Day-Ahead Market Enhancements Downward Products Vistra

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Introduction

- Vistra wants CAISO and stakeholders to ask and answer the question for whether or not downward imbalance reserve product is necessary, and consequently whether a downward product will surface value for decremental capacity or not
- Downward capacity is capacity online or scheduled to be online at a specific operating point that can be decremented down if real-time needs materialize that are lower than the day-ahead market awards
- Alternatively, in WEIM when there are excess renewables and there would otherwise be a desire to decrement downward capacity for balancing, this excess supply can support off-system WEIM transfers rather than the market curtailing the internal supply
  - This concept should also be effective under EDAM so that the benefits are maximized

1 CAISO EDAM Benefits Study, Slide 9 "Modeling EDAM: Key Assumptions to Represent Market, http://www.caiso.com/Documents/Presentation-CAISO-Extended-Day-Ahead-Market-Benefits-Study.pdf

Background on market rules

- Existing Residual Unit Commitment process for maintaining merit order of Integrated Forward Market cleared physical supply is to represent cleared supply in the supply stack with a RUC adder that is a negative $250/MWh adder, capped to $0/MWh
- Existing Real-Time Market process for cleared Integrated Forward Market energy awards to be made available includes two pathways:
  - Self-schedules that act as price taker offers
    - Valued in scheduling run at penalty price of $-400/MWh and $-800/MWh under $1,000/MWh cap or up to $2,000/MWh cap respectively, and adjusted in pricing run to align with bid floor at $-150/MWh
  - Economic offer, could be same as IFM offer, but would allow an incremental or decremental Instructed Imbalance Energy Award relative to the IFM award
- For Multi-Stage Generators, if the market sees a self-schedule on any configuration in real-time, the higher of the IFM award or RUC schedule configuration is binding (calling “RT binding configuration logic”)

RUC changes related to MSG are not a reason for Reliability Capacity Down

RT binding configuration logic challenges not use case for Reliability Capacity Down

- CAISO RUC proposal to allow RUC to transition MSG down to lowest configuration: Operations issues real-time exceptional dispatches to MSGs to operate in a lower configuration, and CAISO argues it would "avoid out-of-market actions"
- We understood CAISO proposal to change RUC to "fixed" energy schedules as removing the process of including day-ahead awards plus RUC adder in the supply stack and allowing RUC to "cut" offers during over generation
  - In practice, concerned this may lead to RUC over-gen infeasibility more often
- If the CAISO's intent was to award Reliability Capacity down to MSGs for that configuration so that real-time the lower configuration is binding instead of the IFM cleared configuration, the proposal does not achieve this end
- Since no RT binding configuration logic changes are proposed, we believe the goal is to provide more information to Operations for its intra-day planning
  - RT binding configuration logic is the higher of IFM or RUC is the binding configuration and CAISO did not propose changes to RTM.
  - Without RT binding configuration logic changes, the RTM will still set the IFM configuration as binding when a self-schedule is submitted

RT binding configuration logic challenges not use case for Reliability Capacity Down Cont.

- CAISO's proposal fails to explain the current RT binding configuration and why real-time may not be able to transition the MSG to the lower configuration or another more economic decremental choice to address congestion
  - Further, it fails to support that RUC congestion observed materializes in RTM
- Any changes to RT binding configuration logic, which might avoid operator action, has not been stakeholder and would need to be vetted before advancing to Board
- Stakeholders need to understand why CAISO believes its RTM cannot address the congestion observed in RUC and changes to the RT binding config logic is needed
- Instead, it is possible there are other answers such as, the CAISO market design sends signals to operate to the day-ahead market and changes are needed to better incentivize real-time flexibility (in scope of price formation)
  - Day-ahead market sends the stronger signal to operate to that schedule
  - CAISO should focus on increasing its real-time price formation so the real-time sends the strongest signal to perform based on real-time needs
  - Price formation improvements would increase likelihood of economic offers and more successfully remove need for out-of-market action

Is there a need for any new downward product – reliability capacity or imbalance reserves?

RSE downward tests

- At Feb. 8, 2023 RIF meeting NV Energy recommended that downward RSE consequences should not exist[1]
  - This recommendation is appropriate if there is a surplus of downward capacity and flexible capacity across WEIM
  - This would align with our theory that there is surplus capacity, including flex, and even if treated as “financial” the value of violating any “physical” limit should be $0/MWh if there’s surplus
- On the new Reliability Capacity downward product, could these reduce WEIM benefits, and potentially EDAM benefits?
  - E.G., If there is a new RUC down product that reserves downward capacity is it allowed to support WEIM transfers still?
- On the new Imbalance Reserve downward product, if there is sufficient surplus of flexible capacity across WEIM, and likely EDAM, is it not expected that the clearing price will be ~$0/MWh?

1 NV Energy RIF RSE Slides, slide 2, https://www.westerneim.com/Documents/Presentation-WEIM-Regional-Issues-Forum-RSEE-NVE.pdf.

DMM 2021 Annual Report - RSE Failures
Show greater challenges upward capacity/flex

Figure 3.10 Frequency of upward capacity test failures by month and area (15-minute intervals)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Arizona PS	5	10	—	—	8	—	5	8	5	—	9	1
BANC	—	—	3	—	—	—	7	—	1	—	—	—
California ISO	—	—	—	—	—	4	6	1	5	—	—	—
Idaho Power	—	—	—	—	—	—	13	25	3	—	—	—
LADWP				—	—	2	—	—	—	8	5	2
NorthWestern						9	36	18	6	253	34	7
NV Energy	—	9	—	1	14	22	15	6	7	8	—	—
PacifiCorp East	—	—	—	—	—	10	9	4	6	4	—	—
PacifiCorp West	—	—	2	—	1	4	7	2	3	2	14	11
Portland GE	—	4	—	11	—	21	25	30	41	13	6	11
Powerex	4	1	—	—	—	1	1	—	2	15	6	6
PSC New Mexico				—	—	—	11	—	5	—	—	—
Puget Sound En	—	2	17	29	18	45	16	21	17	29	18	10
Salt River Proj.	—	215	—	2	4	19	90	76	56	3	20	—
Seattle City Light	—	—	—	—	—	—	—	1	14	4	—	4
Turlock ID			—	—	1	—	—	33	22	46	—	—

2021

Figure 3.11 Frequency of upward flexibility test failures by month and area (15-minute intervals)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Arizona PS	15	13	7	—	19	—	1	—	7	—	10	1
BANC	—	—	—	—	—	—	—	—	—	—	—	—
California ISO	—	—	—	—	—	1	10	3	11	—	3	—
Idaho Power	—	4	—	—	—	—	—	—	—	—	—	1
LADWP				1	3	—	4	—	—	1	1	10
NorthWestern						18	108	20	46	247	14	14
NV Energy	4	13	11	12	20	27	12	15	4	8	1	1
PacifiCorp East	4	2	4	4	1	2	1	—	4	—	2	1
PacifiCorp West	1	5	3	4	1	—	1	2	—	—	16	7
Portland GE	10	15	3	7	7	8	14	5	—	1	—	5
Powerex	7	4	4	4	—	4	15	—	—	7	5	8
PSC New Mexico				11	1	3	15	—	2	—	2	—
Puget Sound En	—	—	—	—	4	2	1	1	—	—	2	—
Salt River Proj.	5	192	8	15	6	26	57	49	24	5	36	1
Seattle City Light	—	—	—	—	—	—	1	—	4	—	—	—
Turlock ID			—	—	9	—	—	—	2	5	—	—

