IMM Quarterly Report: Summer 2015
June – August

MISO Independent Market Monitor

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Potomac Economics

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Quarterly Summary

		Value	Change[1] Prior Qtr.	Change[1] Prior Year
RT Energy Prices ($/MWh)	●	$28.78	*6%*	*-17%*
Fuel Prices ($/MMBtu)				
Natural Gas - Chicago	●	$2.80	*1%*	*-34%*
Natural Gas - Henry Hub	●	$2.78	*2%*	*-33%*
Western Coal	●	$0.58	*0%*	*-16%*
Eastern Coal	●	$1.52	*-7%*	*-20%*
Load (GW)[2]				
Average Load	●	84.1	*19%*	*2%*
Peak Load	●	120.3	*23%*	*4%*
% Scheduled DA (Peak Hour)	●	98.2%	99.2%	100.4%
Transmission Congestion ($M)				
Real-Time Congestion Value	●	$342.2	*-6%*	*3%*
Day-Ahead Congestion Revenue	●	$196.3	*-10%*	*-7%*
Balancing Congestion Revenue[3]	●	-$3.6	-$5.0	-$5.4
Ancillary Service Prices ($/MWh)				
Regulation	●	$7.12	*-2%*	*-21%*
Spinning Reserves	●	$2.22	*73%*	*69%*
Supplemental Reserves	●	$1.41	*182%*	*180%*

		Value	Change[1] Prior Qtr.	Change[1] Prior Year
FTR Funding (%)	●	102%	103%	98%
Wind Output (MW/hr)	●	2,931	*-44%*	*7%*
Guarantee Payments ($M)[4]				
Real-Time RSG	●	$20.2	*60%*	*81%*
Day-Ahead RSG	●	$21.1	*-18%*	*-42%*
Day-Ahead Margin Assurance	●	$7.9	*-16%*	*-44%*
Real-Time Offer Rev. Sufficiency	●	$2.3	*-31%*	*-54%*
Price Convergence[5]				
Market-wide DA Premium	●	0.4%	*-0.4%*	*3.4%*
Virtual Trading				
Cleared Quantity (MW/hr)	●	9,556	*-4%*	*36%*
% Price Insensitive	●	34%	*36%*	*44%*
% Screened for Review	●	1%	*1%*	*2%*
Profitability ($/MW)	●	$0.87	$0.82	$0.22
Dispatch of Peaking Units (MW/hr)	●	1,062	*522*	*532*
Output Gap- Low Thresh. (MW/hr)	●	110	*71*	*130*
Other:				
SPP M2M Coordination	●			

Key:
- ● Expected
- ● Monitor/Discuss
- ● Concern

Notes:
1. Values not in italics are the value for the past period rather than the change.
2. Comparisons adjusted for any change in membership.
3. Net real-time congestion collection, unadjusted for M2M settlements.
4. Includes effects of market power mitigation.
5. Values include allocation of RSG.

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Summary of Summer 2015

- The summer 2015 quarter was generally characterized by moderate weather throughout the footprint and continued low fuel prices.
  - ✓ The South region, however, did experience record peak load conditions during July.
- Overall, the market performed competitively and reliably this summer.
- Considerably lower gas prices this summer compared to last year drove down average system-wide energy prices.
  - ✓ Real-time energy prices fell 17 percent from last year to $28.78 per MWh.
  - ✓ Similarly, day-ahead prices fell 19 percent to $29.26 per MWh.
- Congestion levels were typical for the summer and both day-ahead and real-time congestion was similar to last summer.
- Peaking units were more heavily used during this summer than in prior quarters and the prior summer, which coincides with increases in real-time RSG payments.
- Price convergence was generally good, but was not good at congested locations in in Texas and Louisiana.
- Market-to-Market coordination with SPP has reduced inefficient congestion impacts relative to TLR, but MISO and SPP are trying resolve a number of issues.
- This report also provides a preliminary evaluation of ELMP, which indicates that expanding the online pricing for peaking resources is likely warranted.

Highlights from Summer 2015

Price Convergence (Slide 12)

- Price convergence was generally good in uncongested locations.
- However, the market continued to not quickly respond to congestion related price differences in the day-ahead and real-time markets.
  - ✓ Various line and unit outages near the Louisiana Hub caused high values of congestion that was underpriced in the day-ahead market in June and August. The patterns of congestion around the Louisiana Hub is similar to what was observed last quarter.
  - ✓ Commitments in Texas for VLR caused congestion on lines into the load pocket, which was not sufficiently priced in the day-ahead market during August.

MISO/SPP JOA Payments (Slide 19)

- Price impacts from SPP FGs have declined since M2M began in March.
- M2M startup issues resulted in some inefficiency and ongoing settlement disputes.
  - ✓ Some of these startup issues have been resolved and should not reoccur.
  - ✓ Some issues have arisen related to swings in dispatch flows over M2M constraints:
    - – This sometimes occurs because the non-monitoring RTO dominates the flows.
    - – In this case, the constraint should be transferred to the other RTO, but MISO and SPP are developing other approaches.

Highlights for Summer 2015

Peaking Unit Usage (Slide 22)

- High temperatures in the South, in July particularly, caused peaking units to be more extensively committed in the day-ahead and real-time markets than usual.
  - ✓ Day-ahead average hourly commitments exceeded 700 MW per hour, approximately three times typical rates because of high loads and VLR needs.
  - ✓ Additional real-time commitments resulted in more than 1100 MW of peaking units running each hour during the quarter, double the amount from last summer.
  - ✓ More peaking resources were committed on days when load was under-scheduled, which was generally due to higher than expected temperatures.

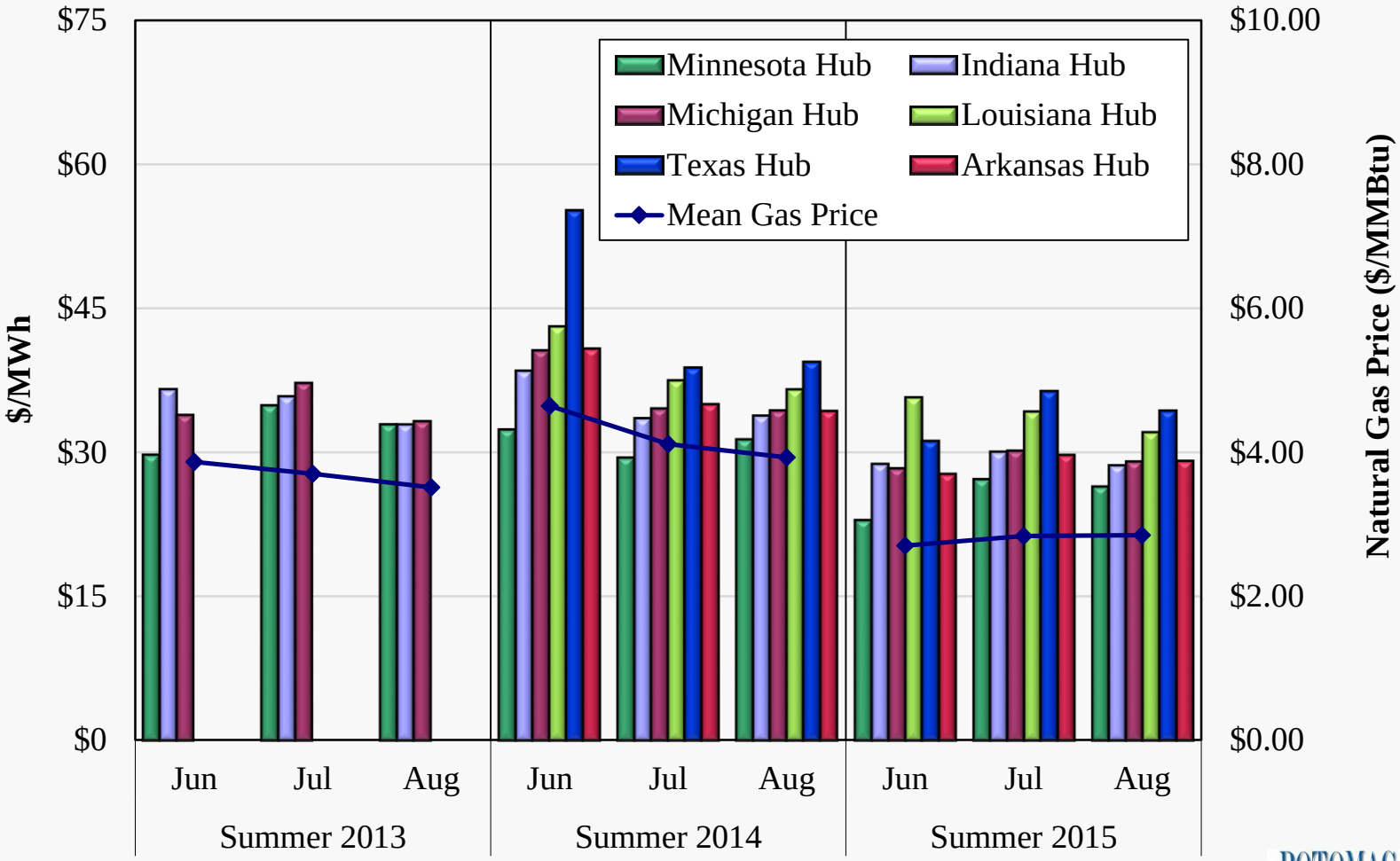
ELMP (Slide 27)

- The overall price effects of ELMP have been very small at most locations.
- The online pricing effects would be larger and more effective if a wider array of online peaking resources were utilized by ELMP. Only roughly 1 percent of the online peaking resources are eligible to set prices under ELMP.
- The offline pricing effects related to operating reserve shortages have been consistent with expectations. We will be investigating price effects related to transmission violations.

Submittals to External Entities and Other Issues

- We responded to FERC questions related to prior referrals regarding resources failing to update real-time offers and we continued to meet with FERC staff on a weekly and monthly basis to discuss market outcomes.
- We continued discussions regarding interface pricing with SPP and PJM staff and stakeholders, making presentations at both PJM and SPP Seams Meetings.
- We presented a summary of the 2014 SOM and Recommendations to FERC staff.
- We received a Civil Investigative Demand from the Department of Justice
  - ✓ We provided the data requested and have had several discussions with DOJ staff to discuss relevant market issues.
- We provided annual training to MISO MPs on Module D monitoring procedures and MP responsibilities to provide cost, operating data, and to review references.
- MISO is reviewing the potential impact of future pseudo-tied capacity. We continue to recommend MISO not support pseudo-ties and instead implement reciprocal procedures to guarantee the firm delivery of external capacity.
- The new mitigation framework and thresholds for RSG Mitigation in BCA and NCAs was implemented on June 30 and has operated as intended.

Day-Ahead Average Monthly Hub Prices
Summer 2013–2015



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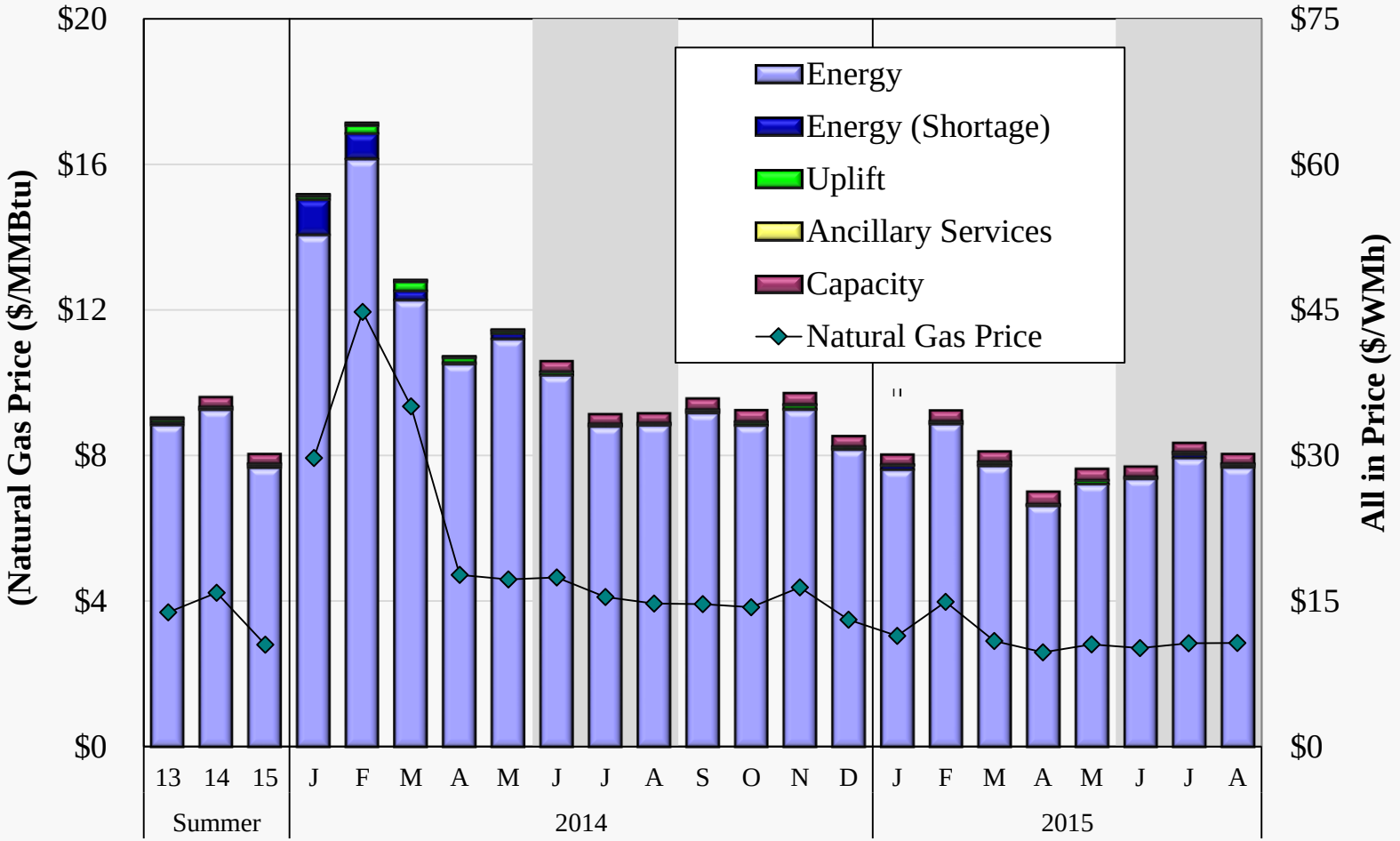
All-In Price
2013 –2015



