



# Summary of 2016 MISO State of the Market Report

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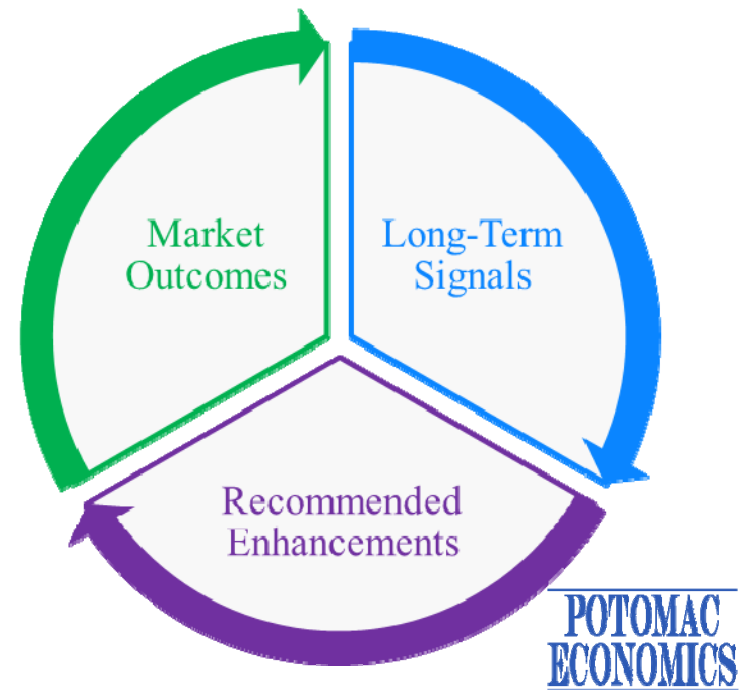
MISO Board Markets Committee

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MISO Independent Market Monitor

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# Introduction

- As the Independent Market Monitor (IMM) for the Midcontinent ISO (MISO), we:
  - ✓ Evaluate the competitive performance and operation of the MISO markets; and
  - ✓ Identify and recommend changes to existing and proposed market rules and operating procedures.
- This presentation summarizes:
  - ✓ Market highlights from 2016;
  - ✓ The competitive performance and operational efficiency of the markets;
  - ✓ Long-term economic signals; and
  - ✓ Recommendations.





## 2016 Market Summary

- The MISO markets performed competitively.
  - ✓ The “price-cost mark-up” was close to zero – prices were highly competitive.
  - ✓ The “output gap” measure of potential economic withholding remained low at 0.11 percent of load, and market power mitigation was infrequently applied.
- Fuel prices fell sharply in 2015 and modestly declined in 2016, which contributed to slightly lower energy prices (3 percent) and real-time make-whole payments (1.6 percent).
- Day-ahead and real-time markets operated efficiently, with the exception of network congestion issues attributable to:
  - ✓ Pseudo-tying MISO generation to PJM;
  - ✓ Market-to-market coordination issues; and
  - ✓ Lack of coordination of generation and transmission outages.
- Capacity prices were volatile and did not produce efficient long-term signals.
  - ✓ Prices rose significantly in the North for the 2016/2017 planning year, but fell to close to zero market-wide in the 2017/2018 planning year.
  - ✓ Market design problems continue to be a significant concern.



## Key Market Developments in 2016

- MISO implemented several market design changes that improved efficiency and competitiveness in 2016:
  - ✓ February 1: The Regional Dispatch Transfer (RDT) constraint replaced the 1,000 MW Subregional Power Balance Constraint, allowing interregional flows of 2,500 MW – 3,000 MW. This produced substantial economic benefits.
  - ✓ May 1: Ramp product was implemented that slightly lowered prices and price volatility.
  - ✓ July 1: Emergency Pricing was implemented to prevent prices from being understated during emergency events.
  - ✓ September 1: The Real-Time Offer Enhancement (RTOE) was implemented to allow resources to update real-time offers intra-hour.
- In May 2017, MISO implemented ELMP Phase 2 that allows an expanded set of fast-starting peaking resources to set energy prices.





## Market Highlights: Load and Price Trends

### MISO Prices and Load in 2016 (Slides 8, 9)

- Energy prices and day-ahead congestion fell slightly (2 to 3 percent) in 2016, largely because fuel prices fell slightly in 2016.
  - ✓ Average natural gas prices fell 10 percent in 2016 reaching historic lows in the first half of the year.
  - ✓ Powder river basin coal prices were virtually unchanged from 2015 to 2016.
- Weather was relatively mild and load was modest in most of 2016, weather was more severe and load was higher in the summer months.
  - ✓ MISO's annual peak load of 121 GW was slightly higher than last year, but well below the forecasted peak of 125.9 GW.
- Although the energy markets generally set efficient prices in 2016, we recommend improvements to MISO's price formation through improved shortage pricing and price-setting by peaking resources.



## Market Highlights: Load and Price Trends

### Transmission Congestion and Regional Transfers (Slide 10)

- While day-ahead congestion fell slightly, the value of real-time congestion rose 4.3 percent to total roughly \$1.4 billion, amongst the highest in the U.S.
- This small increase was comprised of:
  - ✓ No change in congestion throughout the North;
  - ✓ 37 percent *reduction* in congestion on transfers between the North and South subregions; and
  - ✓ 22 percent *increase* in congestion in MISO South, partly due to high and uncoordinated transmission and generation outages.
- Although total congestion increased only slightly, we are concerned that some of the congestion was not efficiently managed related to:
  - ✓ PJM taking dispatch control of MISO resources (affecting \$82 million).
  - ✓ Congestion affected by multiple simultaneous outages (\$224 million).
  - ✓ Potentially conservative transmission ratings (\$155 million).
  - ✓ Market-to-market coordination issues with PJM and SPP (\$238 million).



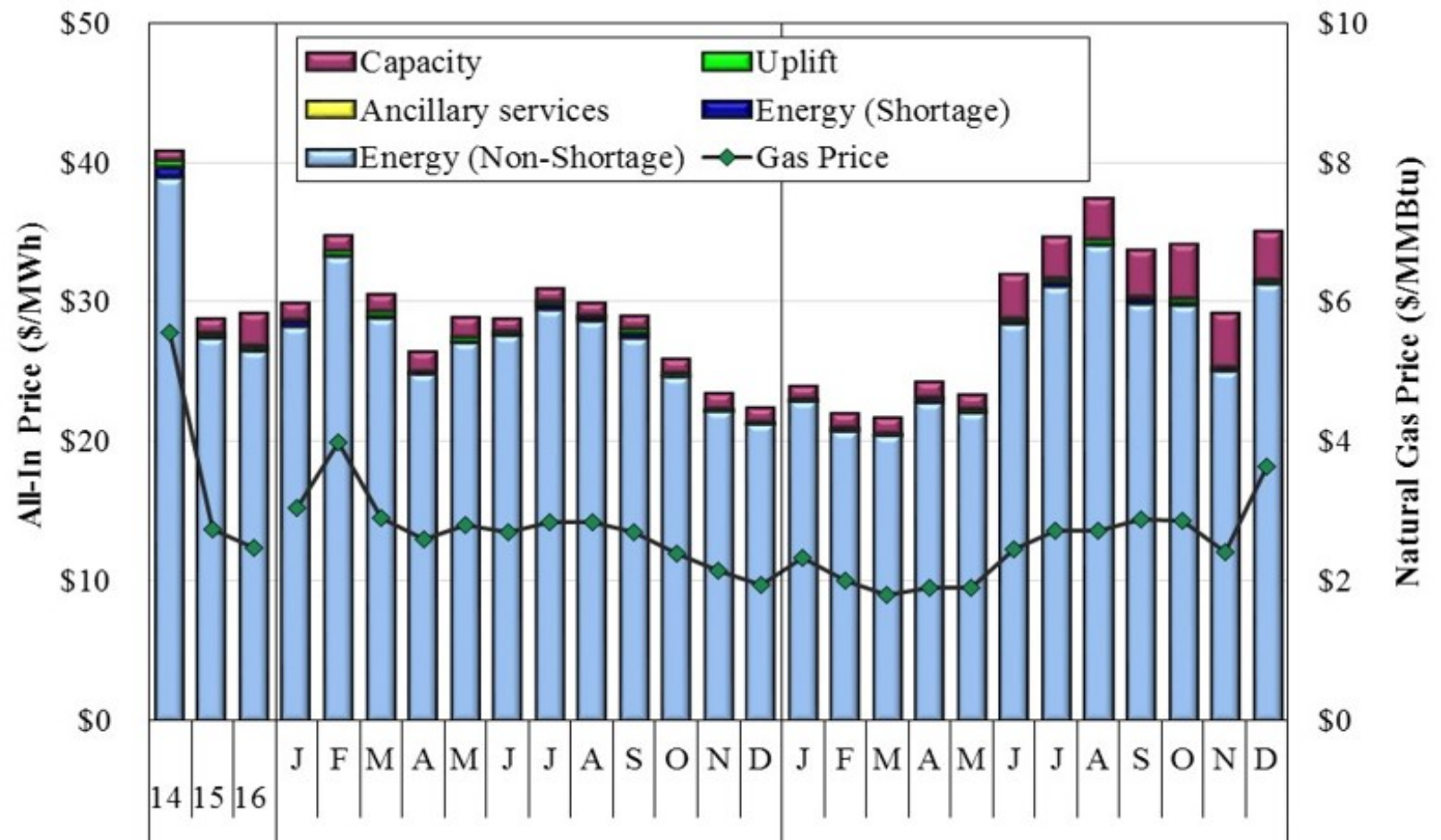
## Market Highlights: Long-Term Price Signals

### **Capacity Margins and Long-Term Economic Signals (Slides 11, 12, 13)**

- While the 2017 summer capacity margin fell to 18.9 percent, sufficient capacity exists to meet the 15.8 percent capacity margin requirement.
- Well-designed markets produce sufficient net revenues to support investment when existing resources are not sufficient to meet the system's needs.
- Net revenues for new resources rose in most areas, but long-term price signals remained well below those needed to incent investment.
  - ✓ This result is partly due to the prevailing capacity surplus in MISO.
  - ✓ But capacity market design continues to undermine long-term signals and will likely cause them remain insufficient when the surplus dissipates.
- Capacity cleared at \$1.50 per MW-day in the 2017/2018 auction for the entire MISO footprint – this is essentially zero.
  - ✓ This is not an efficient price under current capacity levels and will motivate poor retirement and export decisions by MISO's competitive suppliers.
  - ✓ MISO attempted to address this in 2016 with an unsound proposal that was not accepted by FERC, but we encourage MISO to pursue efficient alternatives.



