Day-Ahead Market Enhancements Draft Revised Final Proposal

Stakeholder Meeting

April 7, 2023

Reminders

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- If you need technical assistance during the meeting, please send a chat to the event producer.
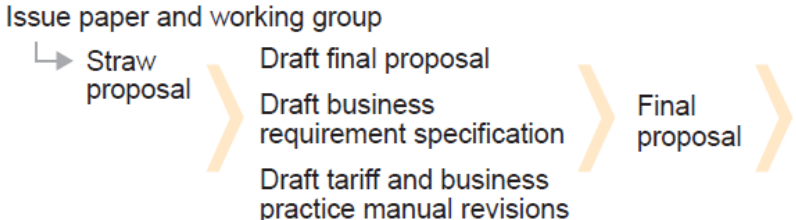
Questions

- In-person attendees:
  - Please raise your hand. To ensure the virtual participants hear your question, please use a microphone.
  - Please state your name and organization when asking your question.

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  - Please raise your hand using the "raise hand" feature in Zoom, or submit your question through the chat.
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Agenda

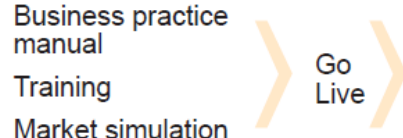| Time	Topic	Presenters
9:00 – 9:10	Welcome and introductions	Brenda Corona
9:10 – 12:00	Changes from final proposal and responses to stakeholder feedback	James Friedrich
12:00 – 1:00	Lunch break	
1:00 – 2:00	Continued discussion on policy changes	James Friedrich
2:00 – 3:30	Changes to storage policy	Gabe Murtaugh
3:30 – 3:50	Excel Solver Examples	George Angelidis
3:50 – 4:00	Next steps	Brenda Corona

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Stakeholder Process

PROPOSAL DEVELOPMENT

Issue paper and working group

Straw proposal

Draft final proposal

Draft business requirement specification

Draft tariff and business practice manual revisions

Final proposal

Stakeholder input

DECISION

ISO Board

EIM Governing Body

Tariff filing

FERC

IMPLEMENTATION

Business practice manual

Training

Market simulation

Go Live

This represents the typical process, and often stages of the process run in parallel.

We are here

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Day-Ahead Market Enhancements

CHANGES FROM FINAL PROPOSAL AND RESPONSES TO STAKEHOLDER FEEDBACK

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Day-Ahead Market Enhancements (DAME)
Extended Stakeholder Process

- The ISO published the DAME final proposal on Jan. 11, 2023

- Extended stakeholder process to address lingering concerns

- Core concerns centered around design details about procurement of imbalance reserves

- The ISO solicited stakeholder presentations and dedicated ~20 hours of public meetings

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Day-Ahead Market Enhancements (DAME)
Extended Stakeholder Process

- **Nodal approach** - procuring imbalance reserves within the IFM (co-optimized with energy and ancillary services) and using deployment scenarios to ensure the awards are transmission feasible if deployed as energy.

- **Zonal approach** - procuring imbalance reserves within the IFM (co-optimized with energy and ancillary services) using zonal procurement similar to ancillary services.

- **SCE approach** - procuring imbalance reserves within the RUC (co-optimized with reliability capacity) using nodal procurement to respect transmission constraints, with a fallback option of keeping imbalance reserves in the IFM but modeling less than full deployment of the imbalance reserves in the deployment scenarios.

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Summary of comments

- Appendix B provides summary of stakeholder comments by entity

- Overall, feedback was mixed

- Disagreement on whether a nodal or zonal approach is preferable

- Disagreement on whether downward imbalance reserve is needed

- Several suggestions to adjust design within the framework of the final proposal (PG&E, SCE, LADWP, DMM) but others disagree with inclusion of imbalance reserve in RUC

- Several entities express concerns about the 15-minute ramp requirement and cost associated with congestion induced in the deployment scenarios

- Frequent comments on: Imbalance reserve demand curve, flexible application of constraints, market power mitigation, uncertainty distribution

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Flexible application of constraints in the deployment scenarios

- The proposal continues nodal procurement of imbalance reserves with some modifications

- The ISO will implement functionality for flexible activation /deactivation of individual transmission constraints in deployment scenarios and build software architecture that can accommodate a range of nodal/zonal outcomes

- This modification addresses stakeholder concerns about computational performance and market impact of nodal approach

- The ISO can enforce fewer constraints in deployment scenarios based on market simulation or operational experience

- Collaboration with EDAM BAAs to identify critical constraints to enforce

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Tunable parameter for imbalance reserve deployment

- The proposal includes implementing a tunable parameter to define the proportion of imbalance reserve awards that are "deployed" with resulting flows in deployment scenarios.
    - For example, if the parameter is set to 0.5, only half of each imbalance reserve award supply injection and demand withdrawal will be modeled against transmission constraints in deployment scenarios.

