New York ISO
Independent System Operator

Ancillary Services Shortage Pricing

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MC

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Agenda

- Background
- Ancillary Services Shortage Pricing Proposal
  - Proposed Reserve Demand Curve Enhancements
  - Proposal for Supplemental Reserves
  - NYCA 30-minute Reserve Demand Curve Structure during Scarcity Activations
  - Interaction of Scarcity Pricing and Supplemental Reserves
- Tariff Revisions
- Next Steps
- Appendix

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Project Overview

- **This project consists of two primary components:**
  - Revisions to the current reserve demand curves
    - Adjustments to shortage pricing values
    - Additional “steps” for a more graduated demand curve for NYCA 30-minute reserves
  - Procurement of supplemental reserves
    - These are additional reserves beyond minimum reliability requirements
- **This project also proposes revisions to the structure of the NYCA 30-minute reserve demand curve that applies in real-time during Special Case Resource (“SCR”)/Emergency Demand Response Program (“EDRP”) activations of less than all zones**

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Proposed Reserve Demand Curve Enhancements

**See appendix for additional details*

Overview of Proposed Enhancements

Reserve Region	Reserve Product	Reserve Reqt.	Demand curve ($/MWh)		Rationale
			Current	Proposed	
NYCA	30-minute	2,620 MW	300 MW at $25/MWh	200 MW at $40/MWh	Allow a portion of the 30 minute total reserves to be forgone against price volatility
			-	125 MW at $100/MWh	Facilitate reduction of unnecessary price volatility by further graduation of the NYCA 30-minute reserve demand curve
			355 MW at $100/MWh	55 MW at $175/MWh	Consistent with cost of operator actions to maintain 30-minute reserves (GT OOMs)
			-	55 MW at $225/MWh	Consistent with cost of operator actions to maintain 30-minute reserves (SREs)
			300 MW at $200/MWh	55 MW at $300/MWh	Facilitate reduction of unnecessary price volatility by further graduation of the NYCA 30-minute reserve demand curve
			-	55 MW at $375/MWh	Represents a value aligned with the average cost of 99% of the resource costs observed for historic SRE and OOM commitments
			-	55 MW at $500/MWh	Consistent with cost of activating SCR/EDRP resources to maintain reserves
			-	55 MW at $625/MWh	Facilitate reduction of unnecessary price volatility by further graduation of the NYCA 30-minute reserve demand curve
			1,665 MW at $750/MWh	1,965 MW at $750/MWh	Consistent with cost of operator actions to replenish reserves by converting 30 min GTs to energy
NYCA	10 minute total	1,310 MW	$750/MWh	$750/MWh	Consistent with cost of operator actions to replenish reserves by converting 30 min GTs to energy
NYCA	10 minute spin	655 MW	$775/MWh	$775/MWh	Provide scheduling priority to NYCA 10-minute total and NYCA 30-minute reserves
EAST	30-minute	1,200 MW	$25/MWh	$40/MWh	Facilitates distribution of reserves throughout NYCA
EAST	10 minute total	1,200 MW	$775/MWh	$775/MWh	Recognizes equal importance with NYCA 10-min spinning reserves
EAST	10 minute spin	330 MW	$25/MWh	$40/MWh	Facilitates distribution of reserves throughout NYCA

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Overview of Proposed Enhancements

Reserve Region	Reserve Product	Reserve Reqt.	Demand curve ($/MWh)		Rationale
			Current	Proposed	
SENY	30-minute	1,550 MW or 1,800 MW	250 MW or 500 MW at $25/MWh (recently approved by stakeholders)	250 MW or 500 MW at $40/MWh	Additional 30-minute reserves to facilitate returning transmission assets to Normal Transfer Criteria following a contingency (see Reserves for Resource Flexibility project)
			1,300 MW at $500/MWh	1,300 MW at $500/MWh	Consistent with cost of activating SCR/EDRP resources to maintain reserves
NYC	30-minute	1,000 MW	$25/MWh	$25/MWh	Facilitates distribution of reserves throughout NYCA
NYC	10-minute total	500 MW	$25/MWh	$25/MWh	Facilitates distribution of reserves throughout NYCA
LI	30-minute	270-540 MW	$25/MWh	$25/MWh	Facilitates distribution of reserves throughout NYCA
LI	10-minute total	120 MW	$25/MWh	$25/MWh	Facilitates distribution of reserves throughout NYCA

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Proposal for Procuring and Pricing Supplemental Reserves

**See appendix for additional details*

Proposal for Supplemental Reserve Requirements

- **The NYISO does not propose to add any supplemental reserve requirements at this time.**
- **Instead the NYISO proposes to establish the process/procedures for implementing/adjusting supplemental reserves when warranted in the future**
  - The NYISO is seeking to implement the necessary tariff revisions to add/adjust these requirements in the future as part of this proposal.
  - The proposal addresses only implementing/adjusting supplemental requirements for existing reserve products (i.e., spinning, 10-minute, and 30-minute reserves)
    - A separate initiative would be required to implement any new reserve product types/durations

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Proposal for Supplemental Reserve Requirements

