IMM Quarterly Report: Winter 2020

MISO Independent Market Monitor

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Highlights and Findings: Winter 2020

- The MISO markets performed competitively this winter, market power mitigation was infrequent, and offers were competitive overall.
- Energy prices fell by 29 percent compared to last winter, attributable to:
  - ✓ Significantly lower natural gas prices;
  - ✓ Lower peak and average load throughout the quarter; and
  - ✓ No major emergency events this quarter, unlike during the prior two winters.
- Peak and average load were 6 and 3 percent lower this winter, respectively.
  - ✓ Temperatures were generally higher than normal throughout the quarter, and weather conditions were mild compared to prior years.
- MISO declared Conservative Operations and a Maximum Generation Alert in the South on February 21 because of cold temperatures that resulted in some delayed unit starts and load that exceeded the forecast.
  - ✓ MISO's declarations were appropriate and the system operated reliability.
- MISO's improvements in its uninstructed deviation make-whole payment rules continued to result in improved generator performance and lower deviations (down 8 percent from last winter).

Quarterly Summary

		Value	Change[1] Prior Qtr.	Change[1] Prior Year
RT Energy Prices ($/MWh)	🟣	$21.13	*-17%*	*-29%*
Fuel Prices ($/MMBtu)				
Natural Gas - Chicago	🟣	$1.92	*-12%*	*-40%*
Natural Gas - Henry Hub	🟣	$2.03	*-17%*	*-38%*
Western Coal	🟢	$0.69	*0%*	*-2%*
Eastern Coal	🟢	$1.32	*-3%*	*-26%*
Load (GW)[2]				
Average Load	🟣	75.5	*2%*	*-3%*
Peak Load	🟣	95.8	*-11%*	*-6%*
% Scheduled DA (Peak Hour)	🟢	98.8%	99.3%	99.1%
Transmission Congestion ($M)				
Real-Time Congestion Value	🟢	$139.1	*-55%*	*-21%*
Day-Ahead Congestion Revenue	🟢	$79.2	*-46%*	*-29%*
Balancing Congestion Revenue[3]	🟢	-$2.2	$4.4	-$1.6
Ancillary Service Prices ($/MWh)				
Regulation	🟢	$7.17	*-11%*	*-19%*
Spinning Reserves	🟢	$1.70	*-25%*	*-23%*
Supplemental Reserves	🟢	$0.27	*-55%*	*-50%*

		Value	Change[1] Prior Qtr.	Change[1] Prior Year
FTR Funding (%)	🟢	98%	96%	99%
Wind Output (MW/hr)	🟣	8,125	*10%*	*22%*
Guarantee Payments ($M)[4]				
Real-Time RSG	🟣	$7.3	*-51%*	*-76%*
Day-Ahead RSG	🟢	$6.7	*-3%*	*-57%*
Day-Ahead Margin Assurance	🟣	$4.2	*-41%*	*-61%*
Real-Time Offer Rev. Sufficiency	🟢	$0.2	*-64%*	*-55%*
Price Convergence[5]				
Market-wide DA Premium	🟢	2.0%	-2.0%	0.0%
Virtual Trading				
Cleared Quantity (MW/hr)	🟢	15,375	*-5%*	*-11%*
% Price Insensitive	🟢	26%	30%	34%
% Screened for Review	🟢	0%	1%	1%
Profitability ($/MW)	🟢	$0.26	$0.38	$0.67
Dispatch of Peaking Units (MW/hr)	🟢	825	904	610
Output Gap- Low Thresh. (MW/hr)	🟢	26	53	78
Other:				

Key:
- 🟢 Expected
- 🟣 Monitor/Discuss
- 🔴 Concern

Notes:
1. Values not in italics are the values 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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Highlights for Winter 2020