2021

Figure 3.12 Frequency of downward capacity test failures by month and area (15-minute intervals)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Arizona PS	—	—	—	—	1	—	—	—	—	—	5	—
BANC	—	1	2	—	—	—	—	—	—	—	—	—
California ISO	—	—	—	—	—	—	—	—	—	—	—	—
Idaho Power	—	—	—	—	—	—	—	—	—	—	4	—
LADWP				—	—	2	—	—	—	5	—	—
NorthWestern						—	—	—	—	29	—	—
NV Energy	—	—	—	—	—	1	—	—	—	—	—	—
PacifiCorp East	—	—	—	—	—	—	—	—	—	—	—	—
PacifiCorp West	—	—	—	—	—	—	—	—	—	—	—	—
Portland GE	—	—	—	—	—	—	—	—	—	—	—	—
Powerex	—	—	—	1	—	8	3	—	24	9	1	—
PSC New Mexico				—	—	—	—	—	—	7	4	—
Puget Sound En	—	—	—	—	—	—	—	—	—	1	—	—
Salt River Proj.	—	—	—	1	—	1	—	—	—	—	—	1
Seattle City Light	—	—	—	—	—	—	1	1	1	—	7	5
Turlock ID			—	—	8	6	1	6	5	20	3	1

2021

Figure 3.13 Frequency of downward flexibility test failures by month and area (15-minute intervals)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Arizona PS	64	61	129	55	8	4	—	4	2	3	15	11
BANC	—	17	10	—	—	—	—	—	—	—	—	4
California ISO	—	—	—	—	—	—	—	—	—	—	—	—
Idaho Power	—	—	—	—	1	—	—	—	—	—	8	1
LADWP				—	—	2	—	—	—	2	—	—
NorthWestern						10	18	11	33	68	4	1
NV Energy	6	163	42	15	127	58	88	74	48	34	11	13
PacifiCorp East	—	—	—	—	—	—	—	—	—	—	—	—
PacifiCorp West	—	—	2	—	—	4	—	—	—	—	1	—
Portland GE	1	—	—	—	—	—	—	—	—	—	—	—
Powerex	12	—	42	6	27	36	12	6	29	12	1	4
PSC New Mexico				39	—	1	—	—	4	11	20	4
Puget Sound En	—	—	—	—	—	—	—	—	—	—	1	—
Salt River Proj.	33	43	35	5	2	5	—	2	1	2	1	2
Seattle City Light	—	—	—	—	—	—	6	—	—	—	1	1
Turlock ID			3	4	16	—	—	1	—	18	3	5

2021

Further analysis into downward surplus

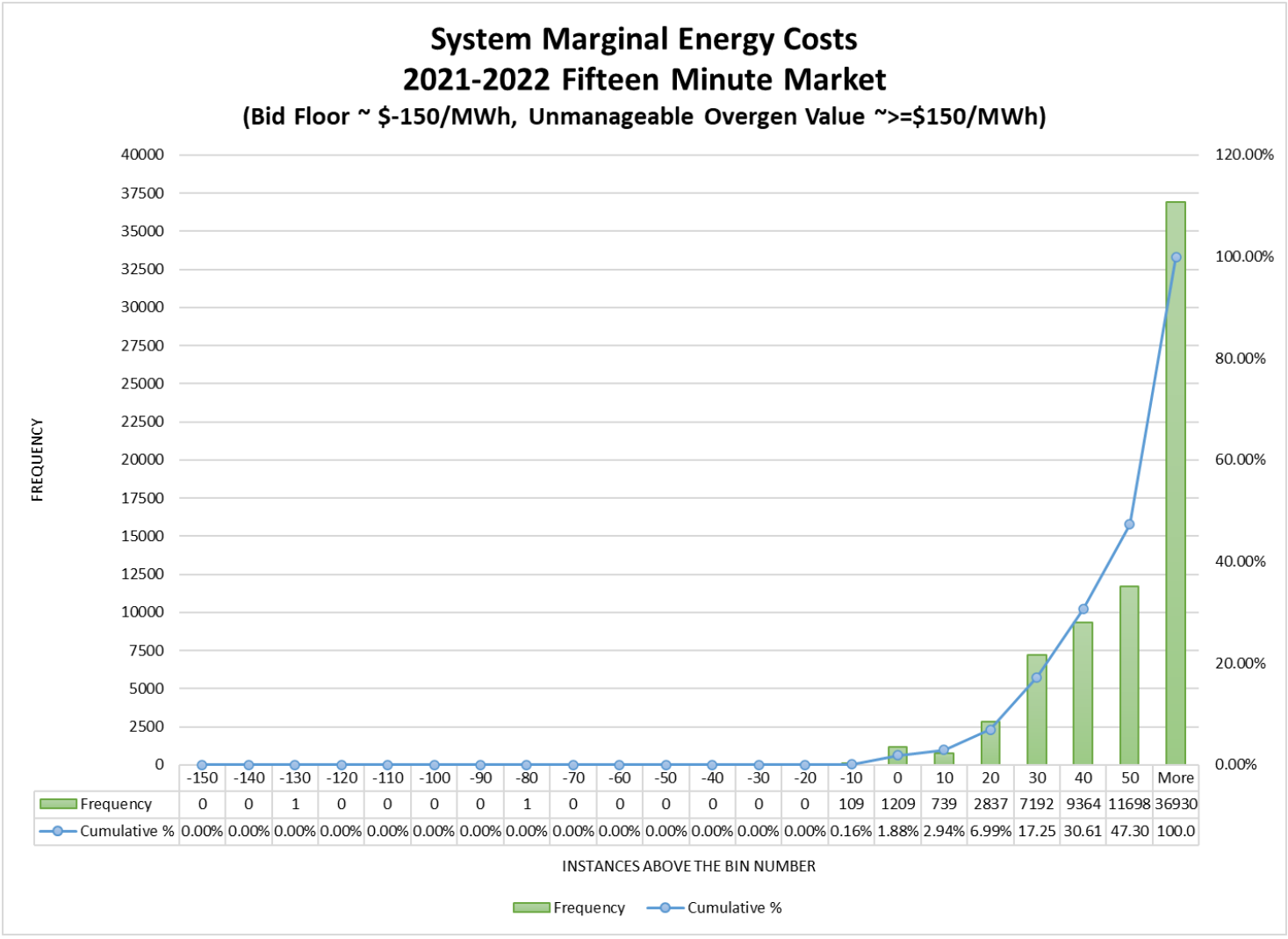
Hour Ending	Surplus Average	Smallest Surplus	Largest Surplus
1	(12,292)	(7,073)	(17,166)
2	(11,556)	(6,327)	(16,252)
3	(11,175)	(6,094)	(16,238)
4	(11,046)	(6,374)	(16,314)
5	(11,459)	(6,243)	(16,831)
6	(12,281)	(6,749)	(19,178)
7	(13,375)	(6,718)	(22,416)
8	(12,937)	(7,442)	(19,992)
9	(12,753)	(7,722)	(18,643)
10	(12,520)	(7,466)	(18,507)
11	(12,647)	(7,441)	(20,569)
12	(13,040)	(6,133)	(22,992)
13	(13,608)	(6,709)	(26,536)
14	(14,163)	(7,329)	(27,107)
15	(14,821)	(7,553)	(29,274)
16	(15,418)	(6,561)	(28,611)
17	(15,852)	(7,177)	(28,230)
18	(17,254)	(8,212)	(29,556)
19	(17,500)	(9,363)	(28,501)
20	(17,204)	(10,429)	(24,828)
21	(16,610)	(10,119)	(25,624)
22	(15,923)	(9,127)	(24,962)
23	(13,916)	(9,025)	(20,249)
24	(12,485)	(7,603)	(19,057)
Total	**(13,826)**	**(6,094)**	**(29,556)**