- **The need for supplemental reserves will be based on the normal expected levels of 30 and 60 minute net load forecast error due to the NYISO's expected forecasting accuracy of load and production capability from installed wind and solar resources**
  - The normal expected levels of 60-minute under-forecast net load forecast error will be monitored to determine the need to implement/adjust 30-minute supplemental reserves
  - The normal expected levels of 30-minute under-forecast net load forecast error will be monitored to determine the need to implement/adjust 10-minute supplemental reserves
    - The NYISO intends to procure 50% of any identified need for 10-minute supplemental reserves as spinning reserves
- **If forecasting systems enhancements cannot fully resolve the under-forecast net load forecast error being observed, the NYISO will conduct a historical analysis of the data to establish the implementation/adjustment of 10-minute and/or 30-minute supplemental reserve procurement targets sufficient to capture 95% of the under-forecast net load forecast error being observed.**

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Proposal for Supplemental Reserve Requirements

- **The NYISO will review any proposal to implement/adjust supplemental reserves at MIWG and SOAS.**
- **Additionally, the NYISO will be required to obtain Operating Committee approval of any proposal to implement/adjust supplemental reserves.**
  - Operating Committee approval is required at least 30 days prior to any supplemental reserves proposal being implemented in the market

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Pricing Proposal

- **The NYISO proposes to price supplemental reserves, when added in the future, based on the following shortage pricing values in all reserve regions**
  - Any supplemental 30-minute reserves= $10/MWh
  - Any supplemental 10-minute total reserves = $12/MWh
  - Any supplemental 10-minute spinning reserves = $15/MWh
- **The pricing values would be set forth in the tariff along with language related to the process for implementing/adjusting supplemental reserves when warranted in the future.**

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NYCA 30-Minute Reserve Demand Curve during SCR/EDRP Activations

Scarcity Pricing: NYCA 30-Minute Reserve Demand Curve

- The NYISO proposes to align the treatment of the applicable Scarcity Reserve Requirement within the MW quantities assigned to the "steps" of the NYCA 30-minute reserve demand curve during all SCR/EDRP activations
- Based on the proposed revisions to the NYCA 30-minute reserve demand curve for the existing statewide reserve requirement of 2,620 MW, the proposed enhancements would result in a revised three "step" curve during SCR/EDRP activations in real-time with consistent logic for assigning MW quantities across the three "steps"
  - $750/MWh "step" up to and including 1,965 MW
  - $625/MWh "step" beyond 1,965 MW through 2,020 MW
  - $500/MWh "step" beyond 2,020 MW through (2,620 + the applicable Scarcity Reserve Requirement)

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Scarcity Pricing Enhancements

**See appendix for additional details*

Pricing of Supplemental Reserves during SCR/EDRP activations

- **During SCR/EDRP activations, the NYISO's proposal would maintain the proposed $10/MWh shortage pricing value for only the quantity of 30-minute supplemental reserves, if any, that exceeds the applicable scarcity reserve requirement(s).**
  - During SCR/EDRP activations, the NYISO would procure the greater of the applicable scarcity reserve requirement(s) and any applicable 30-minute supplemental reserve requirements
  - Reserves procured to satisfy the applicable scarcity reserve requirement(s) will simultaneously serve to meet any applicable 30-minute supplemental reserve requirement
- **For reserve regions that encompass the zones of an SCR/EDRP activation, the updated proposal will account for procuring the greater of the scarcity reserve requirement or applicable supplemental reserve requirement in each affected reserve region**

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Tariff Revisions

Tariff Revisions

- **The NYISO proposes revisions within Section 15.4.7 of Rate Schedule 4 of the Market Administration and Control Area Services Tariff (MST) to reflect the proposed enhancements**
- **Reserve shortage pricing and NYCA 30-minute reserve demand curve changes**
  - Adjusting $25/MWh shortage pricing values to $40/MWh, except for NYC and LI
    - MST Sections 15.4.7(b) and 15.4.7(c): Eastern and SENY spinning reserves
    - MST Sections 15.4.7(h): SENY 10-minute total reserves
    - MST Sections 15.4.7(k), 15.4.7(l), and 15.4.7(m): NYCA and Eastern 30-minute reserves, as well as the SENY incremental 30-minute reserves proposed by the Reserves for Resource Flexibility project
  - Revised NYCA 30-minute reserve demand curve shortage pricing values and inclusion of additional “steps” for a more graduated curve
    - MST 15.4.7(k)

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Tariff Revisions (cont.)

- **Revisions to NYCA 30-minute reserve demand curve structure during SCR/EDRP activations**
  - MST Section 15.4.7(k): second and third paragraphs provide for consistent treatment regardless of whether SCRs/EDRP are activated statewide or is less than all Load Zones
- **Proposal for procuring supplemental reserves**
  - MST Section 15.4.7: general description of the process for implementing/adjusting supplemental reserve requirements including the requirement that proposals to implement/adjust supplemental reserves require stakeholder approval at the Operating Committee at least 30 days prior to implementation or adjustment thereof
  - MST Sections 15.4.7(a), 15.4.7(b), 15.4.7(c), 15.4.7(d), and 15.4.7(e): addition of a $15/MWh shortage pricing value for any supplemental spinning reserve requirements that may be implemented in the future
  - MST Sections 15.4.7(f), 15.4.7(g), 15.4.7(h), 15.4.7(i), and 15.4.7(j): addition of a $12/MWh shortage pricing value for any supplemental 10-minute total reserve requirements that may be implemented in the future
  - MST Sections 15.4.7(k), 15.4.7(l), 15.4.7(m), 15.4.7(n), and 15.4.7(o): addition of a $10/MWh shortage pricing value for any supplemental 30-minute reserve requirements that may be implemented in the future
  - MST Sections 15.4.7(k), 15.4.7(l), 15.4.7(m), 15.4.7(n), and 15.4.7(o): revisions to the 30-minute reserve demand curves applicable during SCR/EDRP activations to: (1) address the procurement of the greater of the applicable scarcity reserve requirement(s) or any applicable 30-minute supplemental reserve requirement during SCR/EDRP activations in real-time; (2) account for reserves procured to meet the applicable scarcity reserve requirement(s) serving to satisfy any applicable 30-minute supplemental reserve requirement; and (3) retain the $10/MWh shortage price assigned to any applicable supplemental reserves only to the extent that any applicable 30-minute supplemental reserve requirement exceeds the otherwise applicable scarcity reserve requirement(s)

