2022 Long-Term Resource Adequacy Assessment for NYSRC

A Report by the
New York Independent System Operator

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Executive Summary

The New York State Reliability Council's (NYSRC) Reliability Rule A.3. R2[1] requires the NYISO to prepare a biennial NYCA Long-Term Resource Adequacy Assessment covering a ten-year look-ahead period. The assessment includes findings from the latest NYISO Reliability Needs Assessment (RNA) or other comparable NYISO-approved resource adequacy reviews, such as the quarterly Short-Term Assessment of Reliability (STAR).[2]

This 2022 NYCA Long-Term Resource Adequacy Assessment report is prepared to fulfill the A.3. R2 requirements. This report summarizes the resource adequacy findings from the 2022 RNA[3] for 2026 through 2032 (year 4 through year 10) and from the 2022-Q3 STAR[4] for 2023 through 2027 (year 1 through year 5) with a focus on year 1 through year 3. While this report is limited to summarizing the resource adequacy findings, the NYISO performed complete reliability criteria assessments, including transmission security evaluations, in both the RNA and STARs.

RNA Key Takeaways

The 2022 RNA was completed on November 15, 2022, and its key takeaways are below:

- The margin to maintain reliability over the next ten years could be eliminated based upon likely changes in planned system conditions. **However, the 2022 RNA finds no long-term actionable reliability needs for the New York State Bulk Power Transmission Facilities as planned from 2026 through 2032 for assumed system demand and with the assumed planned projects meeting their proposed in-service dates.**
- New York City reliability margins are very tight decreasing to approximately 50 MW by 2025 primarily due to the planned unavailability of simple cycle combustion turbines to comply with the DEC's Peaker Rule. The reliability of the grid is heavily reliant on the timely completion of planned transmission projects, chiefly Champlain Hudson Power Express (CHPE). Increased demand, significant delays in projects, or additional generator deactivations could all cause deficiencies in New York City. Some generation affected by the DEC Peaker Rule may need to remain in service until CHPE or other permanent solutions are completed to maintain a reliable grid.

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[1] NYSRC Reliability Rules & Compliance Manual, Version #45, July 17, 2020: http://www.nysrc.org/NYSRCReliabilityRulesComplianceMonitoring.html

[2] Additionally, in addressing the Reliability Rule in A.3 R3, the NYISO submits a report in the Intervening Year between NYCA Long-Term Resource Adequacy Assessments to inform the NYSRC of any significant updates to assumptions and, if available, findings from the latest final NYISO Comprehensive Reliability Plan (CRP) or other final NYISO reports which may include solutions to reliability needs identified in the Long-Term Resource Adequacy Assessment.

[3] 2022 RNA: Report: https://www.nyiso.com/documents/20142/2248793/2022-RNA-Report.pdf
Appendices: https://www.nyiso.com/documents/20142/34651464/2022-RNA-Appendices.pdf
Datasheet: https://www.nyiso.com/documents/20142/34651464/2022-RNA-Datasheet.pdf

[4] 2022-Q3 STAR Report: https://www.nyiso.com/documents/20142/16004172/2022-Q3-STAR-Report-vFinal.pdf

  - Demand forecast uncertainty or potential heatwaves of various degrees pose risks throughout the next ten years, especially in 2025. In fact, the long-term demand forecast for New York City, to be updated in early 2023, is expected to increase due to strong commercial and residential growth along with increased electrification of transportation and home appliances.
  - New York's current reliance on neighboring systems is expected to continue through the next ten years. Without emergency assistance from neighboring regions, New York would not have adequate resources throughout the next ten years.
  - Extreme events, such as heatwaves or storms, could result in deficiencies to serve demand statewide, especially in New York City, considering the plans included in this RNA. This outlook could improve as more resources and transmission are added to New York City.
  - The New York statewide grid is projected to become a winter-peaking system in the mid-2030s, primarily driven by electrification of space heating and transportation. The New York statewide grid is reliable in the winter for the next ten years but will be stressed under gas supply shortage conditions that can occur during cold snaps.
  - Planning for the more extreme system conditions of heatwaves, cold snaps, and fuel availability is currently beyond established design criteria. However, several reliability organizations are investigating whether these events should become design conditions.
  - With increased renewable intermittent generation for achievement of the CLCPA goal of 70% renewable energy by 2030, at least 17,000 MW of existing fossil must be retained to continue to reliably serve forecasted demand. Beyond 2030, dispatchable emissions-free resources (DEFRs) will be needed to balance intermittent supply with demand.
- Since this RNA did not identify any Reliability Needs at this time, the NYISO will proceed to the *2023-2032 Comprehensive Reliability Plan* (CRP), to be completed in 2023. Through the Short-Term Reliability Process, the NYISO will conduct quarterly Short-Term Assessments of Reliability (STARs) to assess reliability needs within a five-year horizon. If necessary, the NYISO will seek solutions to address any reliability needs identified through that process.

2022 Q3 STAR Conclusions

The NYISO competed the 2022 Q3 STAR on October 13, 2022, and concluded that **the planned Bulk Power Transmission Facilities (BPTF) through the study period (2023-2027) are within applicable reliability criteria** based on expected weather and with the assumed planned projects meeting their proposed in-service dates.

The NYISO continue to monitor and track system changes. Subsequent studies, such as the 2023 Comprehensive Reliability Plan, STARs, and future economic and public policy transmission planning studies will build upon the findings of the 2022 planning studies.

1. NYISO Procedures

The findings in this 2022 NYCA Long-Term Resource Adequacy Assessment are based on the 2022 RNA[5] and 2022 Q3 Short Term Assessment of Reliability (STAR).[6] The current Reliability Planning Process and Short-Term Reliability Process were approved by the Federal Energy Regulatory Commission (FERC) and their requirements are contained in Attachments Y and FF, respectively, of the NYISO's Open Access Transmission Tariff (OATT).[7] A detailed process description is contained in the Reliability Planning Process Manual.[8]

Effective May 1, 2020, the study period addressed by the RNA is years 4 through 10 of the planning horizon, while the Short-Term Reliability Process addresses years 1 through 3 and also assesses years 4 and 5. The needs identified in the Short-Term Reliability Process in year 1 through year 3 will be addressed in the applicable quarterly STAR, while the needs identified in years 4 and 5 will only be addressed using the Short-Term Reliability Process if the identified Reliability Need cannot timely be addressed through the Reliability Planning Process.

The models and data employed in both the 2022 RNA and 2022 Q3 STAR are based on the NYISO's 2022 Load and Capacity Data Report (Gold Book), and the application of the reliability planning inclusion rules set forth in the Reliability Planning Process Manual. Additional modeling and results details are in the 2022 RNA November 15, 2022, report, and appendices.

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[5] 2022 RNA Report: https://www.nyiso.com/documents/20142/2248793/2022-RNA-Report.pdf
2022 RNA Appendices: https://www.nyiso.com/documents/20142/34651464/2022-RNA-Appendices.pdf

[6] 2022 Q3 STAR Report: https://www.nyiso.com/documents/20142/16004172/2022-Q3-STAR-Report-vFinal.pdf

[7] NYISO's Tariff: https://www.nyiso.com/regulatory-viewer

[8] RPP Manual: https://www.nyiso.com/manuals-tech-bulletins-user-guides

2. Assumptions and Methodology

Resource Adequacy Base Case Assessments

The following discussion reviews the main findings of the *2022 RNA* resource adequacy[9] assessments applicable to the base case conditions for the RNA 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. 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.

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

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[9] Noteworthy, for complete reliability criteria assessments, both the RNA and the STARs also include transmission security evaluations, which are not subject of this report.

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

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 BtM 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.

Figure 1: NYCA Peak Load and Resources 2026 through 2032

	Year	2026	2027	2028	2029	2030	2031	2032
Peak Load (MW) - Gold Book 2022 NYCA Baseline								
	NYCA*	31,339	31,292	31,317	31,468	31,684	31,946	32,214
	Zone J*	10,778	10,804	10,864	10,986	11,140	11,303	11,441
	Zone K*	4,746	4,768	4,806	4,857	4,907	4,956	5,007
	Zone G-J*	14,936	14,959	15,027	15,173	15,360	15,560	15,735
Resources ICAP (MW)								
NYCA	Capacity**	37,625	37,625	37,625	37,625	37,625	37,625	37,625
	Net Purchases & Sales (Transaction	3,188	3,188	3,188	3,188	3,188	3,188	3,188
	SCR	1,164	1,164	1,164	1,164	1,164	1,164	1,164
	Total Resources	41,977	41,977	41,977	41,977	41,977	41,977	41,977
	Capacity/Load Ratio	120.1%	120.2%	120.1%	119.6%	118.8%	117.8%	116.8%
	Cap+NetPurch/Load Ratio	130.2%	130.4%	130.3%	129.7%	128.8%	127.8%	126.7%
	Cap+NetPurch+SCR/Load Ratio	133.9%	134.1%	134.0%	133.4%	132.5%	131.4%	130.3%
Zone J	Capacity**	8,183	8,183	8,183	8,183	8,183	8,183	8,183
	Cap+fullUDR+SCR/Load Ratio	94.2%	94.0%	93.5%	92.4%	91.2%	89.8%	88.8%
Zone K	Capacity**	5,094	5,094	5,094	5,094	5,094	5,094	5,094
	Cap+fullUDR+SCR/Load Ratio	129.0%	128.4%	127.4%	126.0%	124.7%	123.5%	122.2%
Zone G-J	Capacity**	13,052	13,052	13,052	13,052	13,052	13,052	13,052
	Cap+fullUDR+SCR/Load Ratio	101.2%	101.0%	100.5%	99.6%	98.4%	97.1%	96.0%

	Year	2026	2027	2028	2029	2030	2031	2032
Resources (UCAP MW)								
NYCA	Capacity**	32,670	32,670	32,670	32,670	32,670	32,670	32,670
	Cap+NetPurch+SCR/Load Ratio	117.0%	117.2%	117.1%	116.5%	115.7%	114.8%	113.8%
Zone J	Capacity**	7,968	7,968	7,968	7,968	7,968	7,968	7,968
	Cap+fullUDR+SCR/Load Ratio	89.2%	89.0%	88.5%	87.5%	86.3%	85.1%	84.0%
Zone K	Capacity**	4,702	4,702	4,702	4,702	4,702	4,702	4,702
	Cap+fullUDR+SCR/Load Ratio	118.5%	117.9%	117.0%	115.8%	114.6%	113.5%	112.3%
Zone G-J	Capacity**	12,356	12,356	12,356	12,356	12,356	12,356	12,356
	Cap+fullUDR+SCR/Load Ratio	94.0%	93.8%	93.4%	92.5%	91.4%	90.2%	89.2%

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 2022 Gold Book 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 was 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, and 2018 based on detailed analysis performed by the NYISO.[10] The load bin distribution in GE-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 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.

