

New Products & ORDC: Two Options for Flexibility

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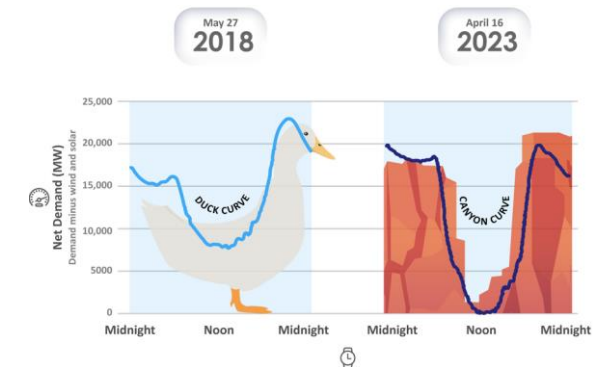
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Changing Systems – the need for flexibility

- Power systems need not just capacity, but enough [rampable capacity](#) (i.e. flexibility) to reliably operate when time is a vital constraint
 - Used to be something that was more or less ubiquitous as system operators would have enough base load from coal/nuclear/hydro and use their fast moving natural gas peakers when necessary
 - Now there is a need to manage this more explicitly as it is no longer a given that procuring the usual amounts of Regulation and Contingency Reserves alone is enough to also satisfy ramp needs
- The system operator has to ensure enough flexibility exists along some time horizon (e.g. 30 minutes, 3 hours...etc) depending on the needs
 - **Example #1**: Unforecasted loss of many GW of wind or solar with short notice (rare, but possible)
 - **Example #2**: Very cheap natural gas prices lead to most of the fast-ramping generation being committed and dispatched to max with only slow-moving resources available to ramp
 - **Example #3**: Large forecasted change in solar output over several hours (i.e. CAISO duck/canyon curve)
- Two main market-based methods exist to handle this issue:
 - **Option #1**: Dedicated market product
 - **Option #2**: Upgrading an existing product (i.e. the ORDC method)
 - See Appendix for summary of other methods



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Option #1: Flexibility (i.e. Ramp) Products

- In this method, a new market product is created that ensures enough rampable capacity is available for the chosen time horizon else shortage pricing occurs
 - Requirement takes into account both variability and uncertainty
 - Both online and offline resources could be utilized
 - Offers or lost opportunity costs can be used for pricing
 - Rampable capacity is procured to match the requirement and these reserves are automatically deployed by SCED when needed
- This type of product exists in several ISOs already to cover both short and longer term needs
 - CAISO: Flexible Ramping Product & proposed Imbalance Reserve
 - MISO: Ramp Product & Short-term Reserve (i.e. STR)
 - SPP: Ramp Product & upcoming Uncertainty Reserve

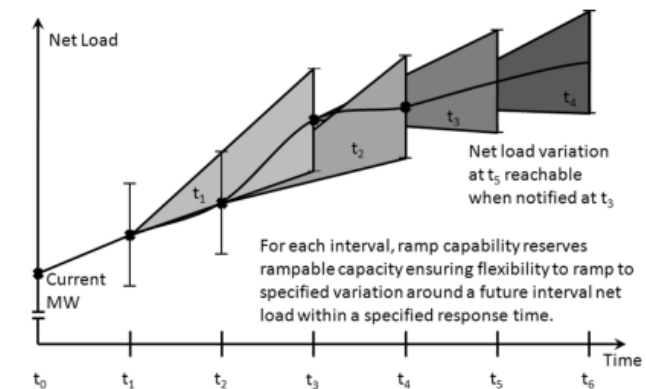


Image Source: Navid & Rosenwald - Market Solutions for Managing Ramp Flexibility w/ High Penetration of Renewable Resource

Option #2: Upgrading an existing Market Product

- Instead of introducing a new market product that does exactly what you want, an existing market product can serve multiple functions if adjusted in the proper manner
 - Ex #1: Instead of a dedicated product for primary frequency response, one could simply require all contingency reserves to be frequency responsive
 - Ex #2: Instead of a dedicated product for rampable capacity, modify the contingency reserve demand curve (i.e. will cover how ORDC does this on next slide)
- The table on the right shows SPP’s method of illustrating how they felt various options (i.e. dedicated product or upgrade of one) best fit the longer-term needs they were trying to satisfy
 - Don’t read into it too much...mainly meant to show how in certain cases, the time horizons of what you want to protect against are so far away from existing products that upgrading might not make much sense

