



California ISO

# Price Formation Enhancements

## *Scarcity Pricing: Market Mechanisms for Gradual Price Increases During Scarcity*

Policy Development Working Group

Morning Session 1

January 22, 2025

## Workshop Goal

- This workshop aims to explore and discuss potential market-based mechanisms that enable prices to rise gradually as supply shortage risks grow. These mechanisms create earlier price signals and incentivize market response before reaching emergency conditions.

# 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.
<b>January 22, 2025</b>	<b>Discuss market-based mechanisms for prices to rise gradually as the risk of shortages increases and the system approaches scarcity conditions.</b>
<b>January 22, 2025</b>	<b>(later today) 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.</b>
February 6, 2025	Discuss market mechanisms to incorporate the pricing impacts of emergency actions during scarcity events. ← <b>Formal Comments</b>
March 27, 2025	Discuss interactions between scarcity pricing and fast-start pricing

# Workshop Agenda

Topic	Presenter	Time
Welcome and Introductions	Brenda Marquez	10 minutes
Review of Previous Working Group Meeting	James Friedrich	30 minutes
Exploring Potential Enhancements	James Friedrich	2 hours
<b>Stakeholder Presentation:</b> Recommendation to increase the FRP uncertainty horizon	Kyle Westendorf (DMM)	
Open Discussion and Q&A	All	20 minutes

Scarcity Pricing

# **REVIEW OF PREVIOUS WORKING GROUP MEETING**

## Limitations of Ancillary Service Procurement Discussed

- Real-time market only procures incremental/replacement AS awards
- Real-time market AS procurement limited to FMM (15-min market), not RTD (5-min market)
- AS procurement limited to CAISO BAA only
- SRDC not triggered during "load arming" events

## Major Questions Asked By Stakeholders

**Q: Why is fully nodal AS procurement considered more complex than nodal procurement of other products like imbalance reserves?**

A: Nodal AS would significantly expand the optimization problem. Nodal AS faces computational challenges that currently rule out its implementation. However, we are collaborating internally to develop solutions that meet as many of the same objectives as possible while ensuring computational feasibility within market timelines.

## Major Questions Asked By Stakeholders

**Q: How would AS settlement changes impact resources that follow their day-ahead dispatch but get reduced AS awards in real-time?**

A: If the real-time AS price ends up being lower than the day-ahead price that the supplier originally sold at, the supplier profits on that spread. If the real-time AS price ends up being higher than the day-ahead price, it is likely the market reallocated that supplier's capacity to a more valuable service (e.g., energy, FRP) where the resulting profit outweighs the loss taken on the AS. Bid cost recovery provides some backstop against real-time market losses.



## Major Questions Asked By Stakeholders

**Q: Should these AS procurement changes be pursued as foundational steps for scarcity pricing or considered as separate enhancements?**

A: The AS procurement changes directly improve price formation and market efficiency. However, the ISO PFE team views their connection to scarcity pricing as weak because the SRDC-based scarcity pricing activates only under extreme or transient conditions. CAISO seeks stakeholder input on the next steps: a) Shift AS procurement changes to a separate policy track, or b) Keep it within the price formation track but implement it in longer-term stages to avoid delaying immediate scarcity pricing improvements, or c) Do something else (please be specific).

## Major Questions Asked By Stakeholders

**Q: Would arming load still be a procedure if CAISO were to move to fully co-optimizing energy and AS in real time?**

A: Arming load would likely remain necessary because the quantity of armed load is conditional on individual LSEs and not determined in the market.

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# **EXPLORING POTENTIAL ENHANCEMENTS**