<u>Significant Drop in Natural Gas Prices (Slides 12, 13, 15, 32, 33, 40)</u>

- Natural gas prices continued to decline, falling 15 percent from last quarter and 39 percent from last winter.
  - ✓ Gas prices were the lowest of any winter quarter in the past 10 years.
  - ✓ Although year-over-year gas consumption increased, surging production put downward pressure on gas prices through the winter.
- Lower gas prices this winter had a wide array of impacts:
  - ✓ Energy prices were much lower than in recent winters;
  - ✓ RSG payments fell by two-thirds;
  - ✓ Price Volatility Make-Whole payments declined more than 60 percent; and
  - ✓ Day-ahead and real-time congestion fell 29 and 21 percent, respectively.
- Lower gas prices also affected the commitment and dispatch of MISO's resources – gas resources increasingly displaced output from coal resources.

Highlights for Winter 2020

Maximum Generation Alert on 2/21 (Slide 20)

- A Maximum Generation Alert was called in the South during the morning ramp hours on February 21.
  - ✓ Cold weather contributed to delayed unit starts and rapidly increasing load.
  - ✓ MISO accurately anticipated the conditions and its actions were appropriate.
  - ✓ The RDT was tight, and this event still highlights the need for better analysis and communication with SPP regarding the flows over the RDT.

Coal Resource Commitment (Slides 17, 19)

- As gas prices have declined, the costs of running many natural gas resources have become comparable to running coal resources.
- This has prompted coal suppliers to change their offer patterns:
  - ✓ Resources are being offered economically more often ("must run" status less often) and more frequently not being scheduled day-ahead (down 19%).
  - ✓ Almost two-thirds of coal units are still offered in as "must-run" – almost all are online and this is a rational means to avoid cycling uneconomically.
  - ✓ Three-quarters of offline coal units are starting offer economically.

Highlights for Winter 2020

<u>Revenue Sufficiency Guarantee Payments (Slides 32, 33)</u>

- Nominal real-time RSG fell 76 percent from last winter.
  - ✓ Emergency events in January 2019 and high gas prices at the end of February 2019 contributed to higher than normal real-time RSG last year.
- Day-ahead RSG fell by 57 percent, in part because a new combined-cycle unit in MISO South helped to reduce VLR uplift by $3 million.
- Although RSG fell overall, payments for transmission-related commitments were $3.6 million in December, continuing an upward trend begun in October.
  - ✓ Resources receiving these payments were committed based on an outage study that was completed in September for an outage ending in December.
- We recommend MISO consider the following:
  - ✓ Developing criteria / triggers based on system or network conditions to revisit outage study-based commitments; and
  - ✓ Including such commitments in the day-ahead market to: a) allow the day-ahead market to produce more efficient commitments, and b) prevent price suppression in real time.

Highlights for Winter 2020

<u>Transmission Line-Loading Relief called by IESO (Slide 21)</u>

- IESO called TLRs multiple times on the Michigan–Ontario interface, causing episodic high prices in Michigan and market-wide price increases.
- Although MISO generally did not get a market flow reduction, IESO’s TLR curtailed 162 GW of imports from PJM across 80 hours. These curtailments resulted in:
  - ✓ Hourly market-wide energy prices (i.e., system marginal prices) that exceeded \$370 per MWh.
  - ✓ Losses by participants that had scheduled imports from PJM in the day-ahead market of almost \$3.5 million.
- We understand from discussions with MISO that the TLRs may have been called because loop flows exceeded the PARS’ ability to control, not because the interface was overloaded.
  - ✓ If true, we are concerned that these TLRs and associated costs were not warranted.
  - ✓ MISO is in discussions with IESO (and other RTOs, PJM and NYISO) regarding the criteria that should be used to call TLRs in the future.

