Price Formation and Reserve Markets

MMUAC

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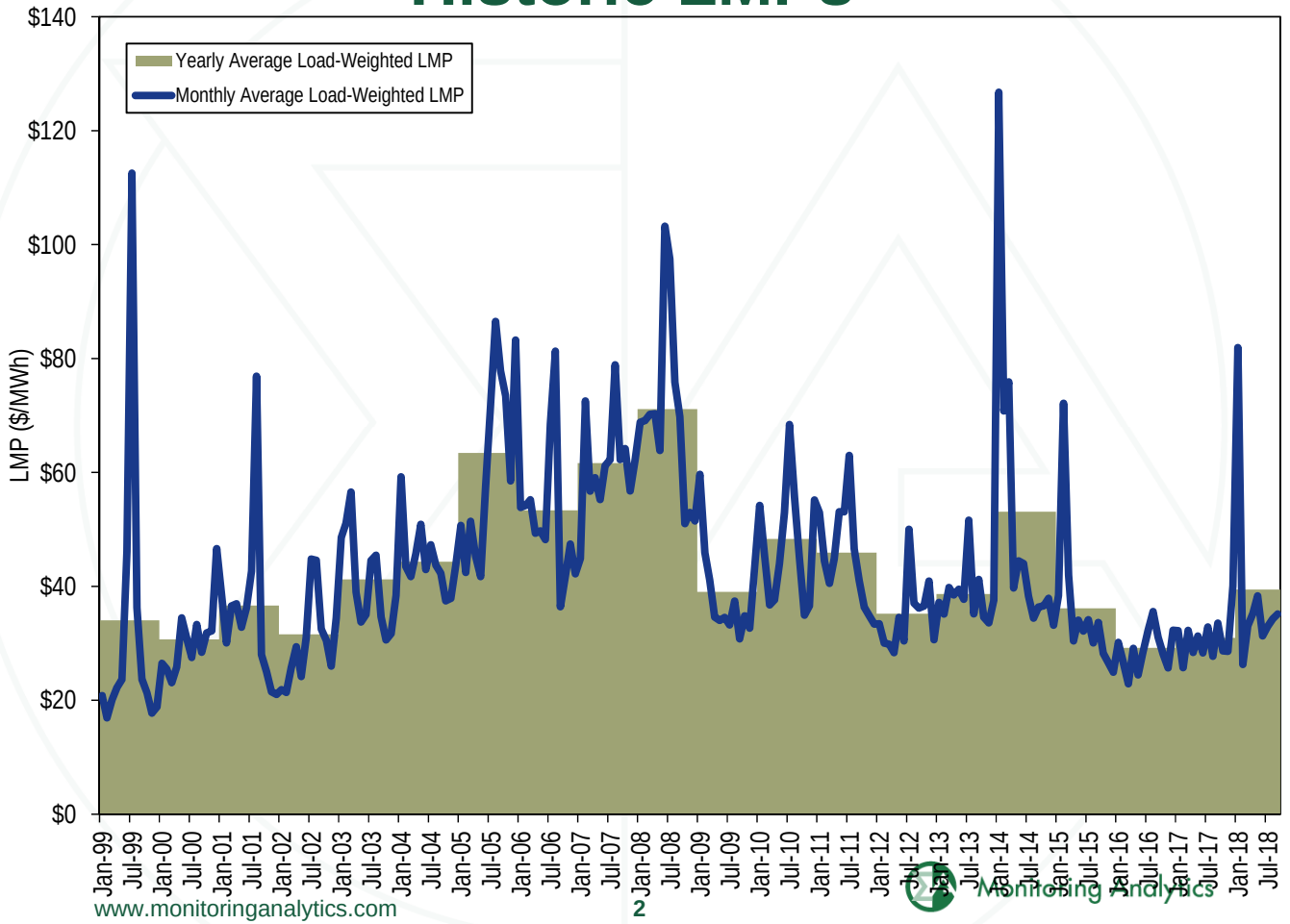
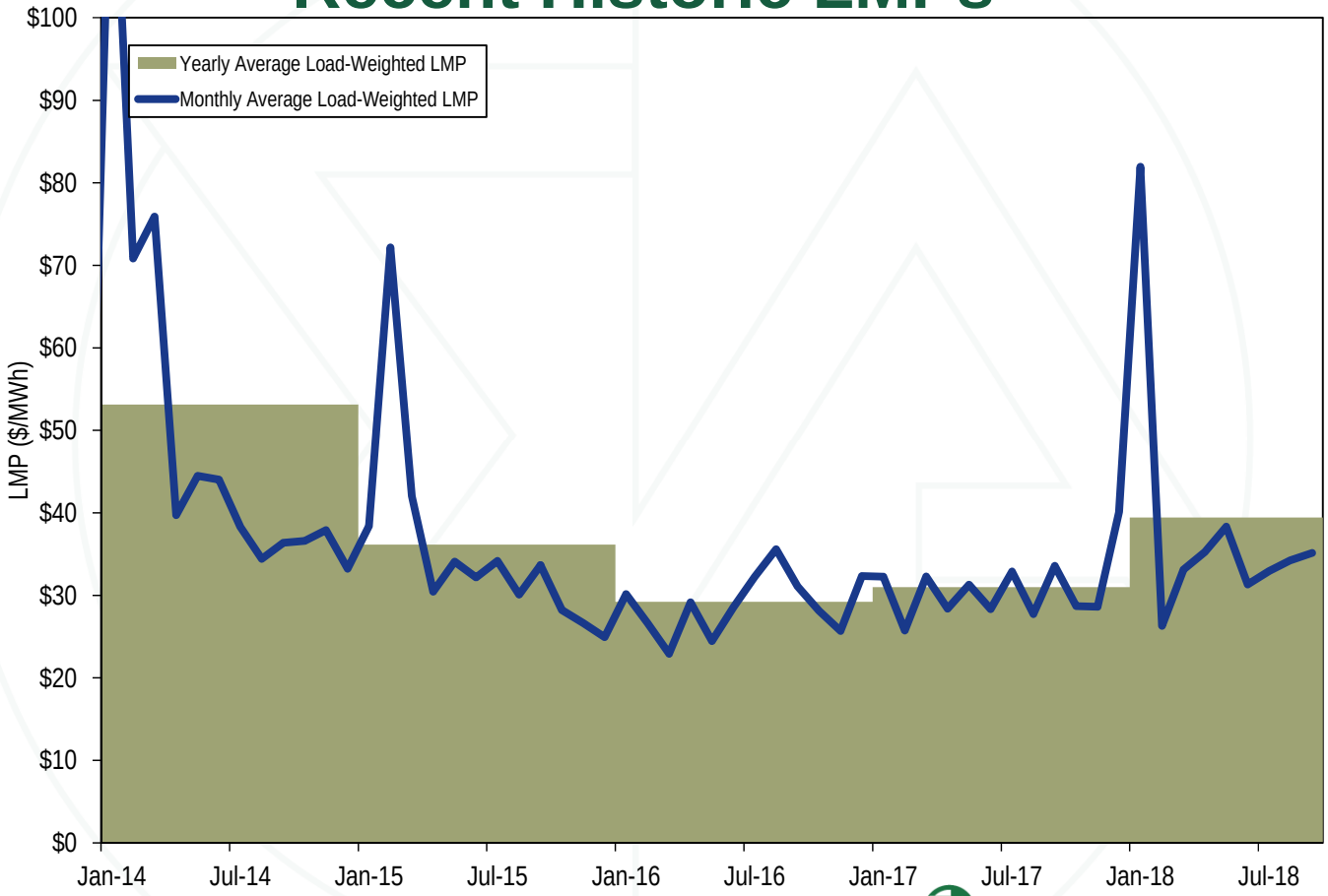
Monitoring Analytics

