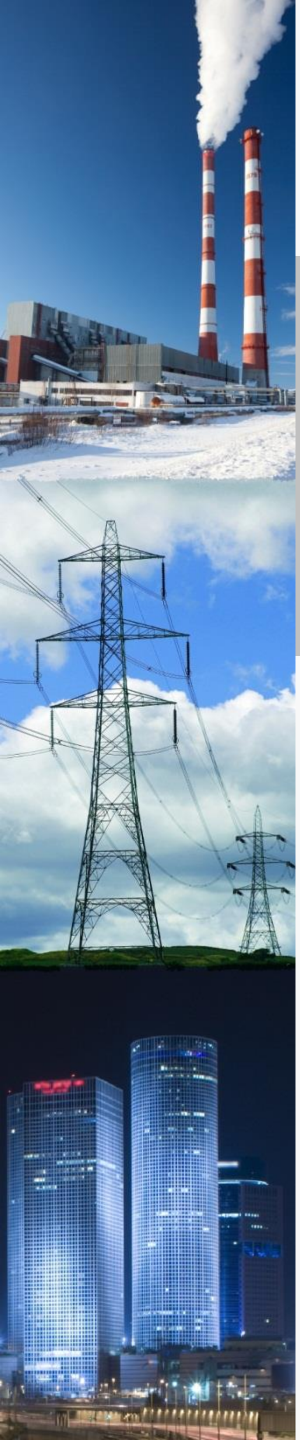

IMM Quarterly Report: Spring 2015
March – May

MISO Independent Market Monitor

David B. Patton, Ph.D.
Potomac Economics

June 17, 2015

Quarterly Summary

		Value	*Change*[1] Prior Qtr.	Prior Year
RT Energy Prices ($/MWh)	🟢	$27.03	*-12%*	*-37%*
Fuel Prices ($/MMBtu)				
Natural Gas - Chicago	🔵	$2.77	*-21%*	*-56%*
Natural Gas - Henry Hub	🔵	$2.74	*-11%*	*-41%*
Western Coal	🟢	$0.58	*-11%*	*-21%*
Eastern Coal	🟢	$1.63	*-14%*	*-16%*
Load (GW)[2]				
Average Load	🟢	70.4	*-12%*	*-2%*
Peak Load	🟢	97.9	*-8%*	*0%*
% Scheduled DA (Peak Hour)	🟢	99.2%	99.3%	99.7%
Transmission Congestion ($M)				
Real-Time Congestion Value	🔵	$364.3	*7%*	*-50%*
Day-Ahead Congestion Revenue	🔵	$217.3	*8%*	*-47%*
Balancing Congestion Revenue[3]	🟢	-$4.0	$1.8	-$3.3
Ancillary Service Prices ($/MWh)				
Regulation	🟢	$7.27	*-6%*	*-46%*
Spinning Reserves	🟢	$1.29	*0%*	*-50%*
Supplemental Reserves	🟢	$0.49	*5%*	*-67%*

		Value	*Change*[1] Prior Qtr.	Prior Year
FTR Funding (%)	🟢	103%	99%	96%
Wind Output (MW/hr)	🟢	5,279	*3%*	*6%*
Guarantee Payments ($M)[4]				
Real-Time RSG	🔵	$12.6	*-13%*	*-75%*
Day-Ahead RSG	🔵	$25.4	*3%*	*-23%*
Day-Ahead Margin Assurance	🟢	$9.6	*-5%*	*-67%*
Real-Time Offer Rev. Sufficiency	🟢	$3.3	*1%*	*-11%*
Price Convergence[5]				
Market-wide DA Premium	🟢	1.0%	*2.6%*	*4.4%*
Virtual Trading				
Cleared Quantity (MW/hr)	🟢	9,640	*8%*	*32%*
% Price Insensitive	🟢	36%	*38%*	*48%*
% Screened for Review	🟢	1%	*2%*	*3%*
Profitability ($/MW)	🟢	$0.84	$0.74	$3.07
Dispatch of Peaking Units (MW/hr)	🟢	551	*491*	*459*
Output Gap- Low Thresh. (MW/hr)	🟢	71	*98*	*237*
Other:				

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 Spring 2015

- The Spring 2015 quarter was characterized by continued decreases in fuel prices, particularly natural gas, and typical mild seasonal temperatures and loads.
- Lower natural gas prices this quarter continued to drive energy prices lower.
  - ✓ Real-time energy prices fell 37 percent from last spring to $27.03 per MWh, coinciding with a natural gas price decline of 56 percent over the same period.
  - ✓ Day-ahead and real-time RSG declined 23 and 75 percent from last spring, respectively.
  - ✓ Ancillary service costs declined by about 50 percent from last spring.
- Congestion levels were typical for the spring, down by about half from last year.
  - ✓ We note that last spring included extreme conditions at the beginning of March 2014, including unusually cold weather and higher and more volatile gas prices.
- MISO-wide price convergence was good, and significantly better than last spring.
  - ✓ Outages, both planned and forced, during the quarter led to price divergence at the Texas Hub in May and at the Louisiana Hub in March.
- Market-to-market coordination with SPP and the ELMP initiative were both successfully deployed on March 1.
  - ✓ Start-up issues with the M2M process are being addressed with SPP.

Highlights from Spring 2015

Fuel Prices (Slide 11)

- Fuel Prices continue to be significantly lower than fuel prices from last year.
  - ✓ Lower gas prices have led to lower energy and ancillary service prices.
- Last March included days during the polar vortex when gas prices were usually high due to shortages.
  - ✓ Excluding polar vortex days from last year gas prices, average prices this year were still 41 percent lower this year ($2.77 per MMBtu) than last spring ($4.70 per MMBtu).

Price Convergence (Slide 13)

- Convergence this spring is significantly better than last spring.
- However, the market is still not quickly responding to congestion-related prices differences.
  - ✓ Forced outages resulting from severe weather and flooding in Texas caused significant price divergence at the Texas Hub in May.
  - ✓ A number of planned and forced outages resulted in two binding local constraints in March and caused price divergence at the Louisiana Hub.

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Highlights from Spring 2015

Virtual Load and Supply (Slides 15-17)

- Cleared virtual transactions rose 32 percent this spring compared to last year.
  - ✓ Total quantity of bids and offers also increased 16 percent.
  - ✓ A non-trivial portion of the increase was from participants in the virtual market exploiting predictable divergence of the marginal loss component of LMP.
    - – MISO implemented and an interim solution at the beginning of April.
    - – A longer term solution has not yet been identified by MISO.
  - ✓ Virtual profitability fell from $3.07 last spring to $0.84 per MWh this spring.
- The DDC rate, paid by portfolios with net virtual supply, was only 34 cents this spring compared to $1.21 last spring.

Highlights from Spring 2015

Congestion (Slides 18-20)

- Day-ahead and real-time congestion revenue fell by 50 percent from last year.
  - ✓ Typical loads and outages during the quarter drove the reduction.
- FTRs were funded at 103 percent this fall, with a surplus totaling $11.3 million.
  - ✓ This is the first quarter with a surplus since the Winter 2014.
  - ✓ The SRPBC produced over $4 million of the surplus.
- MISO paid about $6 Million to SPP for M2M coordination of SPP flowgates, 80 percent of which was not funded via LMP (charged to load as uplift).
  - ✓ This suggests that MISO has low-cost relief that is not being requested that would lower the costs of managing the constraints in both regions.

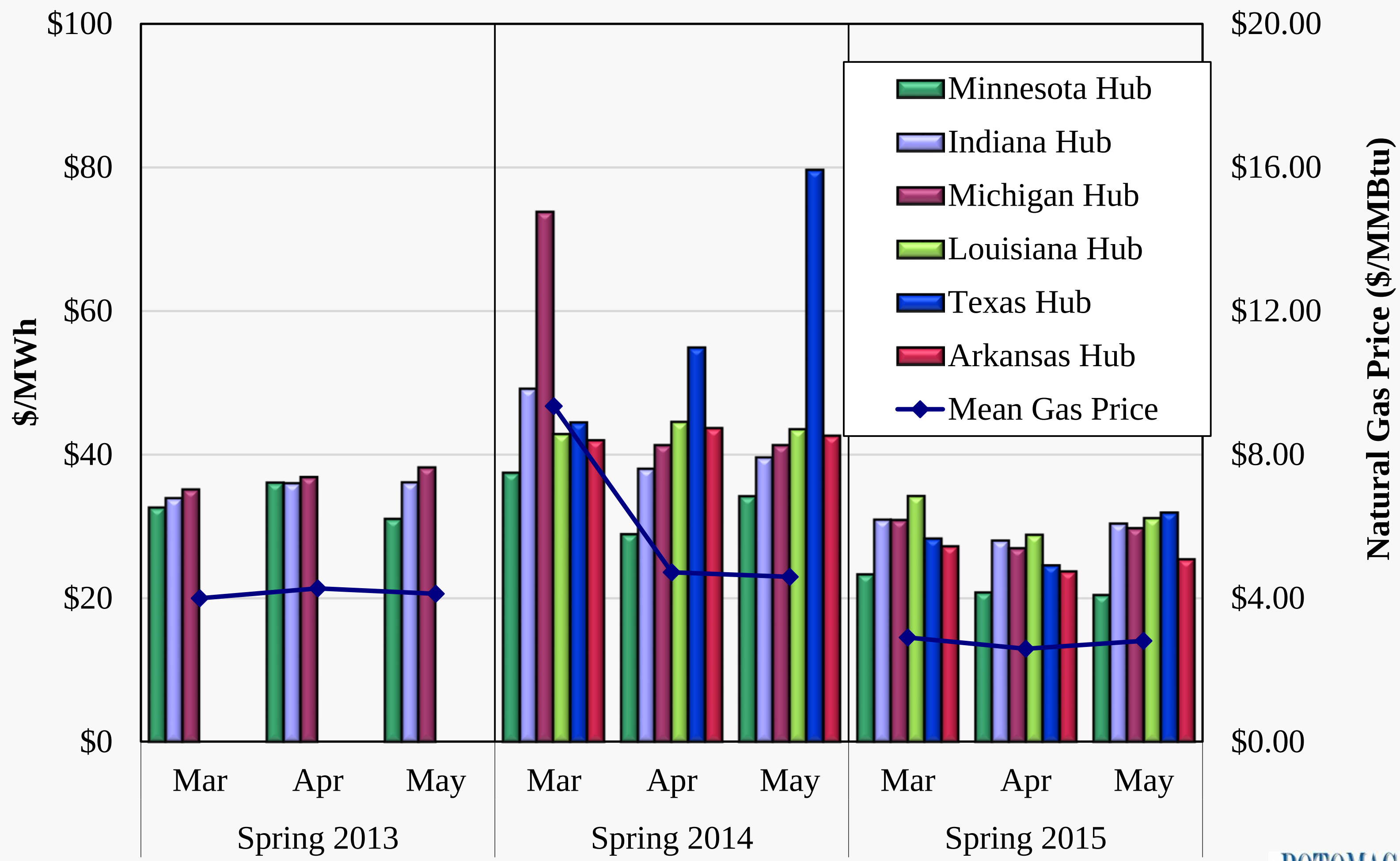
RSG (Slides 22 and 23)

- Nominal values for day-ahead RSG declined 75 percent from last year, despite significantly lower fuel prices.
  - ✓ Most of this RSG was from VLR payments in MISO South to gas-fired generators.
- Real-time RSG has also fell by 23 percent from last year.

Submittals to External Entities and Other Issues

- We provided additional data and analyses to FERC related to prior referrals regarding resources failing to update real-time offers.
- We continued discussions regarding interface pricing with SPP and PJM staff and stakeholders.
- In response to a FERC directive, we filed comments on the status of a number of seams issues with PJM, including interface pricing and capacity deliverability.
- We presented PRA results for the 2 015/2016 planning year with stakeholders at the Supply Adequacy Working Group.
  - ✓ We are reviewing the complaints that have been filed regarding these results.
- We presented a summary of CTS results between PJM and NYISO to the MSC.
- We provided input to MISO and stakeholders in the Market Roadmap process.
- Provided stakeholder training on Module D and IMM operations to MISO stakeholders in May.
- We met with the Texas PUC and the ERSC regarding market outcomes in the South region.