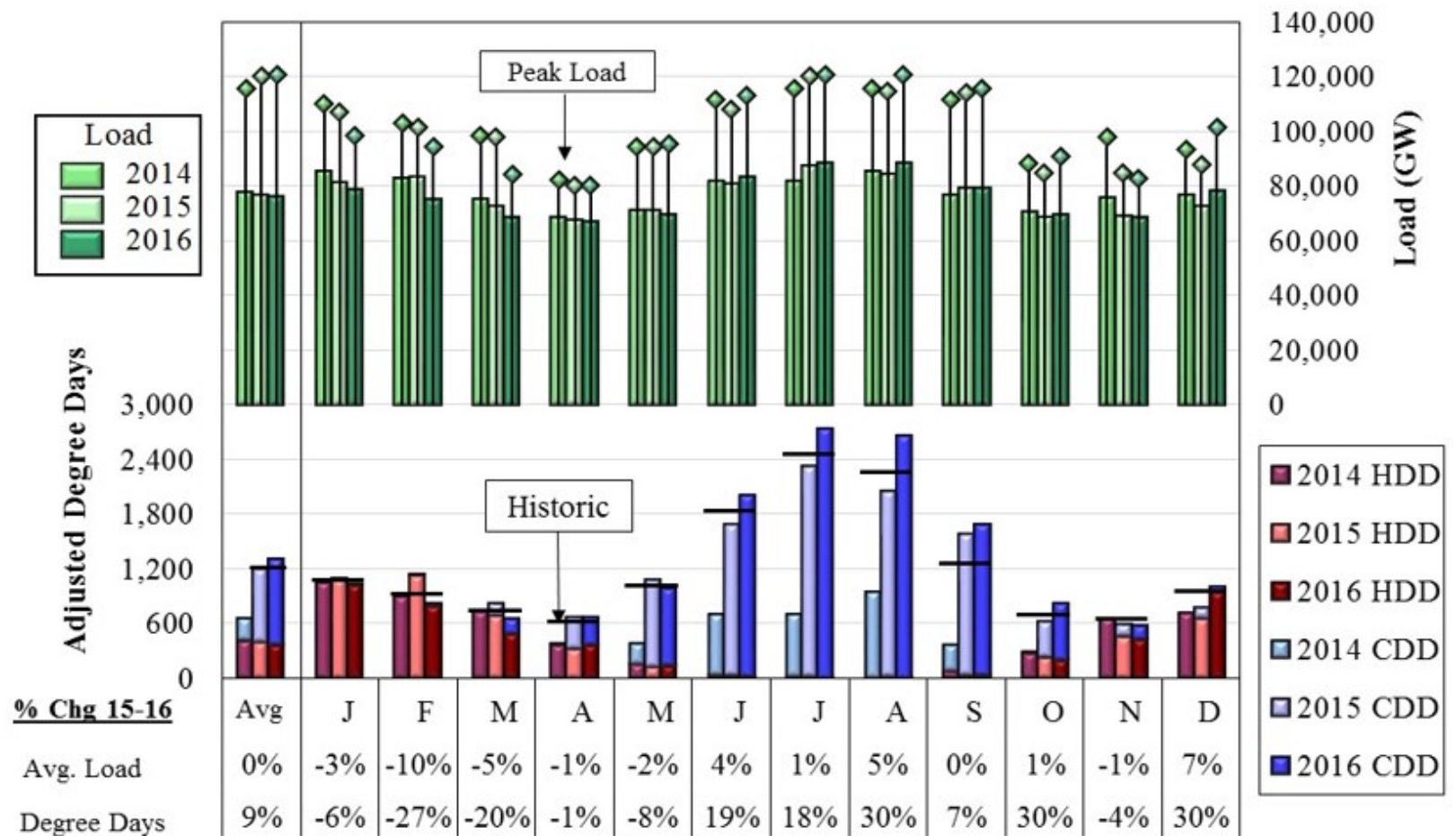
# All-In Price





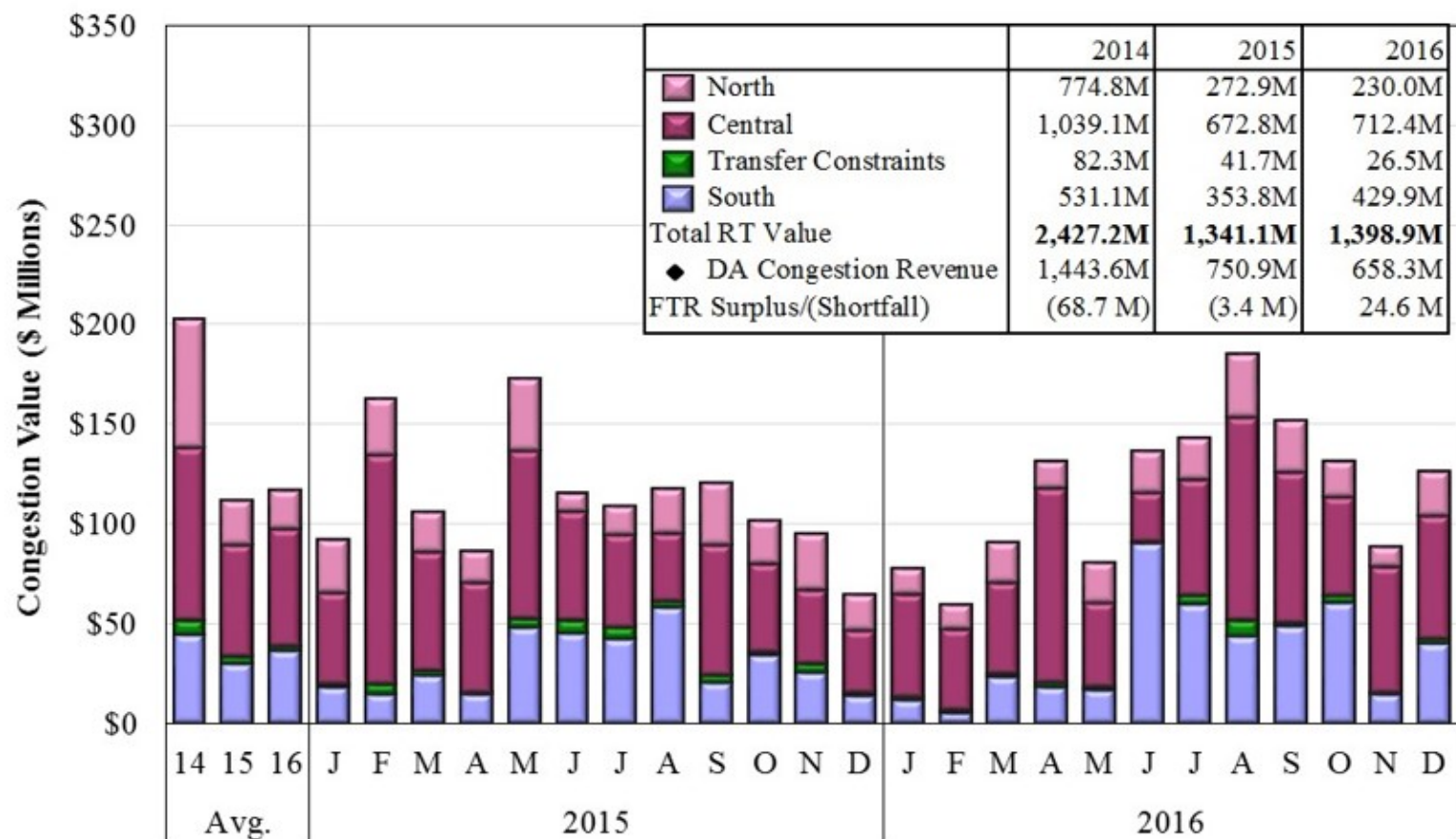


## Weather and Load in 2015





## Real-Time Value of Congestion in MISO





## Capacity Margins in Summer 2017

	Alternative IMM Scenarios			
	Base Case	Realistic DR*	High Temperature Cases	
			Full DR	Realistic DR*
Load				
Base Case	125,020	125,020	125,020	125,020
High Load Increase	-	-	7,211	7,211
Total Load (MW)	125,020	125,020	132,231	132,231
Generation				
Internal Generation	140,850	140,850	140,850	140,850
BTM Generation	4,009	4,009	4,009	4,009
Hi Temp Derates**	-	-	(4,900)	(4,900)
Adjustment due to Transfer Limit***	(2,157)	(2,157)	-	-
Total Generation (MW)	142,701	142,701	139,958	139,958
Imports and Demand Response				
Demand Response****	6,112	4,890	6,112	4,890
Capacity Imports****	3,483	3,483	3,483	3,483
Capacity Exports	(3,636)	(3,636)	(3,636)	(3,636)
Margin (MW)	23,640	22,417	13,686	12,464
Margin (%)	18.9%	17.9%	10.9%	10.0%

\* Assumes 80% response to account for uncertainties in availability and performance.

\*\* Derates are highly variable; this value is based on four of the hottest days since the start of the MISO markets.

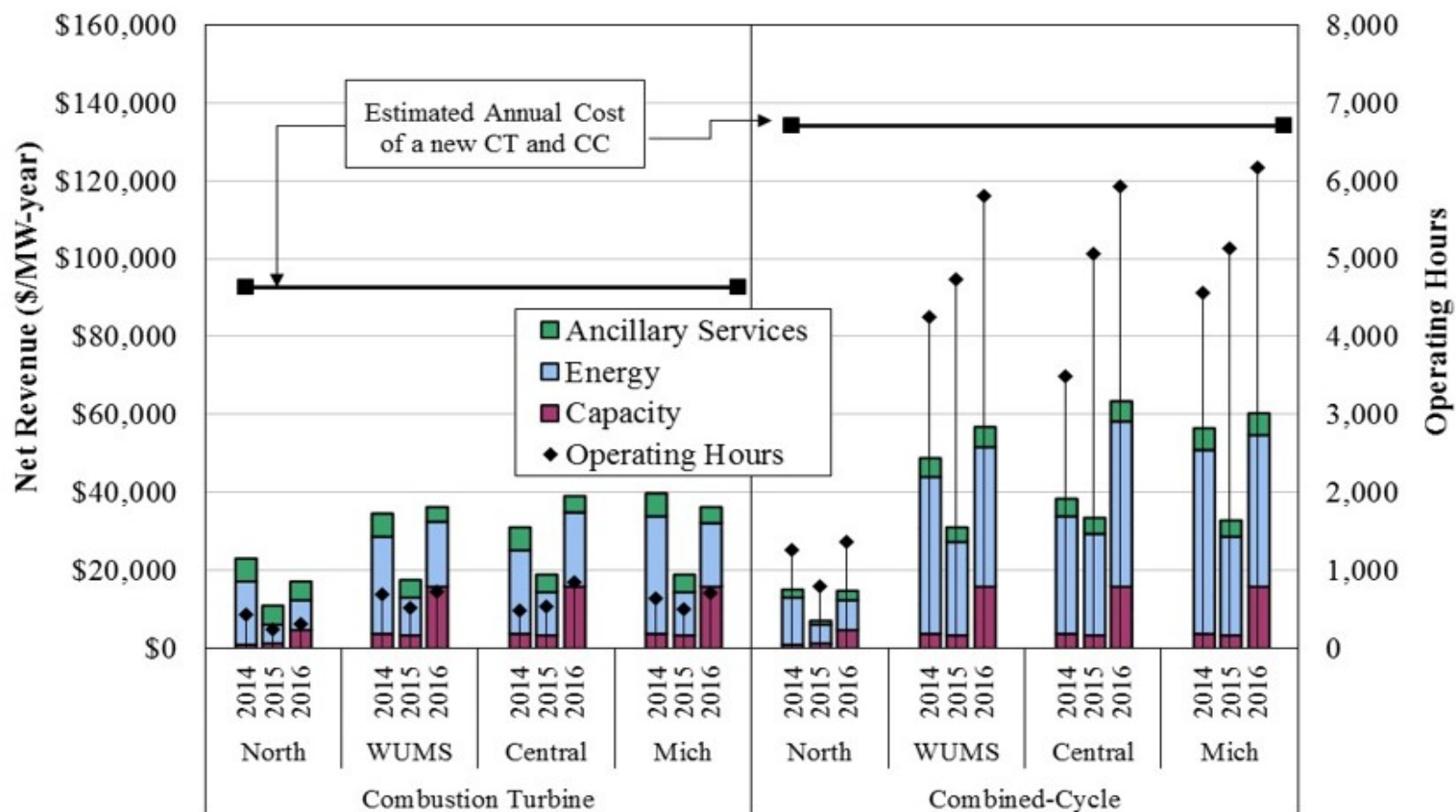
\*\*\* Accounts for resources that may not be accessible because of the transfer constraint; assumes a transfer limit of 2,000 MW (includes probabilistic derates from the full 2,500 MW).

