

Reserves for Resource Flexibility

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Market Issues Working Group

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Agenda

- Background
- Operating Reserves Overview
- Neighboring ISO/RTO Considerations
- Flexibility Reserve: Normal Transfer Criteria
- Flexibility Reserve: Forecast Uncertainty
- Next Steps
- Appendix: Flexible Ramping Products in MISO and CAISO Markets

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.

¹For further discussion, please see the report "Reliability and Market Considerations for a Grid in Transition" at the following link:

<https://www.nyiso.com/documents/20142/6785167/Grid%20in%20Transition%20DRAFT%20FOR%20POSTING.pdf/74eb0b20-6f4c-bdb2-1a23-7d939789ed8c>

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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.

Reserves for Resource Flexibility

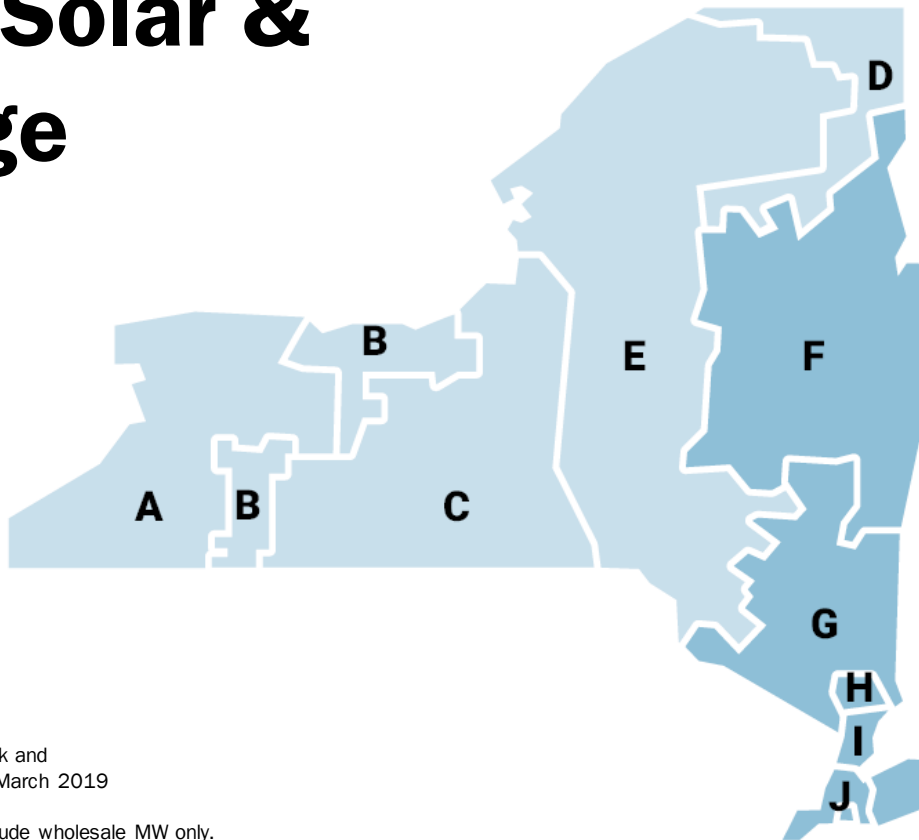
- Today, the NYISO procures the amount of operating reserves required to meet the minimum reliability standards established by NERC, NPCC, and NYSRC.
 - These reserves serve to bring transmission assets to Emergency Transfer Criteria after suffering a contingency.
 - Procuring additional 30 minute reserves where appropriate will provide ready access to additional resource flexibility through a market-based mechanism to bring transmission assets to Normal Transfer Criteria following a contingency.
 - Absent such a mechanism, out of market actions may be required to return facilities to Normal Transfer Criteria following a contingency.
- System volatility is expected to increase as the amount of non-emitting, weather-dependent generation increases within the NYCA.
 - Procuring additional reserves in the NYCA will provide ready access to additional resource flexibility through a market-based mechanism to manage this volatility.
 - Absent such a mechanism, out of market actions may be required to manage this volatility on the grid.








Wind, Solar & Storage

Existing and Proposed Wind, Solar, and Storage nameplate capability in New York State (MW)

Sources: 2019 Gold Book and Interconnection Queue, March 2019

Note: Solar numbers include wholesale MW only.