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Next Steps

Next Step & Implementation Timeline

- **December 2020/January 2021**
  - Seek Board of Directors approval
- **As discussed at the October 2, 2020 MIWG, the NYISO is currently working with its vendor to estimate the anticipated timeline for implementing the various components of the proposal**
  - The NYISO will continue to keep stakeholders informed as these estimates are developed

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Our mission, in collaboration with our stakeholders, is to serve the public interest and provide benefit to consumers by:

- Maintaining and enhancing regional reliability
- Operating open, fair and competitive wholesale electricity markets
- Planning the power system for the future
- Providing factual information to policymakers, stakeholders and investors in the power system

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Appendix

Background

A Grid in Transition – The Plan

- **Carbon Pricing**
- **Comprehensive Mitigation Review**
- **DER Participation Model**
- **Energy Storage Participation Model**
- **Hybrid Storage Model**

Aligning Competitive Markets and New York State Clean Energy Objectives

- **Enhancing Energy & Shortage Pricing**
  - Ancillary Services Shortage Pricing
  - Constraint Specific Transmission Shortage Pricing
  - Enhanced Fast Start Pricing
- **Review Energy & Ancillary Services Product Design**
  - More Granular Operating Reserves
  - Reserve Enhancements for Constrained Areas
  - Reserves for Resource Flexibility

Valuing Resource & Grid Flexibility

- **Enhancements to Resource Adequacy Models**
- **Revise Resource Capacity Ratings to Reflect Reliability Contribution**
  - Expanding Capacity Eligibility
  - Tailored Availability Metric
- **Capacity Demand Curve Adjustments**

Improving Capacity Market Valuation

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Previous Presentations

Date	Working Group	Discussion points and links to materials
12-05-19	ICAPWG/MIWG	Ancillary Services Shortage Pricing - Study Report https://www.nyiso.com/documents/20142/9622070/Ancillary%20Services%20Shortage%20Pricing_study%20report.pdf
04-07-20	ICAPWG/MIWG	Ancillary Services Shortage Pricing - Reserve Demand Curve Enhancements https://www.nyiso.com/documents/20142/11759586/Ancillary%20Services%20Shortage%20Pricing%20MIWG%2004072020.pdf
04-27-20	ICAPWG/MIWG	Ancillary Services Shortage Pricing https://www.nyiso.com/documents/20142/12170360/Ancillary%20Services%20Shortage%20Pricing%20MIWG%2004272020.pdf
07-14-20	ICAPWG/MIWG	Consumer Impact Methodology- Ancillary Services Shortage Pricing https://www.nyiso.com/documents/20142/13769834/CIA%20Methodology%20for%20Ancillary%20Services%20Shortage%20Pricing%20-%20Final.pdf
08-10-20	ICAPWG/MIWG	Ancillary Services Shortage Pricing https://www.nyiso.com/documents/20142/14404876/Ancillary%20Services%20Shortage%20Pricing_08102020_MIWG_final.pdf
09-01-20	ICAPWG/MIWG	Ancillary Services Shortage Pricing https://www.nyiso.com/documents/20142/14935961/Ancillary%20Services%20Shortage%20Pricing%20-%2009012020%20MIWG_final.pdf Consumer Impact Analysis- Ancillary Services Shortage Pricing https://www.nyiso.com/documents/20142/14935961/CIA%20-%20Ancillary%20Services%20Shortage%20Pricing%20-%20Final.pdf
09-22-20	ICAPWG/MIWG	Ancillary Services Shortage Pricing https://www.nyiso.com/documents/20142/15473217/Ancillary%20Services%20Shortage%20Pricing%2009222020%20MIWG.pdf
10-16-20	ICAPWG/MIWG	Ancillary Services Shortage Pricing https://www.nyiso.com/documents/20142/16124862/4%20Ancillary%20Services%20Shortage%20Pricing%2010162020%20MIWG_final.pdf

Ancillary Services Shortage Pricing

- **This is a continuation of a 2019 project**
  - In December 2019, NYISO published a report that evaluated the appropriateness of revising the structure of the current reserve demand curves (including additional, more granular steps).
- **2020 Project Goal : Market Design Complete**

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Reserve Demand Curve Enhancements

Reserve Demand Curve Enhancements

- **Proposed revisions to the values and steps of the current reserve demand curves are intended to:**
  - Ensure continued compliance with applicable reliability requirements
  - Account for more recent data and information regarding resource operating costs
  - Provide targeted market signals that align with actual reliability needs of the NYCA at times when actions are being taken to maintain reliability
  - Provide appropriate locational price signals to incentivize resources to include/maintain capability to provide reserves when and where needed
  - Maintain consistency with actions taken by operators to maintain system reliability

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Proposed NYCA 30-minute Reserve Demand Curve

