G+H+I+J+K)**	7,089	7,089	7,090	7,090	7,090	7,090	7,090	7,090	7,090	7,090
M	**Transmission Security Margin (F+K)**	2,550	2,497	2,415	2,268	2,059	1,785	1,461	1,099	643	96

Notes:

1. Reflects the 2022 Gold Book existing winter capacity plus projected additions and deactivations.
2. Includes all gas only units that do not have a firm gas contract. All includes reductions in units with duct burner capabilities. Duct burner derates on dual fual combined cycle units with non-firm gas account for approximately 150 MW of derated capacity.
3. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 10% of the total nameplate, off-shore wind at 15% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). For winter the expected solar PV output at peak is 0 MW. Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
4. Limits in 2022 and 2023 are based on limits from the summer peak 2023 representations evaluated in the post-2020 RNA updates. Limits for 2024 and 2025 are based on the summer peak 2025 representations evaluated in the post-2020 RNA updates. Limits for 2026 through 2032 are based also based on the summer peak 2025 representations evaluated in the post-2020 RNA analysis which does not include the impact of CHPE.
5. As a conservative winter peak assumption these limits utilize the summer values.

Figure 120: Extreme System Condition – Winter Peak New York City Transmission Security Margin (1-in-10-Year Cold Snap, Emergency Transfer Criteria) with A Shortage of Gas Fuel Supply

Winter Peak, Shortage of Gas Fuel Supply - 1-in-10-Year Cold Snap, Emergency Transfer Criteria (MW)											
Line	**Item**	**2023-24**	**2024-25**	**2025-26**	**2026-27**	**2027-28**	**2028-29**	**2029-30**	**2030-31**	**2031-32**	**2032-33**
A	**Zone J Load Forecast**	(7,825)	(7,880)	(7,968)	(8,122)	(8,342)	(8,630)	(8,971)	(9,351)	(9,831)	(10,406)
B	I+K to J (6), (7)	3,904	3,904	3,904	3,904	3,904	3,904	3,904	3,904	3,904	3,904
C	ABC PARs to J	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)
D	**Total J Import (B+C)**	3,893	3,893	3,893	3,893	3,893	3,893	3,893	3,893	3,893	3,893
E	Loss of Source Contingency	(990)	(990)	(990)	(990)	(990)	(990)	(990)	(990)	(990)	(990)
F	**Resource Need (A+D+E)**	(4,922)	(4,977)	(5,065)	(5,219)	(5,439)	(5,727)	(6,068)	(6,448)	(6,928)	(7,503)
G	J Generation (1)	9,481	9,481	9,447	9,447	9,447	9,447	9,447	9,447	9,447	9,447
H	Shortage of Gas Fuel Supply (2)	(2,164)	(2,164)	(2,130)	(2,130)	(2,130)	(2,130)	(2,130)	(2,130)	(2,130)	(2,130)
I	J Generation Derates (3)	(543)	(543)	(542)	(542)	(542)	(542)	(542)	(542)	(542)	(542)
J	Temperature Based Generation Derates	0	0	0	0	0	0	0	0	0	0
K	Net ICAP External Imports	315	315	315	315	315	315	315	315	315	315
L	SCRs (4), (5)	128	128	128	128	128	128	128	128	128	128
M	**Total Resources Available (G+H+I+J+K+L)**	7,217	7,217	7,218	7,218	7,218	7,218	7,218	7,218	7,218	7,218
N	**Transmission Security Margin (F+M)**	2,295	2,240	2,153	1,999	1,779	1,491	1,150	770	290	(285)

Notes:

1. Reflects the 2022 Gold Book existing winter capacity plus projected additions and deactivations.
2. Includes all gas only units that do not have a firm gas contract. All includes reductions in units with duct burner capabilities. Duct burner derates on dual fual combined cycle units with non-firm gas account for approximately 150 MW of derated capacity.
3. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 10% of the total nameplate, off-shore wind at 15% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). For winter the expected solar PV output at peak is 0 MW. Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
4. SCRs are not applied for transmission security analysis of normal operations, but are included for emergency operations.
5. Includes a de-rate of 116 MW for SCRs.
6. Limits in 2022 and 2023 are based on limits from the summer peak 2023 representations evaluated in the post-2020 RNA updates. Limits for 2024 and 2025 are based on the summer peak 2025 representations evaluated in the post-2020 RNA updates. Limits for 2026 through 2032 are based also based on the summer peak 2025 representations evaluated in the post-2020 RNA analysis which does not include the impact of CHPE.
7. As a conservative winter peak assumption these limits utilize the summer values.

Figure 121: Extreme System Condition – Winter Peak New York City Transmission Security Margin (1-in-100-Year Extreme Cold Snap, Emergency Transfer Criteria) with A Shortage of Gas Fuel Supply

Winter Peak, Shortage of Gas Fuel Supply - 1-in-100-Year Extreme Cold Snap, Emergency Transfer Criteria (MW)											
Line	**Item**	**2023-24**	**2024-25**	**2025-26**	**2026-27**	**2027-28**	**2028-29**	**2029-30**	**2030-31**	**2031-32**	**2032-33**
A	**Zone J Load Forecast**	(8,228)	(8,287)	(8,379)	(8,541)	(8,772)	(9,075)	(9,433)	(9,834)	(10,338)	(10,943)
B	I+K to J (6), (7)	3,904	3,904	3,904	3,904	3,904	3,904	3,904	3,904	3,904	3,904
C	ABC PARs to J	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)	(11)
D	**Total J Import (B+C)**	3,893	3,893	3,893	3,893	3,893	3,893	3,893	3,893	3,893	3,893
E	Loss of Source Contingency	(990)	(990)	(990)	(990)	(990)	(990)	(990)	(990)	(990)	(990)
F	**Resource Need (A+D+E)**	(5,325)	(5,384)	(5,476)	(5,638)	(5,869)	(6,172)	(6,530)	(6,931)	(7,435)	(8,040)
G	J Generation (1)	9,481	9,481	9,447	9,447	9,447	9,447	9,447	9,447	9,447	9,447
H	Shortage of Gas Fuel Supply (2)	(2,164)	(2,164)	(2,130)	(2,130)	(2,130)	(2,130)	(2,130)	(2,130)	(2,130)	(2,130)
I	J Generation Derates (3)	(543)	(543)	(542)	(542)	(542)	(542)	(542)	(542)	(542)	(542)
J	Temperature Based Generation Derates	0	0	0	0	0	0	0	0	0	0
K	Net ICAP External Imports	315	315	315	315	315	315	315	315	315	315
L	SCRs (4), (5)	128	128	128	128	128	128	128	128	128	128
M	**Total Resources Available (G+H+I+J+K+L)**	7,217	7,217	7,218	7,218	7,218	7,218	7,218	7,218	7,218	7,218
N	**Transmission Security Margin (F+M)**	1,892	1,833	1,742	1,580	1,349	1,046	688	287	(217)	(822)

Notes:

1. Reflects the 2022 Gold Book existing winter capacity plus projected additions and deactivations.
2. Includes all gas only units that do not have a firm gas contract. All includes reductions in units with duct burner capabilities. Duct burner derates on dual fual combined cycle units with non-firm gas account for approximately 150 MW of derated capacity.
3. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 10% of the total nameplate, off-shore wind at 15% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). For winter the expected solar PV output at peak is 0 MW. Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
4. SCRs are not applied for transmission security analysis of normal operations, but are included for emergency operations.
5. Includes a de-rate of 116 MW for SCRs.
6. Limits in 2022 and 2023 are based on limits from the summer peak 2023 representations evaluated in the post-2020 RNA updates. Limits for 2024 and 2025 are based on the summer peak 2025 representations evaluated in the post-2020 RNA updates. Limits for 2026 through 2032 are based also based on the summer peak 2025 representations evaluated in the post-2020 RNA analysis which does not include the impact of CHPE.
7. As a conservative winter peak assumption these limits utilize the summer values.

Figure 122: Extreme System Condition – Summary of Winter Peak New York City Transmission Security Margin with A Shortage of Gas Fuel Supply

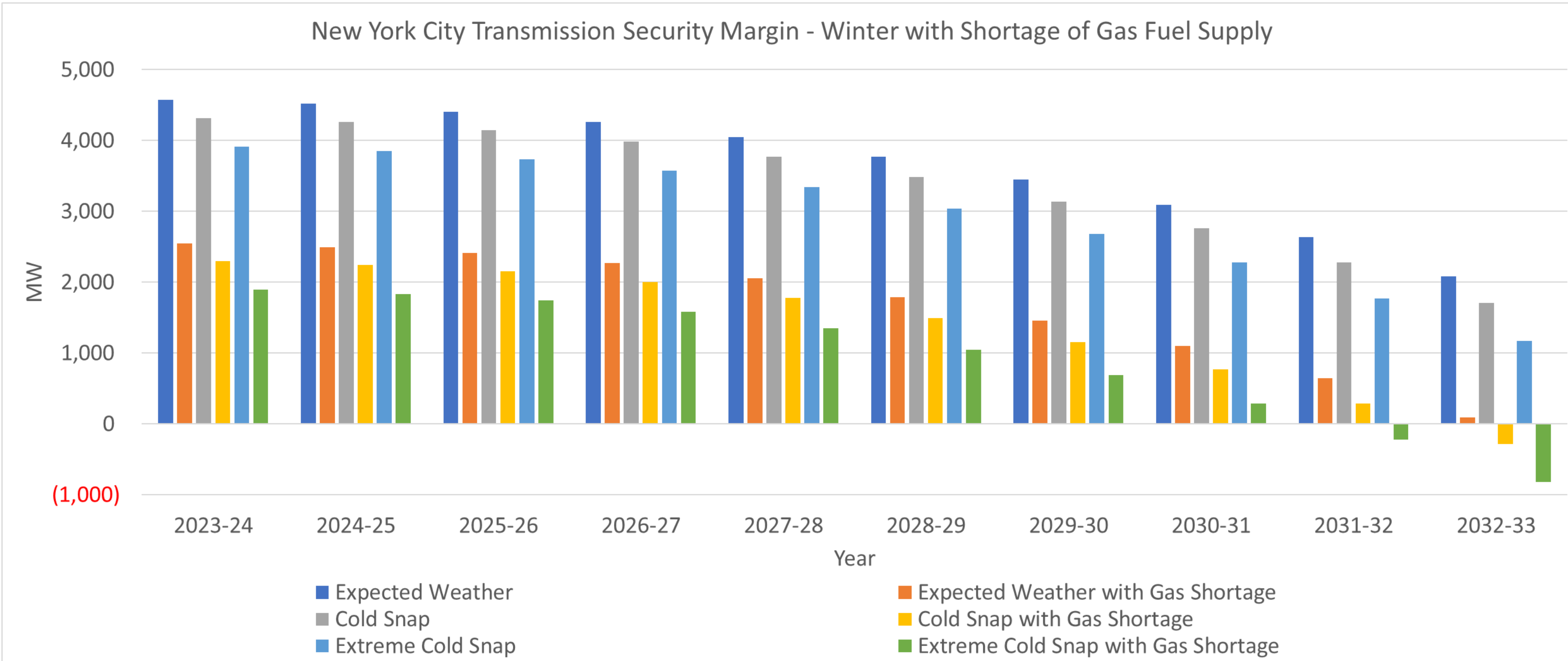


Figure 123: Extreme System Condition – Winter Peak Long Island Transmission Security Margin with A Shortage of Gas Fuel Supply

Winter Peak, Shortage of Gas Fuel Supply - Baseline Expected Weather, Normal Transfer Criteria (MW)											
Line	**Item**	**2023-24**	**2024-25**	**2025-26**	**2026-27**	**2027-28**	**2028-29**	**2029-30**	**2030-31**	**2031-32**	**2032-33**
A	**Zone K Load Forecast**	(3,213)	(3,229)	(3,262)	(3,319)	(3,396)	(3,491)	(3,604)	(3,737)	(3,891)	(4,049)
B	I+J to K (4), (5)	929	929	929	929	929	929	929	929	929	929
C	New England Import (NNC)	0	0	0	0	0	0	0	0	0	0
D	**Total K AC Import (B+C)**	929	929	929	929	929	929	929	929	929	929
E	Loss of Source Contingency	(660)	(660)	(660)	(660)	(660)	(660)	(660)	(660)	(660)	(660)
F	**Resource Need (A+D+E)**	(2,944)	(2,960)	(2,993)	(3,050)	(3,127)	(3,222)	(3,335)	(3,468)	(3,622)	(3,780)
G	K Generation (1)	5,559	5,559	5,559	5,559	5,559	5,559	5,559	5,559	5,559	5,559
H	Shortage of Gas Fuel Supply (2)	(394)	(394)	(394)	(394)	(394)	(394)	(394)	(394)	(394)	(394)
I	K Generation Derates (3)	(610)	(610)	(610)	(610)	(610)	(610)	(610)	(610)	(610)	(610)
J	Temperature Based Generation Derates	0	0	0	0	0	0	0	0	0	0
K	Net ICAP External Imports	660	660	660	660	660	660	660	660	660	660
L	**Total Resources Available (G+H+I+J+K)**	5,215	5,215	5,215	5,215	5,215	5,215	5,215	5,215	5,215	5,215
M	**Transmission Security Margin (F+L)**	2,271	2,255	2,222	2,165	2,088	1,993	1,880	1,747	1,593	1,435

Notes:

1. Reflects the 2022 Gold Book existing winter capacity plus projected additions and deactivations.
2. Includes all gas only units that do not have a firm gas contract. All includes reductions in units with duct burner capabilities. Duct burner derates on dual fual combined cycle units with non-firm gas account for approximately 170 MW of derated capacity.
3. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 10% of the total nameplate, off-shore wind at 15% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). For winter the expected solar PV output at peak is 0 MW. Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
4. Limits in 2022 and 2023 are based on limits from the summer peak 2023 representations evaluated in the post-2020 RNA updates. Limits for 2024 and 2025 are based on the summer peak 2025 representations evaluated in the post-2020 RNA updates. Limits for 2026 through 2032 are based also based on the summer peak 2025 representations evaluated in the post-2020 RNA analysis which does not include the impact of CHPE.
5. As a conservative winter peak assumption these limits utilize the summer values.

