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Independent System Operator

Ancillary Services Shortage Pricing

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Agenda

- **Background**
  - Project overview
  - Reserve pricing
  - Current reserve requirements
  - Current reserve demand curves
- **Proposed Enhancements**
  - Reserve demand curve enhancements
    - Analysis for evaluating current reserve demand curves
    - Proposed revisions to reserve demand curve pricing and structure

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Background

Background- A Grid in Transition

- **Environmentally focused public policies in New York are driving a transition to increased reliance on weather-dependent resources.[1]**
- **The variability and unpredictability of wind and solar generation resources and the potentially large quantities of each present a challenge for future grid operations.**
  - The grid will need responsive and flexible resources to address changes in net load, as well as support reliable operations.

1. For further discussion, please see the report "Reliability and Market Considerations for a Grid in Transition" at the following link: https://www.nyiso.com/documents/20142/2224547/Reliability-and-Market-Considerations-for-a-Grid-in-Transition-20191220%20Final.pdf/61a69b2e-0ca3-f18c-cc39-88a793469d50

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Background- A Grid in Transition

- **Effective pricing of energy and ancillary services products to reflect system conditions and operational needs is crucial.**
  - Reserve prices fall when and where this grid reliability service is not needed or when there is ample supply.
    - In this way, and by fostering competition, prices help to maintain grid reliability at the lowest cost.

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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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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).[1]
  - **Study Conclusion:** The NYISO should consider increasing lower reserve demand curve values to help avoid frequent shortages, and improve the consistency of market price signals with the reliability value of reserves
- **2020 Project Goal : Market Design Complete- Q2, 2020**

1. Link to the Report: https://www.nyiso.com/documents/20142/9622070/Ancillary%20Services%20Shortage%20Pricing_study%20report.pdf/15fb5f26-e1af-fa5a-ee29-3943ab483369

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
    - The NYISO's initial recommendations for enhancements are addressed in this presentation
  - Procurement of additional reserves beyond minimum reliability requirements
    - This concept was previously discussed as part of the Reserves for Resource Flexibility project efforts
    - This will not be discussed today, and will be addressed in future presentations
- **This project will also evaluate the structure of the NYCA 30-minute reserve demand curve that applies during SCR/EDRP activations of less than all zones**
  - This will not be discussed today, and will be addressed in a future presentation

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Need for Operating Reserves

- Reserve requirements are established to protect the reliability of the system when contingencies occur.
  - For example, contingencies can include a generator outage or a transmission facility going out-of-service.
- Reserves can be converted to energy in the event of a real-time power system need.
- Reserves are a location-dependent ancillary service, requiring procurement of reserve quantities within specific regions in addition to ensuring sufficient reserve capability is procured statewide.
- Transmission constraints must be considered when determining where to procure reserves.

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Reserve Pricing

- **Each reserve product (location and product type) produces a shadow price for procurement of the reserve product.**
  - The shadow price is the cost to procure one additional MW of the reserve product in question.
  - The shadow price includes any lost opportunity cost a resource may incur when scheduled to provide reserves rather than produce energy.
  - The maximum shadow price value is capped based on the pricing values of the operating reserve demand curves
- **The NYISO's market pricing renders resources indifferent between providing reserves or energy.**
  - Shadow prices cascade in the calculation of reserve clearing prices, ensuring that resources are compensated for the value provided to the grid.

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Maximum Reserve Shadow Prices

Reserve Product	NYCA	EAST	SENY	NYC	LI
SPIN	S.P.3= $775/MWh	S.P.6 = $25/MWh	S.P.9 = $25/MWh (0 MW requirement)	S.P.12 = $25/MWh (0 MW requirement)	S.P.15 = $25/MWh (0 MW requirement)
10 Total	S.P.2 = $750/MWh	S.P.5 = $775/MWh	S.P.8 = $25/MWh (0 MW requirement)	S.P.11 = $25/MWh	S.P.14 = $25/MWh
30	S.P.1 = $25, $100, $200, $750/MWh	S.P.4 = $25/MWh	S.P.7 = $500/MWh	S.P.10 = $25/MWh	S.P.13 = $25/MWh

