Price Formation Enhancements

Scarcity Pricing

Policy Development Working Group

December 16, 2024

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- The meeting is structured to stimulate dialogue and engage different perspectives.
- Please keep comments professional and respectful.
- Please try to be brief and refrain from repeating what has already been said so that we can manage this time efficiently.

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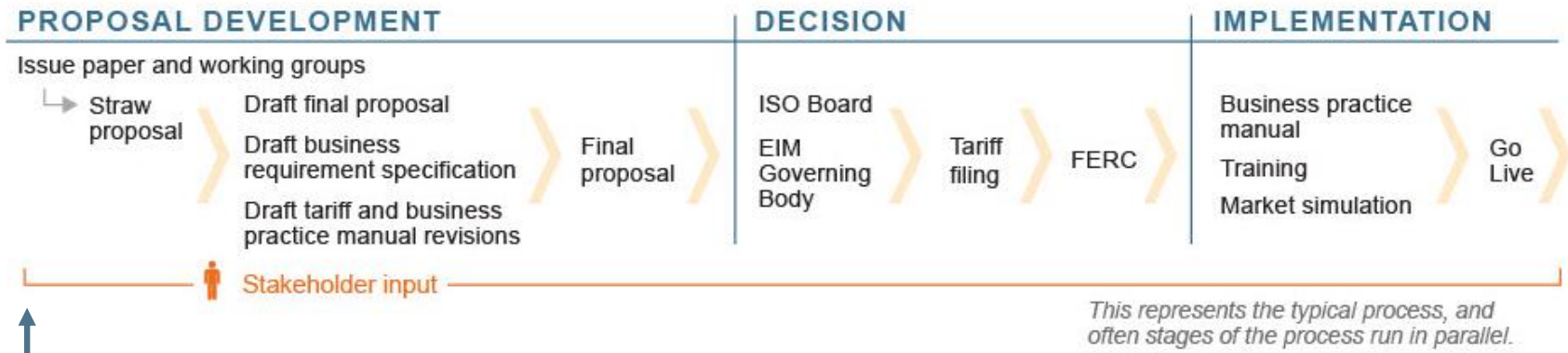

We are here

Meeting Objectives

1. Understand the current limitations in CAISO's real-time ancillary services procurement and scarcity pricing mechanisms, particularly regarding the Scarcity Reserve Demand Curve (SRDC).

2. Review and provide feedback on multiple potential enhancements.

3. For WEIM/EDAM entities specifically, understand how these changes implicate the regional market footprint and provide feedback on what scarcity pricing features they want to see in the market.

Timeline of Scarcity Pricing Working Group Discussions

Date	Topic
December 16, 2024	**Discuss enhancements to ancillary service procurement in the real-time market to improve the ability of the Scarcity Reserve Demand Curve (SRDC) to reflect tight supply conditions.**
January 9, 2025	Discuss market-based mechanisms for prices to rise gradually as the risk of shortages increases and the system approaches scarcity conditions.
January 23, 2025	Review and discuss updates to the value with which to anchor and scale pricing run penalty prices to ensure alignment with current Western Interconnection market conditions and proper scarcity value of reserves.
February 6, 2025	Discuss market mechanisms to incorporate the pricing impacts of emergency actions during scarcity events.
March 27, 2025	Discuss interactions between scarcity pricing and fast-start pricing

Workshop Agenda

Topic	Presenter	Time
Welcome and Introductions	Brenda Corona	10 minutes
Scarcity Pricing Background	James Friedrich	30 minutes
Exploring Potential Enhancements	James Friedrich	80 minutes
Open Discussion and Q&A	All	60 minutes

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BACKGROUND

The role of ancillary services in grid reliability

- Ancillary services support grid reliability by providing a real-time buffer to balance the grid when there are sudden changes in supply or demand.
- They help ensure the stability of the grid frequency and voltage, and provide reserves to respond to contingencies such as unexpected generator trips or transmission line outages.
- As the resource mix evolves and uncertainty and variability increase, these services become even more critical.