- Noticed some BAAs never fail downward
- We further analyzed CAISO's ability to pass downward capacity and flex tests b/c CAISO has significant impact on SMEC
  - Used binding T-40 results from Jul. 2022 – Dec. 2022
  - Requirement minus ramp capability equals downward ramp capability
    - Positive = shortage
    - Negative = surplus
- With the smallest surplus level of 6,094 MW, it appears there is ample downward capability from just a single BAA
  - A next step will be to add the other WEIM BAAs to the analysis

Source: OASIS, Flexible Ramp Requirements Inputs & Outputs (WEIM RSE Flexible Ramping Tests)
Analyzed July 2022 – December 2022 because ramp capacity was not available until July 2022 in the OASIS report.

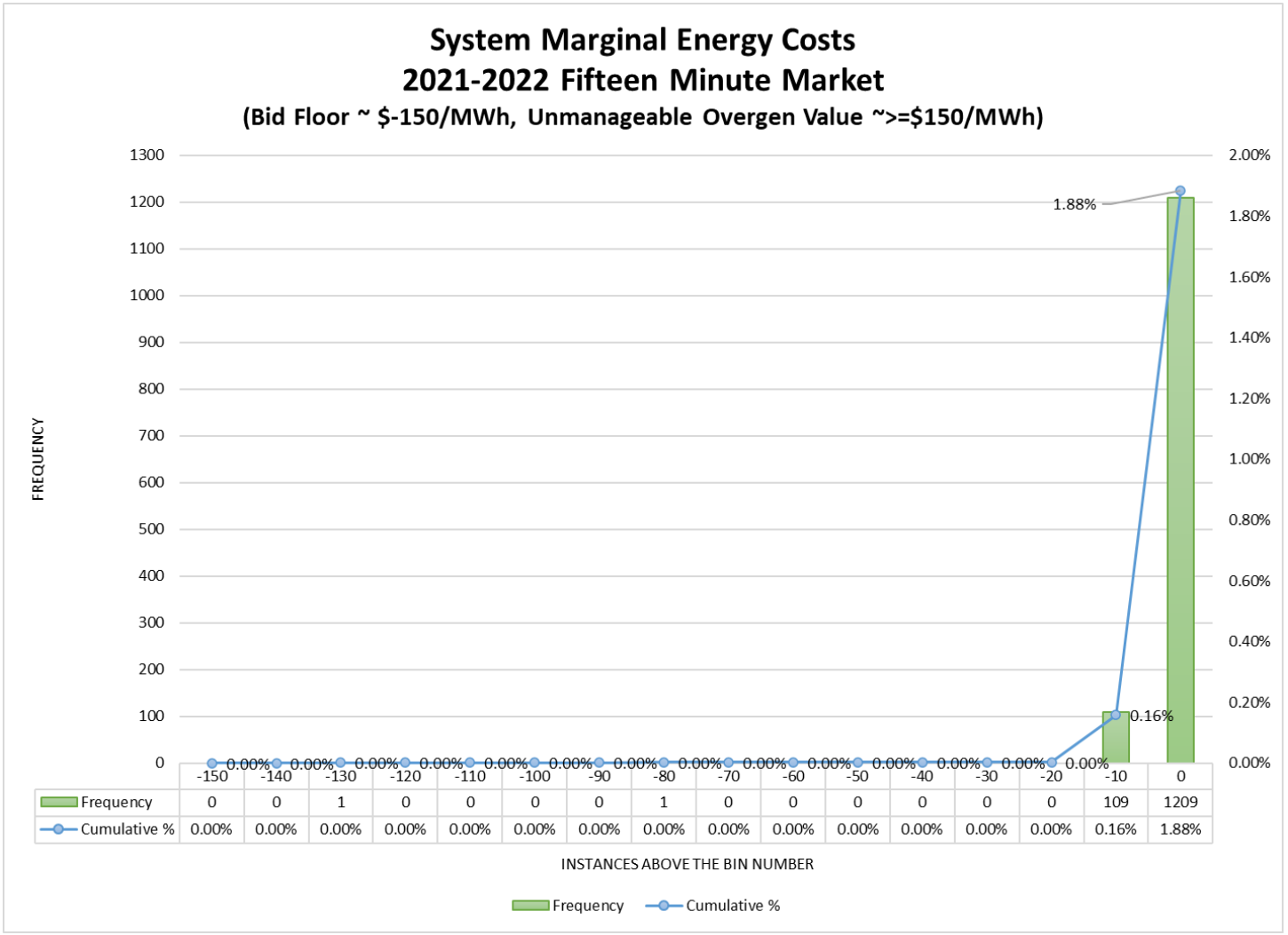
Size oversupply risks in Fifteen Minute Market to see Operation challenges

Question: What is magnitude and frequency of overgeneration risks in FMM?