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[10] 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.

Figure 2: 2022 RNA Load and Energy Forecast: Baseline Forecast, and Baseline with BtM Solar PV Forecasts Added Back

Baseline and Adjusted Baseline Energy Forecasts

Annual GWh	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
2022 Econometric Energy Forecast	159,065	162,750	164,563	165,064	166,282	167,490	168,320	169,296	170,130	171,242	171,863
-- Energy Efficiency and Codes & Standards	2,616	5,458	8,557	11,862	15,218	18,466	21,545	24,447	27,186	29,735	31,883
-- BTM Solar PV	4,635	5,605	6,616	7,559	8,532	9,462	10,298	11,016	11,538	11,853	12,108
-- BTM Non-Solar Distributed Generation	1,656	1,739	1,840	1,900	1,964	2,019	2,068	2,118	2,171	2,224	2,263
+ Storage Net Energy Consumption	47	70	117	184	275	383	510	645	786	891	980
+ Electric Vehicle Energy	567	868	1,263	1,795	2,523	3,503	4,762	6,313	8,151	10,240	12,518
+ Building Electrification	488	1,234	2,110	3,038	4,184	5,541	7,109	8,867	10,848	13,029	15,413
2022 Gold Book Baseline Forecast	151,260	152,120	151,040	148,760	147,550	146,970	146,790	147,540	149,020	151,590	154,520
+ BTM Solar PV	4,635	5,605	6,616	7,559	8,532	9,462	10,298	11,016	11,538	11,853	12,108
2022 RNA Base Case Forecast[1]	155,895	157,725	157,656	156,319	156,082	156,432	157,088	158,556	160,558	163,443	166,628

Baseline and Adjusted Baseline Summer Peak Forecasts

Peak MW	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
2022 Econometric Peak Demand Forecast	33,461	34,295	34,669	34,946	35,308	35,715	36,115	36,577	36,997	37,377	37,691
-- Energy Efficiency and Codes & Standards	365	769	1,213	1,696	2,197	2,687	3,160	3,610	4,044	4,451	4,786
-- BTM Solar PV (Net Peak Hour)	985	1,113	1,216	1,314	1,386	1,421	1,423	1,416	1,379	1,315	1,261
-- BTM Non-Solar Distributed Generation	288	304	319	330	342	352	359	369	376	386	394
-- BTM Storage Peak Reductions	148	244	365	416	469	528	583	640	697	755	812
+ Electric Vehicle Peak Demand	58	96	139	193	269	359	471	610	801	1,025	1,246
+ Building Electrification	32	57	83	122	156	206	256	316	382	451	530
2022 Gold Book Baseline Forecast[2]	31,765	32,018	31,778	31,505	31,339	31,292	31,317	31,468	31,684	31,946	32,214
+ BTM Solar PV	985	1,113	1,216	1,314	1,386	1,421	1,423	1,416	1,379	1,315	1,261
2022 RNA Base Case Forecast[1]	32,750	33,131	32,994	32,819	32,725	32,713	32,740	32,884	33,063	33,261	33,475

[1] For the resource adequacy study, the Gold Book baseline load forecast was modified by adding back BtM solar PV impacts in order to model solar PV explicitly as a generation resource to account for the intermittent nature of its availability.

[2] The transmission security power flow RNA base cases use this Gold Book baseline forecast.

Figure 3: 2022 RNA Load and Energy for High Load Scenario: High Load Scenario Forecast, and High Load Scenario Forecast with BtM Solar PV Added Back

High Load Scenario and Adjusted High Load Scenario Energy Forecasts

Annual GWh	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
2022 High Load Econometric Energy Forecast	160,378	164,754	166,463	167,637	168,937	170,221	171,100	172,158	173,090	174,306	175,075
-- Energy Efficiency and Codes & Standards	1,829	3,816	5,979	8,285	10,625	12,892	15,043	17,069	18,984	20,766	22,266
-- BTM Solar PV	4,441	5,154	5,879	6,616	7,462	8,352	9,239	10,028	10,689	11,183	11,552
-- BTM Non-Solar Distributed Generation	1,656	1,739	1,840	1,900	1,964	2,019	2,068	2,118	2,171	2,224	2,263
+ Storage Net Energy Consumption	42	58	92	141	201	273	351	427	502	573	635
+ Electric Vehicle Energy	569	884	1,326	1,978	2,931	4,275	6,042	8,199	10,717	13,538	16,548
+ Building Electrification	597	1,433	2,387	3,475	4,762	6,274	8,007	9,931	12,105	14,526	17,233
2022 Gold Book High Load Scenario	153,660	156,420	156,570	156,430	156,780	157,780	159,150	161,500	164,570	168,770	173,410
+ BTM Solar PV	4,441	5,154	5,879	6,616	7,462	8,352	9,239	10,028	10,689	11,183	11,552
2022 RNA High Load Scenario[3]	158,101	161,574	162,449	163,046	164,242	166,132	168,389	171,528	175,259	179,953	184,962

High Load Scenario and Adjusted High Load Scenario Summer Peak Forecasts

Peak MW	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
2022 High Load Scenario Econometric Peak Demand	33,689	34,666	35,126	35,454	35,839	36,235	36,688	37,119	37,535	37,920	38,258
-- Energy Efficiency and Codes & Standards	257	538	847	1,185	1,535	1,877	2,210	2,523	2,827	3,111	3,347
-- BTM Solar PV	944	1,023	1,082	1,151	1,212	1,254	1,277	1,288	1,278	1,240	1,202
-- BTM Non-Solar Distributed Generation	288	304	319	330	342	352	359	369	376	386	394
-- BTM Storage Peak Reductions	125	198	289	318	346	377	400	423	445	485	527
+ Electric Vehicle Peak Demand	68	114	168	253	371	536	743	1,056	1,453	1,890	2,330
+ Building Electrification	36	63	92	131	171	222	279	343	413	492	580
2022 Gold Book High Load Scenario	32,179	32,780	32,849	32,854	32,946	33,133	33,464	33,915	34,475	35,080	35,698
+ BTM Solar PV	944	1,023	1,082	1,151	1,212	1,254	1,277	1,288	1,278	1,240	1,202
2022 RNA High Load Scenario[3]	33,123	33,803	33,931	34,005	34,158	34,387	34,741	35,203	35,753	36,320	36,900

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[3] The high load scenario forecast will be used for the high load resource adequacy scenario

External Areas Model

The NYISO models the four external Control Areas that connect to the NYCA (*i.e.*, 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. 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 Control Areas. 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.

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

Emergency Operating Procedures (EOPs)

The New York model in GE-MARS 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 Control Areas.

The NYISO implemented a change for the 2022 RNA to maintain (*i.e.*, no longer deplete) 350 MW of the 1,310 MW 10-min operating reserves as part of the GE-MARS EOPs.[11]

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.

Criterion

Under this type of probabilistic simulation, the NYCA loss of load expectation (LOLE in event-days/year) through the ten-year planning horizon is compared with the NYSRC and NPCC LOLE criterion to not exceed one event-day in 10 years, or LOLE < 0.1 event-days/year.

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[11] 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.

Proposed Resources Additions and Retirements

The assumed proposed generation and transmission projects are listed below and meet the 2022 RNA Base Case based on the NYISO's inclusion rules.

The notable bulk transmission projects that met the inclusion rules and are modeled in the 2022 RNA Base Case are:

- **The NextEra Empire State Line Project** was selected by the NYISO Board of Directors in October 2017 to address the Western New York Public Policy Transmission Need. This project includes a new 345 kV circuit and phase angle regulator (PAR) that will alleviate constraints in the Niagara area. This project is in service as of June 2022.
- **The LS Power and New York Power Authority (NYPA) Segment A, AC Transmission joint project** was selected by the NYISO Board of Directors in April 2019. The project includes a new double-circuit 345 kV line between Edic and New Scotland substations, two new 345 kV substations at Princetown and Rotterdam, two new 345 kV lines between Princetown to Rotterdam substations, and retirement of the existing Porter to Rotterdam 230 kV lines. The planned in-service date is December 2023.
- **The New York Transco Segment B, AC Transmission project** was selected by the NYISO Board of Directors in April 2019. The project includes a new double-circuit 345/115 kV line from a new Knickerbocker 345 kV switching station to the existing Pleasant Valley substation, 50% series compensation on the Knickerbocker to Pleasant Valley 345 kV line, and retirement of 115 kV lines between Greenbush and Pleasant Valley substations. The planned in-service date is December 2023.
- **Champlain Hudson Power Express** (CHPE) 1,250 MW HVDC project from Quebec to Astoria Annex 345 kV in New York City (Zone J), awarded under NYSERDA's Tier 4 REC program. The facility is expected to provide capacity in the summer but not in the winter. The planned in-service date is spring 2026.
- **NYPA/National Grid's Northern New York Priority Transmission Project** is expected to increase the capacity of transmission lines in northern New York, where significant wind and hydro capacity exists and constraints on existing lines contribute to curtailment of these resources. The planned in-service date is December 2025.

Local Transmission Plans: As part of the NYISO's Local Transmission Planning Process, the New York TOs present their Local Transmission Owner Plans (LTPs) to the NYISO and stakeholders during

ESPWG and TPAS meetings. The transmission plans detailed in the LTPs and reported as firm in the *2022 Gold Book* are included in the 2022 RNA Base Case, with consideration for their in-service dates. A summary of these projects is reported in Appendix D of the 2022 RNA report.