- **Based on the NYSRC rules, the NYCA 30-minute requirement of 2,620 MW addresses the following:**
  - 1.5 times the single largest contingency (1.5*1,310 MW = 1,965 MW)
  - Following a contingency, 10-minute operating reserve shall be restored within 30 minutes
    - NYCA 10-minute reserve requirement = 1,310 MW.
    - 1965 MW covers a portion of the supplemental 1,310 MW needed to meet this requirement (1,965-1,310 = 655 MW)
    - Additional 655 MW is required to address this rule bringing the NYCA 30-minute requirement to 2,620 MW (1,965+655 =2,620 MW)
- **The binding NYSRC requirement relates to 1,965 MW. Thus, NYISO operators would seek to avoid reserves falling below the 1.5 x largest single contingency component of the requirement.**
- **Therefore, the NYISO proposes to price this 1,965 MW portion of the total statewide reserve requirement at $750/MWh**
- **For the remaining 655 MW of 30-minute reserves, the NYISO proposes to utilize a stepped approximation of an exponential curve to help smooth the NYCA 30-minute reserve demand curve**
  - An exponential curve was used because, as available reserves approach 1,965 MW, the operators are more likely to take actions to maintain system reliability
  - The cost of various operator actions that may be taken to maintain reliability were utilized in developing the exponential curve construct

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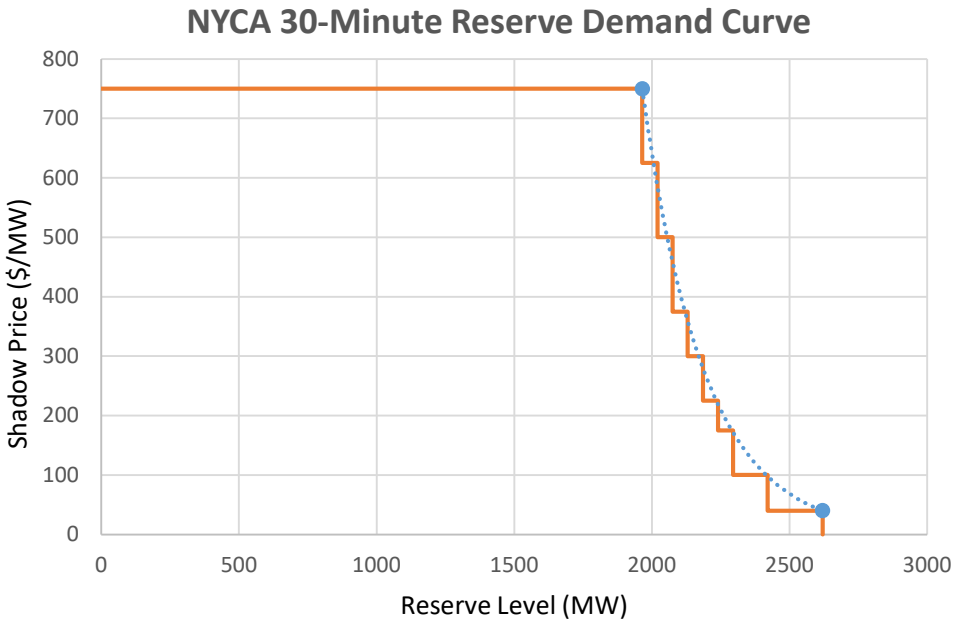
Exponential Curve Construct Analysis



Shortage Price ($/MW)	Reserve Level (MW)	Demand Curve (MW)
750	≤ 1,965 to 0	1,965
625	1,965 to 2,020	55
500	2,020 to 2,075	55
375	2,075 to 2,130	55
300	2,130 to 2,185	55
225	2,185 to 2,240	55
175	2,240 to 2,295	55
100	2,295 to 2,420	125
40	2,420 to 2,620	200

Note:

- Highlighted shortage price cells indicate the values from the costs of operator actions analysis

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Analysis for Reserve Demand Curve Enhancements

Considerations for Shortage Pricing Values

- **Shortage pricing values should be set at levels that are consistent with operator actions to maintain reliability.**
- **In evaluating the current shortage pricing values, the NYISO has considered the following:**
  - Cost of resources capable of providing reserves on peak load days
  - Cost of demand reductions from SCR/EDRP activations
  - Cost of Supplement Resource Evaluation (SRE) commitments
  - Cost of out-of-merit (OOM) actions to commit fast-start resources
  - Re-run of certain Real-Time Commitment (RTC) cases

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Costs of Resources during Peak Load Days

- To evaluate the continued sufficiency of the current $750/MWh “step” of the NYCA 30-minute reserve demand curve, costs of 10-minute and 30-minute resources were analyzed on peak load days from 2017-2019
- Costs were determined using

$$\frac{\text{Startup Cost (\$)}}{\text{Max}(\text{UOL},\text{UOL}_{\text{E}}(\text{MW}))} + \text{Max incremental cost}(\$/\text{MWh})$$

  - Min gen costs are also included as a point on the incremental cost curve

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Costs of Resources during Peak Load Days

- The current $750/MWh value was informed by evaluating resource costs observed during the 2013 summer peak, and 2014 winter peak.
- NYISO proposes to retain a "step" on the NYCA 30-minute reserve demand curve with a shortage pricing value of $750/MWh.