Historic LMPs



Recent Historic LMPs



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Price Formation

- **Prices should reflect supply and demand fundamentals.**
- **Prices are not too low.**
- **Reserve markets should provide incentives for resources to provide reserves and respond to reserve events.**
- **Scarcity pricing is intended for periods when the market is tight, not all the time.**
- **The reserve markets are not in place to provide revenues for uneconomic capacity.**

Reserve Market Reform

- **Progress toward a redesign of the synchronized reserve market**
  - **Combine tier 1 and tier 2 synchronized reserves**
  - **Stronger must offer requirement and implementation**
  - **Performance obligations and stronger penalty**
  - **Cost-based market with unjustified offer margin eliminated**
- **Future progress, yet to be discussed**
  - **Real time obligation for day ahead 30 minute reserves**
  - **Day ahead, real time reserve settlement**

Operating Reserve Demand Curve

- **A well designed, downward sloping ORDC can provide price signals indicating need for additional reserves.**
- **The ORDC does not need to price excess levels of reserves at all times.**
- **PJM regularly has excess reserves.**

PJM's ORDC Proposal

- **PJM proposes high prices for reserves beyond the reserve requirement**
- **Based on PJM's calculations of high probability of shortage under normal levels of forecast error and forced outages.**
- **Historic data does not support PJM's probability of shortage calculations.**
- **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.**

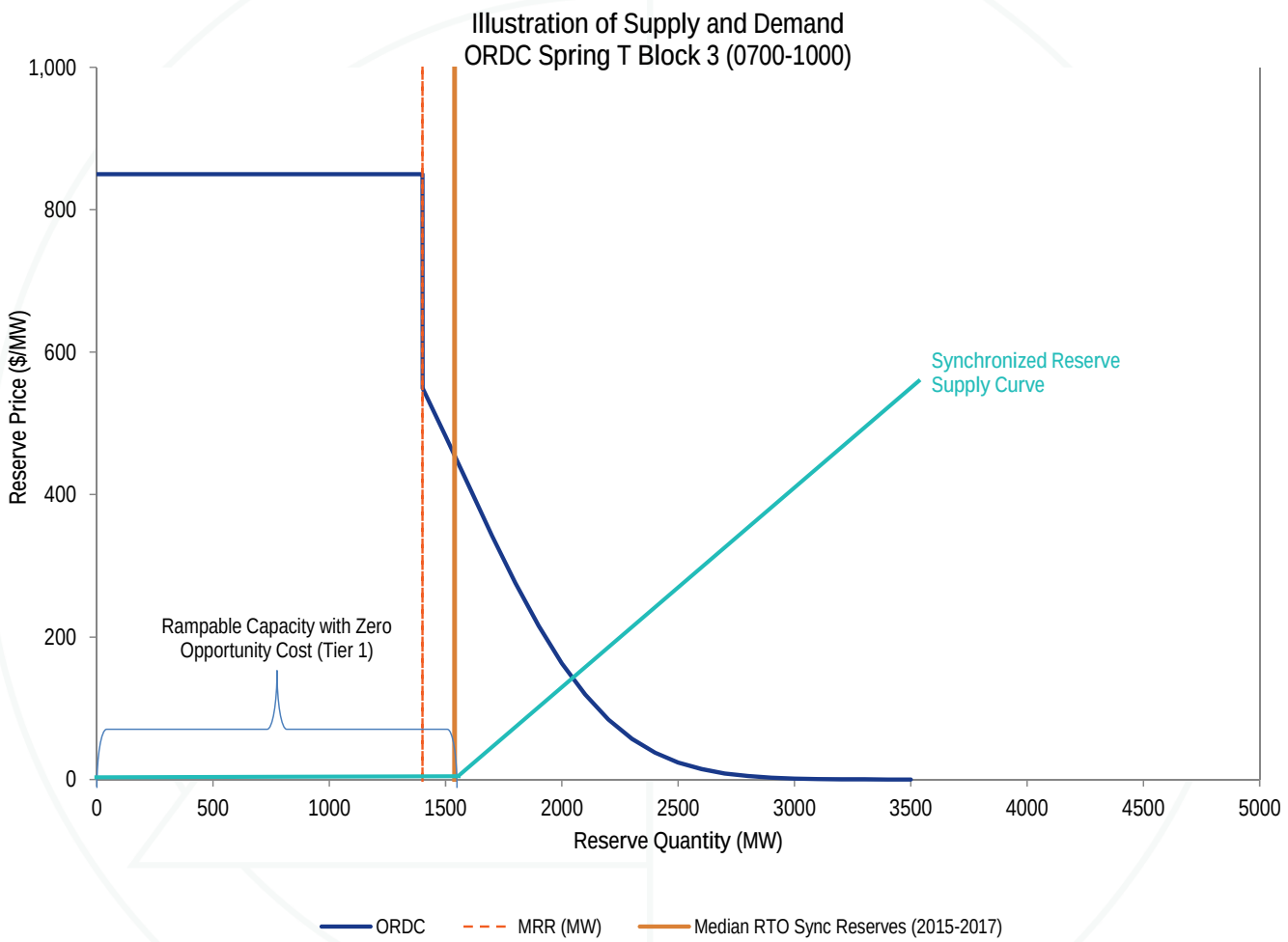
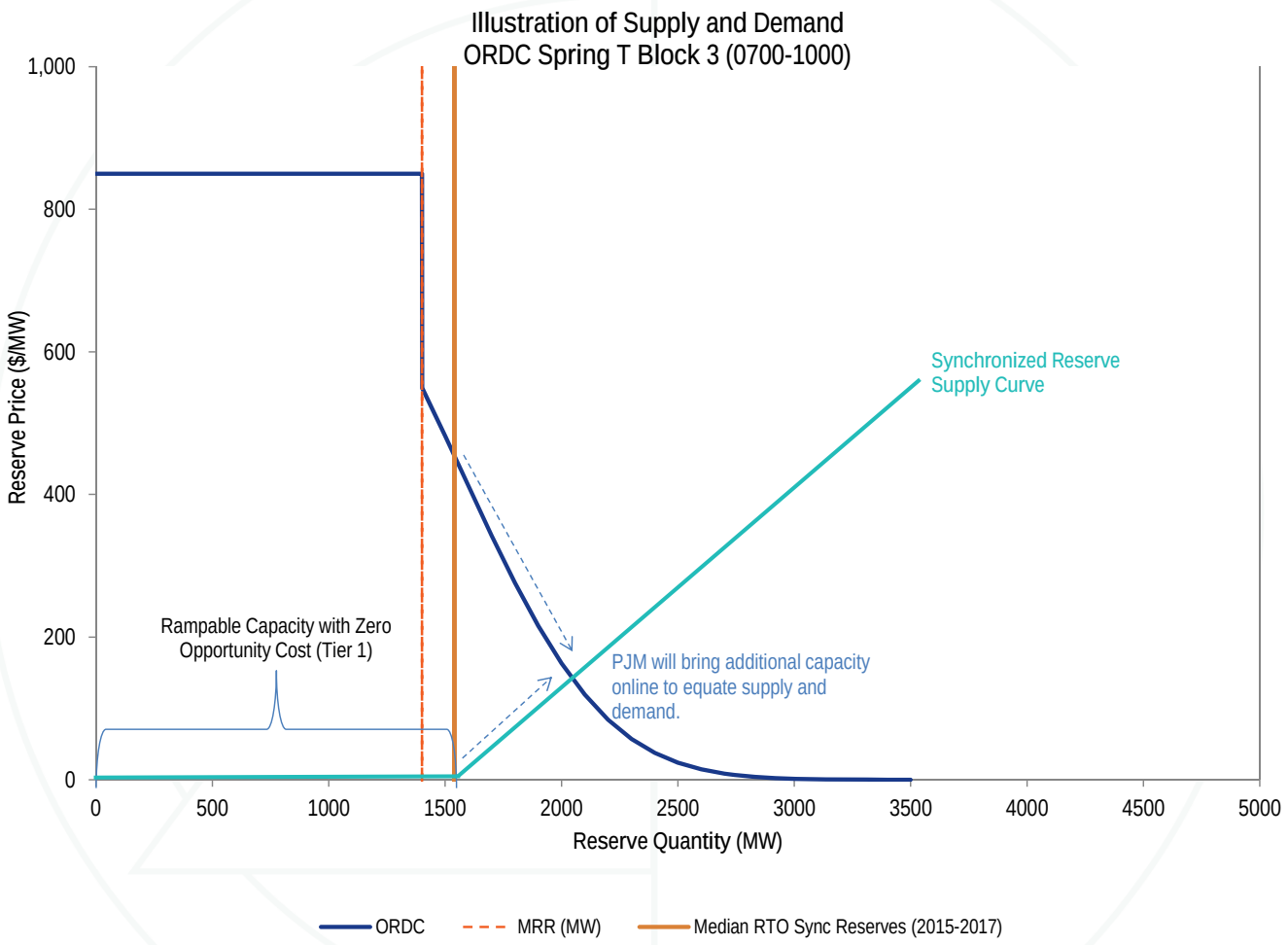