Reserve Clearing Price Calculations

Reserve Product	NYCA	EAST	SENY	NYC	LI
SPIN	S.P.1 + S.P.2 + S.P.3	S.P.1 + S.P.2 + S.P.3 + S.P.4 + S.P.5 + S.P.6	S.P.1 + S.P.2 + S.P.3 + S.P.4 + S.P.5 + S.P.6 + S.P.7 + S.P.8 + S.P.9	S.P.1 + S.P.2 + S.P.3 + S.P.4 + S.P.5 + S.P.6 + S.P.8 + S.P.9 + S.P.10 + S.P.11 + S.P.12	S.P.1 + S.P.2 + S.P.3 + S.P.4 + S.P.5 + S.P.6 + S.P.7 + S.P.8 + S.P.9 + S.P.13 + S.P.14 + S.P.15
10 Total	S.P.1 + S.P.2	S.P.1 + S.P.2 + S.P.4 + S.P.5	S.P.1 + S.P.2 + S.P.4 + S.P.5 + S.P.7 + S.P.8	S.P.1+S.P.2+S.P.4+S.P.5+S.P.7+S.P.8+S.P.10+S.P.11	S.P.1 + S.P.2 + S.P.4 + S.P.5 + S.P.7 + S.P.8 + S.P.13 + S.P.14
30	S.P.1	S.P.1 + S.P.4	S.P.1 + S.P.4 + S.P.7	S.P.1 + S.P.4 + S.P.7 + S.P.10	S.P.1 + S.P.4 + S.P.7 + S.P.13

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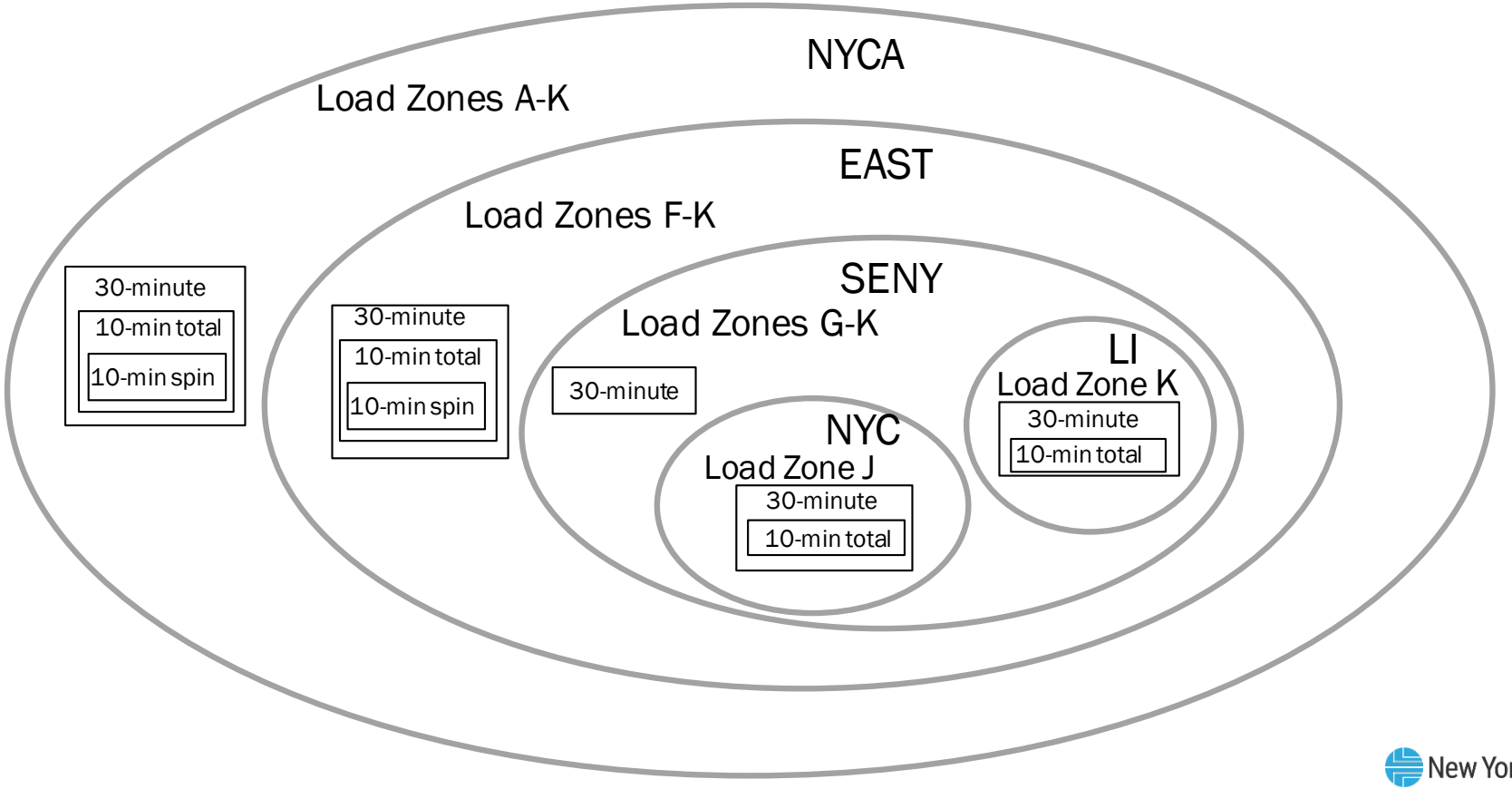
Reserve Cascading/Nesting