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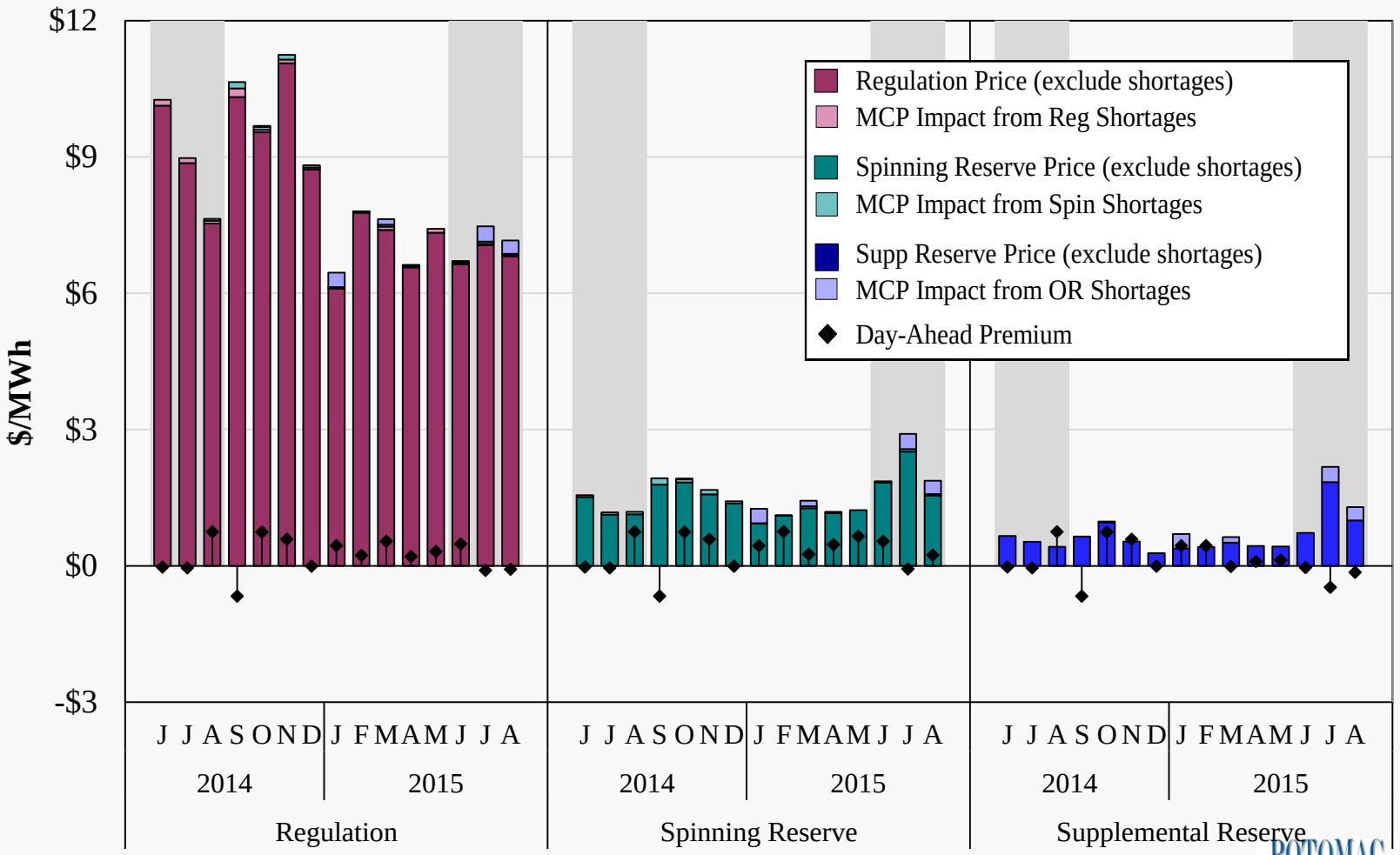
Monthly Average Ancillary Service Prices
Regulation and Contingency Reserves, 2014–2015



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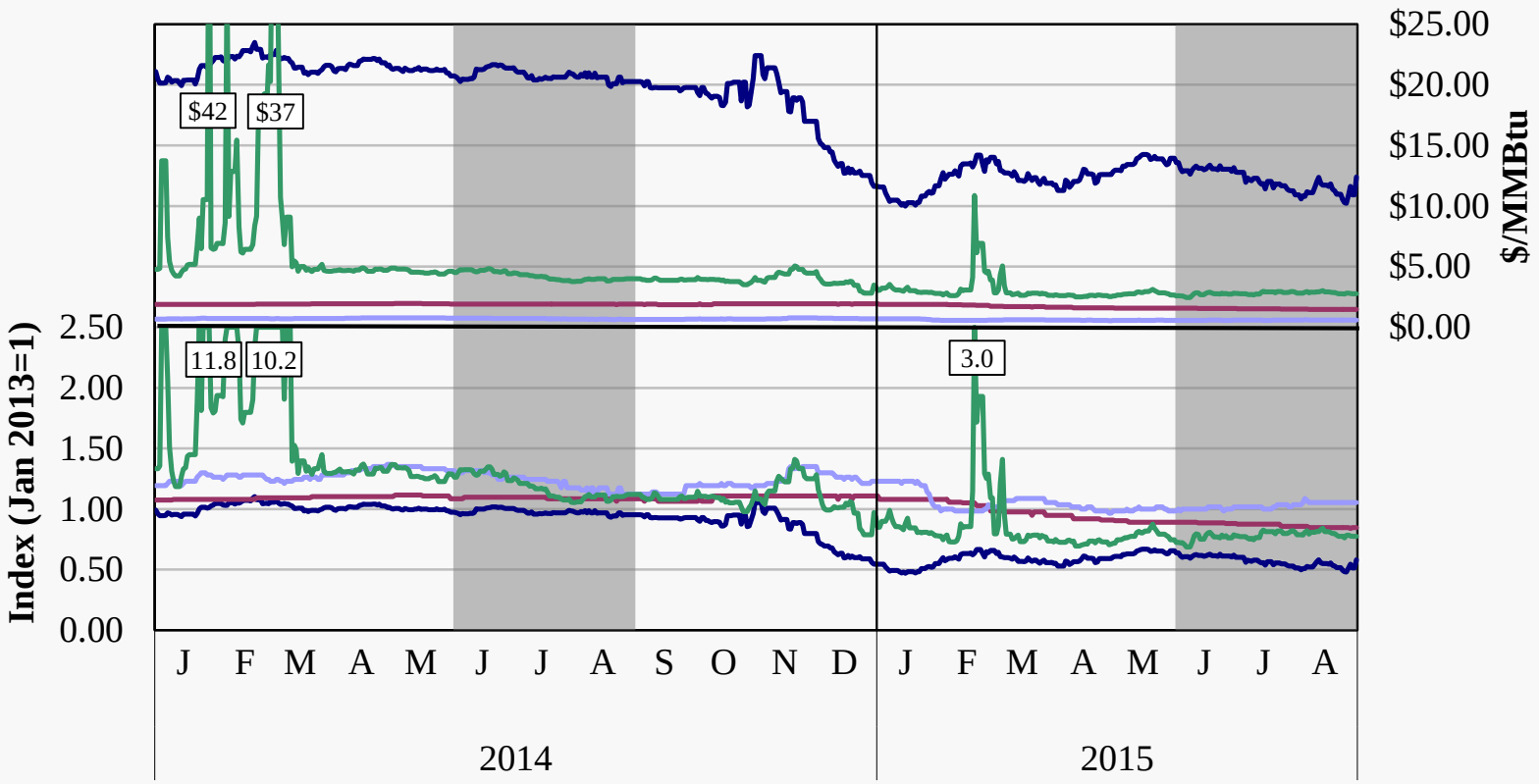
MISO Fuel Prices
2013–2015



Summer Average	2013	2014	2015
Oil	$21.50	$20.77	$12.08
Natural Gas	$3.69	$4.23	$2.80

Summer Average	2013	2014	2015
IB Coal	$1.86	$1.91	$1.52
PRB Coal	$0.61	$0.70	$0.58

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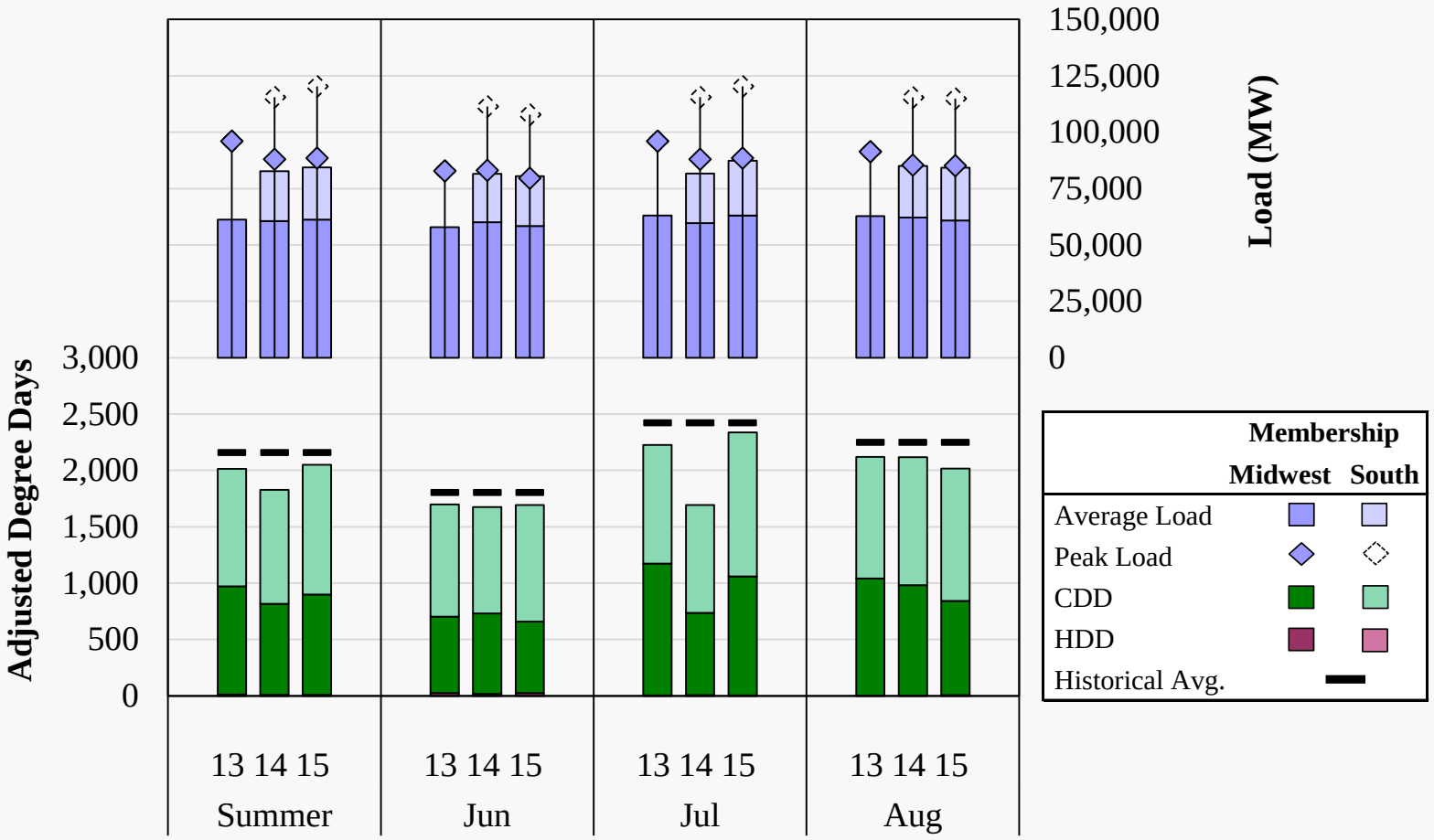
Load and Weather Patterns
Summer 2013–2015



Note: Midwest degree day calculations include four representative cities in the Midwest: Cincinnati, Detroit, Milwaukee and Minneapolis. The South region includes Little Rock and New Orleans.