Figure 124: Extreme System Condition – Winter Peak Long Island Transmission Security Margin (1-in-10-Year Cold Snap, Emergency Transfer Criteria) with A Shortage of Gas Fuel Supply

Winter Peak, Shortage of Gas Fuel Supply - 1-in-10-Year Cold Snap, Emergency Transfer Criteria (MW)											
Line	**Item**	**2023-24**	**2024-25**	**2025-26**	**2026-27**	**2027-28**	**2028-29**	**2029-30**	**2030-31**	**2031-32**	**2032-33**
A	**Zone K Load Forecast**	(3,378)	(3,395)	(3,430)	(3,490)	(3,571)	(3,671)	(3,789)	(3,929)	(4,091)	(4,257)
B	I+J to K (6), (7)	887	887	887	887	887	887	887	887	887	887
C	New England Import (NNC)	0	0	0	0	0	0	0	0	0	0
D	**Total K AC Import (B+C)**	887	887	887	887	887	887	887	887	887	887
E	Loss of Source Contingency	0	0	0	0	0	0	0	0	0	0
F	**Resource Need (A+D+E)**	(2,491)	(2,508)	(2,543)	(2,603)	(2,684)	(2,784)	(2,902)	(3,042)	(3,204)	(3,370)
G	K Generation (1)	5,559	5,559	5,559	5,559	5,559	5,559	5,559	5,559	5,559	5,559
H	Shortage of Gas Fuel Supply (2)	(394)	(394)	(394)	(394)	(394)	(394)	(394)	(394)	(394)	(394)
I	K Generation Derates (3)	(610)	(610)	(610)	(610)	(610)	(610)	(610)	(610)	(610)	(610)
J	Temperature Based Generation Derates	0	0	0	0	0	0	0	0	0	0
K	Net ICAP External Imports	660	660	660	660	660	660	660	660	660	660
L	SCRs (4), (5)	12	12	12	12	12	12	12	12	12	12
M	**Total Resources Available (G+H+I+J+K+L)**	5,227	5,227	5,227	5,227	5,227	5,227	5,227	5,227	5,227	5,227
N	**Transmission Security Margin (F+M)**	2,736	2,719	2,684	2,624	2,543	2,443	2,325	2,185	2,023	1,857

Notes:

1. Reflects the 2022 Gold Book existing winter capacity plus projected additions and deactivations.
2. Includes all gas only units that do not have a firm gas contract. All includes reductions in units with duct burner capabilities. Duct burner derates on dual fual combined cycle units with non-firm gas account for approximately 170 MW of derated capacity.
3. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 10% of the total nameplate, off-shore wind at 15% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). For winter the expected solar PV output at peak is 0 MW. Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
4. SCRs are not applied for transmission security analysis of normal operations, but are included for emergency operations.
5. Includes a de-rate of 10 MW for SCRs.
6. Limits in 2022 and 2023 are based on limits from the summer peak 2023 representations evaluated in the post-2020 RNA updates. Limits for 2024 and 2025 are based on the summer peak 2025 representations evaluated in the post-2020 RNA updates. Limits for 2026 through 2032 are based also based on the summer peak 2025 representations evaluated in the post-2020 RNA analysis which does not include the impact of CHPE.
7. As a conservative winter peak assumption these limits utilize the summer values.

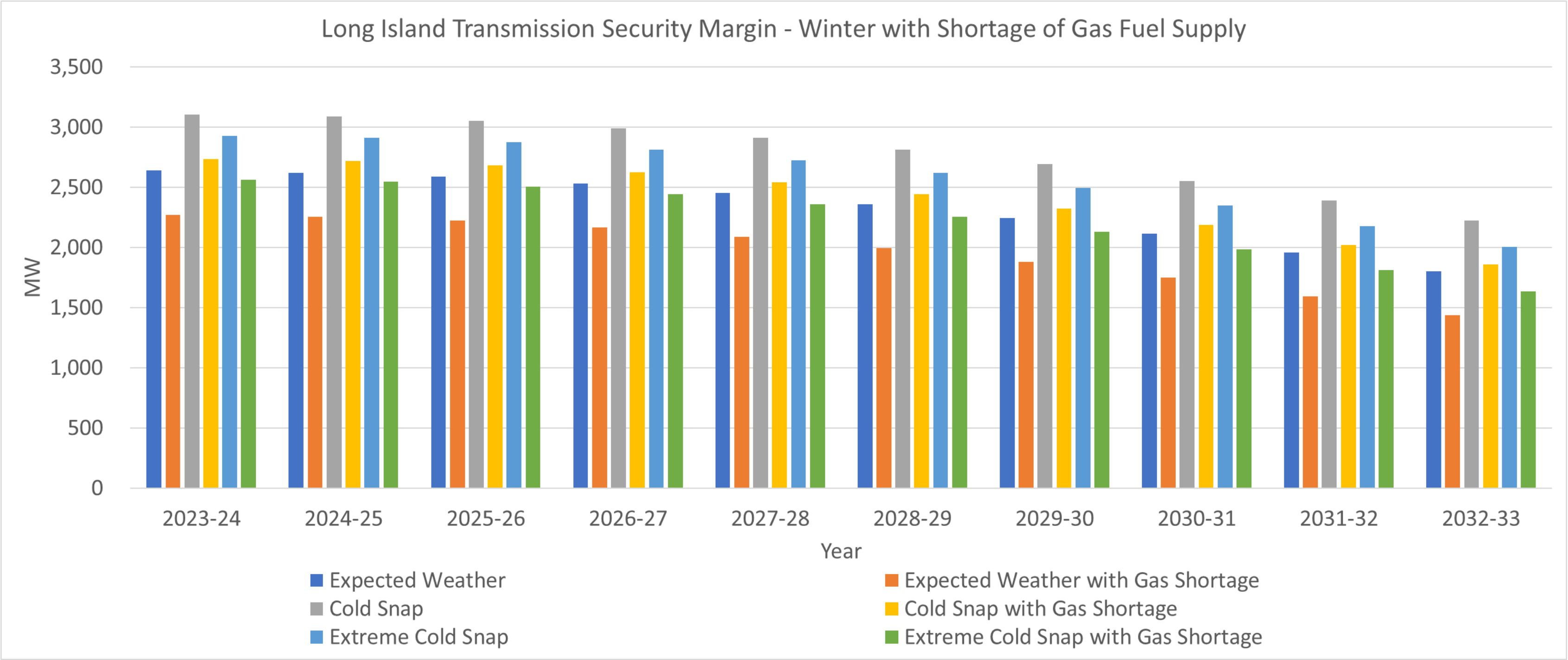
Figure 125: Extreme System Condition – Winter Peak Long Island Transmission Security Margin (1-in-100-Year Extreme Cold Snap, Emergency Transfer Criteria) with A Shortage of Gas Fuel Supply

Winter Peak, Shortage of Gas Fuel Supply - 1-in-100-Year Extreme Cold Snap, Emergency Transfer Criteria (MW)											
Line	**Item**	**2023-24**	**2024-25**	**2025-26**	**2026-27**	**2027-28**	**2028-29**	**2029-30**	**2030-31**	**2031-32**	**2032-33**
A	**Zone K Load Forecast**	(3,552)	(3,570)	(3,607)	(3,670)	(3,755)	(3,860)	(3,985)	(4,132)	(4,302)	(4,477)
B	I+J to K (6), (7)	887	887	887	887	887	887	887	887	887	887
C	New England Import (NNC)	0	0	0	0	0	0	0	0	0	0
D	**Total K AC Import (B+C)**	887	887	887	887	887	887	887	887	887	887
E	Loss of Source Contingency	0	0	0	0	0	0	0	0	0	0
F	**Resource Need (A+D+E)**	(2,665)	(2,683)	(2,720)	(2,783)	(2,868)	(2,973)	(3,098)	(3,245)	(3,415)	(3,590)
G	K Generation (1)	5,559	5,559	5,559	5,559	5,559	5,559	5,559	5,559	5,559	5,559
H	Shortage of Gas Fuel Supply (2)	(394)	(394)	(394)	(394)	(394)	(394)	(394)	(394)	(394)	(394)
I	K Generation Derates (3)	(610)	(610)	(610)	(610)	(610)	(610)	(610)	(610)	(610)	(610)
J	Temperature Based Generation Derates	0	0	0	0	0	0	0	0	0	0
K	Net ICAP External Imports	660	660	660	660	660	660	660	660	660	660
L	SCRs (4), (5)	12	12	12	12	12	12	12	12	12	12
M	**Total Resources Available (G+H+I+J+K+L)**	5,227	5,227	5,227	5,227	5,227	5,227	5,227	5,227	5,227	5,227
N	**Transmission Security Margin (F+M)**	2,562	2,544	2,507	2,444	2,359	2,254	2,129	1,982	1,812	1,637

Notes:

1. Reflects the 2022 Gold Book existing winter capacity plus projected additions and deactivations.
2. Includes all gas only units that do not have a firm gas contract. All includes reductions in units with duct burner capabilities. Duct burner derates on dual fual combined cycle units with non-firm gas account for approximately 170 MW of derated capacity.
3. Reflects the derates for generating resources. For this evaluation land-based wind generation is assumed to have a capability of 10% of the total nameplate, off-shore wind at 15% of the total nameplate, solar generation is based on the ratio of solar PV nameplate capacity (2022 Gold Book Table I-9a) and solar PV peak reductions (2022 Gold Book Table I-9c). For winter the expected solar PV output at peak is 0 MW. Derates for run-of-river hydro are included as well as the Oswego Export limit for all lines in-service. Includes derates for thermal resources based on NERC five-year class average EFORd data (https://www.nerc.com/pa/RAPA/gads/Pages/Reports.aspx).
4. SCRs are not applied for transmission security analysis of normal operations, but are included for emergency operations.
5. Includes a de-rate of 10 MW for SCRs.
6. Limits in 2022 and 2023 are based on limits from the summer peak 2023 representations evaluated in the post-2020 RNA updates. Limits for 2024 and 2025 are based on the summer peak 2025 representations evaluated in the post-2020 RNA updates. Limits for 2026 through 2032 are based also based on the summer peak 2025 representations evaluated in the post-2020 RNA analysis which does not include the impact of CHPE.
7. As a conservative winter peak assumption these limits utilize the summer values.

Figure 126: Extreme System Condition – Summary of Winter Peak Long Island Transmission Security Margin with A Shortage of Gas Fuel Supply



Load shape Details for Tipping Point Analysis

As part of the 2022 Gold Book, representative load shapes for the NYCA summer high load day were produced.[37] For the tipping point analysis, the shapes are adjusted to match the Gold Book coincident peak forecasts. These shapes reflect the current observed base load shape, using the average load shape of high load days from recent summers. The shapes also incorporate the evolving and increasing impacts of BtM-PV, electric vehicle charging, and building electrification on summer hourly loads. For the statewide coincident summer peak, the peak during the 5 pm hour for summers 2023 through 2026. However, due to the impacts of increasing BtM-PV and increased electric vehicle charging in the late afternoon and evening hours, the peak is expected to shift to the 6 pm hour from 2027 through 2032.

The contribution of the hourly shapes from Zones A-F, GHI, J, and K as a fraction of the overall NYCA shape are calculated from the same sample of historical summer high load days used to calculate the NYCA shape. For the localities, the BtM-PV, electric vehicle, and electrification shape impacts for each locality are based on their share of the expected penetration for each technology. Similar processes were utilized to create the 1-in-10-year heatwave and 1-in-100-year extreme heatwave shapes.

As seen in **Figure 127**, the load shapes show a changing peak hour in Zones A-F, GHI, J, and K from 2023 through the 10-year horizon in 2032. For instance, the peak hour in A-F changes from HB17 in 2023 which is the same as the 2023 NYCA peak hour to HB19 in 2032 which is one hour after the NYCA peaks. In reality, zones will often peak on different hour during the same high summer load day, not fully coincident with the NYCA peak hour itself.

[37] The 2022 Long-Term Forecast Load Shape Projections are available here.