\*\*\*\* Cleared amounts for the 2017 / 2018 planning year.





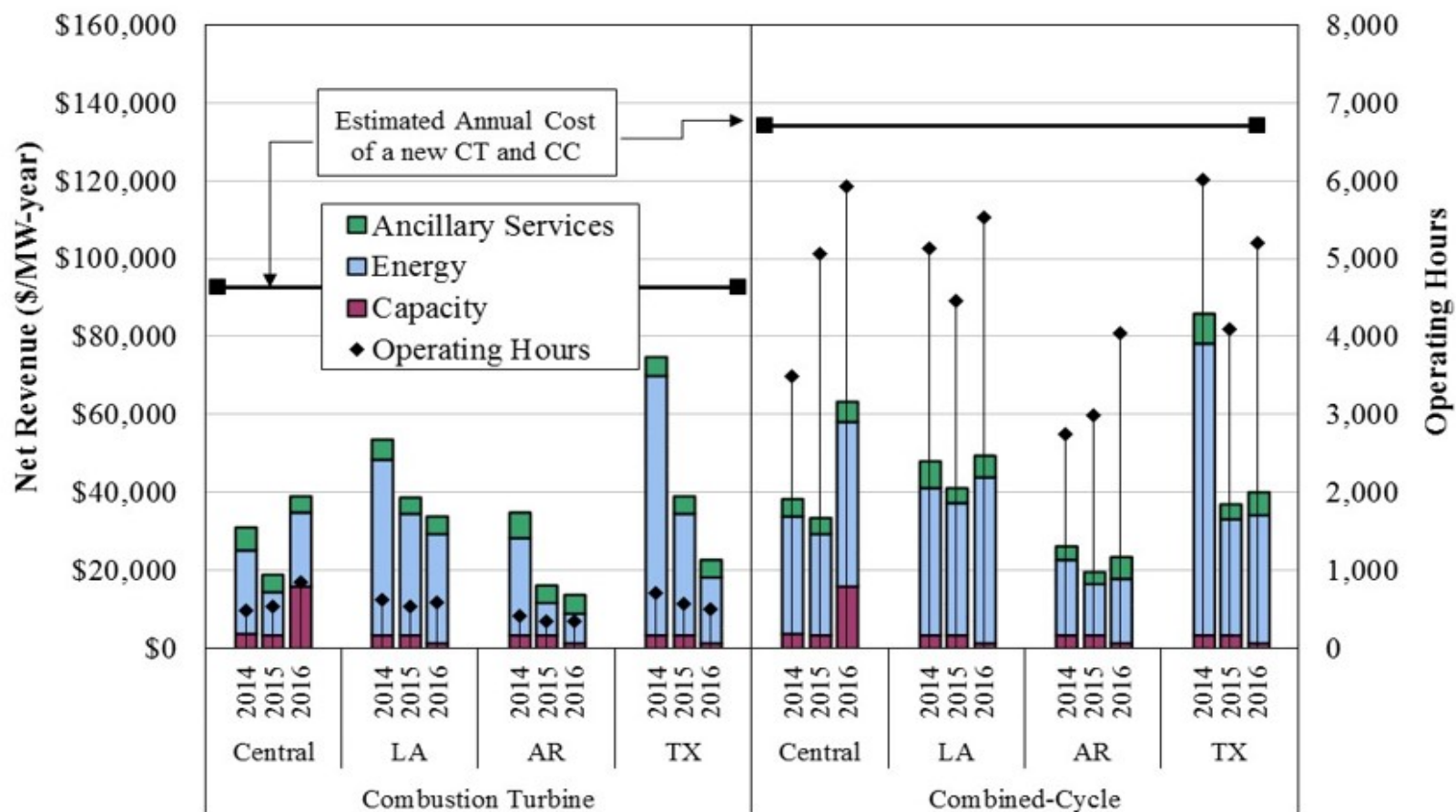
## Long-Run Price Signals: Net Revenue Midwest Region







## Long-Run Price Signals: Net Revenue South Region





## Evaluation of Virtual Trading in MISO

- Some have argued recently that virtual trading may generate costs that are greater than the benefits they provide.
- To evaluate this assertion, we have developed a multi-tiered set of screens to identify virtual trades that improve market efficiency and those that do not.
- A substantial majority of virtual trades improve efficiency (see table below).
  - ✓ Profits of efficiency-enhancing virtual trades exceeded losses by \$65 million, a 15 percent increase over 2015, but the total benefits of virtual transactions are much larger.
  - ✓ Some virtual transactions profit that do not contribute to efficiency (profits on un-modeled constraints or loss factors). These rents totaled \$35 million.

	Financial Participants		Physical Participants		Total	
	Average Hourly MWh	Share of Class	Average Hourly MWh	Share of Class	Average Hourly MWh	Share of Total
Efficiency - Enhancing Virtuals	6,790	58%	400	47%	7,190	57%
Non - Efficiency - Enhancing Virtuals	4,956	42%	456	53%	5,412	43%



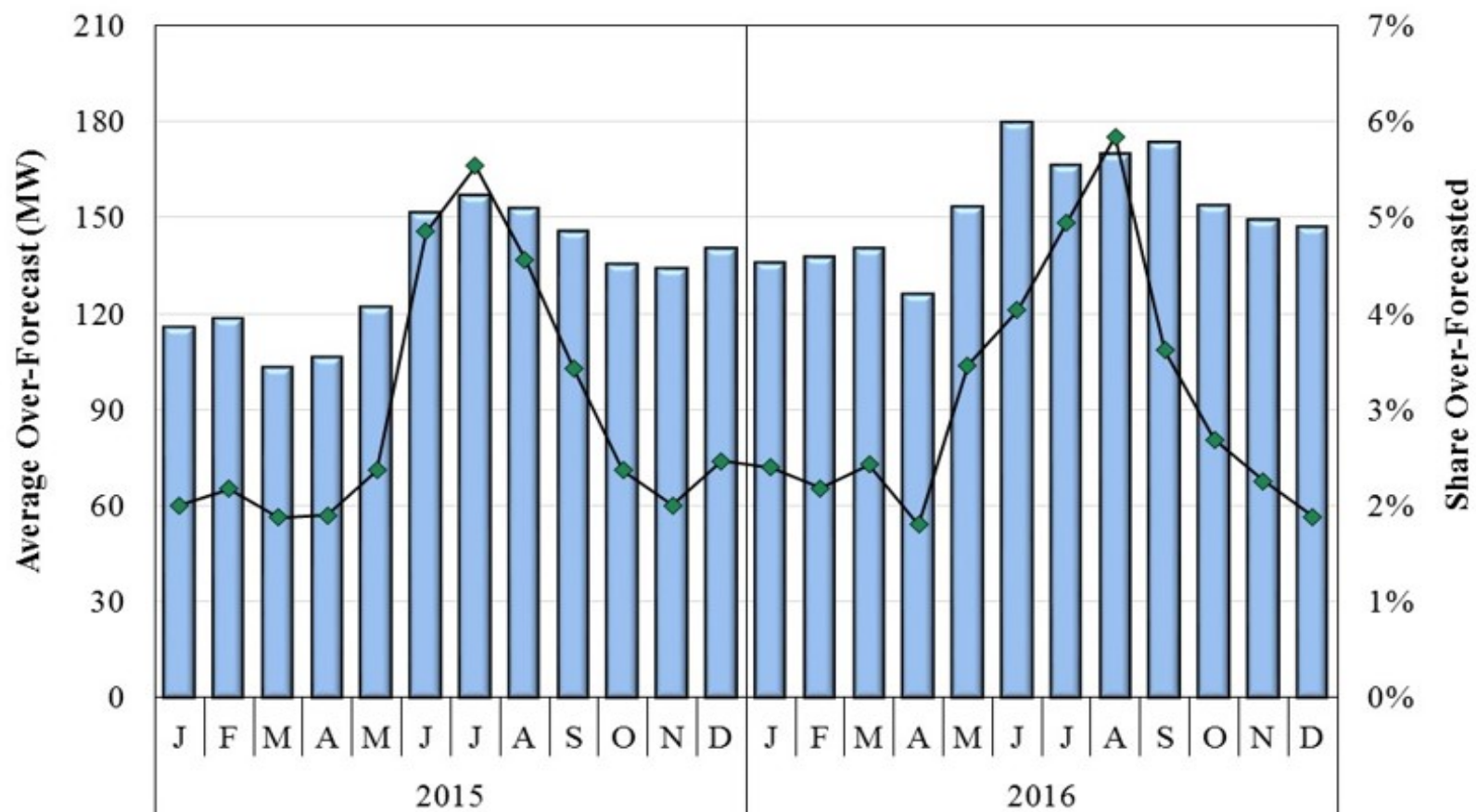
## **IMM Recommendation 2016-6 and 2016-7:** *Improve Deviation Thresholds and Settlement Rules for Wind to Improve Forecasting Incentives and Validate Wind Forecasts*

- MISO has one of the best wind dispatch capabilities through its DIR process, but it is highly dependent on accurate wind forecasts.
  - ✓ MISO dispatch uses wind forecasts as the dispatch maximum for wind units, which generally results in dispatch instructions equal to the wind forecast.
  - ✓ We have identified chronic over-forecasting by certain wind suppliers.
  - ✓ Settlement rules create a strong incentive for DIR wind resources in MISO to over-forecast their output in real-time, due to current market settlement rules.
- Principle/Approach:
  - ✓ Principle: Provide incentives for suppliers to submit accurate forecasts and procedures to address persistent forecasts errors.
  - ✓ Approach: Consider a modified excess energy threshold for wind to allow resources more latitude to exceed their dispatch when no congestion exists and other changes to balance the EXE/DFE settlements that wind units face.
  - ✓ Approach: Develop procedures to validate market participant forecasts and utilize alternative forecasts when participants' forecasts are inaccurate.
- Benefits: Better utilization of transmission and lower production costs.





