



Price Formation Enhancements in Competitive Electric Markets

Presented by Vitol Inc.

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The most important prices are those in the energy and day-ahead market

- Good price formation design begins with real-time market and works backwards
- Spot market prices incentivize efficient behavior in the operational timeframe
 - Price signals for demand response
 - Provide correct incentives for market participants to follow commitment, dispatch instructions, and interchange schedules, and maintain reliability
 - Short-term outcomes of the shortage pricing reforms are expected to provide proper
- Over the long run shortage pricing informs investment decisions for reliable, flexible resources
- Capacity markets and RA programs exist to provide for the “missing money” in the energy and ancillary services markets



The importance of getting price formation correct

Price formation becomes increasingly important as revenue adequacy uncertainty arises from larger penetrations of weather-driven, zero-incremental-cost energy resources

- Need to ensure prices motivate real-time supply and demand adjustments exactly when and where they are needed
- Day-Ahead market design should be aligned with the real-time market to effectively pre-posture the system and foster price convergence
- Effective scarcity pricing mechanisms ensure that market prices reflect the reliability value of supply leading up to and during shortages
 - Provides an opportunity for supply and demand to respond before it's too late
- All ISOs/RTOs have a scarcity pricing mechanism, however CAISO's scarcity reserve demand curve has a limited role in price formation



Scarcity pricing mechanism vary across organized market regions

Most regions employ a penalty factor stepwise curves with some connection to the Value of Lost Load