Figure 127: NYCA Baseline Expected Weather Summer Peak Load shape

	A-F		GHI		J		K		NYCA	
	2023	2032	2023	2032	2023	2032	2023	2032	2023	2032
HB0	8,846	9,012	2,685	2,928	7,894	8,699	2,880	3,093	22,305	23,732
HB1	8,505	8,591	2,515	2,725	7,537	8,288	2,669	2,856	21,226	22,460
HB2	8,260	8,283	2,395	2,573	7,275	7,989	2,518	2,683	20,448	21,528
HB3	8,151	8,107	2,312	2,462	7,126	7,808	2,427	2,571	20,016	20,948
HB4	8,180	8,051	2,284	2,394	7,115	7,754	2,406	2,519	19,985	20,718
HB5	8,400	8,147	2,333	2,414	7,316	7,969	2,451	2,551	20,500	21,081
HB6	8,738	8,130	2,445	2,463	7,792	8,427	2,556	2,602	21,531	21,622
HB7	9,188	8,100	2,640	2,587	8,462	9,024	2,818	2,785	23,108	22,496
HB8	9,567	8,115	2,832	2,749	9,080	9,647	3,131	3,055	24,610	23,566
HB9	9,905	8,102	3,024	2,895	9,572	10,126	3,447	3,319	25,948	24,442
HB10	10,240	8,114	3,233	3,054	9,966	10,490	3,779	3,599	27,218	25,257
HB11	10,549	8,172	3,436	3,205	10,246	10,718	4,091	3,861	28,322	25,956
HB12	10,860	8,375	3,631	3,376	10,462	10,886	4,352	4,097	29,305	26,734
HB13	11,191	8,753	3,809	3,558	10,623	11,028	4,548	4,297	30,171	27,636
HB14	11,401	9,251	3,955	3,754	10,691	11,127	4,696	4,499	30,743	28,631
HB15	11,604	9,822	4,069	3,940	10,782	11,274	4,831	4,704	31,286	29,740
HB16	11,885	10,501	4,173	4,118	10,915	11,456	4,947	4,894	31,920	30,969
HB17	12,006	11,129	4,208	4,256	10,853	11,508	4,951	5,003	32,018	31,896
HB18	11,963	11,472	4,173	4,294	10,733	11,441	4,887	5,007	31,756	32,214
HB19	11,853	11,632	4,060	4,229	10,543	11,295	4,711	4,875	31,167	32,031
HB20	11,679	11,548	3,943	4,124	10,314	11,084	4,513	4,689	30,449	31,445
HB21	11,305	11,236	3,752	3,939	10,062	10,817	4,253	4,426	29,372	30,418
HB22	10,561	10,621	3,455	3,676	9,627	10,407	3,869	4,066	27,512	28,770
HB23	9,802	9,949	3,158	3,396	9,070	9,846	3,476	3,679	25,506	26,870

Figure 128 shows the load shapes for the baseline expected weather summer peak conditions. The statewide behavior can be broken down further into groups of zones. **Figure 129** shows the Zones A-F component of the NYCA baseline expected weather forecast for the summer peak day. As seen in **Figure 129,** over each year with increased penetrations of BtM-PV, the load continues to flatten in the zones in the early morning hours and shifts the peak to later in the day.[38] **Figure 130** shows the Zones G-I component of the NYCA baseline expected weather forecast for the summer peak day. As seen in **Figure 130,** the increased BtM-PV results a slight flattening of the load and shifting of the peak hour is still observed.[39] **Figure 131** shows the Zone J component of the NYCA baseline expected weather forecast for the summer peak day. As seen in **Figure 131,** the BtM-PV

[38] From Table I-9a in the 2022 Load and Capacity Data report, in 2023 Zones A-F has 3,068 MW (nameplate) of the 5,152 MW of BtM-PV (nameplate) statewide (approximately 60% of the statewide BtM-PV). In 2032, the forecast for BtM-PV in Zones A-F more than doubles to 6,768 MW (nameplate) of the 10,484 MW (nameplate) of the BtM-PV statewide (approximately 65% of the statewide BtM-PV).

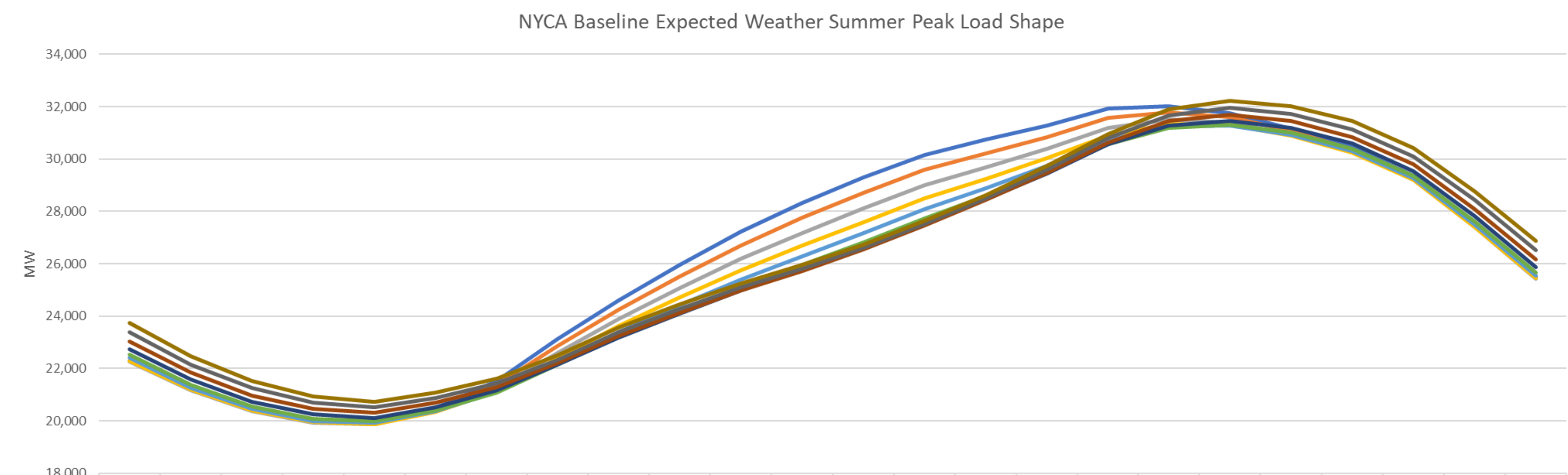
[39] In 2023, Zones G-I has 762 MW (nameplate) of the 5,152 MW (nameplate) of BtM-PV statewide (approximately 15% of the statewide BtM-PV). In 2032, the forecast for BtM-PV in Zones G-I increases by about 80% to 1,366 MW (nameplate) (approximately 13% of the statewide BtM-PV).

primarily reduces the load from year to year but has negligible impact on the shifting of the peak hour.[40] **Figure 132** shows the Zone K component of the NYCA baseline expected weather forecast for the summer peak day. As seen in **Figure 132,** BtM-PV does have some impact on the Zone K shape over time.[41] Similar curves were developed for the heatwave (**Figure 133** through **Figure 137**) and extreme heatwave conditions (**Figure 138** through **Figure 142**).

[40] In 2023, Zone J has 401 MW (nameplate) of the 5,152 MW of BtM-PV (nameplate) statewide (approximately 8% of the statewide BtM-PV). In 2032, the forecast for BtM-PV in Zone J nearly doubles to 793 MW (nameplate) (approximately 8% of the statewide BtM-PV in Zone J).

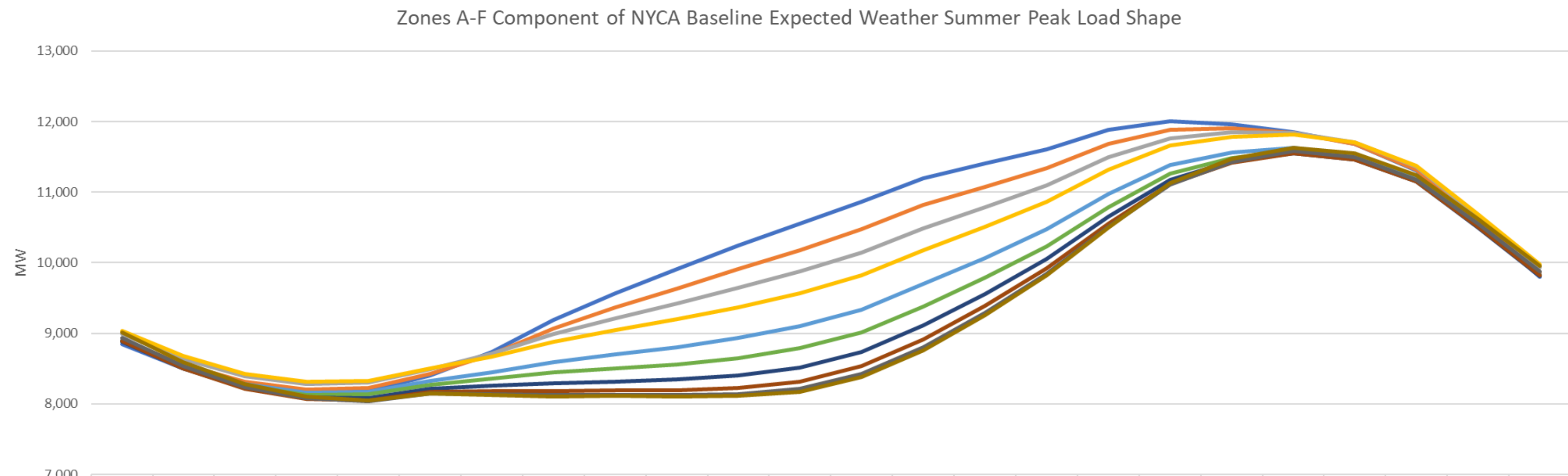
[41] In 2023, Zone K has 921 MW (nameplate) of the 5,152 MW of BtM-PV (nameplate) statewide (approximately 18% of the statewide BtM-PV). In 2032, the forecast for BtM-PV in Zone K increases by approximately 70% to 1,557 MW (nameplate) (approximately 15% of the statewide BtM-PV in Zone K).

Figure 128: NYCA Baseline Expected Weather Summer Peak Load shape



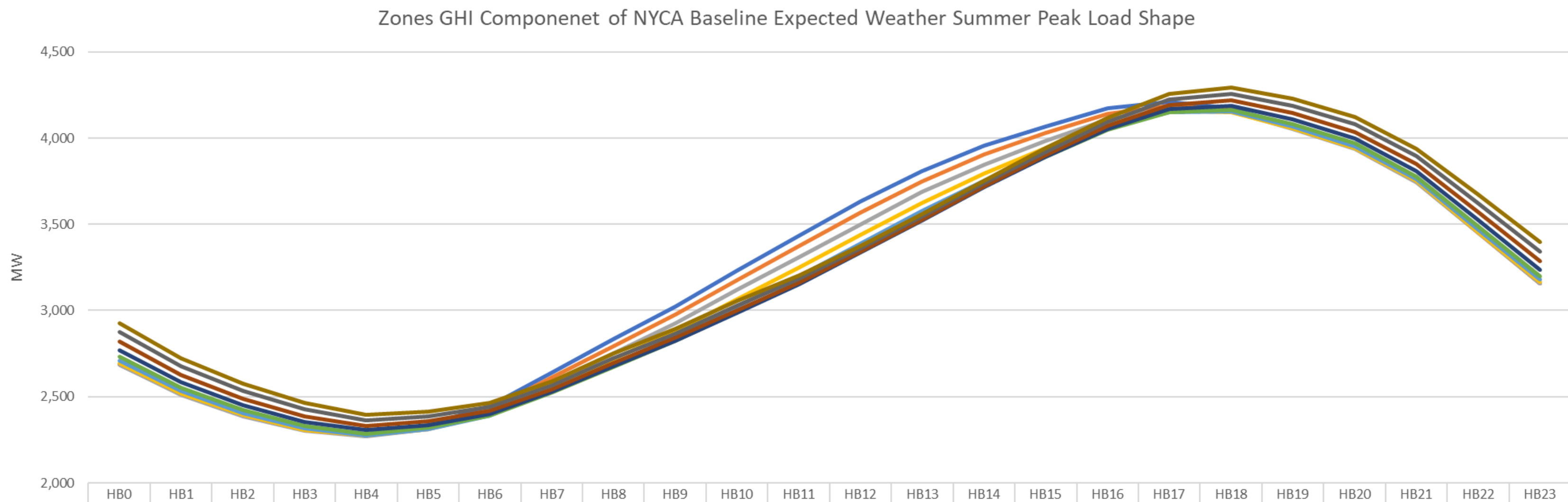
	HB0	HB1	HB2	HB3	HB4	HB5	HB6	HB7	HB8	HB9	HB10	HB11	HB12	HB13	HB14	HB15	HB16	HB17	HB18	HB19	HB20	HB21	HB22	HB23
2023	22,305	21,226	20,448	20,016	19,985	20,500	21,531	23,108	24,610	25,948	27,218	28,322	29,305	30,171	30,743	31,286	31,920	32,018	31,756	31,167	30,449	29,372	27,512	25,506
2024	22,286	21,198	20,416	19,980	19,942	20,437	21,392	22,850	24,253	25,505	26,698	27,749	28,708	29,587	30,222	30,847	31,567	31,778	31,596	31,066	30,371	29,302	27,462	25,469
2025	22,261	21,162	20,375	19,932	19,884	20,362	21,243	22,586	23,894	25,065	26,182	27,179	28,104	28,990	29,683	30,383	31,181	31,505	31,402	30,939	30,270	29,216	27,401	25,431
2026	22,306	21,194	20,398	19,945	19,885	20,343	21,152	22,388	23,611	24,707	25,754	26,698	27,600	28,497	29,250	30,028	30,906	31,339	31,313	30,907	30,258	29,211	27,417	25,463
2027	22,399	21,270	20,462	19,998	19,922	20,362	21,107	22,242	23,391	24,418	25,399	26,292	27,172	28,080	28,892	29,746	30,705	31,243	31,292	30,937	30,305	29,262	27,489	25,545
2028	22,532	21,384	20,562	20,083	19,987	20,410	21,094	22,141	23,228	24,195	25,119	25,962	26,822	27,737	28,603	29,527	30,561	31,198	31,317	31,010	30,392	29,354	27,603	25,669
2029	22,751	21,580	20,737	20,241	20,122	20,528	21,160	22,134	23,180	24,099	24,975	25,775	26,619	27,544	28,462	29,454	30,559	31,287	31,468	31,198	30,587	29,547	27,812	25,883
2030	23,046	21,843	20,975	20,453	20,301	20,690	21,282	22,205	23,237	24,128	24,972	25,732	26,554	27,479	28,436	29,481	30,641	31,448	31,684	31,447	30,844	29,807	28,097	26,178
2031	23,389	22,152	21,252	20,701	20,510	20,884	21,444	22,338	23,384	24,262	25,088	25,815	26,616	27,531	28,512	29,594	30,793	31,665	31,946	31,738	31,145	30,111	28,433	26,523
2032	23,732	22,460	21,528	20,948	20,718	21,081	21,622	22,496	23,566	24,442	25,257	25,956	26,734	27,636	28,631	29,740	30,969	31,896	32,214	32,031	31,445	30,418	28,770	26,870