Highlights for Winter 2020

<u>Wind Output and Forecasting (Slides 26, 27, 28)</u>

- Wind capacity increased 2 GW and output grew 22 percent from last winter.
  - ✓ On February 22, MISO hit a new all-time peak wind record at over 17 GW.
  - ✓ On January 29, conversely, there was no wind output in the entire footprint.
- About 90 percent of wind resources switched to MISO’s forecast after the May 2019 settlement changes went into effect.
  - ✓ This change increased the importance of an accurate MISO wind forecast.
- MISO previously adopted the higher of its vendor forecast or wind resources’ current output as its forecast, resulting in biased forecasts.
  - ✓ On February 3, MISO adopted our recommendation and eliminated the “higher-of” forecast logic in favor of exclusive use of the vendor forecast.
  - ✓ This eliminated the persistent over-forecast bias and reduced the absolute wind forecasting error, most significantly during the ramp-down periods.
- On February 15, MISO worked with the wind vendor to correct an issue related to the processing of outage schedules.
  - ✓ This fix improved the vendor forecast accuracy.

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Highlights for Winter 2020

<u>Impacts of Online ELMP (Slides 38)</u>

- MISO improved real-time ELMP on Nov. 1 by allowing Fast Start Resources committed in the day-ahead market to participate in all-in real-time pricing.
  - ✓ The average effect of the online ELMP pricing during peak hours was $0.24 per MWh this quarter – much higher than the $0.01 that would have prevailed under the prior ELMP methodology.
  - ✓ However, ELMP had an overall effect of $-0.02 on energy prices as the negative effects of offline pricing outweighed online resource pricing.

<u>Impacts of Offline ELMP</u>

- Offline resource participation in ELMP reduced prices by 38 percent in the 54 real-time market intervals exhibiting an ancillary service shortage this winter.
  - ✓ This reduction averaged $110 per MWh.
  - ✓ In these cases, MISO's reserve demand curves should set the price because offline units did not (or could not) actually start up and alleviate the shortage.
- Suppression of shortage pricing harms flexible resources and could provide a disincentive to building flexible resources in MISO, which is in conflict with the objectives of MISO's RAN initiative.

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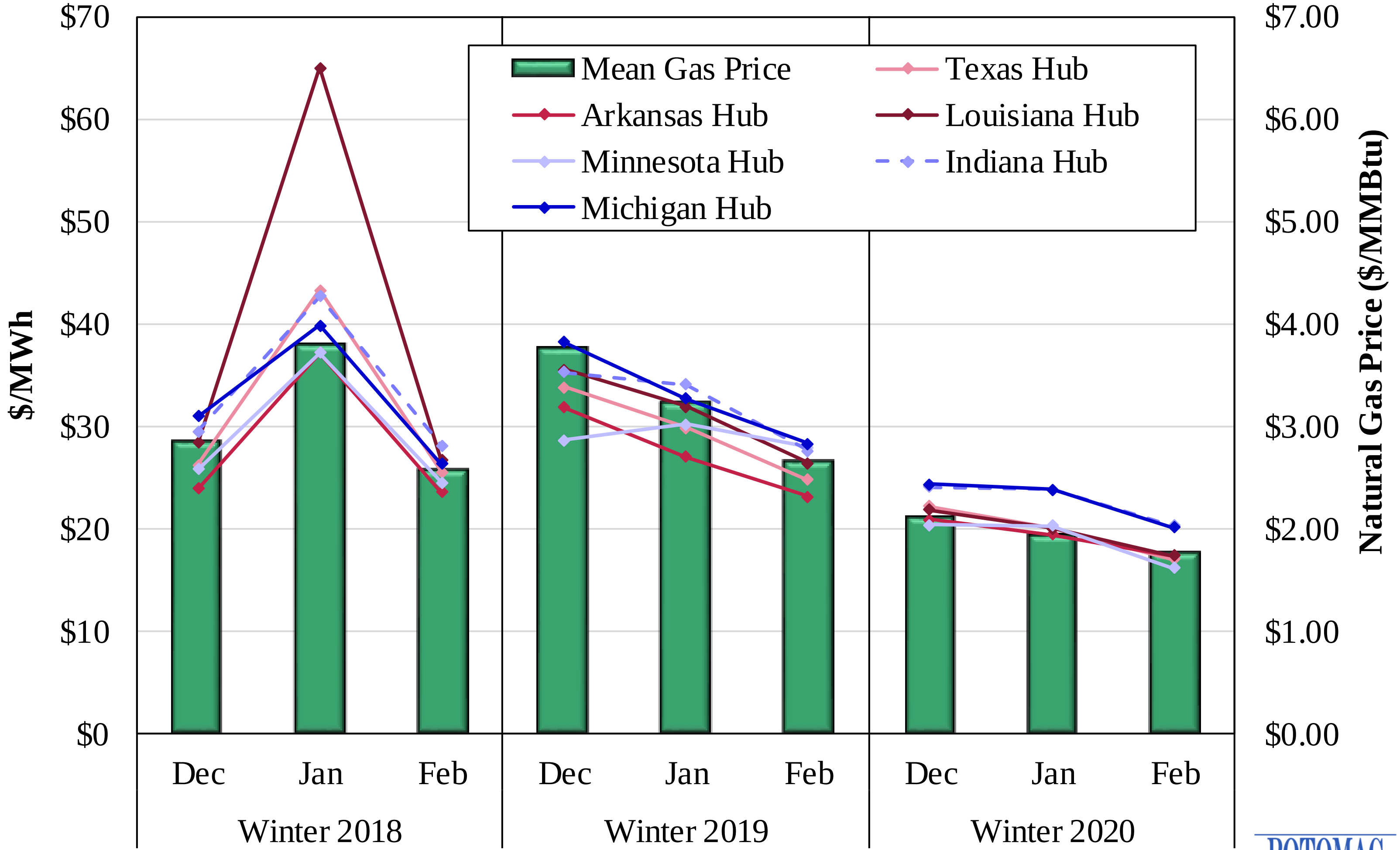
Submittals to External Entities and Other Issues

