



Reserve Market Enhancement Simulations Update

EPSTF

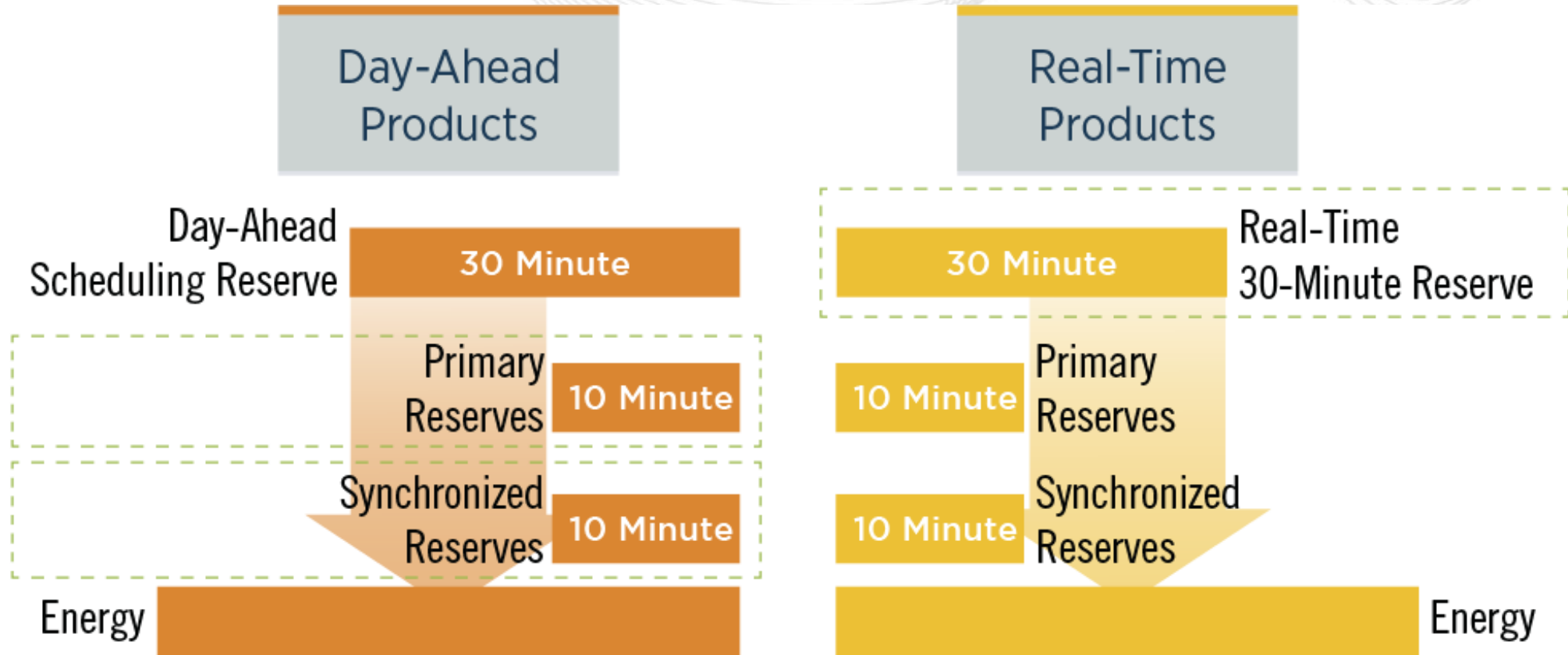
December 14, 2018

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- Use the proposed PJM ORDCs shifted to the left by the regulation requirement as discussed during the last EPFSTF meeting.
 - <https://www.pjm.com/-/media/committees-groups/task-forces/epfstf/20181128/20181128-item-03-ordc-updates-pjm-proposal.ashx>
 - Note: the previous curves used \$850 as a penalty factor.

Day-Ahead and Real-Time Product Alignment



Solidify financial incentives to provide reserves when assigned due to day-ahead financial commitment.
 Remove modeling differences between Day-Ahead and Real-Time Energy Markets.