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Reserve Clearing Price - Example

- **Example Assumptions:**
  - 200 MW shortage of EAST 30-minute reserves and 200 MW shortage of EAST 10-minute total reserves.
    - Shadow price of EAST 30-minute reserves is set by the reserve demand curve =(S.P.4= $25/MWh)
    - Shadow price of EAST 10-minute total is set by the reserve demand curve = (S.P.5= $775/MWh)
  - Shadow price of NYCA 30-minute reserves is $12.50/MWh = (S.P.1= $12.50/MWh)
    - For this hypothetical example, no shortage of NYCA 30-minute reserves is assumed; the shadow price reflects the cost of to provide the next MW of 30-minute reserves statewide
  - Shadow prices for NYCA 10-minute total and NYCA 10-minute spin are assumed to be $0/MWh (S.P.2= $0/MWh; S.P.4= $0/MWh)
    - For the hypothetical example, no shortages of either product are assumed and the $0/MWh shadow price value was selected for simplicity of the example clearing price calculations
- **Example reserve clearing prices for certain products:**
  - NYCA 30-minute = $12.50/MWh (S.P.1)
  - NYCA 10-minute total = $12.50/MWh (S.P.1+S.P.2 = [$12.50+$0])
  - NYCA 10-minute spin = $12.50/MWh (S.P.1+S.P.2+S.P.3 = [$12.50+$0+$0])
  - EAST 30-minute = $37.50/MWh (S.P.1+S.P.4 = [$12.50+$25])
  - EAST 10-minute total = $812.50/MWh (S.P.1+S.P.2+S.P.3+S.P.4+S.P.5 = [$12.50+$0+$0+$25+$775])