	UPSTATE (zones A-E)	DOWNSTATE (zones F-K)
 Proposed land-based wind	4,313	0
 Existing land-based wind	1,985	0
 Proposed offshore wind	0	12,908
 Proposed solar	2,966	1,072
 Existing solar	0	57
 Proposed energy storage	540	1,432
 Existing energy storage	0	30

Expected Benefits

- **Procuring additional reserves could facilitate introducing more gradual demand curve steps, signaling an approaching shortage of reserves procured for the minimum reliability standards as the system becomes more constrained.**
 - This could provide a more stable price signal to which resources and load are better able to respond.
- **Providing resources with a reserve schedule incents those resources to take additional steps to prepare for conversion from reserves to energy.**
 - These steps, such as managing fuel and conducting maintenance, help enhance resource availability when called upon.
- **Additional reserves procured in the NYISO markets offers value in light of greater net load uncertainty resulting from increasing reliance on weather-dependent generation.**
 - Additional reserves will provide more flexibility to respond to unforeseen grid conditions in real-time.

Operating Reserves Overview

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Operating Reserves Overview

- **10-Minute Spinning Reserve:**
 - Currently synchronized to the NYS power system
 - Can change output or reduce demand level in 10 minutes
 - If a resource is capable of providing this product, it is capable of providing all reserve products
- **10-Minute Non-Synchronized Reserve:**
 - Can be started, synchronized, and change output level or reduce demand within 10 minutes
 - If a resource is capable of providing this product, it is also capable of providing 30-Minute Reserve
- **30-Minute Reserve (Spinning and Non-Synchronized):**
 - Spinning: Currently synchronized and can change output level or reduce demand within 30 minutes
 - Non-synchronized: Can be started, synchronized, and change output level or reduce demand within 30 minutes

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NYCA Operating Reserves

NYCA (Zone A – K)	
A=most severe NYCA Operating Capability Loss (1310 MWs)	
10 Min Spinning Reserve	½ A=655 MWs NYSRC Rule
10 Min Total Reserve	A=1310 MWs NYSRC Rule
30 Min Reserve	2xA=2620 MWs NYSRC Rule

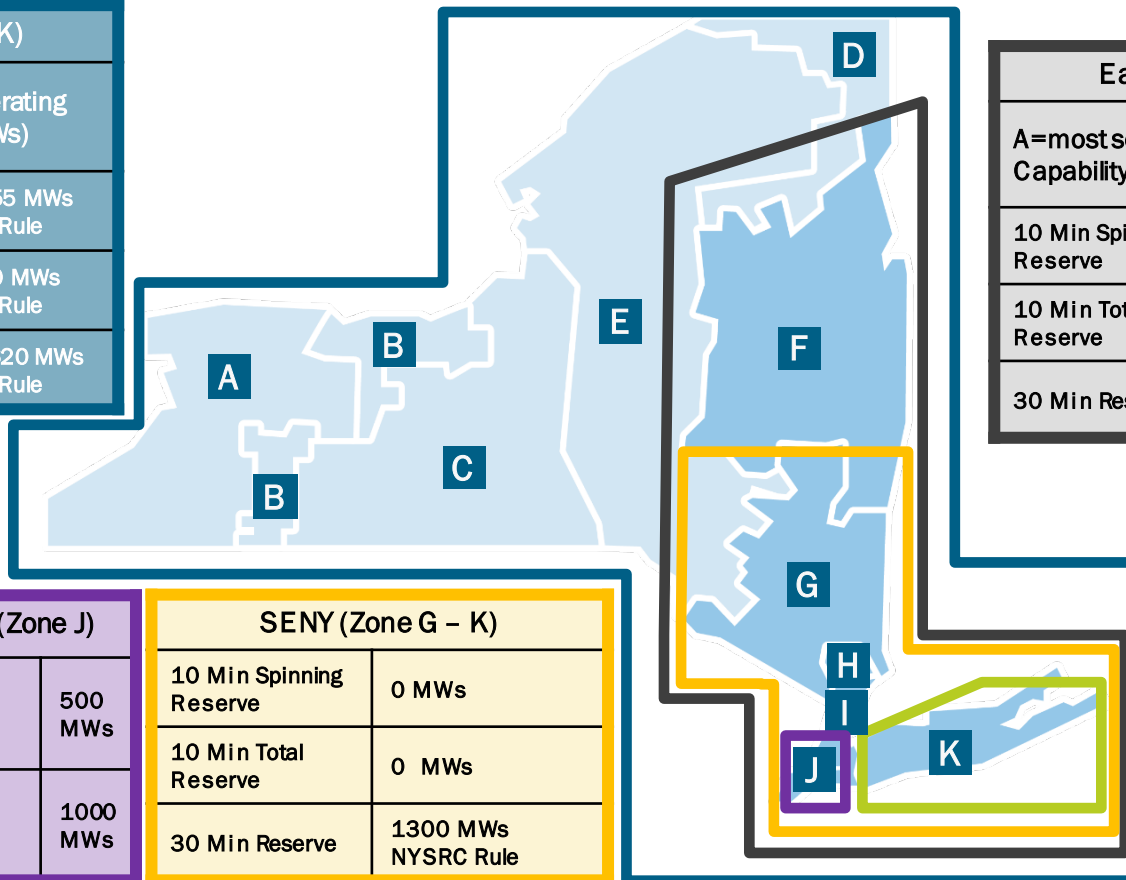
East (Zone F – K)	
A=most severe NYCA Operating Capability Loss (1310 MWs)	
10 Min Spinning Reserve	¼ A=330 MWs NERC, NPCC Rule
10 Min Total Reserve	1200 MWs NYSRC Rule
30 Min Reserve	1200 MWs NERC, NPCC Rule