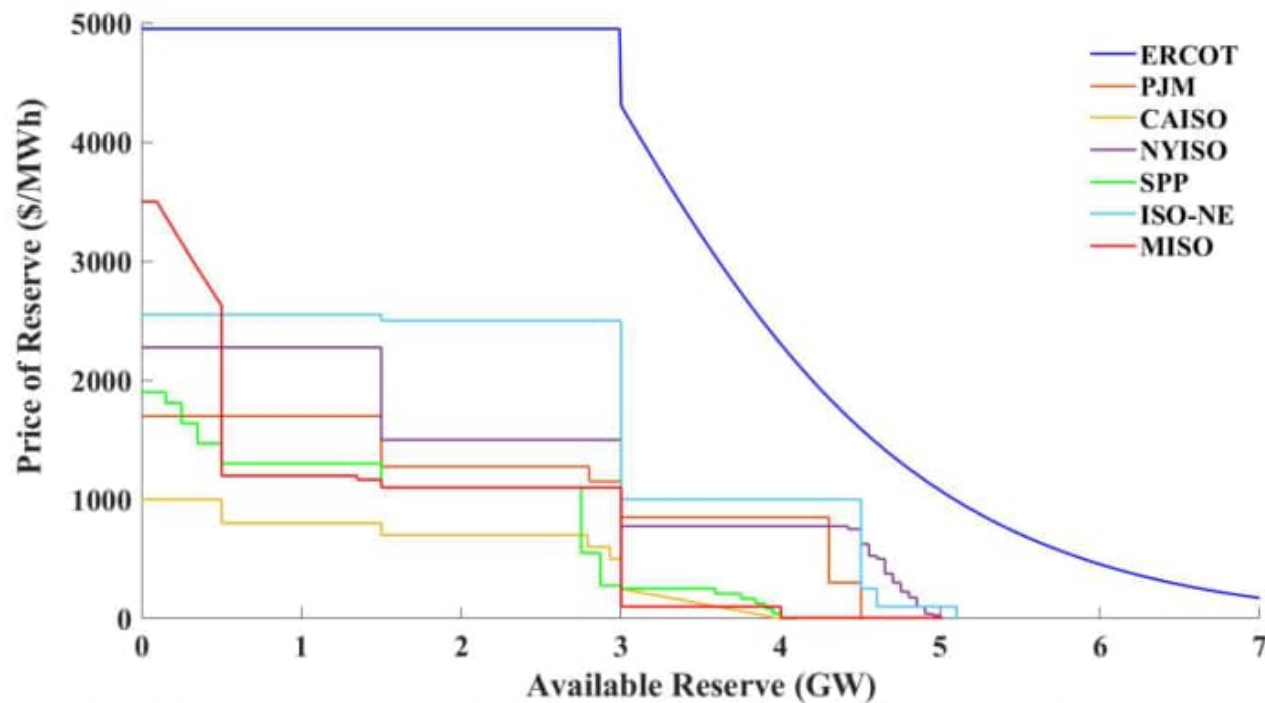


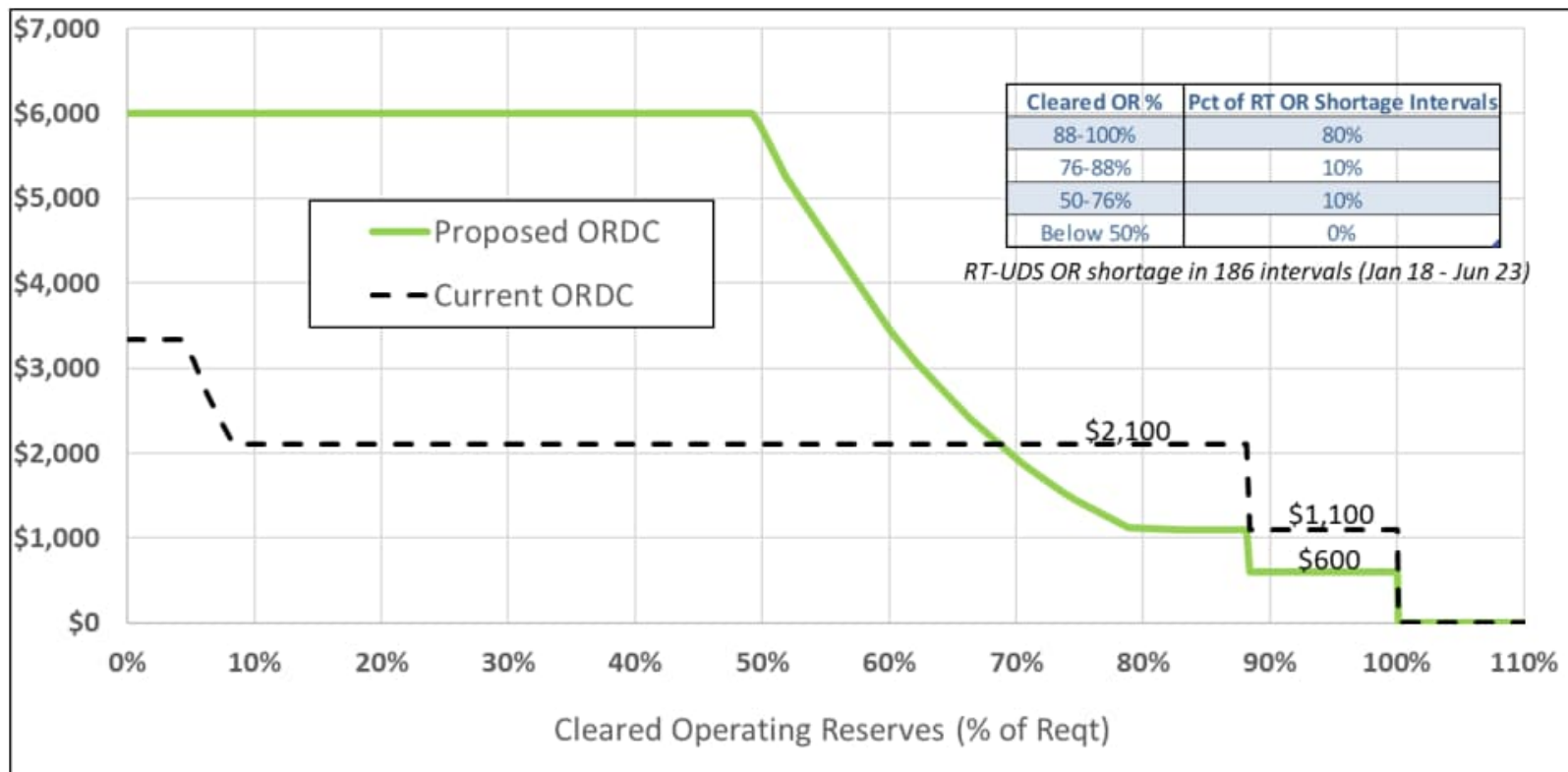
Fig. 11. Results of the comparative numerical example for scarcity premiums across seven U.S. ISOs.