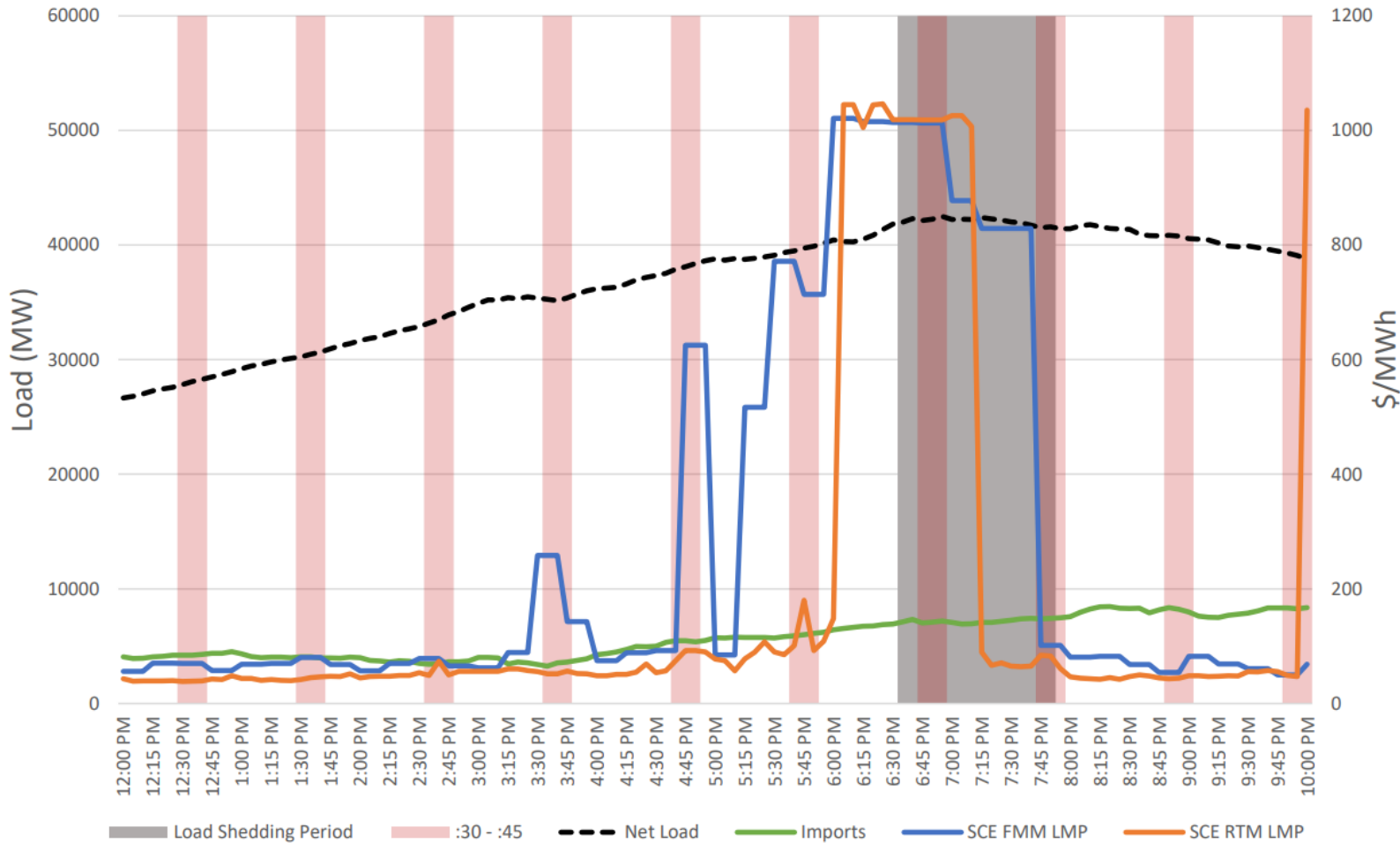
## Revisiting the Problem Statement

- There is limited opportunity for energy prices to gradually rise ahead of impending supply shortfalls.
- Current price signals may not provide enough time for market participants to respond and resolve impending supply shortfalls, which increases the risk of reliability issues.

# Basic Principles of Scarcity Pricing

- Graduated price signals can:
  - Better align grid conditions and prices by reflecting the increased risk of supply shortfalls as system conditions tighten
  - Allow market participants to proactively modify their behavior to prevent impending supply shortfalls
  - Avoid volatile price spikes
  - Reduce reliance on operator actions