Peak Load Day (2017-2019)	Max cost ($/MWh)	99 percentile of cost ($/MWh)
12/15/2016 (Winter 2017)	446.57	379.11
7/19/2017 (Summer 2017)	382.58	363.94
1/5/2018 (Winter 2018)	2347.38	1152.7
8/29/2018 (Summer 2018)	513.94	453.73
1/21/2019 (Winter 2019)	735.76	562.56
7/20/2019 (Summer 2019)	472.08	425.66
Average costs	816.38	563.29

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SCR/EDRP Activations

- Analyzed locations of SCR/EDRP activations from 2001-2019
- SENY 30-minute reserve shortages are valued at $500/MWh in recognition that the NYISO will activate SCR/EDRP (at a general cost of $500/MWh) to maintain such reserves
- The NYISO will also activate SCR/EDRP to maintain NYCA 30-minute reserves. Therefore, a “step” with a shortage pricing value of $500/MWh is proposed to be added to the NYCA 30-minute reserve demand curve

Number of SCR Events by Reserve Region	
SENY	9
NYCA	14

Source: Historic SCR/EDRP event posting

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Costs of SRE Commitments

- The NYISO may use the SRE process to commit additional resources outside of SCUC (Day-Ahead) to meet statewide (NYCA) reliability or local reliability requirements.[1]
- The NYISO evaluated the costs associated with SRE commitments for NYCA reliability from 2017-2019.
  - The average cost of such SRE commitments was $218/MWh
- The NYISO proposes to increase the $200/MWh "step" on the NYCA 30-minute reserve demand curve to $225/MWh.
  - Better representing more recent information regarding resource costs is intended to improve the efficiency of resource commitment and pricing outcomes

1. For additional details on the SRE process refer to the NYISO Transmission and Dispatching Operations Manual at the link below: https://www.nyiso.com/documents/20142/2923301/trans_disp.pdf/9d91ad95-0281-2b17-5573-f054f7169551

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Cost of OOM Commitments for Fast-Start Resource

- **The NYISO evaluated costs of OOM commitments for reserves from 2018-2019 using an adjusted incremental curve approach developed as part of the revised fast-start pricing rules**
  - Adjusted incremental cost curve for GT (since Min Gen= UOL)
    - [Start-up cost ($)+Min Generation cost ($)]/(Min gen (MW)* 1hr)
  - The average cost of such commitments was $171/MWh.
- **To better reflect more recent information, the NYISO proposes to increase the $100/MWh "step" on the NYCA 30-minute reserve demand curve to $175/MWh.**
  - Alignment of shortage pricing values with the cost of operating actions to maintain reliability is intended to facilitate efficient resource commitment and pricing outcomes

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Re-run of RTC Cases

- **The NYISO evaluated RTC re-run cases with different demand curve values to determine a pricing level at which re-dispatch occurs to help reduce or fully resolve historically observed shortages.**
- **16 RTC intervals were re-run from August 2019 - April 2020 where NYCA 30-minute reserves or EAST spinning reserves were short.**
  - These products were selected because the current reserve demand curves for each product include use of a $25/MWh shortage price value. The 2019 study also identified shortages of these two products as being among the most frequent over the three year historic period reviewed (July 2016 - July 2019)
  - $30/MWh shortage price value resolved the historically observed shortages 31% of the time
  - $35/MWh shortage price value resolved the historically observed shortages 50% of the time
  - $40/MWh shortage price value resolved the historically observed shortages 87% of the time
- **Re-run results indicate that a shortage price of $40/MWh facilitates re-dispatch to resolve or minimize otherwise observed shortages for various products and locations that currently utilize a $25/MWh shortage pricing value**
  - Results indicate that absent market power/mitigation concerns, increasing existing $25/MWh shortage price values to $40/MWh should assist with efficiently reducing the frequency and/or magnitude of reserve shortages

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Re-run of RTC Cases

- **The NYISO evaluated whether increasing the $25/MWh shortage price value to $40/MWh would present any market power/mitigation concerns for any of the applicable reserve regions and/or products**
  - This evaluation identified potential concerns for NYC and LI due to limited number of eligible suppliers in these reserve regions
  - As a result, the NYISO does not propose to increase $25/MWh shortage pricing values for these reserve regions to $40/MWh
- **The NYISO proposes to increase the current $25/MWh value to $40/MWh for all applicable products an reserve regions other than NYC and LI**
  - Existing reserve products to be adjusted: NYCA 30-minute reserves, East spinning reserves, and East 30-minute reserves
  - The NYISO also proposes to apply this increase to the recent stakeholder-approved enhancements to the SENY 30-minute reserve requirement to procure up to 500 MW (depending on the hour of the day) as part of the Reserves for Resource Flexibility project
    - The Reserves for Resource Flexibility project proposes an initial $25/MWh shortage pricing value for the additional SENY 30-minute reserves; this value would be increased to $40/MWh upon implementation of the enhancements proposed as part of this project

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Process to Evaluate Supplemental Reserves

Proposal for Supplemental Reserve Requirements

- **Process to evaluate potential need for supplemental reserves:**
  - Supplemental procurement amounts will be based on the normal expected levels of 30 and 60 minute net load forecast error[1] due to the NYISO's expected forecasting accuracy of load and production capability from installed wind and solar resources
    - Net load forecast error = {(Forecast load- actual load) - (forecast wind - actual wind) - (forecast FTM solar- actual FTM solar)}
      - Forecast and actual load includes the impacts of production by BTM solar
    - A negative value indicates an under-forecast error which could be due to any of the three factors.
      - Actual load exceeds the forecast load and/or
      - Actual wind is lower than forecasted wind and/or
      - Actual FTM solar is lower than forecasted solar

1. The 30 and 60-minute net load forecast errors are currently reported in the NYISO Monthly Report https://www.nyiso.com/documents/20142/14062304/03%20Operations_Report.pdf/3787716a-240f-ee6e-e174-38b812c7b55a