Source: Renewable and Sustainable Energy Reviews Volume 183, September 2023, 113465 Reserve and Energy Scarcity Pricing in United States Power Markets: A Comparative Review of Principles and Practices Mahdi Mehrtash, Benjamin F. Hobbs, Erik Ela; September 2023



Scarcity pricing mechanism varies across organized market regions

MISO recently implemented an enhanced ORDC for market-wide reserves that is a continuous function of $\text{LOLP} \times \text{VOLL}$.



Source: MISO filing to FERC (ER25-579) at p.39



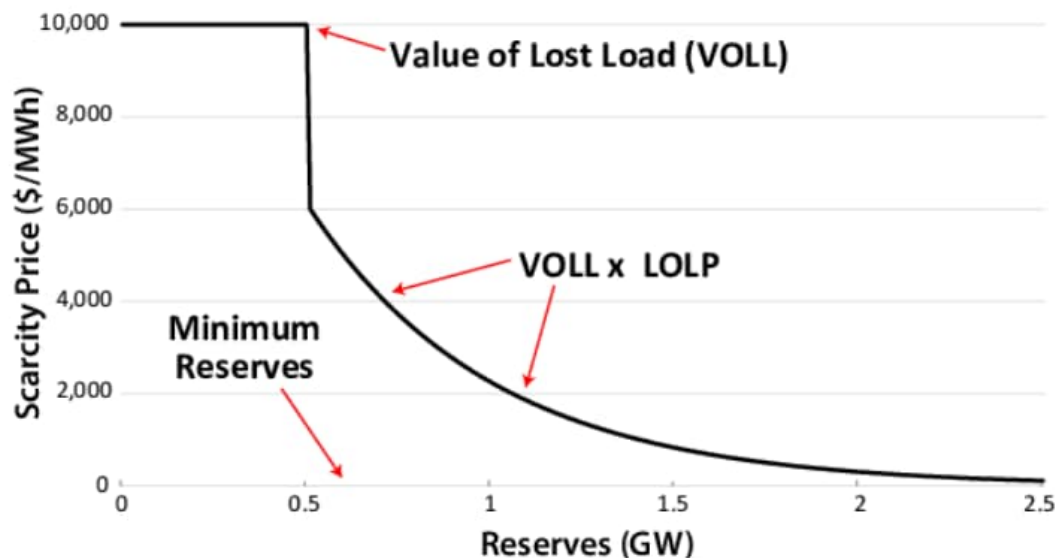
Vitol supports CAISO's proposal to ensure energy prices reflect shortage conditions during load-shed events as a first step

- During involuntary load-shed events energy prices should reflect the cost experienced by load customers from the interruption of service
 - Protections or “circuit breakers” should be embedded in scarcity pricing designs, so the pricing rules are known in advance of shortage events
- Efficient shortage pricing design fosters price convergence between CAISO's sequential markets
- While CAISO proposal advances shortage pricing, it does not address price formation outside of extreme events
- Price formation leading up to shortage conditions is an important consideration



Vitol supports the implementation an enhanced operating reserve demand curve (ORDC) in the real-time and day-ahead market that reflects the reliability value of supply before reserve shortages occur

- The design can help prices rise more gradually and move away from binary and sporadic price movements
- Send valuable price signals ahead of shortages so the supply and demand can respond
- Proper scarcity provides financial incentives encouraging appropriate actions (e.g., fosters competition for DA load hedges and increase resource investment to ensure performance)
- An efficient ORDC should reflect the marginal reliability value of reserves at each shortage level, which is the $VOLL \times \text{LOLP}$



Operating Reserve Demand Curve

source https://www.researchgate.net/figure/Operating-Reserve-Demand-Curve_fig1_323378820



Key design elements for CAISO and stakeholders to consider when developing an enhanced ORDC proposal

Scarcity detection: Loss of Load Probability	Scarcity Valuation: VOLL (\$/MWh)	Minimum contingency reserve value (MW)	Reserve types and MW amounts to be include in reserve requirement
Measurement of the short-run probability (e.g., over the next hour) that unanticipated increases in load or decreases in available generation would reduce operating reserves below the minimum reserve level	- Based on customer data segmented by load class and outage duration - Protections from prolonged extreme prices <u>are critical</u> for ensuring a stable and durable market design	- Level of reserves that corresponds to upper bound for the ORDC price - Indicates severe scarcity conditions (e.g., undertaking or preparing for emergency actions)	Expanding the reserve requirement would start pricing interactions earlier and establish a price on “economic shortages” and periods of actual reserve insufficiency



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