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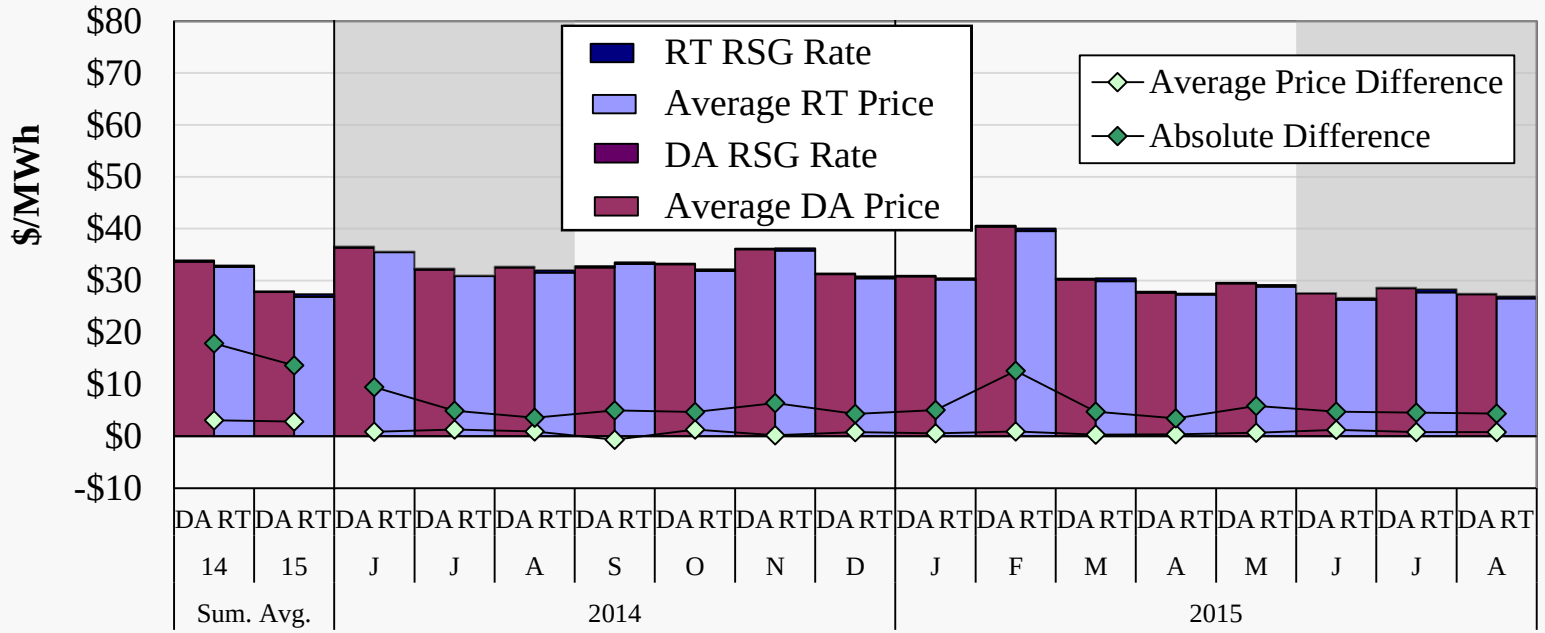
Day-Ahead and Real-Time Price Convergence 2014–2015



Average DA-RT Price Difference Including RSG (% of Real-Time Price)

Indiana Hub	3	2	3	4	2	-2	3	0	2	1	1	0	1	2	3	1	2
Michigan Hub	1	0	-5	4	3	-2	3	0	2	7	6	-1	2	0	0	0	0
Minnesota Hub	3	1	4	1	3	0	3	4	-5	-1	0	-1	2	3	-1	3	0
WUMS Area	1	2	0	2	2	-5	1	3	1	1	0	2	4	1	3	3	0
Arkansas Hub	5	0	10	5	2	-4	-1	3	2	-3	3	-3	4	3	3	-3	0
Louisiana Hub	2	-5	1	4	3	-4	2	2	4	0	2	-10	-2	0	-10	1	-5
Texas Hub	13	-1	31	3	5	2	1	2	5	-1	1	-5	4	-10	4	0	-7

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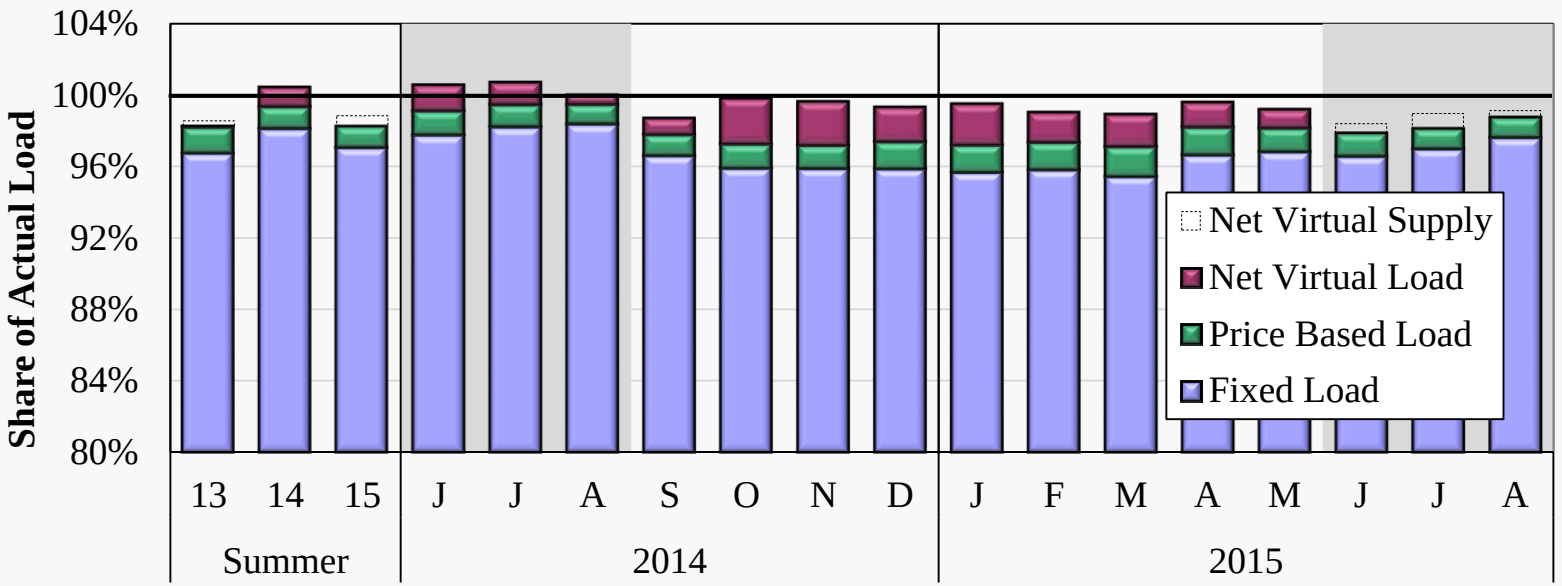
Day-Ahead Peak Hour Load Scheduling 2014–2015



Share of Actual Load (%)

All Hours	98.9	100.0	98.1	100.1	100.2	99.8	98.7	99.0	99.7	99.0	99.1	98.7	97.9	98.3	98.3	97.4	98.4	98.6
Peak Hours Midwest	98.3	99.6	97.4	99.5	99.8	99.5	98.8	100.2	100.7	101.1	99.9	99.7	99.2	98.9	99.1	97.3	97.2	97.9
Peak Hours South		102.0	99.7	102.7	102.5	100.7	99.5	99.7	99.4	97.0	97.9	97.7	97.3	100.2	99.0	98.7	99.9	100.5

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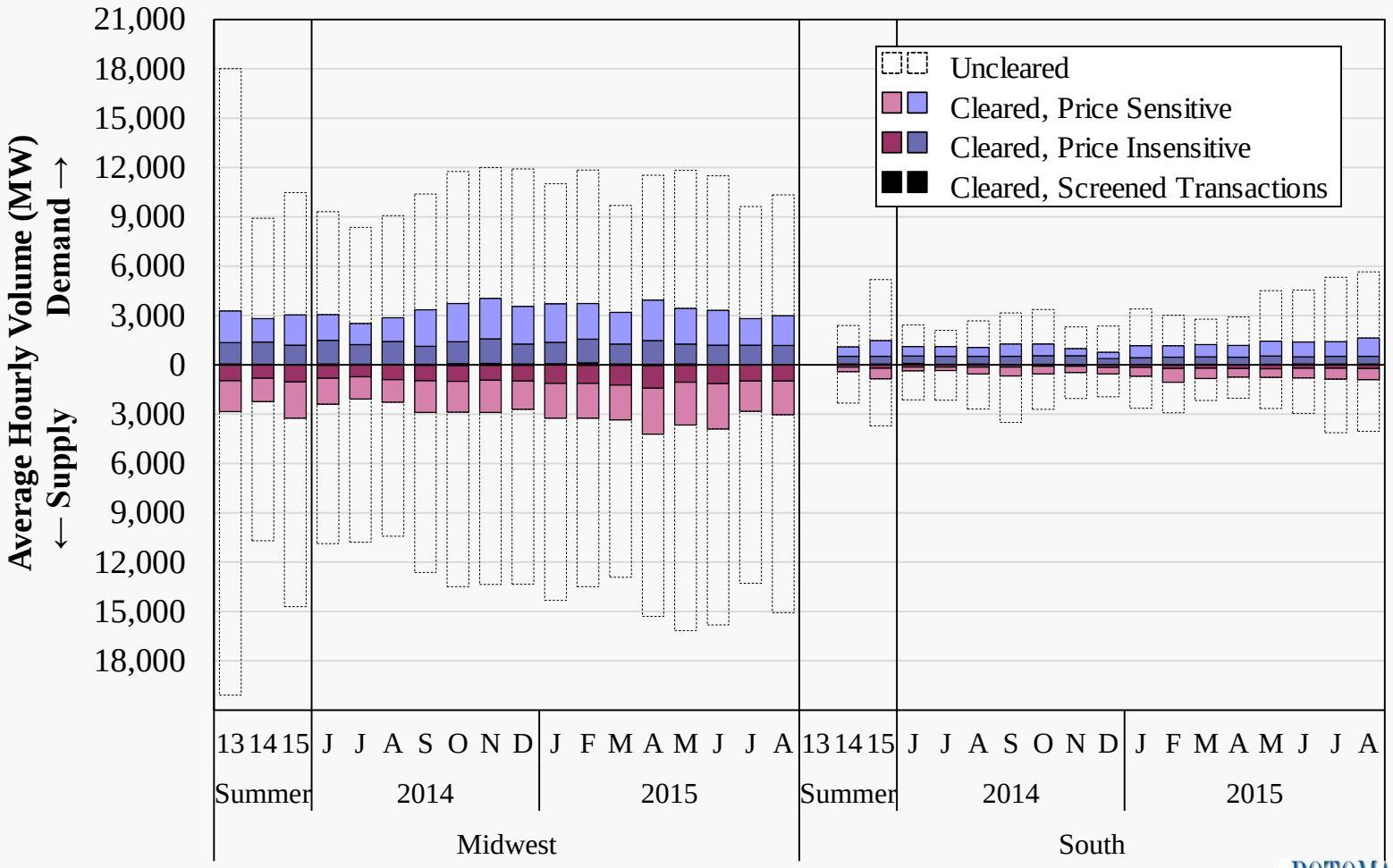
Virtual Load and Supply
2014–2015



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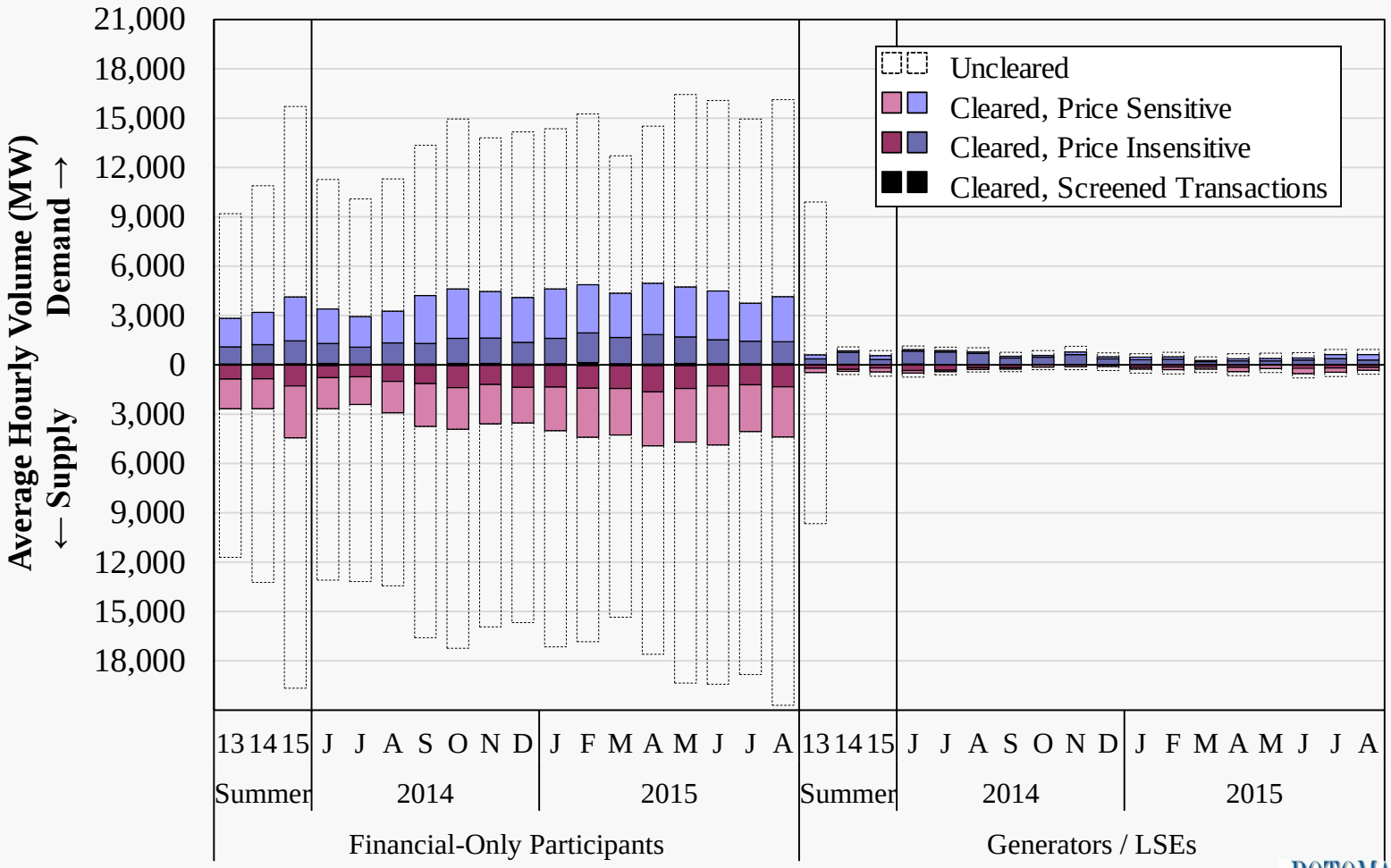
Virtual Load and Supply by Participant Type
Spring 2014–2015