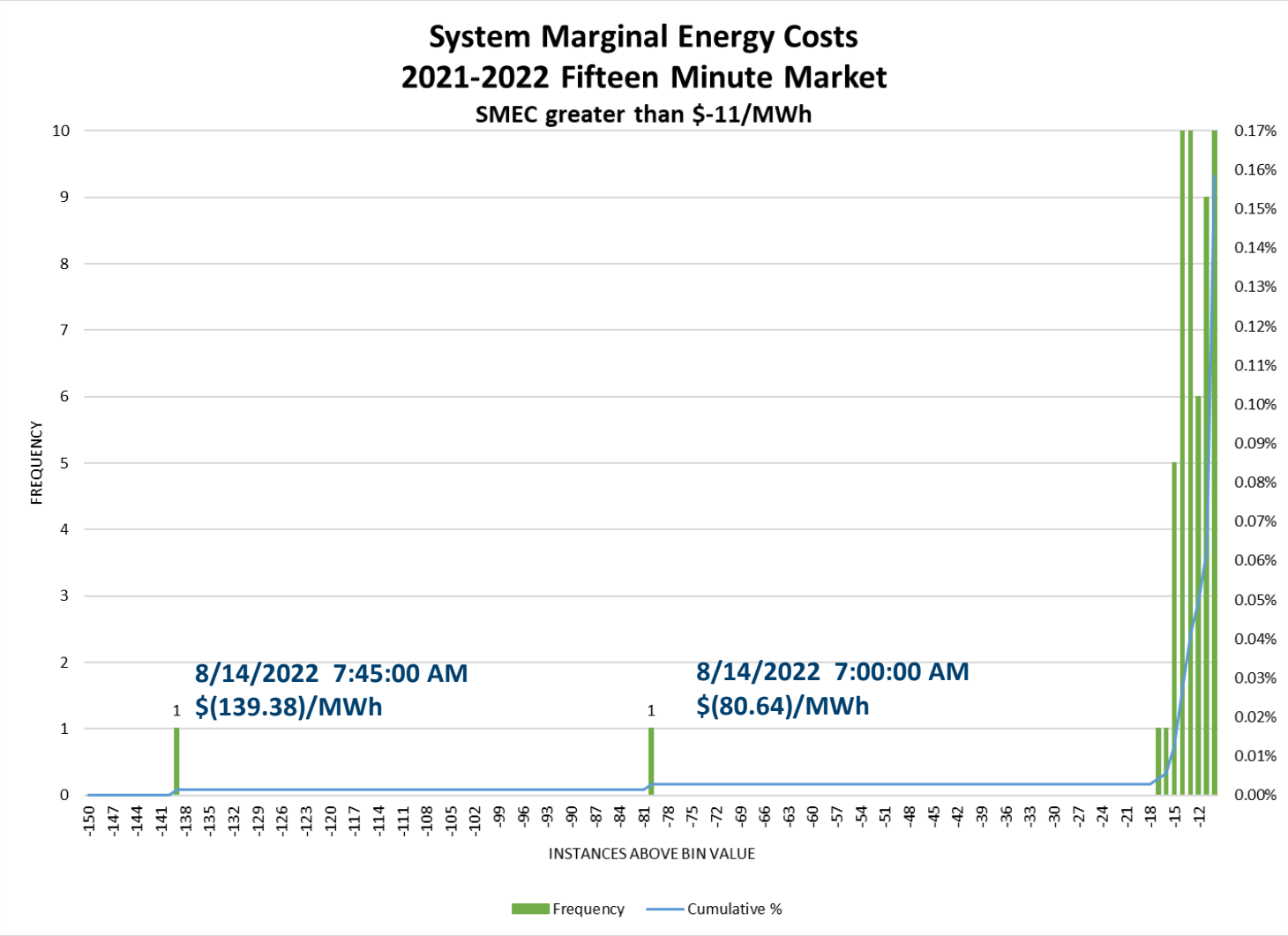
Size oversupply risks in Fifteen Minute Market to see Operation challenges cont.

Question: What about if we zoom in on only those instances where SMEC was <=0?



Size oversupply risks in Fifteen Minute Market to see Operation challenges cont.

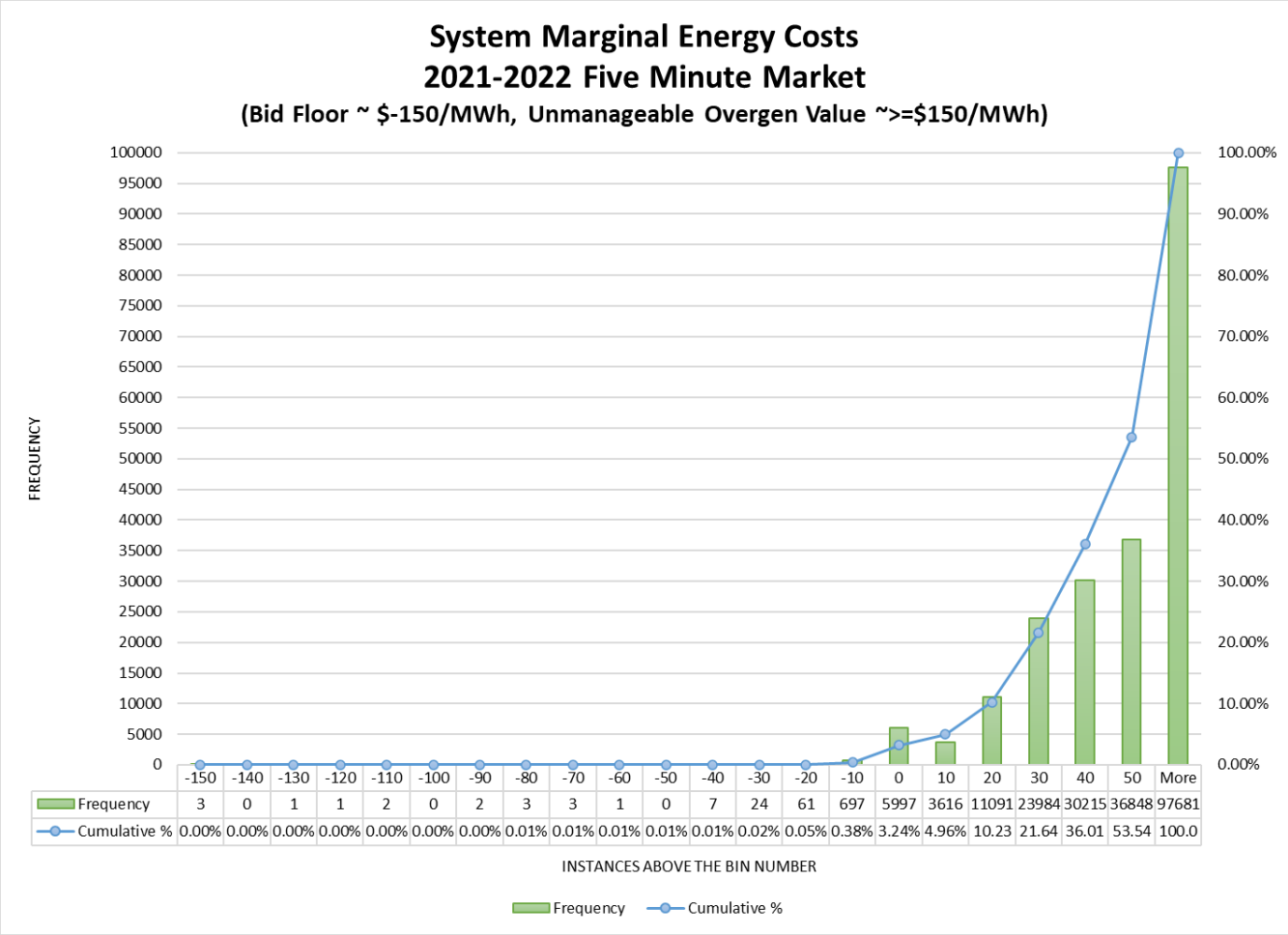
Question: What is the bin for the smallest SMECs that make up 0.06% of the data?