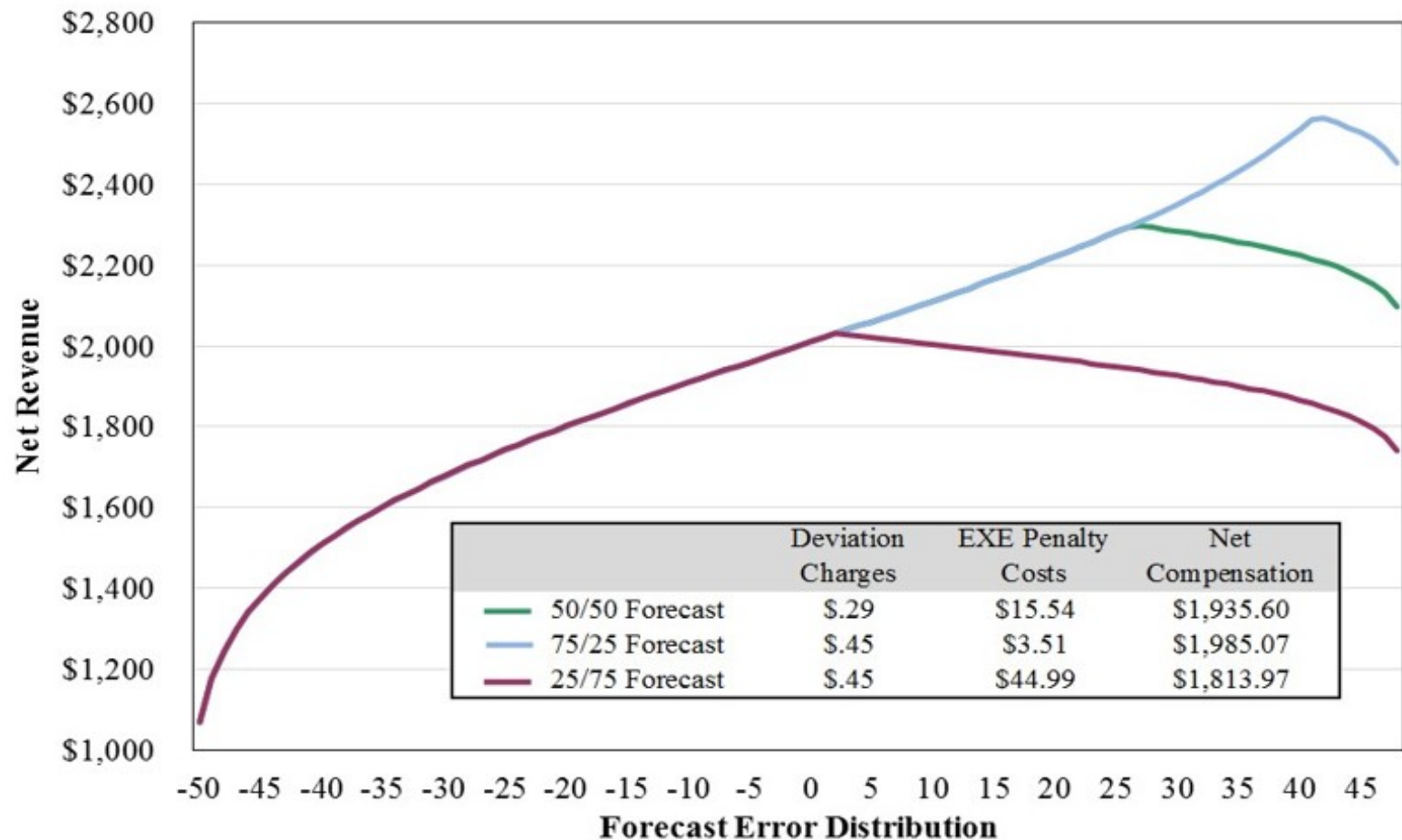
## Wind Over-Forecasting in 2016





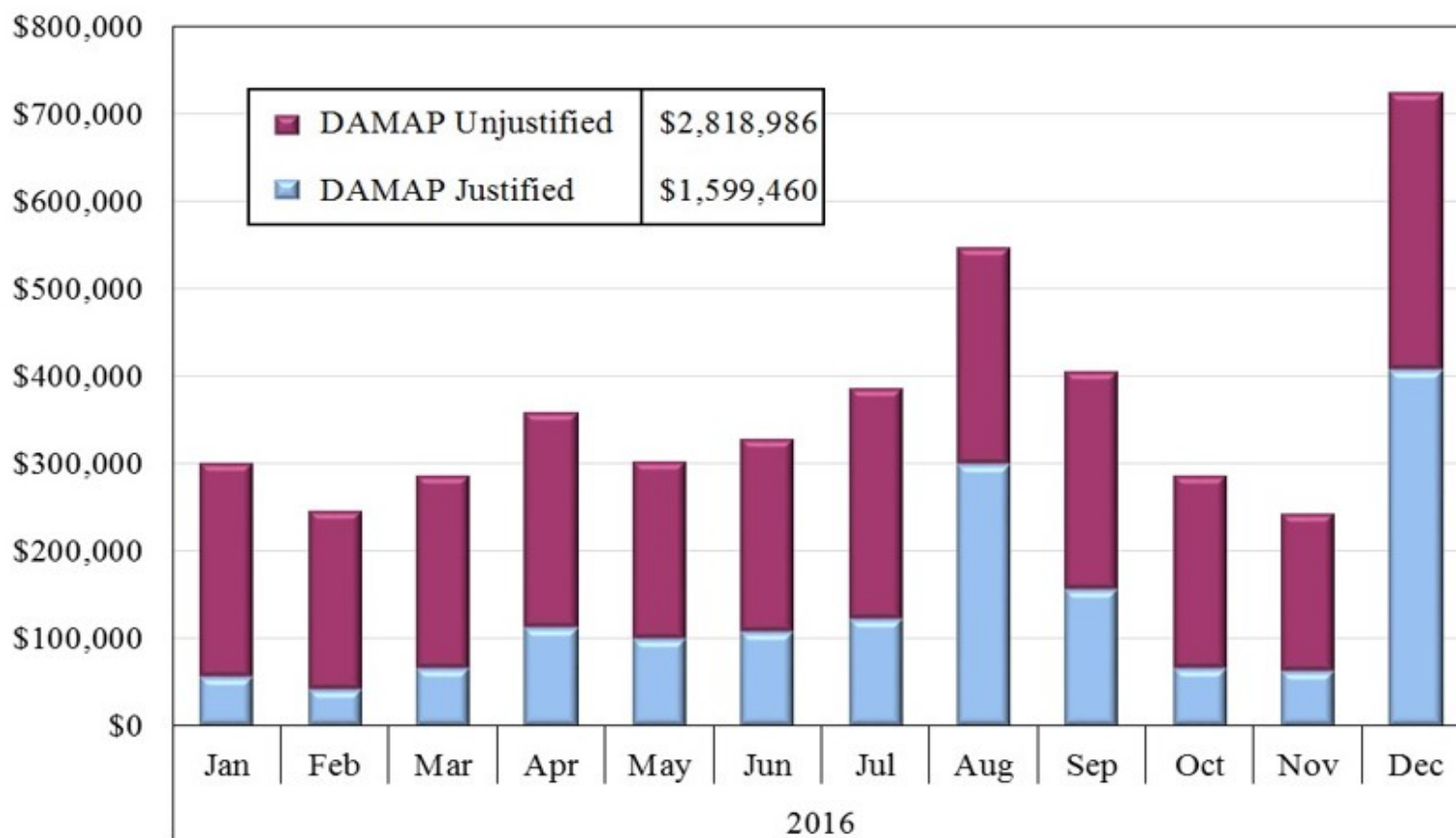


## Expected Settlement Value of Forecast Alternatives for Wind





## DAMAP Compensation to Wind Resources



Note: “Unjustified” DAMAP is paid to wind units dispatched at their ECOMAX, which was not intended and is due to an error in the Tariff.

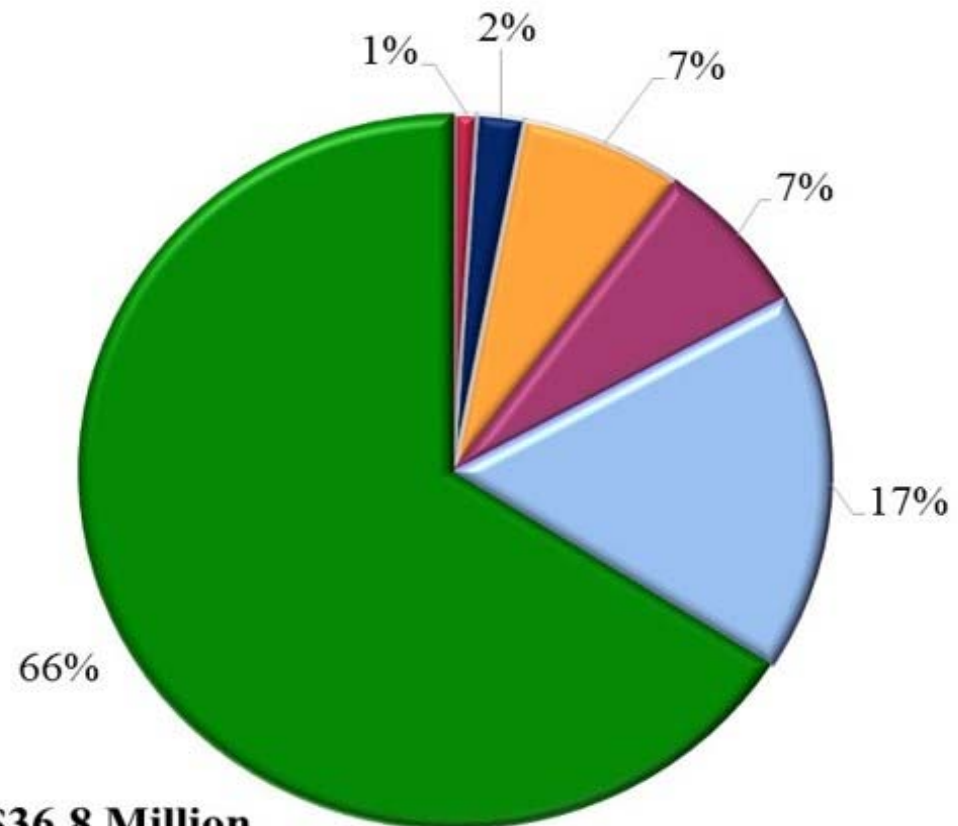


## **IMM Recommendation 2016-5:** *Reform DAMAP and RTORSGP Rules to Improve Performance Incentives and Reduce Gaming Opportunities*

- Our evaluation of DAMAP and RTORSGP reveals that significant amounts were paid to resources not performing well:
  - ✓ Of nearly \$37 million paid to generating resources in 2016, only two-thirds of the payments were paid to units following MISO's dispatch instructions.
  - ✓ The remaining third reduces the costs to generators of performing poorly.
  - ✓ Almost \$3 million was paid to wind resources for forecast errors because of a flaw in MISO's tariff that should be corrected as soon as practicable.
- Principle/Approach:
  - ✓ Principle: Reward good performers and penalize poor performers.
  - ✓ Approach: Incorporate a performance metric in the calculation of make-whole payments that would reduce the payment by the amount that corresponds to resources' dispatch deviations.
- Benefits:
  - ✓ Align incentives with good resource performance, and improving reliability.
  - ✓ Lower inefficient make-whole payment costs.