Figure 4: Proposed Projects Included in the 2022 RNA Base Case

Queue #	Project Name/(Owner)	Zone	Point of Interconnection	Type	COD or I/S Date	Summer Peak MW	Included Starting
Proposed Transmission Additions, other than Local Transmission Owner Plans							
0545A	Empire State Line	A	Dysinger - Stolle 345kV	AC Transmission (WNYPP)	I/S July 2022	n/a	2018-2019 RPP
0543	Segment B Knickerbocker-Pleasant Valley 345 kV	F,G	Greenbush - Pleasant Valley 345kV	AC Transmission (ACPPTPP)	12/2023	n/a	2020-2021 RPP
0556	Segment A Double Circuit	E, F	Edic - New Scotland 345kV		12/2023	n/a	
0430	Cedar Rapids Transmission Upgrade	D	Dennison - Alcoa 115kV	AC Transmission	I/S	+80	
0631	NS Power Express (CHPE)	J	Hertel 735kV (Quebec)-Astoria Annex 345kV (NYC)	HVDC Transmission	12/2025	1000	2022 RNA
0887	CH Uprate					250	
1125	Northern New York Priority Transmission Project (NNYPTP)	D, E	Moses/Adirondack/Porter Path	AC Transmission	12/2025	n/a	
Proposed Large Generation Additions							
396	Baron Winds	C	Hillside - Meyer 230kV	Wind	Dec-23	238.4	2020-2021 RPP
422	Eight Point Wind Enery Center	B	Bennett 115kV	Wind	Sep-22	101.8	
495	Mohawk Solar	F	St. Johnsville - Marshville 115kV	Solar	Nov-24	90.5	2022 RNA
505	Ball Hill Wind	A	Dunkirk - Gardenville 230kV	Wind	Nov-22	100.0	2020-2021 RPP
531	Number 3 Wind Energy	E	Taylorville - Boonville 115kV	Wind	Oct-22	103.9	2021 Q3 STAR
579	Bluestone Wind	E	Afton - Stilesville 115kV	Wind	Oct-22	111.8	2022 RNA
612	South Fork Wind Farm	K	East Hampton 69kV	Offshore Wind	Aug-23	96.0	
617	Watkins Glen Solar	C	Bath - Montour Falls 115kV	Solar	Nov-23	50.0	
618	High River Solar	F	Inghams - Rotterdam 115kV	Solar	Nov-22	90.0	
619	East Point Solar	F	Cobleskill - Marshville 69kV	Solar	Nov-22	50.0	
637	Flint Mine Solar	G	LaFarge - Pleasant Valley 115kV, Feura Bush - North Catskill 115kV	Solar	Sep-23	100.0	
678	Calverton Solar Energy Center	K	Edwards Substation 138kV	Solar	Jun-22	22.9	2020-2021 RPP
695	South Fork Wind Farm II	K	East Hampton 69kV	Offshore Wind	Aug-23	40.0	2022 RNA
720	Trelina Solar Energy Center	C	Border City - Station 168 115 KV	Solar	Nov-23	80.0	
721	Excelsior Energy Center	A	N. Rochester - Niagara 345 kV	Solar	Nov-22	280.0	
758	Independence GS1 to GS4 *+9MW ERIS only*	C	Scriba 345 kV	Gas	I/S	9.0	

Queue #	Project Name/(Owner)	Zone	Point of Interconnection	Type	COD or I/S Date	Summer Peak MW	Included Starting
Proposed Small Generation Additions							
545	Sky High Solar* (Sky High Solar, LLC)	C	Tilden -Tully Center 115kV	Solar	06/2023	20	2021 Q3 STAR
565	Tayandenega Solar* (Tayandenega Solar, LLC)	F	St. Johnsville - Inghams 115kV	Solar	10/2022	20	
570	Albany County 1* (Hecate Energy Albany 1 LLC)	F	Long Lane - Lafarge 115kV	Solar	12/2022	20	
572	Greene County 1* (Hecate Energy Greene 1 LLC)	G	Coxsackie - North Catskill 69kV	Solar	01/2023	20	
573	Greene County 2* (Hecate Energy Greene 2 LLC)	G	Coxsackie Substation 13.8kV	Solar	03/2023	10	
584	Dog Corners Solar* (SED NY Holdings LLC)	C	Aurora Substation 34.5kV	Solar	05/2022	20	
586	Watkins Road Solar* (SED NY Holdings LLC)	E	Watkins Rd - Ilion 115kV	Solar	06/2023	20	
590	Scipio Solar (Duke Energy Renewables Solar, LLC)	C	Scipio 34.5kV Substation	Solar	05/2023	18	
592	Niagara Solar (Duke Energy Renewables Solar, LLC)	B	Bennington 34.5kV Substation	Solar	05/2023	20	
598	Albany County 2* (Hecate Energy Albany 2 LLC)	F	Long Lane - Lafarge 115kV	Solar	12/2022	20	
638	Pattersonville* (Pattersonville Solar Facility, LLC)	F	Rotterdam - Meco 115kV	Solar	12/2022	20	
666	Martin Solar* (Martin Solar LLC)	A	Arcade - Five Mile 115kV	Solar	10/2022	20	
667	Bakerstand Solar* (Bakerstand Solar LLC)	A	Machias - Maplehurst 34.5kV	Solar	10/2022	20	2021 Q3 STAR
682	Grissom Solar* (Grissom Solar, LLC)	F	Ephratah - Florida 115kV	Solar	06/2022	20	
730	Darby Solar* (Darby Solar, LLC)	F	Mohican - Schaghticoke 115kV	Solar	12/2022	20	
731	Branscomb Solar* (Branscomb Solar, LLC)	F	Battenkill - Eastover 115kV	Solar	I/S	20	
735	ELP Stillwater Solar (ELP Stillwater Solar LLC)	F	Luther Forest - Mohican 115kV	Solar	09/2022	20	
748	Regan Solar* (Regan Solar, LLC)	F	Market Hill - Johnstown 69kV	Solar	06/2022	20	
768	Janis Solar* (Janis Solar, LLC)	C	Willet 34.5kV	Solar	04/2022	20	
775	Puckett Solar* (Puckett Solar, LLC)	E	Chenango Forks Substation 34.5kV	Solar	04/2022	20	
564	Rock District Solar* (Rock District Solar, LLC)	F	Sharon - Cobleskill 69kV	Solar	12/2022	20	
670	Skyline Solar* (SunEast Skyline Solar LLC)	E	Campus Rd - Clinton 46kV	Solar	04/2022	20	
581	Hills Solar (SunEast Hills Solar LLC)	E	Fairfield - Inghams 115kV	Solar	08/2023	20	2022 RNA
734	Ticonderoga Solar* (ELP Ticonderoga Solar LLC)	F	ELP Ticonderoga Solar LLC	Solar	8/1/2022	20	
759	KCE NY 6* (KCE NY 6, LLC)	A	Gardenville - Bethlehem Steel Wind 115kV	Storage	04/2022	20	
769	North County Energy Storage (New York Power Authority)	D	Willis 115kV	Storage	03/2022	20	
807	Hilltop Solar (SunEast Hilltop Solar LLC)	E	Eastover - Schaghticoke 115kV	Solar	07/2023	20	
848	Fairway Solar (SunEast Fairway Solar LLC.)	E	McIntyre - Colton 115kV	Solar	10/1/2023	20	
855	NY13 Solar (Bald Mountain Solar LLC)	F	Mohican - Schaghticoke 115kV	Solar	11/1/2023	20	

Notes:

*Only these proposed small generators obtained Capacity Resource Interconnection Service (CRIS) and therefore are modeled for the resource adequacy Base Cases.

All proposed large generators obtained, or are assumed to obtain, both Energy Resource Interconnection Service (ERIS) and CRIS and are modeled in both transmission security and resource adequacy Base Cases, unless otherwise noted as “ERIS only,” in which case they are modeled only for the transmission security assessments.

Figure 5: 2022 RNA Generation Deactivations[12] Assumptions

2022 GB Table	Owner/ Operator	Plant Name	Zone	Summer Capability	2022 RNA Base Case Status	2020 RNA Base Case Status
Table IV-3: Deactivated Units with Unexpired CRIS Rights Not Listed in Existing Capacity Table III-2	International Paper Company	Ticonderoga (4)	F	9.5	out	out
	Helix Ravenswood, LLC	Ravenswood 2-4	J	30.7	out	out
	Helix Ravenswood, LLC	Ravenswood 3-1	J	31.9	out	out
	Helix Ravenswood, LLC	Ravenswood 3-2	J	29.4	out	out
	Helix Ravenswood, LLC	Ravenswood 3-4	J	31.2	out	out
	Exelon Generation Company LLC	Monroe Livingston	B	2.4	out	out
	Innovative Energy Systems, Inc	Steuben County LF	C	3.2	out	out
	Consolidated Edison Co. of NY, Inc	Hudson Ave 4	J	14	out	out
	New York State Elec& Gas Corp.	Auburn - State St	C	4.1	out	out
	Cayuga Operating Company, LLC	Cayuga 1	C	151	out	out
	Albany Energy LLC	Albany LFGE	F	5.6	out	out
	Somerset Operating Company, LLC	Somerset	A	676.4	out	out
	Entergy Nuclear Power Marketing, LLC	Indian Point 2	H	1011.5	out	out
	Astoria Generating Company L.P.	Gowanus 1-8(5)	J	16	out	out
Table IV-4: Deactivated Units Listed in Existing Capacity Table III-2	Entergy Nuclear Power Marketing, LLC	Indian Point 3	H	1036.3	out	out
	Helix Ravenswood, LLC	Ravenswood 01 (3)	J	7.7	out	out
		Ravenswood 11 (3)	J	16.1	out	out
Table IV-5: Notices of Proposed Deactivations as of March 15, 2020	National Grid	West Babylon 4	K	41.2	out	out
	Long Island Power Authority	Glenwood GT 01	K	13	out	out
	Seneca Power Partners. L.P.	Allegheny Cogen	B	62	out	in
		Sithe Batavia	B	48.7	out	in
		Sithe Sterling	B	49.2	out	in
	ENGIE Energy Marketing NA, Inc.	Nassau Energy Corporation	K	38.5	out	in
	Astoria Generating Company, L.P.	Gowanus 1-1 through 1-7	J	117.1	out	out
		Gowanus 4-1 through 4-8	J	138.8	out	out
	NRG Power Marketing LLC	Astoria GT 2-1 through 2-4	J	141.6	out	out
		Astoria GT 3-1 through 3-4	J	140.5	out	out
		Astoria GT 4-1	J	138.3	out	out
			Total	4005.9		
			Changes since CRP	198.4		

Figure 6: Existing Plants Impacted by DEC's Peaker Rule

2022 GB Table	Owner/ Operator	Plant Name	Zone	Summer Capability	Status Change Date 2022 RNA Base Case	2020 RNA Base Case Status
Table IV-6: Proposed Staus Change to Comply with DEC Peaker Rule	Central Hudson Gas & Elec. Corp.	Coxsackie GT	G	19.2	05/01/2023	same
		South Cairo	G	18.9	05/01/2023	same
	Consolidated Edison Co. of NY, Inc.	74 St. GT 1 & 2	J	39.3	05/01/2023	same
		Hudson Ave 3	J	13.6	05/01/2023	same
		Hudson Ave 5	J	12.3	05/01/2023	same
		59 St. GT 1	J	15.3	05/01/2025	same
	Helix Ravenswood, LLC	Ravenswood 10	J	16.0	05/01/2023	same
	National Grid	Northport GT	K	12.0	05/01/2023	same
		Port Jefferson GT 01	K	12.6	05/01/2023	same
		Shoreham 1	K	44.7	05/01/2023	in service
		Shoreham 2	K	15.7	05/01/2023	in service
		Glenwood GT 03	K	44.7	05/01/2023	in service
	NRG Power Marketing, LLC	Arthur Kill GT 1	J	13.1	05/01/2025	same
	Astoria Generating Company, L.P.	Astoria GT 01	J	12.1	05/01/2023	same
		Gowanus 2-1 through 2-8	J	145.5	05/01/2025	same
		Gowanus 3-1 through 3-8	J	137.4	05/01/2025	same
		Narrows 1-1 through 2-8	J	291.5	05/01/2025	same
			Total	863.9		
			Changes since CRP	105.1		

Note: NYSDEC's Part 227-3 applies to all simple cycle gas turbines with nameplates equal to or greater than 15 MW. Thus, all simple cycle generators are subject to the rule and all owners of these machines were required to submit compliance plans to the NYSDEC. The compliance plans consist of statements that the generator; (i) already complies with the new NOx limits, (ii) will retire, (iii) will limit operation during the ozone season, and/or (iv) will retrofit emission control technology to meet the emission limits of the new rule. If the plant owners submitted compliance plans that state that the generator will be able to operate within the new NOx limits during the ozone season, these generators remain in-service in the RNA base case.