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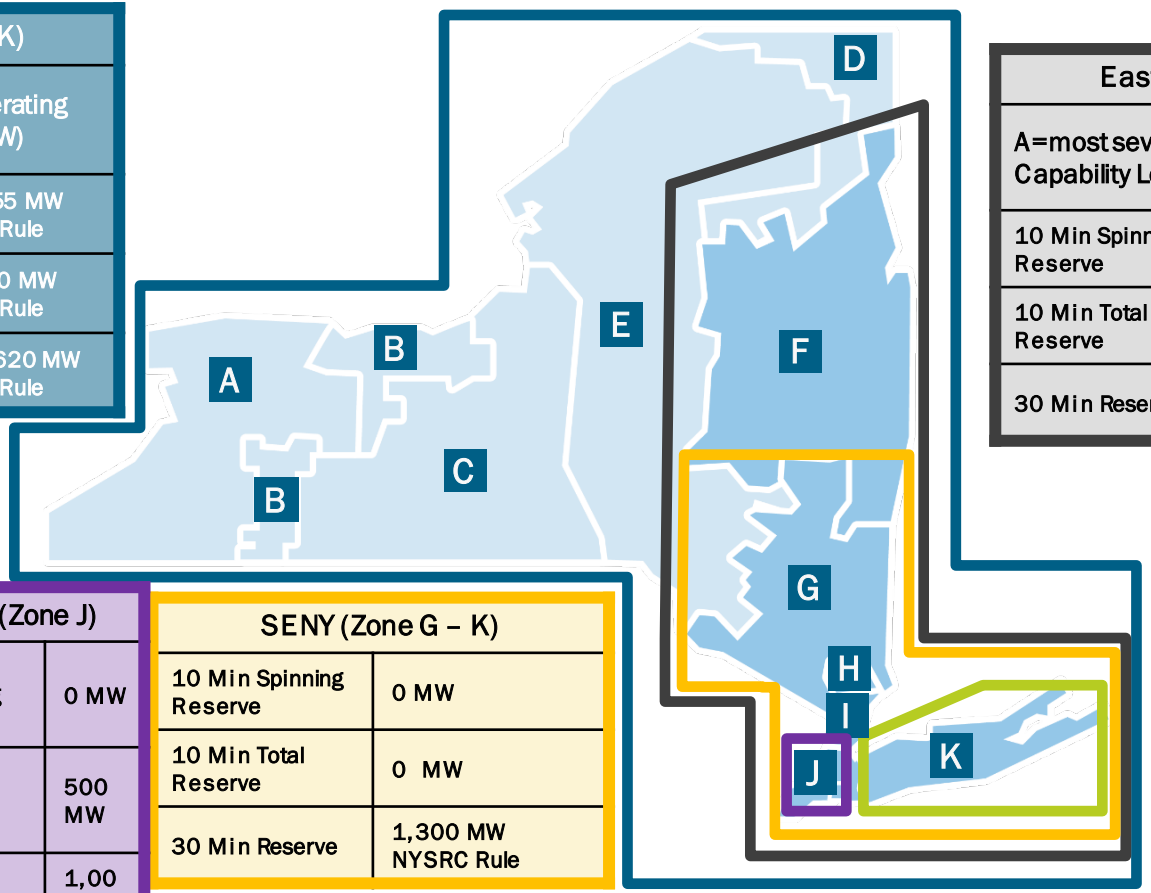
Current Operating Reserve Requirements

Current Operating Reserve Requirements

NYCA (Zone A – K)	
A=most severe NYCA Operating Capability Loss (1,310 MW)	
10 Min Spinning Reserve	½ A=655 MW NYSRC Rule
10 Min Total Reserve	A=1,310 MW NYSRC Rule
30 Min Reserve	2xA=2,620 MW NYSRC Rule

A	WEST
B	GENESE
C	CENTRL
D	NORTH
E	MHK VL
F	CAPITL
G	HUD VL
H	MILLWD
I	DUNWOD
J	N.Y.C.
K	LONGIL



East (Zone F – K)	
A=most severe NYCA Operating Capability Loss (1,310 MW)	
10 Min Spinning Reserve	¼ A=330 MW NERC, NPCC Rule
10 Min Total Reserve	1,200 MW NYSRC Rule
30 Min Reserve	1,200 MW NERC, NPCC Rule

NYC (Zone J)	
10 Min Spinning Reserve	0 MW
10 Min Total Reserve	500 MW
30 Min Reserve	1,000 MW

SENY (Zone G – K)	
10 Min Spinning Reserve	0 MW
10 Min Total Reserve	0 MW
30 Min Reserve	1,300 MW NYSRC Rule

Long Island (Zone K)	
10 Min Spinning Reserve	0 MW
10 Min Total Reserve	120 MW NERC, NPCC Rule
30 Min Reserve	270 – 540 MW Max limits NYSRC Rule

Current Operating Reserve Demand Curves

Current Reserve Demand Curves

New York Region	Type	Demand Curve Amount (MW)	Demand Curve Price ($)
NYCA	Regulation	25.0 80.0 remainder	$25.00 $525.00 $775.00
NYCA	Spinning Reserve	All	$775.00
NYCA	10 Minute Reserve	All	$750.00
NYCA	30 Minute Reserve	300.0 655.0 955.0 remainder	$25.00 $100.00 $200.00 $750.00
Eastern New York (EAST)	Spinning Reserve	All	$25.00
	10 Minute Reserve	All	$775.00
	30 Minute Reserve	All	$25.00
Southeastern New York (SENY)	Spinning Reserve	All	$25.00
	10 Minute Reserve	All	$25.00
	30 Minute Reserve	All	$500.00
New York City (NYC)	Spinning Reserve	All	$25.00
	10 Minute Reserve	All	$25.00
	30 Minute Reserve	All	$25.00
Long Island (LI)	Spinning Reserve	All	$25.00
	10 Minute Reserve	All	$25.00
	30 Minute Reserve	All	$25.00

Note: The reserve demand curve values in the table above apply during periods when the EDRP and/or Special Case Resource program have not been activated.