Day-Ahead Average Monthly Hub Prices
Spring 2013–2015



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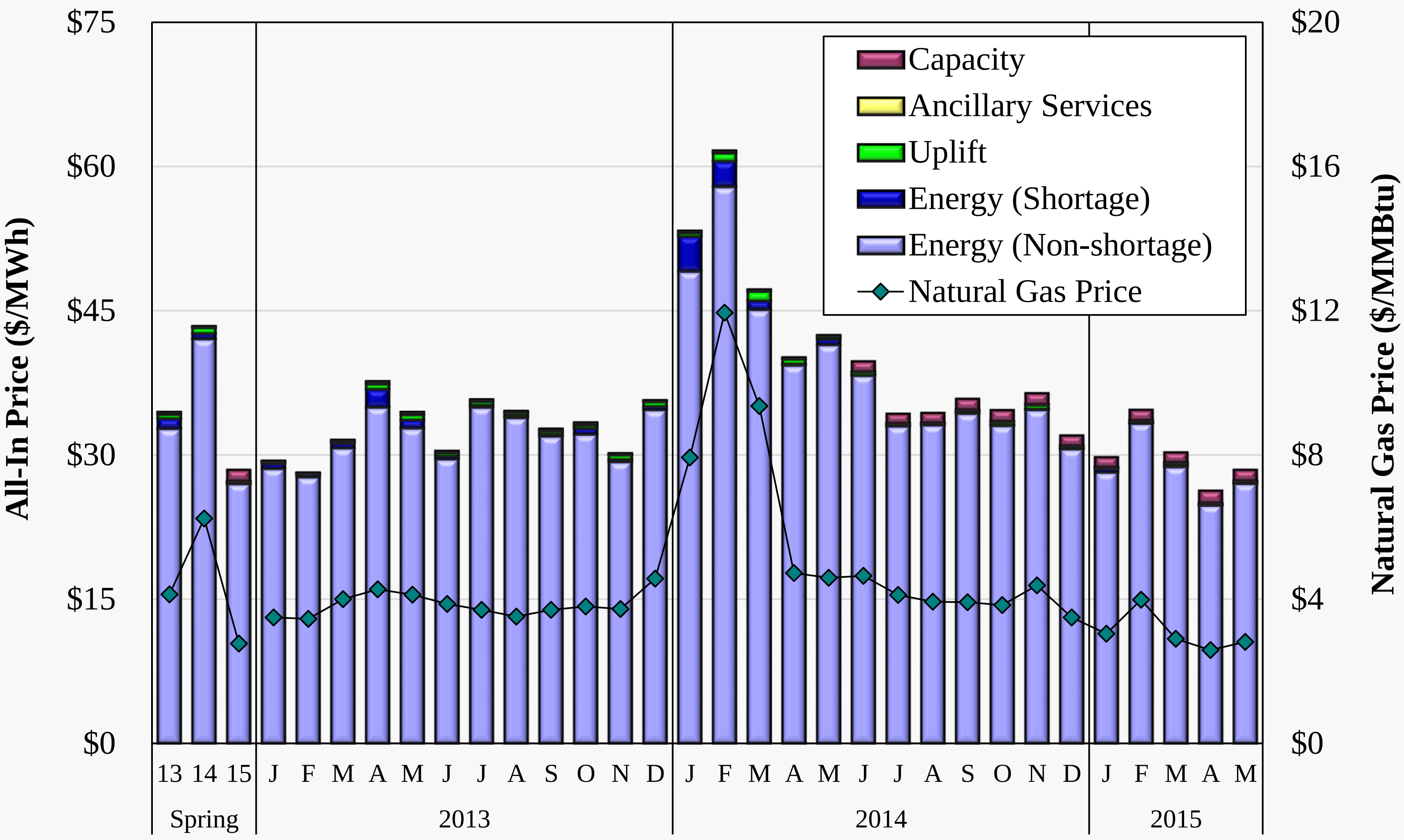
All-In Price
2013 –2015



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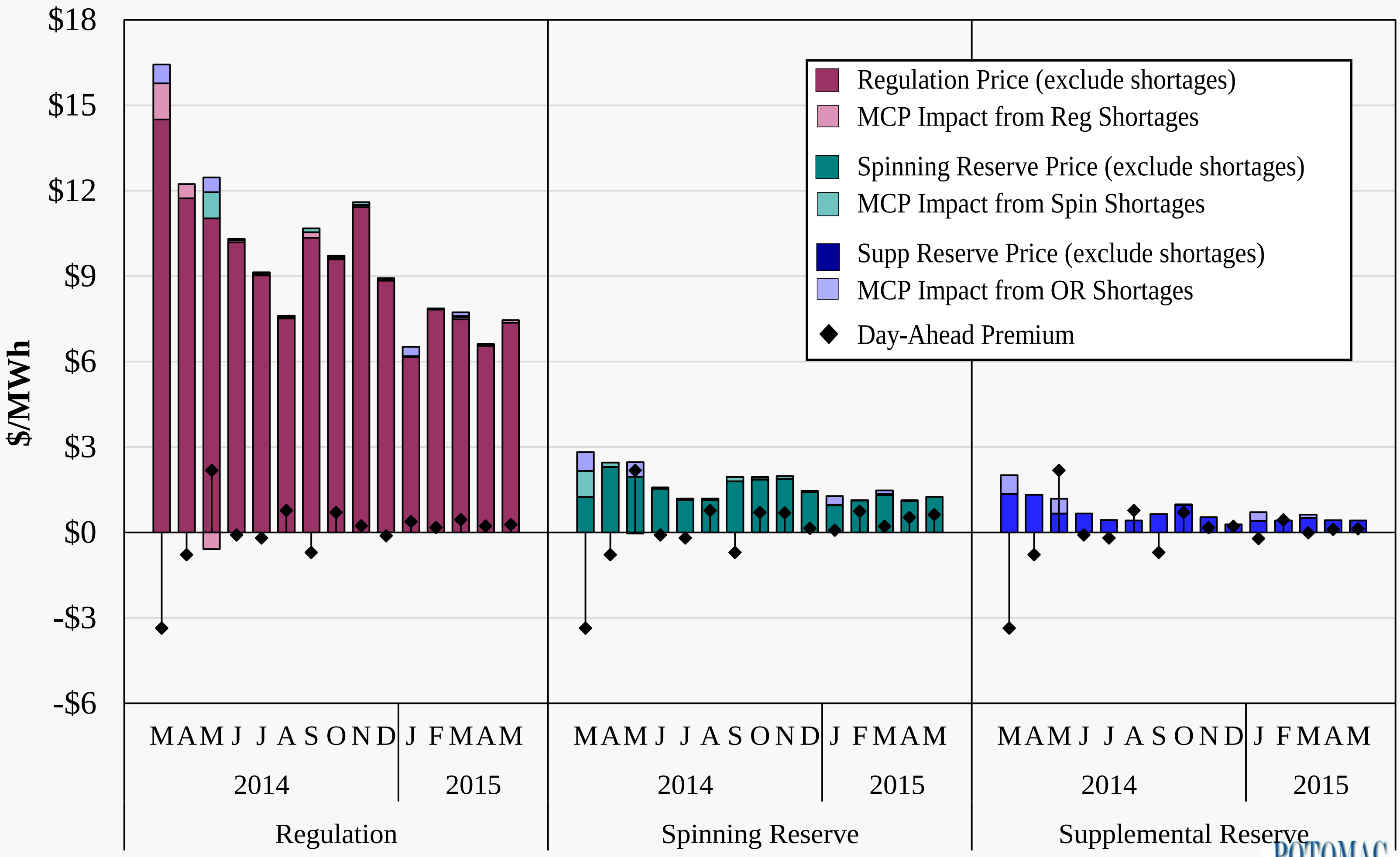
Monthly Average Ancillary Service Prices
Regulation and Contingency Reserves, 2014–2015



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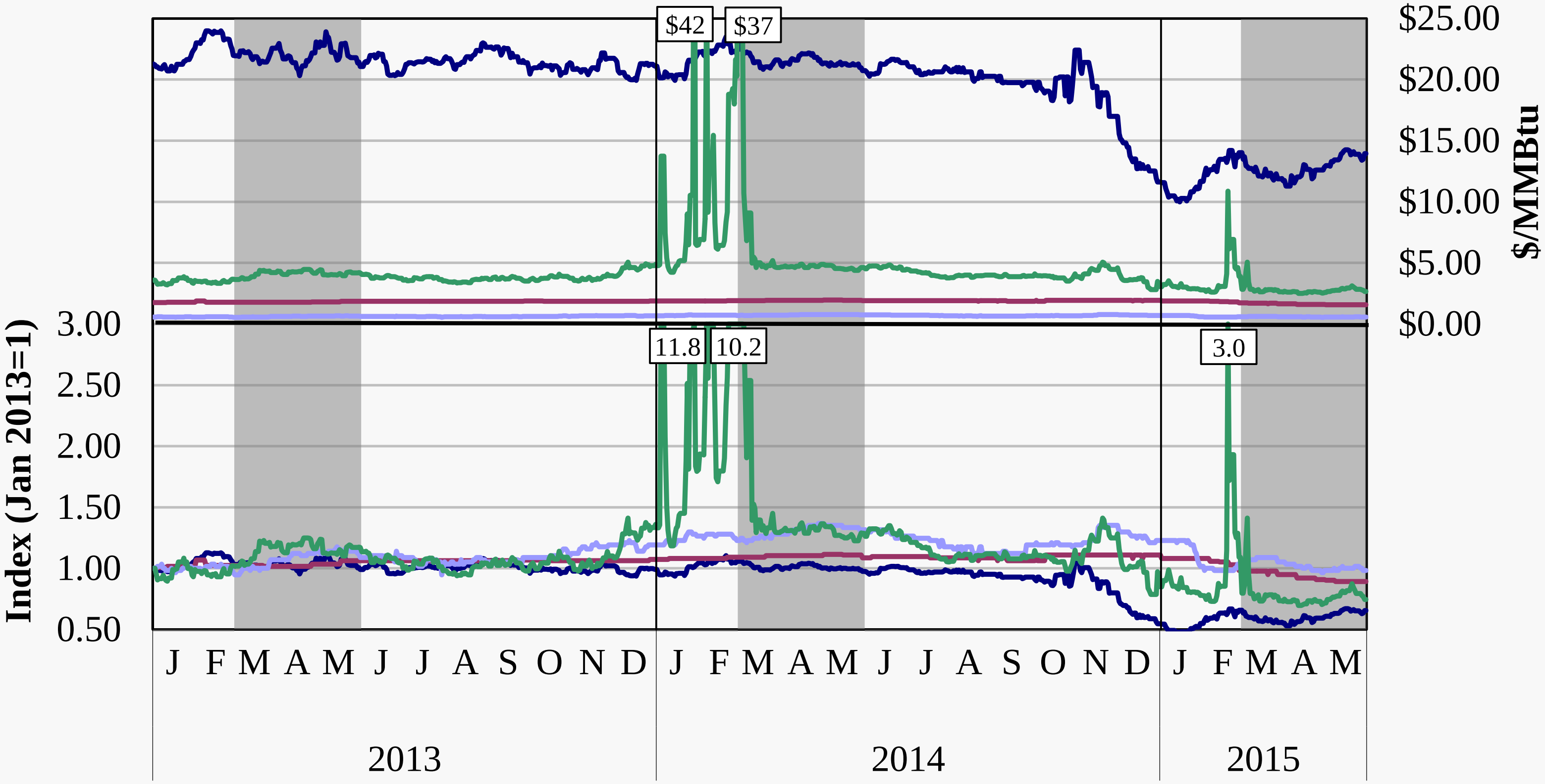
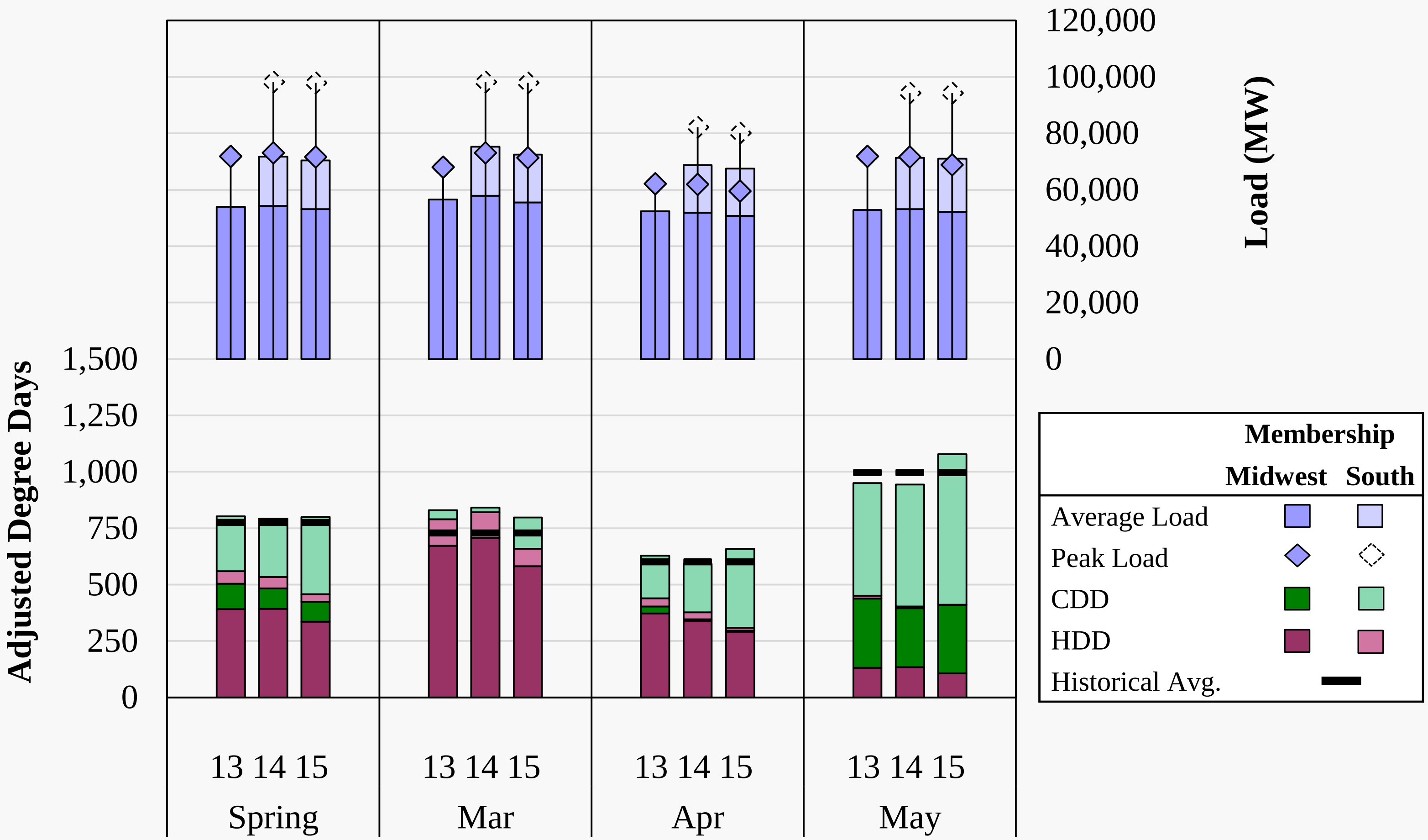
MISO Fuel Prices
2013–2015