Option	Ramp Time & Capacity Alignment	Commitment Impact	Market Product Requirements
Regulation Up			
CR			
Ramp Product			
ILC			
Uncertainty Constraint			
Uncertainty Product			

Image Source: SPP Uncertainty Product Whitepaper – Table 43

ORDC

- ERCOT has an operating reserve demand curve (ORDC) that is essentially an upgraded CR product
 - Concept is that there is always a value to having more reserves on the system up to a point of diminishing returns
 - The flatline at 3000 MW means having at least 3000 MW is essential and valued at the VOLL of \$5000/MWh
 - Value still exists beyond 3000 MW, but the value declines when the reserve has a lower probability of need
 - Prices approach zero in the final purple block
- The slope allows for the commitment and procurement of additional flexibility past the actual need (similar to a dedicated product)
- PJM has considered moving in this direction before

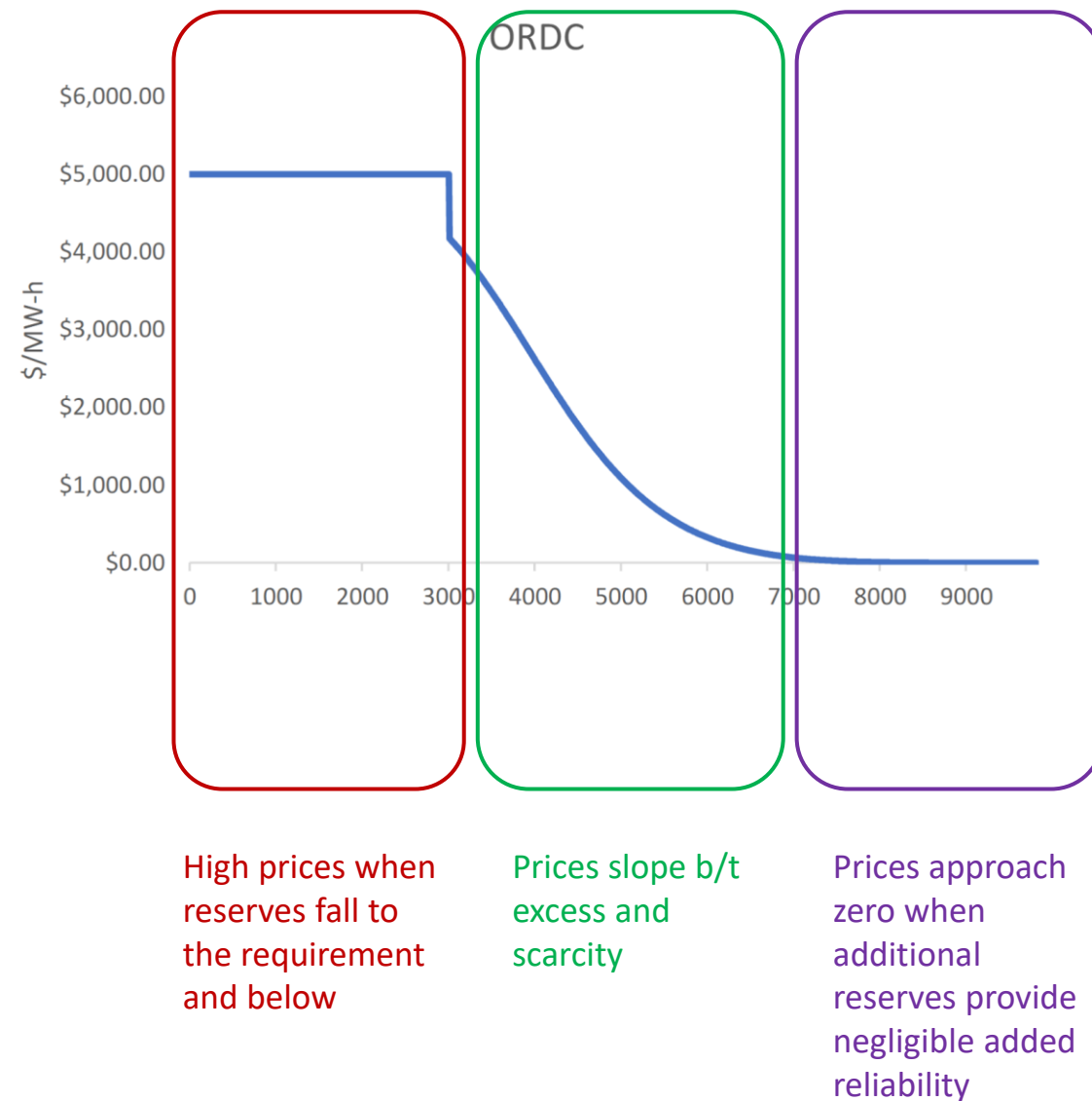


Image Source: Approximation of ERCOT ORDC design

Comparison of Flex Products & ORDC

Design Feature	Dedicated Flex Product	ORDC
Requirement Setting	Time horizon variability + uncertainty	Uncertainty b/t scheduling processes
Shortage/Scarcity Pricing	Many methods exist – generally highest step below lowest step of existing reserves of higher priority	VOLL * LOLP
Curve Steps	Single price to multiple steps (e.g. 5)	Multiple with approximate non-linear curve
Time Horizon	Range from minutes (e.g. 10 minutes) for short-term products and hours (e.g. 1 hour) for longer term products	10 minute
Pricing Hierarchy	Usually not cascaded	Same as the existing product being reused including any cascading prices
Market Processes	Depends on ISO. Could be all or real time only	All
Offer	Usually no offers (based on lost opportunity), but longer term products that allow offline participation allow offers	Standard offer rules for the contingency reserve product being adjusted for flexibility

Table Source: EPRI “Quick Insight” on Flexibility & ORDC – Ela & Vazquez

Conclusion

- Flexibility is already vital to many ISOs and will continue to grow in importance
 - Multiple methods exist for procuring additional flexibility (see appendix), but building a dedicated product or going the ORDC route seem to be the most common
- EPRI research on an ERCOT-like system shows that both methods can procure the flexibility needed for a reliable system to reduce shortages
 - Both methods share much in common. For example, regions with a dedicated flex product have a “composite” curve (if one looks at all scarcity pricing together) that is similar in nature to ORDC. See appendix.
 - Despite the similarities with respect to flexibility, there are certainly differences (especially with regards to their original purposes)
 - ISOs will want to evaluate both options when considering making market changes to procure additional flexibility