# DAMAP Payments



**Total DAMAP in 2016 = \$36.8 Million**

\* Excluded Hour 0 in the analysis



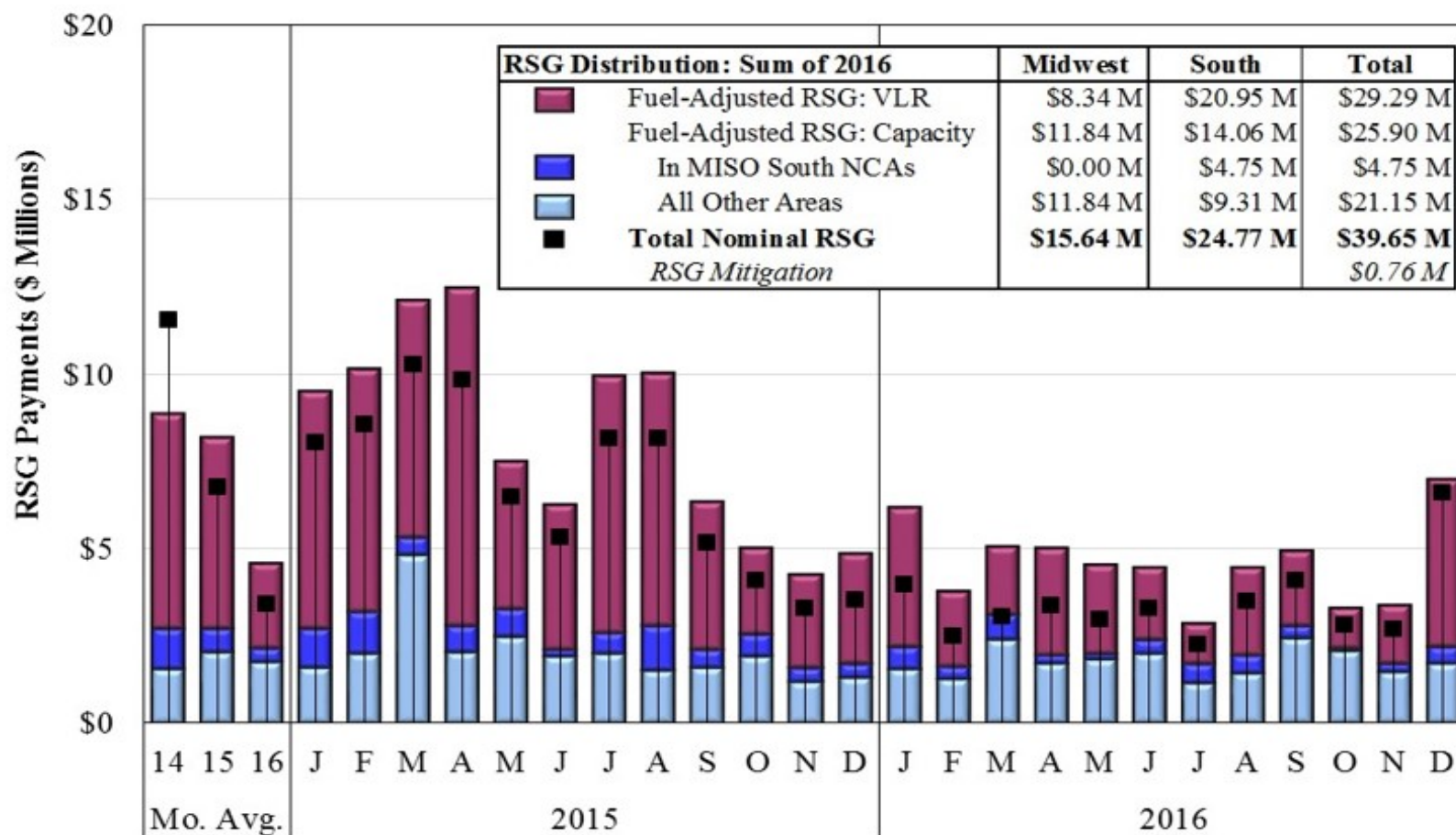


## **IMM Recommendation 2016-4 and 2014-2:** *Establish Regional Reserve Requirements and a 30-Minute Local Reserve Product to Reflect the VLR and Subregional Capacity Needs*

- MISO incurs high RSG costs in some areas to satisfy subregional capacity or VLR needs beyond first contingencies – which are operating reserve needs.
  - ✓ The VLR needs exist because some areas do not have resources that can start within 30 minutes to restore the lost supply after a contingency.
  - ✓ MISO makes a substantial number of resource commitments and often incurs RSG to satisfy subregional capacity needs when the RDT may bind.
- Principle/Approach:
  - ✓ Principle: Align market products with reliability needs.
  - ✓ Approach: Create a local 30-minute reserve product and establish procurement requirements for the VLR areas and the subregions.
- Benefits:
  - ✓ Lower costs by allowing the markets to satisfy MISO's reliability needs and reducing out-of-market actions by MISO operators.
  - ✓ Expand the supply available to meet the VLR requirements.
  - ✓ Provide market signals to build fast-starting units that can satisfy the VLR needs at a much lower cost (they can satisfy the requirements while offline).
  - ✓ Allow MISO to accurately price subregional shortages (N and S).

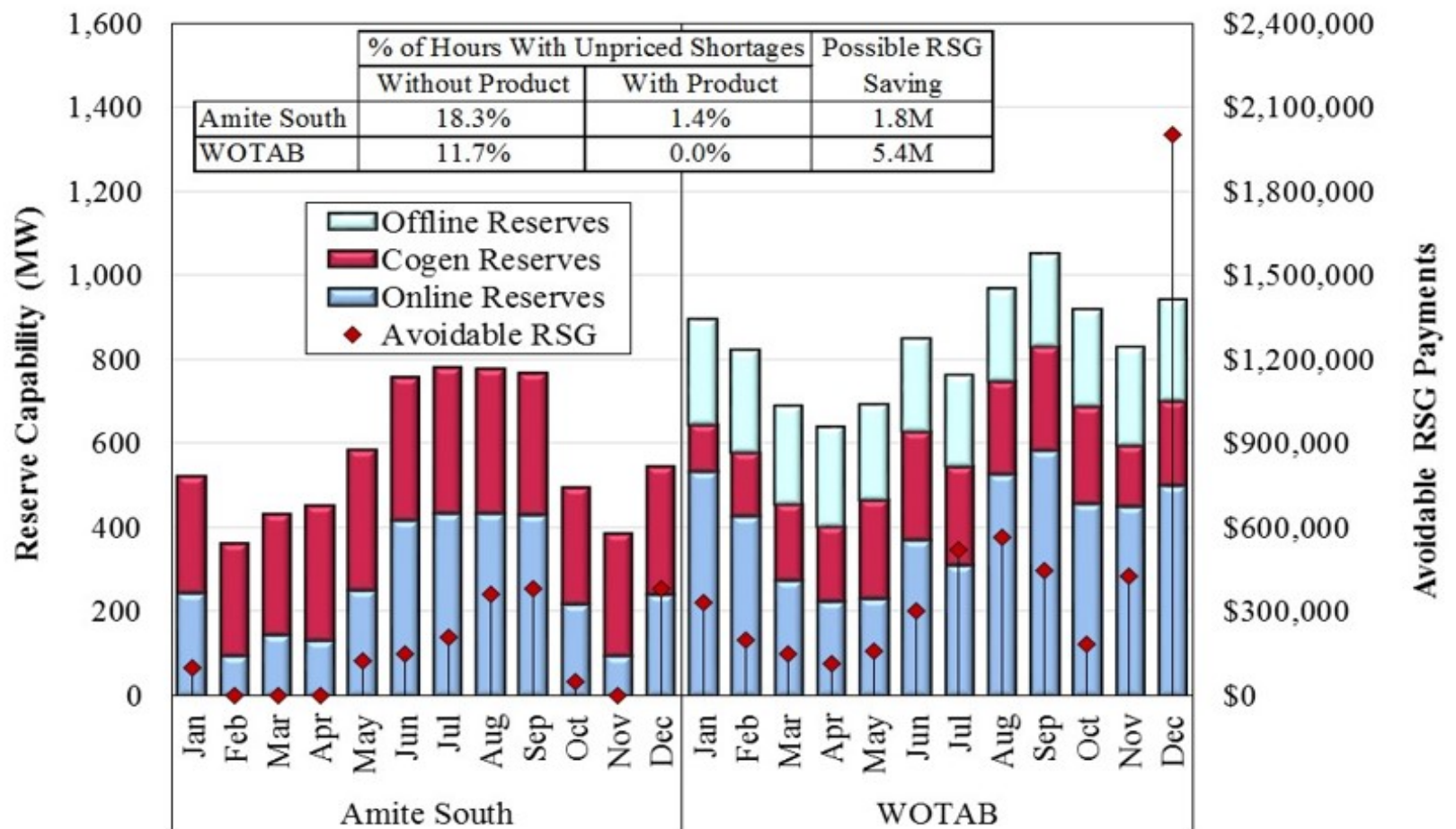


## Day-Ahead RSG Payments 2015-2016





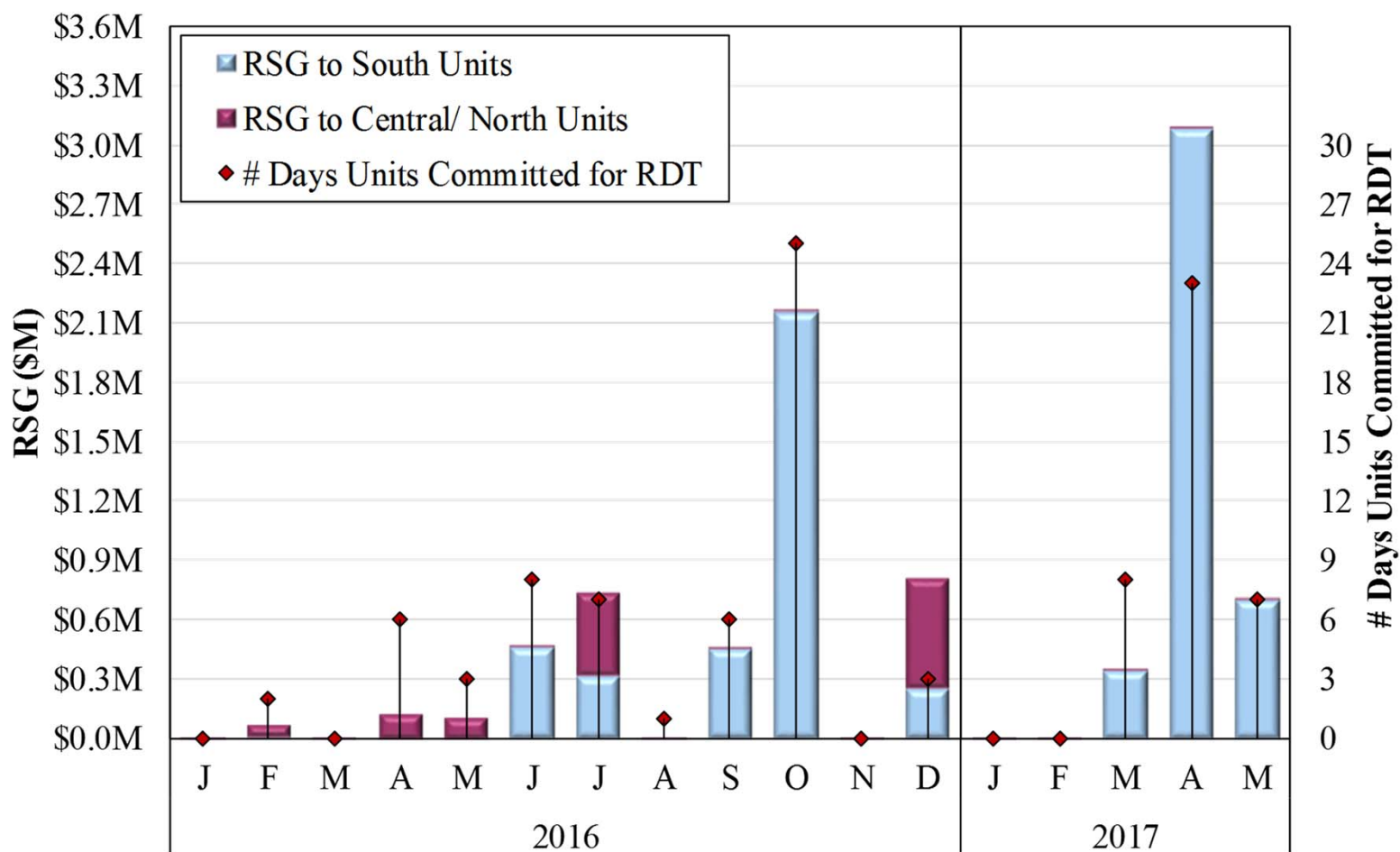
## 30 Minute Reserve Capability in MISO South Load Pockets