- We responded to FERC questions related to prior referrals and FERC investigations, and we continued to meet with FERC on a weekly basis.
- We continued to provide comments related to the FERC Technical Conference on Grid Enhancing Technologies.
- We provided comments on MISO's RAN initiatives related to LMR accreditation and LOLE modeling.
- We participated in RASC meetings to discuss ICAP deliverability issues.
  - ✓ We have been consulting with MISO and participants in the Resource Adequacy Subcommittee to address the flaw in MISO's deliverability rules.
- We provided an update on development of improvements to the market power mitigation measures in Module D of the Tariff to the MSC.
- We presented several new initiatives to stakeholders at the Integrated Roadmap workshop and provide comments on overall prioritization.
  - ✓ These will also appear as recommendations in the IMM SOM.

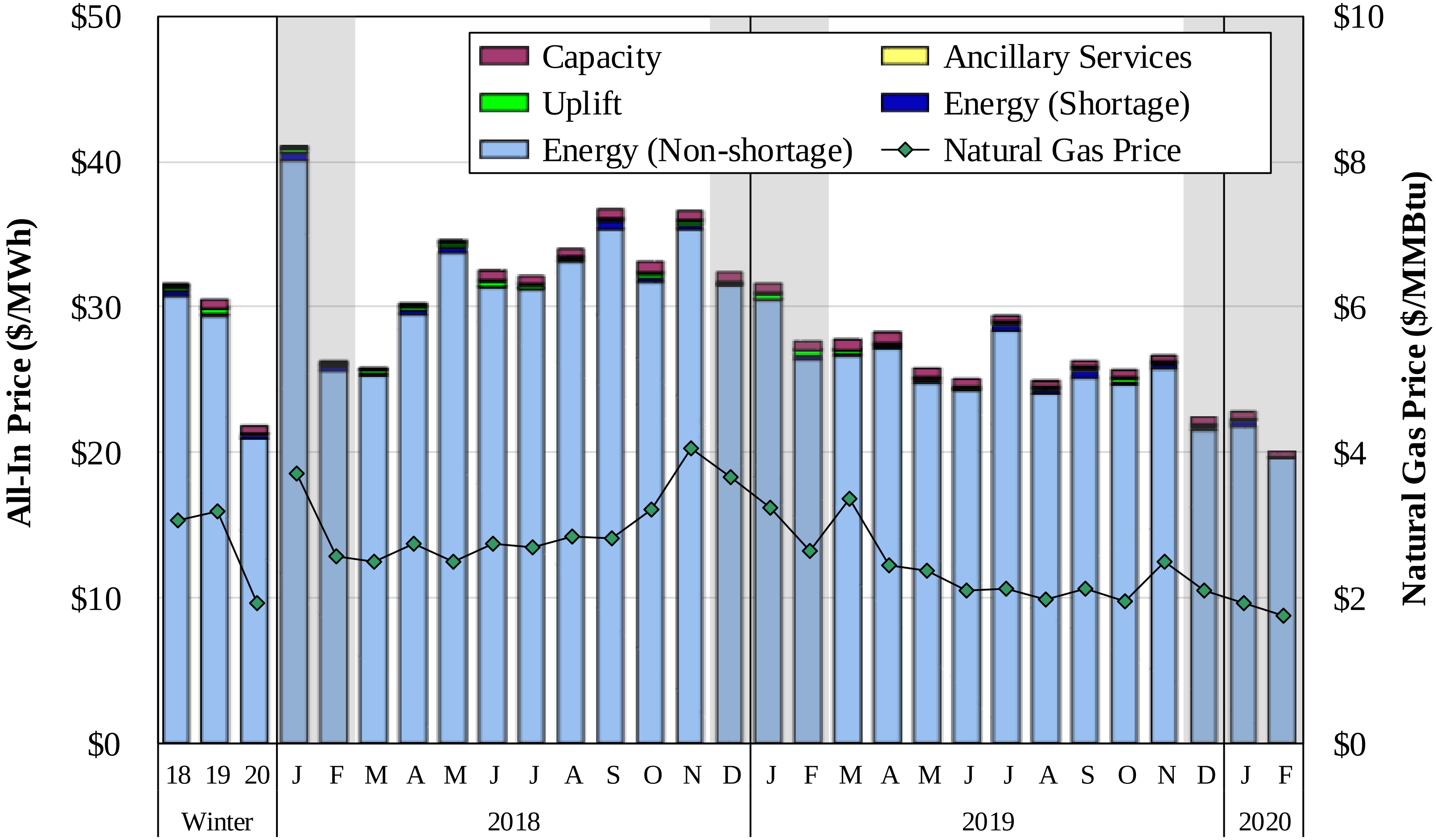
Submittals to External Entities and Other Issues

- We continued working with the SPP MMU and MISO on the Tier 1 items prioritized for study and have begun planning for Tier 2 items.
  - ✓ Two initial Tier 1 reports have been completed and drafts have been provided to the States: Joint Dispatch Study and Rate Pancaking Study.
  - ✓ The Tier 1 study of market-to-market coordination has been delayed because of SPP data limitations – we hope to complete the study in early April.
  - ✓ We have also begun work on the Tier 2 Interface Pricing report and hope to complete this report in April as well.
- In February, we presented a summary of MISO South market results and issues to the Entergy Regional State Committee.