Figure 129: Zones A-F Component of NYCA Baseline Expected Weather Summer Peak Load shape



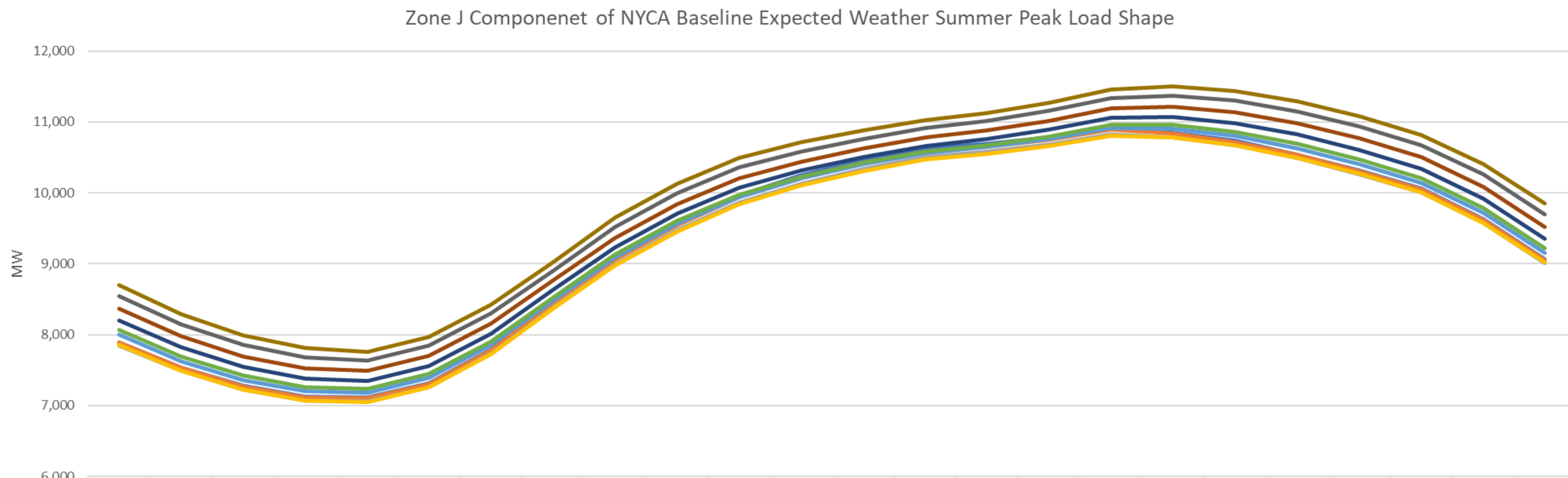
	HB0	HB1	HB2	HB3	HB4	HB5	HB6	HB7	HB8	HB9	HB10	HB11	HB12	HB13	HB14	HB15	HB16	HB17	HB18	HB19	HB20	HB21	HB22	HB23
2023	8,846	8,505	8,260	8,151	8,180	8,400	8,738	9,188	9,567	9,905	10,240	10,549	10,860	11,191	11,401	11,604	11,885	12,006	11,963	11,853	11,679	11,305	10,561	9,802
2024	8,902	8,554	8,310	8,199	8,227	8,429	8,705	9,065	9,367	9,636	9,911	10,181	10,473	10,814	11,072	11,335	11,680	11,882	11,900	11,837	11,681	11,322	10,596	9,850
2025	8,990	8,640	8,394	8,278	8,303	8,488	8,710	8,990	9,216	9,427	9,644	9,880	10,144	10,487	10,783	11,093	11,490	11,766	11,845	11,835	11,702	11,359	10,656	9,935
2026	9,034	8,677	8,428	8,309	8,328	8,499	8,671	8,881	9,045	9,200	9,372	9,571	9,823	10,171	10,504	10,863	11,313	11,657	11,786	11,816	11,701	11,370	10,684	9,976
2027	8,898	8,537	8,281	8,156	8,167	8,326	8,449	8,591	8,701	8,807	8,933	9,099	9,338	9,699	10,067	10,476	10,978	11,385	11,565	11,632	11,529	11,206	10,532	9,835
2028	8,889	8,521	8,259	8,130	8,133	8,274	8,356	8,443	8,503	8,563	8,651	8,789	9,016	9,379	9,785	10,237	10,790	11,260	11,484	11,581	11,488	11,171	10,513	9,823
2029	8,878	8,497	8,225	8,090	8,080	8,211	8,256	8,293	8,319	8,345	8,400	8,513	8,735	9,112	9,554	10,051	10,651	11,176	11,438	11,556	11,464	11,148	10,496	9,809
2030	8,893	8,501	8,218	8,070	8,049	8,165	8,181	8,184	8,192	8,196	8,228	8,317	8,532	8,915	9,385	9,916	10,553	11,121	11,417	11,553	11,466	11,149	10,507	9,826
2031	8,940	8,535	8,239	8,076	8,037	8,143	8,138	8,122	8,130	8,122	8,139	8,215	8,421	8,802	9,291	9,846	10,507	11,110	11,430	11,583	11,496	11,179	10,552	9,877
2032	9,012	8,591	8,283	8,107	8,051	8,147	8,130	8,100	8,115	8,102	8,114	8,172	8,375	8,753	9,251	9,822	10,501	11,129	11,472	11,632	11,548	11,236	10,621	9,949

Figure 130: Zones GHI Component of NYCA Baseline Expected Weather Summer Peak Load shape



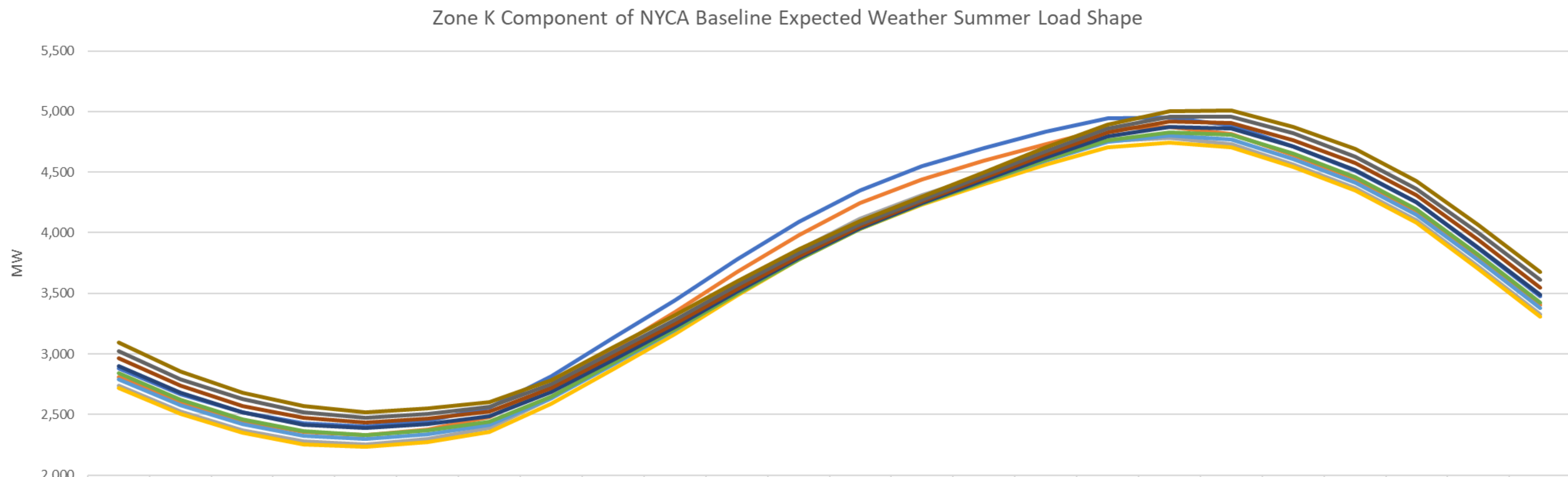
	HB0	HB1	HB2	HB3	HB4	HB5	HB6	HB7	HB8	HB9	HB10	HB11	HB12	HB13	HB14	HB15	HB16	HB17	HB18	HB19	HB20	HB21	HB22	HB23
2023	2,685	2,515	2,395	2,312	2,284	2,333	2,445	2,640	2,832	3,024	3,233	3,436	3,631	3,809	3,955	4,069	4,173	4,208	4,173	4,060	3,943	3,752	3,455	3,158
2024	2,685	2,514	2,391	2,307	2,278	2,323	2,427	2,611	2,793	2,977	3,177	3,375	3,568	3,750	3,903	4,028	4,142	4,189	4,163	4,056	3,940	3,748	3,452	3,156
2025	2,685	2,512	2,387	2,304	2,271	2,314	2,410	2,580	2,752	2,926	3,119	3,309	3,501	3,686	3,847	3,983	4,109	4,171	4,154	4,051	3,936	3,745	3,451	3,155
2026	2,697	2,521	2,395	2,308	2,273	2,312	2,397	2,554	2,718	2,882	3,065	3,249	3,439	3,625	3,796	3,944	4,081	4,158	4,152	4,056	3,943	3,751	3,458	3,164
2027	2,711	2,532	2,404	2,315	2,277	2,312	2,389	2,536	2,691	2,847	3,022	3,200	3,386	3,575	3,755	3,912	4,061	4,152	4,155	4,065	3,953	3,760	3,471	3,178
2028	2,734	2,552	2,421	2,328	2,286	2,319	2,388	2,523	2,674	2,825	2,993	3,165	3,350	3,539	3,725	3,891	4,049	4,151	4,163	4,079	3,969	3,777	3,490	3,200
2029	2,770	2,585	2,451	2,354	2,307	2,337	2,399	2,529	2,678	2,825	2,988	3,154	3,337	3,524	3,715	3,889	4,054	4,167	4,187	4,107	3,999	3,808	3,525	3,237
2030	2,819	2,627	2,489	2,387	2,332	2,359	2,417	2,543	2,696	2,842	3,002	3,163	3,342	3,528	3,722	3,900	4,071	4,193	4,220	4,145	4,036	3,848	3,572	3,287
2031	2,875	2,678	2,533	2,426	2,363	2,387	2,440	2,565	2,722	2,868	3,028	3,183	3,359	3,543	3,737	3,919	4,094	4,224	4,257	4,186	4,082	3,895	3,625	3,343
2032	2,928	2,725	2,573	2,462	2,394	2,414	2,463	2,587	2,749	2,895	3,054	3,205	3,376	3,558	3,754	3,940	4,118	4,256	4,294	4,229	4,124	3,939	3,676	3,396

Figure 131: Zone J Component of NYCA Baseline Expected Weather Summer Peak Load shape



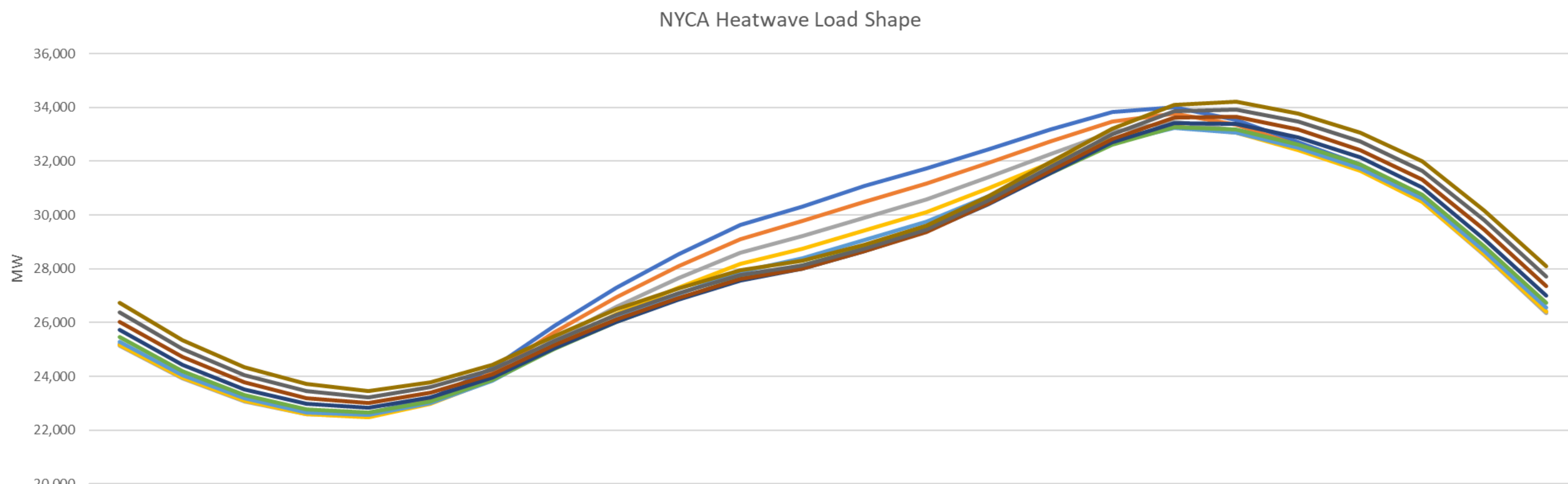
	HB0	HB1	HB2	HB3	HB4	HB5	HB6	HB7	HB8	HB9	HB10	HB11	HB12	HB13	HB14	HB15	HB16	HB17	HB18	HB19	HB20	HB21	HB22	HB23
2023	7,894	7,537	7,275	7,126	7,115	7,316	7,792	8,462	9,080	9,572	9,966	10,246	10,462	10,623	10,691	10,782	10,915	10,853	10,733	10,543	10,314	10,062	9,627	9,070
2024	7,888	7,530	7,266	7,117	7,104	7,307	7,781	8,442	9,055	9,545	9,935	10,210	10,424	10,584	10,655	10,751	10,888	10,837	10,720	10,534	10,307	10,051	9,616	9,058
2025	7,848	7,485	7,221	7,070	7,054	7,261	7,731	8,381	8,992	9,478	9,864	10,134	10,344	10,504	10,579	10,683	10,825	10,786	10,672	10,489	10,264	10,007	9,571	9,012
2026	7,856	7,490	7,224	7,071	7,052	7,259	7,726	8,365	8,972	9,456	9,836	10,101	10,306	10,467	10,547	10,657	10,806	10,778	10,671	10,494	10,268	10,008	9,574	9,015
2027	7,998	7,626	7,357	7,202	7,180	7,388	7,854	8,482	9,087	9,567	9,943	10,203	10,404	10,561	10,647	10,764	10,918	10,905	10,804	10,630	10,407	10,145	9,713	9,152
2028	8,069	7,691	7,419	7,259	7,233	7,444	7,906	8,524	9,127	9,605	9,977	10,228	10,424	10,583	10,672	10,797	10,958	10,958	10,864	10,696	10,475	10,211	9,780	9,220
2029	8,202	7,819	7,542	7,378	7,348	7,558	8,017	8,627	9,231	9,706	10,073	10,318	10,508	10,665	10,758	10,891	11,059	11,072	10,986	10,825	10,605	10,339	9,913	9,351
2030	8,371	7,978	7,694	7,525	7,486	7,699	8,156	8,760	9,366	9,840	10,206	10,444	10,627	10,779	10,877	11,016	11,190	11,218	11,140	10,984	10,767	10,501	10,079	9,518
2031	8,549	8,146	7,854	7,679	7,633	7,846	8,302	8,901	9,516	9,991	10,357	10,588	10,765	10,912	11,011	11,154	11,332	11,373	11,303	11,151	10,938	10,672	10,257	9,694
2032	8,699	8,288	7,989	7,808	7,754	7,969	8,427	9,024	9,647	10,126	10,490	10,718	10,886	11,028	11,127	11,274	11,456	11,508	11,441	11,295	11,084	10,817	10,407	9,846