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

NYC (Zone J)	
10 Min Total Reserve	500 MWs
30 Min Reserve	1000 MWs

SENY (Zone G – K)	
10 Min Spinning Reserve	0 MWs
10 Min Total Reserve	0 MWs
30 Min Reserve	1300 MWs NYSRC Rule

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



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Neighboring ISO/RTO Considerations

PJM

- **PJM has recently proposed to procure reserves beyond minimum reliability requirements, reflecting the value of resource flexibility.***
 - PJM will determine the probability of reserve shortage beyond minimum reserve requirements (MRRs).
 - Uncertainty of load, the wind and solar forecast, and forced outages of thermal units determines the probability of reserve shortage under PJM’s methodology.
- **The additional reserve is valued at lower demand curve prices than the MRRs.**

*For further information, please see the “PJM Enhanced Price Formation in Reserve Markets” filing at the following link:

<https://pjm.com/directory/etariff/FercDockets/4036/20190329-el19-58-000.pdf>



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ISO-NE

- **Earlier this year, ISO-NE released the Energy Security Improvements ISO Discussion Paper.***
 - This paper envisions the creation of a number of additional day-ahead reserve products to manage uncertainties each operating day.
- **The additional reserve products being considered include:^**
 - Generation Contingency Reserves (GCR)
 - Energy Imbalance Reserves (EIR)
 - Replacement Energy Reserves (RER)

*Link to the Energy Security Improvements paper:

https://www.iso-ne.com/static-assets/documents/2019/04/a00_iso_discussion_paper_energy_security_improvements.pdf

^Link to ISONE presentation describing additional reserve products: [https://www.iso-ne.com/static-](https://www.iso-ne.com/static-assets/documents/2019/06/a2a_iso_presentation_energy_security_improvements_market_based_approaches.pptx)

[assets/documents/2019/06/a2a_iso_presentation_energy_security_improvements_market_based_approaches.pptx](https://www.iso-ne.com/static-assets/documents/2019/06/a2a_iso_presentation_energy_security_improvements_market_based_approaches.pptx)

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Flexibility Reserve: Normal Transfer Criteria

Flexibility Reserve: Normal Transfer Criteria

- **The NYISO proposes to procure an additional 500 MW of 30-minute reserves in the SENY reserve region (zones G-K).**
 - This reserve will be procured as a subset of the current 2,620 MW NYCA 30-minute reserve requirement.
 - Increases the portion of the total statewide reserve requirement carried in SENY from 1,300 MW to 1,800 MW
 - This additional reserve would be procured at all times in the Day-Ahead and Real-Time Markets.
- **Sufficient reserve capability is currently procured in the EAST (zones F-K) and NYC (zone J) reserve regions to return transmission facilities to normal transfer criteria post-contingency.**

Flexibility Reserve: Normal Transfer Criteria

- The NYISO does not recommend changes to the LI reserve requirement at this time, due to the concern that this could result in more reserves being held on LI than is actually deliverable to the rest of the NYCA.¹

¹For a discussion of the LI Reserve Modeling, please see the presentation at the following link:
<https://www.nyiso.com/documents/20142/1403425/LI%20Reserve%20Modeling%20-%20Nov%20MIWG%20FINAL.pdf/439eb65b-879c-fa77-6337-b36eb5435b bf>