Reserves and scarcity pricing

- Scarcity pricing fundamentally reflects the relationship between available reserves and system reliability.
- The concept recognizes that having more reserves available provides additional reliability value to the system.
- As available reserves decrease, prices increase to reflect the growing risk of reliability issues and to incentivize additional resources to be available.
  - Signals the severity of the situation to all market participants
  - Incentivizes supply- and demand-side responses
- It is a well-established and widely implemented feature of LMP markets.

The function of the SRDC and its role in scarcity pricing

- CAISO's **Scarcity Reserve Demand Curve** is a tiered demand curve used to set ancillary service marginal prices when there is a shortage of AS supply.
  - This mechanism ensures that AS prices rise automatically to predetermined levels in scarcity conditions, reflecting the increasing cost of procuring additional AS as the system gets tighter.

- The SRDC mechanism impacts energy prices as well.
  - This is because the energy price will now include the opportunity cost of forgoing the scarce AS capacity.

RTM limitations that impact the SRDC (1/4)

Limitation #1: The real-time market only procures incremental AS awards beyond the quantity procured in the day-ahead market.

- The market procures 100 percent of CAISO BAA's forecasted AS requirements in the day-ahead market.
- Incremental AS procurement may not fully capture the extent of AS scarcity in real-time, which could potentially delay the triggering of the SRDC and lead to underpricing of AS during periods of emerging scarcity.
- Full AS re-optimization would lead to better real-time price formation because the market could better reflect real-time system conditions and costs by releasing DAM AS capacity that could be more valuable for energy (or other services) in real-time.

RTM limitations that impact the SRDC (2/4)

Limitation #2: The real-time market only procures incremental AS awards in FMM and not in RTD.

- In FMM (15 minute market), energy prices incorporate the opportunity cost of providing AS, but in RTD (5 minute market) they won't. This could lead to misalignment between system needs and prices.

- SRDC signals would only flow through FMM, and RTD prices would not fully reflect AS scarcity.

RTM limitations that impact the SRDC (3/4)

Limitation #3: The markets only procure AS within the CAISO BAA.

- The WEIM/EDAM market structure delegates the responsibility for AS procurement and management to individual WEIM entities outside CAISO
- Creates asymmetric pricing dynamics between CAISO and other BAAs
- This suggests a need to explore SRDC-like mechanisms for WEIM areas outside the CAISO BAA.

“Arming load” does not trigger the SRDC (4/4)

- The practice of **arming load** occurs when system operators inform load-serving entities to prepare to drop load in a controlled manner in case there is a generation contingency.
- Armed load can count for contingency reserves and make the resources providing those reserves available to serve load.
- The SRDC is not triggered when this occurs.

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EXPLORING POTENTIAL ENHANCEMENTS

WEIM/EDAM Considerations

- Today, the SRDC directly applies solely to the CAISO BA. However, when the SRDC triggers in the CAISO BA, it affects energy prices through the opportunity cost of ancillary services capacity, which can then propagate to energy prices throughout the WEIM footprint.

- These issues are relevant to the potential expansion of energy-AS co-optimization in future EDAM/WEIM enhancements.

- Requesting feedback from WEIM/EDAM entities on the scarcity pricing features they want in the market, highlighting some related existing features:
  - **Available Balancing Capacity** allows a WEIM entity to designate capacity from participating and non-participating resources to address infeasible power balance conditions in their BA
  - **Assistance Energy Transfers** enable WEIM BAAs facing capacity or flexibility shortfalls to access excess supply from other WEIM entities for an ex-post surcharge.
  - **FRP/Imbalance Reserve Demand Curves** (more discussion next session)

Potential enhancements

1. Full re-optimization of ancillary services in real-time
2. Deliverability tests for ancillary services
3. Procurement of ancillary services in the 5-minute market (RTD)
4. Implement settlement-for-differences between day-ahead and real-time markets
5. Collapse spinning reserves and non-spinning reserves into one operating reserve product
6. Eliminate the cascading procurement between regulation and operating reserves
7. Trigger the SRDC when “arming load”
8. Enhancements for the EDAM/WEIM?

The current scheduling run penalty prices for AS in RTM may not be desirable under a paradigm where AS is fully re-optimized in RT

- Scheduling run penalty prices for AS products are higher than energy in IFM but generally lower than energy in RTM.

