New York ISO
Independent System Operator

2022 Reliability Needs Assessment (RNA)

A Report from the New York Independent System Operator

Draft Report Excerpts
September 19, 2022 TPAS/ESPWG

Base Case Reliability Assessments

Overview

This section provides the methodology and results for the resource adequacy and transmission security of the New York BPTF over the RNA Study Period. If any reliability criteria violations are identified, the NYISO identifies Reliability Needs. Violations of the criteria are translated into MW or MVAr amounts to provide a relative quantification of the Reliability Needs, and to support the development of solutions in the CRP. Enhancements to the application of the reliability criteria were added to the 2022 RNA and are noted below.

Methodology for the Determination of Needs

The OATT defines Reliability Needs in terms of total deficiencies relative to reliability criteria determined from the assessments of the BPTF performed in the RNA. The BPTF include all of the facilities designated by the NYISO as a Bulk Power System (BPS) element as defined by the NYSRC and NPCC, as well as other transmission facilities that are relevant to planning the New York State Transmission System. There are two steps to analyzing the reliability of the BPTF. The first is to evaluate the security of the transmission system. The second is to evaluate the resource and transmission adequacy of the system, subject to the security constraints.

For this 2022 RNA, enhancements to the application of reliability rules were employed for both transmission security and resources adequacy:

- For transmission security, to represent that not all generation would be available at any given time, a derating factor is applied to thermal units. Additionally, intermittent, weather dependent generation is dispatched according to their expected availability coincident with the represented system condition. The enhancements also include the ability to identify BPTF reliability needs for instances where the transmission security margin for a constrained area of the system is less than zero MW.
- For resource adequacy, to ensure that some level of operating reserves is maintained, the Emergency Operating Procedure (EOP) step will retain 350 MW of operating reserves at the time of a load shedding event.

Transmission Security

Transmission security is the ability of the power system to withstand disturbances, such as electric short circuits or unanticipated loss of system elements, and continue to supply and deliver electricity. The analysis for the transmission security assessment is conducted in accordance with NERC Reliability Standards, NPCC Transmission Design Criteria, and the NYSRC Reliability Rules. Transmission security is assessed deterministically with potential disturbances being applied without concern for the likelihood of the disturbance in the assessment. These disturbances (single-element and multiple-element contingencies) are categorized as the design criteria contingencies, which are explicitly defined in the reliability criteria. The impacts resulting from applying these design criteria contingencies are assessed to determine whether thermal loading, voltage, or stability violations will occur. In addition, the NYISO performs a short circuit analysis to determine if the system can clear faulted facilities reliably under short circuit conditions. The NYISO's "Guideline for Fault Current Assessment"[11] describes the methodology for that analysis.

Contingency analysis is performed on the BPTF to evaluate thermal and voltage performance under design contingency conditions using the Siemens PTI PSS®E and PowerGEM TARA programs. Generation is dispatched to match load plus system losses, while respecting transmission security. Scheduled inter-area transfers modeled in the base case between the NYCA and neighboring systems are held constant.

Transmission security analysis includes the assessment of various combinations of credible system conditions intended to stress the system. As transmission security analysis is deterministic, these various credible combinations of system conditions are evaluated throughout the study period to identify Reliability Needs.[12] Intermittent generation is represented based on expected output during the modeled system conditions.[13]

Transmission security margins included in this assessment is to identify plausible changes in conditions or assumptions that might adversely impact the reliability of the 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 derates (total resources). This assessment is performed using a deterministic approach through a spreadsheet-based method using the RNA study assumptions. For the purposes of identifying Reliability Needs on the BPTF using transmission security margin calculations, thermal generation MW capability is considered available based on NERC five-year class averages for the relevant type of units.[14] The derates for thermal generation are included due to the aging fleet without expected replacement, while the share of intermittent, weather dependent, generation is growing. Figure

[11] Attachment I of Transmission, Expansion and Interconnection Manual.

[12]fir

[13] The RNA assumptions matrix is posted under the July 1, 2022 TPAS/ESPWG meeting materials, which is available at here, and also in **Appendix D**.

[14] The NERC five-year class average EFORd data is available here.

27 shows the NERC five-year class-average outate rate for combined cycle, gas turbine, fossil steam turbine, and jet engine generators. Figure 28 shows the impact of the thermal derates on the total resources available statewide, as well as the Lower Hudson Valley, New York City, and Long Island localities. Reductions in thermal derates over time are driven by the assumed generator deactivations in this assessment.

Figure 27: NERC Five-Year Class Average Outage Rate

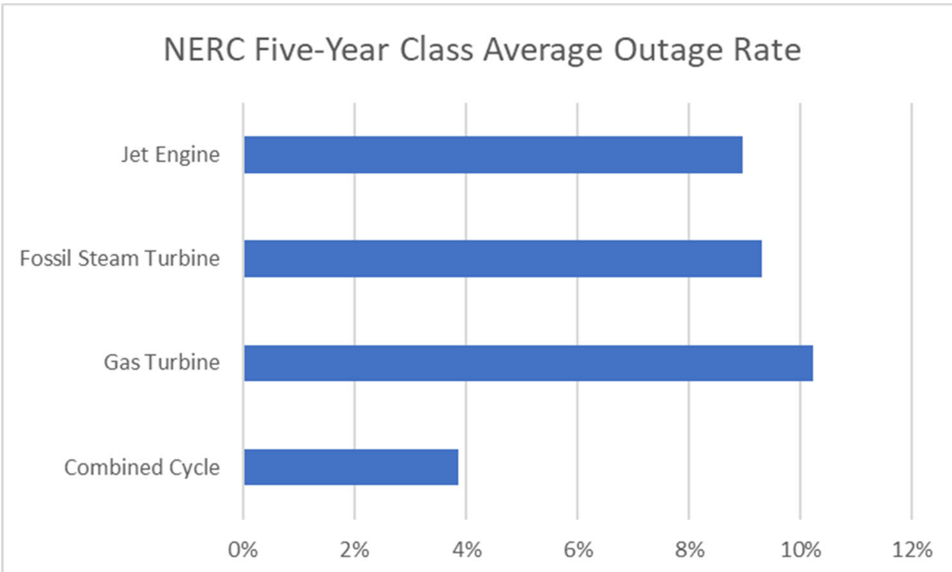
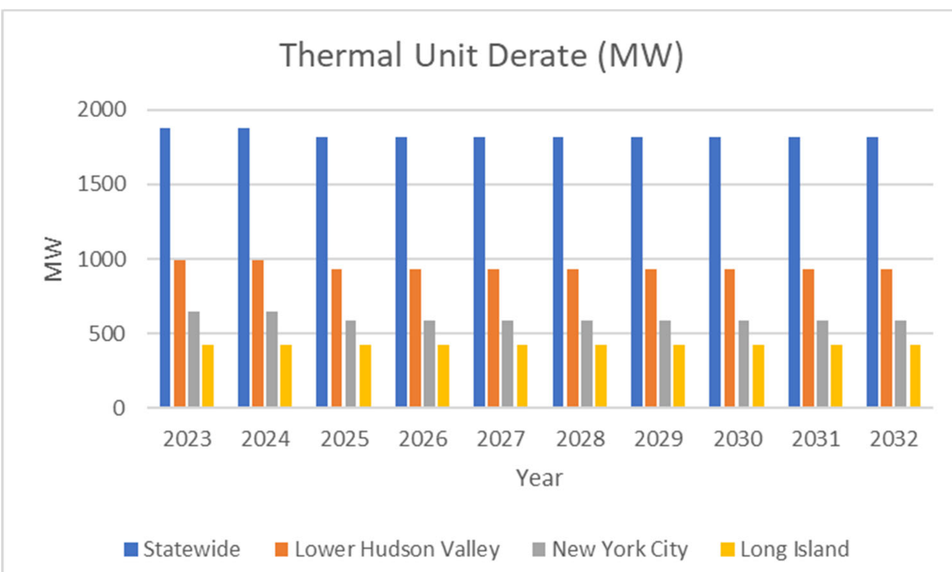


Figure 28: Thermal Unit Derate (MW) for New York



For the transmission security margin assessment, margins 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 reliability need is identified when the margin is less than zero under baseline expected weather, normal transfer criteria conditions. Additional details regarding the impact of heatwaves, cold snaps, and other system conditions are provided in **Appendix E** for informational purposes.

