

# Reserve Market Design and Energy Market Price Formation

EPFSTF

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# Energy and Reserve Price Formation Goals

- **Prices should reflect nodal competitive supply and demand conditions**
- **Prices should provide incentives consistent with economic fundamentals**
- **Price formation should be transparent**
- **Price formation should be as simple as possible**
- **Price formation should be feasible to implement**
- **Reserve prices should reflect actual demand for reserves, including demand defined by operator actions**

# Energy and Reserve Price Formation Goals

- **Price formation should be designed to produce competitive results and explicitly address market power**
- **Prices should reflect short run marginal costs**
- **Prices should not reflect market power through inclusion of maintenance expenses and associated multipliers**
- **Prices should not reflect market power through inclusion of arbitrary adders to reserve offers**

# IMM Issues

- **PJM energy and reserve market prices should reflect energy market economic fundamentals**
- **Goal is not to raise energy prices**
- **Goal is not an energy only market**
- **Goal is not to implement ERCOT energy only model**
- **PJM energy market prices should not be set to reach a defined revenue target or a defined overall market revenue share**
- **If energy prices increase, cleared capacity auction prices need to be addressed to prevent double recovery**

# EPFSTF Purpose

- **Design Criteria:**
  - **Efficient prices, Transparency, Simplicity, Incentives**
  - **Market power, Feasibility, Implementation**
- **April 2018 PJM [Board Letter](#)**
  - **“Specifically, there are times when operators commit resources to ensure reliability but these commitments are not reflected through market clearing prices such that those prices can be suppressed and result in undesirable outcomes.”**
- **Identify changes able to implement for 2018/19**

# EPFSTF Purpose

- **Board proposed changes**
  - **30 minute reserve product**
  - **Synch reserve market implementation**
  - **Dynamic reserve requirements to reflect operator actions**
  - **Enhance ORDCs**
- **“These enhancements would result in more transparent energy and reserve price signals that better reflect operator actions.”**

# IMM Proposal Responds to the Board's Request

- **Synchronized reserve market consolidation**
  - **Combine tier 1 and tier 2 synchronized reserve markets**
  - **Address market power by reducing margin adder**
  - **Must offer requirements stronger**
  - **Penalties stronger for appropriate incentives**
- **Dynamic reserve requirements to reflect identified operator actions to change market demand for reserves**
- **Improve and enhance demand curve for reserves (ORDC)**

# Reserve Market Enhancements

- **Consolidation of synchronized reserves into a single product creates stronger incentives for participation and response to spinning events.**
- **Accuracy improvements in reserve calculations, reserve dispatch software, and offer parameters**
- **Reserve subzones capture system conditions better**
- **Stronger must offer requirement and enforcement prohibits withholding of reserves**



# Market Power in Reserve Markets

- Cost-based reserve market
- Pivotal suppliers can withhold reserves and raise prices in the reserve market in at least half of historic market hours.
- There is no demonstrated cost of providing reserves for most resources.
- The \$7.50 per MWh allowable offer margin exceeds competitive offers.
- The IMM proposed \$3.80 per MWh margin is a compromise between \$7.50 and the actual cost of zero.

# Must Offer and Penalties

- PJM and IMM jointly propose a stronger must offer requirement for the consolidated synchronized reserve market.
- The IMM further proposes penalties to support the requirement.

# Synchronized Reserve Nonperformance

- **Synchronized reserve nonperformance penalty is too low to deter manipulation.**
- **Resources can profitably clear reserves and never perform.**
- **Penalties should be based on the time period since the last spinning event that exceeds 10 minutes duration and the time of nonperformance.**
- **Penalty should be the revenues per MWh received in the reserve market, including uplift, since the time of the last spinning even with duration greater than 10 minutes, times the nonperformance MWh.**

# PJM's ORDC Proposal

- **PJM proposes high demand prices for reserves beyond the reserve requirement**
- **Based on nontrivial probabilities of a shortage under normal levels of forecast error and forced outages.**
- **The PJM market has seen 21 five minute intervals, less than 2 hours, of shortage since five minute shortage pricing began in 2017.**
  - **Only 10 minutes of synchronized reserve shortage.**
- **Historic data does not support PJM's probability of shortage calculations.**