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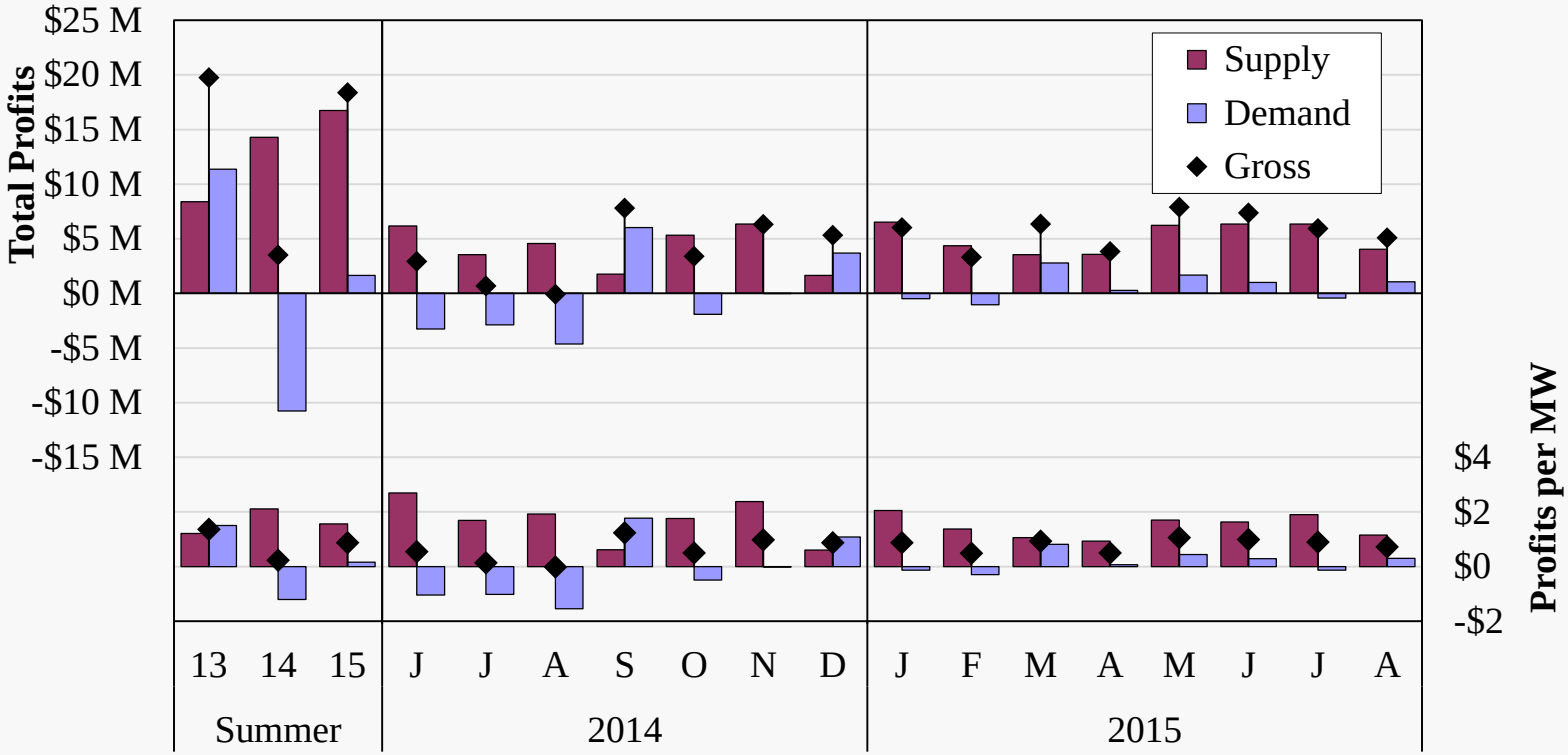
Virtual Profitability
2014–2015



Percent Screened

Demand	1.6	2.3	1.6	3.2	1.7	2.0	1.3	1.9	1.8	1.2	1.6	3.0	1.7	1.0	1.7	1.6	1.6	1.7
Supply	0.7	0.8	0.3	1.6	0.7	0.2	0.8	1.4	1.0	1.0	0.6	1.0	1.0	0.9	1.0	0.4	0.4	0.2
Total	1.2	1.7	1.0	2.5	1.3	1.2	1.1	1.7	1.5	1.1	1.1	2.1	1.4	1.0	1.4	0.9	1.0	1.0

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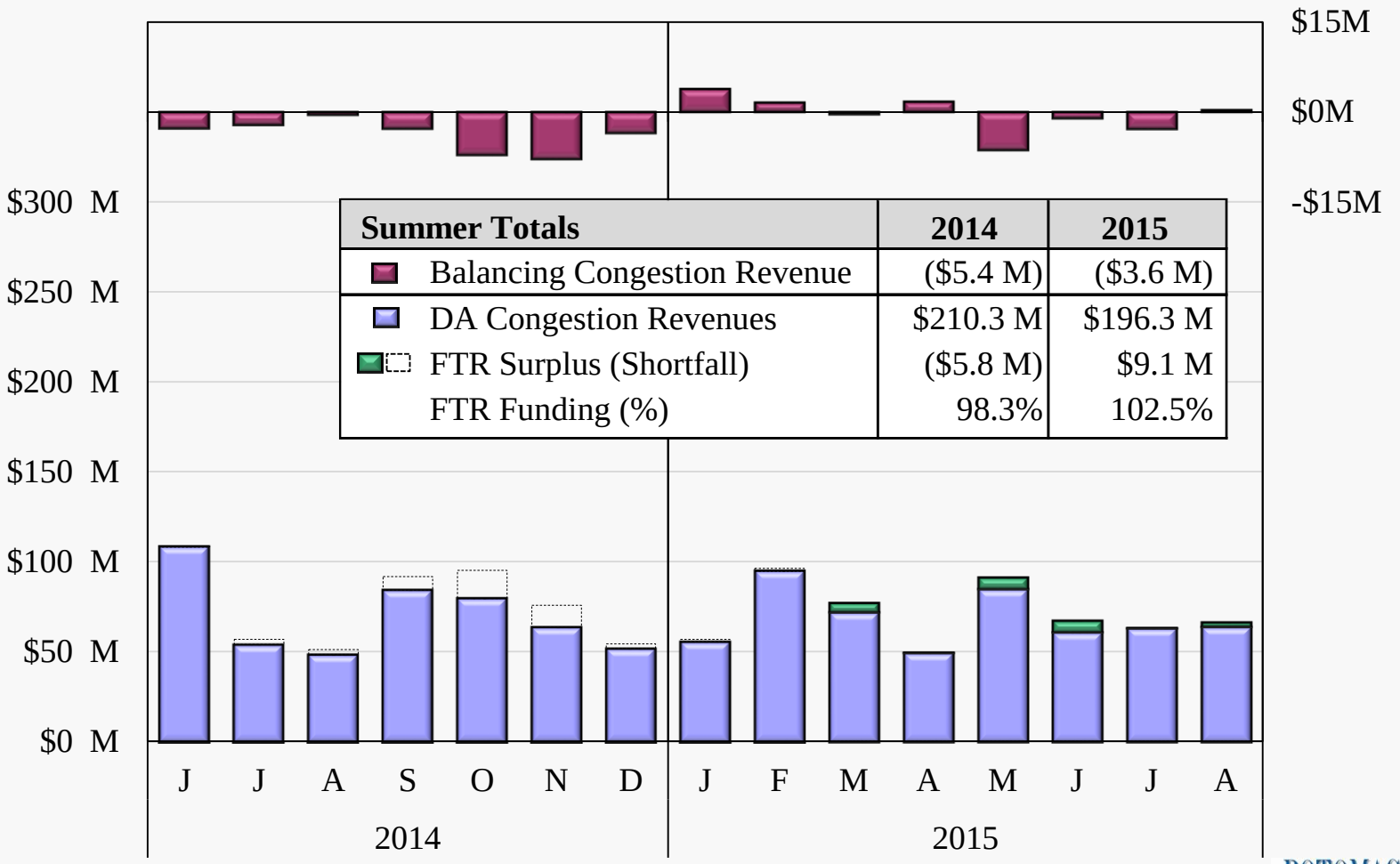
Day-Ahead Congestion, Balancing Congestion and FTR Underfunding, 2014–2015



Summer Totals	2014	2015
Balancing Congestion Revenue	($5.4 M)	($3.6 M)
DA Congestion Revenues	$210.3 M	$196.3 M
FTR Surplus (Shortfall)	($5.8 M)	$9.1 M
FTR Funding (%)	98.3%	102.5%

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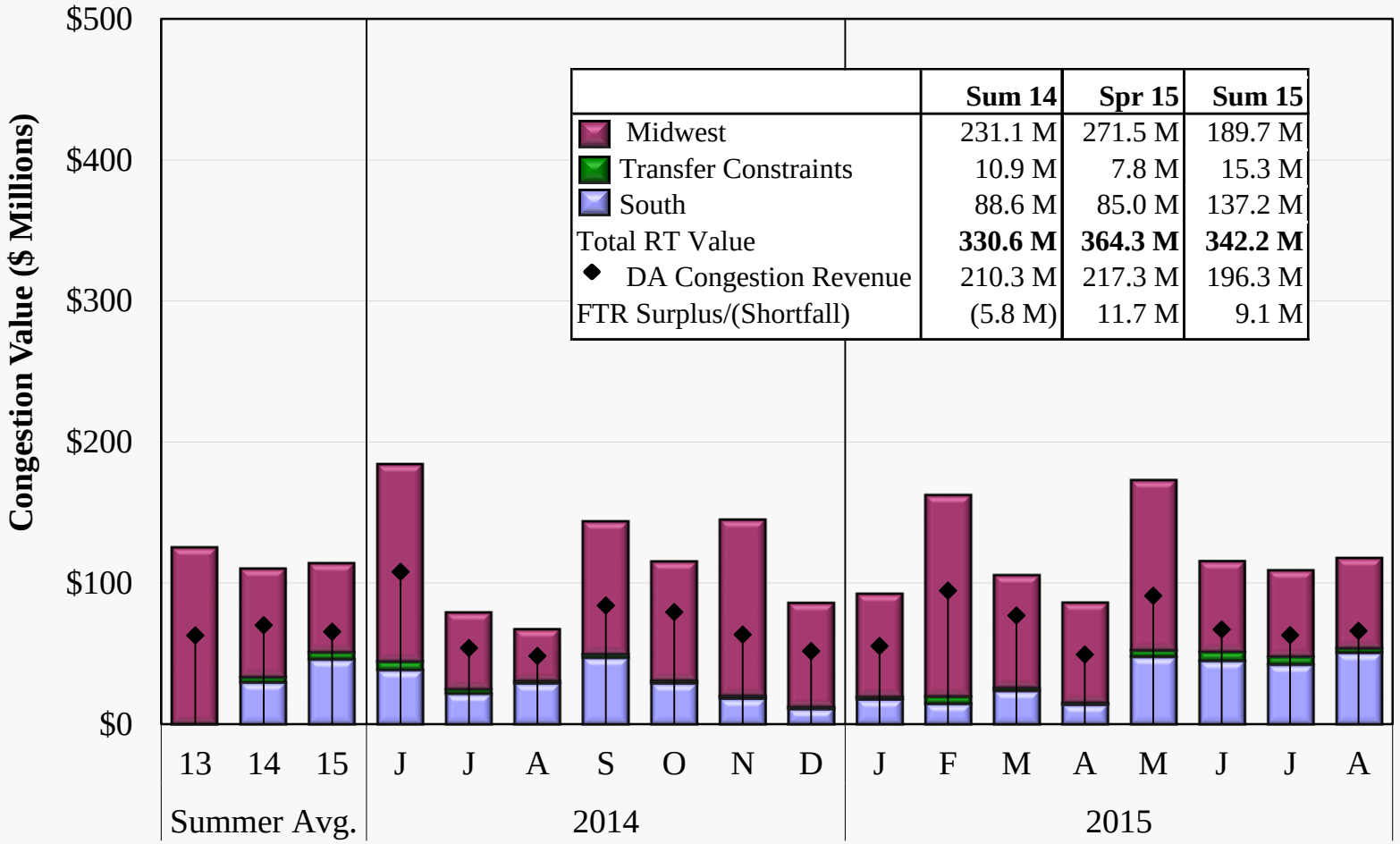
Value of Real-Time Congestion
2014–2015