## RDT – Associated RSG June 2016 – April 2017







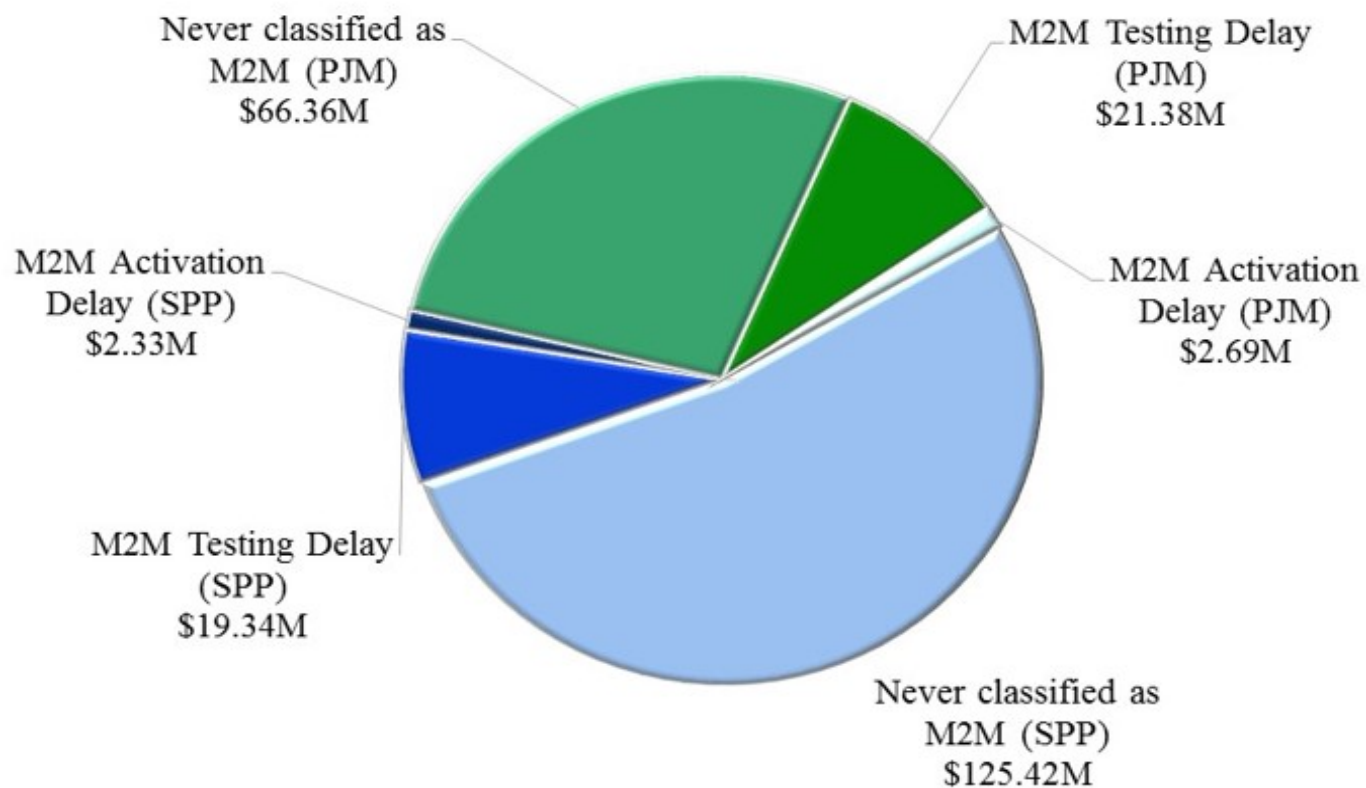
## **IMM Recommendation 2016-2:** *Improve Procedures for M2M Activation and Coordination, including Identifying, Testing, and Transferring Control*

- Procedural issues have caused coordinated congestion management between MISO and its neighbors to not be fully efficient.
  - ✓ In 2016, more than \$238 million of congestion could have been more efficiently managed through better M2M coordination procedures.
  - ✓ In Spring 2017, more than \$66 million of congestion accumulated on two coordinated MISO constraints that are dominated by PJM.
- Principle/Approach:
  - ✓ Principle: Least-cost resources should be dispatched to manage constraints.
  - ✓ Approach: Improve automation and logging of testing and activation of M2M constraints.
  - ✓ Approach: Develop criteria with JOA partners to transfer monitoring of M2M constraints to the RTO with the most dispatch relief.
  - ✓ Approach: Develop a JOA with TVA to coordinate congestion management.
- Benefits: Substantially reduce inefficient congestion and associated production costs.



## Congestion Due to Inefficient Market-to-Market Coordination

Congestion due to Inefficient M2M Coordination = \$238M





## Potential for Congestion Coordination with TVA

Status	Total Congestion Value (\$ Millions)	Re-dispatch Savings (\$ Millions)
MISO Constraints when TVA Generators had significant impact	\$169.6 M	\$16.9 M
TVA (TLR) Constraints when MISO Generators had significant impact	\$21.1 M	\$4.9 M
<b>Total</b>	<b>\$190.7 M</b>	<b>\$21.8 M</b>



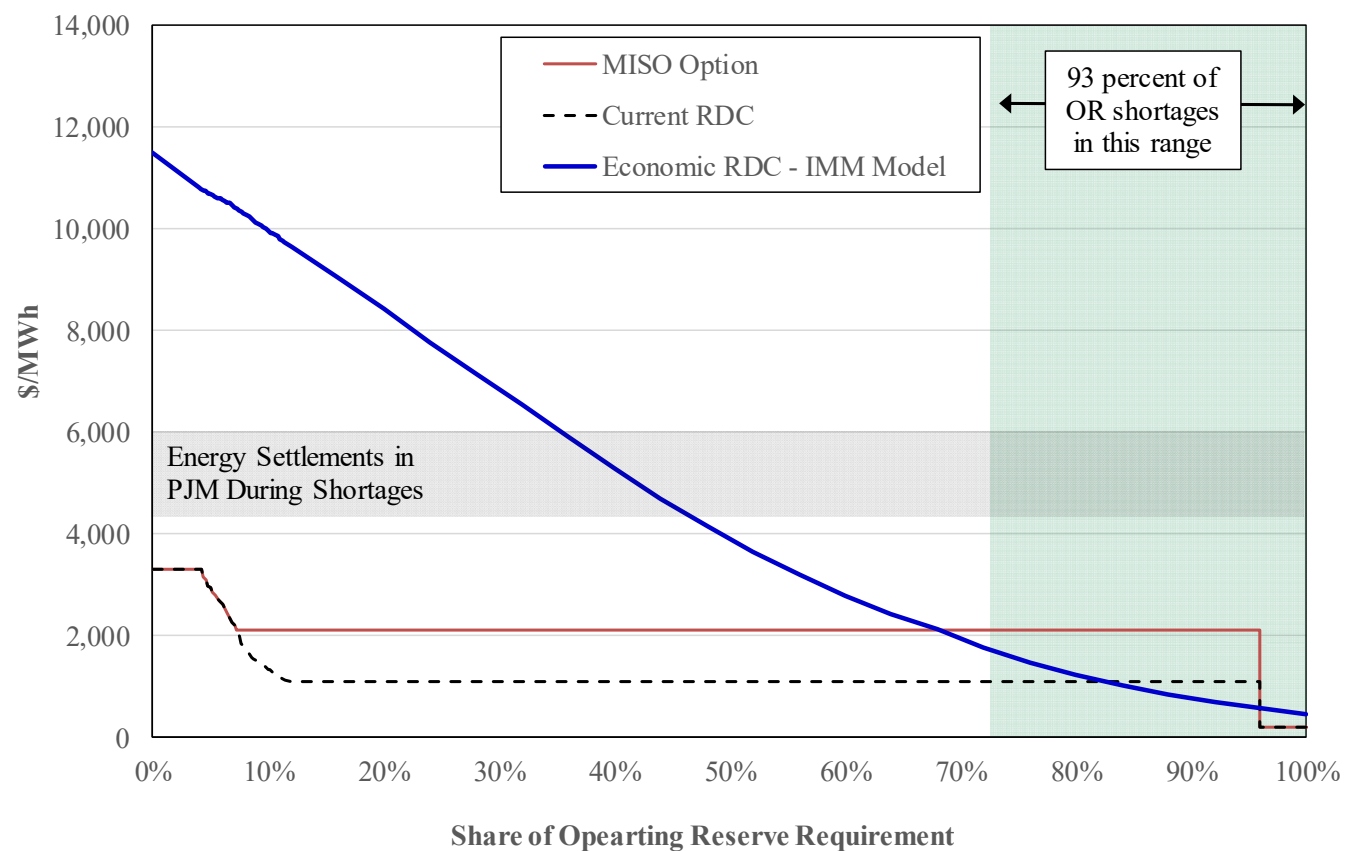


## **IMM Recommendation 2016-1:** *Improve Shortage Pricing by Adopting an Improved Contingency Reserve Demand Curve that Reflects that Expected VOLL*

- Well-designed markets will produce efficient shortage pricing, which is based on properly-valued Reserve Demand Curves (RDC).
  - ✓ The marginal reliability value of reserves at any shortage level is equal to the expected value of the load that may not be served:  
$$\text{Value of Lost Load (VOLL)} * \text{Probability of Losing Load}$$
  - ✓ MISO's current RDC results in overstated shortage prices for small shortages and understated shortage prices for larger shortages.
- Principle/Approach:
  - ✓ Principle: Energy and reserve prices should reflect the marginal reliability value of resources at any given level of shortage.
  - ✓ Approach: Increase the VOLL to better reflect the value of serving the highest value loads.
  - ✓ Approach: Develop RDCs whose slope is based on the probability of losing load at any particular level of reserves.
- Benefits: Efficient shortage prices will facilitate more efficient short-term decisions (commitment, import/export, etc.) and longer-term decisions (forward contracting, investment, etc.).



# IMM Proposed Operating Reserve Demand Curve





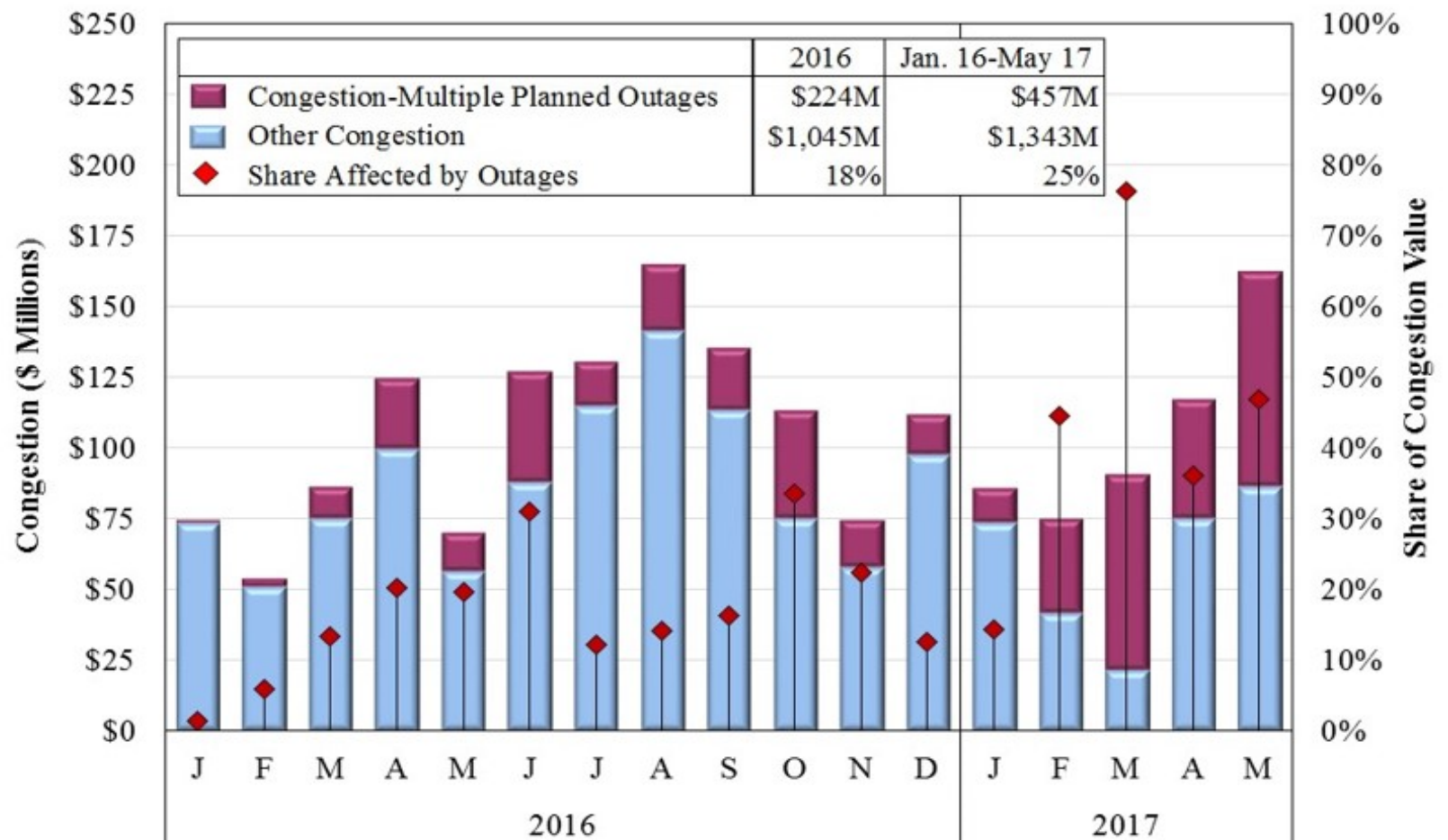
## **IMM Recommendation 2016-3: *Enhanced Transmission and Generation Planned Outage Approval Authority***