Appendix

Other Methods for Dealing w/ Flexibility

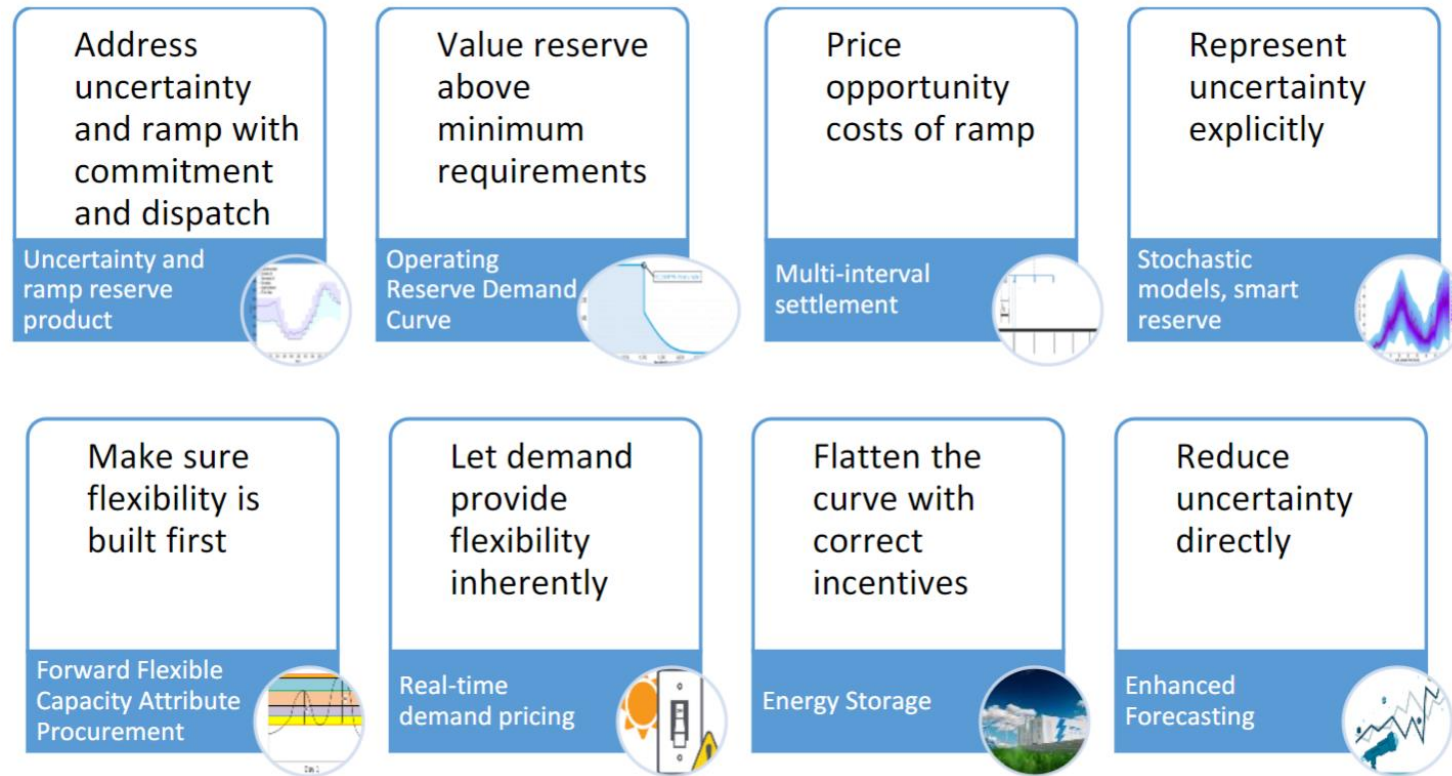


Image Source: An Enhanced Dynamic Reserve Method for Balancing Areas, EPRI, Palo Alto, CA: 2017. 3002010941