	Sum 14	Spr 15	Sum 15
Midwest	231.1 M	271.5 M	189.7 M
Transfer Constraints	10.9 M	7.8 M	15.3 M
South	88.6 M	85.0 M	137.2 M
Total RT Value	**330.6 M**	**364.3 M**	**342.2 M**
◆ DA Congestion Revenue	210.3 M	217.3 M	196.3 M
FTR Surplus/(Shortfall)	(5.8 M)	11.7 M	9.1 M

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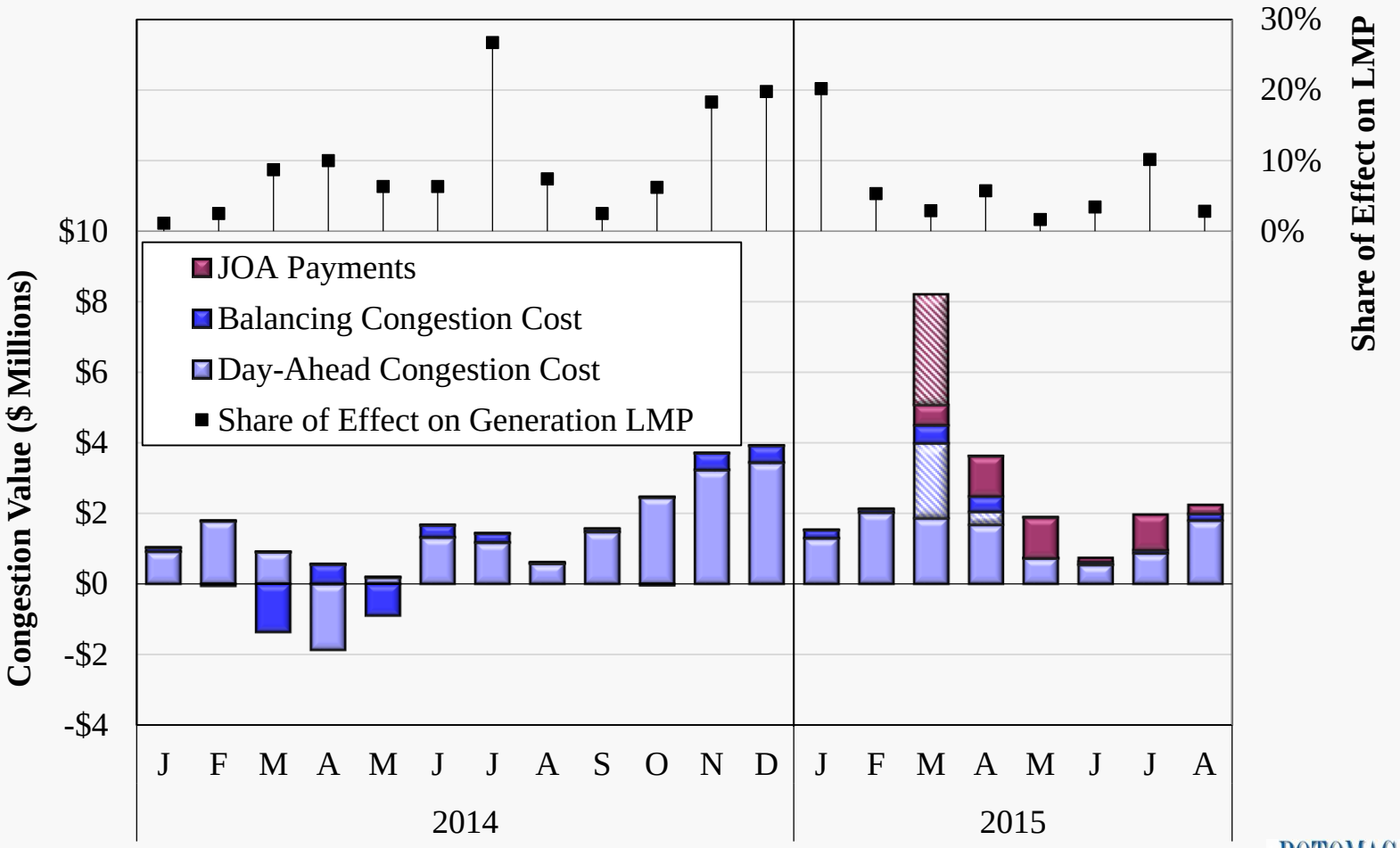
Congestion Costs on SPP Flowgates
2014–2015



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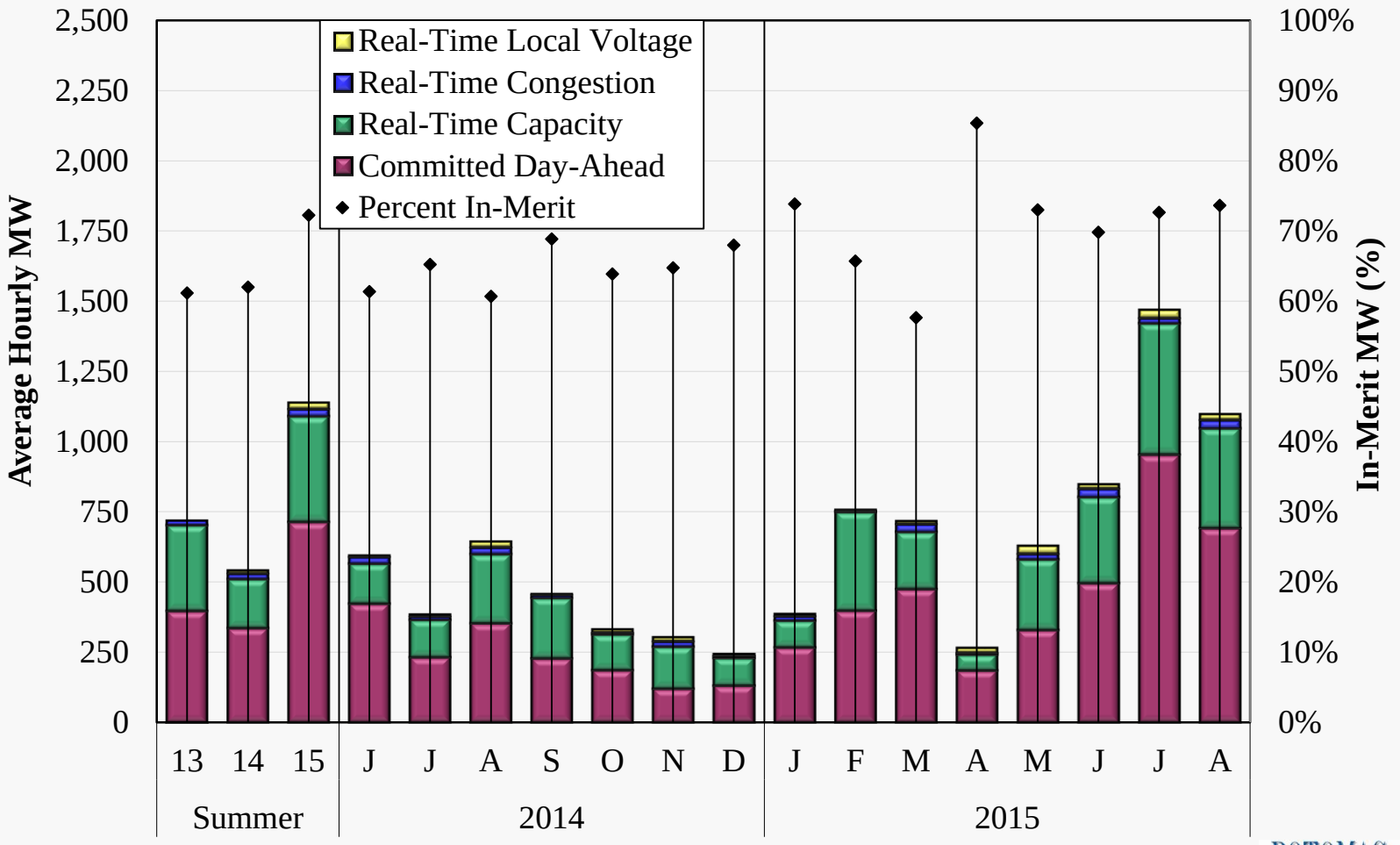
Peaking Resource Dispatch
2014–2015



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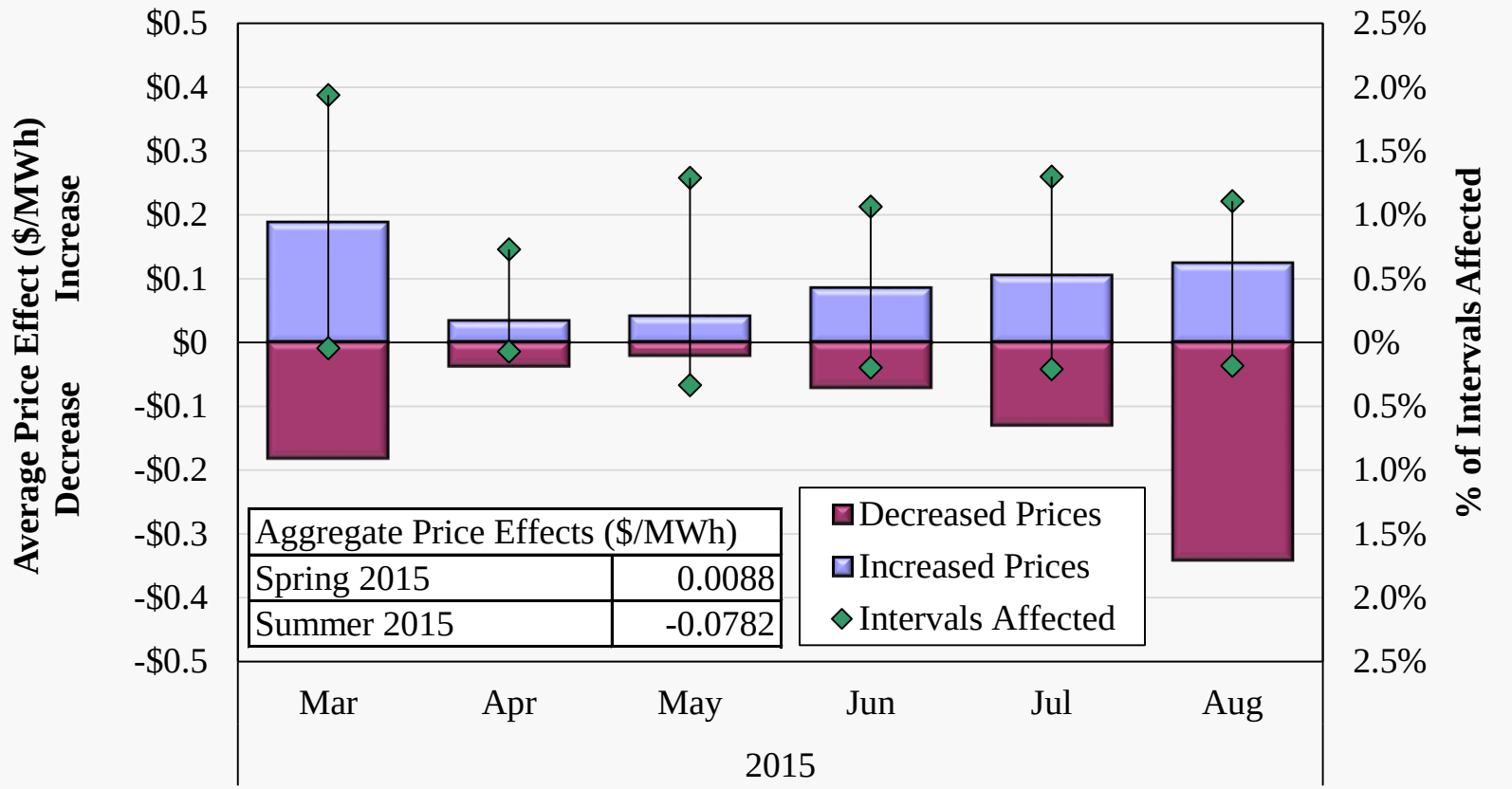
ELMP Price Effects
Market-Wide



Aggregate Price Effects ($/MWh)	
Spring 2015	0.0088
Summer 2015	-0.0782

	Mar	Apr	May	Jun	Jul	Aug
SMP Increase	1.51	0.71	0.61	1.37	1.37	2.03
SMP Decrease	-63.99	-8.04	-1.21	-6.19	-10.44	-33.45