- MISO is responsible for approving the schedules of planned transmission and generation outages, but does not coordinate outage schedules to lower costs.
  - ✓ Approval process considers only reliability concerns associated with requested outages, not the potential economic costs.
  - ✓ One quarter of all real-time congestion (\$457 million) was attributable to concurrent generation outages from January 2016 to May 2017.
- Principle/Approach:
  - ✓ Principle: Outage scheduling and coordination should incorporate economic considerations to minimize unnecessary and inefficient congestion costs.
  - ✓ Approach: Expand outage approval/coordination authority to address economic congestion that does not raise clear reliability concerns.
- Benefits:
  - ✓ Outage-related congestion will be reduced during peak outage season.
  - ✓ Fewer instances of capacity-related emergency events during the shoulder months.



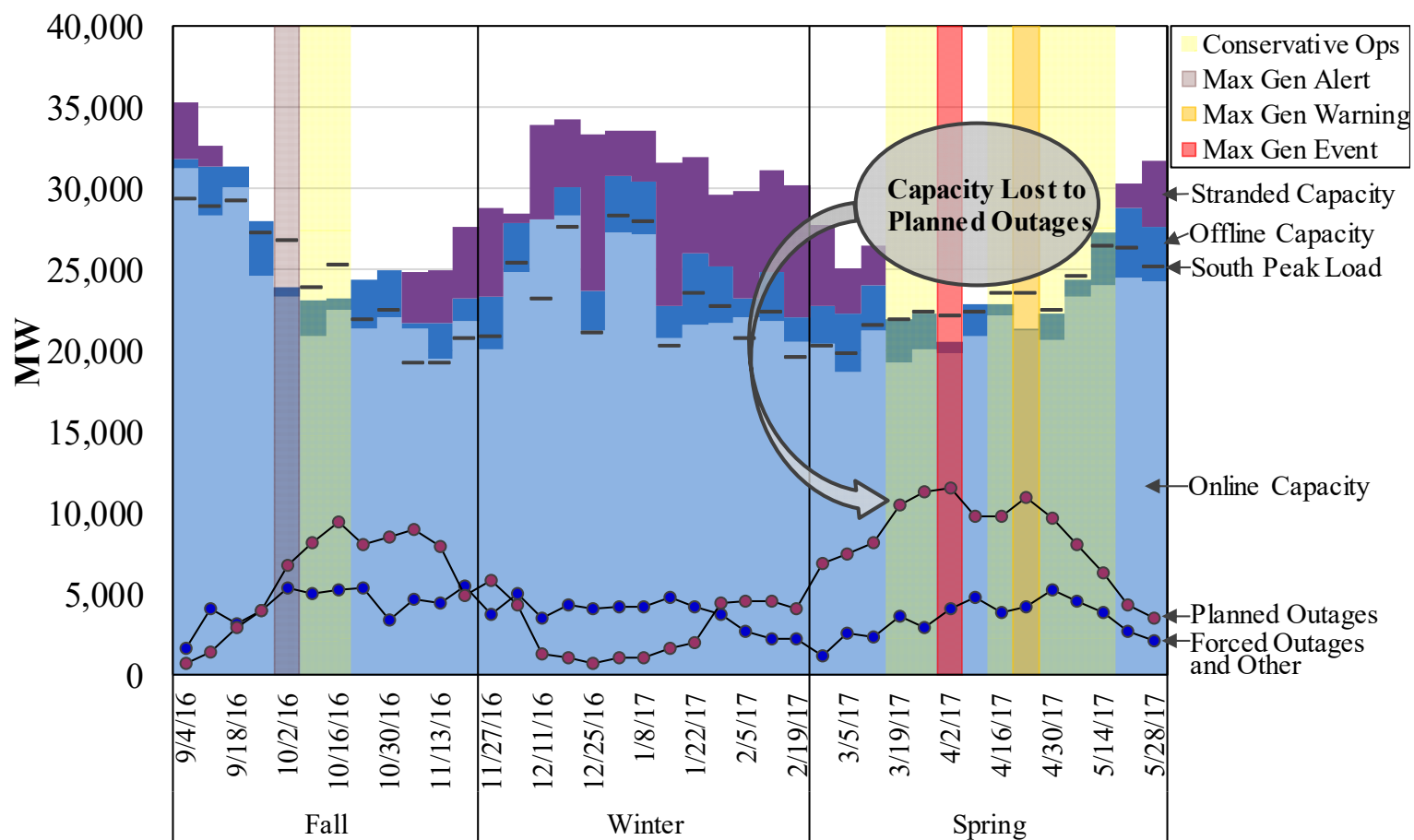


## Outage-Related Congestion





## Planned Outages and Associated MISO South Events





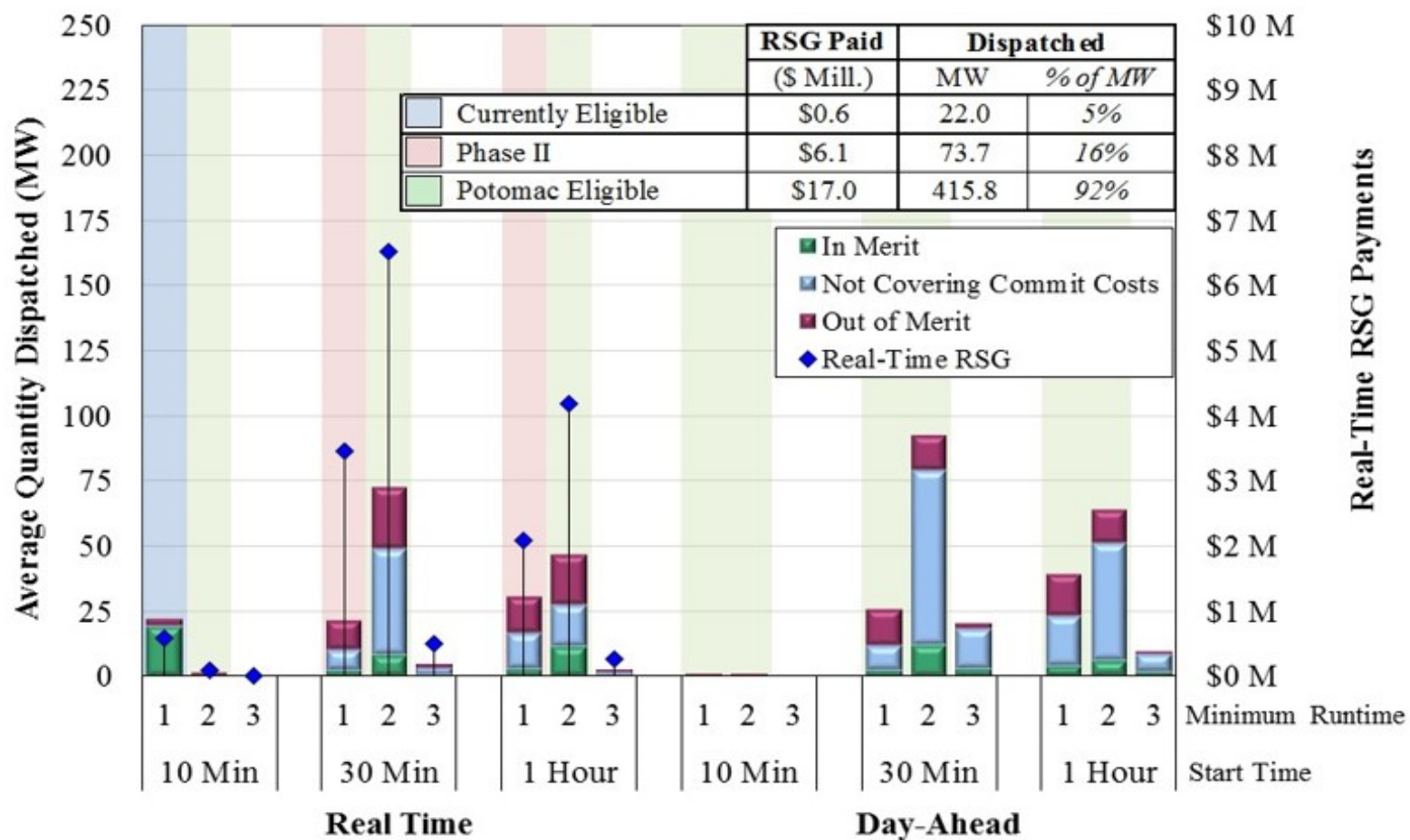
## **IMM Recommendation 2015-1:** *Expand Eligibility for Online Pricing in ELMP and Disable Offline Price Setting*

- Allowing fast-start peaking resources to set prices is essential for establishing efficient real-time energy and reserve prices.
- Based on our evaluation of the performance of Phase I the ELMP model:
  - ✓ The price effects of the online resources averaged 9 cents per MWh because a very small share of MISO's peaking resources were eligible under ELMP.
  - ✓ The offline price effects averaged a reduction of 11 cents per MWh, but our assessment indicates that these effects were generally inefficient.
- Principle/Approach:
  - ✓ Principle: Marginal economic sources of supply should set real-time prices.
  - ✓ Approach: Expand the price-setting eligibility for online resources to appropriately include as larger a share of peaking resources.
  - ✓ Approach: Disable the offline price-setting logic in ELMP.
- Benefits:
  - ✓ Improved real-time price formation will improve the day-ahead market scheduling and prices, ultimately lower overall production costs.