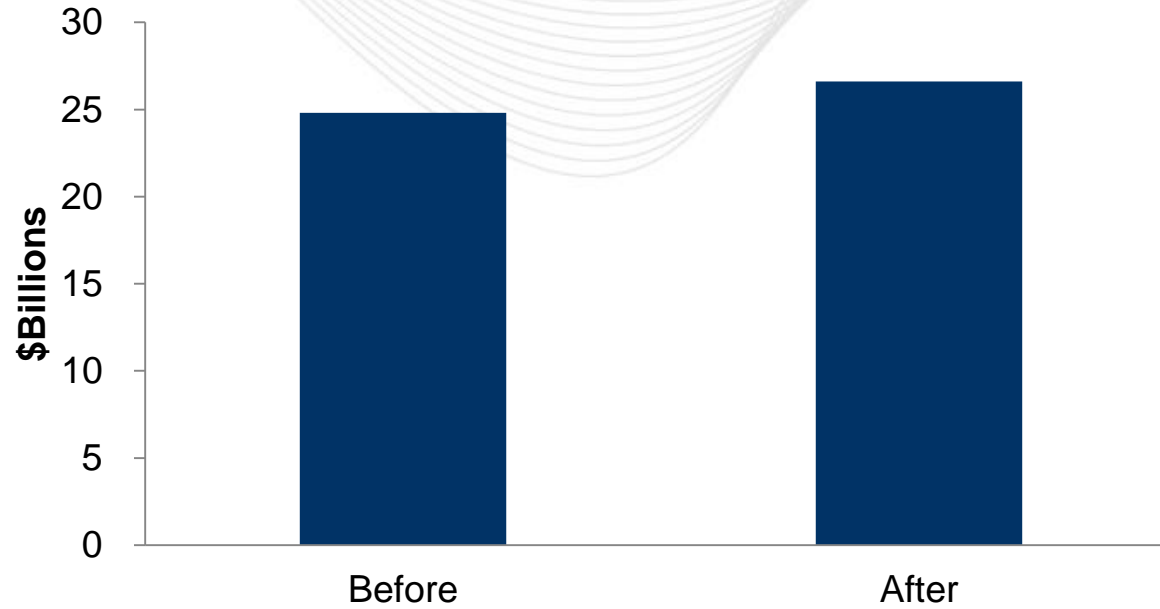
		Base Case	Simulation Case
Real-Time Reserve Market	30-Minute	✘ Not Modeled	<div style="border: 1px solid black; padding: 5px; display: inline-block;"> Modeled with ORDC </div> + \$ 500/MWh Penalty Factor
	10-Minute	= Status Quo	<div style="border: 1px solid black; padding: 5px; display: inline-block;"> Modeled with ORDC </div> + \$ 2,000/MWh Penalty Factor
Reserve Offer Prices	10-Minute	↑ As submitted	Set @ \$ 0.00/MWh
	30-Minute	Not Applicable	Set @ \$ 0.00/MWh
Locational Reserve Requirements	10-Minute	✘ Not Modeled	✘ Not Modeled
Resource Commitment		! Recommitment of fast start units only	↻ Full recommitment of all resources
Energy Market Offers		↑ As submitted	↑ As submitted

¹¹ The Mid-Atlantic and Dominion reserve sub-zone requirements were disabled for the purpose of this simulation to simplify the analysis. The Mid-Atlantic and Dominion reserve sub-zone bound in less than 3% of all hours in 2017 and therefore its impact was not considered significant.

- Both base case and simulation case results assume the consolidation of Tier 1 and Tier 2 synchronized reserve products.
- 30 Min. Secondary Reserve Minimum Reserve Requirement (MRR):
3,000 MW
- **Objective:** For 6/1/2017 thru 5/31/2018, simulate energy, reserve and uplift impacts using the current RTO step ORDC and the proposed PJM Reserve Market Enhancements.