Illustration of Supply and Demand
ORDC Spring T Block 3 (0700-1000)
Reserve Price ($/MW)
1,000
800
600
400
200
0
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
Reserve Quantity (MW)
Synchronized Reserve Supply Curve
Rampable Capacity with Zero Opportunity Cost (Tier 1)
ORDC
MRR (MW)
Median RTO Sync Reserves (2015-2017)



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PJM ORDCs

- **The ORDC proposed by PJM is based on ERCOT's ORDC. ERCOT uses ORDC in place of capacity market.**
- **The ORDC means that PJM will buy more than required reserve levels and pay higher prices for reserves.**
- **Used within the energy and reserve joint optimization, the ORDCs would require PJM to carry more online capacity than it has historically.**
- **The implication is not only a change to price formation, but also a change to operations.**
- **Actual shortage becomes less likely, but reserve and energy prices include scarcity pricing all the time.**

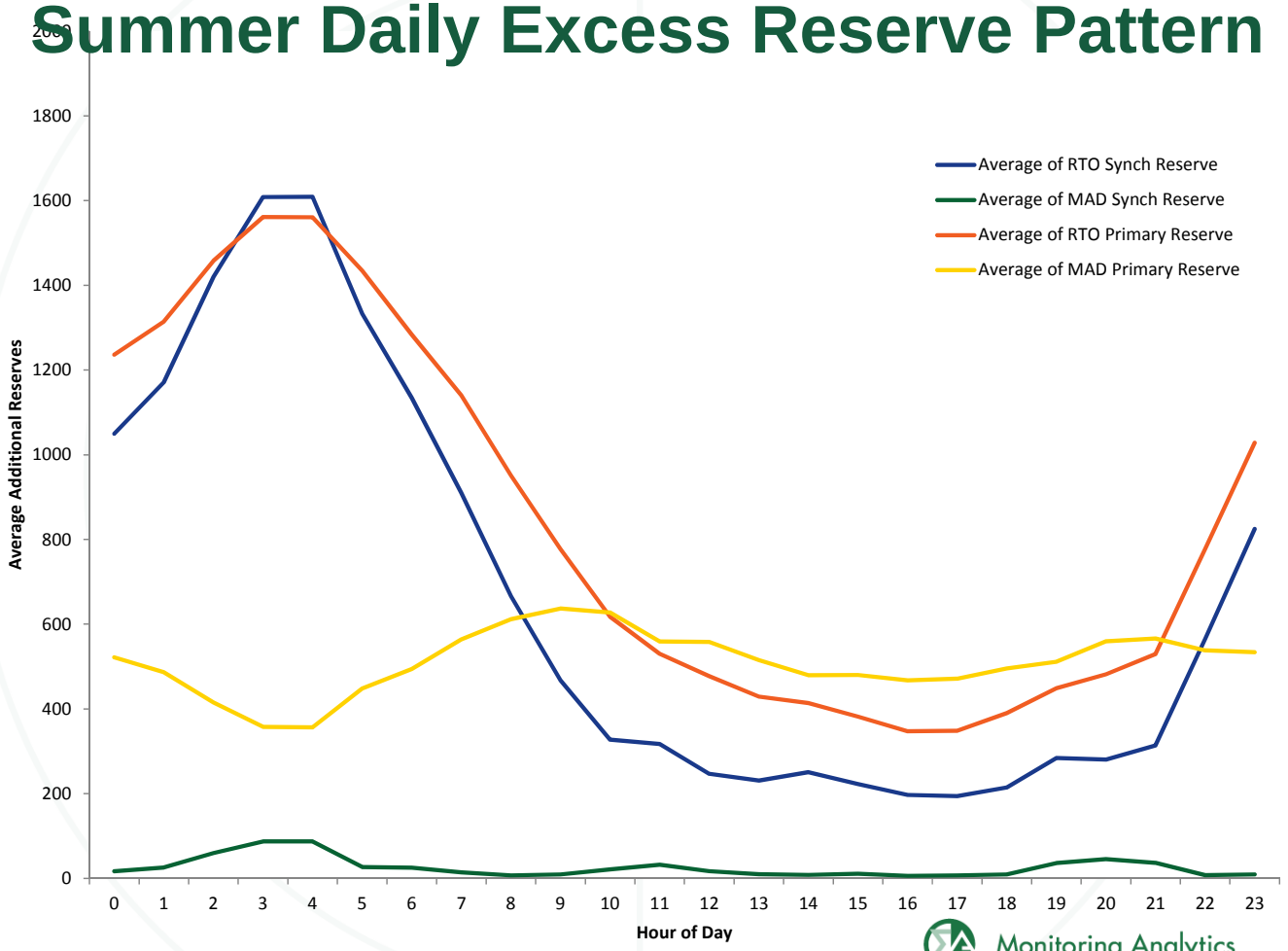
IMM ORDC Proposal

- **Goal: construct a demand curve that provides an appropriate price signal for additional reserves when needed.**
- **The IMM proposes an ORDC based on analysis of actual operator demand for additional reserves.**
- **The resulting ORDC provides sufficient, but not excessive, prices for market procurement of additional reserves when needed.**