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Proposed 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
  - Recognize the increasing value of reserves to meeting needs for the evolving grid
  - 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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Overview of Proposed Enhancements

Reserve Region	Reserve Product	Reserve Reqt.	Demand curve ($/MWh)		Rationale
			Current	Proposed	
NYCA	30-minute	2620 MW	300 MW at $25	55 MW at $40	Allow a portion of the 30 minute total reserves to be forgone against price volatility
			355 MW at $100	200 MW at $175	Consistent with cost of operator actions to maintain 30-minute reserves (GT OOMs)
			300 MW at $200	200 MW at $225	Consistent with cost of operator actions to maintain 30-minute reserves (SREs)
			-	200 MW at $500	Consistent with cost of activating SCR/EDRP resources to maintain reserves
			Remainder at $750	Remainder at $750	Consistent with cost of operator actions to replenish by converting 30 min GTs to energy
NYCA	10 minute total	1310 MW	$750/MWh	$750/MWh	Consistent with cost of operator actions to replenish 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	1200 MW	$25/MWh	$40/MWh	Facilitates distribution of reserves throughout NYCA
EAST	10 minute total	1200 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
SENY	30-minute	1300 MW	$500/MWh	$500/MWh	Consistent with cost of activating SCR/EDRP resources to maintain reserves
NYC	30-minute	1000 MW	$25/MWh	$40/MWh	Facilitates distribution of reserves throughout NYCA
NYC	10-minute total	500 MW	$25/MWh	$40/MWh	Facilitates distribution of reserves throughout NYCA
LI	30-minute	270-540 MW	$25/MWh	$40/MWh	Facilitates distribution of reserves throughout NYCA
LI	10-minute total	120 MW	$25/MWh	$40/MWh	Facilitates distribution of reserves throughout NYCA

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 (see Appendix for further details on the calculation of these costs)
- **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 2019 Ancillary Services Shortage Pricing study identified that the highest number of reserve shortages occurred with respect to East spinning reserves**
  - The current demand curve price for East spinning reserves is $25/MWh
  - The $25/MWh demand curve price also applies to NYCA 30-minute, EAST 30-minute, NYC 30-minute, NYC 10-minute total, LI 30-minute and LI 10-minute total
- **The NYISO is evaluating RTC re-run cases with different demand curve values to determine a pricing level at which re-dispatch occurs to resolve the shortages.**
  - Initial re-run results indicate that a price of $40/MWh facilitates re-dispatch to resolve or minimize otherwise observed shortages for various products and locations (East spin, NYC 10-minute, and NYC 30-minute)
- **The NYISO will also evaluate whether increasing the $25/MWh value to $40/MWh would present any market power/mitigation concerns**

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NYCA 30-Minute Reserve Demand Curve Structure

- **The proposed enhancements described in the previous slides include a proposal to add one incremental "step" to the NYCA 30-minute reserve demand curve (i.e., a "step" with a $500/MWh value)**
- **The NYISO is continuing to evaluate the potential for including additional pricing steps**
  - Further graduation of the NYCA 30-minute reserve demand curve could help to reduce price volatility and provide the market software greater degrees of freedom in determining the least cost solution to meet system needs
    - For example, addition of a "step" with a $375/MWh shortage pricing value; this represents a value aligned with the average cost of 99% of the resource costs observed for historic SRE and OOM commitments assessed in evaluating potential changes to the current NYCA 30-minute reserve demand curve (see Appendix for additional details)

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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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Questions?

Appendix

Costs of SRE

- **Equation used to determine SRE costs**

$$\text{Amortized Cost} = \frac{Startup\ Cost\ (\$)}{Min\ Gen(MW)/Max(hours\ SRE, Min\ run\ time(hours))} + \frac{Min\ Gen\ cost\ (\$/_{hr})}{Min\ Gen\ (MW)}$$

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Potential Additional Pricing Steps for the NYCA 30-Minute Reserve Demand Curve

- The table provides the 99 percentile data from the costs of SRE commitments (2017-2019) and OOM commitments (2018-2019)
- Assessment of these costs is further discussed on Slides 25 and 26

Analysis	99 percentile of costs
Cost of SRE commitments	$391/MWh
Cost of OOM commitments	$354/MWh
Average costs	$372.50/MWh

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