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Flexibility Reserve: Normal Transfer Criteria

- The NYISO conducted an analysis to determine the proposed additional reserve quantity.
 - A summer case was analyzed with transmission facility flow into SENY at limits.
 - The analysis confirmed that the current 1,300 MW 30-minute reserve requirement provides ready access to sufficient resource capability to recover from the first worst contingency in SENY, and return transmission facilities into SENY to Emergency Transfer Criteria post-contingency.
 - Emergency Transfer Criteria in this case indicates that post-contingency facility flow would be below short-term emergency (STE) ratings.
 - The analysis further demonstrated that increasing the SENY 30-minute reserve requirement by an additional 500 MW provides ready access to resource capability that allows the NYISO to return transmission facilities into SENY to Normal Transfer Criteria post-contingency.
 - Normal Transfer Criteria in this case indicates that post-contingency flow would be below long-term emergency (LTE) ratings.

Flexibility Reserve: Forecast Uncertainty

Flexibility Reserve: Forecast Uncertainty

- In addition to returning facilities to normal transfer criteria, additional reserve procurements could provide a mechanism to account for forecast uncertainty introduced by increasing reliance on weather-dependent resources (distributed and grid-connected).
 - Procuring the flexibility needed for anticipated weather-dependent generation will send price signals incenting resources needed for the grid of the future.
- **The NYISO is continuing to analyze additional reserve needs related to addressing forecast uncertainty.**
 - The NYISO plans to present further on this topic at future meetings.
 - The following slide provides an overview of the analysis currently being undertaken to assist in quantifying any additional reserve requirements needed for addressing forecast uncertainty.

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Flexibility Reserve: Forecast Uncertainty

- The NYISO will analyze load forecast error, net of the wind forecast error, within the 10-minute and 30-minute timeframe to inform appropriate additional reserve requirements.
 - To the extent appropriate based on the results of the analysis, potential utilization of time varying reserve requirements will be considered (e.g., a static requirement, hourly, daily, etc.).

Flexibility Reserve: Forecast Uncertainty

- The NYISO contemplates this methodology would be used for revising the quantity of additional reserves procured to address forecast uncertainty as the levels of weather-dependent resources on the system continue to increase.

Next Steps

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Next Steps

■ August 2019

- Continue stakeholder discussions by reviewing the analysis of forecast uncertainty.

■ September 2019

- Continue stakeholder discussions by reviewing the potential adjustments to reserve demand curve values.
- Seek stakeholder approval of completed market design at BIC/MC.

■ 2020

- Seek to implement approved enhancements to reserve procurements.

Appendix: Flexible Ramping Products in MISO and CAISO Markets

MISO Ramp Capability Product – Reasons for Implementation

- The real-time optimization used by MISO for commitment and dispatch considers one 5-minute interval at a time.
 - The ramp capability product helps position the system to meet ramping needs.
 - Avoids unnecessary shortage pricing events.

MISO Ramp Capability Product – Features

- Ramp Capability Product features:
 - Procured day-ahead and in real-time
 - The MW range output a resource can attain within 10 minutes beyond the next 10 minute target setpoint counts toward the ramp up or ramp down requirements
 - Co-optimized with energy and ancillary services
 - Requirement applies to the entire region (*i.e.*, not zonal)
 - Resources can provide only ramp up, only ramp down, or both
 - All online dispatchable resources are able to provide the product
 - Resources may opt out of providing the product, but most participate

MISO Ramp Capability Product - Requirements

- Ramp requirements determined by forecasted change in load for the region, wind generation, and interchange (*i.e.*, change in ‘Net Demand’), plus
 - An additional amount of ramp up and ramp down are added to the requirement (*i.e.*, “Uncertainty,” currently set to +/- 575 MW)
- Day-ahead hourly requirements are scaled to mimic the real-time 10 minute ramp up and down Requirements
- Ramp Capability Up Requirement = $\max([\text{Net Demand in future interval} - \text{Net Demand in current interval}] + \text{Uncertainty}, 0)$
- Ramp Capability Down Requirement = $\max([\text{Net Demand in current interval} - \text{Net Demand in future interval}] + \text{Uncertainty}, 0)$