Simulation Results - Energy Revenues

Energy Revenues

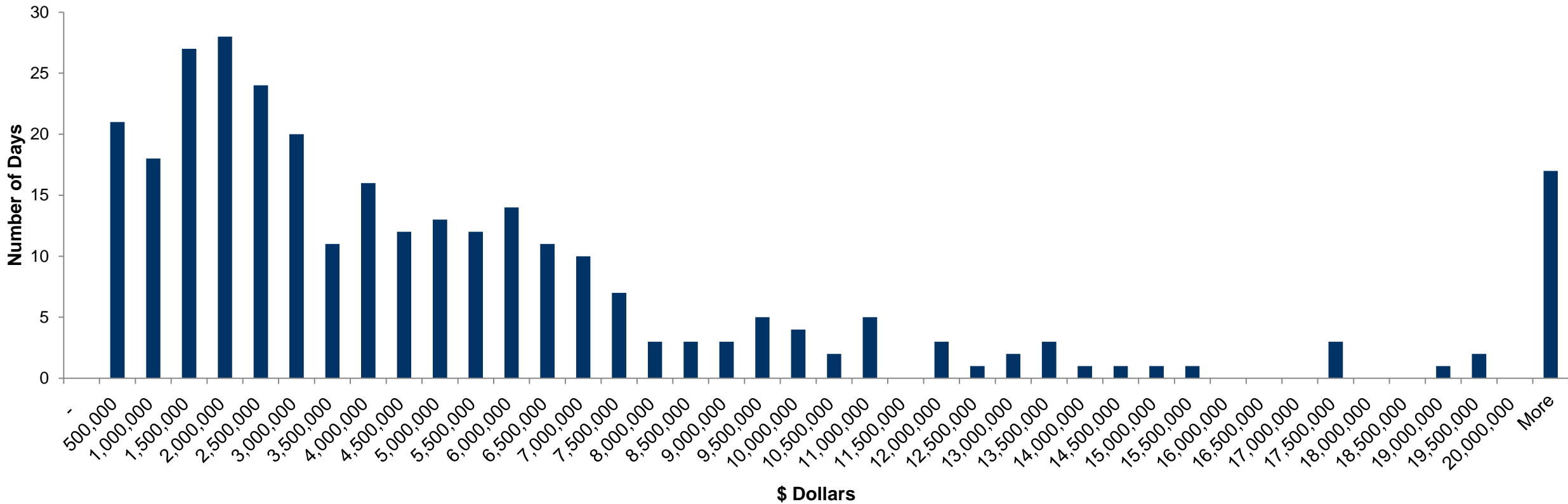


Energy Revenues (\$Million)	
Before	\$24,800
After	\$26,600
Increase	\$1,800
% Increase	7.3%



Simulation Results Energy Revenue Delta Distribution

Histogram: Simulation Case minus Base Case (Energy Revenue)