Fluctuations in Supply and Demand

- **If the total amount of reserves falls due to fluctuations in supply and demand.**
- **Possible outcomes:**
  1. **No impact because reserves are greater than requirement**
  2. **Reserves fall below requirement**
  3. **More reserves needed for the next peak**
- **Current ORDC addresses 1 and 2.**
- **3. creates a demand for reserves that may lead to a real time unit commitment to increase reserves.**

Summer Daily Excess Reserve Pattern



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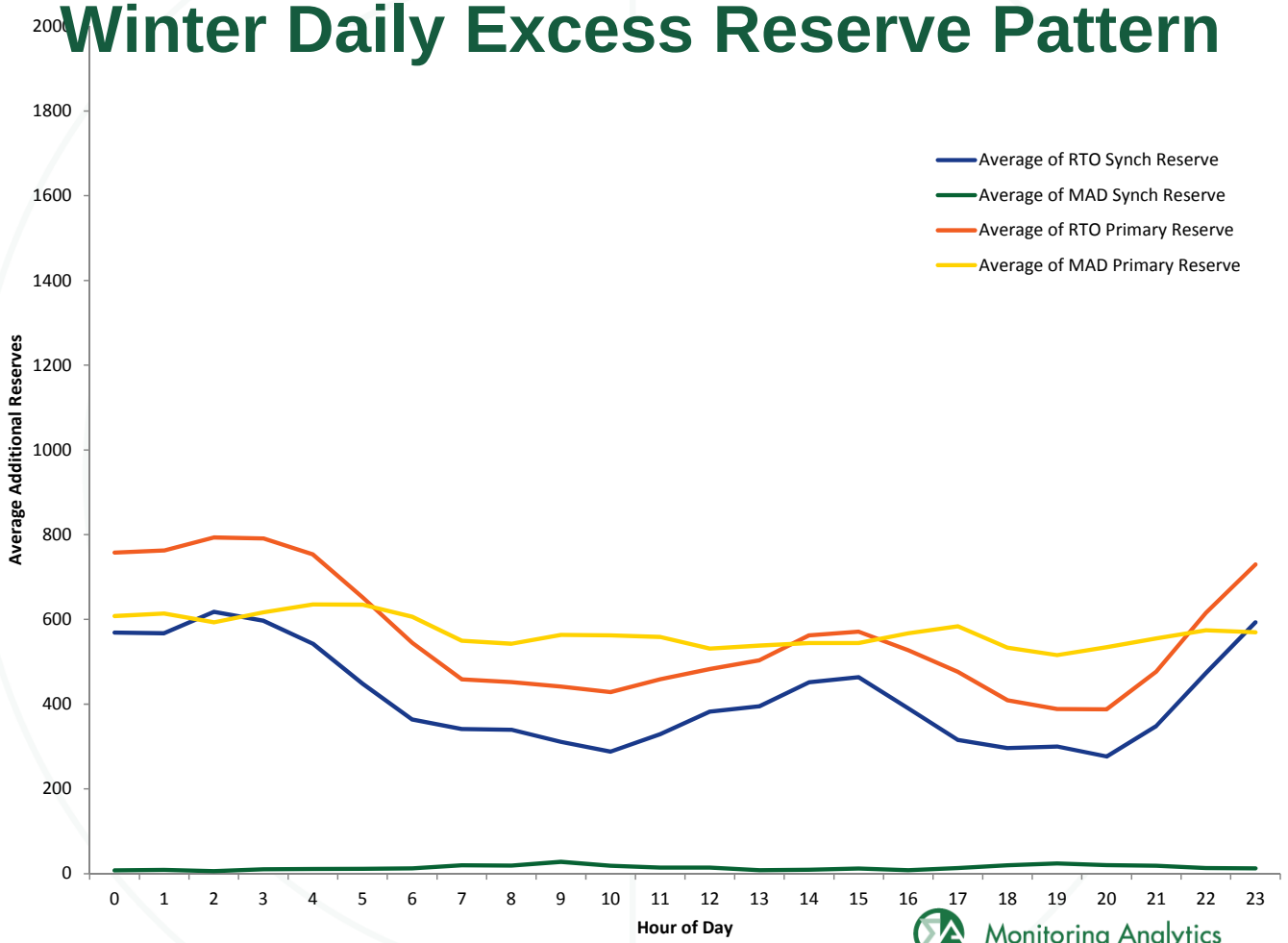