Spring Average	2013	2014	2015
Oil	$22.02	$21.51	$12.79
Natural Gas	$4.13	$6.24	$2.77

Spring Average	2013	2014	2015
IB Coal	$1.80	$1.93	$1.63
PRB Coal	$0.62	$0.74	$0.58

Load and Weather Patterns Spring 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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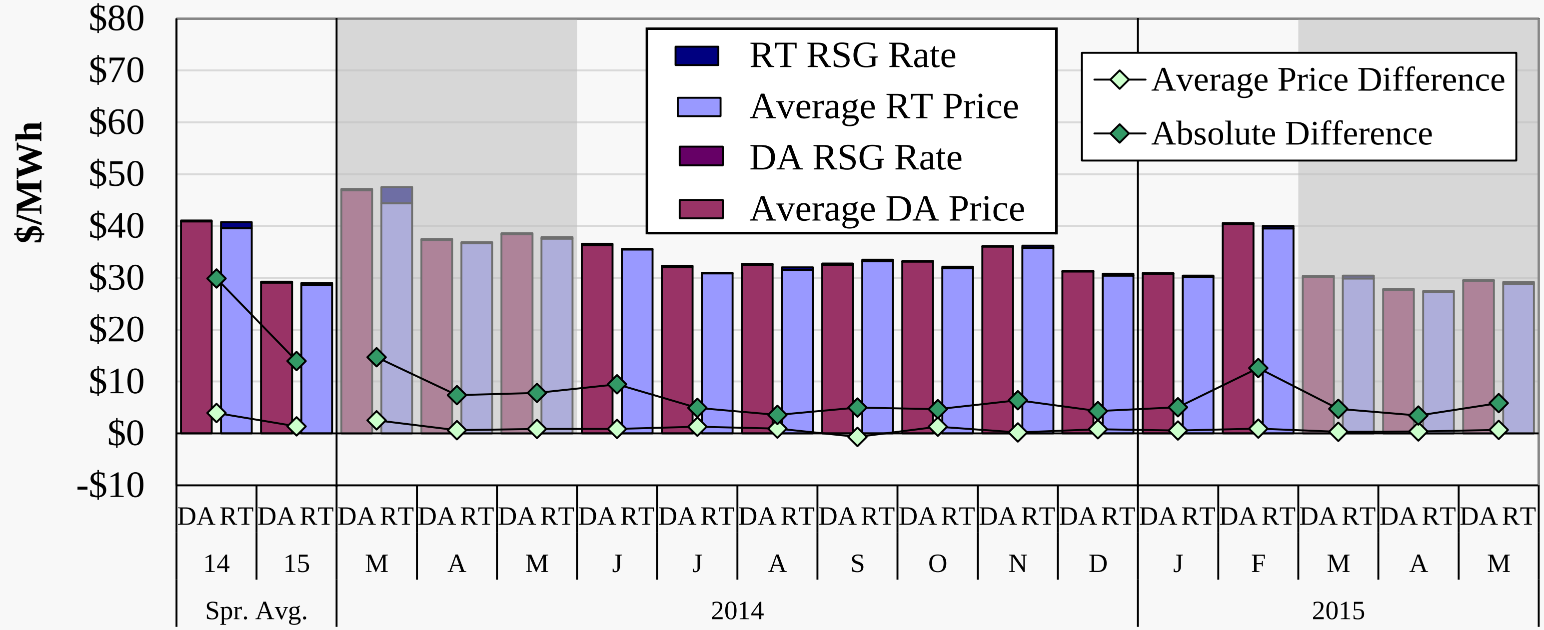
Day-Ahead and Real-Time Price Convergence 2014–2015



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

Indiana Hub	1	1	-1	2	2	3	4	2	-2	3	0	2	1	1	0	1	1
Michigan Hub	9	0	26	-1	2	-5	4	3	-2	3	0	2	7	6	-1	2	-1
Minnesota Hub	-2	1	-5	-3	3	4	1	3	0	3	4	-5	-1	0	-1	2	3
WUMS Area	0	2	-1	-3	3	0	2	2	-5	1	3	1	1	0	2	4	1
Arkansas Hub	-5	1	-20	1	4	10	5	2	-4	-1	3	2	-3	3	-3	4	3
Louisiana Hub	-6	-4	-19	-12	11	1	4	3	-4	2	2	4	0	2	-10	-2	0
Texas Hub	-7	-4	-13	-4	-6	31	3	5	2	1	2	5	-1	1	-5	4	-10

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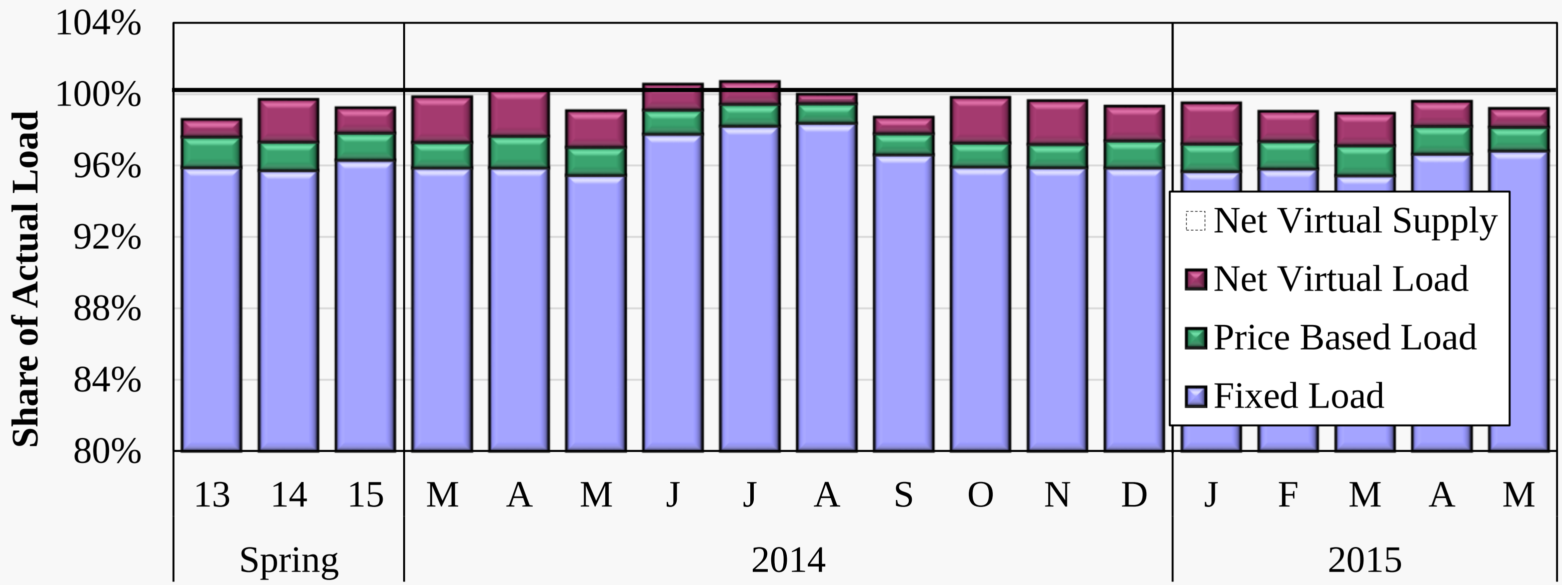
Day-Ahead Peak Hour Load Scheduling 2014–2015



Share of Actual Load (%)

	Spring 13	Spring 14	Spring 15	2014 M	2014 A	2014 M	2014 J	2014 J	2014 A	2014 S	2014 O	2014 N	2014 D	2015 J	2015 F	2015 M	2015 A	2015 M
All Hours	99.0	99.4	98.2	99.2	99.8	99.1	100.1	100.2	99.8	98.7	99.0	99.7	99.0	99.1	98.7	97.9	98.3	98.3
Peak Hours Midwest	98.6	98.9	99.2	99.3	99.5	98.0	99.5	99.8	99.5	98.8	100.2	100.7	101.1	99.9	99.7	99.2	98.9	99.3
Peak Hours South		101.2	98.8	100.4	101.5	101.6	102.7	102.5	100.7	99.5	99.7	99.4	97.0	97.9	97.7	97.3	100.2	99.0