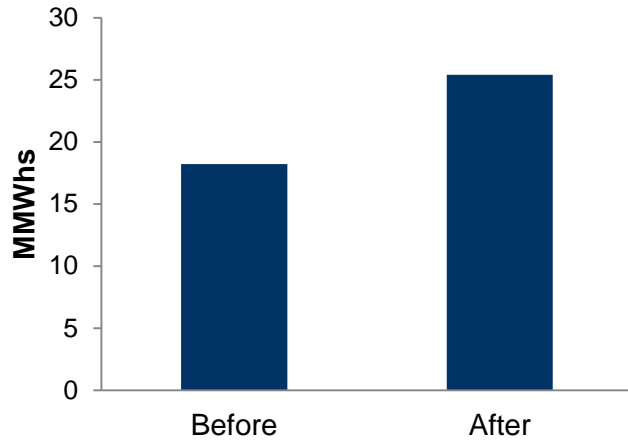


Simulation Results Energy Revenue Delta Distribution

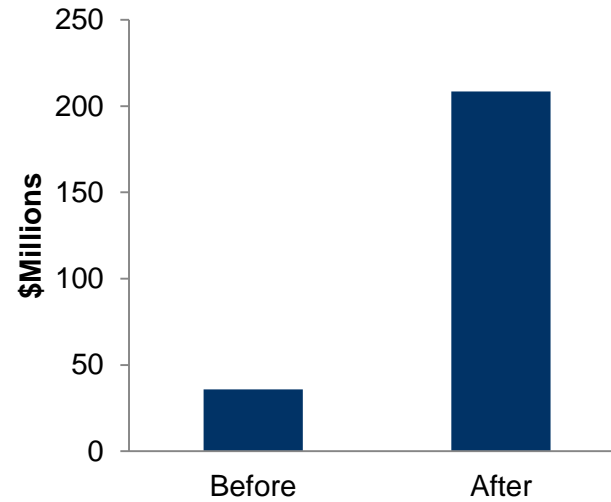
Top Ten Days Revenue Distribution

DATE	Revenue\$ DIFF (\$Million)	% Increase From Base to Simulation Case
12/22/2017	\$ 112	199%
12/21/2017	\$ 52.9	78%
12/16/2017	\$ 45.7	79%
1/6/2018	\$ 38.7	10%
1/5/2018	\$ 37.1	9%
1/13/2018	\$ 36.9	33%
1/2/2018	\$ 34.4	11%
1/16/2018	\$ 33.0	21%
4/3/2018	\$ 32.2	48%
12/17/2017	\$ 29.2	48%

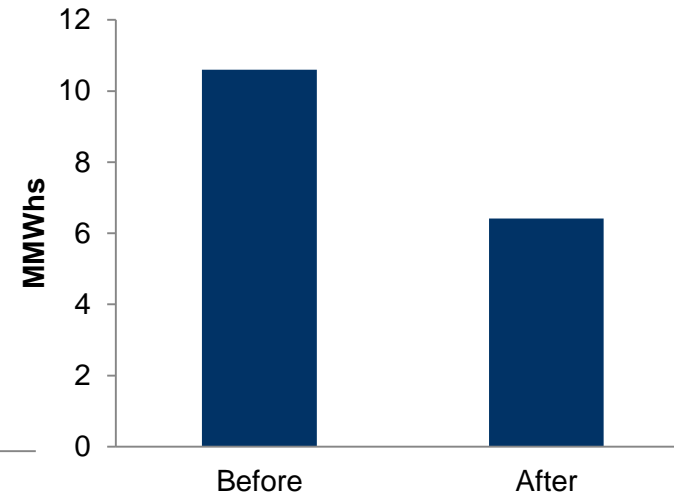
Total Cleared SR MWhs



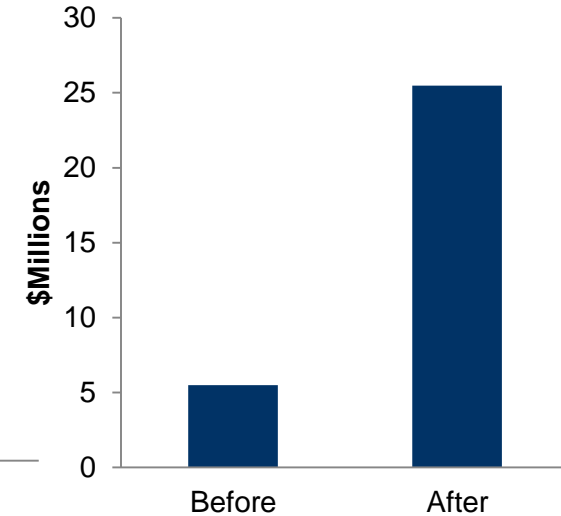
Total SR Revenue



Total Cleared NSR MWhs



Total NSR Revenue



SR MMWhs

SR Revenues (\$Million)

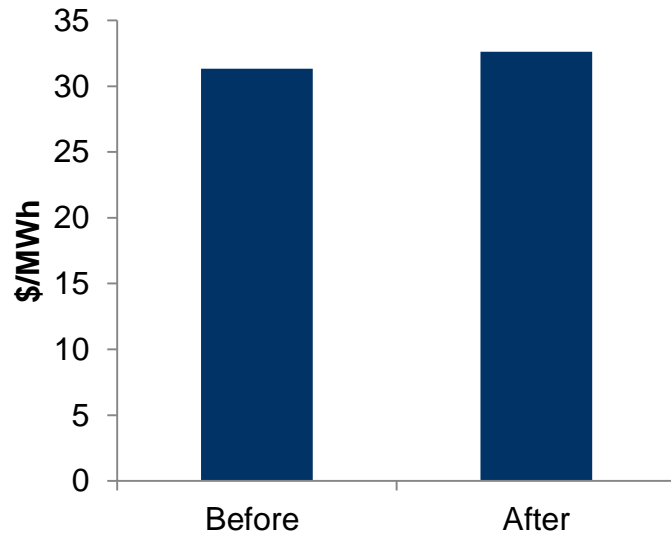
Before	18.2	\$35.8
After	25.4	\$208.5
Increase	7.4	\$172.7