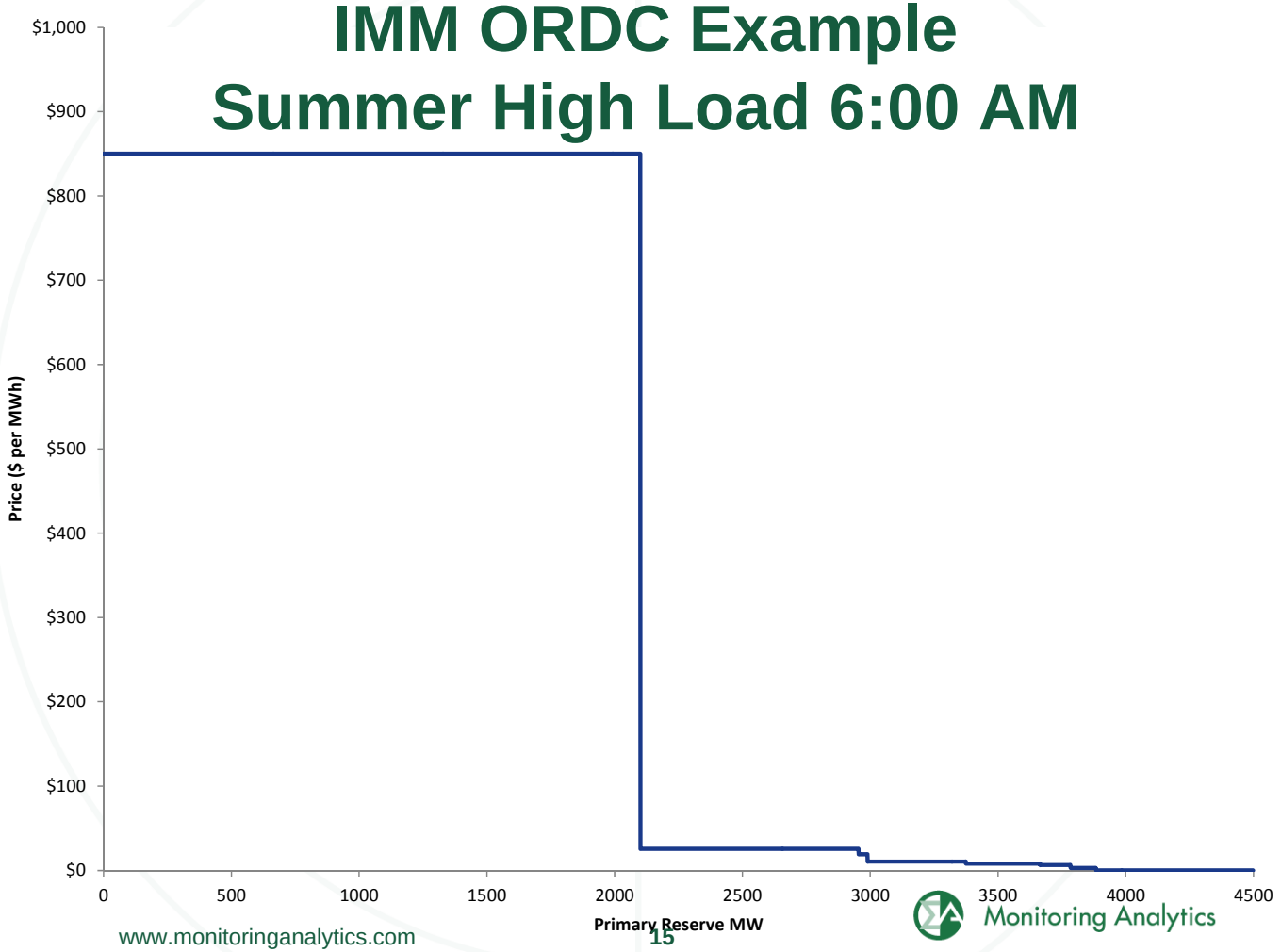
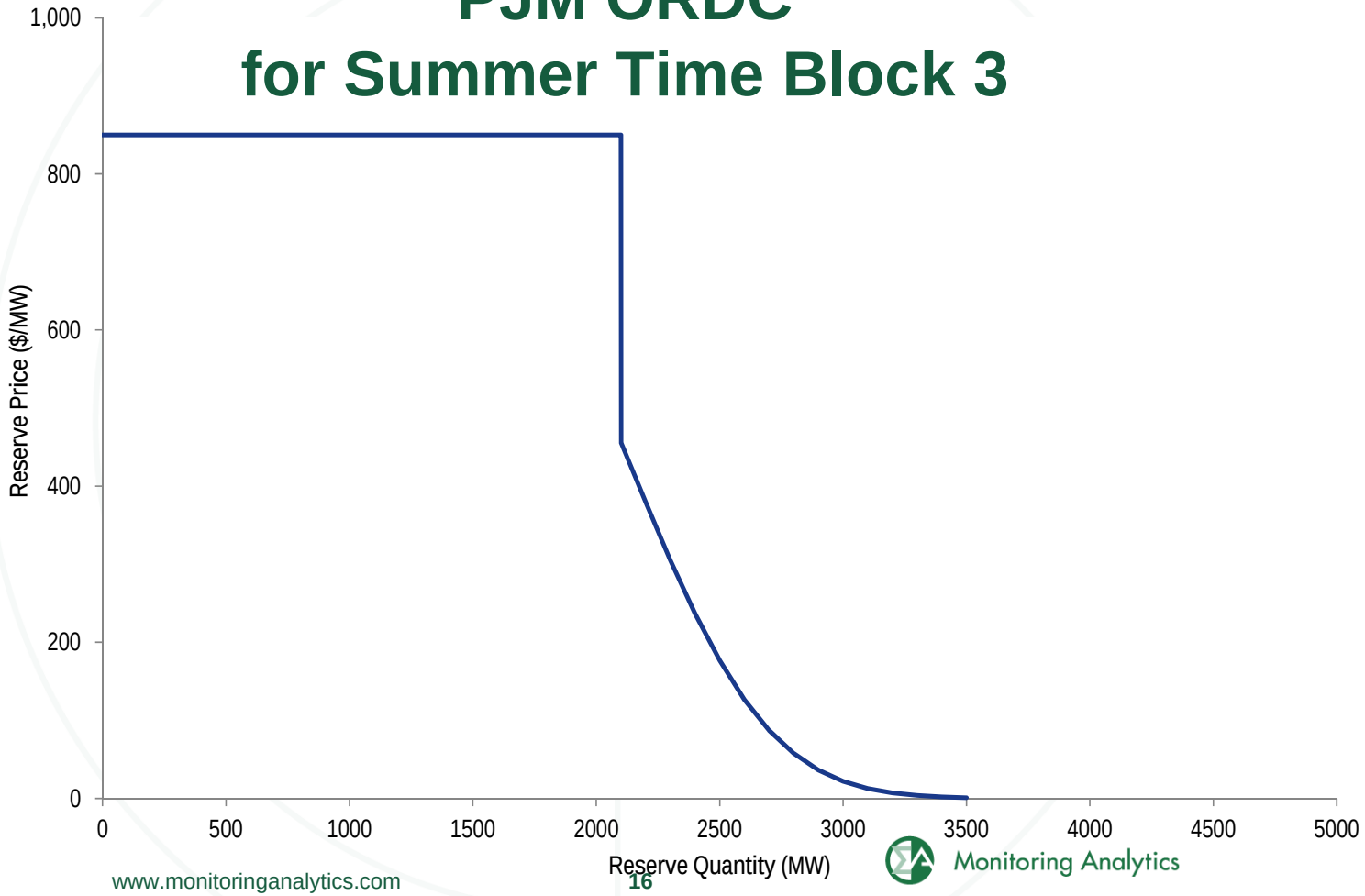
Winter Daily Excess Reserve Pattern



IMM ORDC Example
Summer High Load 6:00 AM



PJM ORDC
for Summer Time Block 3



EPFSTF Purpose

- **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 that can be implemented for 2018/19**

EPFSTF Purpose

- **Board proposed changes**
  - **Synch reserve market implementation**
  - **30 minute reserve product**
  - **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.”**

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

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/MWh x 770,000 GWh/year = $950 million per year**

Other Initiatives Interact with ORDC

- **Combined effects on market are more than additive.**
  - **Reserve market price changes**
  - **Higher ORDC penalty at $2,000 per MWh**
  - **Additional demand curves for 30 minute reserves**
  - **Fast start pricing**
  - **Maintenance adders**
- **$1.5 billion is an underestimate of final impact of PJM proposed energy market design changes, if any of PJM's related proposals are implemented.**

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