- Scarcity pricing requires the market to forego reserve procurement in order for the reserve opportunity cost (as defined by the reserve demand curve value) to translate into higher energy prices.

- The effectiveness of the SRDC as a general scarcity pricing mechanism depends on the willingness to procure less than the target procurement requirement

Full re-optimization of ancillary services in real-time

Potential Benefits

- Enhanced grid reliability - could reduce the risk of reliability events and potentially lower overall system operating costs (in connection with the next suggestion)
- Improved price formation and market efficiency - allows resources to be put to their most valuable use in real-time based on actual system conditions and better reflects the actual scarcity of AS in real-time, leading to more accurate price signals and more efficient resource allocation

Potential challenges

- Operational complexity – operators would find it harder to track AS as it moves between resources, which is a non-starter without higher deliverability assurance.
- Implementation challenges – would require enhanced deliverability tests, revision to settlement systems, significant market software changes.

Deliverability tests for ancillary services

Potential benefits

- Enhanced grid reliability - better ensure that procured AS can be reliably delivered to where they are needed
- Improved price formation and market efficiency - could allocate AS more efficiently and potentially lower overall procurement costs by filtering out bids from resources that, despite being technically capable, face transmission constraints.
- Reduced operator actions – Could reduce CAISO's reliance on operator interventions and exceptional dispatches to maintain AS deliverability

Potential challenges

- Computational complexity and implementation challenges – fully nodal AS is not considered technically feasible within the market timelines; AS regions could be made more refined and granular but there is internal skepticism it will be sufficient.
- Operational complexity – will impact existing operational practices and could require changes to how operators assess system reliability

Procurement of ancillary services in the 5-minute market (RTD)

Potential benefits

- Enhanced grid reliability – better alignment between market outcomes and actual system conditions
- Increased market efficiency – maximizes the utilization of available AS resources, which could lead to cost savings and potentially lower overall AS procurement costs.
- Improved price formation - 5-minute energy prices would better reflect actual reserve conditions, would incorporate reserve shortage prices into 5-minute market, more consistent price signals between 15-minute and 5-minute markets

Potential challenges

- Implementation challenges - Would require significant market software changes and resolution of technical challenges
- Operational complexity – may require new operational tools and procedures
- CAISO PFE team is not sure the benefits are proportional to the significant added complexity – seeking feedback from the working group

Implement AS settlement-for-differences between day-ahead and real-time markets

Existing paradigm

- Day-ahead market: Suppliers receive payment equal to the Ancillary Service Marginal Price (ASMP) multiplied by the awarded capacity quantity for each ancillary service, region, and trade hour.
- Fifteen-minute market: same concept applies to the quantity of ancillary services that was not already awarded and paid for in the day-ahead market
  - When a resource that has been awarded and paid for ancillary services in the DAM becomes unavailable in real time, the supplier will not receive the full payment for the ancillary service they were unable to provide.

Implement AS settlement-for-differences between day-ahead and real-time markets

Simple example

- Let's say a resource is scheduled to provide 100 MW of non-spinning reserve for a specific hour in the DAM. The DAM price for non-spinning reserve is $20/MW.
  - The unit would initially receive a payment of $2,000 (100 MW x $20/MW)
- However, shortly before the hour begins, the unit experiences an unexpected forced outage due to a mechanical failure.
  - The ISO would rescind the unit's $2,000 day-ahead payment

*Real-world scenarios can be more complex, involving factors like partial unavailability, multiple capacity obligations, etc.

Implement AS settlement-for-differences between day-ahead and real-time markets

New paradigm

- Resources with day-ahead AS awards would be charged/credited at real-time AS prices for any differences between their day-ahead AS awards and real-time AS awards
  - This would be similar to how energy settlement works, where resources pay/receive the real-time price for deviations from day-ahead schedules

- The overall goal is to create stronger financial incentives for resources to:
  - Maintain availability of awarded AS capacity in real-time
  - Be responsive to changing system conditions and needs
  - Pay the full cost of any unavailability that harms system reliability

Collapse spinning reserves and non-spinning reserves into one contingency reserve product

- WECC removed the mandate for maintaining a minimum of 50% spinning reserves as part of the contingency reserve
  - Despite the elimination of the fixed percentage, CAISO continues to procure spinning reserves, but the target procurement may be less than 50% (operator discretion)