Resource Adequacy

Resource adequacy is the ability of the electric system to supply the aggregate electrical demand and energy requirements of the firm load at all times, taking into account scheduled and reasonably expected unscheduled outages of system elements. Resource adequacy considers the transmission systems, generation resources, and other capacity resources, such as demand response. The NYISO performs resource adequacy assessments on a probabilistic basis to capture the random nature of system element outages. If a system has sufficient transmission and generation, the probability of an unplanned disconnection of firm load 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 to meet an LOLE that, at any given point in time, is less than or equal to an involuntary firm load disconnection that is not more frequent than once in every 10 years, or 0.1 events per year. This requirement forms the basis of New York's Installed Reserve Margin (IRM) requirement and is analyzed on a statewide basis.

If Reliability Needs are identified, the RNA identifies various amounts and locations of compensatory MW required for the NYCA to address those needs to translate the criteria violations to understandable MW quantities. The analysis determines the compensatory MW amounts by adding generic capacity resources to NYISO zones to effectively satisfy the needs. The compensatory MW amounts and locations are based on a review of binding transmission constraints and zonal LOLE determinations in an iterative process to determine various combinations that will result in reliability criteria being met. These additions are used to estimate the amount of resources generally needed to satisfy the identified Reliability Needs. The compensatory MW additions are not intended to represent specific proposed solutions. Resource needs could potentially be met by other combinations of resources in other areas including generation, transmission and demand response measures.

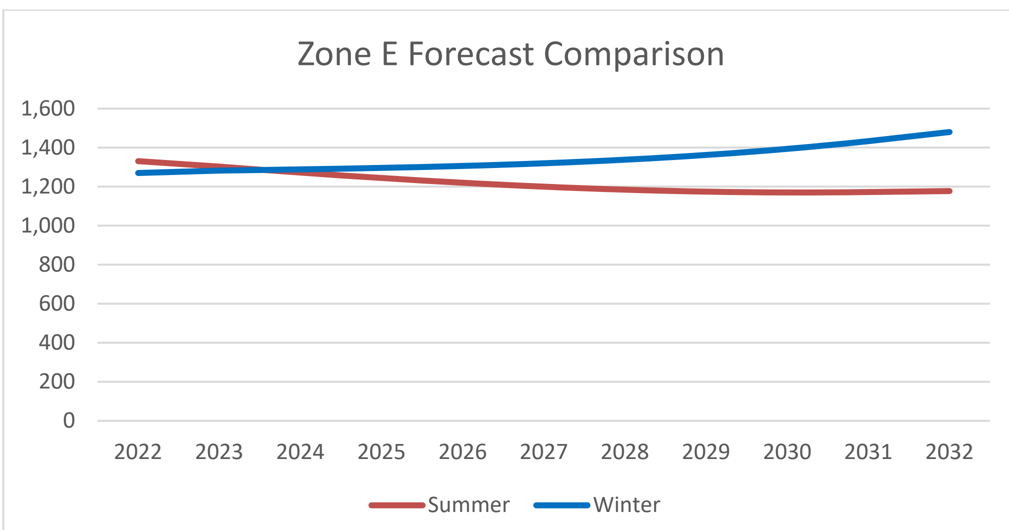
Due to the different types of supply and demand-side resources, and also due to transmission constraints, the amounts and locations of resources necessary to match the level of compensatory MW needs identified will vary. Reliability Needs could be met in part by transmission system reconfigurations that increase transfer limits, or by changes in operating protocols. Operating protocols could include such actions as using dynamic ratings for certain facilities, invoking operating exceptions, or establishing special protection systems.

The procedure to quantify compensatory MW for BPTF transmission security violations is a separate process from calculating compensatory MW for resource adequacy violations. This quantification is performed by first calculating transfer distribution factors on the overloaded facilities. The power transfer used for this calculation is created by injecting power at existing buses within the zone where the violation occurs and reducing power at an aggregate of existing generators outside of the area.

Transmission Security Base Case Assessments

To assist in the assessment, the NYISO reviewed previously completed transmission security assessments, such as the Short-Term Assessments of Reliability and other NERC, NPCC, and NYSRC compliance studies. The transmission security analysis evaluated expected summer peak, winter peak, and light load conditions under normal transfer criteria. While past RNAs have looked at various system conditions, they focused mainly on summer peak conditions, as these were the most stressful conditions that would occur over the whole year. However, with the load forecast showing that, while the total state remains summer peaking within the RNA horizon, several upstate zones will become winter peaking within the RNA 10-year horizon. As such, the transmission security analysis for this RNA also evaluated winter peak conditions. For instance, Zone E becomes winter peaking in winter 2024-25.

Figure 29: Zone E Summer and Winter Forecast Comparison



Additionally, the amount of solar DER has recently been forecasted to increase to over 10,000 MW (nameplate) by 2030. During spring daytime conditions when the load is very light and solar output could be near its maximum output capability, the amount of other generating resources needed to serve load may be significantly reduced. To capture any potential reliability issues, this transmission security case analyzed the expected load and solar generation under daytime light load conditions.

Figure 30: Expected Load and Solar Generation Under Daytime Light Load Conditions

	Final Gross Load	BTM Solar Generation	Net Load Forecast
2022	14,990	2,755	12,235
2023	15,261	3,329	11,932
2024	15,345	3,986	11,359
2025	15,297	4,656	10,641
2026	15,310	5,283	10,027
2027	15,383	5,872	9,511
2028	15,468	6,415	9,053
2029	15,621	6,878	8,743
2030	15,801	7,247	8,554
2031	16,021	7,487	8,534
2032	16,258	7,655	8,603

Potential Reliability Needs

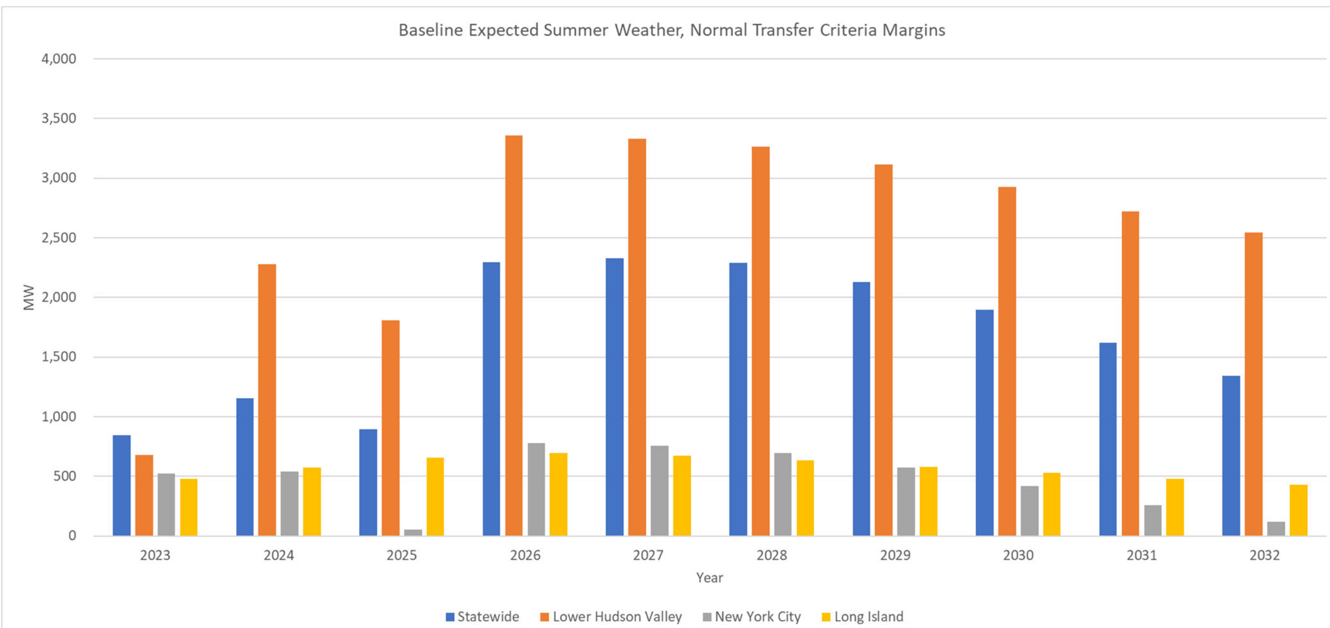
A potential steady-state transmission security Reliability Need was identified for the Study Period under expected winter peak conditions. No other steady-state transmission security related needs were observed under other system conditions. Additionally, no stability or short-circuit needs were observed for any system conditions.