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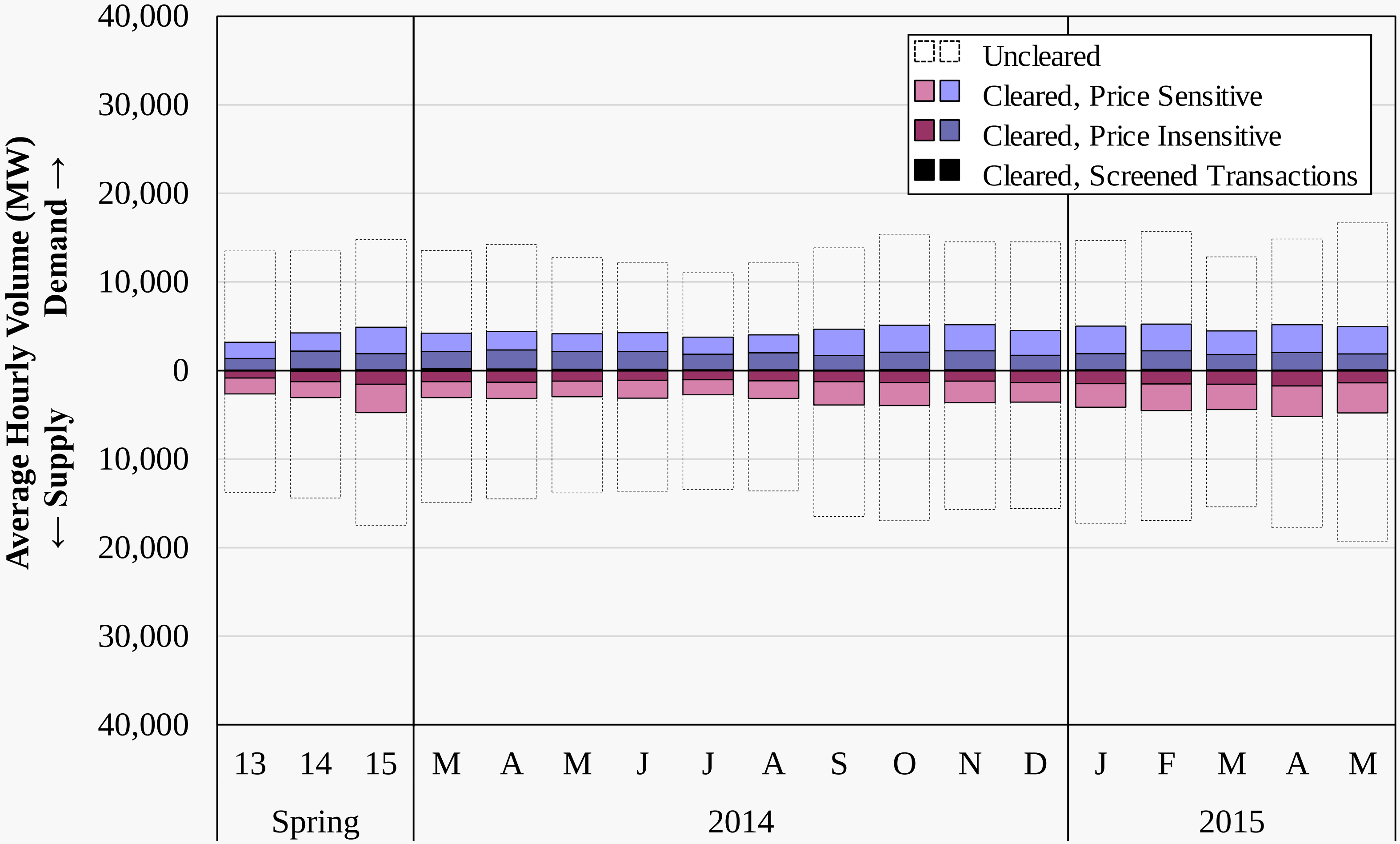
Virtual Load and Supply
2014–2015



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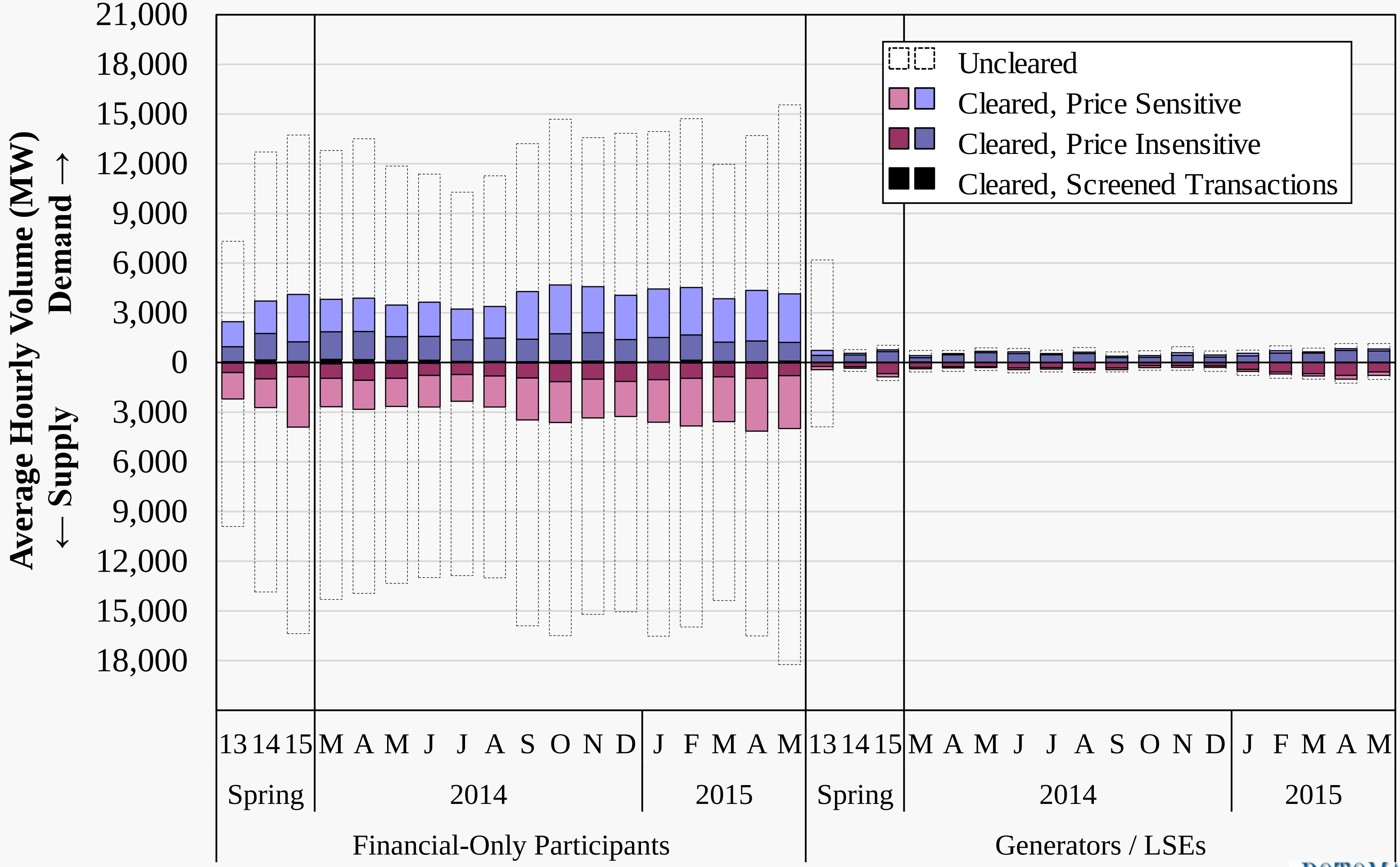
Virtual Load and Supply by Participant Type
Spring 2014–2015



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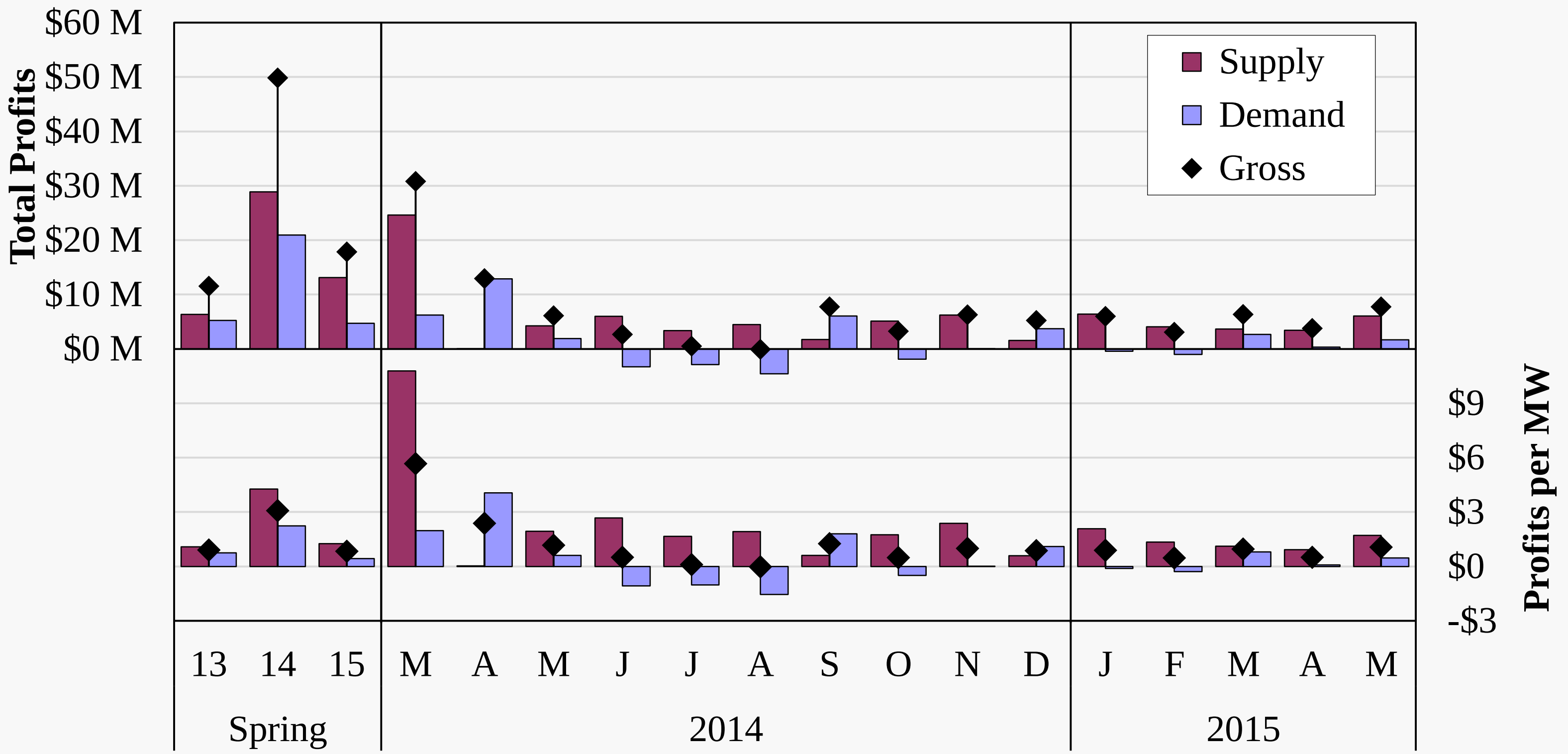
Virtual Profitability
2014–2015



Percent Screened

Demand	2.1	4.3	1.6	5.3	4.3	3.2	3.5	1.8	2.0	1.3	2.0	1.9	1.2	1.7	3.1	1.8	1.1	1.9
Supply	1.3	2.2	1.0	2.7	1.9	2.0	1.6	0.9	0.2	0.8	1.5	1.0	1.0	0.6	1.1	1.1	0.9	1.0
Total	1.7	3.4	1.3	4.2	3.3	2.7	2.7	1.4	1.2	1.1	1.7	1.5	1.1	1.2	2.2	1.4	1.0	1.5