Size oversupply risks in Five Minute Market to see Operation challenges

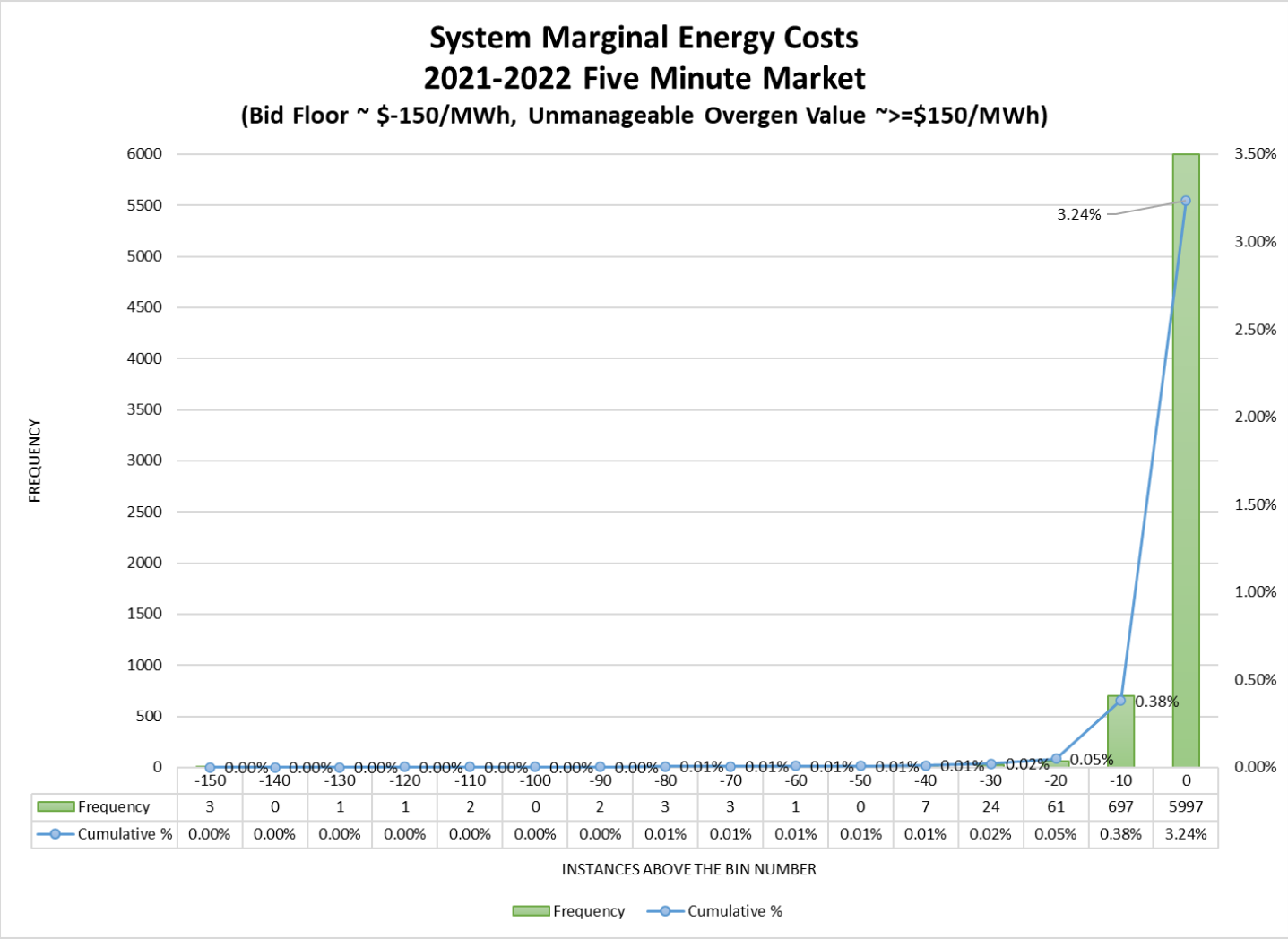
Question: What is magnitude and frequency of overgeneration risks in FMM?

We noticed that the percent of dataset above $0/MWh increases from 1.88% to 3.24%



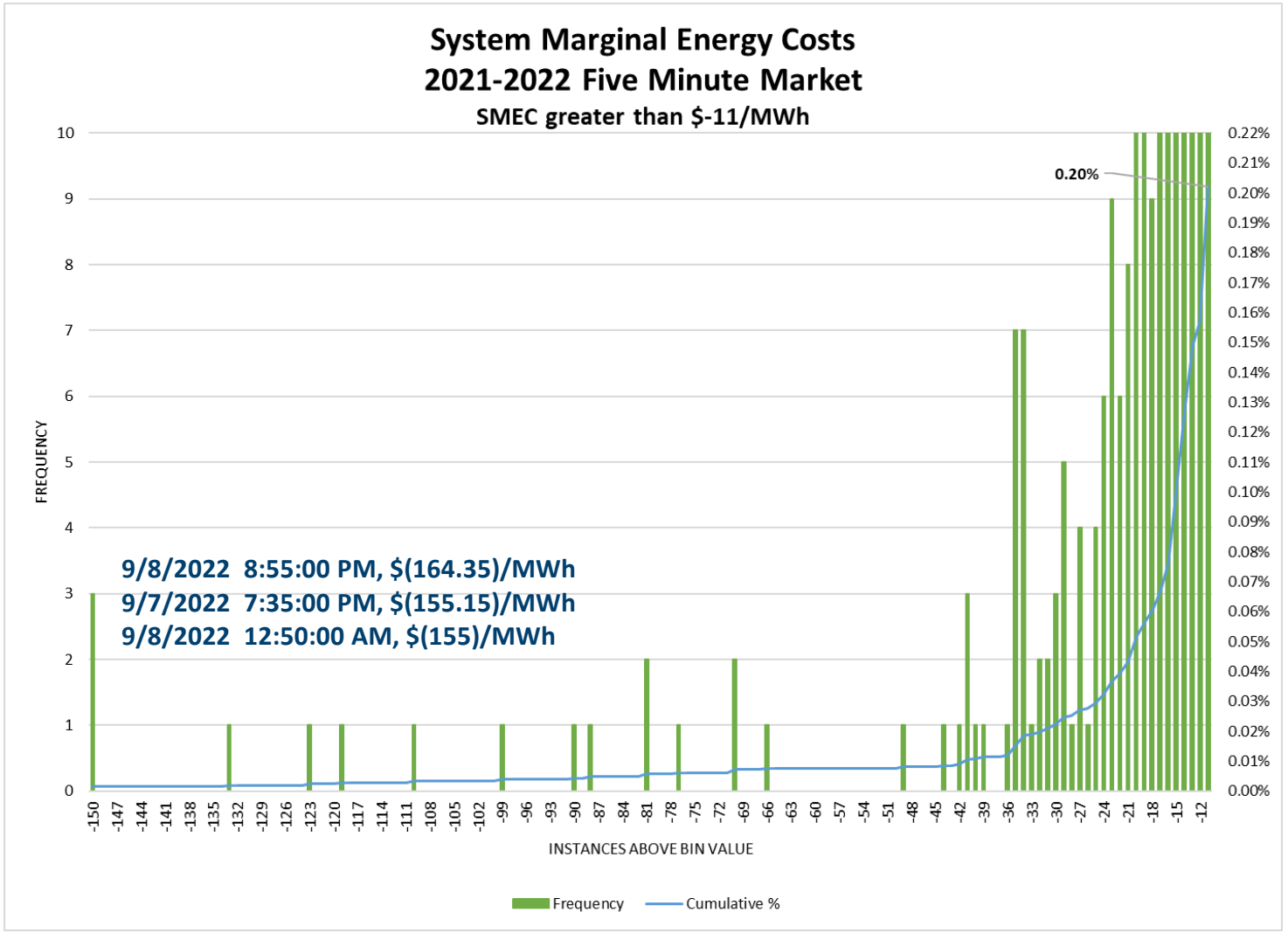
Size oversupply risks in Five Minute Market to see Operation challenges cont.

Question: What about if we zoom in on only those instances where SMEC was <=0?



Size oversupply risks in Five Minute Market to see Operation challenges cont.

Question: What is the bin for the smallest SMECs that make up 0.20% of the data?