The identified transmission security Reliability Need is a low voltage violation at the Porter 115 kV bus following various contingency combinations resulting in the loss of both Edic-to-Porter 345/115 kV transformers under expected winter peak conditions. The low voltage violation at the Porter 115 kV bus is observed starting in winter 2025-26 due to the retirement of the two Porter 230/115 kV buses, which is planned to occur that winter with the Smart Path Connect Project (interconnection queue #Q1125), and the increasing load in Zone E observed in winter. The evaluation did not observe the low voltage violation at the Porter 115 kV bus under summer peak load conditions because the load forecast for Zone E is higher in winter than in summer. Since the low voltage needs observed at the Porter 115 kV bus occur due to the planned changes with Q1125, this issue will be addressed through the NYISO's interconnection process.

Transmission Security Margins (Tipping Points)

In the Lower Hudson Valley and Long Island localities, the BPTF system is designed to remain reliable in the event of two non-simultaneous outages (N-1-1). In the Con Edison service territory, the 345 kV transmission system and specific portions of the 138 kV transmission system are designed to remain reliability after the occurrence of two non-simultaneous outages and a return to normal ratings (N-1-1-0). The RNA found that the transmission security margins for the Lower Hudson Valley, New York City, and Long Island localities, as well as the statewide system margin, are sufficient for all study years. Figure 31 provides a summary of the margins under baseline expected summer weather, normal transfer criteria. While the margins are sufficient statewide (as well as in all localities), the margins within New York City are very narrow in 2025 (about 50 MW). With the planned addition of CHPE, there is an increase in the observed margins beginning summer 2026. However, the margin decreases over time due to increased load. The margin within New York City reduces to just over 100 MW by the end of the study period. If projects such as CHPE are delayed or the peak load forecast increases, there may be a need to extend the peaker operation until those projects are completed. Additional details of the transmission security margins are provided in **Appendix E**.

Figure 31: Summary of Baseline Expected Summer Weather, Normal Transfer Criteria Margins



Resource Adequacy Base Case Assessments

The following discussion reviews the main modeling assumptions and findings of the 2022 RNA resource adequacy assessments applicable to the Base Case conditions for the Study Period.

Resource Adequacy Model

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, **Appendix D**. 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.

Noteworthy, the MARS simulations do not take into consideration potential reliability impacts due to unit commitment and dispatch, ramp rate constraints, other production cost modeling techniques, or impacts due to sub-zonal constraints on the transmission system.

Generation Model

The NYISO models the generation system in GE-MARS using several types of units. Thermal units 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. 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. The historical shapes used in the past (2002, 2006 and 2007) were replaced by the shapes for 2013, 2017 and 2018 based on the detailed analysis performed by the NYISO.[15]

[15] The analysis was presented at the March 24, 2022 LFTF/TPAS/ESPWG, which is 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.

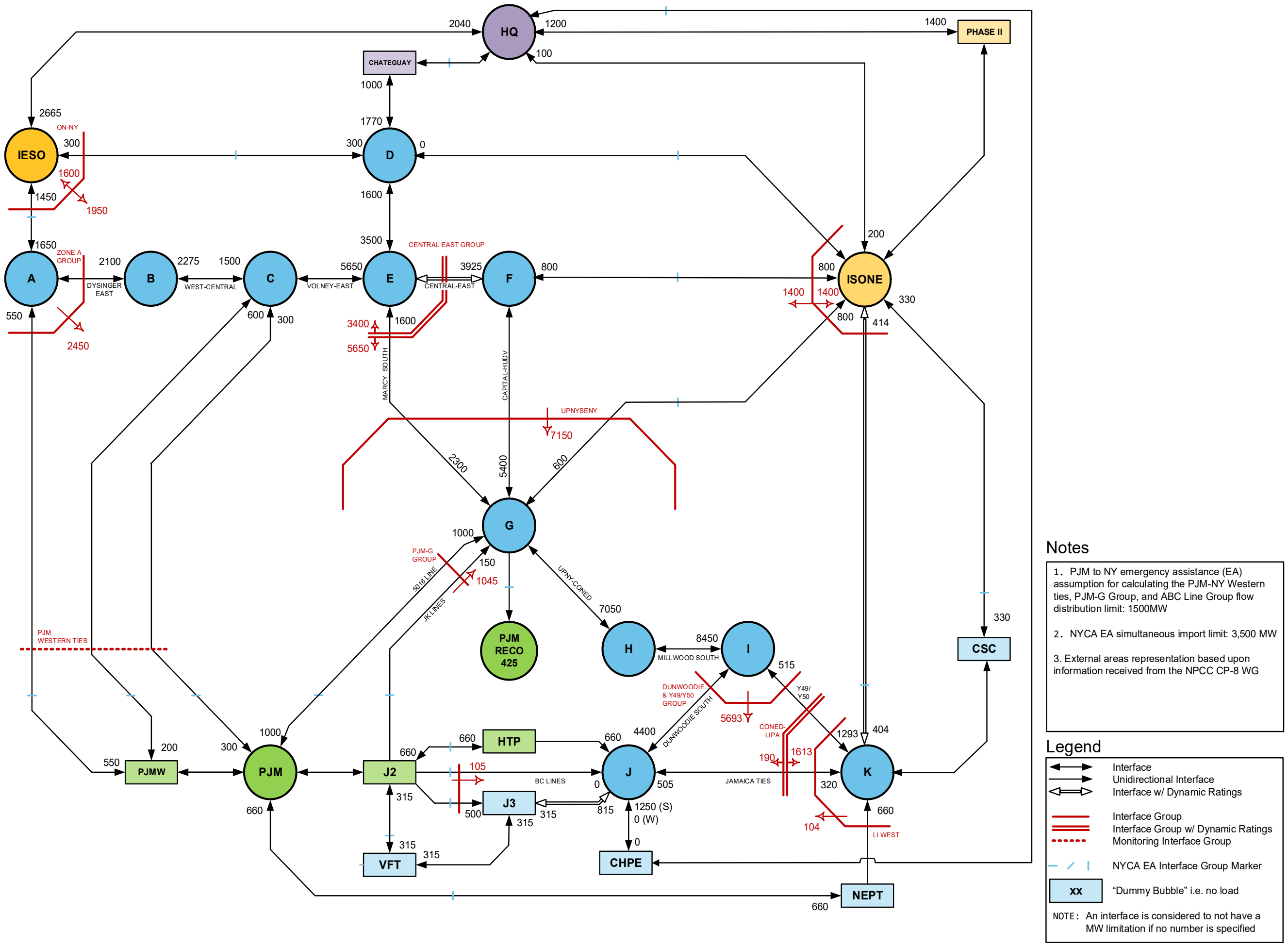
External Areas Model

The NYISO models the four external Control Areas that connect to the NYCA (ISO-New England, PJM, Ontario and Quebec). The transfer limits between the NYCA and these external Control Areas are set in collaboration with the NPCC CP-8 Working Group and are shown in the MARS Topology, Figure 32. Additionally, the probabilistic model used in the RNA to assess resource adequacy employs a number of methods aimed at preventing overreliance on support from these external systems. These methods 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 Control Areas are modeled to maintain their LOLE range within 0.10 to 0.15 event-days/year.

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 the four neighboring Control Areas (ISO-New England, PJM, Ontario and Quebec). MARS does not model in detail any generation pockets in Zone J or Zone K.

Figure 32 - MARS Topology Study Years 4 through 10



Emergency Operating Procedures (EOPs)

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

A change was implemented for this RNA to maintain (*i.e.*, no longer deplete) 350 MW of the 1,310 MW 10-min operating reserves as part of the MARS EOPs. The NYISO presented and discussed this change at the May 5, 2022 ESPWG/TPAS.[16]

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[16] Details of this change were presented at the May 5, 2022 ESPWG/TPAS, which presentation is available at: https://www.nyiso.com/documents/20142/30451285/08_Reliability_Practices_TPAS-ESPWG_2022-05-05.pdf.

Resource Adequacy Base Case Results

The 2022 RNA Base Case resource adequacy studies show that the LOLE for the NYCA is below its 0.1 event-days/year criterion throughout the entire study period. Therefore, the NYISO identifies no resource adequacy Reliability Needs. The NYCA LOLE results are presented in Figure 33 below.