# Example: August 14, 2020

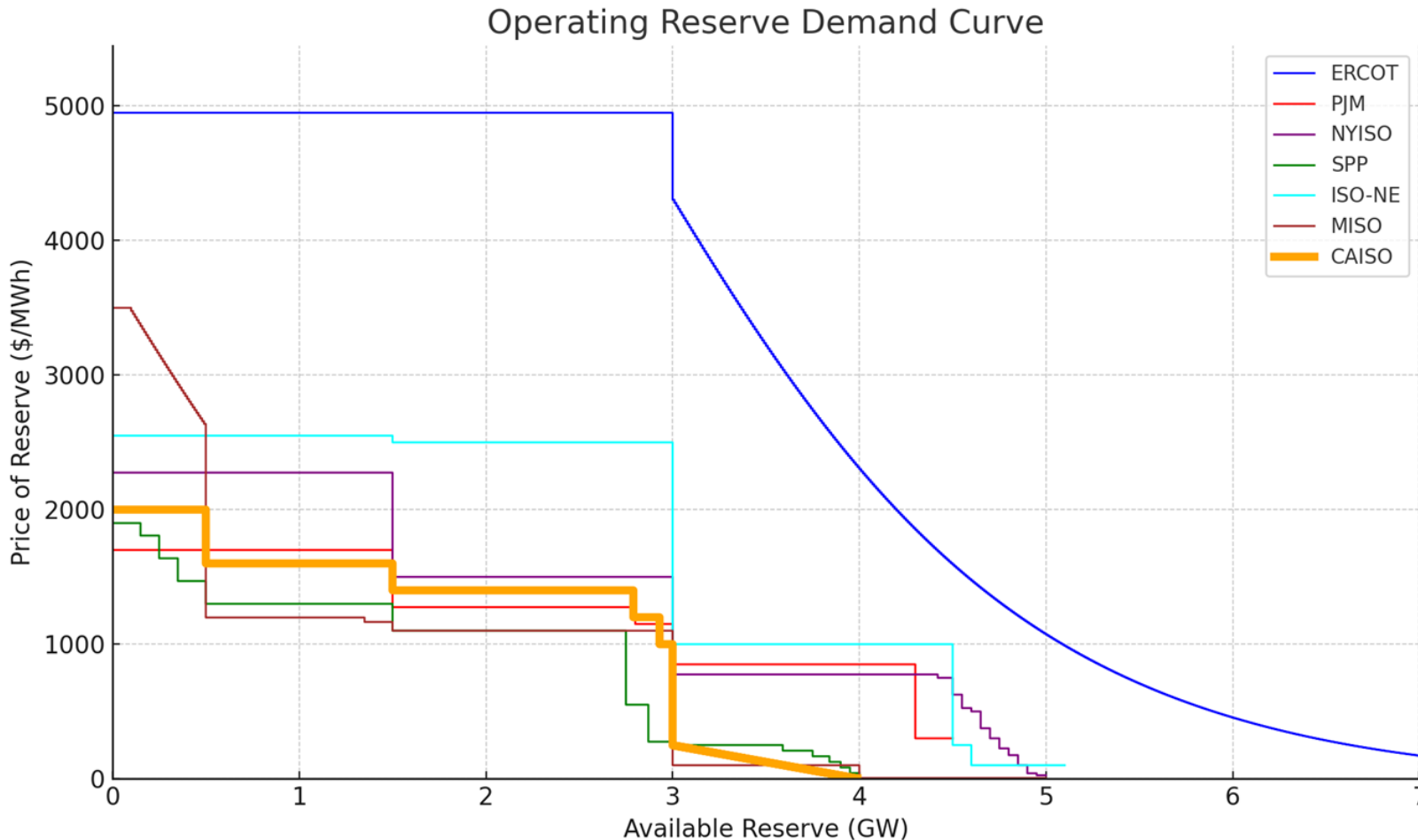


The market didn't provide clear signals of growing system stress until emergency conditions were imminent.

This example demonstrates why graduated scarcity pricing that rises with system stress levels could be more effective than the current mechanism that provides primarily emergency-driven price signals that come too late to prevent reliability events.

Harvey, Scott M. *Scarcity Pricing Background Discussion*, December 11, 2020. California ISO Market Surveillance Committee. [https://www.caiso.com/Documents/ScarcityPricingBackgroundDiscussionHarvey-Presentation-Dec11\\_2020.pdf](https://www.caiso.com/Documents/ScarcityPricingBackgroundDiscussionHarvey-Presentation-Dec11_2020.pdf).

# Reserve Shortage Pricing in ISO/RTO Markets



All U.S. ISOs/RTOs use administrative shortage pricing that creates graduated price increases as reserves become scarce.

Multiple ISOs have implemented mechanisms to price "replacement reserves" or additional reserve targets beyond minimum requirements. These tend to be 30-minute reserves and/or uncertainty products.

This allows prices to begin rising before reaching critical shortage levels.

The CAISO FRP demand curve is an example of pricing that can vary from \$0 to \$247 depending on the degree of shortage.

Chart adapted from Mehrtash, Mahdi, Benjamin F. Hobbs, and Erik Ela. "Reserve and energy scarcity pricing in United States power markets: A comparative review of principles and practices." *Renewable and Sustainable Energy Reviews* (2023)

## Reserve Shortage Pricing in ISO/RTO Markets

ISO/RTO	Product
CAISO	Flexible Ramp Product
ERCOT	Spinning Reserve 30-minute Reserve
ISO-NE	30-minute Reserve
MISO	30-minute Reserve Flexible Ramp Product
NYISO	10-minute Reserves (Spin and Non-Spin) 30-minute Reserve
PJM	Primary Reserves (Spin + Non-Spin) 30-minute Reserve
SPP	Flexible Ramp Product

Note: these are generic terms not the specific product names



De Mello et al., "Comparison of Flexibility Reserves and Operating Reserve Demand Curves for Increasing System Flexibility," EPRI, Palo Alto, CA: 2023.