Day-Ahead Market Enhancements Vistra FERC Jurisdictional Markets Flexibility Product Benchmark

February 27, 2023

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Summary

- All Independent System Operators/Regional Transmission Organizations (ISO/RTO) either have adopted a day-ahead uncertainty product or are in the process of developing one.

- A properly designed DA flexibility product would unlock significant value for flexible energy attributes that would further incent flexibility.

- A poorly designed DA flexibility product would expose resources to significant operational risks, without providing commensurate payment for incurring the increased risks.

- Common themes emerge across ISO/RTO design direction:
  - System or zonal products
  - Upward requirements only (except for regulation)
  - Disincentivizing inflexibility

On-going efforts across the country to address changing grid needs due to net load uncertainty

California ISO

Day-Ahead Market Enhancements work 2018[1] to present. Targeting end of 2023 implementation, if FERC approved.

Extended Day-Ahead Market another tool that can address CAISO net load uncertainty through imbalance reserves procured EDAM wide (Fall 2024 target).

Western Energy Imbalance Market tool to address CAISO net load uncertainty.

Southwest Power Pool

Holistic Integrated Tariff Team (HITT) work during 2018-2019 and committee review recommendations 2019-2021

- Filed ER22-914[2] on 1/28/22
- ER22-914[3] approved on 8/16/2022
- End of 2023 target implementation

Western Energy Imbalance Services also tool to address SPP net load uncertainty

ISO-NE

Day-Ahead Ancillary Services Initiative, including new Imbalance Reserve product, with goal of filing by end of 2023 targeting a Q4 2024 or Q1 2025 implementation.[7]

NYISO

Energy & Ancillary Services initiatives spanning multiple efforts described in 2022 Master Plan[6] include projects for:

- Balancing Intermittency (22-25)
- Review RTM Structure (25-27+)
- Dynamic Reserves (22-26)
- More Granular OR (25-27)
- Separating Reg - Up & Down (25-27)
- 5-Min Transaction Scheduling (24-27)

Midcontinent ISO

Reliability Imperative[4] effort including its Markets of the Future report[5] lay out plan to address evolving needs from now to 2035.

PJM

Does not believe they have flexibility issues today, but are concerned not valuing flexibility does not incent investment in flex resources either. Planning to address flexibility in next 5-10 years.[8]

In near term, exploring uplift policies to incent flexibility and disincentivize deviations.[9]

1 https://www.caiso.com/Documents/IssuePaper-StrawProposal-DayAheadMarketEnhancements.pdf
2 https://www.spp.org/documents/66491/20220128_revisions%20to%20attachment%20ae%20to%20add%20uncertainty%20reserve_er22-914-000.pdf, 3 https://www.spp.org/Documents/67746/20220816_Order%20-%20Revisions%20to%20Attachment%20AE%20to%20Add%20Uncertainty%20Reserve_ER22-914-000%20and%20001.pdf
4 https://www.misoenergy.org/stakeholder-engagement/MISO-Dashboard/market-redefinition---reliability-imperative/, 5 https://cdn.misoenergy.org/MISO%20Markets%20of%20the%20Future604872.pdf#:~:text=MISO%E2%80%99s%20conclusion%20is%20that%20the%20foundational%20market%20constructs,but%20only%20with%20significant%20market%20enhancements%20and%20optimizations
6 https://www.nyiso.com/documents/20142/34670203/Final%202022%20Master%20Plan.pdf/c10b4a23-fe72-fef8-b434-bc7f2b849e8e
7 https://www.iso-ne.com/static-assets/documents/2022/04/a05_mc_2022-04-12_day_ahead_ancillary_services_memo.pdf, https://www.iso-ne.com/committees/key-projects/day-ahead-ancillary-services-initiative/
8 https://elibrary.ferc.gov/eLibrary/filedownload?fileid=62E4B06B-4F5A-CECE-9B90-83ECC5A00000, 9 https://www.pjm.com/committees-and-groups/issue-tracking/issue-tracking-details.aspx?Issue=f9b3dbf5-4149-4ea6-9ad3-0c452ff9f386

A common theme emerges – changing resource mix driving need for tools to mitigate uncertainty

California ISO

"Real-time energy ramping needs may exceed that accounted for in hourly day-ahead market schedules…Ramping needs to meet the real-time market's final 5-minute dispatch may be much greater than ramping needs for [day-ahead] hourly …Increased amounts of VER, BTM solar, extreme weather, and other variables have contributed to large differences between forecasts and actual load…Large energy imbalances between DAM and RTM create risk DAM will not commit enough resources with sufficient capacity and ramping capability to meet uncertainty that may realize in the RTM.[1]

Southwest Power Pool

"With changes in both the flexibility of supply and increases in system variability in time periods of an hour or more, operators have experienced real-time challenges in maintaining the levels of flexibility needed to maintain reliability…With the balance between available flexibility and system variability expected to tighten in the future, efficient methods to assist in providing the needed flexibility with the available generation fleet will become increasingly important to economical and reliable operations."[2]

ISO-NE

Currently ISO-NE believes its AS suite allows it to manage net load uncertainty, which relatively forecastable, however "As the penetration of weather-dependent resources continues to grow, including substantial levels of offshore wind growth, the ISO expects these deviations may present more acute challenges."[5]

"Capability of the ISO-administered wholesale markets to pro-actively identify, price, and compensate for evolving system needs is essential to both the efficiency and reliability of the power system."[6]

NYISO

"Challenges that will arise in the Energy and Ancillary Services markets with significant additional penetration of weather-dependent, intermittent resources are balancing intermittency and improving price formation … require resources that can balance intermittence for extended periods of time, resources that can quickly turn on and are flexible in dispatch, and resources able to meet the sharp and occasionally sustained ramping needs created by the sudden disruption in solar or wind output while also conforming to New York State's CLCPA goals."[4]

Midcontinent ISO

"MISO can foresee a need for greater flexibility… because days with scattered cloud cover will increase energy variation…In the morning and evening, increased ramp capabilities will be needed to effectively manage changes in net load…High penetrations of solar generation also increase the need for other resources to quickly ramp down…But we are working to better quantify the uncertainty around various risk factors so that we can continue to improve these tools, the operator decisions they inform, and over the long term, identify and implement market products to maintain reliability and efficiency"[3]

PJM

"Shifting electricity system resource mix and the growing quantity of distributed energy resources are causing a rise in uncertainty and volatility…This is compounded by …thermal generation retirements."[7] "With increased grid uncertainty, ability to follow PJM's dispatch signal will be increasingly important to grid reliability; the incentives and penalties for following dispatch will need to be reviewed to ensure the correct market rules are in place…If [ramping] attributes are not valued, acquired and compensated, new replacement flexible resources may not develop and system will lose needed flexibility with retirement of existing resources."[8]