Figure 33: NYCA Resource Adequacy Results

Study Year		Baseline Forecast Load (MW)	RNA Base Case LOLE (days/year)
y1	2023	32,018	0.025
y2	2024	31,778	0.018
y3	2025	31,505	0.024
y4	2026	31,339	0.004
y5	2027	31,292	0.005
y6	2028	31,317	0.004
y7	2029	31,468	0.005
y8	2030	31,684	0.006
y9	2031	31,946	0.010
y10	2032	32,214	0.022

Notes:

- NYCA load values represent baseline coincident summer peak demand from the 2022 Gold Book.
- 2022 RNA Study Years are year 4 (2026) through year 10 (2032). Years 1 through 3 are for information.

LOLE accounts for events but does not account for the magnitude (MW) or duration (hours) of a deficit. Therefore, the NYISO conducts two additional reliability indices for informational purposes—loss of load hours (LOLH in hours/year) and expected unserved energy (EUE in MWh/year).[17]

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 shall not exceed one day in 10 years, or LOLE < 0.1 days/year.

LOLH is generally defined as the expected number of hours per period (*e.g.,* one study year) when a

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

system's hourly demand is projected to exceed the zonal resources (event hour). If the zonal demand exceeds the resources within an hour, this will be counted as one event hour.

EUE, also referred to as loss of energy expectation (LOEE), is generally defined 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.

While the resource adequacy reliability criterion of 0.1 days/year established by the NYSRC and the NPCC is compared with the loss of load expectation (LOLE in days/year) calculation, currently there is no criterion for determining a reliable system based on the LOLH and EUE reliability indices.

Figure 34: NYCA Resource Adequacy Results

Study Year		LOLE	LOLH	LOEE
		event-days/year	event-hours/year	MWh/year
y1	2023	0.025	0.061	23.860
y2	2024	0.018	0.035	11.538
y3	2025	0.023	0.048	18.399
y4	2026	0.004	0.008	1.734
y5	2027	0.005	0.010	2.529
y6	2028	0.004	0.008	1.626
y7	2029	0.005	0.009	1.799
y8	2030	0.006	0.013	3.051
y9	2031	0.010	0.020	5.095
y10	2032	0.022	0.045	11.382

Impact of Emergency Operating Procedures

The LOLE results after each of the emergency operating procedures (EOPs) are shown in Figure 35. GE-MARS evaluates the need for using EOP MW by calculating after each EOP step the expected number of days per year that the system is at a positive (surplus) and a negative (deficiency) MW margin. Each EOP's MW is used as needed, and in sequential order.

The EOP step 8 shows the impact of emergency assistance from external areas. As an example, study year 2032 results show that after EOP steps 1 through 7 have been applied and before the emergency assistance is available, the NYCA LOLE is 1.23 days/year, which is above the 0.1 days/year criterion. After the external area emergency assistance from EOP step 8 becomes available, the LOLE decreases to 0.09 days/year. This demonstrates that without emergency assistance from neighboring regions, there would not be sufficient resources to serve demand within New York. As a result, a sensitivity was performed to identify at what limit of emergency assistance would result in a resource deficiency in 2032. When the emergency assistance limit is reduced from 3,500 MW to 1,200 MW, the NYCA LOLE changes from 0.02 days/year to 0.1 days/year (at criterion).

Figure 35: LOLE Results by Emergency Operating Procedure Step

		NYCA LOLE (days/year) by Margin State									
Step	EOP	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
1	Removing Operating Reserve	6.32	4.37	4.99	1.91	2.98	2.32	2.89	2.94	5.02	6.74
2	Require SCRs (Load and Generator)	3.30	2.72	3.16	0.94	1.46	1.38	1.54	1.72	2.73	4.12
3	5% Manual Voltage Reduction	3.12	2.59	3.01	0.88	1.34	1.32	1.47	1.64	2.60	3.94
4	30-Minute Reserve (*i.e.,* 655 MW) to Zero	2.01	1.42	1.89	0.41	0.79	0.55	0.65	0.76	1.20	2.05
5	5% Remote Controlled Voltage Reduction	1.36	1.00	1.32	0.27	0.52	0.37	0.44	0.51	0.81	1.47
6	Voluntary Load Curtailment	1.18	0.84	1.11	0.23	0.47	0.30	0.37	0.42	0.69	1.32
7	Public Appeals	1.13	0.78	1.06	0.21	0.44	0.27	0.33	0.38	0.63	1.23
8	Emergency Assistance	0.11	0.10	0.11	0.05	0.05	0.04	0.04	0.05	0.07	0.09
9	Part of 10-Minute Reserve (*i.e.* , 960 of 1310 MW) to Zero	**0.02**	**0.02**	**0.02**	**0.00**	**0.00**	**0.00**	**0.00**	**0.01**	**0.01**	**0.02**

Notes:

- **The results in bold font** represents the LOLE at the last step (9) and is the NYCA LOLE that is compared against the 0.1 days/year criterion.

There are several modeling methods currently employed to limit New York's reliance on external areas. For instance, the NYISO will apply a statewide limitation on emergency assistance and representing external areas to assure those areas are self-sufficient before providing assistance to New York.

Clean energy production (primarily heat pumps and electrical vehicles) is a key underlying element of electrification policies that will drive the New York electric system to become winter peaking in future decades. Typically, the NYISO's reliability studies and modeling have focused on summer peak as the most constraining condition. However, with the potential increase in winter loads and DER affecting spring (light load) demand, both transmission security and resource adequacy assessments will need to focus on evolving the models and evaluations to a seasonal or even sub-seasonal and diurnal focus to assess potential needs that could occur in the winter, light load, and other critical system states, in addition to the traditional summertime period.

Figure 36 shows a comparison between summer and winter zonal demand forecasts used for this 2022 RNA and the 2020 RNA resource adequacy base cases. The comparison shows that additional zones are becoming either winter peaking or dual peaking. While the LOLE is below its 0.1 days/year criterion throughout the study period, this shift is the main driver for events occurring during winter. Additional details of the events analysis can be found in **Appendix D**.

Figure 36: 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

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

Key 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 compared to the CRP base cases. Additionally, the RNA Base Case includes 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 Northern New York Priority Transmission Project starting in 2026.
- Summer season and using the new (2013, 2017, 2018) historical shapes: the MARS events for the RNA 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 3, with some in bins 4-6 (as shown in the **Appendix D** event analysis graphs).
- Winter season and using the new (2013, 2017, 2018) historical shapes: the MARS events observed in January in bin 1 (and some in bin 2). Figure 36 shows 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 shifting, to a winter peak throughout the study period (as shown in the **Appendix D** event analysis graphs).

Base Case Variation Scenarios

The NYISO, in conjunction with stakeholders and Market Participants, developed reliability scenarios pursuant to Section 31.2.2.5 of Attachment Y of the OATT. Scenarios are variations on the preliminary (1st pass) RNA Base Case to assess the impact of possible changes in key study assumptions which, if they occurred, could change the timing, location, or degree of violations of reliability criteria on the NYCA system during the Study Period. There are no changes between the preliminary RNA Base Case and the final Base Case. RNA scenarios are provided for information only, and do not lead to Reliability Needs identification or mitigation. The NYISO evaluated the following scenarios as part of this RNA, with an identification of the type of assessment performed:

1. **High Load Forecast Scenario**
    - The 2022 Gold Book High Load forecast was used for the resource adequacy analysis.
2. **Zonal Resource Adequacy Margins (ZRAM)**
    - Identification of the maximum level of zonal MW capacity that can be removed without either causing NYCA LOLE violations or exceeding the zonal capacity.
3. **"Status-quo" Scenario**
    - Removal of proposed major transmission and generation projects assumed in the RNA Base Case.
4. **Winter Scenarios**
5. **CLCPA Scenarios – Policy Case Scenario for Study Year 2030**

The results of the scenarios 1-4 are summarized in the following sections while the results of the CLCPA scenarios are summarized in **Section 8** below.