- The report demonstrates through simulations that this gradual pricing approach:
  - Reduces magnitude and frequency of price spikes compared to fixed penalty prices.
  - Significantly reduces shortages of energy and reserves (60-99%).
- While they can avoid high penalty costs associated with shortages, the cost of procuring and holding additional reserves generally leads to a small increase in overall system costs in most simulations (0.5-2%), although there are some periods where operating costs are reduced. The cost-effectiveness depends on the specific design parameters, the frequency and severity of shortage events, and the value placed on avoiding those shortages.
- The report finds that, for their test system, procuring reserves in the hour-ahead timeframe was most impactful in reducing shortages.

## Market Surveillance Committee on this concept

- “...a complete scarcity pricing proposal would define mechanisms for prices to rise in increments as the probability of load shedding increases as a result of falling reserve margins... Furthermore, the scarcity prices in a more complete scarcity pricing design would be predictably, transparently, and logically related to the likelihood of, and of consumer costs resulting from, load shedding and to the costs that the CAISO is required to incur to meet NERC and WECC reliability standards” – [Opinion on Market Enhancements for Summer 2021 Readiness](#), page 2
- “It would be preferable to implement a full scarcity pricing design that would cause prices to gradually rise as the CAISO approached the point at which it was necessary for the CAISO to “arm load” and rely on load shedding to meet its WECC reserve requirements...” – Id, page 4
- “...we support the CAISO moving forward with the effort to develop a comprehensive scarcity pricing design” – Id, page 7
- [Market Surveillance Committee Scarcity Pricing Background Discussion \(2020\)](#) pages 11-13 summarize trends in other ISOs, including a move towards higher shortage pricing levels and more continuous penalty curves.

## Three Concepts for Discussion

1. Extending the procurement curve for the flexible ramp product
2. Extending the procurement curve for spin/non-spin beyond minimum requirements.
3. Implementing a new reserve product and associated demand curve.

## Extending the procurement curve for the flexible ramp product

- FRP is designed to ensure that the market has enough ramping capability to meet real-time changes in demand and supply.
- FRP addresses uncertainty between the FMM and RTD markets, and between RTD market runs.

<Switch to DMM slides>

## SOC Management for FRP Awards

- Currently, the SOC calculation does not model the impacts of FRP awards
- A mismatch between FRP awards and SOC availability can lead to price formation issues
- This topic was discussed at the 12/12/2024 MPPF meeting and enhancements are being assessed in the Storage Design and Modeling working group

## Extending the procurement curve for spin/non-spin beyond minimum requirements

- Spinning Reserve (Spin) and Non-Spinning Reserve (Non-Spin) are ancillary services in CAISO that provide operating reserves to quickly respond to unexpected outages or significant deviations between supply and demand.
- Currently, CAISO procures these reserves to meet a minimum requirement based on NERC standards.
- Extending the procurement curve means establishing a demand curve that values additional Spin and Non-Spin beyond the minimum requirement. The market would then procure these additional reserves if they are offered at prices along this extended curve.

## Extending the procurement curve for spin/non-spin beyond minimum requirements

- Advantages
  - No need to design and implement a new reserve product
- Disadvantages
  - Only directly tied to CAISO BAA reserve scarcity (although the prices can spread across the market footprint)
  - Spin and non-spin reserves are for very short-term needs so may be unnecessarily costly relative to longer-duration flexibility products



## Implementing a new reserve product and associated demand curve

- This option involves creating a completely new reserve product. Some stakeholders have suggested a 30-minute product.
- The ISO would procure this new reserve product in the real-time market based on an associated demand curve would be established to reflect the value of this product at different levels of system stress.
- CAISO is open to ideas how to design and implement this new product

# Implementing a new reserve product and associated demand curve

- Advantages
  - Can be specifically tailored to the type of flexibility needed, potentially providing a more efficient and effective mechanism than modifying an existing product.
  - Could fill the gap between ancillary services and FRP
  - Can be offered to all WEIM entities and procured across the WEIM
- Disadvantages
  - A new product has to be defined (e.g., response time, duration, eligibility criteria, cost allocation) and implemented