Figure 132: Zone K Component of NYCA Baseline Expected Weather Summer Peak Load shape



	HB0	HB1	HB2	HB3	HB4	HB5	HB6	HB7	HB8	HB9	HB10	HB11	HB12	HB13	HB14	HB15	HB16	HB17	HB18	HB19	HB20	HB21	HB22	HB23
2023	2,880	2,669	2,518	2,427	2,406	2,451	2,556	2,818	3,131	3,447	3,779	4,091	4,352	4,548	4,696	4,831	4,947	4,951	4,887	4,711	4,513	4,253	3,869	3,476
2024	2,811	2,600	2,449	2,357	2,333	2,378	2,479	2,732	3,038	3,347	3,675	3,983	4,243	4,439	4,592	4,733	4,857	4,870	4,813	4,639	4,443	4,181	3,798	3,405
2025	2,738	2,525	2,373	2,280	2,256	2,299	2,392	2,635	2,934	3,234	3,555	3,856	4,115	4,313	4,474	4,624	4,757	4,782	4,731	4,564	4,368	4,105	3,723	3,329
2026	2,719	2,506	2,351	2,257	2,232	2,273	2,358	2,588	2,876	3,169	3,481	3,777	4,032	4,234	4,403	4,564	4,706	4,746	4,704	4,541	4,346	4,082	3,701	3,308
2027	2,792	2,575	2,420	2,325	2,298	2,336	2,415	2,633	2,912	3,197	3,501	3,790	4,044	4,245	4,423	4,594	4,748	4,801	4,768	4,610	4,416	4,151	3,773	3,380
2028	2,840	2,620	2,463	2,366	2,335	2,373	2,444	2,651	2,924	3,202	3,498	3,780	4,032	4,236	4,421	4,602	4,764	4,829	4,806	4,654	4,460	4,195	3,820	3,426
2029	2,901	2,679	2,519	2,419	2,387	2,422	2,488	2,685	2,952	3,223	3,514	3,790	4,039	4,243	4,435	4,623	4,795	4,872	4,857	4,710	4,519	4,252	3,878	3,486
2030	2,963	2,737	2,574	2,471	2,434	2,467	2,528	2,718	2,983	3,250	3,536	3,808	4,053	4,257	4,452	4,649	4,827	4,916	4,907	4,765	4,575	4,309	3,939	3,547
2031	3,025	2,793	2,626	2,520	2,477	2,508	2,564	2,750	3,016	3,281	3,564	3,829	4,071	4,274	4,473	4,675	4,860	4,958	4,956	4,818	4,629	4,365	3,999	3,609
2032	3,093	2,856	2,683	2,571	2,519	2,551	2,602	2,785	3,055	3,319	3,599	3,861	4,097	4,297	4,499	4,704	4,894	5,003	5,007	4,875	4,689	4,426	4,066	3,679

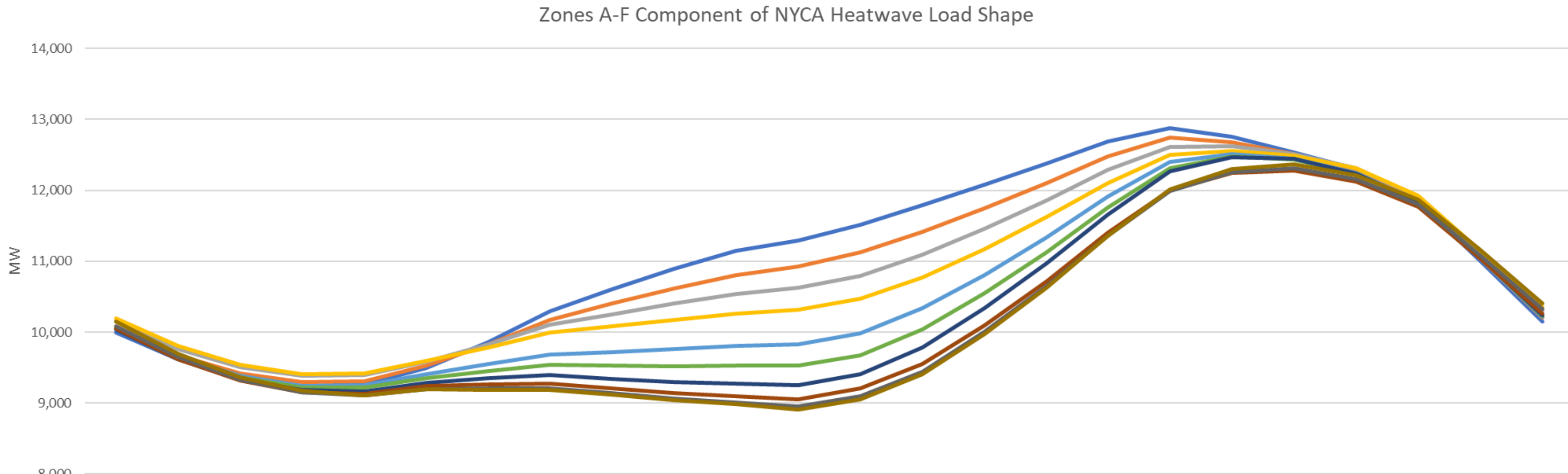
Figure 133: NYCA Heatwave Load shape



	HB0	HB1	HB2	HB3	HB4	HB5	HB6	HB7	HB8	HB9	HB10	HB11
2023	25,192	23,990	23,169	22,689	22,622	23,172	24,299	25,888	27,285	28,523	29,619	30,325
2024	25,166	23,956	23,127	22,642	22,567	23,092	24,143	25,634	26,935	28,089	29,112	29,769
2025	25,134	23,914	23,075	22,583	22,500	23,001	23,979	25,374	26,584	27,657	28,608	29,217
2026	25,175	23,942	23,091	22,588	22,493	22,968	23,874	25,182	26,312	27,311	28,196	28,758
2027	25,293	24,043	23,177	22,663	22,553	23,004	23,845	25,074	26,132	27,063	27,886	28,403
2028	25,463	24,195	23,310	22,781	22,652	23,079	23,860	25,020	26,022	26,893	27,662	28,136
2029	25,719	24,428	23,520	22,973	22,821	23,226	23,956	25,063	26,026	26,850	27,576	28,011
2030	26,035	24,714	23,776	23,202	23,018	23,400	24,089	25,165	26,119	26,916	27,613	28,015
2031	26,388	25,032	24,058	23,455	23,232	23,592	24,252	25,318	26,289	27,075	27,758	28,132
2032	26,740	25,349	24,340	23,707	23,446	23,789	24,429	25,497	26,495	27,279	27,955	28,307

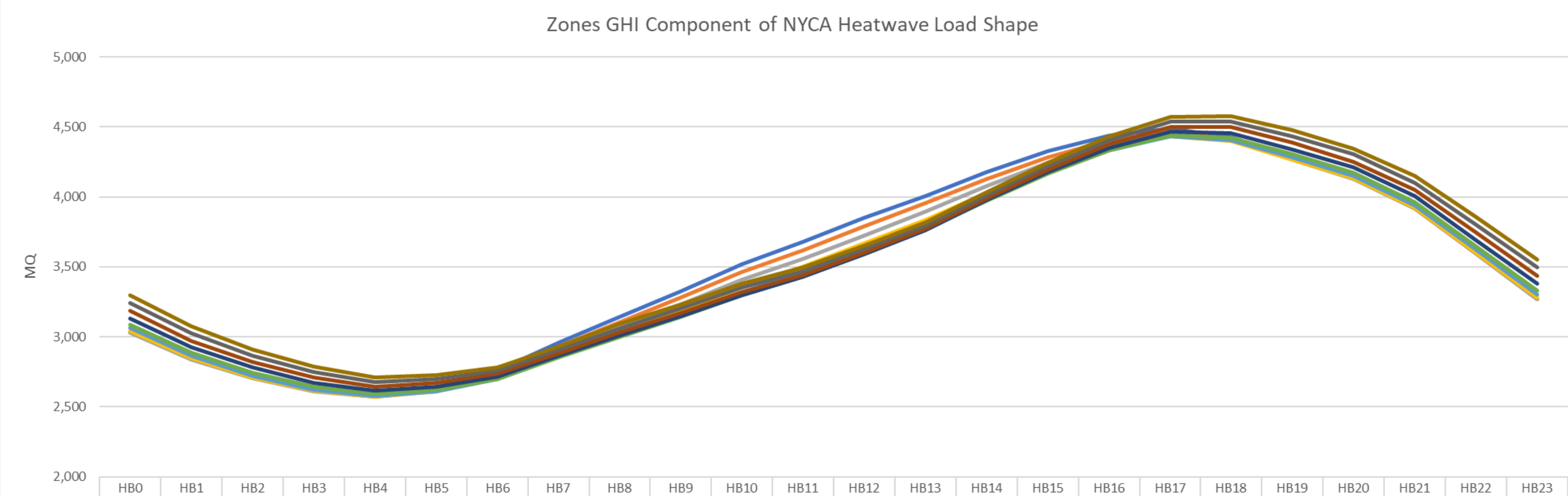
	HB12	HB13	HB14	HB15	HB16	HB17	HB18	HB19	HB20	HB21	HB22	HB23
2023	31,067	31,733	32,438	33,178	33,827	34,016	33,535	32,715	31,868	30,648	28,597	26,405
2024	30,489	31,166	31,927	32,739	33,470	33,758	33,358	32,600	31,777	30,581	28,556	26,385
2025	29,908	30,587	31,398	32,275	33,082	33,467	33,148	32,459	31,665	30,499	28,507	26,363
2026	29,427	30,115	30,978	31,924	32,809	33,288	33,048	32,417	31,645	30,503	28,538	26,414
2027	29,058	29,760	30,682	31,700	32,669	33,238	33,074	32,490	31,731	30,603	28,659	26,545
2028	28,780	29,496	30,472	31,560	32,609	33,263	33,170	32,628	31,877	30,761	28,837	26,730
2029	28,651	29,382	30,412	31,567	32,693	33,422	33,393	32,881	32,131	31,020	29,111	27,005
2030	28,642	29,375	30,441	31,643	32,828	33,621	33,649	33,167	32,422	31,324	29,441	27,344
2031	28,743	29,466	30,553	31,785	33,009	33,852	33,926	33,473	32,735	31,654	29,806	27,722
2032	28,900	29,609	30,707	31,959	33,213	34,096	34,209	33,780	33,050	31,987	30,173	28,101