1 CAISO AD21-10 Report, Page 1 & 7, https://elibrary.ferc.gov/eLibrary/filedownload?fileid=B6CEB7B6-5A3D-C669-9348-83ECC4800000
2 SPP AD21-10 Report, Pages 4-7, https://elibrary.ferc.gov/eLibrary/filedownload?fileid=1BFA3065-574B-C2FE-9FE9-83EBA1900000
3 MISO AD21-10 Report, Page 21-24, https://elibrary.ferc.gov/eLibrary/filedownload?fileid=897EF372-978A-C67A-9DEA-83EBE6200000
4 NYISO AD21-10 Report, Page 21, https://elibrary.ferc.gov/eLibrary/filedownload?fileid=143A0487-98B7-C07C-9FFE-83EC6E400000
5 ISO-NE AD21-10 Report, Page 43-44, https://elibrary.ferc.gov/eLibrary/filedownload?fileid=1A5042B5-32FD-C887-9F0C-83ECC7A00000
6 ISO-NE AD21-10 Report, Page 37, https://elibrary.ferc.gov/eLibrary/filedownload?fileid=1A5042B5-32FD-C887-9F0C-83ECC7A00000
7 PJM AD21-10 Report, Page 2, https://elibrary.ferc.gov/eLibrary/filedownload?fileid=62E4B06B-4F5A-CECE-9B90-83ECC5A00000
8 PJM AD21-10 Report, Page 4, https://elibrary.ferc.gov/eLibrary/filedownload?fileid=62E4B06B-4F5A-CECE-9B90-83ECC5A00000

Southwest Power Pool Design Direction

- Implemented RTM Ramp Capability product for 10-20 min ramp capability[1]
- Day-ahead and real-time **Uncertainty Reserve Upward Zonal product** to procure ramp capability for a one-hour horizon to be implemented in 2023[2]
  - ***Monitor and assess for transmission deliverability intra-day to ensure reliable deployment***
  - **Zonal reserve upward product** can be set at either system or zonal
  - **No offers from online resources but will allow offers from offline resources up to $1,000/MWh** to allow amortizing commitment costs of off-line resources into the Uncertainty Reserve offers, which is necessary because make-whole payments exclude periods with an uncertainty reserve award.
  - **Lost opportunity cost for online resources available** [3]
  - **Mitigate offline resource offers up to amortized commitment costs**
  - Marginal clearing price based on marginal resource's opportunity cost pricing and if offline resource is marginal then its Uncertainty Reserve offer[3]

1 SPP AD21-10 Report, Pages 7, https://elibrary.ferc.gov/eLibrary/filedownload?fileid=1BFA3065-574B-C2FE-9FE9-83EBA1900000

2 SPP AD21-10 Report, Pages 6-7, https://elibrary.ferc.gov/eLibrary/filedownload?fileid=1BFA3065-574B-C2FE-9FE9-83EBA1900000; FERC Order Approving, https://www.spp.org/Documents/67746/20220816_Order%20-%20Revisions%20to%20Attachment%20AE%20to%20Add%20Uncertainty%20Reserve_ER22-914-000%20and%20001.pdf; SPP ER22-914 Filing, Pages 15-23, https://elibrary.ferc.gov/eLibrary/filedownload?fileid=CD915646-3465-C392-9CED-7EA196000000

3 This is our current understanding.

ISO-New England Design Direction

- ***Day-Ahead Energy Imbalance Reserve*** **Upward** ***System*** product co-optimized with energy targeting end of 2023 filing[1,2]
  - Energy Imbalance Reserve would be **amount to fill "energy gap" when RT load forecast is greater than physical DA cleared supply** each hour
  - ***Is a call option on real-time energy***
    - Imposes a financial position that internalizes the replacement cost to the market if the awarded resource does not perform in real-time
  - ***Provides incentives to provide RT energy when needed***
    - If resource scheduled in real-time, receives real-time energy price
    - If resource is not available in real-time, it must pay incremental RTM replacement cost of undelivered energy at difference of RTM price and strike price K
- **DA imbalance reserve product results in financial exposure by:**
  - Sets a strike price, K, prior to the day-ahead market
  - Resource is paid DA Imbalance Reserve clearing price
  - Resource charged difference between real-time price and its strike price (K) when real-time price exceeds strike price
    - Option charges with high RTM LMPs expected to be offset by RTM energy sales

1 ISO-NE AD21-10 Report, Pages 51-59, https://elibrary.ferc.gov/eLibrary/filedownload?fileid=1A5042B5-32FD-C887-9F0C-83ECC7A00000
2 ISO-NE Day-Ahead Ancillary Services Initiative, https://www.iso-ne.com/static-assets/documents/2022/04/a05_mc_2022-04-12_day_ahead_ancillary_services_memo.pdf, https://www.iso-ne.com/committees/key-projects/day-ahead-ancillary-services-initiative/

NYISO Design Direction

- ***Dynamic reserve requirements for each zone***
  - Lower cost reserves through more precisely calculated dynamic requirements
- ***More granular operating reserve zones:***[2]
  - Within constrained load pockets in New York City (targeting 2024 filing)
  - Resources compensated for zonal value through more granular zones
- ***Improving shortage pricing for AS*** *e.g., AS demand curves as f(VOLL)*
- ***Disincentivize inflexibility***[3] w/ better incentives to follow dispatch and respond to ramping and flexibility needs e.g., incentives for Long Island reserves (target 2024)
- ***Appropriate price signals for responsive resources*** including quick start, ramping, flexibility, load following, and dynamic reserves to respond to net load uncertainty
- ***5-minute external transaction scheduling enhancements***[4] to explore how best to schedule external transactions every 5-min with neighboring areas
- Exploring ***regulation up and down*** instead of single product

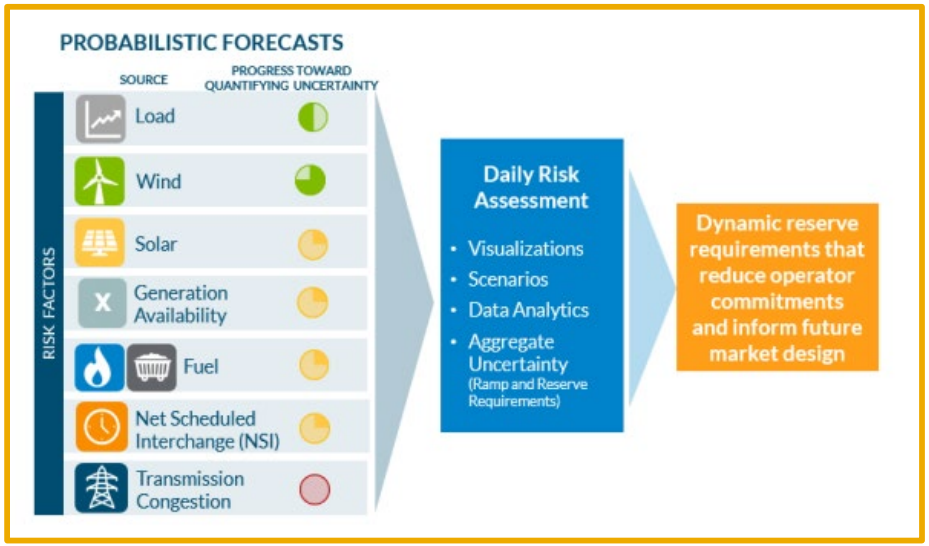
1 NYISO AD21-10 Report, Page 21, https://elibrary.ferc.gov/eLibrary/filedownload?fileid=143A0487-98B7-C07C-9FFE-83EC6E400000
2 *Id* at Page 23
3 *Id* at Page 22
4 *Id* at Page 23