Proposal for Supplemental Reserve Requirements

- The under-forecast scenario of the net load forecast error will be considered when proposing any 30 and/or 10-minute supplemental reserves.
- The NYISO proposes to monitor the normal expected levels of 60-minute under-forecast net load forecast error and may recommend to implement/adjust 30-minute supplemental reserves to maintain the resources available to restore 10-minute and 30-minute reserves as required by NYSRC and NPCC.
- The NYISO also proposes to monitor the normal expected values of 30-minute under-forecast net load forecast error and may recommend to implement/adjust 10-minute supplemental reserves (with 50% of any proposed 10-minute supplemental reserves to be procured as spinning reserves) to allow ready access to flexible resources in real-time to maintain the levels of 10-minute synchronous and 10-minute total reserve as required by NYSRC

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Proposal for Supplemental Reserve Requirements

- **Considerations that may trigger the need to implement/adjust supplemental reserves**
  - The following conditions are examples of events that may trigger the need to implement/adjust 30-minute and/or 10-minute supplemental reserve requirements:
    - Every increase in quantity of installed solar and wind capacity equal to or greater than 2,000 MW above the 2020 base line of 4,000 MW of wind and solar resources.
    - A maximum under-forecast net load forecast error of 1,000 MW or higher for at least 2 consecutive months that cannot be addressed through improvements to the forecasting systems.
    - An increase in the occurrence of state changes (Alert, Major Emergency) associated with reserve shortages driven by net load and/or wind/solar forecast error

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Proposal for Supplemental Reserve Requirements

- **Evaluation/Reporting Procedure:**
  - Prior to proposing any supplemental reserve requirements, the NYISO will conduct an assessment which will include the following :
    - An evaluation of the NYISO's current forecasting systems and the potential impacts of improvements thereto on the need for implementing/adjusting supplemental reserve requirements
    - The reliability requirements at risk of becoming non-compliant absent remedial action
    - Any recommended implementation/adjustment of 10-minute and/or 30-minute supplemental reserve requirements (either statewide or for a specific reserve region) and the rationale for any such proposal

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Analysis for Pricing of Supplemental Reserves

Proposal for Pricing Supplemental Reserve Requirements

- **Pricing of supplemental reserves**
  - Appropriate shortage pricing values should support procurement of the supplemental reserves, as well as conversion of such reserves to energy when required to meet system needs
  - The NYISO proposes to price these reserves lower than the proposed lowest shortage pricing value for other reserves (i.e., $25/MWh)
    - The proposal to price the supplemental reserves at a non-zero value lower than $25/MWh would provide a signal to procure these reserves when the cost of doing so is relatively low.
    - Additionally, the market software would go short of these reserves prior to going short of the reserves established to meet applicable reliability requirements.

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Proposal for Pricing Supplemental Reserve Requirements

- **The NYISO analyzed the following to help inform the appropriate shortage pricing value for supplemental reserves :**
  - Historic reserve shadow prices to determine the cost of providing the next MW and;
  - Historic reserve offers to determine the willingness to be paid/expected costs

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Proposal for Pricing Supplemental Reserve Requirements

- **Historic reserve shadow price analysis**
  - The NYISO evaluated shadow prices for all day-ahead and real-time (RTD) instances from December 2015 to July 2020 where there were no reserve shortages
    - Reserve shadow prices for any product was either $0/MWh or greater than $0/MWh but less than or equal to the applicable shortage price for the respective product.
    - The shadow price represents the cost to procure one supplemental MW of the reserve product in question
  - This timeframe was considered to account for the changes from the Comprehensive Shortage Pricing project which was implemented in November 2015.

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Pricing Analysis- Historic Reserve Shadow Price

- **DA shadow price analysis**
  - This analysis includes data from all reserve regions
    - 10-minute spin = NYCA spin, EAST spin
    - 10-minute total = NYCA 10, EAST 10, NYC 10, LI 10
    - 30-minute = NYCA 30, EAST 30, SENY 30, NYC 30, LI 30

	10-minute Spin	10-minute total	30-minute
95th percentile of reserve shadow price	$2/MWh	$0.3/MWh	$5/MWh
98th percentile of reserve shadow price	$4/MWh	$1.3/MWh	$5.8/MWh
99th percentile of reserve shadow price	$6.6/MWh	$2.1/MWh	$8/MWh

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Pricing Analysis- Historic Reserve Shadow Price

- **RTD shadow price analysis**
  - This analysis includes data from all reserve regions
    - 10-minute spin = NYCA spin, EAST spin
    - 10-minute total = NYCA 10, EAST 10, NYC 10, LI 10
    - 30-minute = NYCA 30, EAST 30, SENY 30, NYC 30, LI 30

	10-minute Spin	10-minute total	30-minute
95th percentile of reserve shadow price	$1.2/MWh	$0/MWh	$0/MWh
98th percentile of reserve shadow price	$10.9/MWh	$0/MWh	$0/MWh
99th percentile of reserve shadow price	$19.2/MWh	$0/MWh	$0/MWh

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Proposal for Pricing Supplemental Reserve Requirements

- **The NYISO also evaluated historic reserve supply offers**
  - One day from each month in 2019 was considered for this analysis
    - Days with high forecast error and/or peak load days were considered
    - Day-Ahead Market reserve offers for 10-minute spinning, 10-minute total and 30-minute reserves were analyzed

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Pricing Analysis – Historic Reserve Supply Offers