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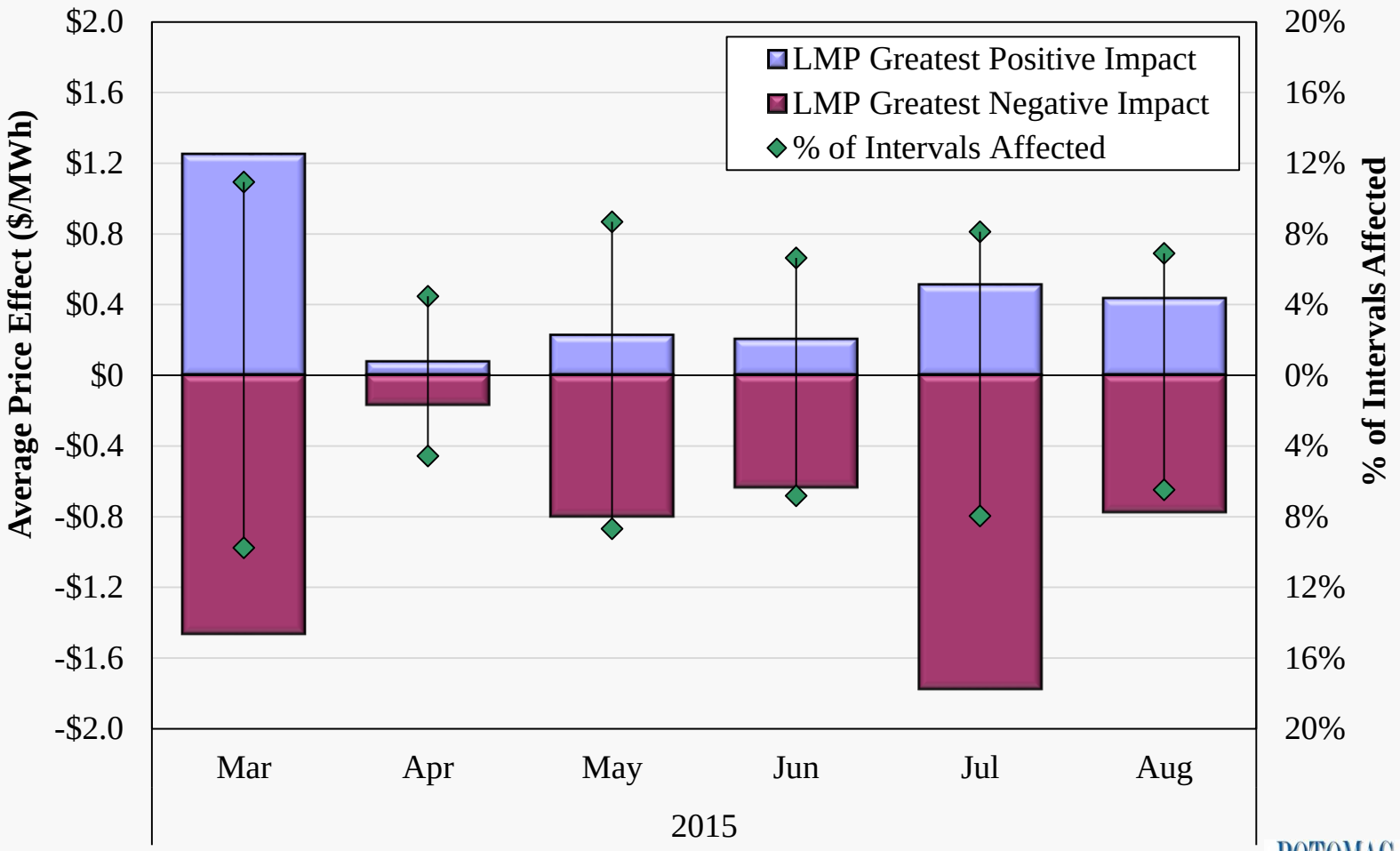
ELMP Price Effects
Most Affected Locations



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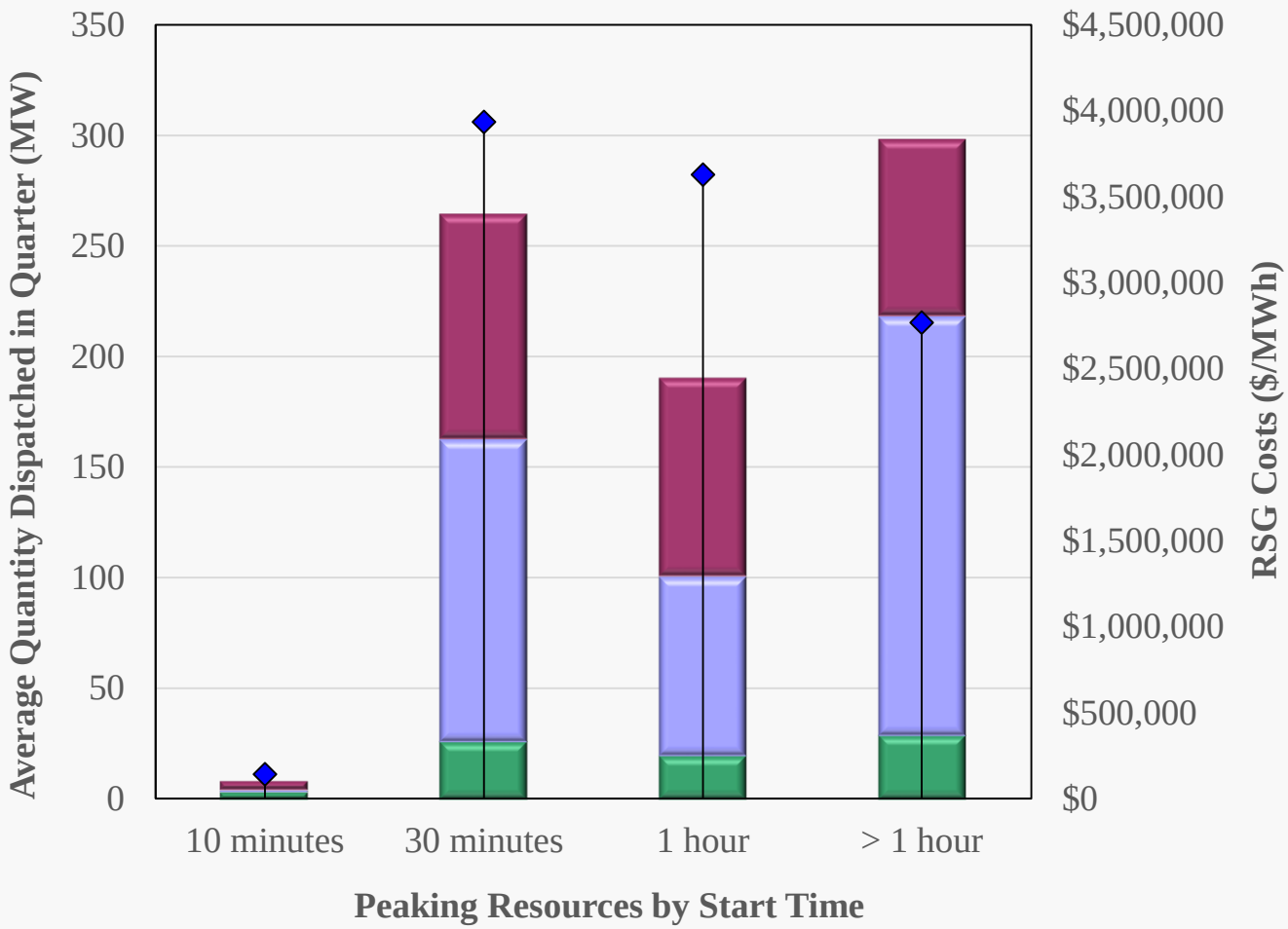
Peaking Units Eligible to Set Prices



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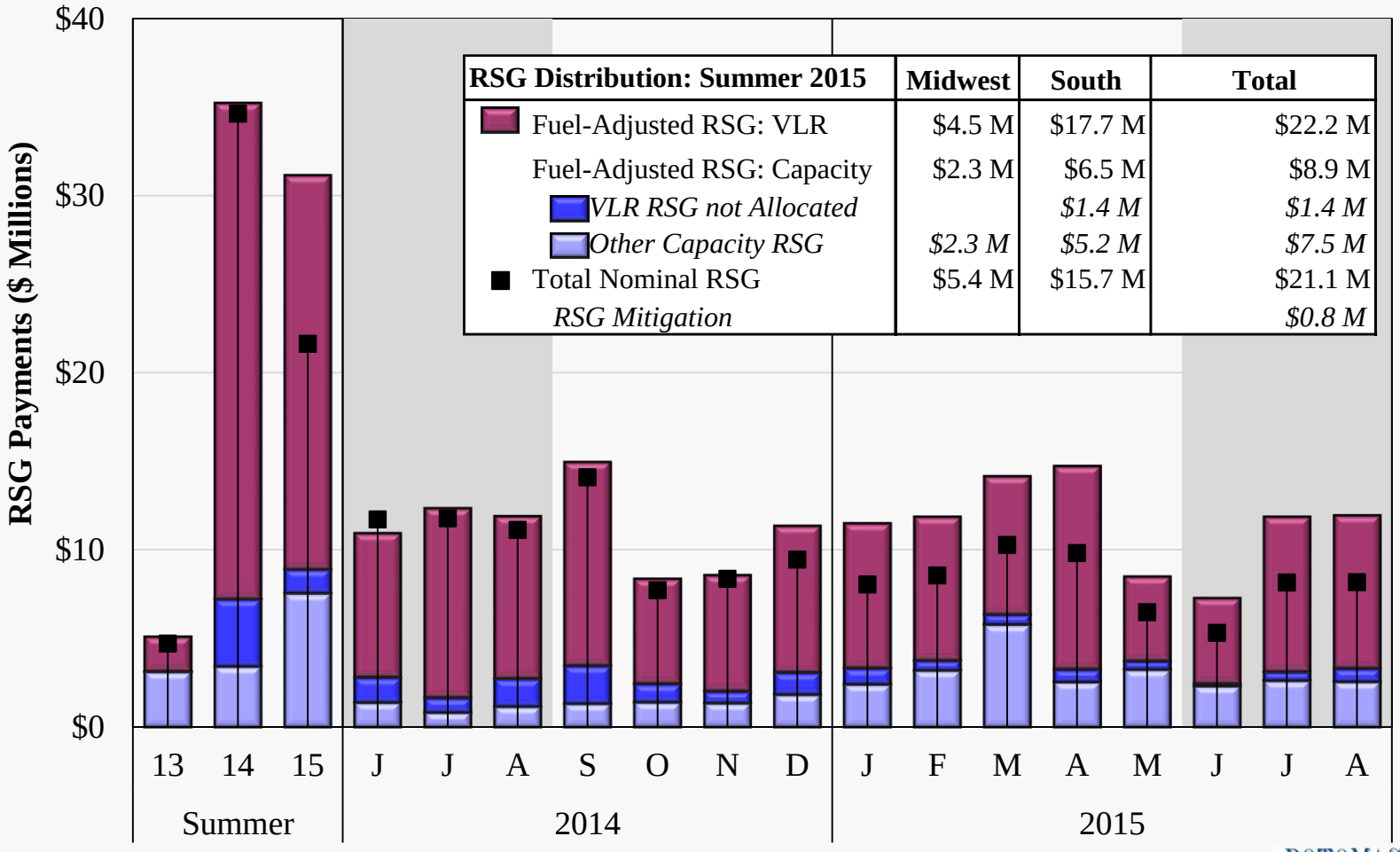
Day-Ahead RSG Payments
Summer 2014–2015



RSG Distribution: Summer 2015	Midwest	South	Total
Fuel-Adjusted RSG: VLR	$4.5 M	$17.7 M	$22.2 M
Fuel-Adjusted RSG: Capacity	$2.3 M	$6.5 M	$8.9 M
VLR RSG not Allocated		*$1.4 M*	*$1.4 M*
Other Capacity RSG	*$2.3 M*	*$5.2 M*	*$7.5 M*
Total Nominal RSG	$5.4 M	$15.7 M	$21.1 M
RSG Mitigation			*$0.8 M*

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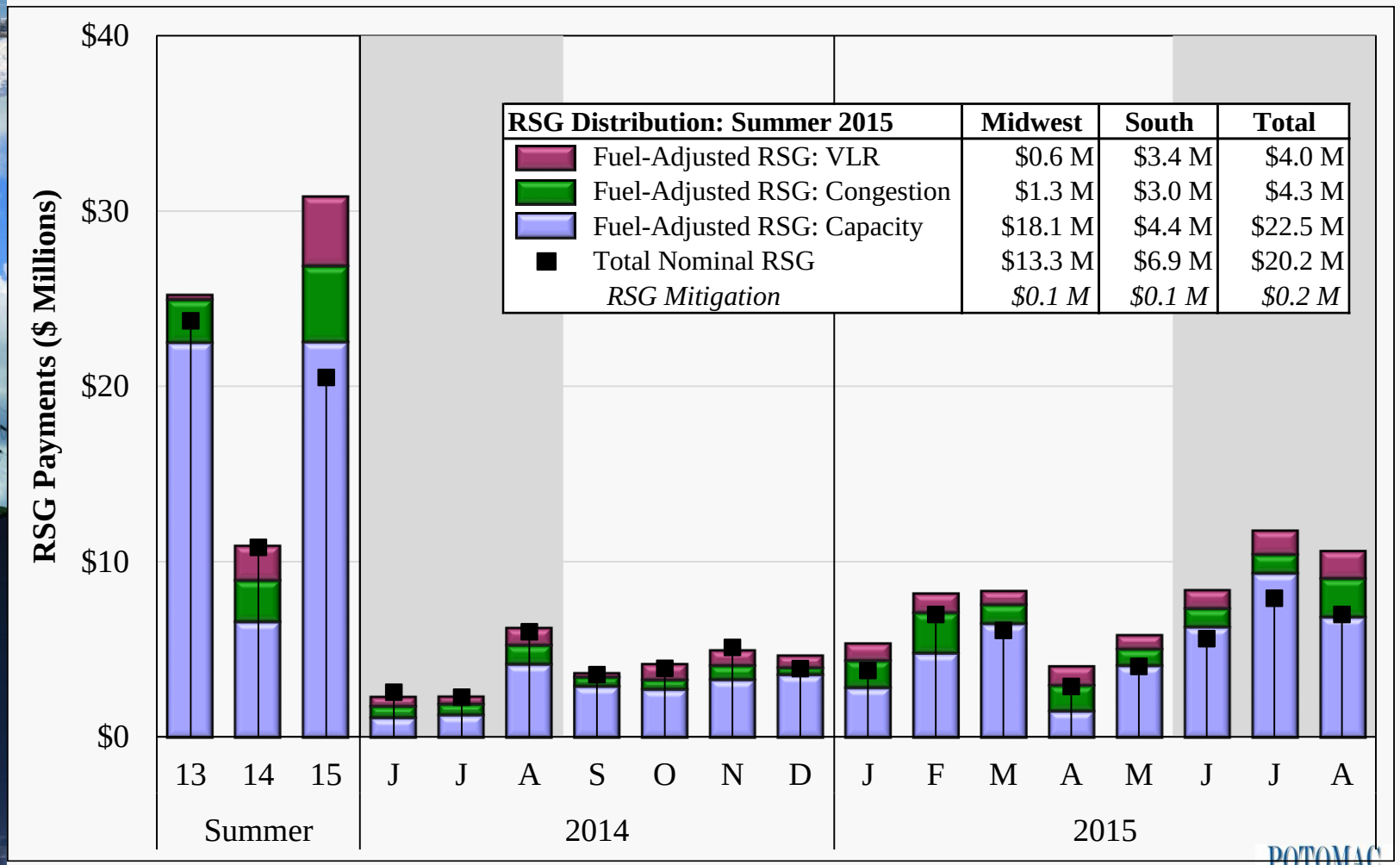
Real-Time RSG Payments
Summer 2014–2015