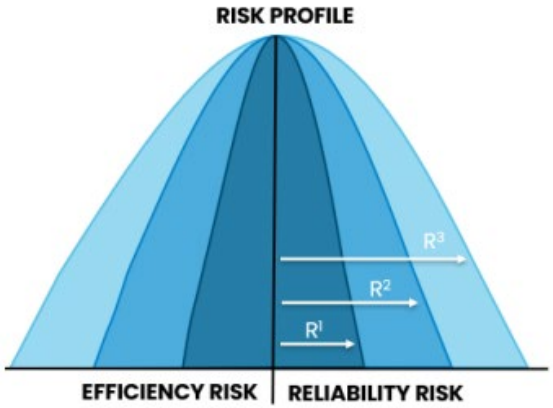
Midcontinent ISO Design Direction

- Pursuing potential enhancements, including adaptation of reserve and ramp product suite to prepare for higher levels of uncertainty[1,2]
  - ***Dynamic requirements using probabilistic zonal forecasts[3]***
    - Create daily risk assessment showing risk to manage on a given day and what is needed to mitigate it.
    - Create Dynamic Reserve Requirements, operationalizing and automating analytical and meteorological expertise, based on Daily Risk Assessment.
  - Ensuring ***zonal deliverability through transmission planning[4]***:
    - Ensures sufficient zonal or sub-zonal capacity resources
    - Urges ***proactive transmission upgrades*** to ensure sufficient transmission ***to support power flows across the system***
- MISO stated they are working to better quantify various uncertainties to improve tools, inform operator decisions, and over long term, identify products to maintain reliability and efficiency

1 Reliability Imperative effort, https://www.misoenergy.org/stakeholder-engagement/MISO-Dashboard/market-redefinition---reliability-imperative
2 MISO AD21-10 Report, Pages 12-13, https://elibrary.ferc.gov/eLibrary/filedownload?fileid=897EF372-978A-C67A-9DEA-83EBE6200000
3 *Id* at Page 25-26
4 *Id* at Page 12, 29-30

Midcontinent ISO Design Direction Cont.





For systems with deliverability challenges, these challenges are quantifiable and if persistent may trigger transmission upgrades.

- "MISO's current process incorporates zonal reserve deliverability in the energy and reserve co-optimization. Similar to local energy delivery, extreme conditions can impede the delivery of reserves just as it would energy." (Report, Page 29)
- "Lastly, MISO's RIIA Summary report demonstrated that if no new transmission is built some needed 10-minute ramp capability product may have "delivery challenges" at 40% renewable penetration." (Report, Page 29-30)

MISO AD21-10 Report, Pages 21-26, https://elibrary.ferc.gov/eLibrary/filedownload?fileid=897EF372-978A-C67A-9DEA-83EBE6200000
MISO's Renewable Integration Impact Assessment (RIIA) is an example of the type of studies that can be made public on deliverability risks of reserves, https://cdn.misoenergy.org/RIIA%20Summary%20Report520051.pdf.

PJM Design Direction

- **Disincentivize inflexibility** through developing new rules and processes to disqualify resources for uplift credits when they do not adequately follow PJM dispatch instructions[1]
- Actively investigating flexibility metrics to explore a **new product to procure intra-hour flexibility (like Imbalance Reserves or Flexible Ramping Product)** in the next five years[2]
- Increase **incentives for demand flexibility**[3]

1 PJM AD21-10 Report, Page 29, https://elibrary.ferc.gov/eLibrary/filedownload?fileid=62E4B06B-4F5A-CECE-9B90-83ECC5A00000
2 *Id* at Page 18-19
3 *Id* at Page 14

Day-Ahead Market Enhancements
Zonal Design Concept
Vistra

February 27, 2023

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Introduction

- CAISO currently includes in Residual Unit Commitment load biases an amount to cover upward uncertainty risks so that they can procure additional backstop resource adequacy for additional must offer capacity into real-time
- Day-Ahead Imbalance Reserves will improve the market's ability to better:
  - A new proposed ancillary service product intended to meet operational risks beyond those the BAL standards require to allow operators to reduce load biasing for imbalance risks, provides lower quality service than spin or non-spin
  - Provide certainty that Integrated Forward Market cleared physical supply transferred to real-time market or any uncleared resources with must offer obligations will bid economically to provide ramp capability for RTM needs
  - Value and compensate resources for their flexibility attributes so the system will not lose needed flexibility as we transition to a SB 100 future
- Vistra performed benchmarking of ISO/RTO design directions to address net load uncertainty, which led us to propose a conceptual upward zonal design
- Our proposed BAA or intra-BAA zonal design likely increase benefits identified by Energy Strategies' EDAM Benefits study since they studied a system-wide imbalance reserves product.[1]

1 CAISO EDAM Benefits Study, Slide 9 "Modeling EDAM: Key Assumptions to Represent Market, http://www.caiso.com/Documents/Presentation-CAISO-Extended-Day-Ahead-Market-Benefits-Study.pdf

Conceptual upward zonal design framework

1. Procure expected uncertainty to meet imbalances for when real-time needs are expected to be greater than the IFM cleared physical supply
   - dynamic reserve requirements based on probabilistic forecasts of upward uncertainty between IFM and RTM
2. Ensure deliverability via zonal design at either EDAM BAA or intra-EDAM BAA level
3. BAA operations should have flexibility to identify level of reserves locational granularity ➔ design should allow each BAA to enforce at BAA or intra-BAA zones
4. Allow Imbalance Reserve bids up to the Ancillary Services bid cap of $250/MWh
   - Mitigate market power concerns through the bid cap at $250/MWh
   - With system or zonal requirements, it is expected to have sufficient resources to provide the service than is required to resolve any market power concerns
5. Co-optimize Energy and Ancillary Services include new Imbalance Reserves product
   - IR is lowest quality AS (maybe Sched Run PF^{1kCap}<$2,000?)
   - IR is higher quality than energy (maybe Sched Run PF^{1kCap}>=$1,800?)
   - Do not include Imbalance Reserve in any cascading of BAL min AS requirements
6. Determine Imbalance Reserves marginal clearing price based on marginal resource's opportunity cost pricing and Imbalance Reserve capacity offer
7. Develop uplift rules for differences between IR zonal and FRP nodal revenues
8. Develop new uplift rules and processes to disqualify resources/load for uplift payments or allocate uplift costs when they do not adequately follow dispatch

Initial thoughts on process to establish BAA or intra-BAA dynamic zonal requirements

- **Forward basis:** Each EDAM BAA perform forward studies (e.g. seasonal) to identify deliverability risks to Ancillary Services where there are deliverability risks that could leave any AS or Imbalance reserves stranded
  - Ideally, pre-defined zones would be posted to OASIS under atlas ref.
- **Daily basis:** On daily basis calculate hourly dynamic reserve requirements for BAA and each pre-defined intra-BAA zone using probabilistic forecasts to estimate each EDAM BAA or pre-defined intra-EDAM BAA zones uncertainty forecasts
- **Pre-IFM Run:** EDAM BAA operations should have flexibility to identify whether each EDAM BAA or pre-defined intra-BAA zones are needed
  - Perform intra-day risk assessment to identify next day's expected risks and whether there are deliverability risks that could leave any reserves stranded
  - Determine whether BAA or intra-BAA zonal requirements for the pre-defined zones should be enforced using this assessment
- **IFM Run:** IFM would use applicable dynamic reserve requirement for the enforced "zone" either EDAM BAA or pre-defined intra-EDAM BAA zones
- **RTM Runs:** Flexible Ramping Product requirements will position "zonal" reserve requirements to most optimal location in real-time ➔ increasing benefits