Figure 134: Zones A-F Component of NYCA Heatwave Load shape



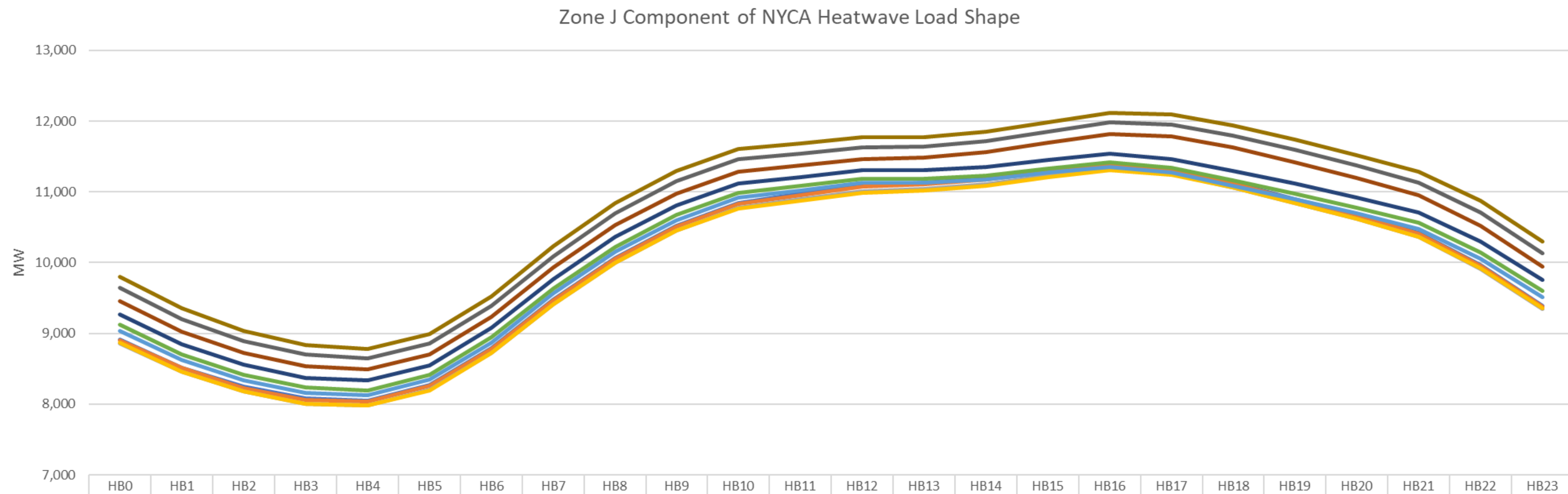
	HB0	HB1	HB2	HB3	HB4	HB5	HB6	HB7	HB8	HB9	HB10	HB11	HB12	HB13	HB14	HB15	HB16	HB17	HB18	HB19	HB20	HB21	HB22	HB23
2023	9,991	9,612	9,359	9,240	9,260	9,495	9,861	10,293	10,607	10,888	11,144	11,295	11,513	11,795	12,077	12,376	12,688	12,872	12,750	12,535	12,294	11,843	11,001	10,147
2024	10,053	9,667	9,414	9,291	9,310	9,524	9,824	10,169	10,403	10,612	10,807	10,922	11,123	11,414	11,743	12,101	12,477	12,739	12,680	12,515	12,291	11,863	11,041	10,205
2025	10,151	9,764	9,507	9,379	9,395	9,588	9,832	10,100	10,254	10,402	10,538	10,621	10,795	11,087	11,453	11,854	12,284	12,615	12,620	12,510	12,312	11,904	11,109	10,299
2026	10,196	9,802	9,541	9,410	9,420	9,596	9,787	9,989	10,080	10,170	10,261	10,310	10,473	10,772	11,171	11,618	12,101	12,497	12,554	12,485	12,307	11,918	11,144	10,348
2027	10,047	9,650	9,380	9,243	9,246	9,406	9,545	9,685	9,721	9,761	9,808	9,830	9,986	10,337	10,806	11,336	11,909	12,399	12,510	12,445	12,243	11,835	11,038	10,220
2028	10,046	9,642	9,363	9,222	9,218	9,356	9,452	9,541	9,526	9,518	9,527	9,525	9,675	10,035	10,547	11,127	11,759	12,313	12,472	12,431	12,234	11,830	11,045	10,229
2029	10,037	9,618	9,329	9,181	9,164	9,290	9,347	9,391	9,341	9,298	9,275	9,251	9,402	9,785	10,338	10,967	11,655	12,264	12,463	12,439	12,238	11,834	11,051	10,234
2030	10,047	9,618	9,315	9,155	9,126	9,235	9,260	9,275	9,208	9,143	9,098	9,055	9,203	9,554	10,093	10,713	11,398	12,005	12,241	12,277	12,123	11,763	11,034	10,264
2031	10,086	9,645	9,327	9,151	9,103	9,199	9,203	9,205	9,140	9,064	9,005	8,952	9,094	9,444	10,003	10,644	11,356	11,994	12,255	12,310	12,152	11,799	11,085	10,324
2032	10,154	9,696	9,365	9,174	9,111	9,193	9,185	9,180	9,123	9,043	8,981	8,912	9,053	9,401	9,968	10,626	11,356	12,014	12,300	12,361	12,209	11,862	11,162	10,404

Figure 135: Zones GHI Component of NYCA Heatwave Load shape



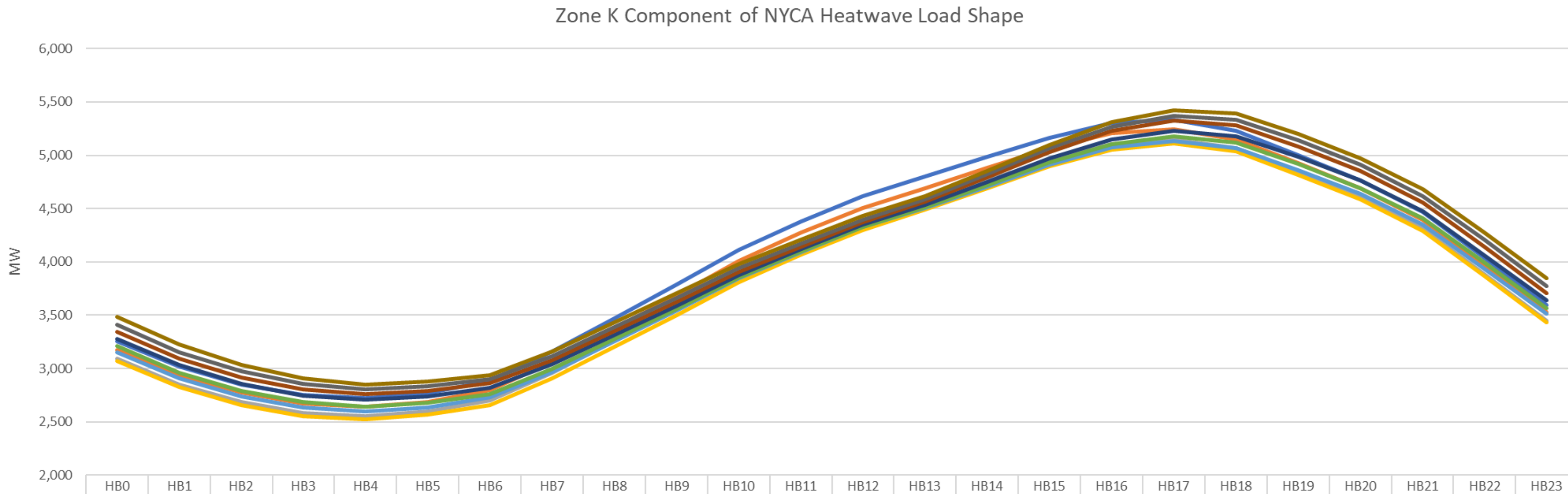
	HB0	HB1	HB2	HB3	HB4	HB5	HB6	HB7	HB8	HB9	HB10	HB11	HB12	HB13	HB14	HB15	HB16	HB17	HB18	HB19	HB20	HB21	HB22	HB23
2023	3,032	2,843	2,714	2,620	2,585	2,637	2,759	2,958	3,140	3,324	3,518	3,679	3,849	4,009	4,180	4,326	4,437	4,489	4,425	4,276	4,137	3,922	3,594	3,269
2024	3,032	2,841	2,708	2,615	2,578	2,625	2,739	2,929	3,102	3,279	3,465	3,621	3,789	3,954	4,131	4,285	4,406	4,468	4,413	4,270	4,133	3,919	3,594	3,269
2025	3,031	2,839	2,703	2,611	2,570	2,614	2,720	2,898	3,062	3,229	3,408	3,557	3,726	3,893	4,077	4,242	4,374	4,449	4,404	4,265	4,128	3,918	3,595	3,271
2026	3,044	2,848	2,711	2,614	2,571	2,610	2,706	2,873	3,029	3,185	3,355	3,500	3,667	3,834	4,027	4,204	4,348	4,435	4,400	4,269	4,134	3,924	3,603	3,282
2027	3,062	2,862	2,723	2,623	2,578	2,612	2,699	2,859	3,006	3,156	3,317	3,457	3,621	3,792	3,993	4,178	4,333	4,432	4,407	4,281	4,148	3,938	3,622	3,303
2028	3,089	2,887	2,744	2,641	2,591	2,623	2,701	2,851	2,995	3,140	3,296	3,430	3,594	3,766	3,975	4,167	4,333	4,440	4,423	4,304	4,171	3,964	3,648	3,332
2029	3,131	2,926	2,780	2,672	2,616	2,645	2,716	2,863	3,007	3,147	3,299	3,428	3,592	3,762	3,976	4,177	4,349	4,466	4,458	4,341	4,210	4,004	3,693	3,378
2030	3,184	2,972	2,822	2,708	2,644	2,668	2,736	2,882	3,030	3,170	3,320	3,443	3,604	3,774	3,992	4,197	4,377	4,502	4,501	4,387	4,253	4,052	3,746	3,433
2031	3,244	3,026	2,867	2,748	2,677	2,697	2,760	2,908	3,060	3,201	3,351	3,469	3,628	3,796	4,013	4,222	4,405	4,537	4,541	4,431	4,304	4,102	3,804	3,494
2032	3,299	3,076	2,909	2,787	2,709	2,724	2,783	2,932	3,091	3,231	3,380	3,495	3,650	3,816	4,035	4,246	4,433	4,570	4,580	4,477	4,346	4,151	3,859	3,552

Figure 136: Zone J Component of NYCA Heatwave Load shape



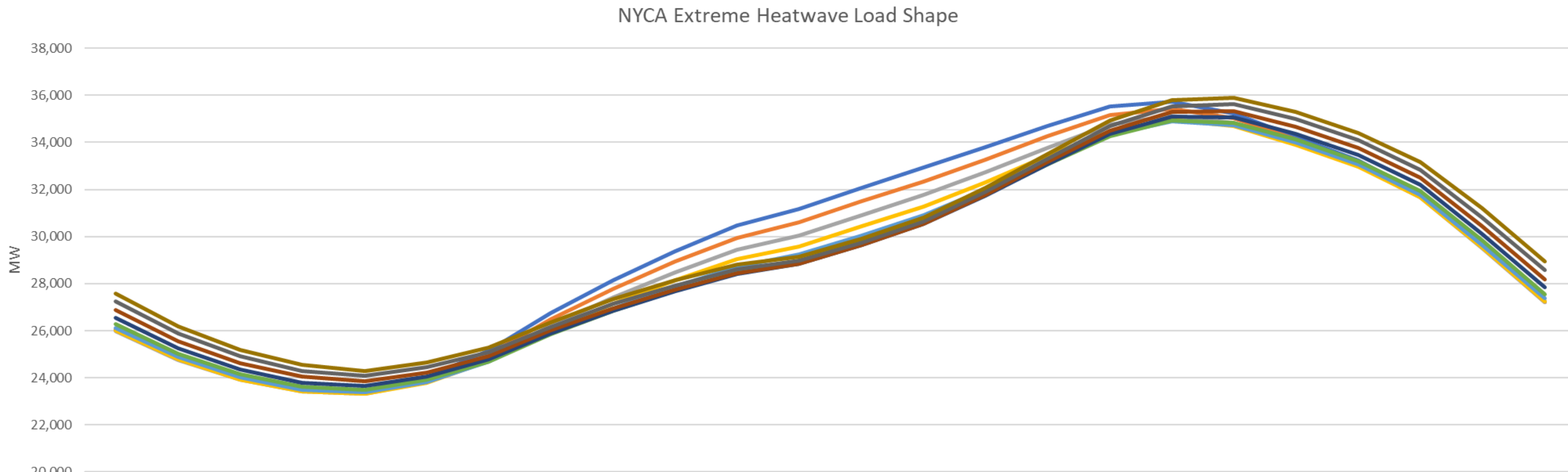
	HB0	HB1	HB2	HB3	HB4	HB5	HB6	HB7	HB8	HB9	HB10	HB11	HB12	HB13	HB14	HB15	HB16	HB17	HB18	HB19	HB20	HB21	HB22	HB23
2023	8,916	8,518	8,243	8,078	8,054	8,270	8,794	9,480	10,067	10,522	10,845	10,971	11,091	11,132	11,198	11,310	11,402	11,324	11,128	10,902	10,671	10,417	9,966	9,390
2024	8,907	8,510	8,231	8,065	8,039	8,256	8,782	9,471	10,056	10,512	10,833	10,953	11,071	11,108	11,174	11,288	11,381	11,308	11,114	10,891	10,662	10,408	9,958	9,384
2025	8,861	8,458	8,178	8,010	7,982	8,202	8,727	9,416	10,004	10,458	10,778	10,894	11,008	11,042	11,108	11,226	11,322	11,254	11,061	10,841	10,615	10,364	9,916	9,342
2026	8,866	8,461	8,178	8,008	7,977	8,196	8,720	9,409	9,998	10,453	10,769	10,880	10,988	11,021	11,089	11,209	11,309	11,246	11,060	10,845	10,618	10,370	9,925	9,352
2027	9,031	8,620	8,333	8,162	8,128	8,347	8,873	9,562	10,152	10,603	10,917	11,022	11,126	11,127	11,176	11,274	11,354	11,273	11,091	10,902	10,700	10,479	10,060	9,510
2028	9,119	8,702	8,411	8,234	8,197	8,417	8,943	9,632	10,225	10,676	10,987	11,084	11,185	11,185	11,230	11,332	11,414	11,336	11,160	10,976	10,779	10,561	10,148	9,601
2029	9,272	8,851	8,554	8,374	8,334	8,551	9,076	9,769	10,364	10,814	11,122	11,213	11,310	11,304	11,349	11,453	11,539	11,463	11,293	11,117	10,921	10,708	10,303	9,756
2030	9,457	9,027	8,721	8,536	8,488	8,707	9,232	9,928	10,528	10,977	11,285	11,371	11,463	11,482	11,561	11,700	11,823	11,786	11,624	11,419	11,194	10,952	10,520	9,942
2031	9,645	9,205	8,891	8,701	8,646	8,863	9,389	10,088	10,698	11,149	11,459	11,538	11,625	11,637	11,715	11,854	11,980	11,948	11,794	11,593	11,370	11,135	10,710	10,132
2032	9,802	9,354	9,033	8,836	8,775	8,993	9,521	10,228	10,846	11,301	11,611	11,689	11,768	11,773	11,849	11,988	12,116	12,090	11,938	11,742	11,523	11,290	10,873	10,297