High Load Forecast Scenario

The RNA Base Case forecast includes impacts associated with projected energy reductions coming from statewide energy efficiency and behind-the-meter solar PV programs. The High Load Forecast Scenario excludes these energy efficiency program impacts from the peak forecast, resulting in higher forecast levels. The comparison of the High and Baseline forecasted loads is provided in the Figure 37 below. There is an increase of 3,484 MW in the peak load in 2032 from the Base Case forecast. Given that the peak load in the High Load Forecast Scenario is higher than in the Base Case, the probability of violating the LOLE criterion increases with violations potentially starting in 2030. The NYCA LOLE results are in

Figure 38.

Figure 37: 2022 Gold Book NYCA High Load vs. Baseline Summer Peak Forecast

Study Year		Baseline Load (BL)	High Load (HL)	Delta MW (HL-BL)
y1	2023	32,018	32,780	762
y2	2024	31,778	32,849	1,071
y3	2025	31,505	32,854	1,349
y4	2026	31,339	32,946	1,607
y5	2027	31,292	33,133	1,841
y6	2028	31,317	33,464	2,147
y7	2029	31,468	33,915	2,447
y8	2030	31,684	34,475	2,791
y9	2031	31,946	35,080	3,134
y10	2032	32,214	35,698	3,484

Figure 38: 2022 RNA Resource Adequacy High Load Scenario NYCA LOLE Results

Study Year		RNA Base Case LOLE (days/year)	High Load Scenario LOLE (days/year)	Delta LOLE
y1	2023	0.025	0.044	0.018
y2	2024	0.018	0.039	0.021
y3	2025	0.024	0.068	0.045
y4	2026	0.004	0.027	0.023
y5	2027	0.005	0.035	0.030
y6	2028	0.004	0.052	0.047
y7	2029	0.005	0.079	0.074
y8	2030	0.006	0.149	0.143
y9	2031	0.010	0.342	0.332
y10	2032	0.022	0.676	0.654

This scenario indicates that if expected energy efficiency and peak load reduction programs do not materialize at the expected levels, criterion violations could start in 2030 for a load level that is 2,791 MW higher than the baseline load.

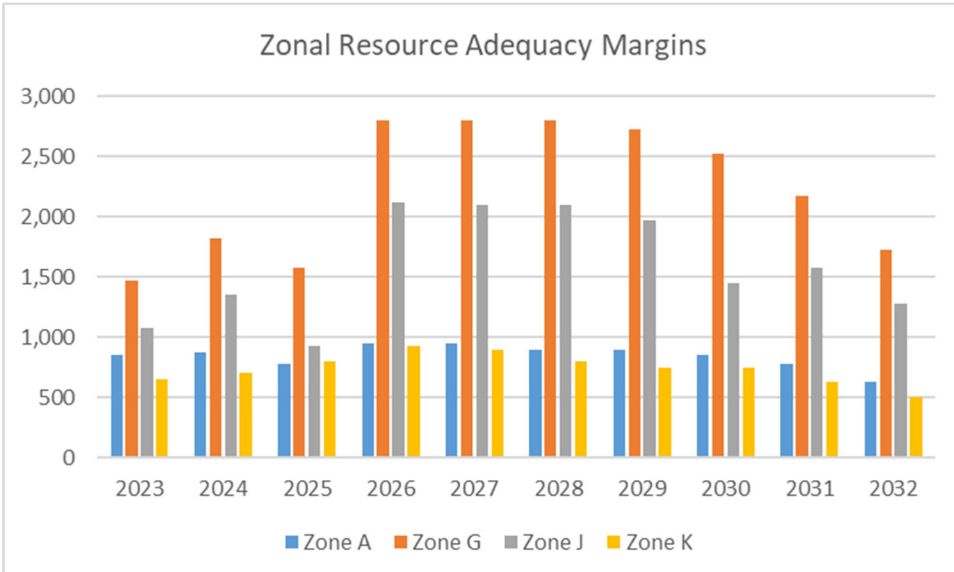
Zonal Resource Adequacy Margin (ZRAM)

Resource adequacy simulations were performed on the RNA Base Cases[18] to determine the amount of "perfect" capacity" in each zone that could be removed before the NYCA LOLE reaches 0.1 event-days/year (one-event-day-in-ten-years), and to offer another relative measure of how close the system is from not

[18] The CRP base cases already reflect the DEC Peaker Rule compliance plans submitted by the affected generation owners to DEC, which are summarized in the assumption tables from Appendix B.

having adequate resources to reliably serve load. As shown in Figure 39, this analysis continues to find tightening margins across the NYCA over time, with a margin of only 500 MW in Long Island (Zone K) and only 650 MW in western New York (Zone A) by 2032. In 2023, the margins are 650 MW in Zone K and 850 MW in western New York.

Figure 39: Summary of Key Zonal Resource Adequacy Margins



In performing this analysis, resource capacity is reduced one zone at a time to determine when a violation occurs. This analysis is performed in the same manner as the compensatory "perfect" MW are added to mitigate resource adequacy violations but with the opposite impact. "Perfect capacity" is capacity that is not derated (*e.g.,* due to ambient temperature or unit unavailability), not subject to energy durations limitations (*i.e.*, available at maximum capacity every hour of the study year), and not tested for transmission security or interface impacts. A map of NYISO zones is shown in Figure 40, and the zonal resource margin analysis (ZRAM) is summarized in Figure 41**.**

Figure 40: NYISO Load Zone Map

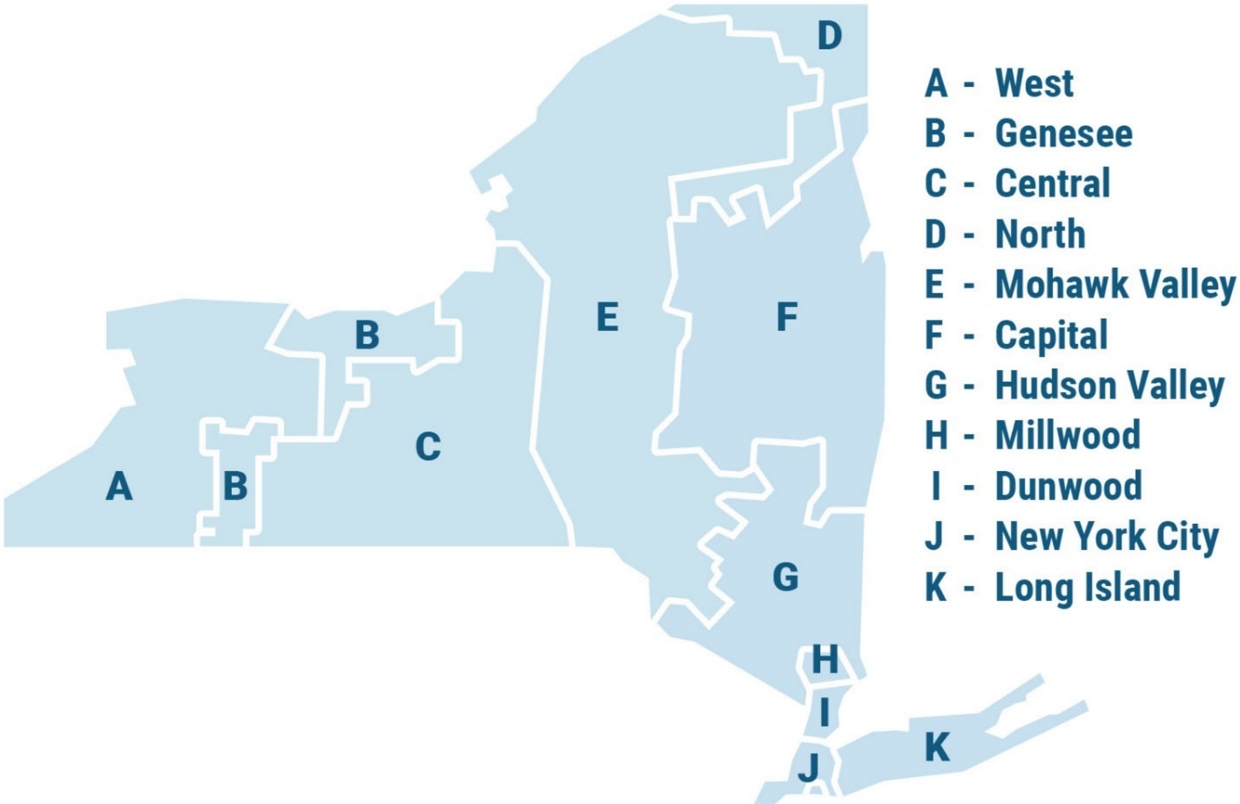


Figure 41: Zonal Resource Adequacy Margins (MW)