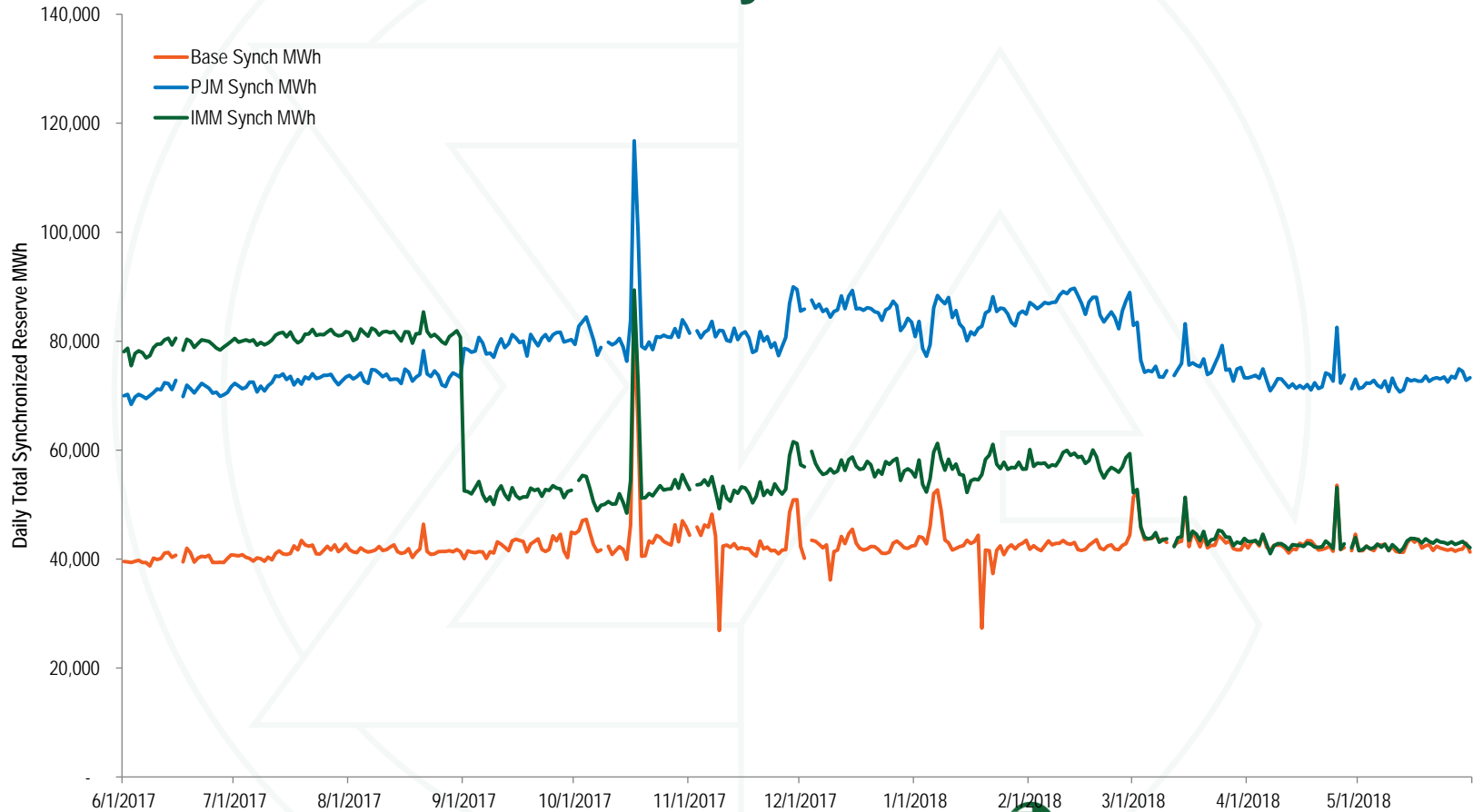
# IMM ORDC Proposal

- **Demand for reserves should reflect system needs on a targeted basis**
- **IMM analysis of actual reserve requirements including actual operator actions**
- **Increased need for reserves should affect reserve prices and energy prices**
- **Reserve prices and energy prices should not be affected when there is not an increased need for reserves**

