Day-ahead ORDC

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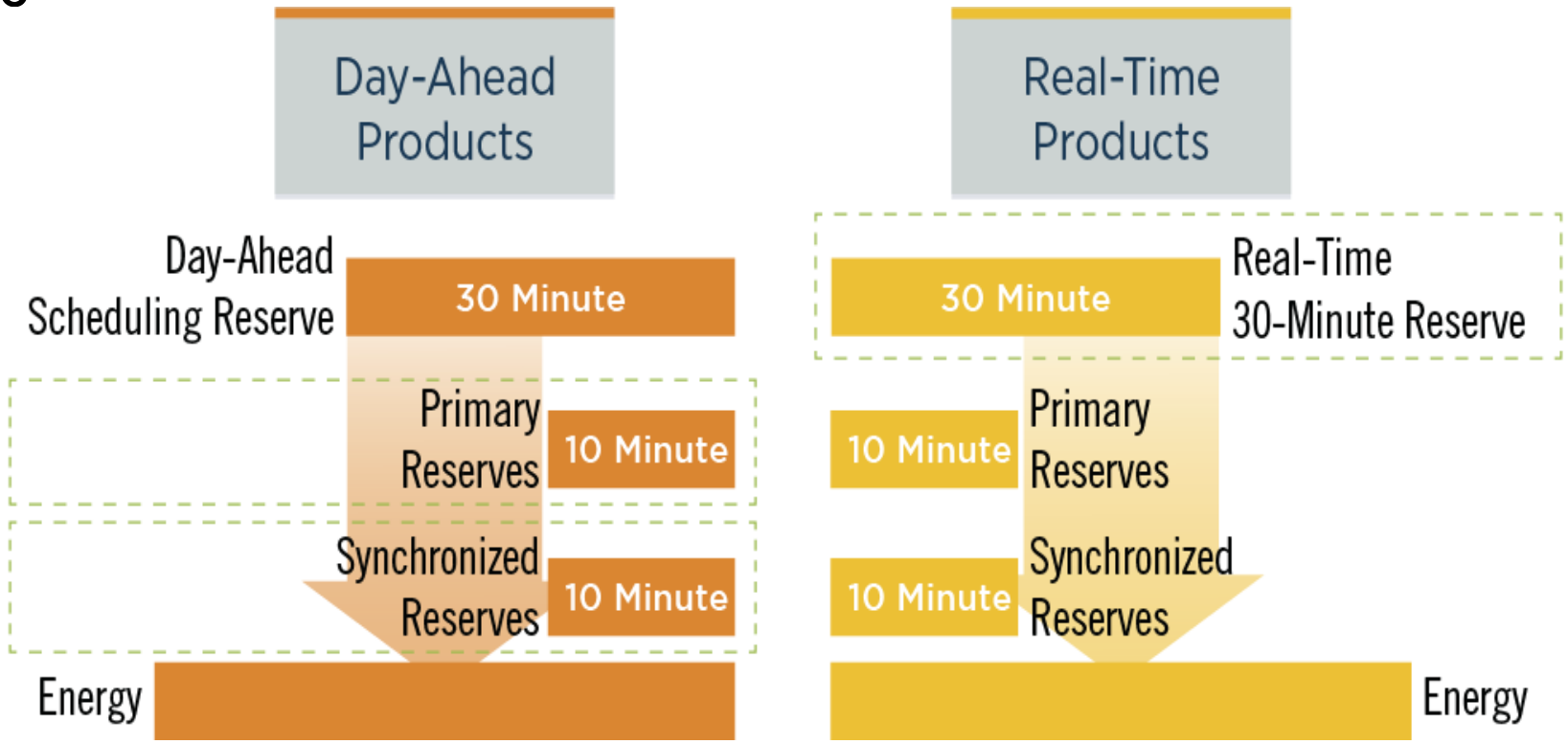
January 4, 2019

- PJM has proposed implementing 10- and 30-minute in both day-ahead and real-time



Theoretical Model: Similar Concepts

- DA and RT ORDCs are based on similar concepts but are not exact
  - Probabilities are the same
  - Maximum price on the curves different

- The maximum price on the curves are different because the highest point on the DA ORDC incorporates the marginal cost of energy at the expected value of real-time load.
- This load level, and therefore this price, will likely never be realized in real-time resulting in a different ORDC in DA and RT.