- Benefits: Simplifies AS procurement, AS co-optimization, AS deliverability, and many other related CAISO processes and settlements
- Challenges: Participants may need to update their contractual self-provision and update their AS certification

Eliminate the cascading procurement between regulation and contingency reserves (1/2)

- Today the market can substitute higher quality AS products to meet lower quality products if its economic to do so
  - Market can substitute Regulation Up for Spin and Non-Spin
  - Market can substitute Spin for Non-Spin
- Increased battery penetration is resulting in increased substitution of Regulation Up for Spin and Non-Spin requirement
- Under stressed conditions, the dispatch of Regulation Up to meet real-time needs can leave CAISO exposed to intervals with no contingency reserve capacity
- These are separate products that meet different needs

Eliminate the cascading procurement between regulation and contingency reserves (2/2)

- Expected impacts:
  - Could see higher spin/non-spin procurement costs since the market couldn't use regulation for spin/non-spin when economic.
  - Could see lower regulation up procurement costs since it would be priced independently based on its own supply/demand fundamentals.
  - Could see increased scarcity pricing events in spin/non-spin markets that previously would have been mitigated by regulation up substitution.
  - Simplifies AS procurement, AS co-optimization, AS deliverability, and many other related CAISO processes and settlements.
  - Improves grid reliability by maintaining clearer separation between regulation and contingency reserves.
  - Would need to decide if regulation up and spin/non-spin penalty prices and SRDC values are still appropriate

Trigger the SRDC when “arming load”

- Arguments for:
  - When system operators resort to arming load, it indicates a very tight supply situation where they're preparing for potential supply shortfalls. The armed load is being used as a substitute for traditional contingency reserves, which suggests there's a scarcity of traditional AS supply. This scarcity of AS supply is exactly what the SRDC is designed to reflect in prices. Therefore, it seems counterintuitive that the SRDC wouldn't be triggered during load arming events.

- Arguments against:
  - Arming load increases the effective reserve capability of the system because the armed load can be treated as “contingency reserve.” By making load itself available as a last-resort capacity resource, the system’s need for traditional generation-based reserves is reduced. This means that the system is no longer as critically short on reserves as it might otherwise have been. Since arming load effectively alleviates some of that scarcity by creating additional contingency reserve capability, there is no longer a shortage that should trigger the SRDC mechanism.

Enhancements for the EDAM/WEIM

- How to implement an SRDC-like mechanism for WEIM areas outside the CAISO BAA while maintaining a decentralized AS procurement model?

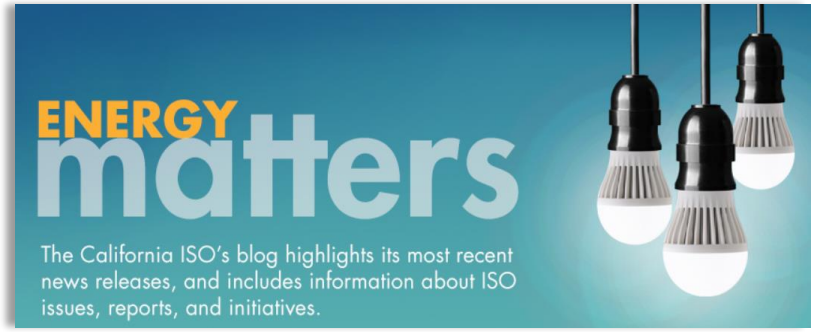
CAISO recognizes the complexity of these changes

- Pursuit of these changes would require significant software, settlement, process, and operational changes.
- The benefits of these enhancements extend well beyond scarcity pricing.
- As such, it may be appropriate for ancillary service procurement enhancements to be holistically considered in a distinct policy effort OR for the implementation of these changes to occur in longer-term stages so as not to delay more immediate scarcity pricing enhancements
  - CAISO welcomes stakeholder feedback as to which approach to take

Next Steps

- Visit initiative webpage for more information:
- https://stakeholdercenter.caiso.com/StakeholderInitiatives/Price-formation-enhancements

- If you have any questions, please contact isostakeholderaffairs@caiso.com



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