RSG Distribution: Summer 2015	Midwest	South	Total
Fuel-Adjusted RSG: VLR	$0.6 M	$3.4 M	$4.0 M
Fuel-Adjusted RSG: Congestion	$1.3 M	$3.0 M	$4.3 M
Fuel-Adjusted RSG: Capacity	$18.1 M	$4.4 M	$22.5 M
Total Nominal RSG	$13.3 M	$6.9 M	$20.2 M
RSG Mitigation	*$0.1 M*	*$0.1 M*	*$0.2 M*

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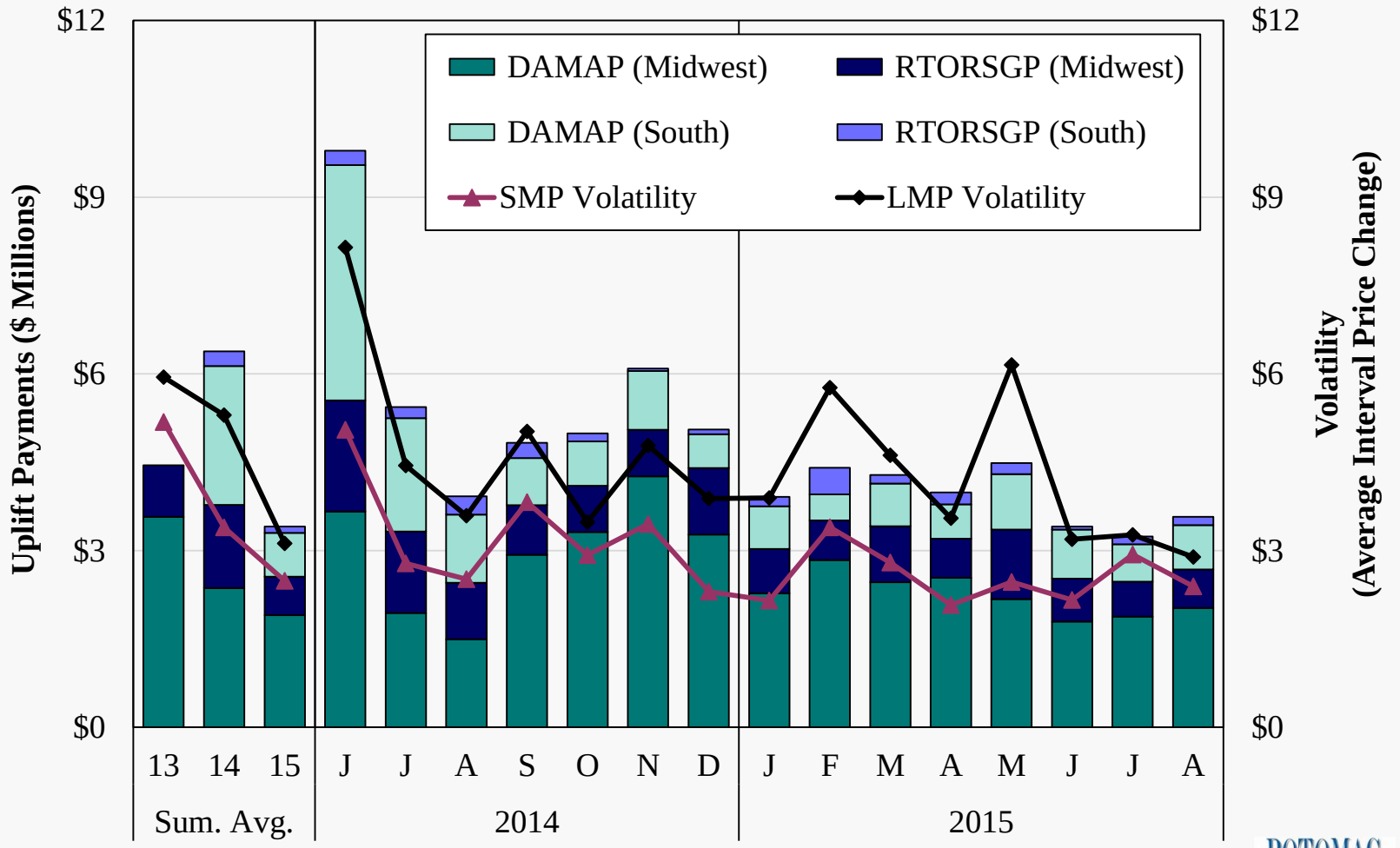
Price Volatility Make Whole Payments 2014–2015



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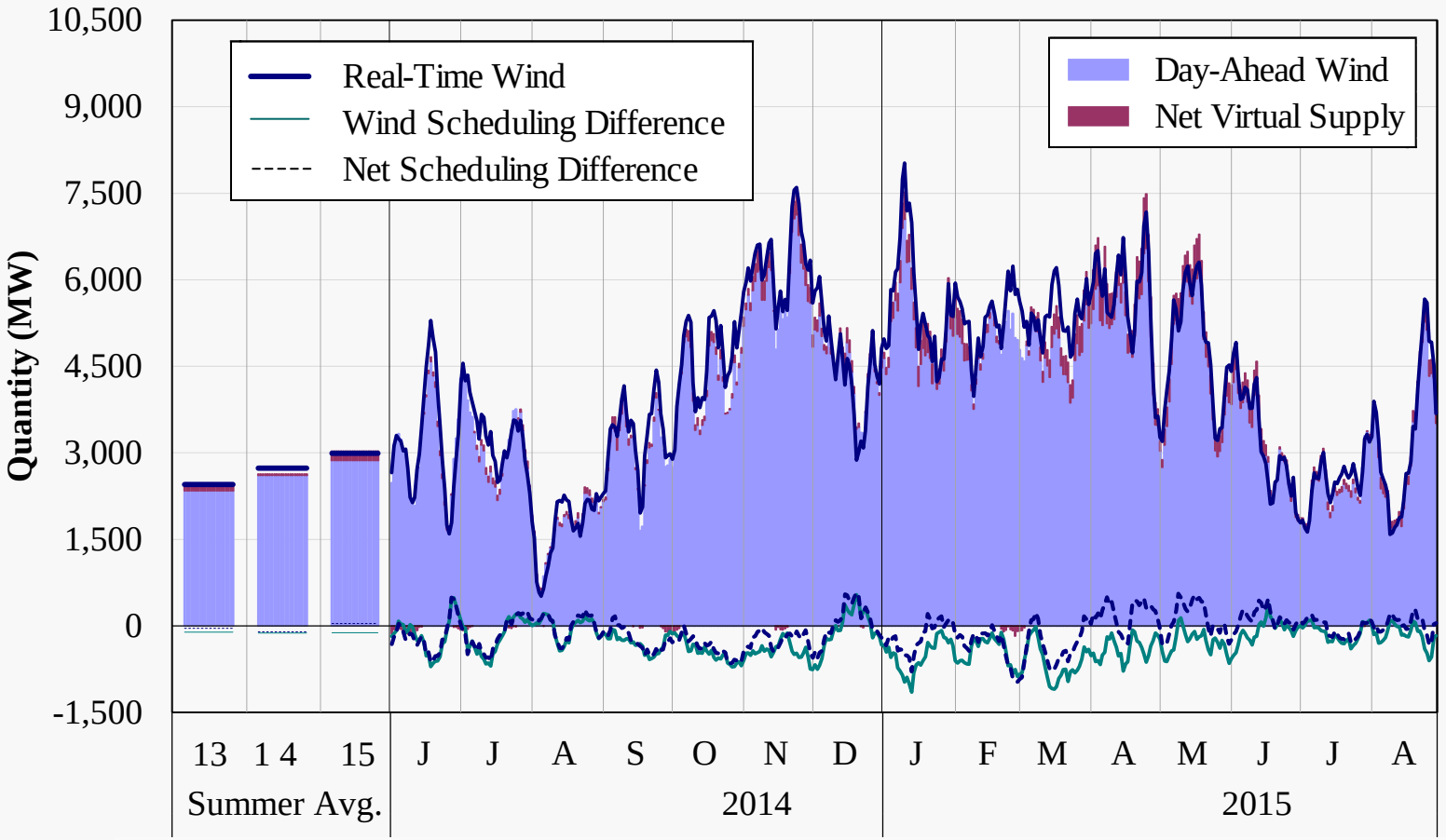
Wind Output in Real-Time and Day-Ahead Markets
7-Day Moving Average, 2014–2015



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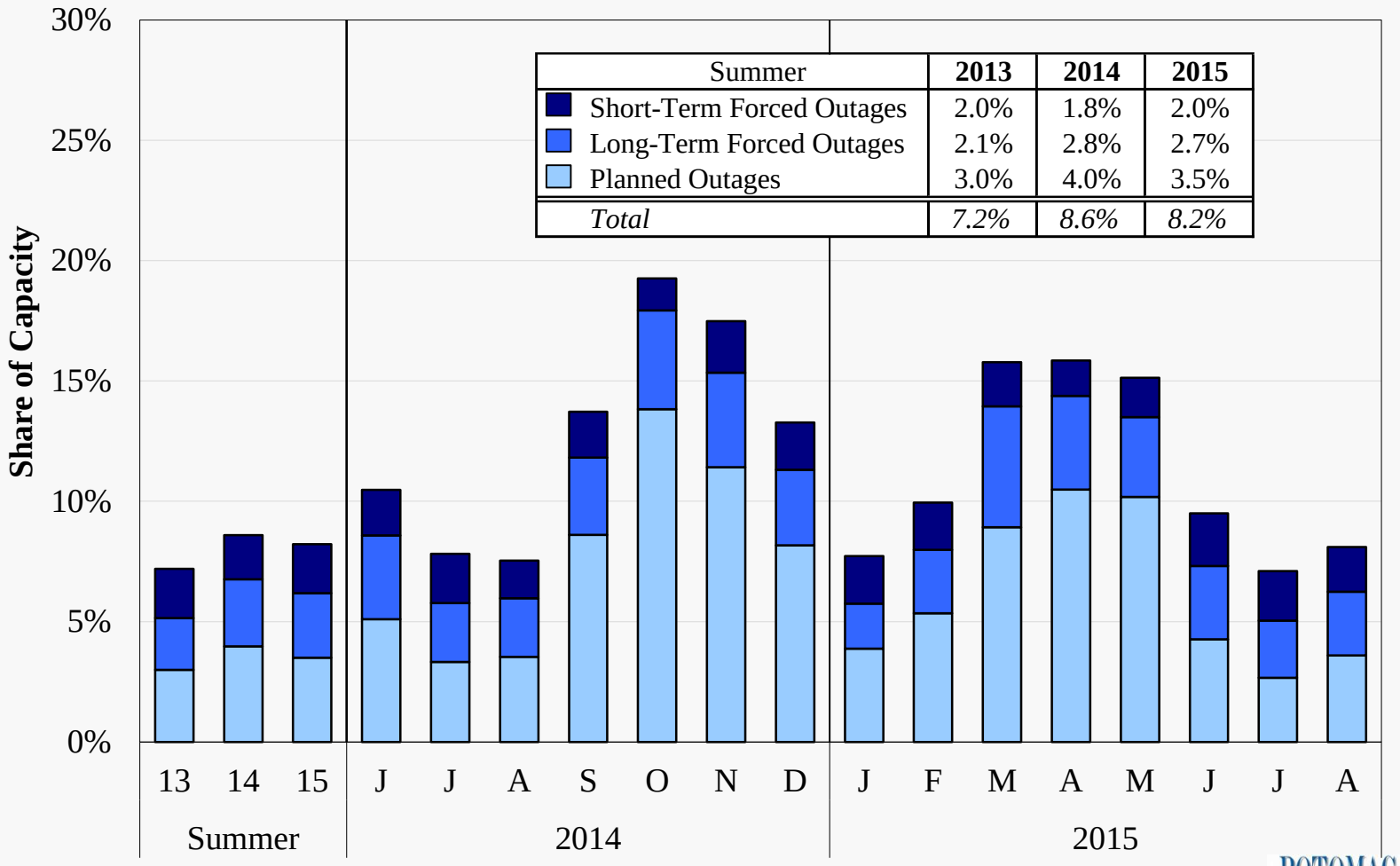
Generation Outage Rates
2014–2015