Normalized Composite Curves

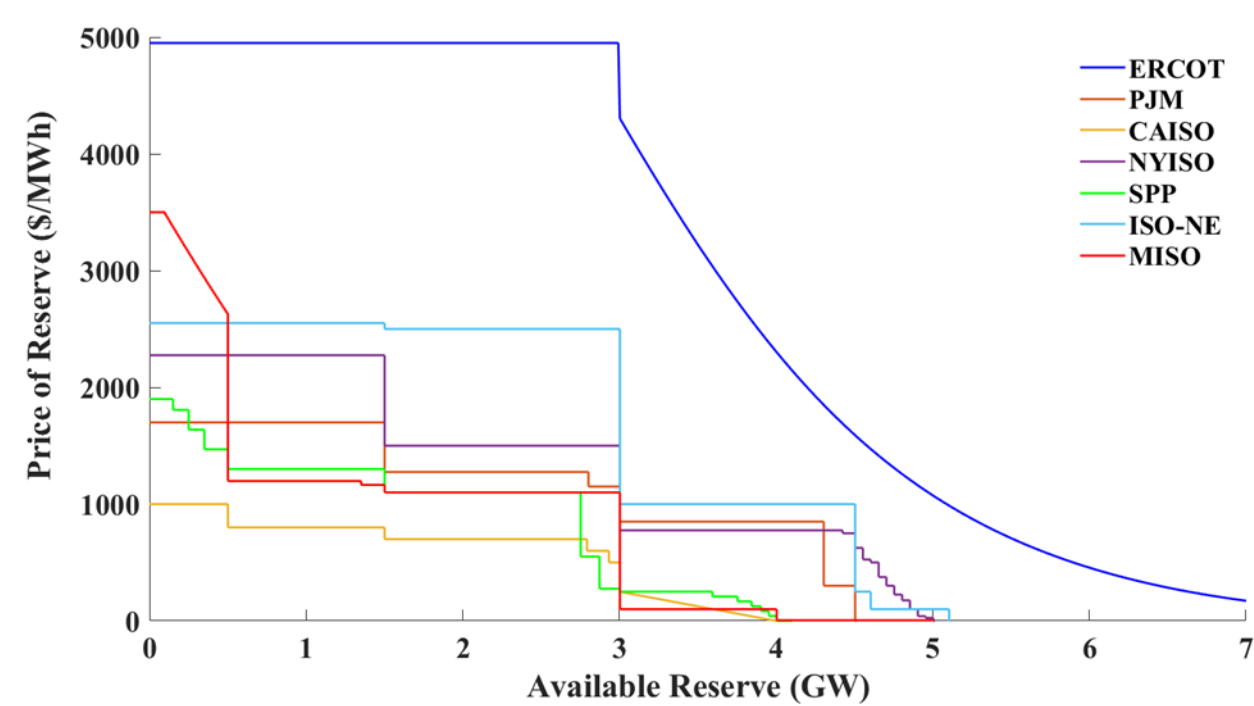


Image Source: Reserve and Energy Scarcity Pricing in United States Power Markets: A Comparative Review of Principles and Practices – Mehrtaash, Hobbs, & Ela