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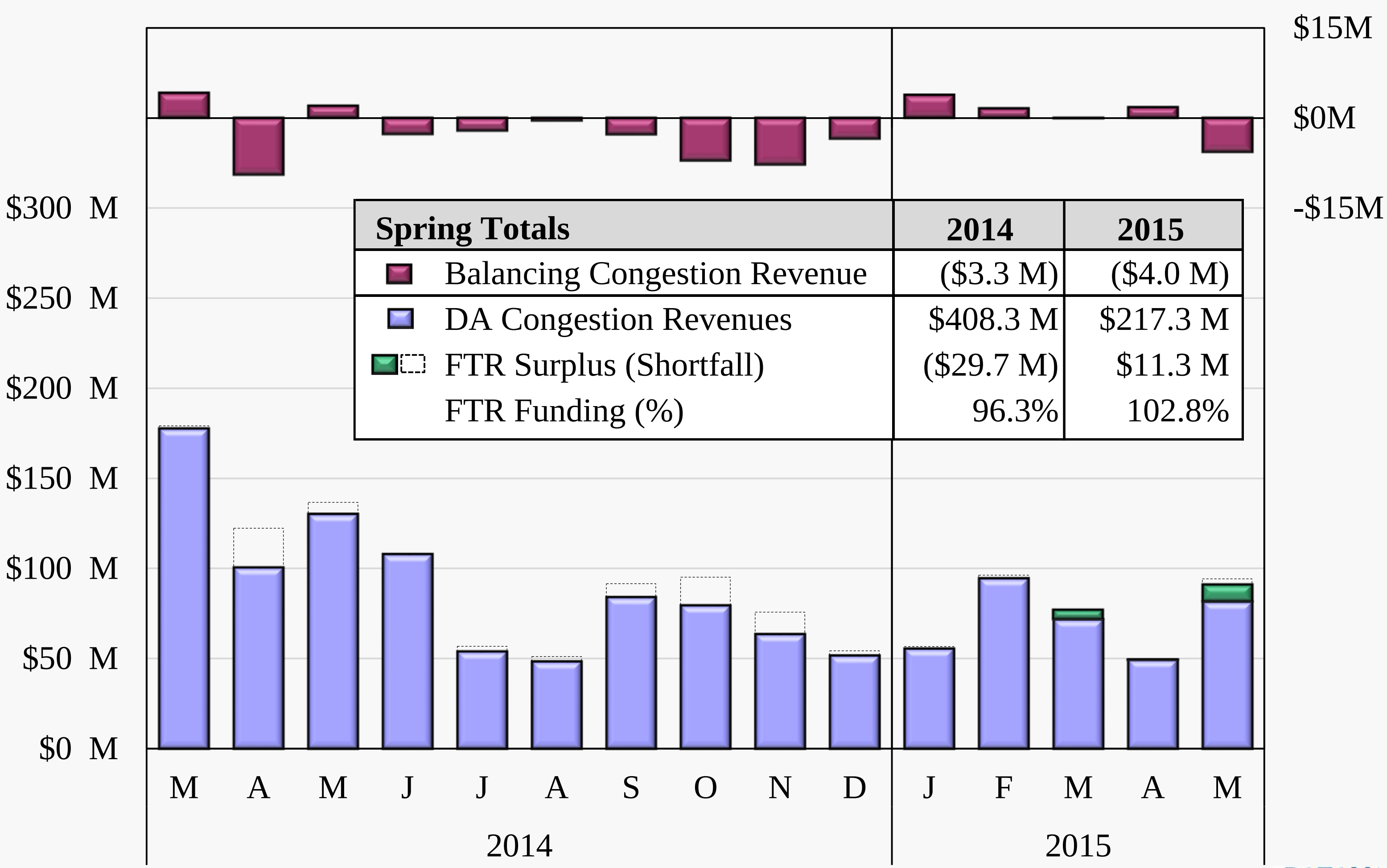
Day-Ahead Congestion, Balancing Congestion and FTR Underfunding, 2014–2015



Spring Totals	2014	2015
Balancing Congestion Revenue	($3.3 M)	($4.0 M)
DA Congestion Revenues	$408.3 M	$217.3 M
FTR Surplus (Shortfall)	($29.7 M)	$11.3 M
FTR Funding (%)	96.3%	102.8%

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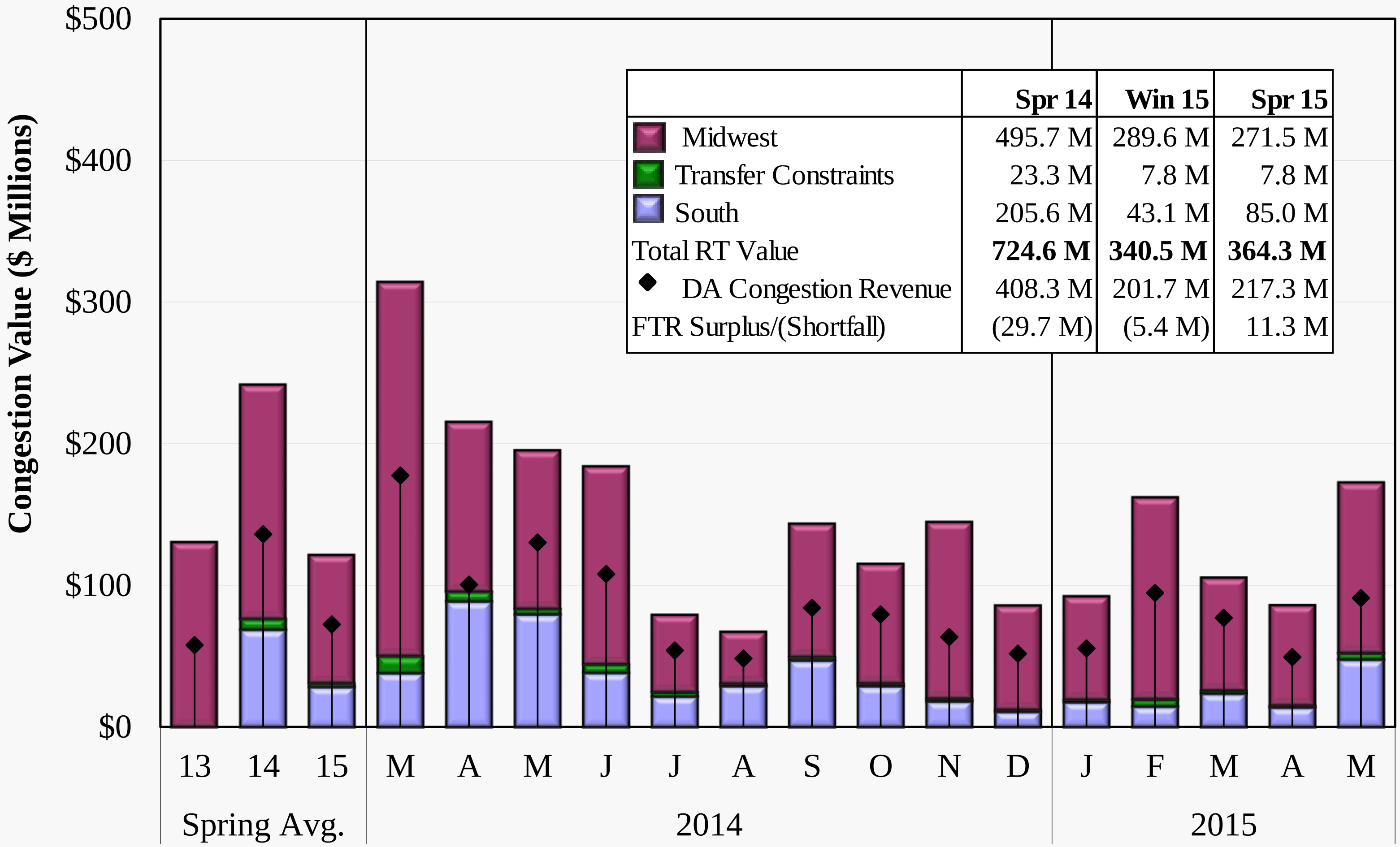
Value of Real-Time Congestion 2014–2015



	Spr 14	Win 15	Spr 15
Midwest	495.7 M	289.6 M	271.5 M
Transfer Constraints	23.3 M	7.8 M	7.8 M
South	205.6 M	43.1 M	85.0 M
Total RT Value	**724.6 M**	**340.5 M**	**364.3 M**
◆ DA Congestion Revenue	408.3 M	201.7 M	217.3 M
FTR Surplus/(Shortfall)	(29.7 M)	(5.4 M)	11.3 M

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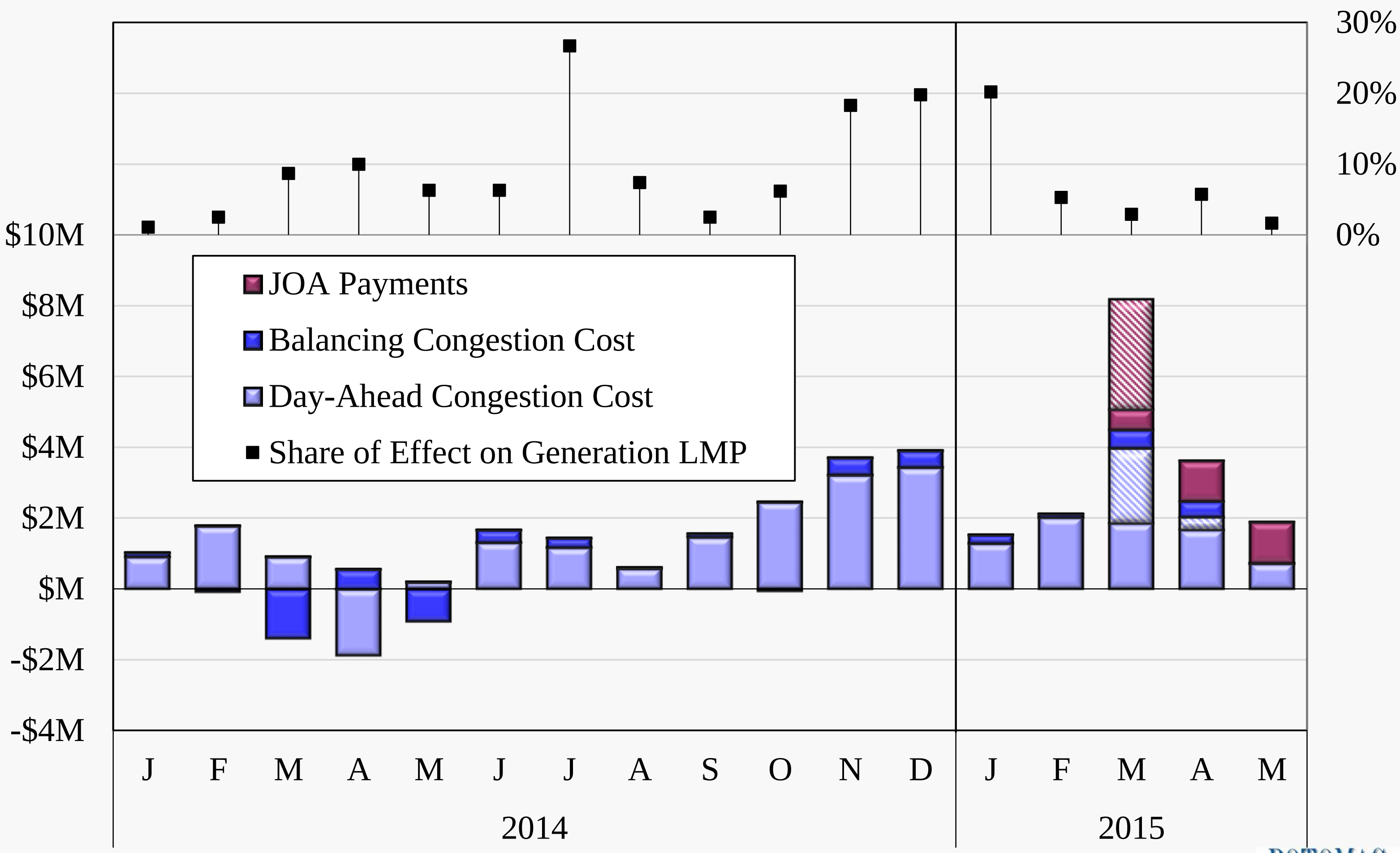
Congestion Costs on SPP Flowgates 2014–2015