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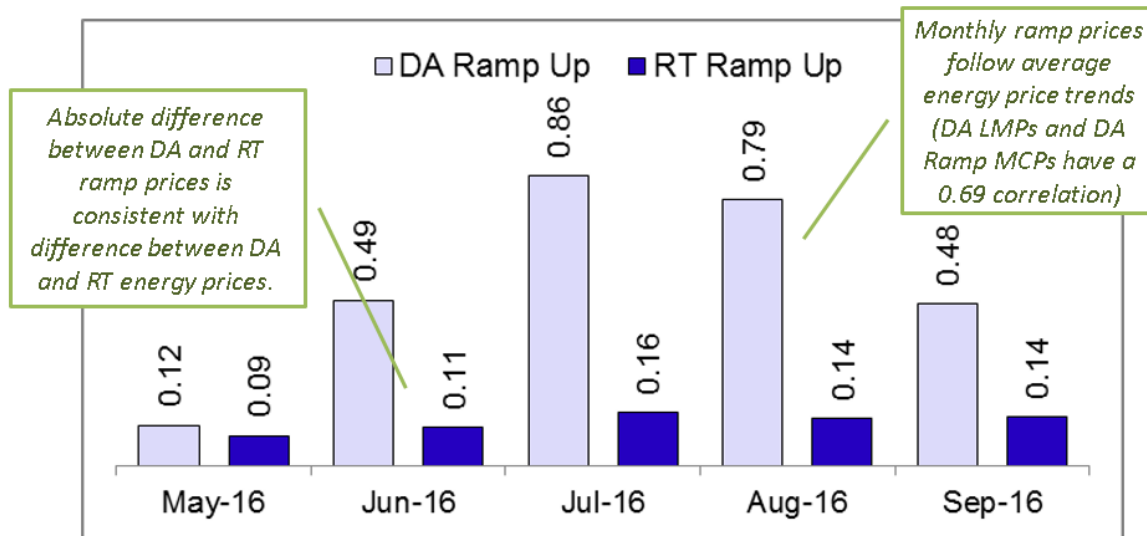
MISO Ramp Capability Product - Bidding

- **Units do not provide bids for this product.**
 - The ramp capability clearing price is based on lost opportunity cost given the clearing price of other products.
 - *E.g.*, if a unit bidding \$30/MWh for energy is dispatched down from producing energy priced at \$40/MWh by 1 MW in order to provide ramp up, then the clearing price of ramp will be \$10/MWh, all else equal

MISO Ramp Capability Product – Demand Curve

- Demand curve price currently set to \$5/MWh for ramp up and ramp down
 - Demand curve prices were determined by simulating with different demand curve price levels
 - Appropriate trade-offs with other products were considered
 - Cost of procuring the ramp requirement was considered

Monthly Average RCP Up Marginal Clearing Prices (MCPs)



Average DA MCP = \$.55/MWh, RT MCP = \$.13/MWh

Source: "Ramp Capability Product Performance Update" MISO Market Subcommittee, November 29, 2016:

Date range: 5/1/16 – 9/30/16

<https://cdn.misoenergy.org/20161129%20MSC%20Item%2005f%20Ramp%20Capability%20Post%20Implementation%20Analysis74816.pdf>

CAISO Flexible Ramping Product - Features

- Flexible Ramp Product features:
 - Only in real-time
 - Market software includes a look-ahead capability
 - Real-time unit commitment (RTUC) energy schedules binding at the fifteen minute market (FMM) price from RTUC, re-optimized and settled in real-time dispatch (RTD)
 - The MW output a resource can attain within 5 minutes counts toward the flexible ramping product requirement
 - Co-optimized with energy and ancillary services
 - Requirement applies to the entire region (*i.e.*, not zonal)
 - Resources can provide only ramp up, only ramp down, or both

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CAISO Flexible Ramping Product - Requirements

- Hourly requirements calculated every day and posted the day prior
- RTD Net Load Forecast Error is the difference between the binding interval and the prior advisory for the same interval
 - 30-day histogram tracks the net forecast error for each hour of the day
 - Flex up uncertainty requirement is the 97.5 percentile
 - Flex down uncertainty requirement is the 2.5 percentile