Figure 137: Zone K Component of NYCA Heatwave Load shape



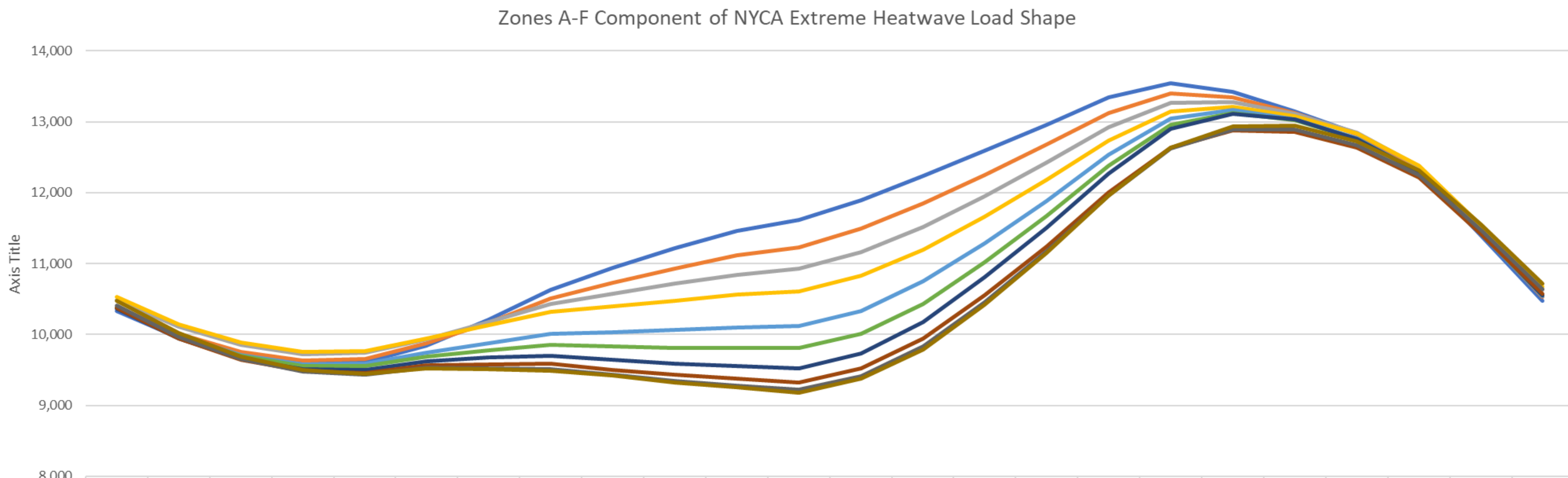
	HB0	HB1	HB2	HB3	HB4	HB5	HB6	HB7	HB8	HB9	HB10	HB11	HB12	HB13	HB14	HB15	HB16	HB17	HB18	HB19	HB20	HB21	HB22	HB23
2023	3,253	3,017	2,853	2,751	2,723	2,770	2,885	3,157	3,471	3,789	4,112	4,380	4,614	4,797	4,983	5,166	5,300	5,331	5,232	5,002	4,766	4,466	4,036	3,599
2024	3,174	2,938	2,774	2,671	2,640	2,687	2,798	3,065	3,374	3,686	4,007	4,273	4,506	4,690	4,879	5,065	5,206	5,243	5,151	4,924	4,691	4,391	3,963	3,527
2025	3,091	2,853	2,687	2,583	2,553	2,597	2,700	2,960	3,264	3,568	3,884	4,145	4,379	4,565	4,760	4,953	5,102	5,149	5,063	4,843	4,610	4,313	3,887	3,451
2026	3,069	2,831	2,661	2,556	2,525	2,566	2,661	2,911	3,205	3,503	3,811	4,068	4,299	4,488	4,691	4,893	5,051	5,110	5,034	4,818	4,586	4,291	3,866	3,432
2027	3,153	2,911	2,741	2,635	2,601	2,639	2,728	2,968	3,253	3,543	3,844	4,094	4,325	4,504	4,707	4,912	5,073	5,134	5,066	4,862	4,640	4,351	3,939	3,512
2028	3,209	2,964	2,792	2,684	2,646	2,683	2,764	2,996	3,276	3,559	3,852	4,097	4,326	4,510	4,720	4,934	5,103	5,174	5,115	4,917	4,693	4,406	3,996	3,568
2029	3,279	3,033	2,857	2,746	2,707	2,740	2,817	3,040	3,314	3,591	3,880	4,119	4,347	4,531	4,749	4,970	5,150	5,229	5,179	4,984	4,762	4,474	4,064	3,637
2030	3,347	3,097	2,918	2,803	2,760	2,790	2,861	3,080	3,353	3,626	3,910	4,146	4,372	4,565	4,795	5,033	5,230	5,328	5,283	5,084	4,852	4,557	4,141	3,705
2031	3,413	3,156	2,973	2,855	2,806	2,833	2,900	3,117	3,391	3,661	3,943	4,173	4,396	4,589	4,822	5,065	5,268	5,373	5,336	5,139	4,909	4,618	4,207	3,772
2032	3,485	3,223	3,033	2,910	2,851	2,879	2,940	3,157	3,435	3,704	3,983	4,211	4,429	4,619	4,855	5,099	5,308	5,422	5,391	5,200	4,972	4,684	4,279	3,848

Figure 138: NYCA Extreme Heatwave Load shape



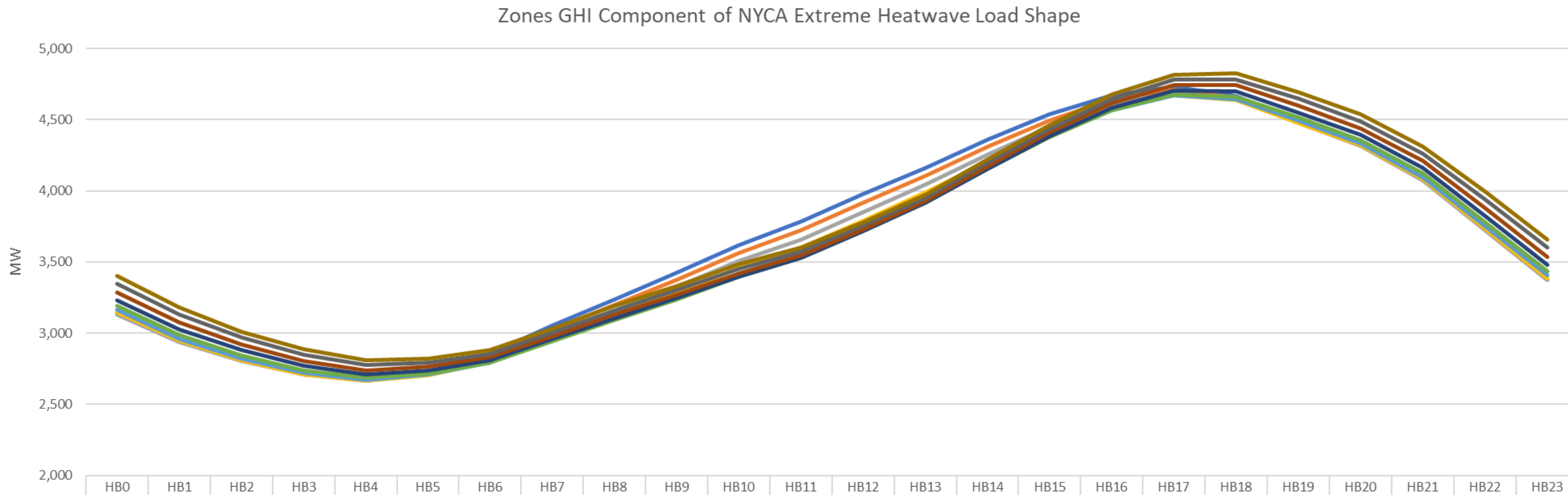
	HB0	HB1	HB2	HB3	HB4	HB5	HB6	HB7	HB8	HB9	HB10	HB11	HB12	HB13	HB14	HB15	HB16	HB17	HB18	HB19	HB20	HB21	HB22	HB23
2023	26,041	24,839	24,018	23,538	23,471	24,021	25,148	26,737	28,134	29,372	30,468	31,174	32,085	32,921	33,795	34,705	35,524	35,713	35,232	34,242	33,225	31,836	29,615	27,254
2024	26,009	24,799	23,970	23,485	23,410	23,935	24,986	26,477	27,778	28,932	29,955	30,612	31,500	32,346	33,275	34,256	35,155	35,443	35,043	34,117	33,125	31,761	29,567	27,228
2025	25,970	24,750	23,911	23,419	23,336	23,837	24,815	26,210	27,420	28,493	29,444	30,053	30,911	31,757	32,734	33,779	34,753	35,138	34,819	33,963	33,001	31,669	29,510	27,199
2026	26,007	24,774	23,923	23,420	23,325	23,800	24,706	26,014	27,144	28,143	29,028	29,590	30,425	31,279	32,309	33,420	34,472	34,951	34,711	33,913	32,976	31,667	29,536	27,246
2027	26,122	24,872	24,006	23,492	23,382	23,833	24,674	25,903	26,961	27,892	28,715	29,232	30,053	30,921	32,009	33,193	34,328	34,897	34,733	33,983	33,058	31,764	29,654	27,374
2028	26,292	25,024	24,139	23,610	23,481	23,908	24,689	25,849	26,851	27,722	28,491	28,965	29,775	30,657	31,799	33,052	34,267	34,921	34,828	34,120	33,204	31,922	29,832	27,559
2029	26,552	25,261	24,353	23,806	23,654	24,059	24,789	25,896	26,859	27,683	28,409	28,844	29,650	30,548	31,745	33,066	34,359	35,088	35,059	34,380	33,464	32,186	30,110	27,838
2030	26,873	25,552	24,614	24,040	23,856	24,238	24,927	26,003	26,957	27,754	28,451	28,853	29,648	30,549	31,782	33,153	34,505	35,298	35,326	34,677	33,763	32,498	30,447	28,182
2031	27,234	25,878	24,904	24,301	24,078	24,438	25,098	26,164	27,135	27,921	28,604	28,978	29,758	30,650	31,905	33,307	34,700	35,543	35,617	34,995	34,087	32,838	30,821	28,568
2032	27,591	26,200	25,191	24,558	24,297	24,640	25,280	26,348	27,346	28,130	28,806	29,158	29,921	30,800	32,067	33,490	34,914	35,797	35,910	35,311	34,410	33,178	31,194	28,952

Figure 139: Zones A-F Component of NYCA Extreme Heatwave Load shape



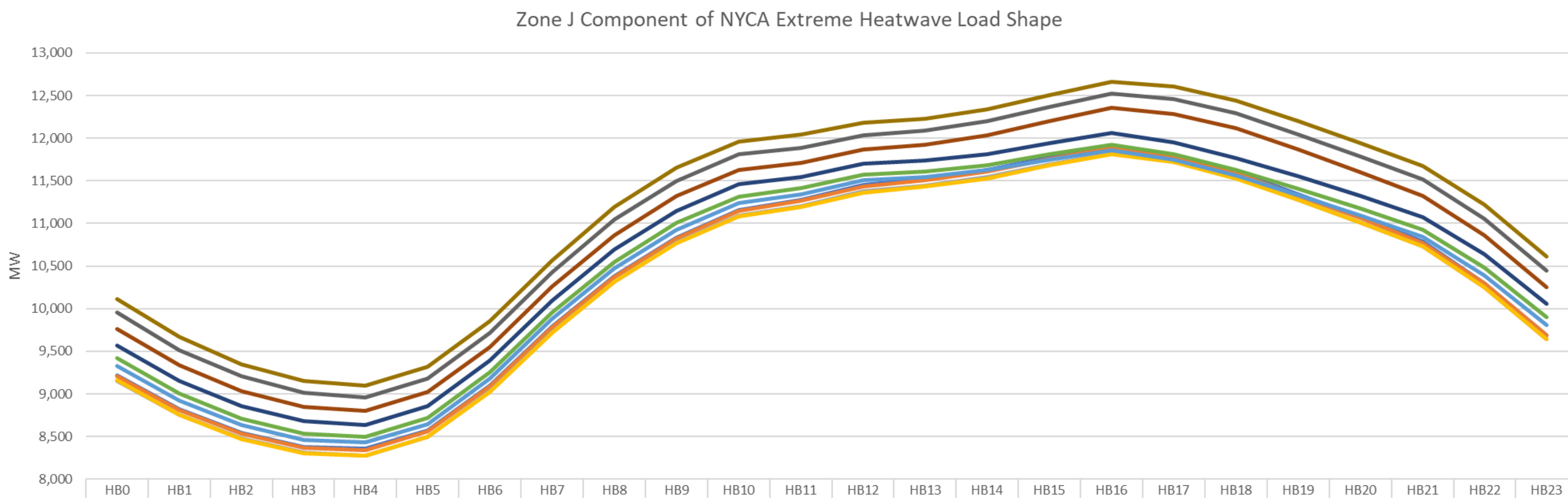
	HB0	HB1	HB2	HB3	HB4	HB5	HB6	HB7	HB8	HB9	HB10	HB11	HB12	HB13	HB14	HB15	HB16	HB17	HB18	HB19	HB20	HB21	HB22	HB23
2023	10,328	9,953	9,702	9,585	9,607	9,843	10,206	10,630	10,937	11,212	11,463	11,611	11,890	12,240	12,593	12,961	13,346	13,541	13,421	13,142	12,833	12,313	11,397	10,474
2024	10,389	10,007	9,757	9,638	9,657	9,872	10,168	10,504	10,728	10,930	11,120	11,231	11,491	11,852	12,250	12,678	13,128	13,402	13,348	13,119	12,830	12,332	11,438	10,530
2025	10,488	10,105	9,851	9,726	9,744	9,937	10,175	10,432	10,576	10,717	10,845	10,924	11,157	11,518	11,951	12,422	12,925	13,272	13,283	13,111	12,847	12,372	11,506	10,626
2026	10,533	10,143	9,885	9,757	9,769	9,944	10,128	10,320	10,399	10,479	10,563	10,608	10,828	11,193	11,662	12,179	12,737	13,149	13,213	13,084	12,841	12,385	11,539	10,674
2027	10,377	9,983	9,715	9,581	9,586	9,745	9,877	10,005	10,029	10,060	10,099	10,116	10,328	10,747	11,284	11,887	12,536	13,045	13,165	13,039	12,773	12,295	11,428	10,539
2028	10,372	9,971	9,696	9,557	9,555	9,692	9,780	9,857	9,829	9,811	9,812	9,806	10,009	10,436	11,018	11,669	12,377	12,953	13,120	13,021	12,760	12,288	11,432	10,547
2029	10,361	9,946	9,659	9,515	9,498	9,623	9,672	9,703	9,639	9,586	9,555	9,527	9,730	10,179	10,803	11,505	12,271	12,902	13,112	13,030	12,763	12,290	11,437	10,550
2030	10,370	9,944	9,643	9,486	9,459	9,565	9,582	9,584	9,503	9,428	9,374	9,326	9,526	9,941	10,549	11,241	12,004	12,632	12,879	12,860	12,641	12,216	11,416	10,578
2031	10,410	9,970	9,655	9,481	9,435	9,529	9,525	9,513	9,434	9,347	9,280	9,222	9,415	9,829	10,457	11,172	11,961	12,622	12,894	12,893	12,673	12,252	11,468	10,639
2032	10,477	10,021	9,692	9,504	9,442	9,522	9,506	9,487	9,417	9,324	9,254	9,180	9,374	9,785	10,421	11,151	11,959	12,640	12,939	12,943	12,727	12,315	11,545	10,720