NSR MMWhs

NSR Revenues (\$Million)

Before	10.6	\$5.5
After	6.4	\$25.5
Increase	-4.2	\$20.0

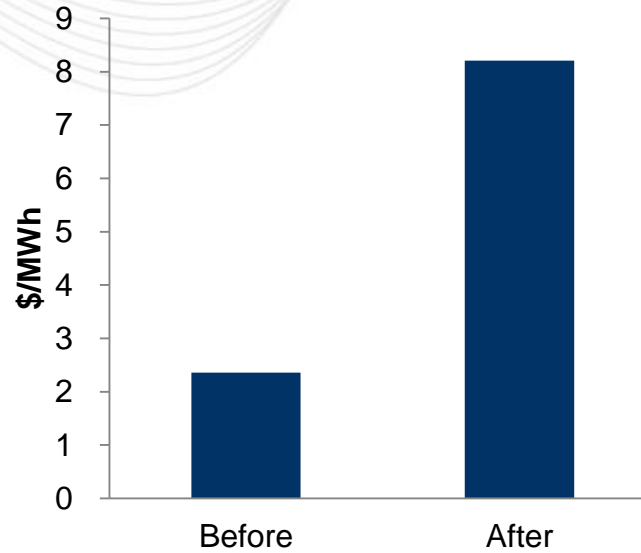
Gen. Weighted Avg. LMP



Gen. Weighted Avg. LMP (\$/MWh)

Before	\$31.24
After	\$33.51
Increase	\$2.27

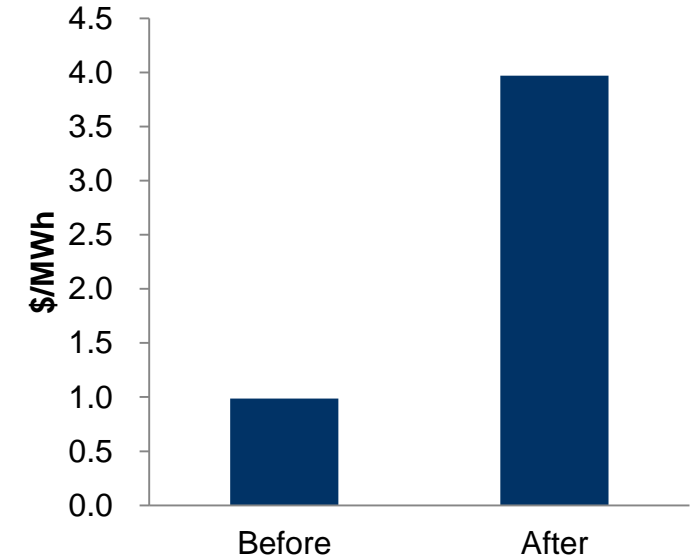
SR MCP



SR MCP (\$/MWh)

Before	\$2.36
After	\$8.21
Increase	\$5.85

NSR MCP



NSR MCP (\$/MWh)



Net Impacts to PJM Billing

VARIABLE	Base Case	Difference	Simulation Case
Weighted LMP (\$/MWh)	\$31.24/MWh	\$2.27/MWh	\$33.51/MWh
Energy Revenues (\$M)	\$24,800	\$1,800	\$26,600
Reserve Revenues (\$M)	\$40	\$190	\$230
Uplift (\$M)	\$160	-\$70	\$90
Total Energy and Reserve Market Revenues (\$M)	\$25,000	\$1,920	\$26,920
Net Increase in Energy and Reserve Market Revenues (\$M)	1,920	1,920	1,920
Potential Capacity Market Revenue Reduction (\$M)	440	640	1,500
Potential Retail Rate Cost to Load Reduction (\$M)	390	580	770
Net Cost Increase (\$M)	1,090	700	-350
Net Cost Increase* (%) (*as % of total energy and capacity market revenue)	3.2	2.0	-1.0