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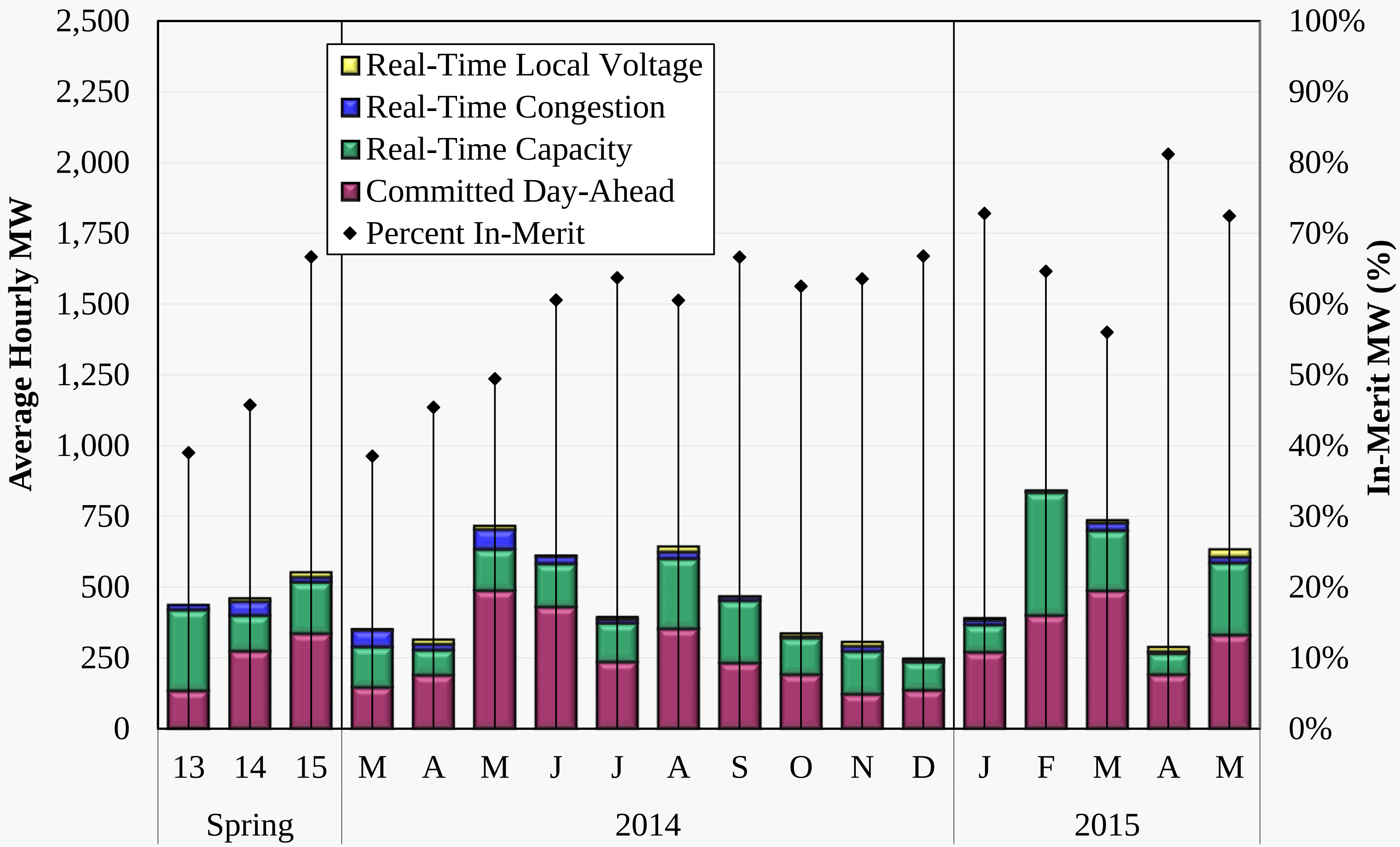
Peaking Resource Dispatch
2014–2015



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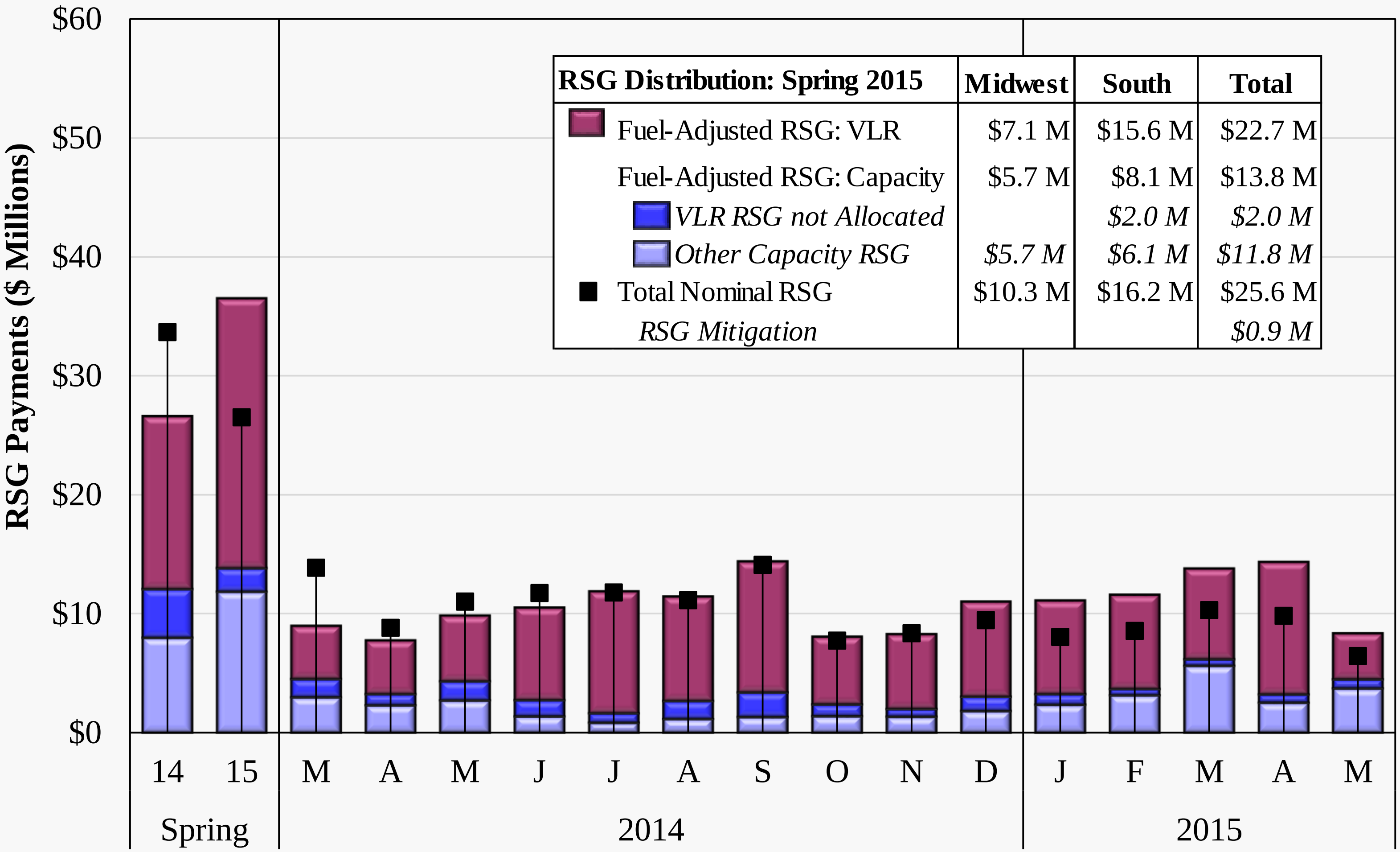
Day-Ahead RSG Payments
Spring 2014–2015



RSG Distribution: Spring 2015	Midwest	South	Total
Fuel-Adjusted RSG: VLR	$7.1 M	$15.6 M	$22.7 M
Fuel-Adjusted RSG: Capacity	$5.7 M	$8.1 M	$13.8 M
VLR RSG not Allocated		*$2.0 M*	*$2.0 M*
Other Capacity RSG	*$5.7 M*	*$6.1 M*	*$11.8 M*
Total Nominal RSG	$10.3 M	$16.2 M	$25.6 M
RSG Mitigation			*$0.9 M*

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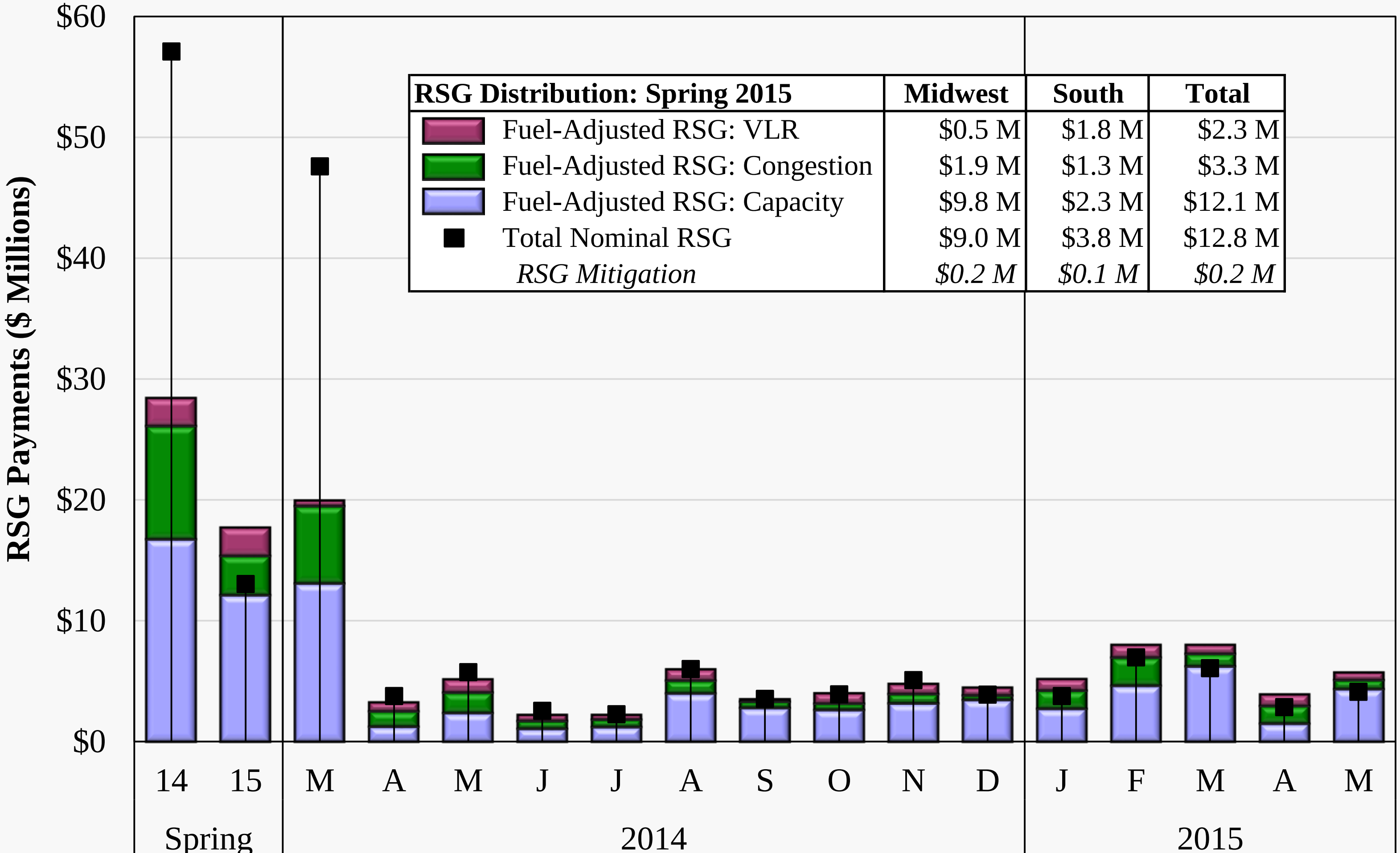
Real-Time RSG Payments
Spring 2014–2015