3. Base Case Findings

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 did not identify any resource adequacy Reliability Needs. The NYCA LOLE results are presented in **Figure 7** below.

Figure 7: NYCA Resource Adequacy Results

Study Year	Baseline Forecast Load (MW)	RNA Base Case LOLE (days/year)
2023	32,018	0.025
2024	31,778	0.018
2025	31,505	0.024
2026	31,339	0.004
2027	31,292	0.005
2028	31,317	0.004
2029	31,468	0.005
2030	31,684	0.006
2031	31,946	0.010
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).[13]

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.

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[13] 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.

LOLH is generally defined 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). 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 8: NYCA Resource Adequacy Results

Study Year	LOLE	LOLH	LOEE
	event-days/year	event-hours/year	MWh/year
2023	0.025	0.061	23.860
2024	0.018	0.035	11.538
2025	0.023	0.048	18.399
2026	0.004	0.008	1.734
2027	0.005	0.010	2.529
2028	0.004	0.008	1.626
2029	0.005	0.009	1.799
2030	0.006	0.013	3.051
2031	0.010	0.020	5.095
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 9**. 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 9: 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**

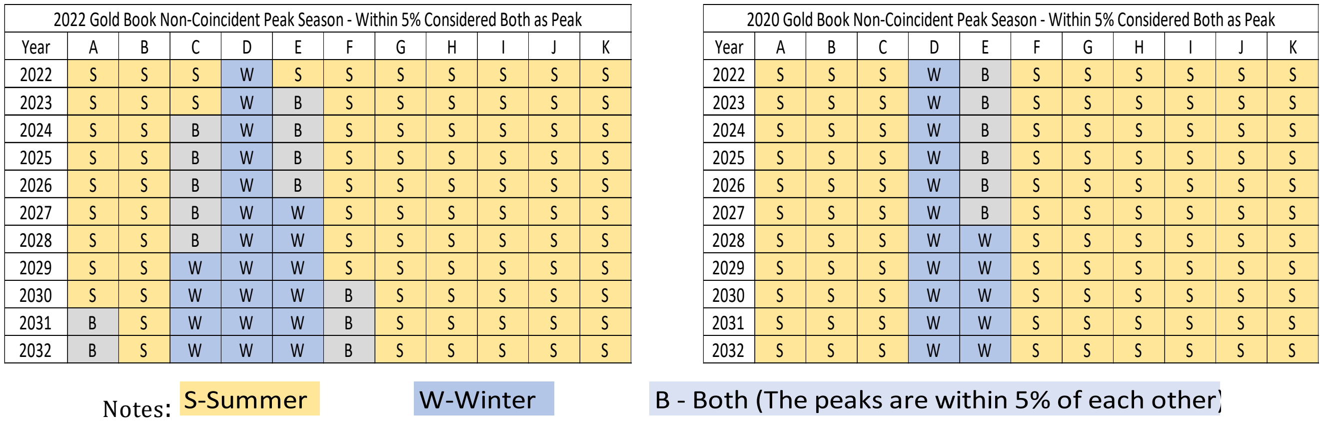
Notes:

- **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.

The NYISO currently employs several modeling methods 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 in a manner to assure those areas are self-sufficient before providing assistance to New York.

Figure 10 shows a comparison between summer and winter zonal demand forecasts used for the resource adequacy base cases in the 2022 and 2020 RNAs. 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 of the 2022 RNA report.

Figure 10: 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)

The 2022 RNA Base Case resource adequacy results show that:

- The New York Control Area (NYCA) loss of load expectation (LOLE in days/year) through the ten-year planning horizon is below NYSRC's and Northeast Power Coordinating Council's (NPCC's) criterion of one day in 10 years, or 0.1 days per year. This is mainly due to the net MW resources included in the 2022 RNA Base Case is higher as compared to the prior CRP base cases. Additionally, the 2022 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.
- The GE-MARS events are distributed in June, July (the most), August, and September in the afternoon hours (as shown in the Appendix D event analysis graphs).
- Additionally, there are events observed in the winter months. 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). Figure 10 shows a comparison of the distribution of summer versus winter forecasts between the 2022 Gold Book and 2020 Gold Book.

4. Scenarios and Resource Adequacy Risks

The NYISO, in conjunction with stakeholders and Market Participants, developed reliability scenarios for the 2022 RNA. Scenarios are variations on the 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. 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 the 2022 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 2022 RNA Base Case.
4. **Winter Scenarios**
5. **CLCPA Scenarios – Policy Case Scenario for Study Year 2030**

The results of the scenarios are summarized in the following sections.

High Load Forecast Scenario

The 2022 RNA Base Case forecast includes impacts associated with projected energy reductions coming from statewide energy efficiency and BtM 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 11 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 12.

Figure 11: 2022 Gold Book NYCA High Load vs. Baseline Summer Peak Forecast

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

Figure 12: High Load Scenario Resource Adequacy Results

Study Year	RNA Base Case LOLE (days/year)	High Load Scenario LOLE (days/year)	Delta LOLE
2023	0.025	0.044	0.018
2024	0.018	0.039	0.021
2025	0.024	0.068	0.045
2026	0.004	0.027	0.023
2027	0.005	0.035	0.030
2028	0.004	0.052	0.047
2029	0.005	0.079	0.074
2030	0.006	0.149	0.143
2031	0.010	0.342	0.332
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 Margins (ZRAM)

Resource adequacy simulations were also performed on the 2022 RNA Base Cases[14] 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 having adequate resources to reliably serve load.

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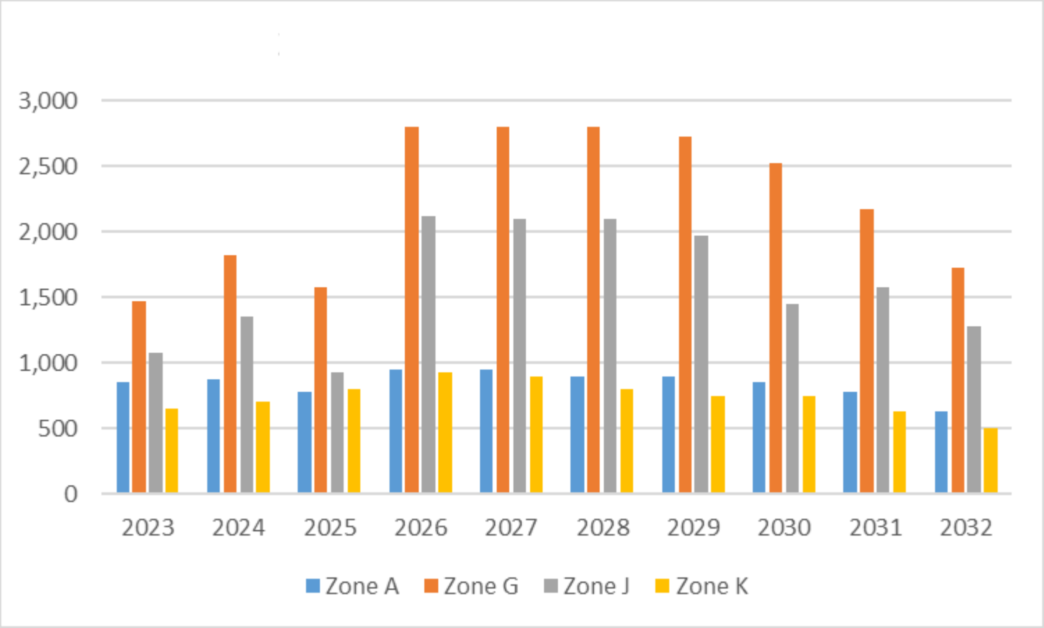
[14] The CRP base cases already reflect the DEC Peaker Rule compliance plans submitted by the affected generation owners to DEC, which are summarized in the assumption tables from Appendix B.

Figure 13 shows the tightening of zonal resource adequacy margins for western New York (Zone A), Hudson Valley (Zone G), New York City (Zone J), and Long Island (Zone K). New York may experience even smaller resource adequacy margins if additional power plants become unavailable or if demand is greater than forecasted. As shown in Figure 13, the margin is only 500 MW in Long Island (Zone K) and only 625 MW in western New York (Zone A) by 2032. The Long Island margin is likely to increase as a result of the Long Island Offshore Wind Export Public Policy Transmission Need.