Study Year	RNA Base Case LOLE *(days/year)*	Zone A	Zone B	Zone C	Zone D	Zone E	Zone F	Zone G	Zone H	Zone I	Zone J	Zone K
2023	0.025	-850	-850	-1,475	-1,425	-1,500	-1,500	-1,475	-1,375	-1,375	-1,075	-650
2024	0.018	-875	-875	-1,800	-1,675	-1,800	-1,800	-1,825	-1,700	-1,700	-1,350	-700
2025	0.024	-775	-775	-1,475	-1,475	-1,550	-1,550	-1,575	-1,475	-1,475	-925	-800
2026	0.004	-950	-950	-2,625	-1,925	-2,800	-2,800	-2,800	-2,575	-2,600	-2,125	-925
2027	0.005	-950	-950	-2,600	-1,925	-2,800	-2,800	-2,800	-2,575	-2,575	-2,100	-900
2028	0.004	-900	-900	-2,600	-1,925	-2,800	-2,800	-2,800	-2,575	-2,575	-2,100	-800
2029	0.005	-900	-900	-2,500	-1,925	-2,700	-2,700	-2,725	-2,450	-2,450	-1,975	-750
2030	0.006	-850	-850	-2,325	-1,925	-2,525	-2,525	-2,525	-2,175	-2,175	-1,450	-750
2031	0.010	-775	-775	-2,050	-1,775	-2,175	-2,175	-2,175	-1,975	-1,975	-1,575	-625
2032	0.022	-625	-625	-1,700	-1,450	-1,725	-1,725	-1,725	-1,625	-1,625	-1,275	-500

Notes:
- Negative numbers indicate the amount of “perfect MW” that can be removed from a zone without causing a violation.
- EZR - Exceeds Zonal Resources (all generation can be removed without causing a violation).
- The generation pockets in Zone J and Zone K are not modeled in detail for this analysis and the margins identified here may be smaller as a result.

The ZRAM assessment identifies a maximum level of “perfect capacity” that can be removed from each zone without causing a NYCA LOLE criterion violation. However, the impacts of removing capacity on the reliability of the transmission system and on transfer capability are highly location dependent. Thus, removal of lower amounts of capacity are likely to result in reliability issues at specific transmission locations. These simulations did not attempt to assess a comprehensive set of potential scenarios that might arise from specific unit retirements. Therefore, actual proposed capacity removals from any of these zones would need to be further studied in light of the specific capacity locations in the transmission network to determine whether any additional violations of reliability criteria would result. Additional transmission security analysis, such as N-1-1 steady-state analysis, transient stability, and short circuit, would be necessary under the applicable process for any contemplated plant retirement in any zone.

Binding Interfaces

To determine whether a specific transmission interface impacts system resource adequacy, "free-flow" simulations were performed for targeted interfaces. This analysis removes the limit on various transmission interfaces in resource adequacy models, either one at the time, or in various combinations (*i.e.,* "free flow"). A decrease in the NYCA LOLE resulting from removal of an interface limit is an indication that the flow of power across the interface is "binding" due to transmission constraints.
The results of these simulations shown in Figure 42:

Figure 42: Binding Interface Analysis

Study Year		2022 RNA Base Case NYCA LOLE	Free Flow NYCA LOLE	Delta LOLE
y4	2026	0.004	0.003	-0.001
y5	2027	0.005	0.003	-0.002
y6	2028	0.004	0.003	-0.002
y7	2029	0.005	0.002	-0.002
y8	2030	0.006	0.004	-0.002
y9	2031	0.010	0.005	-0.005
y10	2032	0.022	0.010	-0.012

The results show that while NYCA LOLE is below its 0.1 event-days/year criterion, increasing transmission system limits can allow more power to come across the state.

Status-Quo Scenario

This scenario evaluates the reliability of the system based on the assumption that no major transmission or generation projects come to fruition within the RNA Study Period. This includes the removal of all proposed transmission and generation projects that have met the inclusion rules for the 2022 RNA Base Case and removal of generators that require modifications to comply with the DEC's Peaker Rule (Figure 21, Figure 22, and Figure 23). The AC Transmission Public Policy Project and the Western New York Public Policy Project are not removed for this scenario due to their advancement in development. The results of this scenario are contained in the Figure 43 below.

Figure 43: 2022 RNA Resource Adequacy Status-quo Scenario NYCA LOLE Results

		2022 RNA 1st Pass Base Case vs Status-Quo Scenario LOLE *(days/year)*				2022 RNA 1st Pass Base Case vs Remove CHPE Sensitivity LOLE *(days/year)*		
Study Year		RNA Base Case	Status Quo	Delta	Study Year	RNA Base Case	TDI/CHPE Removed	Delta
y1	2023	0.025	0.028	0.003	2023	0.025	0.025	0.000
y2	2024	0.018	0.024	0.007	2024	0.018	0.018	0.000
y3	2025	0.024	0.033	0.010	2025	0.024	0.024	0.000
y4	2026	0.004	0.022	0.018	2026	0.004	0.015	0.011
y5	2027	0.005	0.026	0.021	2027	0.005	0.016	0.011
y6	2028	0.004	0.020	0.015	2028	0.004	0.014	0.010
y7	2029	0.005	0.021	0.017	2029	0.005	0.015	0.011
y8	2030	0.006	0.042	0.036	2030	0.006	0.033	0.026
y9	2031	0.010	0.041	0.031	2031	0.010	0.033	0.023
y10	2032	0.022	0.068	0.046	2032	0.022	0.047	0.025

From a resource adequacy perspective, this scenario indicates that even if the LOLE is still below its 0.1 event-days/year criterion, there may be a significant impact if the expected generation and transmission projects are not built. Additionally, an additional sensitivity was performed with only removing the proposed 1,250 MW HVDC CHPE project from Quebec to Zone J. Those results indicate that most of the NYCA LOLE impact is due to this project's removal.

The steady state transmission security results show, as compared to the RNA Base Case, overloads are observed under N-1-1 conditions in the NYSEG, National Grid, Con Edison, and PSEG-LI service territories. The results of the steady state transmission security N-1-1 evaluation of the BPTF for this scenario are shown in Figure 44. Figure 45 provides a comparison of the statewide system margin under the status quo scenario assumptions to the RNA baseline conditions. Similarly, Figure 46 and Figure 47 show the New York City and Long Island transmission security margins for the status quo scenario compared to the RNA baseline assumptions. The status quo assumptions show that the statewide system margin is insufficient in 2032 by about 10 MW. The New York City transmission security margin under status quo assumptions is insufficient to serve demand starting in year 2028 (about 25 MW) with 2032 being deficient by about 600 MW. The New York City transmission security margin analysis includes the removal of CHPE.[19] The Long Island transmission security margin under the status quo assumptions is deficient as early as 2023 by

[19] In a recent press issued in August 2022, CHPE updated the project's full operation date to the spring of 2026, shifting from the originally anticipated in-service date of late 2025. The press release is available at: https://chpexpress.com/news/champlain-hudson-power-express-provides-update-on-anticipated-full-operation-date/.

about 300 MW which increases to just under 600 MW in 2032.