- This modification aims to mitigate stakeholder concerns about excessive congestion costs in deployment scenarios.

- The ISO plans to initially set the parameter to "1" for full deployment of imbalance reserves but can flexibly adjust if needed after market sim or operational experience.

- Note: process would not affect scheduling limit constraints for EDAM transfers

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Evaluating regional uncertainty in nodal deployment scenarios

- The ISO is committed to evaluating the need for a layer of regional uncertainty in nodal uncertainty distribution.

- Stakeholder concern: The ISO's approach to distributing uncertainty in deployment scenarios is flawed as it does not account for differences in uncertainty across locations.

- Example: Two variable energy resources (VERs) with the same forecast but in different climate zones receive the same uncertainty allocation, even if one VER is in a climate zone with higher variability.

- More accurate uncertainty allocation can lead to improved market efficiency by reflecting the actual variability of resources and load in different locations in the deployment scenarios

- Process can be implemented shortly after DAME/EDAM

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Revised imbalance reserve demand curve approach

- ISO BAA subject to a hybrid design for its imbalance reserve requirement where 50% of the imbalance reserve requirement will be subject to a demand curve, while the other 50% will be subject to high penalty prices

- Penalty price values for the latter portion will be set to prioritize imbalance reserve over low-priority self-scheduled exports in the IFM

- This mitigates the concern that the ISO will forego reserves to meet its BAA's net load uncertainty in favor of clearing LPT exports, providing more certainty about expected volume of protected exports in real-time

- For the former portion, the demand curve will reflect the design implemented for the flexible ramping product with a cap of $247

- Other EDAM BAAs participating in EDAM will use only the imbalance reserve demand curve

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Updates to real-time curtailment for exports in RUC

- Updates to the RUC market formulation in DAME require changes to the process for indicating exports at risk of curtailment in real-time

- If an economic export submits an RCU bid and is awarded RCU, that RCU award will be paid at the relevant marginal RCU price.

- Economic exports (that do not bid RCU) and LPT exports will be considered in the RUC scheduling run with RCU bids at penalty prices that maintain the merit order of their energy bids in the IFM
  - Note that these RCU awards are proxy awards and will not be paid at the relevant marginal RCU price

- If there is no available physical supply capacity in the RUC above energy schedules to meet both the demand forecast and the economic and LPT exports that cleared the IFM, the latter will receive a curtailment indication for the RTM in the form of RCU awards

- The export scheduling coordinator will be obligated to submit economic bids for the RCU capacity, similar to the must-offer obligation for RCU awards

Expansion of imbalance reserve product

- The ISO will expand the imbalance reserve product to include the 30-minute ramp-capable portion of the resource

- This expansion is in response to stakeholder concerns that the 15-minute ramping nature of the imbalance reserve product is too restrictive
  - Real-time net load uncertainty often arises with longer lead times and is correlated between hours
  - Should address the real-time operational need at lower costs by requiring fewer resources to provide imbalance reserves

- However, resources providing imbalance reserves still need to be 15-minute dispatchable, so the expansion does not change which resources are eligible to provide the product

- No associated change to deviation settlement with FRP

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Mechanism to collect congestion rent on imbalance reserve flows

- Stakeholders have pointed out that without a mechanism to collect congestion rent on imbalance reserve flows, the ISO would be shifting costs away from entities entitled to congestion revenues, and not considering the full cost of using the transmission system.

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Proposed mechanism

- The ISO proposes the following mechanism to address the problem:
  - The ISO would determine the "displaced" congestion revenue from imbalance reserve up flows by calculating and summing (Imbalance Reserve Up Flow) * (Shift Factor) * (Shadow Price of Transmission Constraint) for all binding constraints in the upward deployment scenario.
  - Similarly, the ISO would determine the "displaced" congestion revenue from imbalance reserve down flows by calculating and summing (Imbalance Reserve Down Flow) * (Shift Factor) * (Shadow Price of Transmission Constraint) for all binding constraints in the downward deployment scenario.

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Congestion revenue collection and distribution

- The ISO would collect this revenue through the existing imbalance reserve cost allocation.
  - Congestion contributions to transmission constraints in an EDAM BAA from resources in other EDAM BAAs contribute to the congestion offset of the EDAM BAA where the congestion occurs.