Figure 13: 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 14, and the zonal resource margin analysis (ZRAM) is summarized in Figure 15**.**

Figure 14: NYISO Load Zone Map

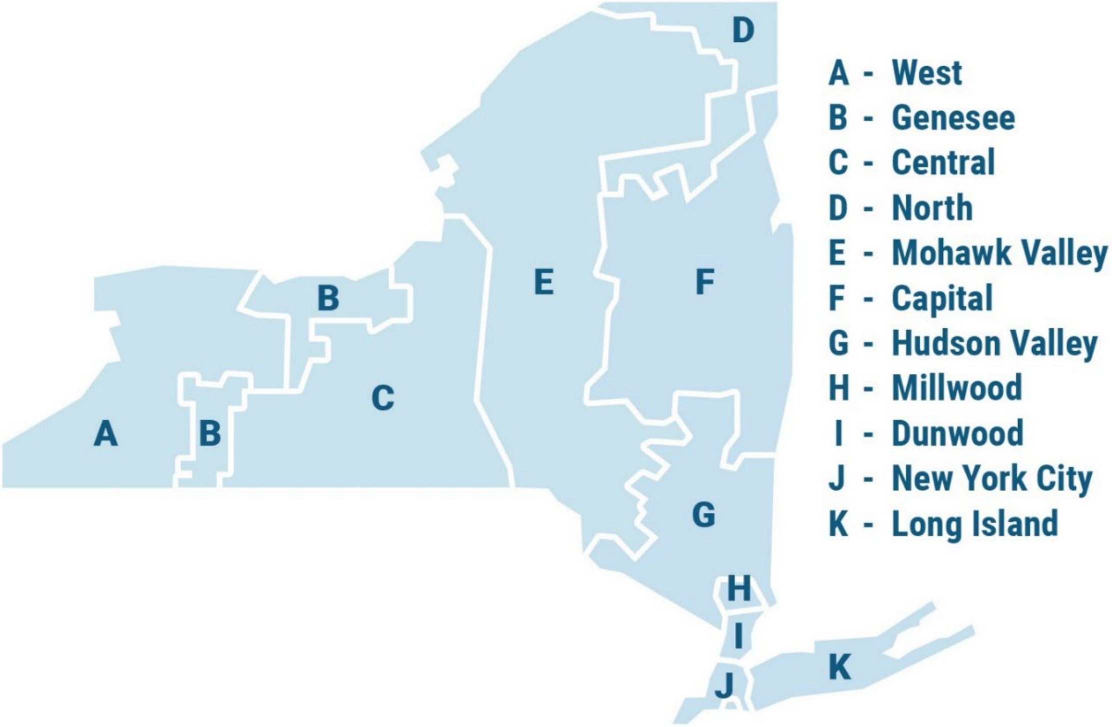


Figure 15: Zonal Resource Adequacy Margins (MW)

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 will 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, will be necessary under the applicable planning 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 16.

Figure 16: Binding Interface Analysis

Study Year	2022 RNA Base Case NYCA LOLE	Free Flow NYCA LOLE	Delta LOLE
2026	0.004	0.003	-0.001
2027	0.005	0.003	-0.002
2028	0.004	0.003	-0.002
2029	0.005	0.002	-0.002
2030	0.006	0.004	-0.002
2031	0.010	0.005	-0.005
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 that are assumed under the 2022 RNA Base Case 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 4, Figure 5, and Figure 6). The AC Transmission Public Policy Projects and the Western New York Public Policy Project are not removed for this scenario due to their advancement in development.

Figure 17: Status-quo Scenario Resource Adequacy Results

	2022 RNA 1st Pass Base Case vs Status-Quo Scenario LOLE *(days/year)*		
Study Year	RNA Base Case	Status Quo	Delta
2023	0.025	0.028	0.003
2024	0.018	0.024	0.007
2025	0.024	0.033	0.010
2026	0.004	0.022	0.018
2027	0.005	0.026	0.021
2028	0.004	0.020	0.015
2029	0.005	0.021	0.017
2030	0.006	0.042	0.036
2031	0.010	0.041	0.031
2032	0.022	0.068	0.046

	2022 RNA 1st Pass Base Case vs Remove CHPE Sensitivity LOLE *(days/year)*		
Study Year	RNA Base Case	TDI/CHPE Removed	Delta
2023	0.025	0.025	0.000
2024	0.018	0.018	0.000
2025	0.024	0.024	0.000
2026	0.004	0.015	0.011
2027	0.005	0.016	0.011
2028	0.004	0.014	0.010
2029	0.005	0.015	0.011
2030	0.006	0.033	0.026
2031	0.010	0.033	0.023
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. Figure 17 shows the LOLE results when removing the proposed additions from the Base Case while leaving in-service the generators that require modifications to comply with the DEC's Peaker Rule. For those generators requiring modifications, the total MW capability exceeds the zonal resource adequacy margin for Zone K shown in Figure 15, signifying that the resource adequacy criterion would not be met if those modifications are not completed. An additional sensitivity was performed with only removing the CHPE project. Those results indicate that most of the NYCA LOLE impact is due to this project's removal.

Winter Scenarios: Gas Shortage

For the 2022 RNA, the NYISO assessed winter reliability for cold snap and gas supply shortage conditions. With input from NYISO's ongoing fuel & energy security initiatives, approximately 6,300 MW of existing gas-fueled generation was identified as potentially at-risk under gas shortage conditions. 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 are outlined in the *2022 Gold Book*, as well as the *2022 Power Trends Report*.[15]

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."[16] 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.[17] Locally, the NYSRC has established goals to identify actions to preserve NYCA reliability for extreme weather events and other extreme system conditions.[18]

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.[19] 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.[20] 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.[21] At the nationwide level, NERC identified a project, entitled Project 2022-03 Energy Assurance with Energy-Constrained Resources, that proposes to address several energy assurance concerns related to both the operations and planning time horizons.[22]

For both the resource adequacy simulations and the transmission security margin evaluation of

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[15] Power Trends 2022

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

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

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

[19] 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.

[20] 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.

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

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

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.

The 2022 RNA, therefore, conducted a resource adequacy scenario that simulated for the gas shortage conditions described above. This 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 degradation in the resource adequacy of the system (*e.g.,* LOLE from 0.022 to 0.049 days/year) under a gas shortage scenario.

Figure 18: 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	2,130	394	3,829	6,353	0.049
*The resource adequacy models reflect the lesser of CRIS and DMNC					

However, the NYISO is currently performing its Public Policy Transmission Planning Process that is evaluating solutions to 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 system reliability (*e.g.,* LOLE from 0.049 days/year to 0.037 days/year) if the import capability into Long Island is increased.

Additionally, and to complete the gas shortage assessment with the transmission security margins perspective, the Figure 19 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 20 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 margins for all conditions throughout the study period.

Figure 19: Winter Weather Statewide System Margins

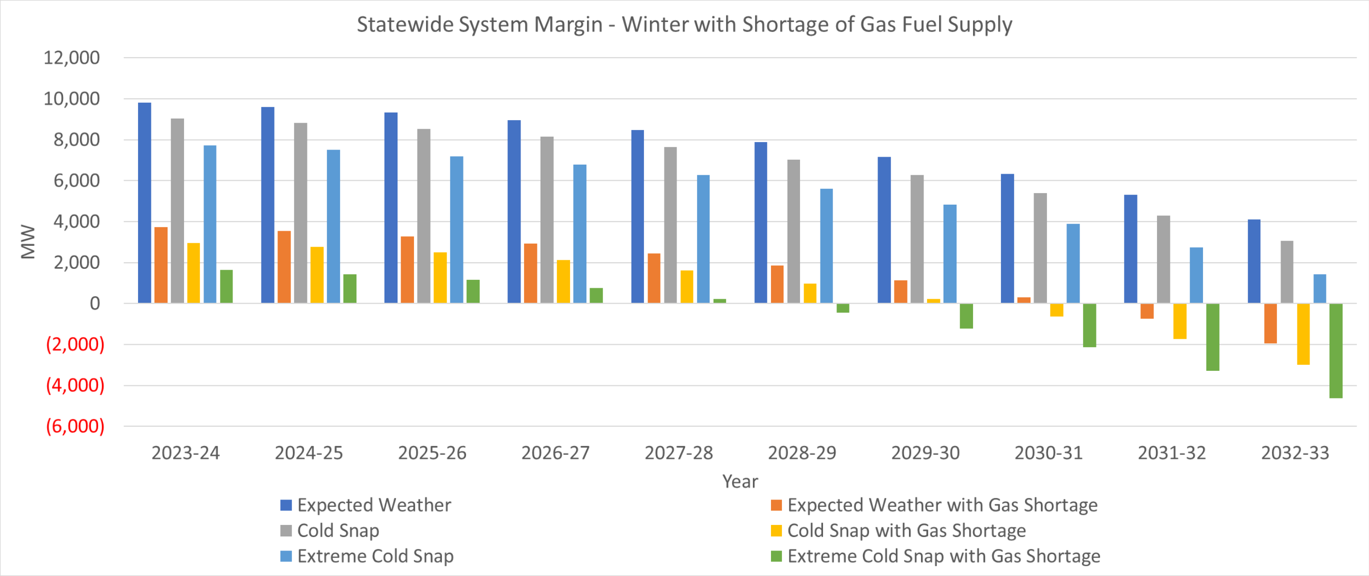
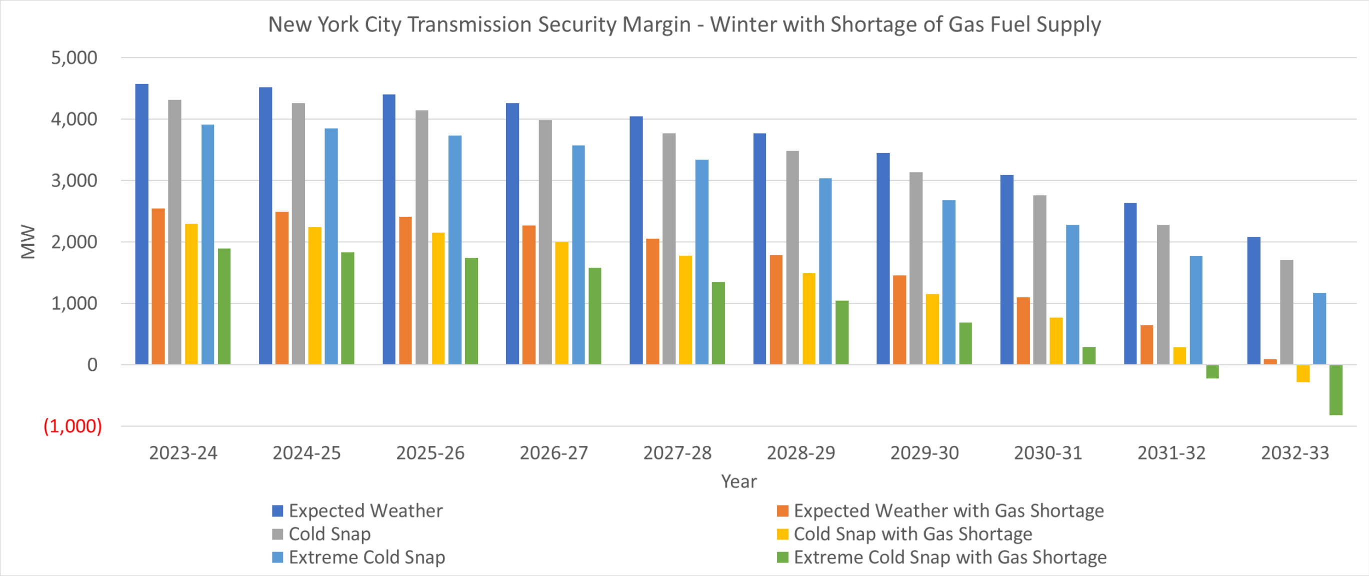


Figure 20: Winter Weather New York City Transmission Security Margins



5. Road to 2040 – 70 x 30 Policy Case Scenario

Significant shifts are expected in both the demand and supply sides of the electric grid, and these changes will affect how the power system is currently planned and operated. As part of the *2021-2040 System & Resource Outlook* (the Outlook), the NYISO assessed several policy-driven futures to identify potential resource mixes and examine resulting system constraints and operational limitations. The 2022 RNA built upon the findings of the Outlook and performed a Policy Case scenario with an analysis of the postulated 2030 system conditions.