Figure 44: 2022 RNA Transmission Security Status-quo Scenario Results

Zone	Owner	Circuit
A	NYSEG	North Gardenville 230/115/34.5
C	NGRID	Clay - Volney 345kV (6)
I/K	ConEd/LIPA	Dunwoodie - Shore Rd 345kV (Y50)
I/K	NYPA	Sprainbrook - East Garden City 345kV (Y49)
J	ConEd	Fresh Kills - Fresh Kills PAR 138kV (21192)
J	ConEd	Fresh Kills 345/138 (TA1)
J	ConEd	Fresh Kills 345/138 (TB1)
J	ConEd	Fresh Kills PAR 138kV (R1)
J	ConEd	Fresh Kills PAR 138kV (R2)
J	ConEd	Gowanus 345/138 (T14)
J	ConEd	Gowanus 345/138 (T2)
J	ConEd	Rainey West - Farragut East 345kV (61)
K	LIPA	Carle Pl - East Garden City 138kV (361)
K	LIPA	Edwards Avenue - Riverhead 138kV (893)
K	LIPA	Elwood - Northport 138kV (678)
K	LIPA	Glenwood - Shore Rd 138kV (365)
K	LIPA	Northport - Pilgrim 138kV (672)
K	LIPA	Northport - Pilgrim 138kV (677)
K	LIPA	Northport - Pilgrim 138kV (679)
K	LIPA	Shore Rd 345/138kV (Bank #1)
K	LIPA	Shore Rd 345/138kV (Bank #2)

Figure 45: Status Quo Scenario Statewide System Margin

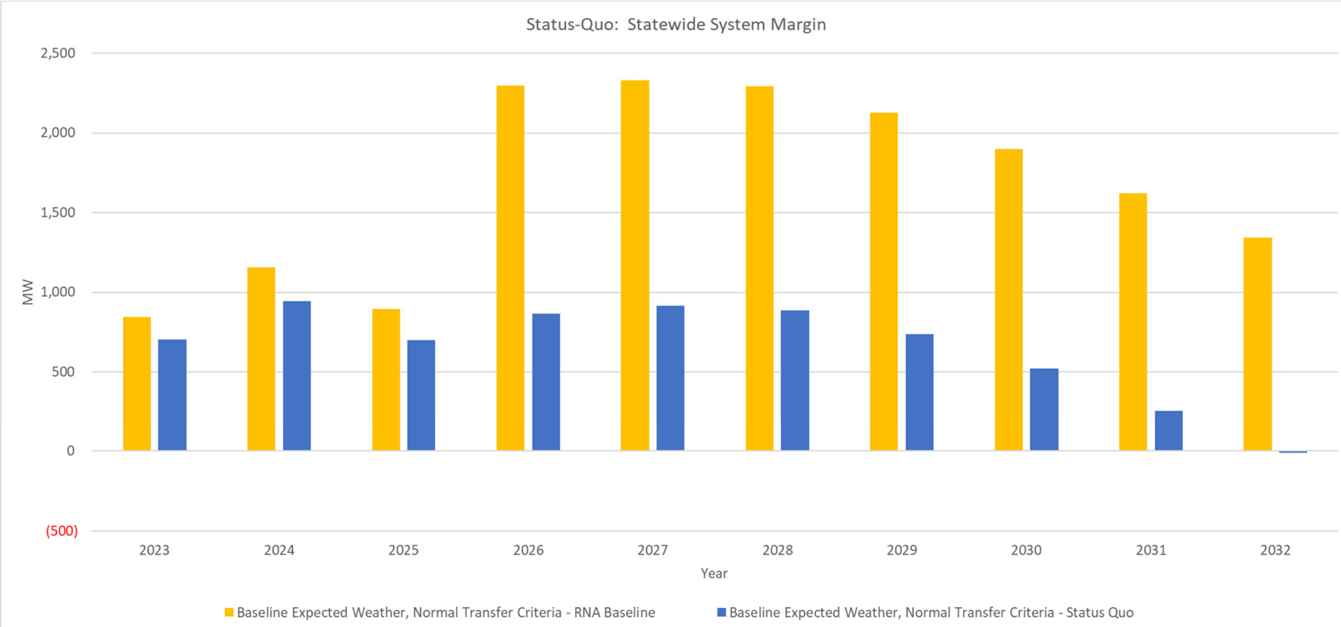


Figure 46: Status Quo Scenario New York City Transmission Security Margin

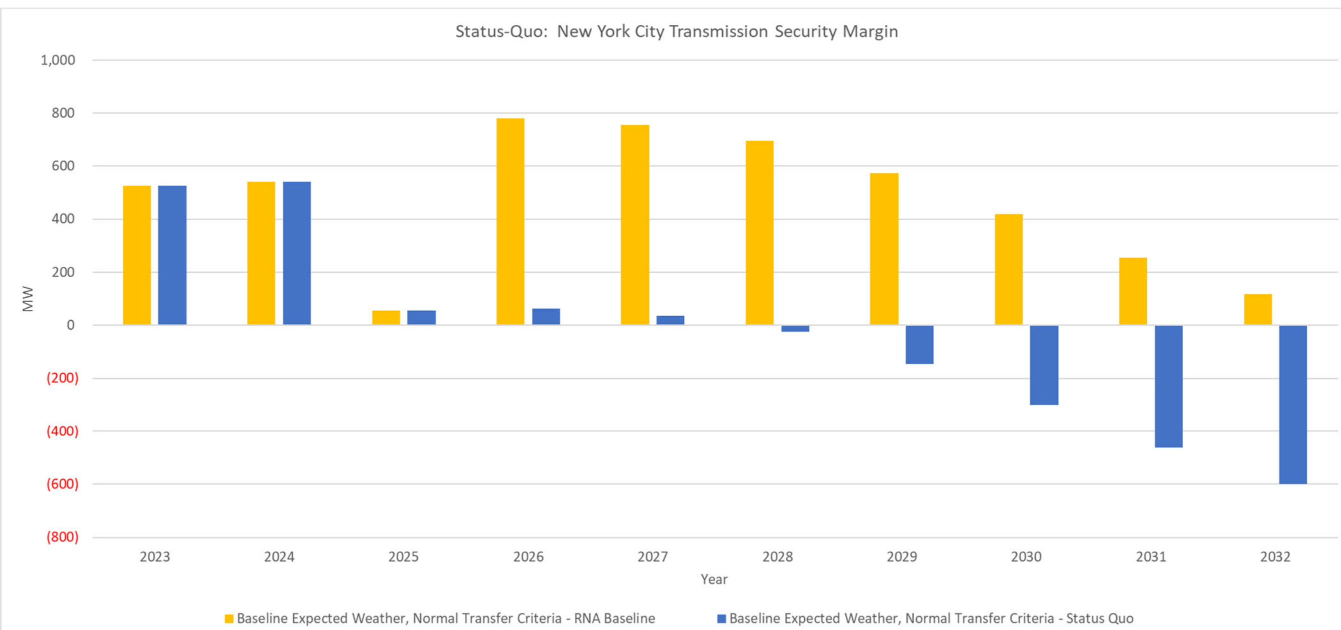
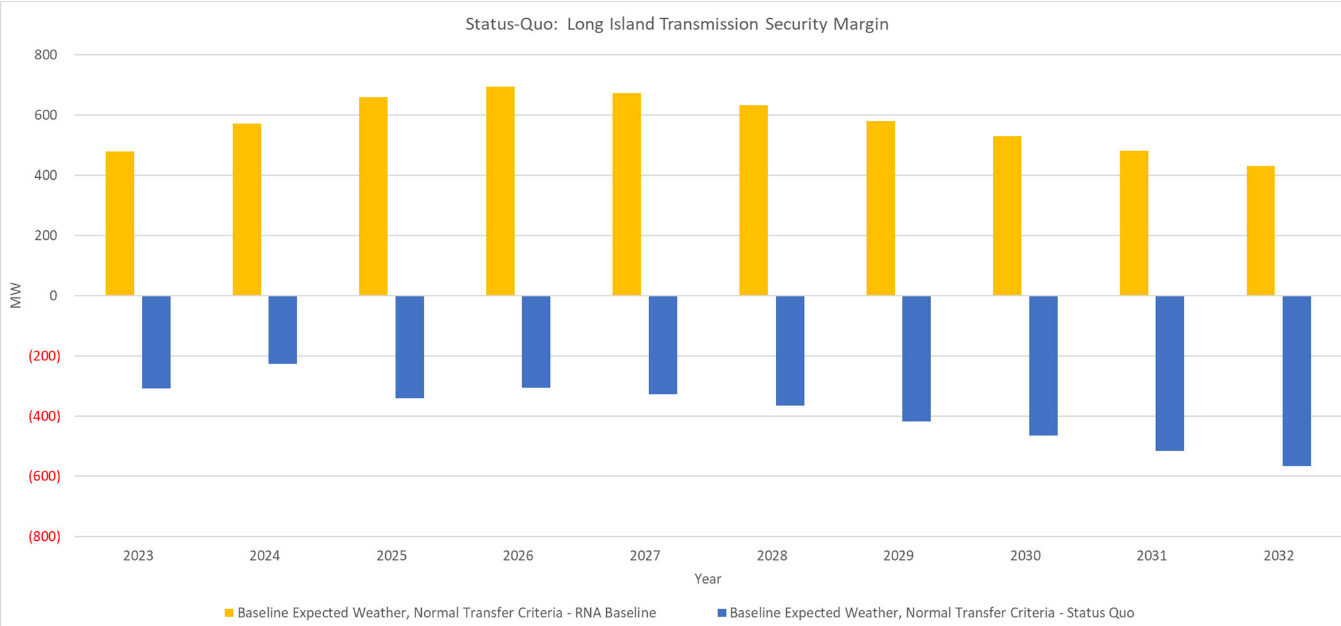