Figure 140: Zones GHI Component of NYCA Extreme Heatwave Load shape



	HB0	HB1	HB2	HB3	HB4	HB5	HB6	HB7	HB8	HB9	HB10	HB11	HB12	HB13	HB14	HB15	HB16	HB17	HB18	HB19	HB20	HB21	HB22	HB23
2023	3,135	2,943	2,813	2,719	2,682	2,733	2,856	3,055	3,238	3,423	3,619	3,782	3,976	4,164	4,362	4,536	4,673	4,730	4,666	4,489	4,325	4,081	3,727	3,374
2024	3,133	2,941	2,807	2,711	2,675	2,720	2,835	3,025	3,199	3,377	3,565	3,724	3,915	4,107	4,313	4,494	4,641	4,708	4,653	4,483	4,318	4,078	3,724	3,374
2025	3,132	2,938	2,801	2,707	2,665	2,709	2,815	2,994	3,158	3,326	3,508	3,659	3,851	4,044	4,257	4,451	4,610	4,689	4,643	4,477	4,314	4,074	3,723	3,374
2026	3,145	2,947	2,809	2,710	2,666	2,704	2,800	2,967	3,124	3,283	3,455	3,601	3,791	3,987	4,208	4,411	4,581	4,674	4,640	4,479	4,320	4,082	3,733	3,386
2027	3,162	2,961	2,821	2,720	2,672	2,707	2,793	2,954	3,102	3,252	3,417	3,558	3,745	3,942	4,173	4,386	4,567	4,671	4,645	4,492	4,333	4,095	3,750	3,406
2028	3,190	2,987	2,842	2,737	2,686	2,716	2,795	2,945	3,091	3,237	3,395	3,531	3,718	3,918	4,155	4,375	4,567	4,679	4,663	4,515	4,356	4,121	3,778	3,435
2029	3,233	3,026	2,879	2,769	2,712	2,739	2,810	2,959	3,103	3,246	3,399	3,529	3,716	3,915	4,156	4,385	4,584	4,706	4,697	4,552	4,395	4,162	3,823	3,482
2030	3,287	3,073	2,921	2,805	2,740	2,764	2,831	2,978	3,128	3,269	3,420	3,546	3,732	3,929	4,175	4,409	4,615	4,745	4,743	4,602	4,441	4,210	3,878	3,538
2031	3,348	3,129	2,968	2,848	2,774	2,793	2,855	3,004	3,159	3,300	3,453	3,573	3,755	3,953	4,198	4,434	4,644	4,780	4,785	4,647	4,491	4,263	3,938	3,601
2032	3,404	3,179	3,011	2,886	2,808	2,822	2,879	3,030	3,190	3,332	3,483	3,601	3,778	3,972	4,221	4,459	4,675	4,816	4,825	4,694	4,536	4,313	3,993	3,659

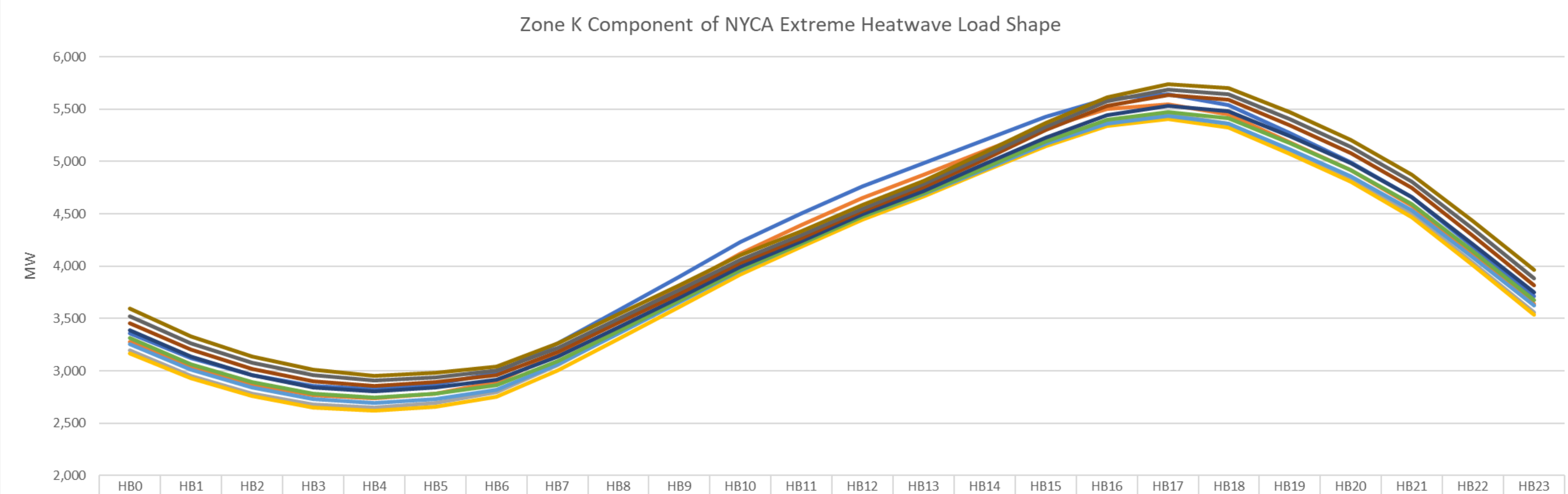
Figure 141: Zone J Component of NYCA Extreme Heatwave Load shape



	HB0	HB1	HB2	HB3	HB4	HB5	HB6	HB7	HB8	HB9	HB10	HB11
2023	9,216	8,820	8,545	8,380	8,356	8,573	9,101	9,791	10,380	10,835	11,156	11,278
2024	9,206	8,809	8,531	8,366	8,339	8,558	9,088	9,782	10,371	10,828	11,147	11,263
2025	9,156	8,754	8,474	8,307	8,279	8,500	9,031	9,726	10,319	10,774	11,093	11,206
2026	9,159	8,755	8,472	8,303	8,272	8,493	9,024	9,720	10,315	10,771	11,086	11,195
2027	9,327	8,917	8,631	8,460	8,427	8,647	9,181	9,878	10,474	10,928	11,241	11,344
2028	9,416	9,000	8,710	8,534	8,497	8,720	9,253	9,952	10,551	11,005	11,316	11,411
2029	9,572	9,153	8,857	8,677	8,638	8,858	9,392	10,093	10,696	11,149	11,458	11,547
2030	9,761	9,333	9,029	8,845	8,797	9,019	9,553	10,258	10,865	11,319	11,628	11,711
2031	9,954	9,516	9,204	9,014	8,961	9,181	9,717	10,426	11,042	11,498	11,808	11,885
2032	10,114	9,668	9,348	9,154	9,093	9,314	9,853	10,569	11,194	11,654	11,964	12,040

	HB12	HB13	HB14	HB15	HB16	HB17	HB18	HB19	HB20	HB21	HB22	HB23
2023	11,454	11,530	11,631	11,778	11,905	11,802	11,605	11,341	11,072	10,785	10,302	9,692
2024	11,438	11,511	11,610	11,758	11,884	11,785	11,588	11,327	11,061	10,773	10,293	9,684
2025	11,377	11,447	11,546	11,696	11,824	11,729	11,532	11,273	11,009	10,727	10,248	9,639
2026	11,361	11,429	11,530	11,682	11,814	11,721	11,530	11,276	11,011	10,729	10,254	9,646
2027	11,507	11,544	11,624	11,752	11,861	11,749	11,561	11,332	11,093	10,840	10,392	9,807
2028	11,572	11,607	11,683	11,815	11,925	11,814	11,630	11,407	11,173	10,923	10,480	9,899
2029	11,705	11,734	11,811	11,945	12,058	11,947	11,770	11,553	11,321	11,074	10,638	10,057
2030	11,865	11,922	12,034	12,204	12,355	12,284	12,114	11,866	11,602	11,326	10,861	10,247
2031	12,036	12,086	12,197	12,367	12,522	12,456	12,292	12,047	11,785	11,515	11,056	10,441
2032	12,184	12,229	12,337	12,509	12,665	12,603	12,442	12,202	11,942	11,673	11,222	10,609

Figure 142: Zone K Component of NYCA Extreme Heatwave Load shape



	HB0	HB1	HB2	HB3	HB4	HB5	HB6	HB7	HB8	HB9	HB10	HB11	HB12	HB13	HB14	HB15	HB16	HB17	HB18	HB19	HB20	HB21	HB22	HB23
2023	3,362	3,123	2,958	2,854	2,826	2,872	2,985	3,261	3,579	3,902	4,230	4,503	4,765	4,987	5,209	5,430	5,600	5,640	5,540	5,270	4,995	4,657	4,189	3,714
2024	3,281	3,042	2,875	2,770	2,739	2,785	2,895	3,166	3,480	3,797	4,123	4,394	4,656	4,876	5,102	5,326	5,502	5,548	5,454	5,188	4,916	4,578	4,112	3,640
2025	3,194	2,953	2,785	2,679	2,648	2,691	2,794	3,058	3,367	3,676	3,998	4,264	4,526	4,748	4,980	5,210	5,394	5,448	5,361	5,102	4,831	4,496	4,033	3,560
2026	3,170	2,929	2,757	2,650	2,618	2,659	2,754	3,007	3,306	3,610	3,924	4,186	4,445	4,670	4,909	5,148	5,340	5,407	5,328	5,074	4,804	4,471	4,010	3,540
2027	3,256	3,011	2,839	2,731	2,697	2,734	2,823	3,066	3,356	3,652	3,958	4,214	4,473	4,688	4,928	5,168	5,364	5,432	5,362	5,120	4,859	4,534	4,084	3,622
2028	3,314	3,066	2,891	2,782	2,743	2,780	2,861	3,095	3,380	3,669	3,968	4,217	4,476	4,696	4,943	5,193	5,398	5,475	5,415	5,177	4,915	4,590	4,142	3,678
2029	3,386	3,136	2,958	2,845	2,806	2,839	2,915	3,141	3,421	3,702	3,997	4,241	4,499	4,720	4,975	5,231	5,446	5,533	5,480	5,245	4,985	4,660	4,212	3,749
2030	3,455	3,202	3,021	2,904	2,860	2,890	2,961	3,183	3,461	3,738	4,029	4,270	4,525	4,757	5,024	5,299	5,531	5,637	5,590	5,349	5,079	4,746	4,292	3,819
2031	3,522	3,263	3,077	2,958	2,908	2,935	3,001	3,221	3,500	3,776	4,063	4,298	4,552	4,782	5,053	5,334	5,573	5,685	5,646	5,408	5,138	4,808	4,359	3,887
2032	3,596	3,332	3,140	3,014	2,954	2,982	3,042	3,262	3,545	3,820	4,105	4,337	4,585	4,814	5,088	5,371	5,615	5,738	5,704	5,472	5,205	4,877	4,434	3,964

Appendix G - Historic Congestion

Appendix A of Attachment Y of the OATT states:

> As part of its CSPP, the ISO will prepare summaries and detailed analysis of historic and projected congestion across the NYS Transmission System. This will include analysis to identify the significant causes of historic congestion in an effort to help market participants and other interested parties distinguish persistent and addressable congestion from congestion that results from onetime events or transient adjustments in operating procedures that may or may not recur. This information will assist market participants and other stakeholders to make appropriately informed decisions.

The historic congestion information can be found on the NYISO website:

https://www.nyiso.com/ny-power-system-information-outlook (Congested Elements Reports)

Also, information on the NYISO's Economic Planning Studies can be found here:

https://www.nyiso.com/library (Planning Reports, Economic Planning Studies)

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