Background of the 2022 RNA 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 New York State's CLCPA 70 x 30 renewable mandate and the 2040 zero-emissions directive.

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. Scenario 2 in the Outlook Policy Case 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. 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 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 the 2022 RNA resource adequacy Policy Case scenario, the NYISO used the Scenario 2 results from 2030. Projected resource mixes for Scenario 2 are provided in Figure 21. Historical zonal capacity by type is shown in Figure 22 for comparison to the Outlook Policy Case results for Scenario 2, which are provided in Figure 23.

Figure 21: Outlook Policy Case Scenario 2 Capacity Expansion Results

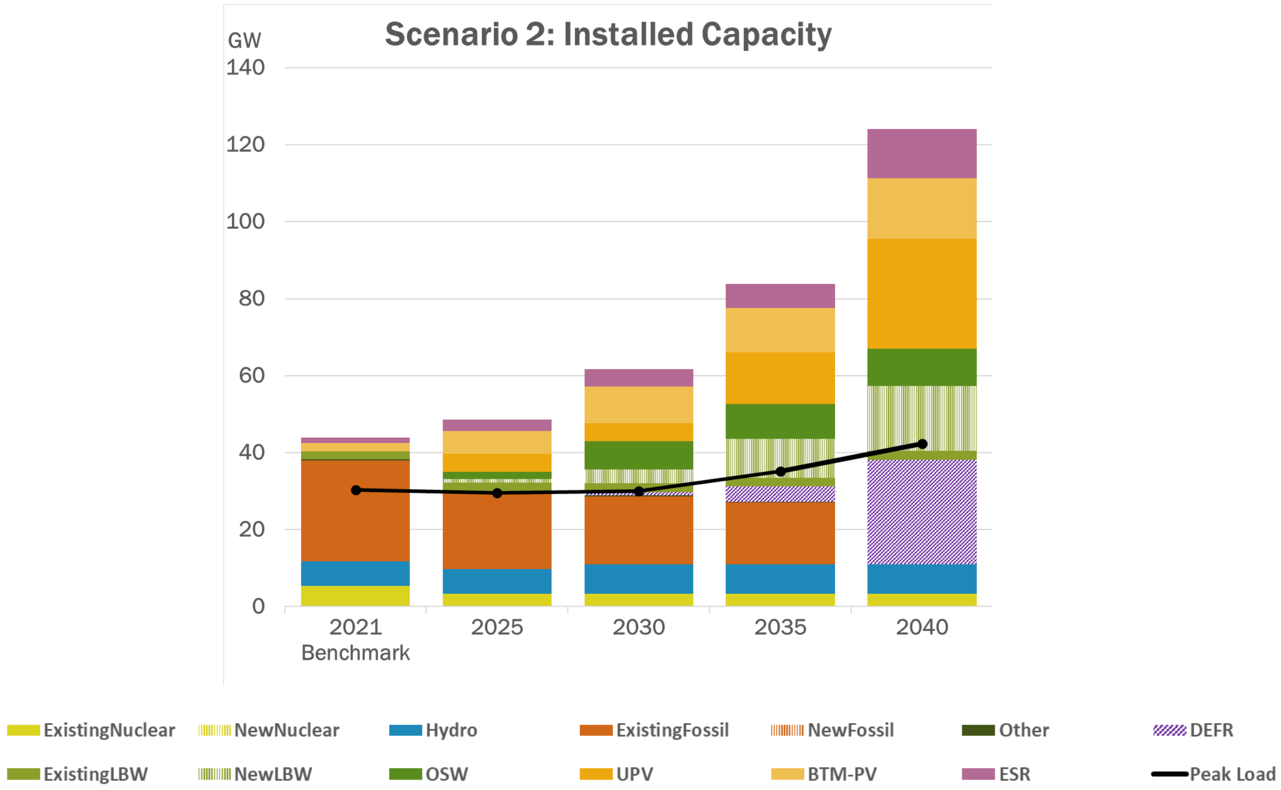


Figure 22: 2021 Actual Installed Capacity By Zone

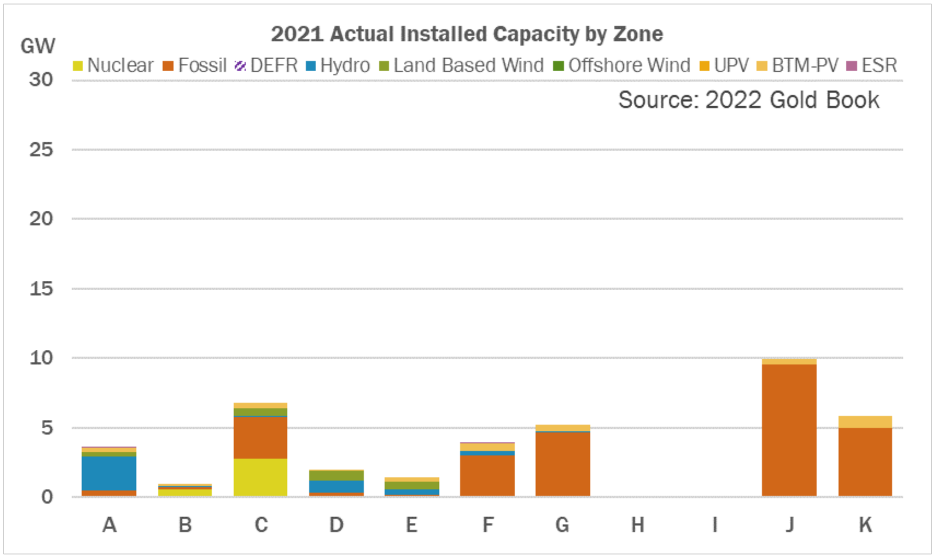
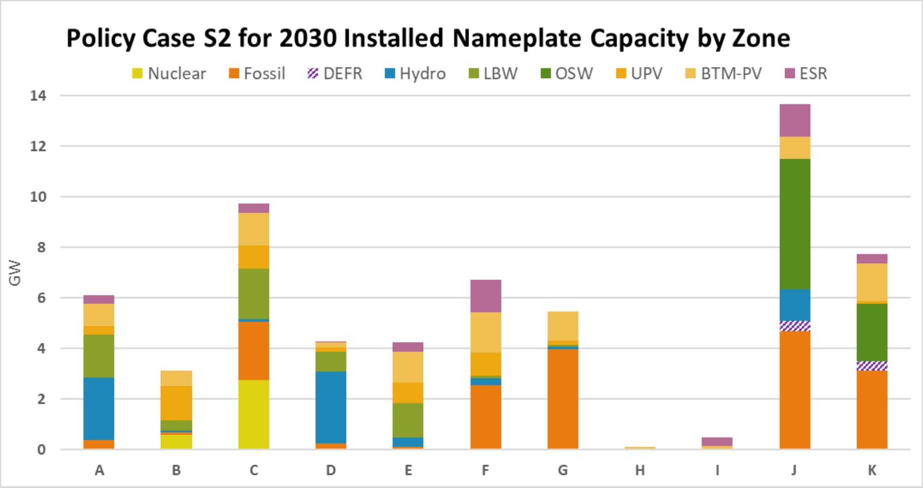


Figure 23: Outlook Policy Case Scenario 2 Installed Nameplate Capacity by Zone - 2030



2022 RNA Policy Case Scenario Assumptions

The following detail the assumptions used in the Policy Case scenario for the 2022 RNA, with additional details in Appendix E.

Load Assumptions

The same 8,760 hourly load shape from the Outlook Policy Case Scenario 2 for 2030 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 24 below, with BtM solar forecast added back.

Figure 24: 2030 Policy Case Demand Forecasts

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

Figure 25: 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. The 2022 RNA scenario modeled 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 Solar 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 Policy Case Scenario 2 forecast were from the *Climate Impact Study Phase II.* [23] They were modified to align with the projected BtM PV capacity from Berkley's Lab Integration Analysis.[24]

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 23 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 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)

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

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

Transmission

The 2022 RNA Policy Case 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 CHPE is also included in the 2022 RNA Base Case. Both projects are reflected in the resource adequacy model using the Outlook Policy Case 8,760 hourly MW flow.

- 1,250 MW Champlain Hudson Power Express Project,[25] 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,[26] 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 the 2022 RNA Policy Case scenario.

Policy Case Analysis and Findings

New cases were developed based on the assumptions described above, and two fossil removal sensitivities (age-based and zonal MW removal) were performed to better understand the impact of various factors.

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 26 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

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

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

surplus of available generation for resource adequacy purposes.

Figure 26: 2030 Policy Case Resource Adequacy Results

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

Policy Case Zonal Resource Adequacy Margins

Additional simulations were performed on the 2022 RNA Policy Case scenario to gauge the sensitivity of the system when capacity is removed. 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 must be larger in order to achieve the same impact as perfect-capacity resources.

Figure 27: 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 provided in Figure 27 show that while the NYCA LOLE for the Outlook Policy Case Scenario 2 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 MW in Zone D) can lead to resource adequacy violations. Removing 450 MW of perfect capacity in Zone K results in approximately 17,200 MW of fossil generation remaining to maintain an adequate system.

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.

Both the Outlook Policy Case and the 2022 RNA Policy Case 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.