Figure 47: Status Quo Scenario Long Island Transmission Security Margin



Winter Scenarios: Gas Shortage

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.[20]

The study conditions for evaluating the impact of the gas fuel supply shortages 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."[21] 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.[22] Locally, the NYSRC has established goals to identify actions to preserve NYCA reliability for extreme weather events and other extreme system conditions.[23]

[20] Power Trends 2022

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

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

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

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.[24] 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.[25] The NYISO identified a 2023 project, Enhancing Fuel and Energy Security, to refresh the assumptions from the Analysis Group's 2019 fuel and energy security report to assess emerging operational and grid reliability concerns.[26] At the nationwide level, NERC identified a project, entitled Project 2022-02 Energy Assurance with Energy-Constrained Resources, that proposes to address several energy assurance concerns related to both the operations and planning time horizons.[27]

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

Figure 48 shows the statewide system margin for winter weather conditions including cold snap and extreme cold snap conditions. A cold snap with a statewide daily average temperature of 6 degrees Fahrenheit (1-in-10-year, or 90/10) has sufficient margin throughout the study period. Additionally, an extreme cold snap with a statewide daily average temperature of 0 degrees Fahrenheit (1-in-100-year, or 99/1) also has sufficient margin. Under the extreme system condition of a gas fuel shortage the statewide system margin is deficient by winter 2031-32. These deficiencies are exacerbated under cold snap and extreme cold snap conditions. Figure 49 shows the New York City transmission security margin for similar winter weather conditions, including the gas fuel shortage condition. For New York City, in winter 2032-33 the system is deficient under the shortage of gas fuel supply conditions with a cold snap. The Lower Hudson Valley and Long Island localities show sufficient margin for all conditions throughout the study period.

[24] 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.

[25] 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.

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

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

Figure 48: Winter Weather Statewide System Margins

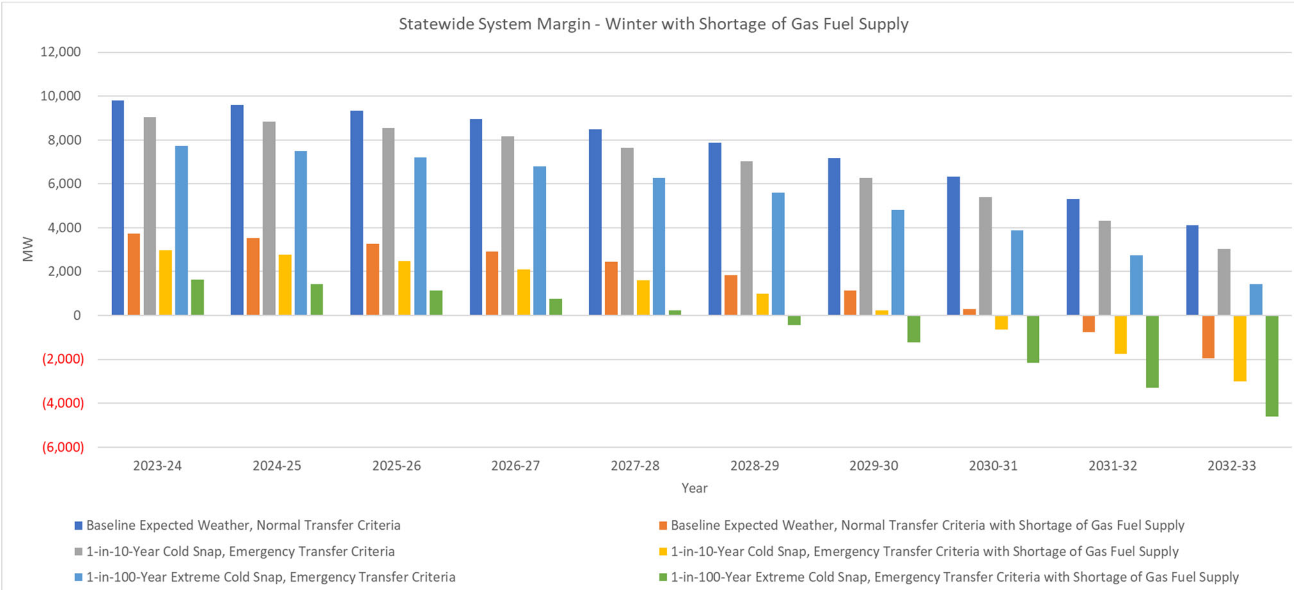
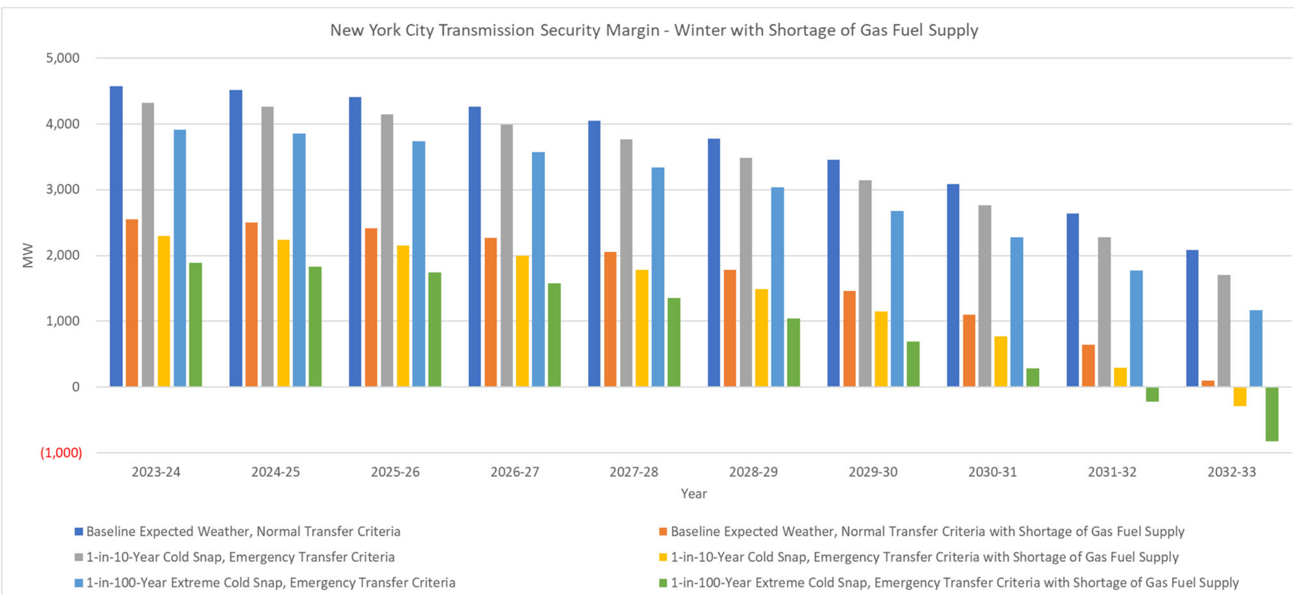


Figure 49: Winter Weather New York City Transmission Security Margin



Additionally, the RNA conducted a resource adequacy scenario that simulated for the gas shortage conditions described above. Under this scenario, the scenario removed certain generators for the months of December, January, and February of the study year 2032 and recalculated the NYCA LOLE reliability index. The results indicate that, while still below the LOLE criterion of 0.1 days/year, there is a significant change in the LOLE from 0.022 to 0.049 days/year.

Figure 50: Winter Scenarios LOLE Results

	MW Reductions in Winter (Dec-Feb)				NYCA LOLE
Y2032	Zone J	Zone K	Other	Total	
RNA Base Case	0	0	0	0	0.022
Gas Shortage	2,124	394	3,682	6,200	0.049

However, the NYISO is currently performing its Public Policy Transmission Planning Process that is evaluating solutions with a Public Policy Transmission Need with the goal to increase imports and exports from Long Island. The RNA conducted additional sensitivity to the gas shortage scenario that removes the topology limits into Long Island. The results show an improvement in the LOLE from 0.049 days/year to 0.037 days/year.