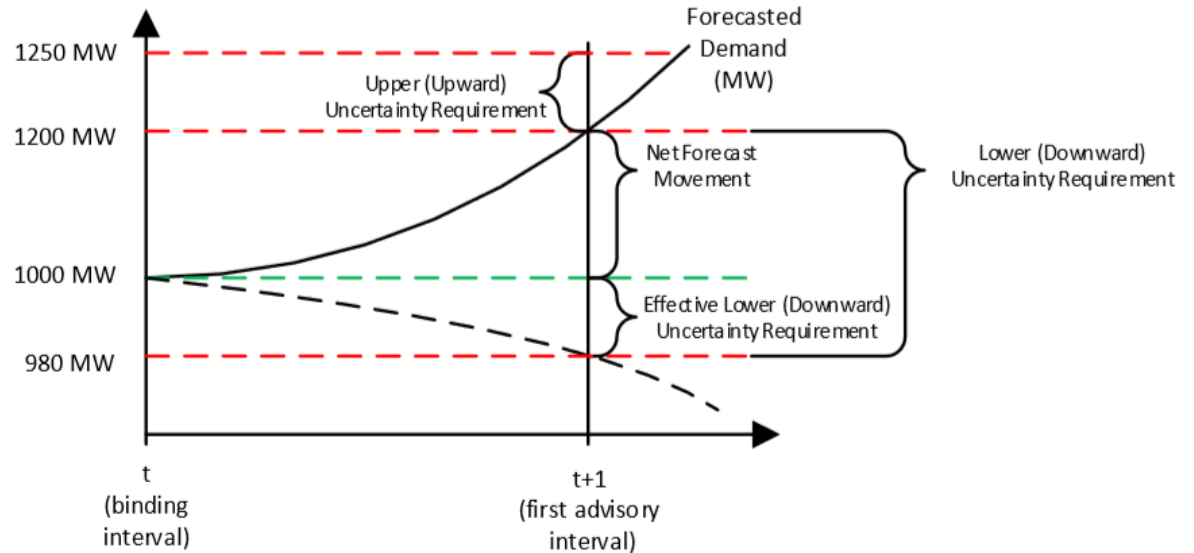


Figure 1 Flexible Ramping Product Uncertainty Requirements

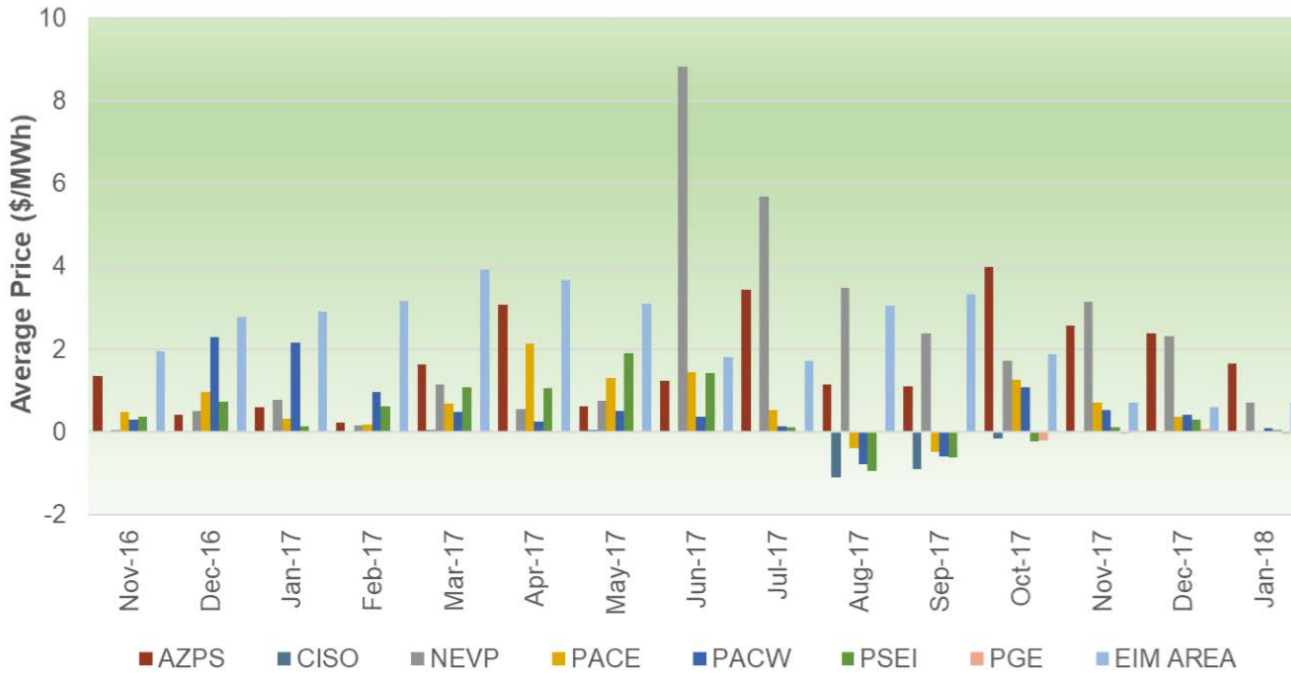
Source: CAISO Business Practice Manual for Market Operations:
<https://bpmcm.caiso.com/Pages/BPMDetails.aspx?BPM=Market%20Operations>