- For the ISO BAA, the congestion offset distribution is through the CRR Balancing Account.

- For non-ISO BAAs, the ISO would return the revenues to the BAA for distribution to its participants according to their OATT processes.

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Redefining CRR notional value

- For the ISO BAA, the ISO would redefine the notional value of CRRs to incorporate marginal cost of congestion differences between source and sink for imbalance reserve deployment scenarios.

- The ISO would also redefine the congestion revenue collection to fund the CRR notional value to include imbalance reserve deployment scenarios.

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Introducing a transitional RA true-up mechanism

- The ISO proposes a three-year "opt-in" transitional RA true-up mechanism.

- Entities can choose to have imbalance reserve and reliability capacity payments that overlap with RA capacity to be "trued-up" through the ISO settlement system.
    - Both parties must opt-in

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Compensation for "opt-in" RA capacity

- The ISO will compensate the LSE for "opt-in" RA capacity at the respective imbalance reserve capacity price (minus opportunity costs) and/or reliability capacity price.

- The RA resource will be compensated for the same overlapping RA capacity at the respective imbalance reserve opportunity cost.

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Compensation for non "opt-in" RA capacity

- The ISO will continue to compensate the RA resource for any overlapping RA capacity that has not elected to "opt-in" to the RA true-up mechanism, as well as non-RA capacity, at the respective marginal imbalance reserve price or marginal reliability capacity price.

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Calculation of overlapping RA capacity

- The ISO will calculate overlapping RA capacity by comparing the resource's shown RA capacity against the resource's stacked awards for energy, ancillary service, imbalance reserve, and reliability capacity.

- Any portion of RA capacity that overlaps with imbalance reserve or reliability capacity awards will be potentially subject to the RA true-up mechanism.

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Distribution of overlapping RA capacity

- For resources shown on multiple LSE's monthly RA plans, the ISO will determine the portion of overlapping RA capacity associated with LSEs that "opt-in" or "opt-out" of the RA true-up mechanism.

- Overlapping RA capacity will be distributed to LSEs in proration to their RA showing compared to the resource's total RA showings.

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Day-Ahead Market Enhancements

CHANGES TO STORAGE POLICY

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The day-ahead market enhancements policy proposes three changes applicable to storage resources

1. Storage resources will participate in the RUC process
   – This will be a change from today, where storage schedules from the integrated forward market run are used in residual unit commitment

2. The ancillary service state of charge constraint will be updated to include imbalance reserves

3. The day-ahead market will generate an estimate for the upper and lower (an envelope for) state of charge
   – Constraint helps ensure that storage resources are available to deliver imbalance reserves in the real-time market

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Day-Ahead Market Enhancements

RESIDUAL UNIT COMMITMENT

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Some stakeholders raised concerns about how storage participates in the RUC process today

- The day-ahead market process uses the residual unit commitment process to ensure that sufficient capacity is committed to meet the ISO load forecast
  - Resources may not be committed in the integrated forward market run, because of virtual supply and demand

- Residual capacity process for commitment decisions
  - Bids specified in $/MW, and include incremental + decremental energy
  - Integrated forward market schedules are respected

- Today integrated forward market results are used, without flexibility, in the residual unit commitment run for storage
  - Bids from storage resources are not considered in RUC

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The current process could introduce inefficiencies and increase overall costs to operate the system

- Schedules for typical day-ahead schedules for storage resources may be fairly good representations of actual operation

- Barring storage resources from the residual unit commitment process could result in less than optimal commitments
  - Higher commitments could increase overall costs, and lower efficiency

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This proposal allows for storage resource participation in the residual unit commitment process

- Today, most resource adequacy resources are required to bid RA capacity into RUC at $0/MW
  - Non-resource adequacy capacity may submit bids into the RUC process

- RUC awards impose bidding obligations in real-time

- Propose to require storage resource participation in RUC
  - Storage resources both shown and not shown for resource adequacy may specify a bid for residual unit commitment, this bid will not be required to be $0/MW

- Constraints ensuring state of charge and modeling state of charge apply in the residual unit commitment process

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ANCILLARY SERVICE STATE OF CHARGE CONSTRAINT

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DAME leverages current policy established to ensure state of charge for ancillary service awards

- Today the market already ensures that there is sufficient state of charge for storage resources to provide ancillary services

- The DAME policy continues to propose that these requirements include imbalance reserves

$$SOC_{i,t-1} - RU_{i,t} - SR_{i,t} - NR_{i,t} - IRU_{i,t} \geq \underline{SOC}_{i,t}$$
$$SOC_{i,t-1} + \eta_i(RD_{i,t} + IRD_{i,t}) \leq \overline{SOC}_{i,t}$$