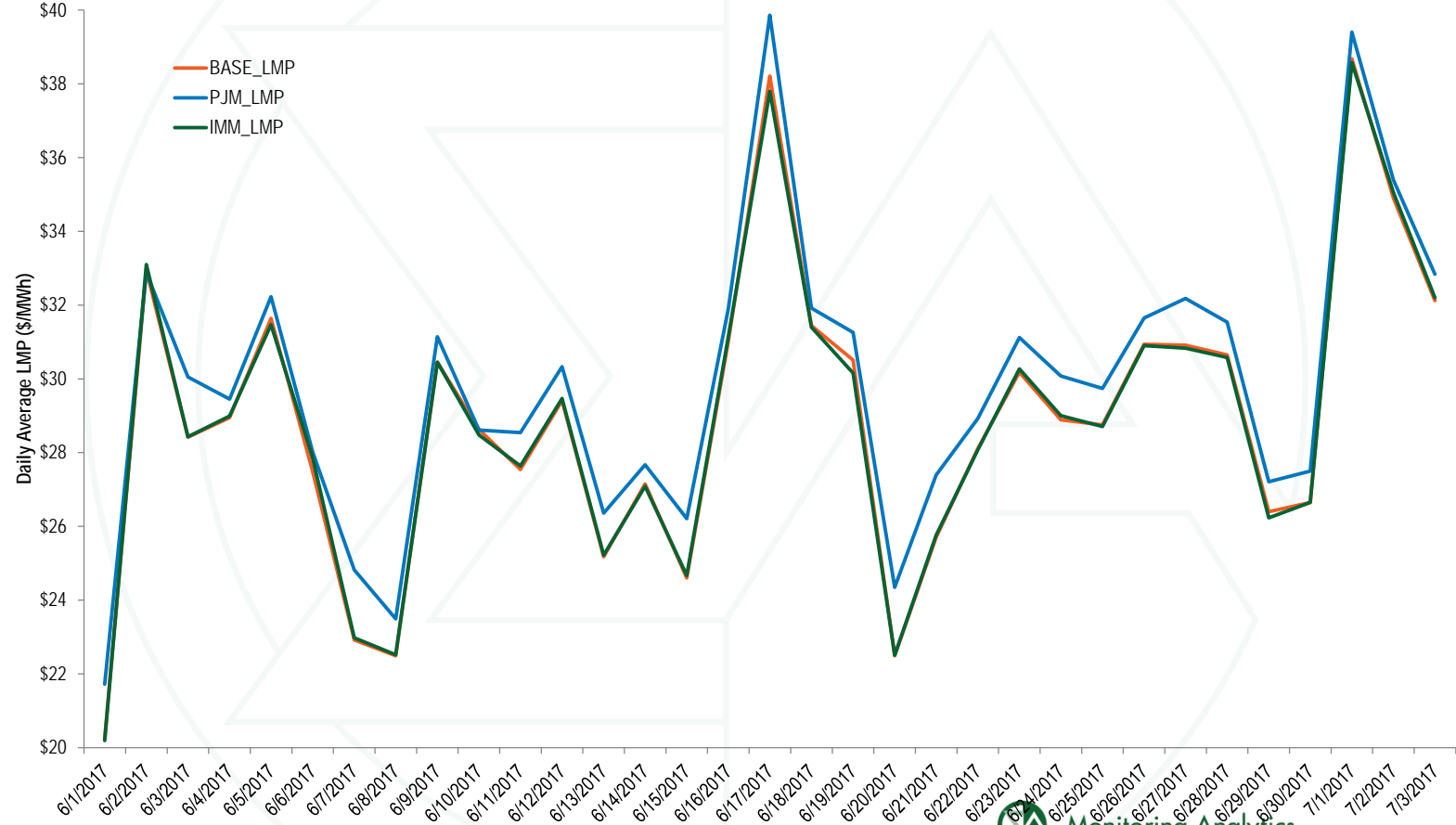
# Simulation Results

- PJM ran simulations using IMM ORDCs.
- Using the same model, time period, and assumptions as [PJM simulations](#)
- Not exact match to IMM proposal because PJM uses seasonal curves for time blocks instead of varying the ORDC hourly and with daily peak load levels
- More targeted ORDC increases, lower cost
- IMM ORDCs vs. PJM ORDCs
  - More reserves in summer than PJM ORDCs
  - More reserves than current, less than PJM in fall, winter
  - Reserves similar to current in spring