CAISO Flexible Ramping Product – Demand Curve

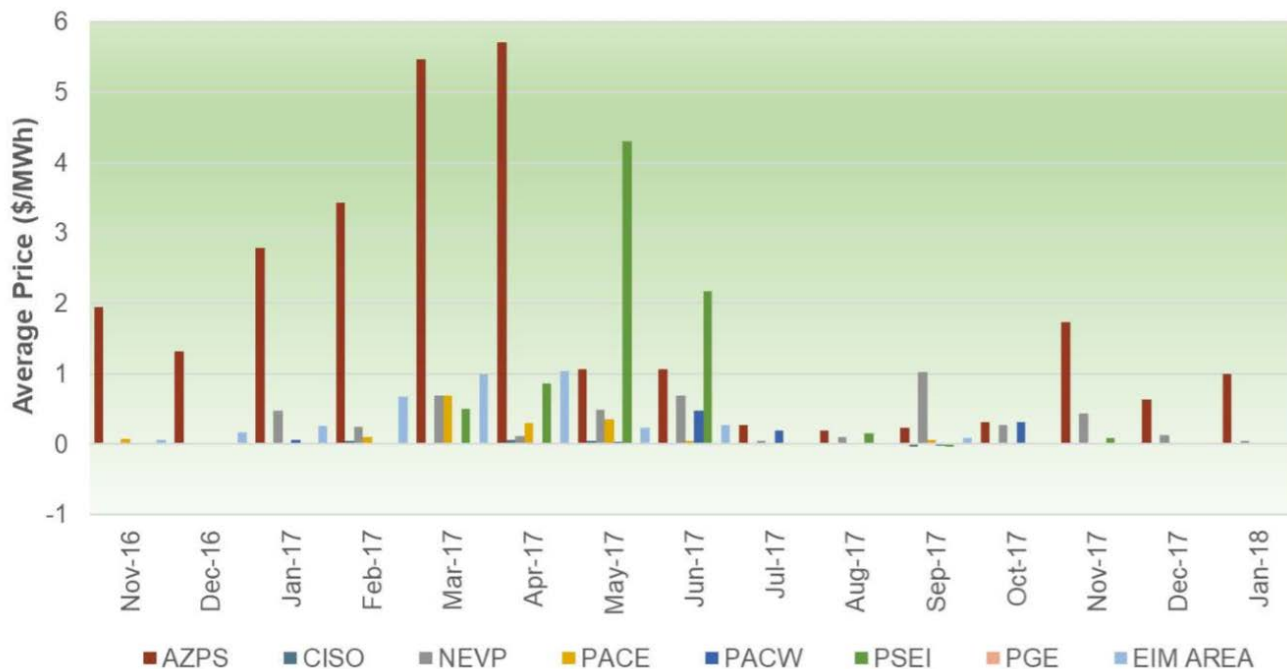
- **Units do not provide bids for this product**
 - Clearing price is based on lost opportunity cost
- **Ramp up demand curve price capped at \$247/MWh**
 - This is a value slightly less than the contingency reserve relaxation parameter
 - Allows for appropriate trade-offs
 - The probability of a load balance constraint binding a certain level of procured flexible ramp is multiplied by \$247/MWh
 - Multiple levels of procured ramp are used in this calculation to form the ramp up demand curve
- **Ramp down demand curve price is capped at \$152/MWh**
 - This value is slightly more than the regulation down relaxation parameter
 - Allows for appropriate trade-offs
 - Ramp-down demand curve calculated using the same methodology as that used for the ramp up demand curve, but at a price of \$152/MWh

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Average Flexible Ramp Up Price (\$/MWh)



Average Flexible Ramp Down Price (\$/MWh)



The Mission of the New York Independent System Operator, in collaboration with its stakeholders, is to serve the public interest and provide benefits 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 policy makers, stakeholders and investors in the power system



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