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Day-Ahead Market Enhancements

ENVELOPE EQUATIONS

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Imbalance reserves are different than traditional products and may require new tools for management

- Resources may receive imbalance reserve in both directions during any specific hour
  - The real-time outcome will only result in energy realized one direction or the other

- When the system is relying heavily on imbalance reserves, it will consume most of the reserves in the direction of the actual imbalance
  - If storage resources are not available and are relied on for these reserves, it could result in reliability issues
  - Need adequate tools to protect against an outcome like this

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The envelope equations are meant to model a hypothetical upper and lower bound for storage

$$SOC_{i,t}^{(u)} = SOC_{i,t-1}^{(u)} - EN_{i,t}^{(+)} - \eta_i\, EN_{i,t}^{(-)} + \eta_i\, AIRD_t\, IRD_{i,t} \leq \overline{SOC}_{i,t}$$

$$SOC_{i,t}^{(l)} = SOC_{i,t-1}^{(l)} - EN_{i,t}^{(+)} - \eta_i\, EN_{i,t}^{(-)} - AIRU_t\, IRU_{i,t} \geq \underline{SOC}_{i,t}$$

- The upper envelope is impacted by downward imbalance reserves, which can increase state of charge
- The lower envelope is impacted by upward imbalance reserves, which can decrease state of charge
- Both values must stay with the operating limits of the resource
- Multipliers are attached to each of the imbalance terms

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Setting the correct values for the multipliers will be crucial to ensure participation and availability

- This proposal sets the multipliers initially at 0.2 for all hours for upward and downward imbalance reserves
  - This is likely a "conservative" value
  - Multipliers will be updated with operational experience

- The business practice manuals will document:
  - What the multipliers are set to (for each hour)
  - The methodology used to set the multipliers

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Example 1: A storage resource and calculated state of charge values

Assume that a storage resource can:

- Operate between -100 MW (charging) to +100 MW (discharge)

- Provide four hours of service

  – Energy limits from 0 MWh to 400 MWh

- Has 100% round trip efficiencies

- Begins the day half charged, at 200 MWh

Assume we are using values of 1.0 for the multipliers in the state of charge envelope equation

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Example 1: A storage resource may be awarded a combination of energy or imbalance reserves

Only an upward imbalance reserve award

Hour	En	IRU	IRD	SOC_U	SOC	SOC_L
0				200	200	200
1	0	100	0	200	200	100

A charging award with an upward imbalance reserve award

Hour	En	IRU	IRD	SOC_U	SOC	SOC_L
0				200	200	200
1	-100	100	0	300	300	200

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Example 1: A storage resource may be awarded a combination of energy or imbalance reserves

Discharge award with a downward imbalance award

Hour	En	IRU	IRD	SOC_U	SOC	SOC_L
0				200	200	200
1	100	0	100	200	100	100

An imbalance down award with an imbalance up award

Hour	En	IRU	IRD	SOC_U	SOC	SOC_L
0				200	200	200
1	-100	100	0	300	300	200

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Example 1 Extension: The constraint will prevent some awards

If the upper and lower envelopes reach the extremes, no further dispatch is will be awarded

Hour	En	IRU	IRD	SOC_U	SOC	SOC_L
0				200	200	200
1	0	100	100	300	200	100
2	0	100	100	400	200	0
3	100	0	100	400	100	-100

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Example 2: Same example resource with a 0.2 multiplier on both multipliers

Awards over multiple hours, with a 0.2 multiplier

Hour	En	IRU	IRD	SOC_U	SOC	SOC_L
0				100	100	100
1	20	50	0	80	80	70
2	0	80	100	100	80	54
3	-100	0	100	220	180	154
4	0	100	100	240	180	134
5	0	100	100	260	180	114

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Day-Ahead Market Enhancements

NEXT STEPS

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Next Steps

Milestone	Date
Draft Revised Final Proposal	April 6, 2023
Stakeholder Meeting	April 7, 2023
Comments Due	April 20, 2023
Revised Final Proposal	April 28, 2023
Joint ISO Board of Governors and WEIM Governing Body meeting	May 17, 2023
Implementation	Fall 2024

Submit comments using the comment template linked on the initiative webpage https://stakeholdercenter.caiso.com/StakeholderInitiatives/Day-ahead-market-enhancements

Please contact inicosia@caiso.com or isostakeholderaffairs@caiso.com if you have any questions.

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