	10-minute spin		10-minute total		30-minute	
	95th percentile of offers	99th percentile of offers	95th percentile of offers	99th percentile of offers	95th percentile of offers	99th percentile of offers
NYCA	$7/MWh	$50/MWh	$5.95/MWh	$11.74/MWh	$8.75/MWh	$50/MWh
NYC and LI	$5.5/MWh	$6/MWh	$6.45/MWh	$14.49/MWh	$8.75/MWh	$10/MWh

- Note - NYC and LI reserve offers are broken out separately to help identify any potential for material differences in offer costs from resources in these regions

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Scarcity Pricing with Supplemental Reserves - Examples

Pricing of Supplemental Reserves during SCR/EDRP activations

- **For reserve regions that encompass the zones of an SCR/EDRP activation, the updated proposal will account for procuring the greater of the scarcity reserve requirement or applicable supplemental reserve requirement in each affected reserve region**
  - Example: Assume during a real-time interval that the following scarcity and supplemental reserve requirements apply: (1) a 300 MW scarcity reserve requirement were applicable in all EAST Load Zones (zones F-K), (2) a 0 MW 30-minute supplemental reserve requirement was in effect for EAST, and (3) a 500 MW 30-minute supplemental reserve requirement was in effect for NYCA
  - The updated proposal would add 300 MW of scarcity reserve priced at a $500/MWh to the EAST 30-minute reserve demand curve
  - Additionally, for the NYCA 30-minute reserve demand curve, the updated proposal would: (1) value the 300 MW of the otherwise applicable 500 MW supplemental reserve requirement at $500/MWh (accounting for the applicable scarcity reserve requirement) and (2) value the remaining 200 MW of supplemental reserves at $10/MWh

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Scenario 1 (NYCA): 30-Minute Supplemental Reserves Requirement Exceeds Scarcity Reserves Requirement

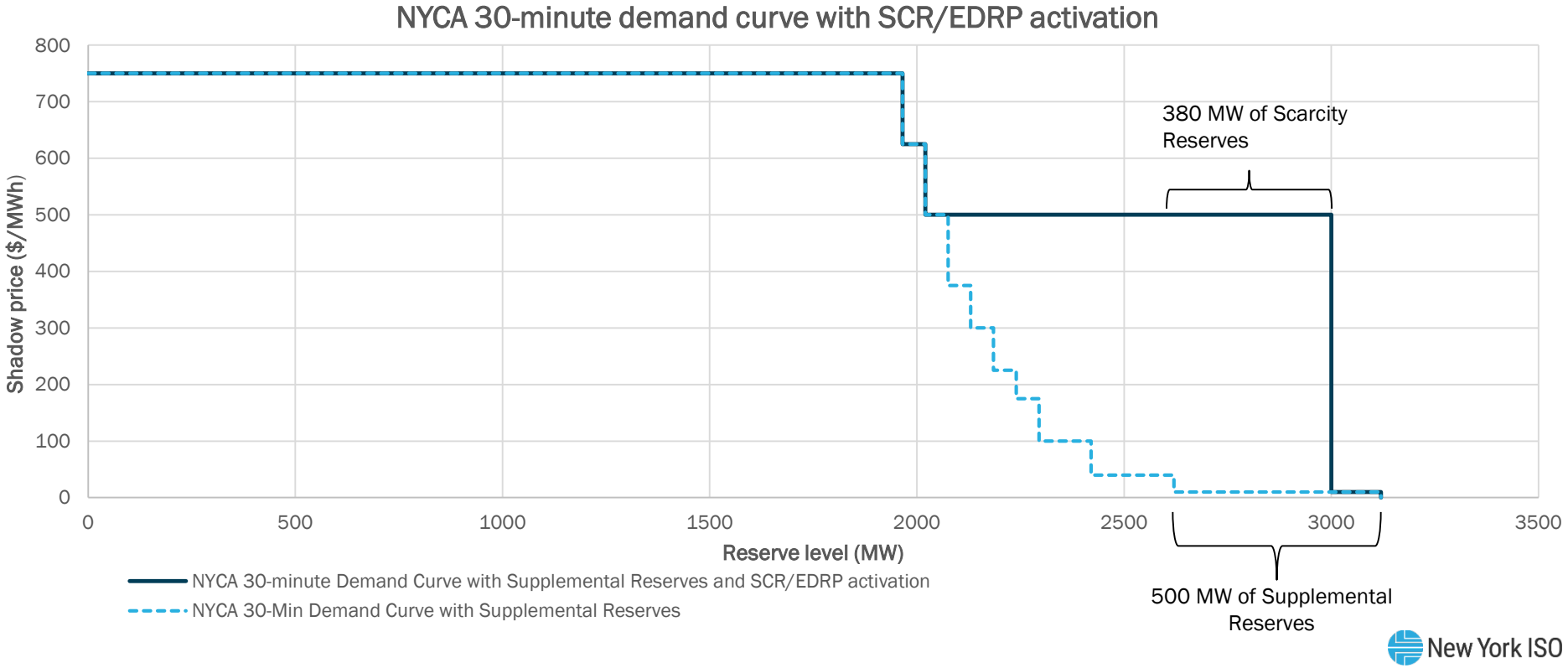
Considerations for Scenario 1	
Ordinary Requirement	2620 MW
Scarcity Reserves Reqt.	380 MW
Supp. Reserves Reqt.	500 MW
Target Level (Proposal)	3120 MW

- Proposed NYCA 30-minute reserve requirement during SCR/EDRP activations:
  - Target level = minimum requirement + max(30-minute supplemental reserves req. or the applicable scarcity reserve req.)
  - 2620+max(500,380) = 2620+500 = 3120 MW