# Simulation Results: Synchronized Reserves

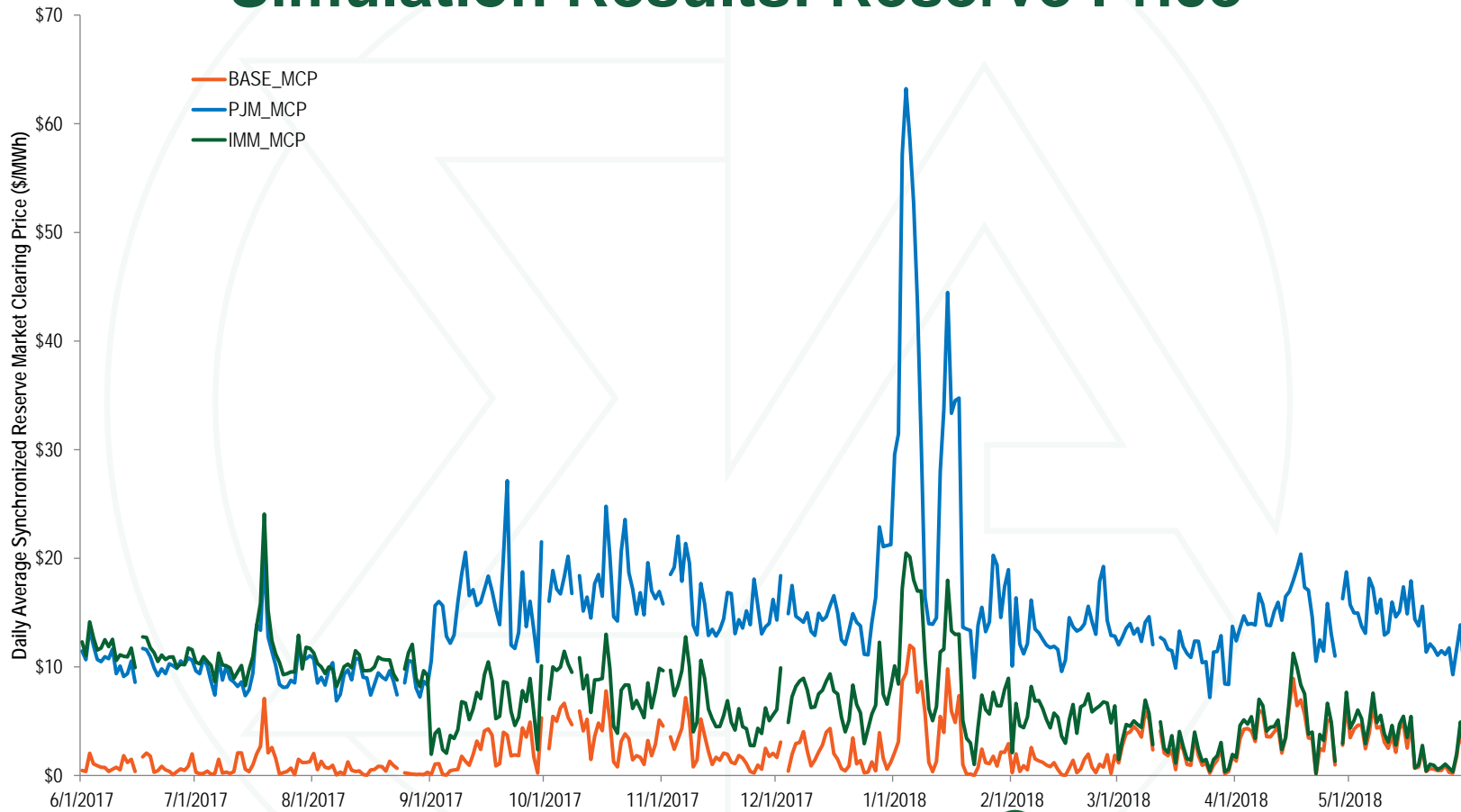


# Simulation Results: Energy Price





# Simulation Results: Reserve Price



# Simulation Results: Revenues and Costs

	Base Case	PJM Proposal	IMM Proposal
Energy Revenue	\$25,003,019,858	\$26,024,763,147	\$25,380,005,969
Reserve Revenue	\$41,385,708	\$457,011,975	\$183,592,234
Energy + Reserve Revenue	\$25,044,405,566	\$26,481,775,123	\$25,563,598,203
Difference from Base Case	-	\$1,437,369,557	\$519,192,637

	Base Case	PJM Proposal	IMM Proposal
Generator Bid Production Cost	\$12,502,385,925	\$12,564,576,781	\$12,518,509,947
Difference from Base Case	-	\$62,190,856	\$16,124,021

# IMM ORDCs: Correlation and Causation

- **Constructive comments from the EPFSTF**
- **It is important to distinguish between additional reserves that support the reserve requirement from other sources of correlation among hourly reserve values.**
- **Further analysis will identify days when additional reserves were necessary to maintain load plus reserve requirements**

# IMM ORDCs: Price Forecast Process

- **Daily peak price**
  - **Forward intraday energy prices**
  - **Forward intraday gas prices**



# IMM Proposal: Net Revenue Offset Transition

- **If energy prices increase, cleared capacity auction prices need to be addressed to prevent double recovery.**
- **If energy prices increase, forward looking capacity auctions must incorporate increased energy and ancillary services offset.**
- **Energy and ancillary services offsets should be forward looking.**

# Other Initiatives Interact with ORDC

- **Fast Start Pricing**
  - [ISO New England Market Monitor estimates](#)
  - Nearly 3 times higher reserve payments as a result of fast start pricing in 2017
- **Maintenance Costs (VOM issue)**
  - IMM estimates current rules result in \$2.34 per MWh of LMP due to VOM vs. \$1.11 per MWh if limited to short run marginal costs.
  - $\$1.23/\text{MWh} \times 770,000 \text{ GWh/year} = \$950 \text{ million per year}$

# Other Initiatives Interact with ORDC

- **Combined effects on market are more than additive.**
  - Reserve market price changes
  - Fast start pricing
  - Maintenance adders
- **\$1.5 billion is an underestimate of final impact of PJM proposed energy market design changes, especially if PJM's proposals on fast start pricing and maintenance costs are implemented.**

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