Day-Ahead Average Monthly Hub Prices Winter 2018 – 2020



All-In Price
Winter 2018 – 2020



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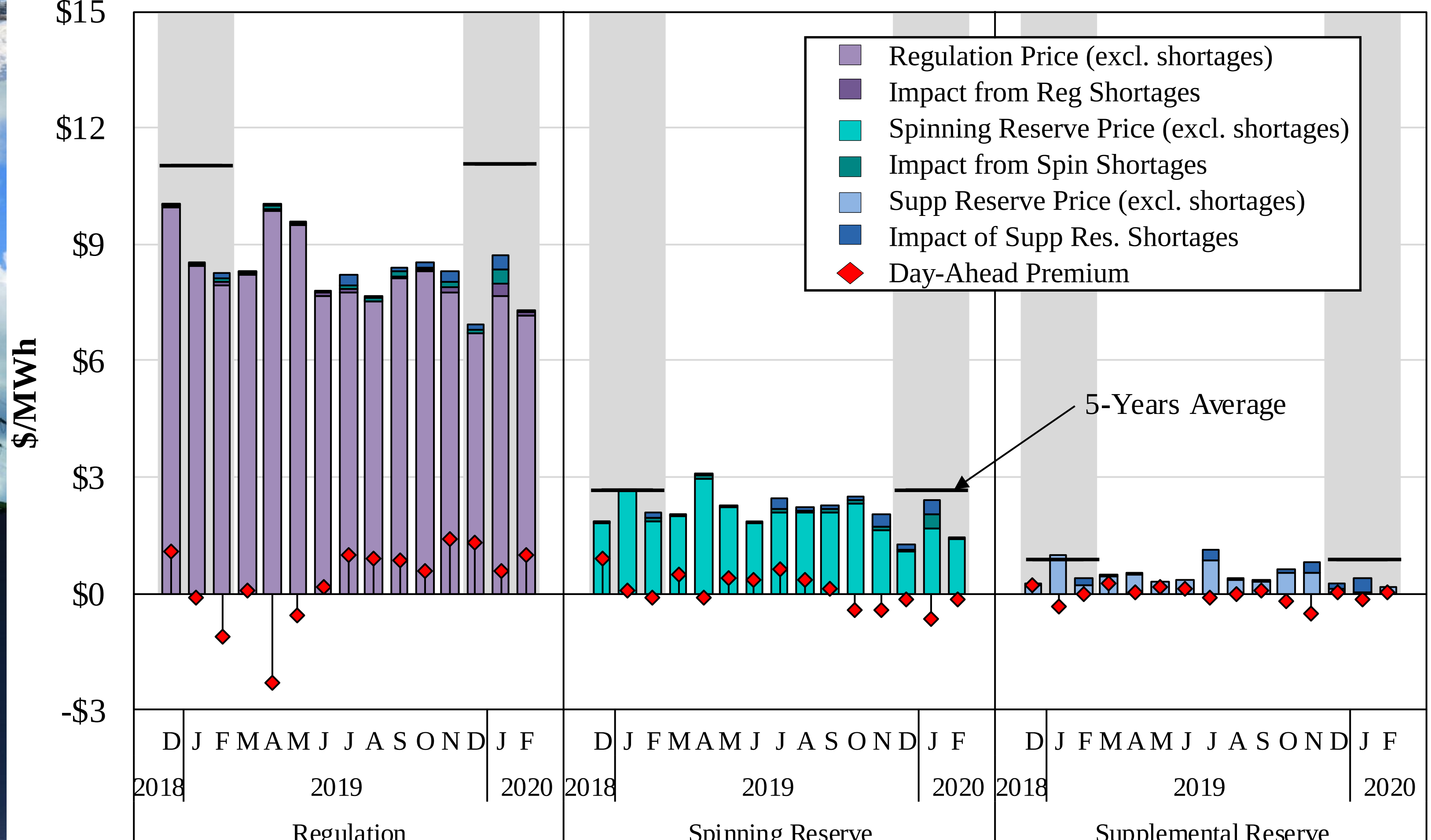
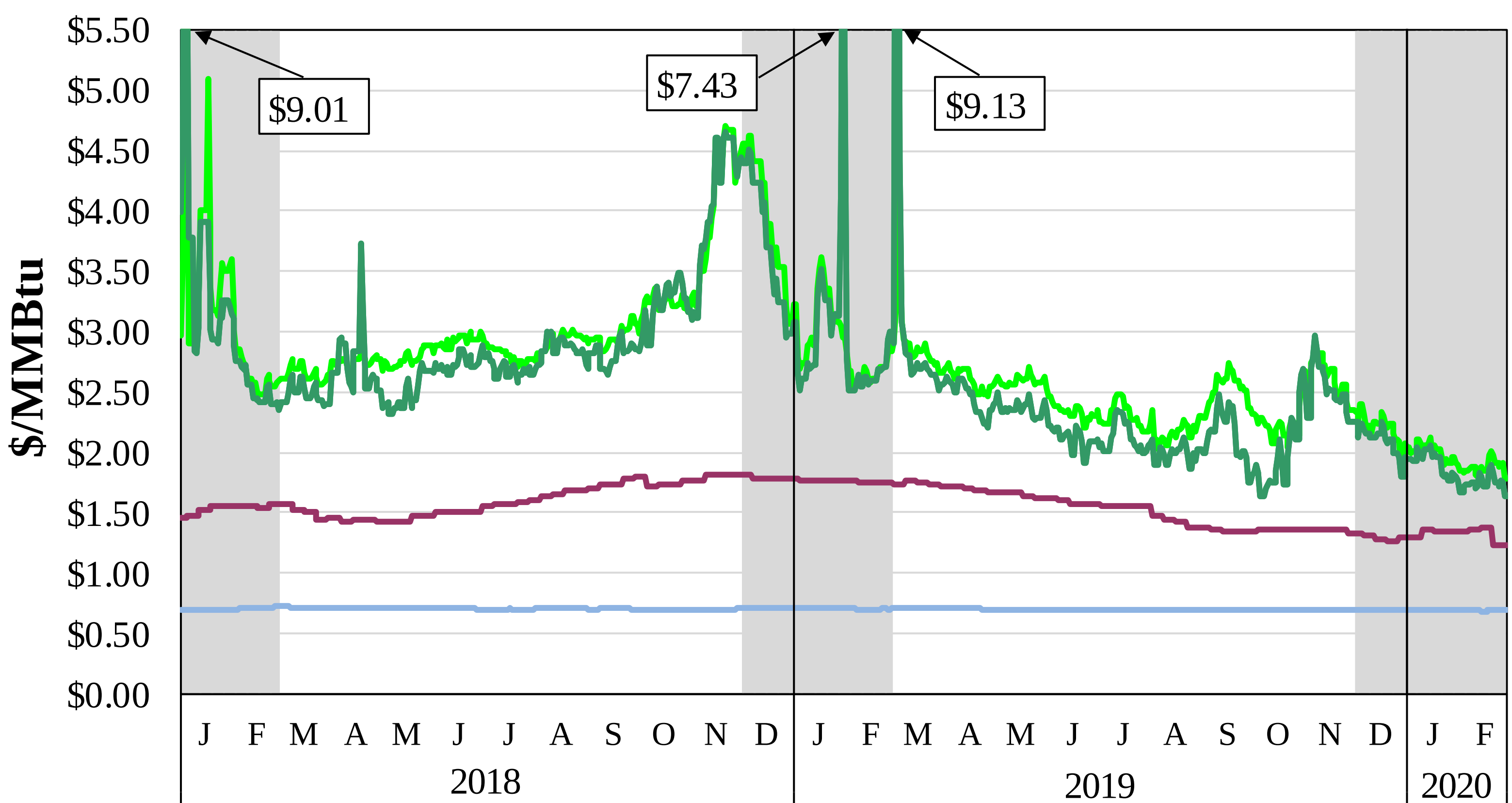
Monthly Average Ancillary Service Prices 2018 – 2020