- Under the NYISO's proposal, when the 30-minute supplemental reserve requirement exceeds the scarcity reserve requirement, the NYCA 30-minute demand curve in real-time during SCR/EDRP activations results in a four "step" demand curve as follows:
  - $750/MWh "step" up to and including 1,965 MW
  - $625/MWh "step" beyond 1,965 through 2,020 MW
  - $500/MWh "step" beyond 2,020 MW through (2,620 + the applicable Scarcity Reserve Requirement) [beyond 2,020 MW through 3,000 MW for Scenario 1]
  - $10/MWh "step" beyond (2,620 + the applicable Scarcity Reserve Requirement) through ((2,620 + the applicable Scarcity Reserve Requirement) + (Supplemental requirement - Scarcity Reserve Requirement)) [beyond 3,000 MW up to and including 3,120 MW for Scenario 1]

New York ISO

Scenario 1 (NYCA): 30-Minute Supplemental Reserves Requirement Exceeds Scarcity Reserves Requirement



New York ISO

Scenario 2 (NYCA): Scarcity Reserves Requirement Exceeds 30-Minute Supplemental Reserves Requirement

Considerations for Scenario 2	
Ordinary Requirement	2620 MW
Scarcity Reserves Reqt.	600 MW
Supp. Reserves Reqt.	500 MW
Target Level (Updated Proposal)	3220 MW

- Proposed NYCA 30-minute reserve requirement during SCR/EDRP activations:
  - Target level = minimum requirement + max(30-minute supplemental reserves req. or the applicable scarcity reserve req.)
  - 2620+max(500,600) = 2620+600= 3220 MW

- Under the NYISO's proposal, when the scarcity reserve requirement exceeds the 30-minute supplemental reserve requirement, NYCA 30-minute demand curve in real-time during SCR/EDRP activations results in a three "step" demand curve as follows:
  - $750/MWh "step" up to and including 1,965 MW
  - $625/MWh "step" beyond 1,965 through 2,020 MW
  - $500/MWh "step" beyond 2,020 MW through (2,620 + the applicable Scarcity Reserve Requirement) [beyond 2,020 MW up to and including 3,220 MW for Scenario 2]

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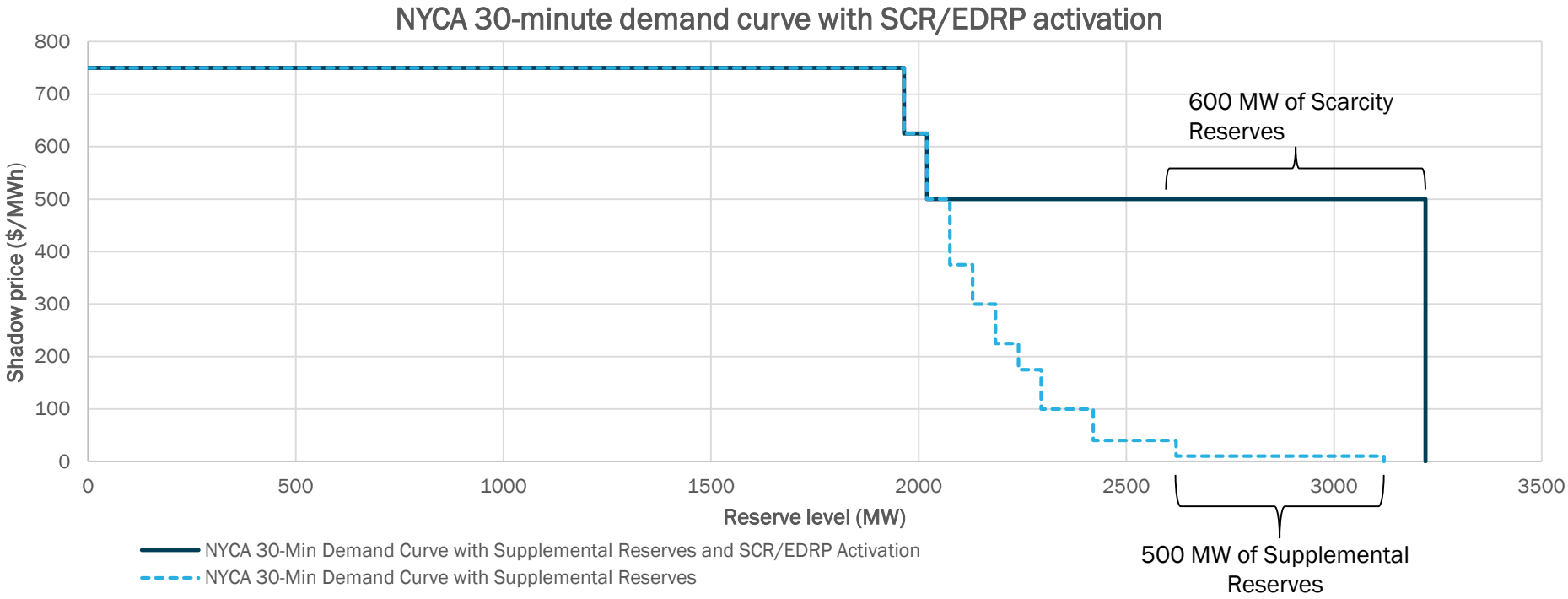
Scenario 2 (NYCA): Scarcity Reserves Requirement Exceeds 30-Minute Supplemental Reserves Requirement



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