Summer	2013	2014	2015
Short-Term Forced Outages	2.0%	1.8%	2.0%
Long-Term Forced Outages	2.1%	2.8%	2.7%
Planned Outages	3.0%	4.0%	3.5%
Total	*7.2%*	*8.6%*	*8.2%*

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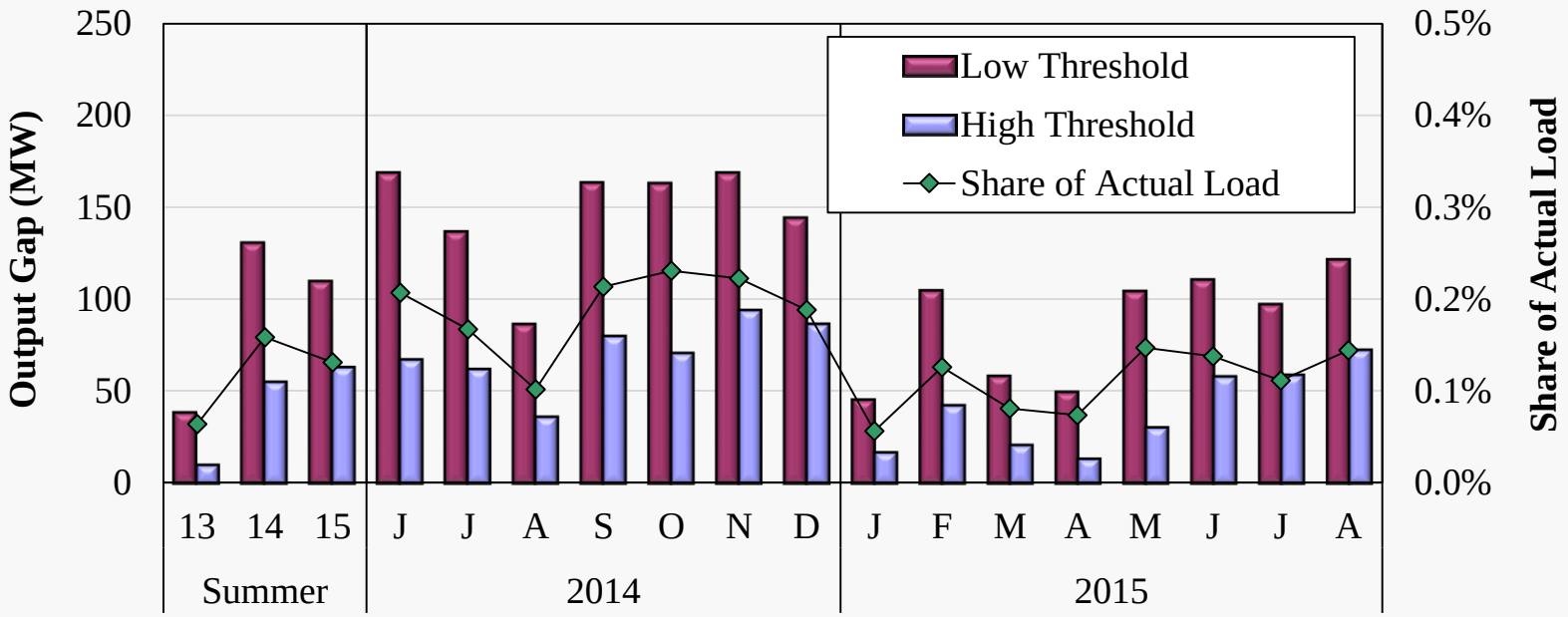
Monthly Output Gap
2014–2015



High Threshold Results by Unit Status (MW)

Offline	2	17	47	13	21	15	20	9	19	50	11	18	5	3	11	34	49	58
Online	8	39	16	54	41	21	60	62	75	36	6	24	16	10	19	24	9	14

Low Threshold Results by Unit Status (MW)

Offline	4	23	54	18	29	22	32	14	21	52	12	33	5	4	15	43	54	65
Online	35	107	56	150	107	65	131	149	147	92	34	72	53	46	90	68	43	56

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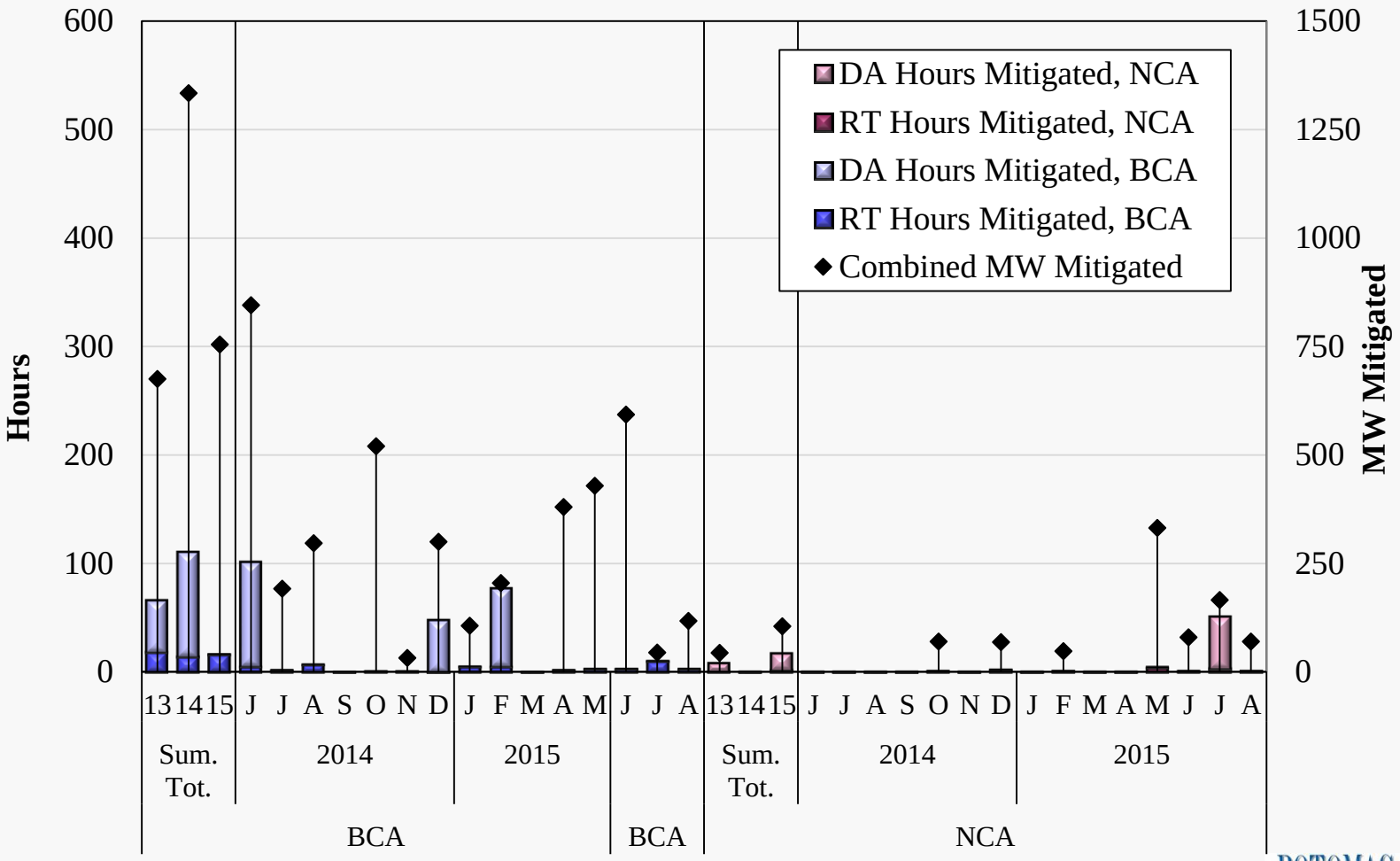
Day-Ahead And Real-Time Energy Mitigation 2014–2015



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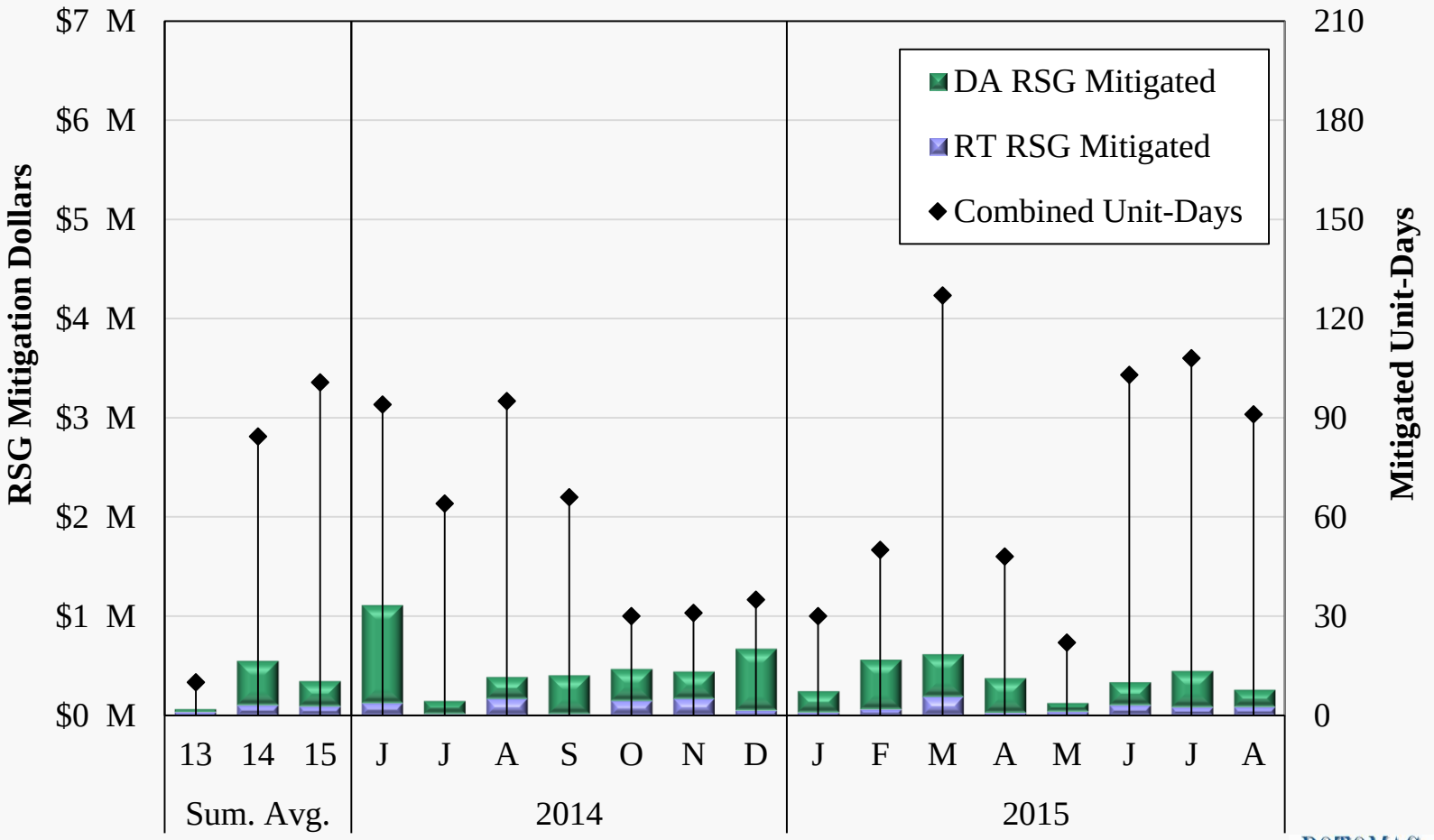
Day-Ahead and Real-Time RSG Mitigation 2014–2015



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List of Acronyms

✓	AMP	Automated Mitigation Procedures
✓	BCA	Broad Constrained Area
✓	CDD	Cooling Degree Days
✓	CMC	Constraint Management Charge
✓	DAMAP	Day-Ahead Margin Assurance Payment
✓	DDC	Day-Ahead Deviation & Headroom Charge
✓	DIR	Dispatchable Intermittent Resource
✓	HDD	Heating Degree Days
✓	JCM	Joint and Common Market Initiative
✓	JOA	Joint Operating Agreement
✓	LAC	Look-Ahead Commitment
✓	LSE	Load-Serving Entities
✓	M2M	Market-to-Market
✓	MSC	MISO Market Subcommittee
✓	NCA	Narrow Constrained Area
✓	ORCA	Operations Reliability Coordination Agreement
✓	ORDC	Operating Reserve Demand Curve
✓	PRA	Planning Resource Auction
✓	PVMWP	Price Volatility Make Whole Payment
✓	RAC	Resource Adequacy Construct
✓	RSG	Revenue Sufficiency Guarantee
✓	RTORSGP	Real-Time Offer Revenue Sufficiency Guarantee Payment
✓	SMP	System Marginal Price
✓	SOM	State of the Market
✓	SRPBC	Sub-Regional Power Balance Constraint
✓	TLR	Transmission Line Loading Relief
✓	TCDC	Transmission Constraint Demand Curve
✓	VCA	Voluntary Capacity Auction
✓	VLR	Voltage and Local Reliability
✓	WPP	Weekly Procurement Process
✓	WUMS	Wisconsin Upper Michigan System