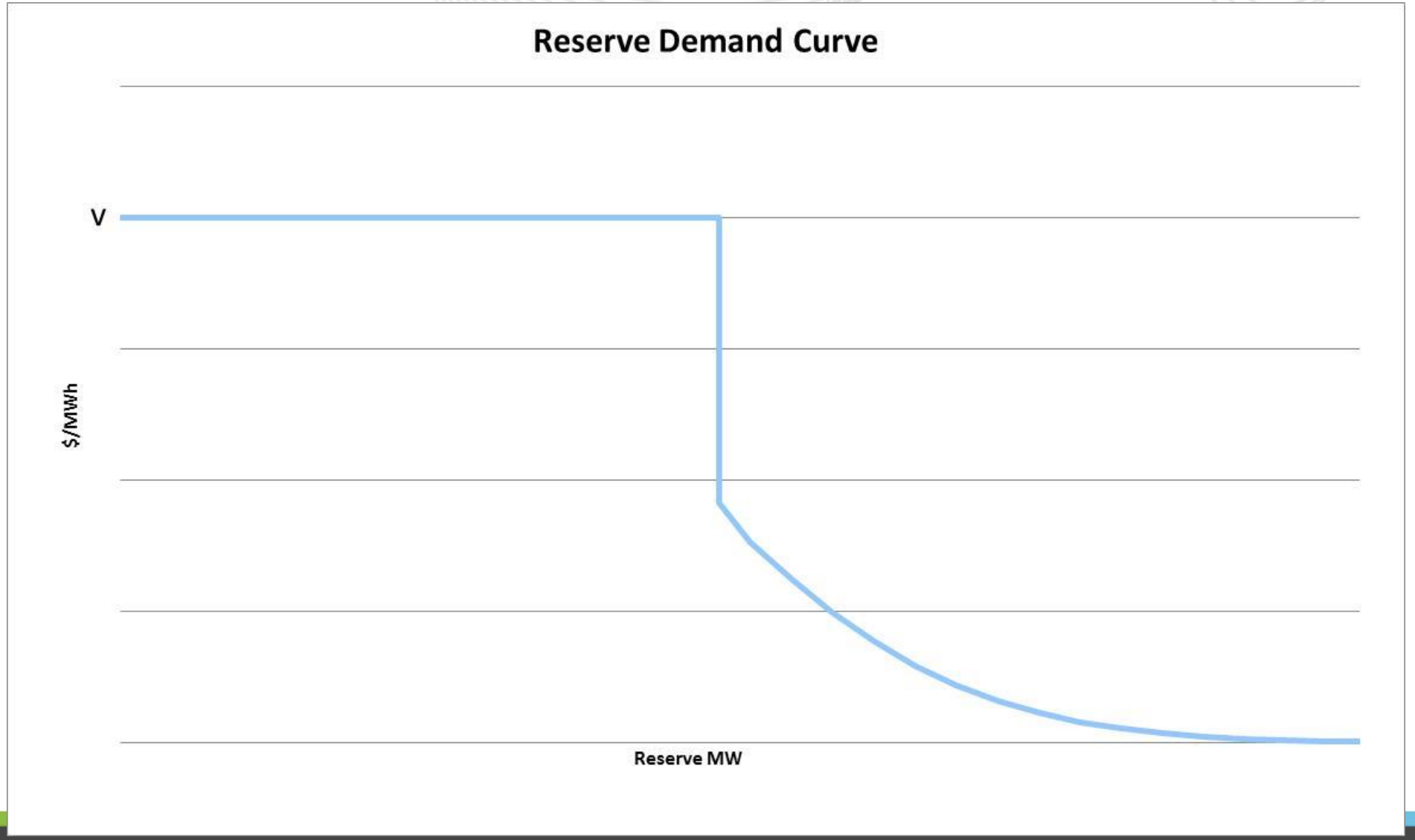
Theoretical Model: Value of Lost Load (VOLL)

- In the theoretical model, the maximum price for energy or reserves is the VOLL.

- This value is pre-determined.
  - It is used to calculate the height of the demand curve but it is not the only factor.
  - It also serves as a cap on energy offers.

- Because of the need to strictly adhere to a maximum price of the VOLL, the implementation of the ORDC is different than what PJM has proposed.

Theoretical Model: ORDC



v = VOLL – marginal cost of energy

Several factors in the theoretical model require this relationship

1. The strict adherence to the VOLL as the maximum price.
2. The additive nature of the cost of reserves and the cost of energy through co-optimization.
3. The ability to reflect scarcity value in generator offers under the theoretical model.

Theoretical Model: Why subtract the marginal cost of energy?

- As cleared offer prices reach the VOLL and the system is in shortage, the theoretical model could result in prices of 2 * VOLL absent any intervention.
- The mitigating measure taken is to decrement the ORDC by the expected value of the marginal cost of energy.
- For this type of implementation, this value must be estimated prior to solving the dispatch and pricing solution.
- Estimating this value accurately is not easy. Inaccurate estimates will bias the dispatch and market solutions.

Theoretical Model: v = VOLL – marginal cost of energy

- The net result of this is that in the theoretical model
  - The ORDC will change as the marginal cost of energy changes
  - The ORDC will be different in DA and RT because the marginal cost of energy will be different. The probabilities all remain the same.

- The theoretical model also permits virtual trading of reserves in the DA market.
- These bids are used to converge the reserve market solutions to better align with real-time given the different in ORDCs.

Differences Between PJM Market Rules and the Theoretical Model

1. PJM's proposal does not seek to cap the ultimate price of energy at a pre-determined VOLL.

2. Energy offers in PJM are not permitted to rise to the level of the VOLL.
   - They are capped at $1,000/MWh unless cost exceeds that level.
   - Ultimately capped at $2,000/MWh for price-setting.

3. PJM does not currently permit, and at this time is not proposing to permit, virtual trading of reserves in the DA market.

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- FERC Order 831 implemented offers caps at the currently specified levels.
  - These offer caps permit far less (if any) ability to reflect scarcity value in energy offers.
  - Scarcity revenues are collected via high energy/reserve prices that are not related to energy offers that approach the VOLL.

- In this model, the marginal cost of energy, and the maximum price on the demand curve are complementary, not overlapping, as in the theoretical model.

- Given the differences between PJM's market design and the rules assumed in the theoretical model, PJM believes that implementing identical curves in DA and RT is logical.

- In addition to the provided market design differences
  - Identical curves eliminates the potential need for virtual transactions for reserves. PJM does not support implementing these at this time.
  - Eliminates modeling discrepancies related to ORDC differences.