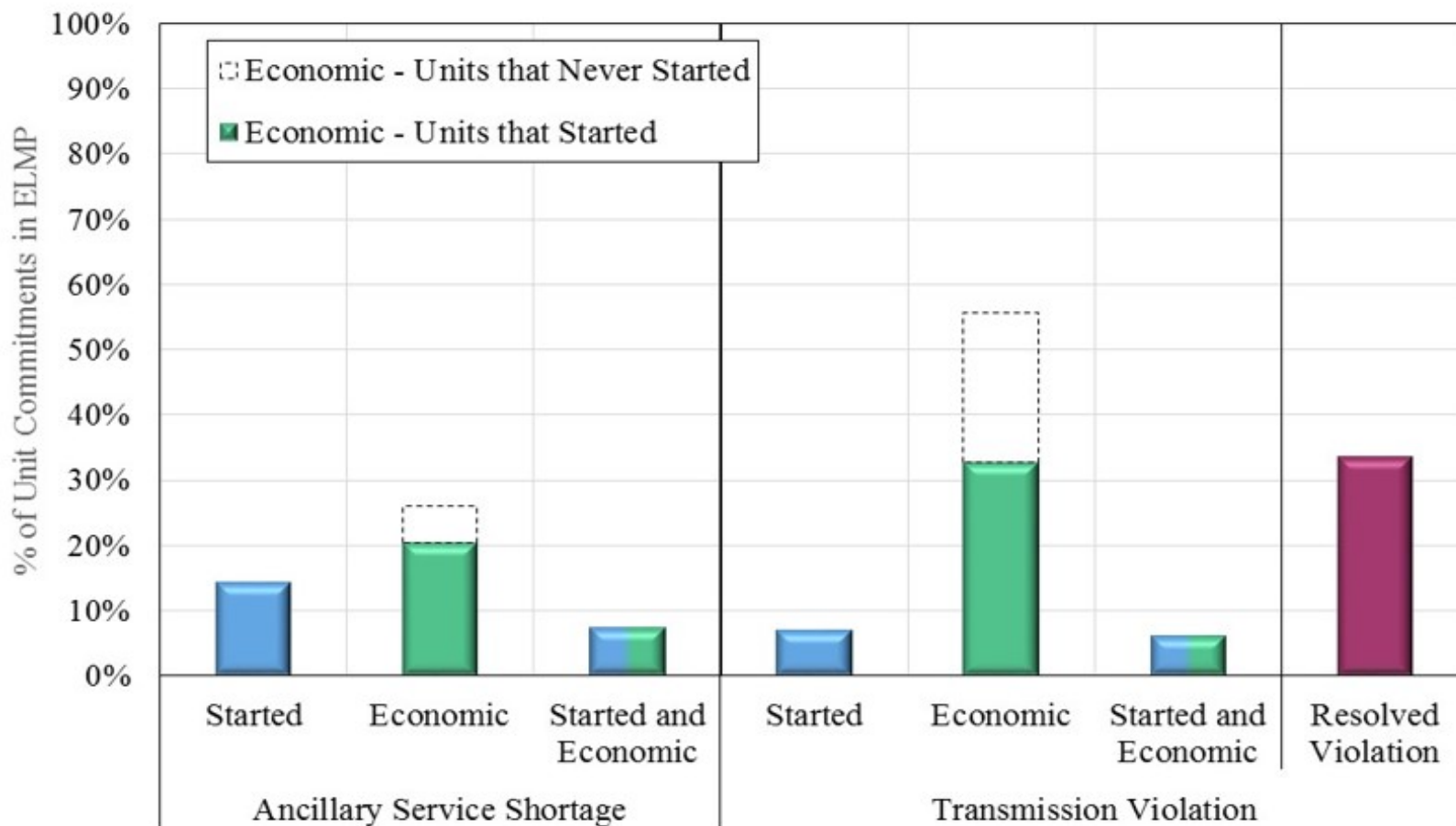




## ELMP Online Pricing Eligibility



# ELMP Offline Pricing





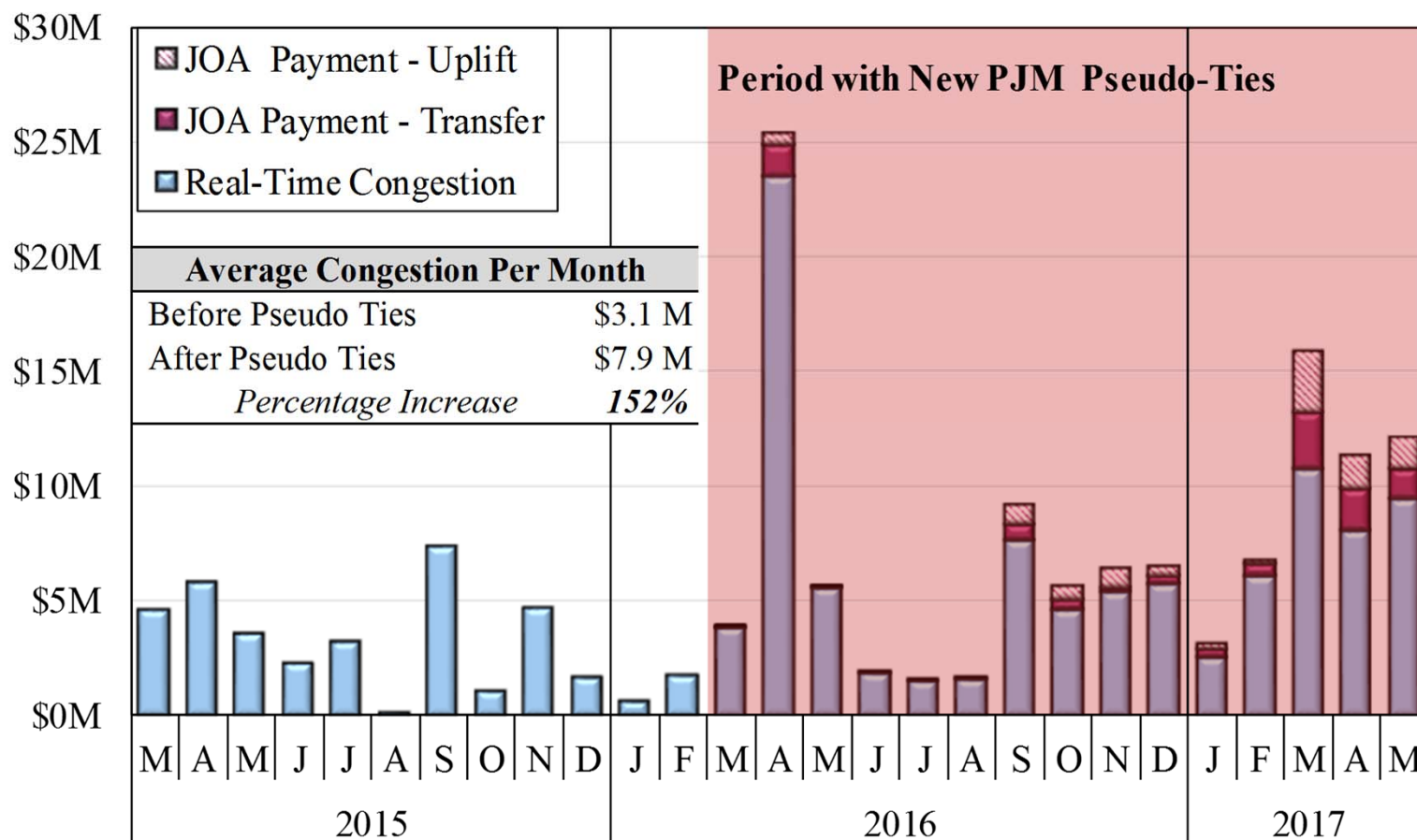
## **IMM Recommendation 2015-5:** *Implement Firm Capacity Delivery Procedures with PJM*

- PJM requires external capacity resources to be pseudo-tied to PJM.
  - ✓ 12 units have been pseudo-tied to PJM in March and June of 2016.
  - ✓ Transferring dispatch control to PJM reduces the efficiency of the dispatch and impairs reliability because these units affect flows over MISO's network.
  - ✓ The RTOs must rely on market-to-market coordination and >100 new M2M constraints have been defined so far.
- Principle/Approach:
  - ✓ Principle: Accommodate capacity exports without undermining the economic real-time dispatch in MISO.
  - ✓ Approach: Replace the PJM pseudo-tie requirement with procedures to guarantee delivery of the capacity that has been exported to PJM.
- Benefits:
  - ✓ PJM receives the full benefits of its capacity imports and avoids market-to-market congestion costs they will otherwise incur.
  - ✓ MISO will retain the ability to dispatch its system efficiently.





## Effects of Pseudo-Tying MISO's Generators to PJM





## Other Key Recommendations: Improvements to the Planning Resource Auction

- MISO's PRA is not providing efficient economic signals to facilitate investment, retirement, and capacity import/export decisions. As a result, margins are falling.
  - ✓ This is troubling for the competitive loads and supply that rely on the wholesale markets (no regulatory backstop).
  - ✓ The most important recommendation is to *implement capacity demand curves that reflect reliability value, at least for competitive load and supply.*
  - ✓ MISO's proposal to address this issue was rejected by FERC, but more reasonable and efficient alternatives should be pursued.
- In addition, we've identified some concerns with the current PRA that have prompted the following new recommendations:
  - ✓ 2015-6 and 8: Improve the modeling of transmission constraints and the transfer constraint between subregions in the PRA.
  - ✓ 2015-7: Modify the mitigation measures to address uneconomic retirements.
  - ✓ 2016-9: Disqualify resources not expected to be available during peak conditions.
- Benefits:
  - ✓ Ensure efficient locational price separation to reflect true transmission constraints
  - ✓ Establish efficient price signals to facilitate long-term decisions to invest, retire, and import/export capacity, which will lower costs for MISO's loads.



## List of Recommendations

SOM Number	Focus Area	Recommendations	High Benefit	Feasible in ST
<b>Energy Pricing and Transmission Congestion</b>				
2015-1	3	Expand eligibility for online units to set prices in ELMP and suspend offline pricing.	✓	
2015-2	2,3	Expand utilization of temperature-adjusted and short-term emergency ratings for transmission facilities	✓	
2014-3	2	Improve external congestion related to TLRs by developing a JOA with TVA.		
2012-5	1,2	Introduce a virtual spread product.		
2016-1	1,3,7	Improve shortage pricing by adopting an improved contingency reserve demand curve that reflects the expected value of lost load.	✓	
2016-2	3,4	Improve procedures for M2M Activation and Coordination including identifying, testing, and transferring control of M2M Flowgates.	✓	
2016-3	2,7	Enhanced Transmission and Generation Planned Outage Approval Authority.		





## List of Recommendations

SOM Number	Focus Area	Recommendations	High Benefit	Feasible in ST
<b>Operating Reserves and Guarantee Payments</b>				
2014-2	1,3,7	Introduce a 30-Minute reserve product to reflect VLR requirements and other local reliability needs.	✓	
2016-4	1,3,7	Establish regional reserve requirements and cost allocation.		
2016-5	1,5	Reform DAMAP and RTORSGP rules to improve performance incentives, and reduce gaming opportunities and unjustified costs.	✓	
<b>Improve Dispatch Efficiency and Real-Time Market Operations</b>				
2012-12	1,5	Improve thresholds for uninstructed deviations.	✓	✓
2012-16	1,3	Re-order MISO's emergency procedures to utilize demand response efficiently.		✓
2015-4	1	Enhanced tools and procedures to address poor dispatch performance.		✓
2016-6	1	Improve the accuracy of the LAC recommendations.		✓
2016-7	1,5	Improve forecasting incentives for wind resources by modifying deviation thresholds and settlement rules.		
2016-8	1,7	Validation of wind suppliers' forecasts and use results to correct dispatch instructions.		✓



## List of Recommendations

SOM Number	Focus Area	Recommendations	High Benefit	Feasible in ST
<b>Resource Adequacy</b>				
2010-14	7	Introduce a sloped demand curve in the RAC to replace the current vertical demand curve.	✓✓	
2013-4	7	Improve alignment of the PRA and the Attachment Y process governing retirement and suspensions.		✓
2014-5	7	Transition to seasonal capacity market procurements.		
2014-6	7	Define local resource zones primarily based on transmission constraints and local reliability requirements.		
2015-5	7	Implement Firm Capacity Delivery Procedures with PJM.	✓✓	
2015-6	7	Improve the modeling of transmission constraints in the PRA.	✓	
2015-7	7	Improve the physical withholding mitigation measures for the PRA by addressing uneconomic retirements.		✓
2015-8	7	Improve the limit on the transfer constraint between MISO South and Midwest in the PRA.		✓
2016-9	7	Qualification of planning resources.		✓