RSG Distribution: Spring 2015	Midwest	South	Total
Fuel-Adjusted RSG: VLR	$0.5 M	$1.8 M	$2.3 M
Fuel-Adjusted RSG: Congestion	$1.9 M	$1.3 M	$3.3 M
Fuel-Adjusted RSG: Capacity	$9.8 M	$2.3 M	$12.1 M
Total Nominal RSG	$9.0 M	$3.8 M	$12.8 M
RSG Mitigation	*$0.2 M*	*$0.1 M*	*$0.2 M*

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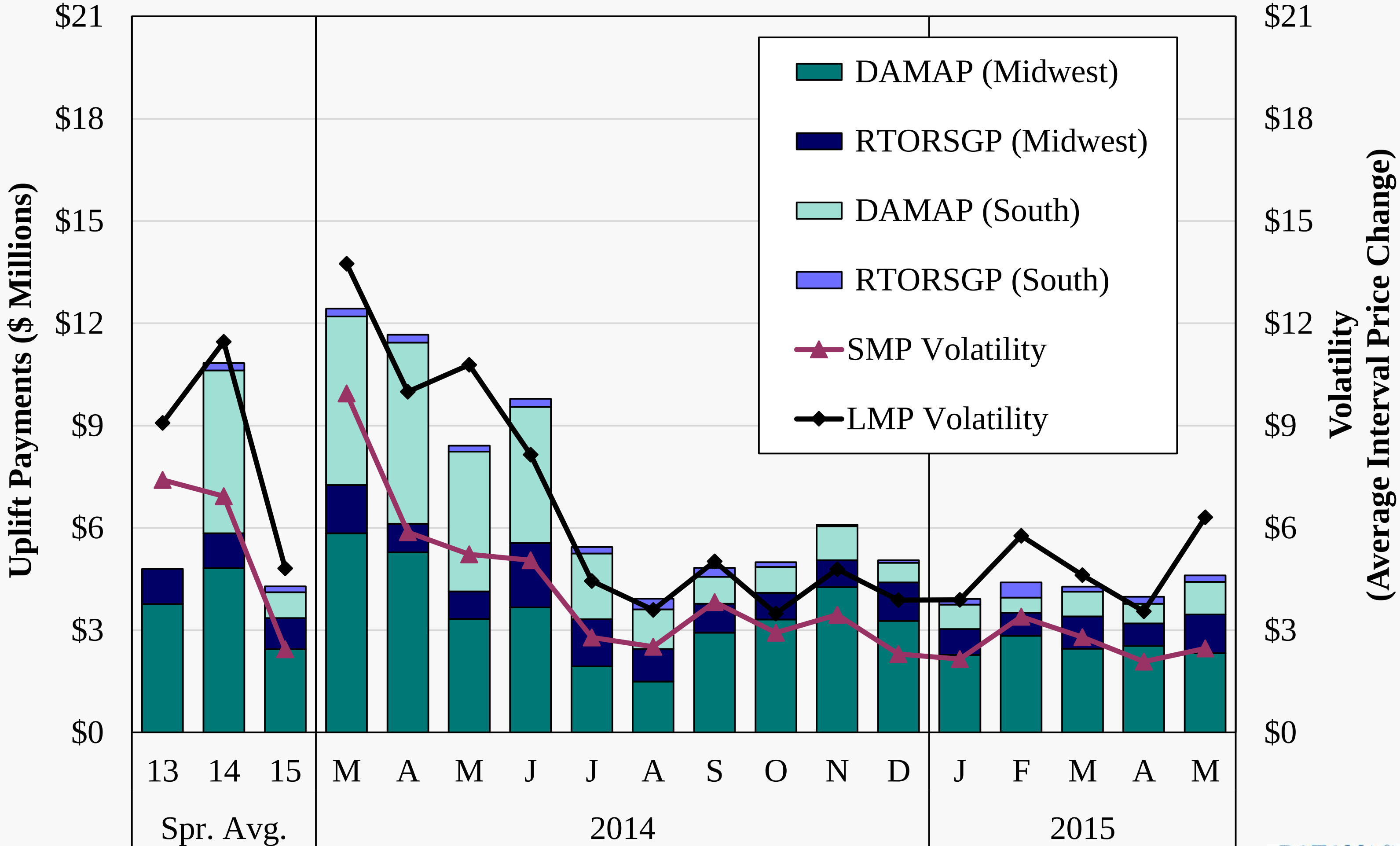
Price Volatility Make Whole Payments 2014–2015



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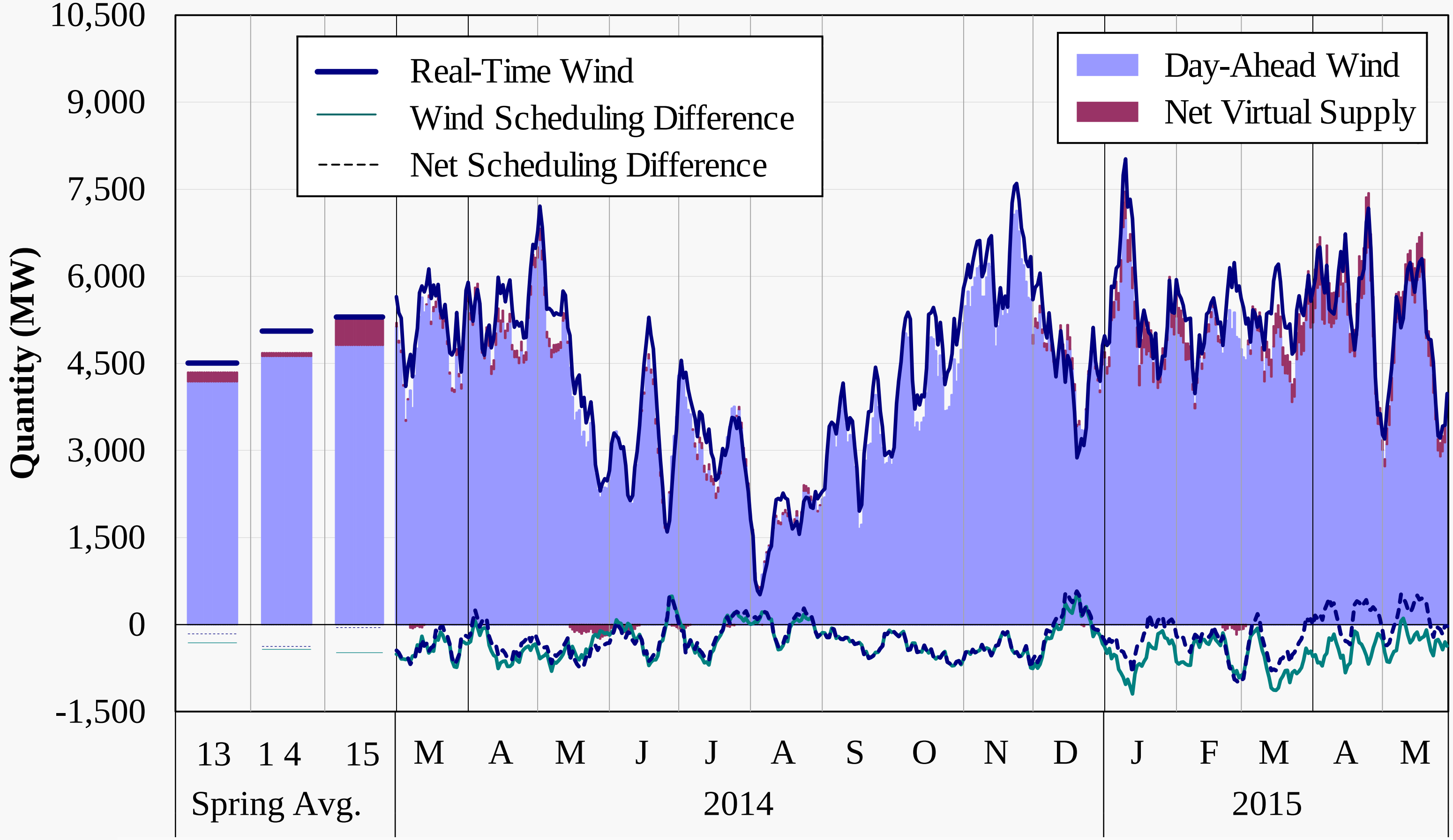
Wind Output in Real-Time and Day-Ahead Markets
7-Day Moving Average, 2014–2015



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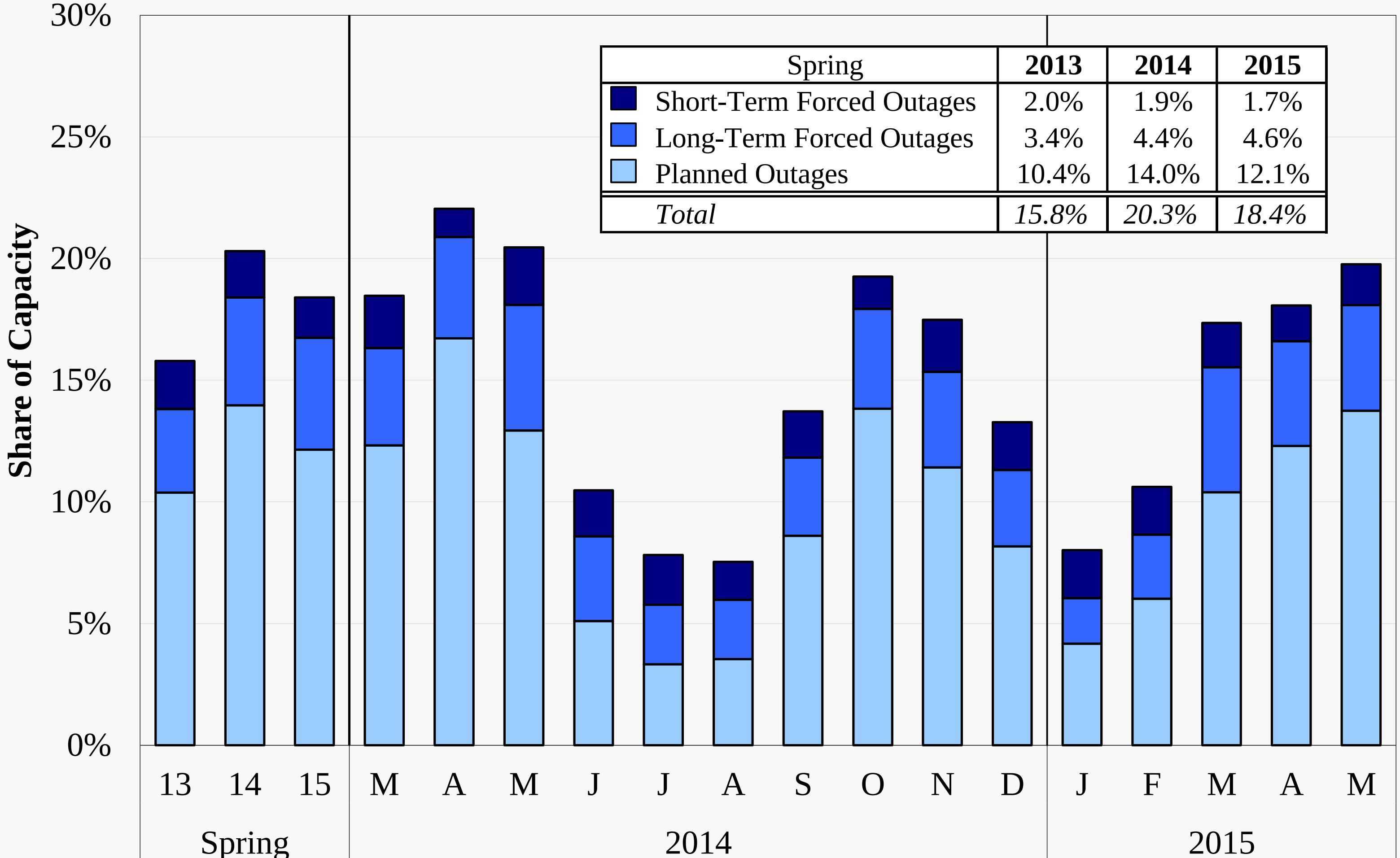
Generation Outage Rates
2014–2015