Figure 28: 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

This age-based scenario shows that approximately 17,000 MW must be retained to have an adequate system with a net peak demand of 26,700 MW. For different conditions, such as higher peak load or different zonal resources and types, this value can be higher. If the higher RNA base case peak load materializes, additional existing fossil generation will be needed 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, and 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 29 and Figure 30 below show the resulting resource 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 29: 2030 Policy Case: NYCA Resource Mix after the Age-Based Fossil Removal

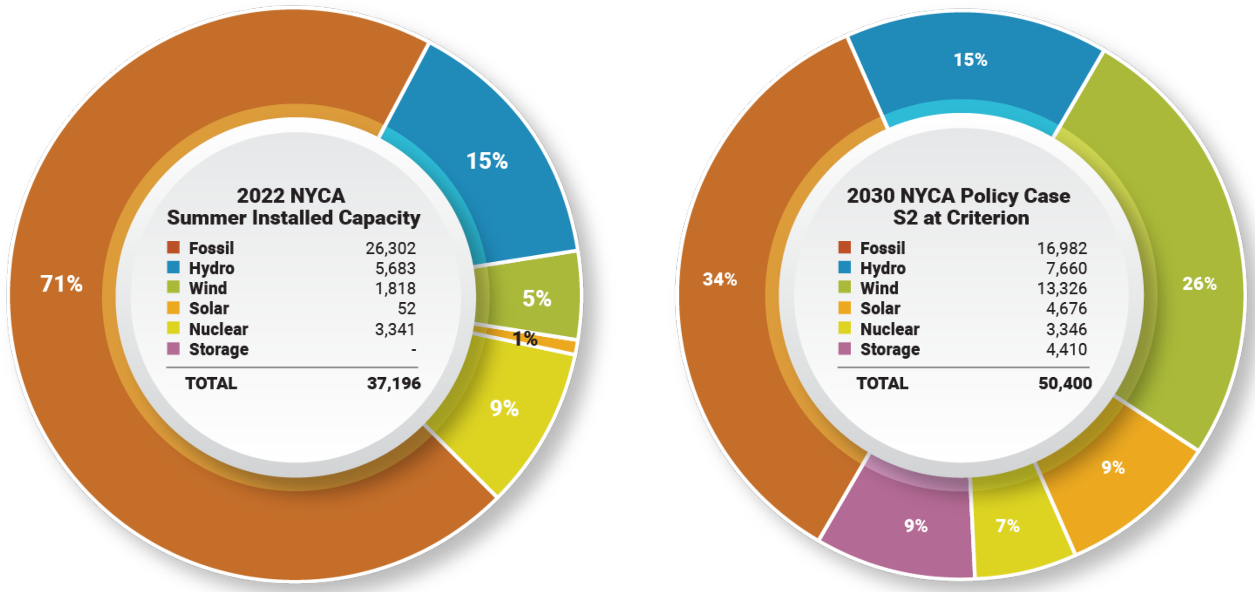


Figure 30: 2030 Policy Case: New York City (Zone J) and Long Island (Zone K) Resource Mix at Criterion

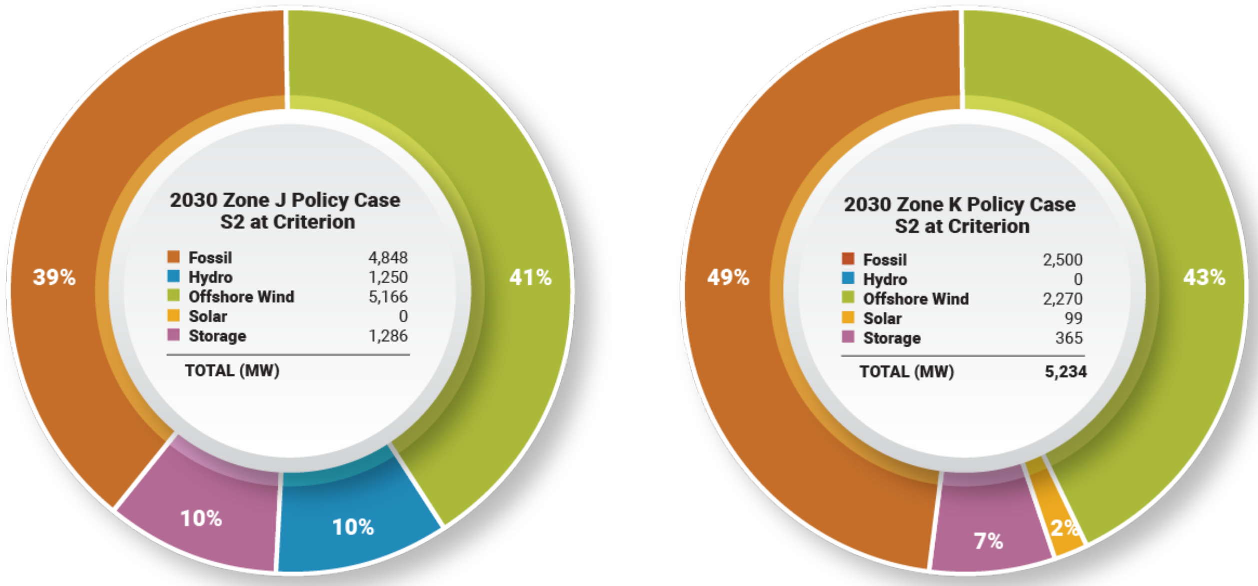


Figure 31 shows a comparison between the total installed capacity and unforced capacity (with consideration for unit unavailability) for the 2022 RNA scenario case when the system is close to LOLE criterion. After removal of fossil generation to bring the model to criterion, the remaining resources result in a statewide total capacity-to-load ratio of 188.5%, equivalent to an unforced capacity-to-load ratio of 135.8%.

Figure 31: 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.

6. Next Steps

The 2022 RNA was the first step of the 2022-2023 cycle of the NYISO's Reliability Planning Process. Since the 2022 RNA did not identify any actionable Reliability Needs, the NYISO will proceed with the preparation of the Comprehensive Reliability Plan (CRP). In addition to the CRP, the NYISO will continue to evaluate the system on a quarterly basis through the Short-Term Reliability Process. The 2022 Q3 STAR for 2023 through 2027 similarly did not identify any actionable reliability need. In the event that there is a future STAR that identifies a reliability need in year 1 through year 3, the NYISO will address it through that STAR, while needs identified in years 4 and 5 will be addressed in a subsequent cycle of the Reliability Planning Process.

Appendix A – 2022 RNA Resource Adequacy Assumptions

2022 RNA MARS Assumptions Matrix

#	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 Base Case (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 2022 Q3 STAR: [link]	Nov 15, 2022: NYISO Board approval, Final 2022 RNA: [link] [link]	

<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
Base Case

(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 Base Case (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 Base Case (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 Base Case (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.
11 a	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.
11 b	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.
12 a	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.

#	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 Base Case (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*
12 b	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]
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

#	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 Base Case (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*
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
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

#	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 Base Case (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*
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
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

#	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 Base Case (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*
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

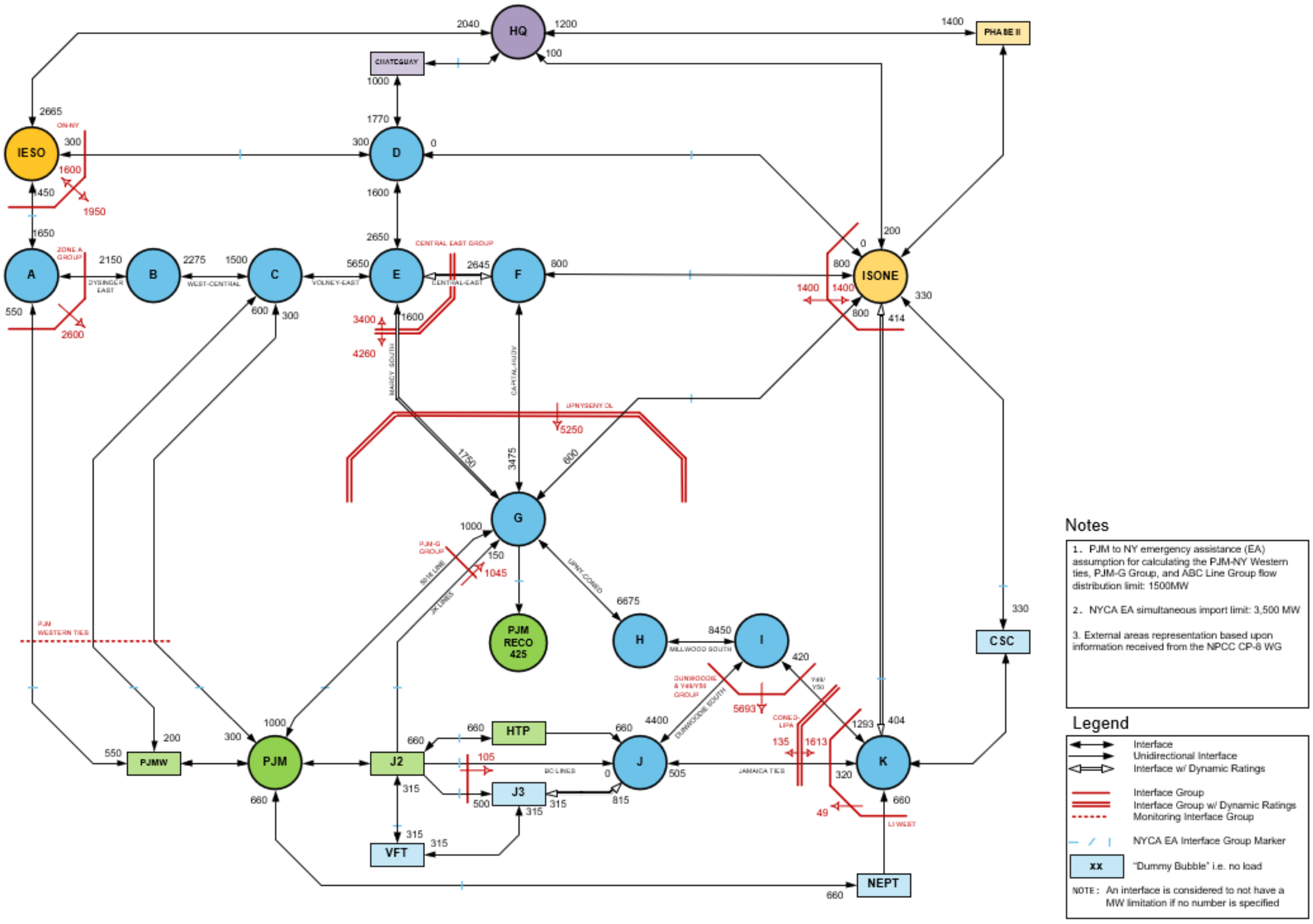
#	Parameter	2020 RNA *(2020 GB)* Study Period: 2024 (y4) - 2030 (y10)	2021-2030 CRP and 2021 Q2 STAR (*2020 GB updated as applicable)* Study Period: 2024-2030 and 2021(y1) -2025 (y5), respectively	2022 RNA Base Case (2022 Gold Book) Study Period: y4 (2026)-y10 (2032)	2022 RNA Outlook Scenario *Based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