Spring	2013	2014	2015
Short-Term Forced Outages	2.0%	1.9%	1.7%
Long-Term Forced Outages	3.4%	4.4%	4.6%
Planned Outages	10.4%	14.0%	12.1%
Total	*15.8%*	*20.3%*	*18.4%*

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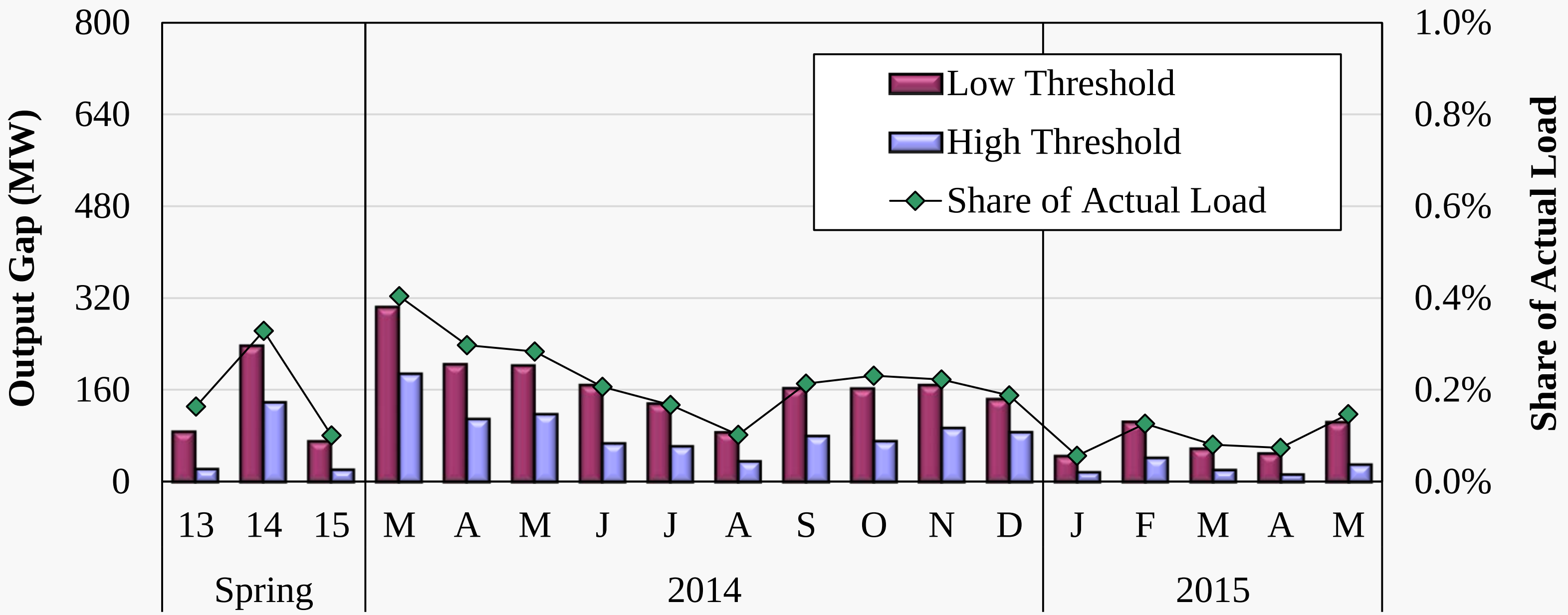
Monthly Output Gap 2014–2015



High Threshold Results by Unit Status (MW)

Offline	5	95	7	130	83	71	13	21	15	20	9	19	50	11	18	5	3	11
Online	18	43	15	57	26	46	54	41	21	60	62	75	36	6	24	16	10	19

Low Threshold Results by Unit Status (MW)

Offline	6	112	8	154	99	82	18	29	22	32	14	21	52	12	33	5	4	15
Online	81	125	63	150	105	120	150	107	65	131	149	147	92	34	72	53	46	90

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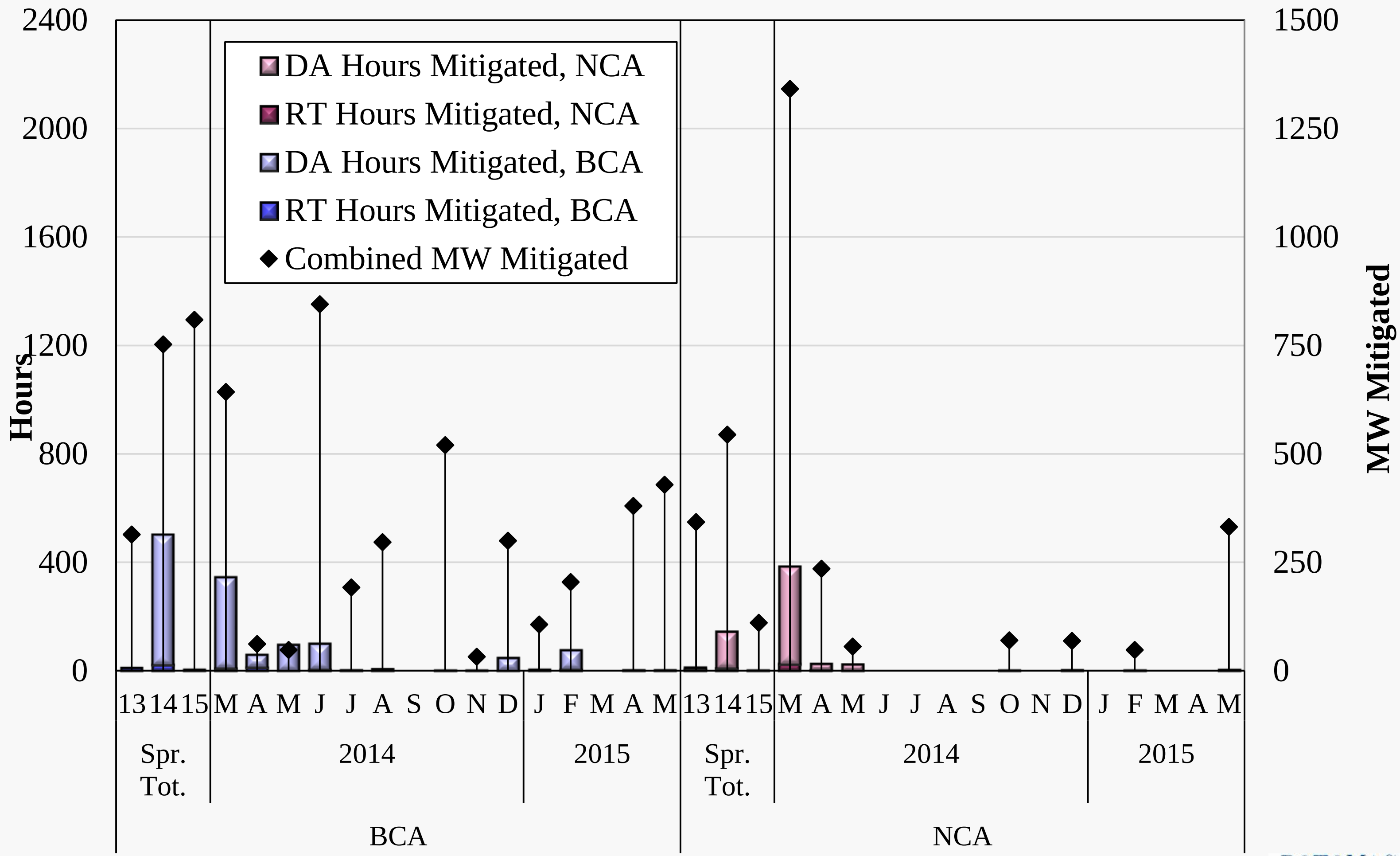
Day-Ahead And Real-Time Energy Mitigation 2014–2015



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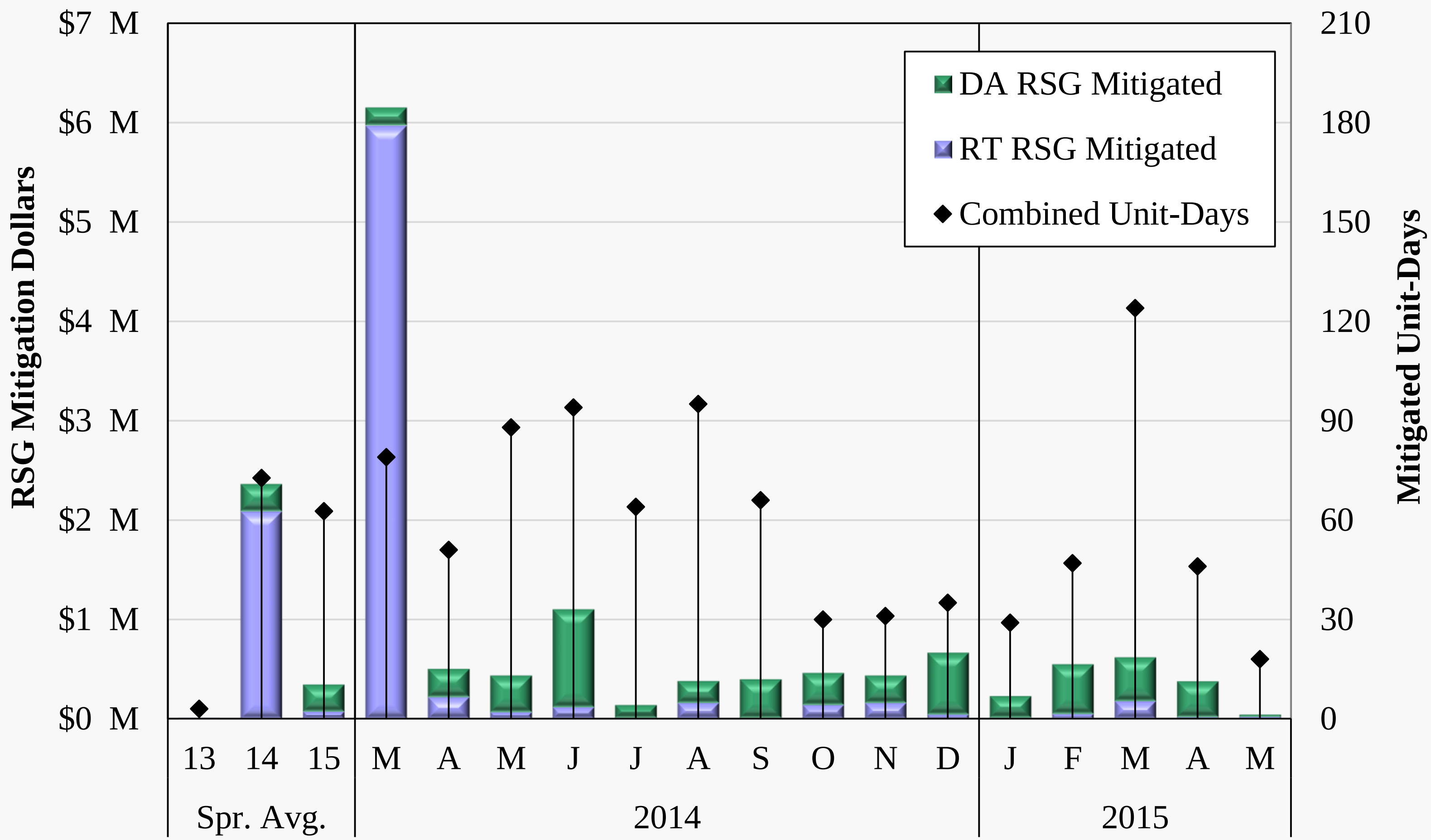
Day-Ahead and Real-Time RSG Mitigation 2014–2015



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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

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