2022 RNA MARS Topology

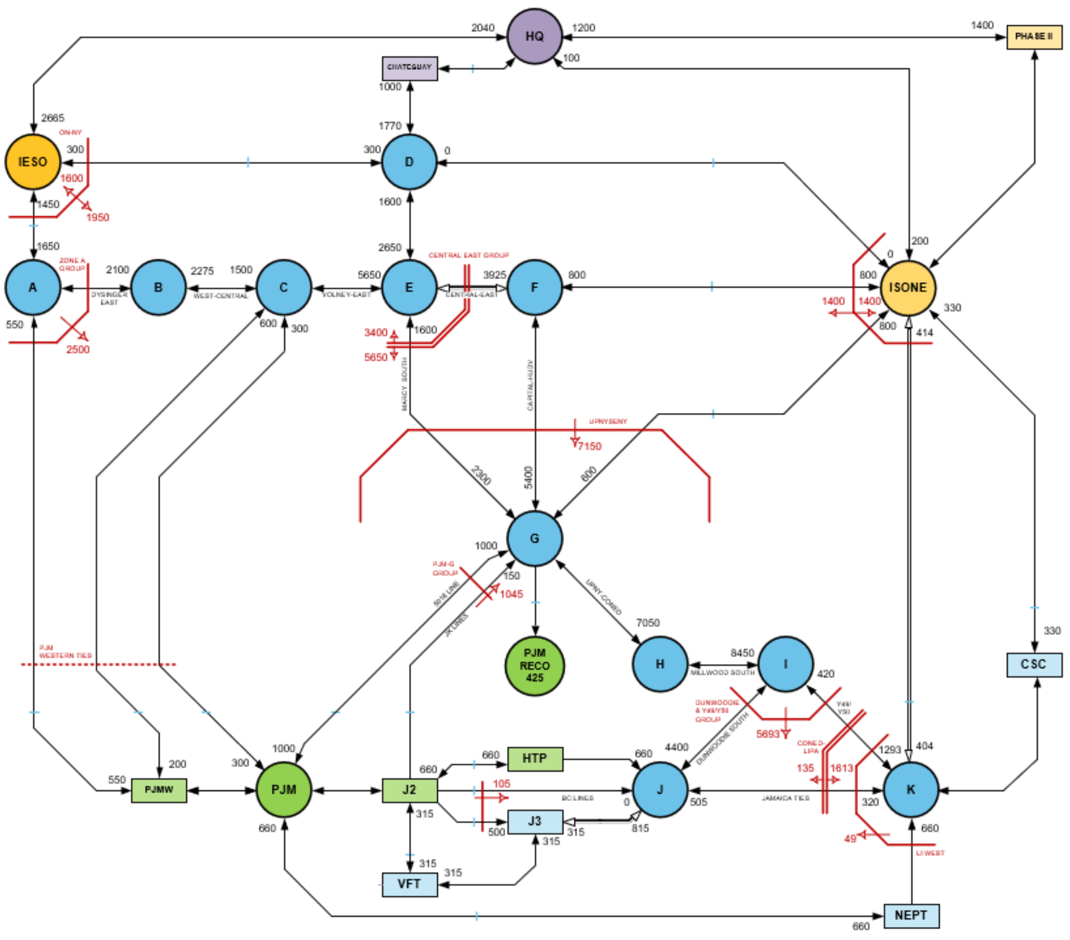
2022 RNA Topology Year 1 (2023)



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

2022 RNA Topology Year 2 (2024)



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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

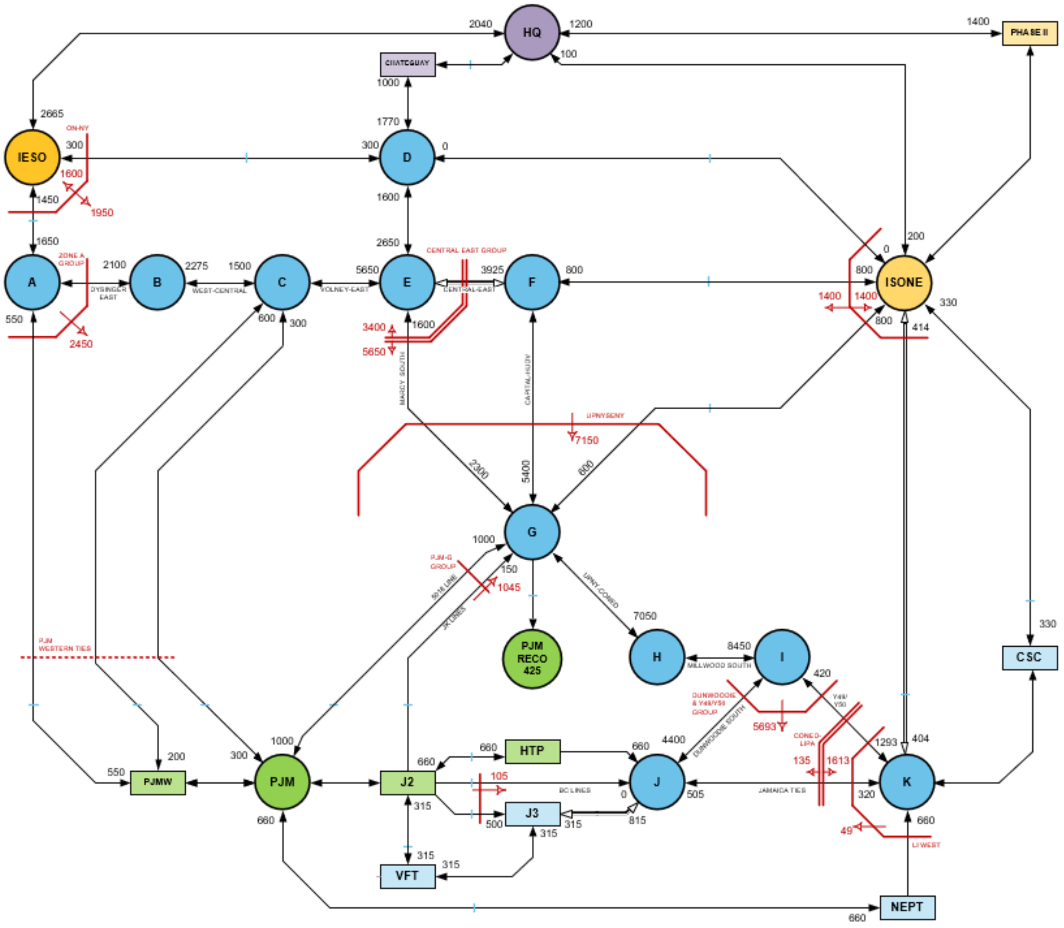
3. External areas representation based upon information received from the NPCC CP-8 WG

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

2022 RNA Topology Year 3 (2025)



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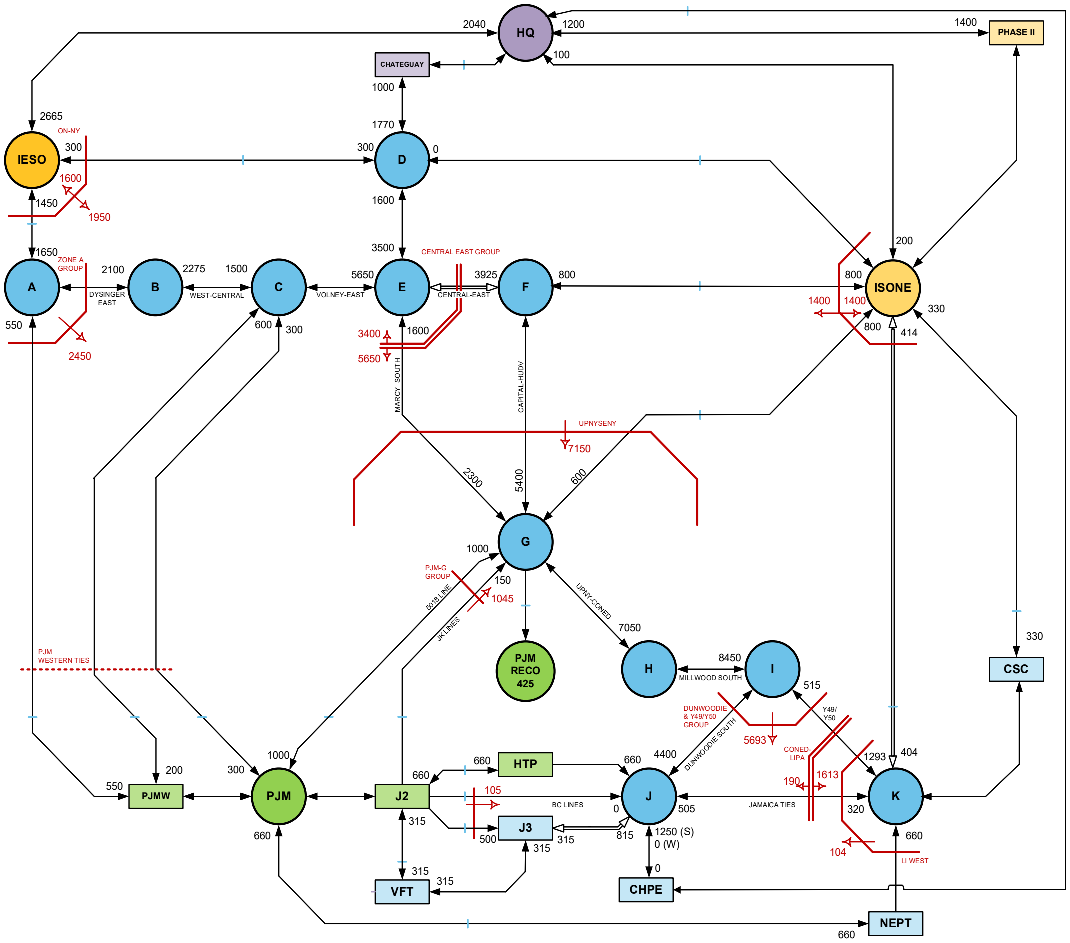
2. NYCA EA simultaneous import limit: 3,500 MW
3. External areas representation based upon information received from the NPCC CP-8 WG

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

2022 RNA Topology Years 4-10 (2026 -2032)



Notes

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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