MISO Fuel Prices
2018 – 2020



Winter Average	2018	2019	2020
Chicago NG	$3.08	$3.22	$1.92
Henry NG	$3.08	$3.24	$2.03

Winter Average	2018	2019	2020
IB Coal	$1.51	$1.77	$1.32
PRB Coal	$0.70	$0.70	$0.69

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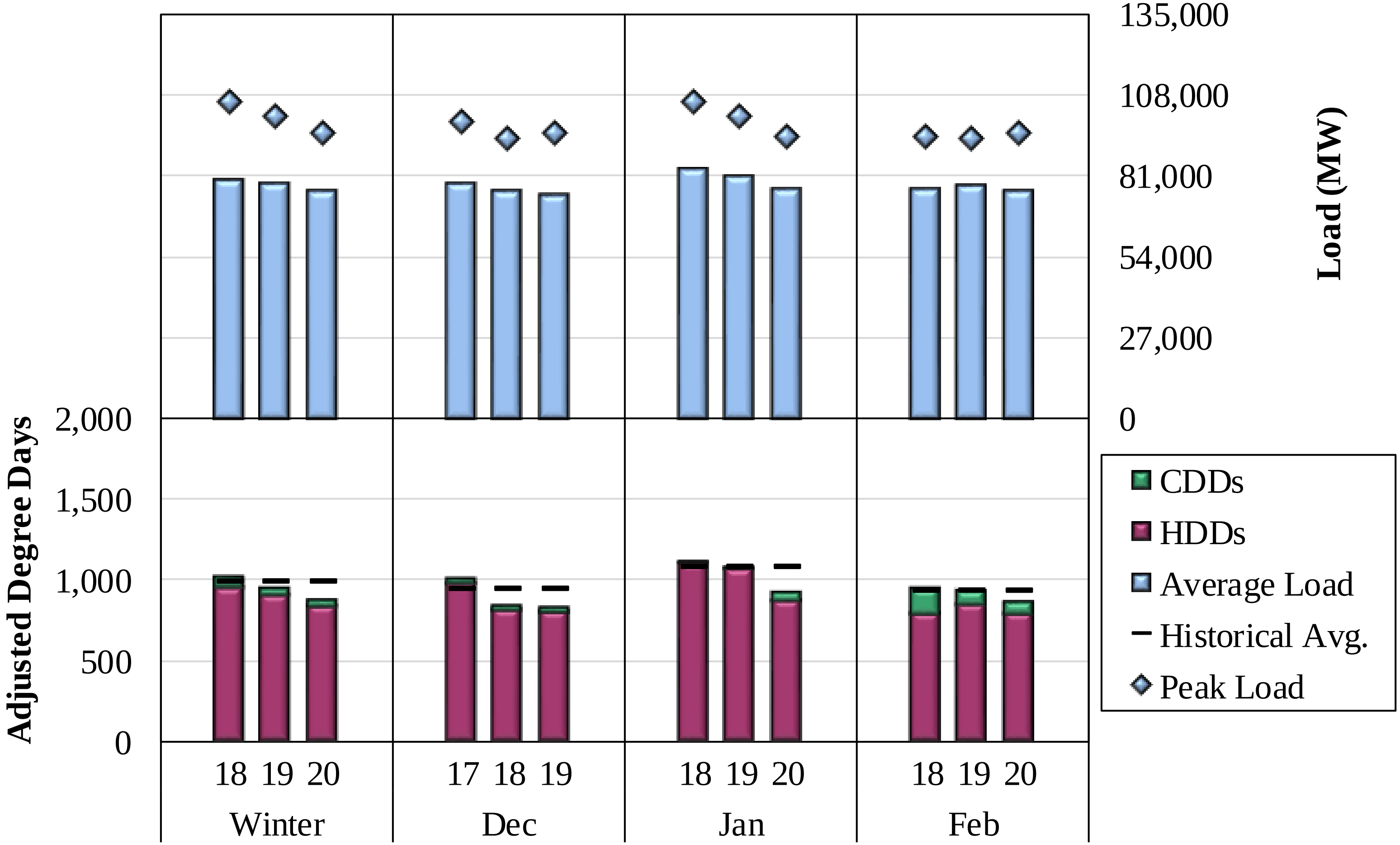
Load and Weather Patterns
Winter 2018 – 2020

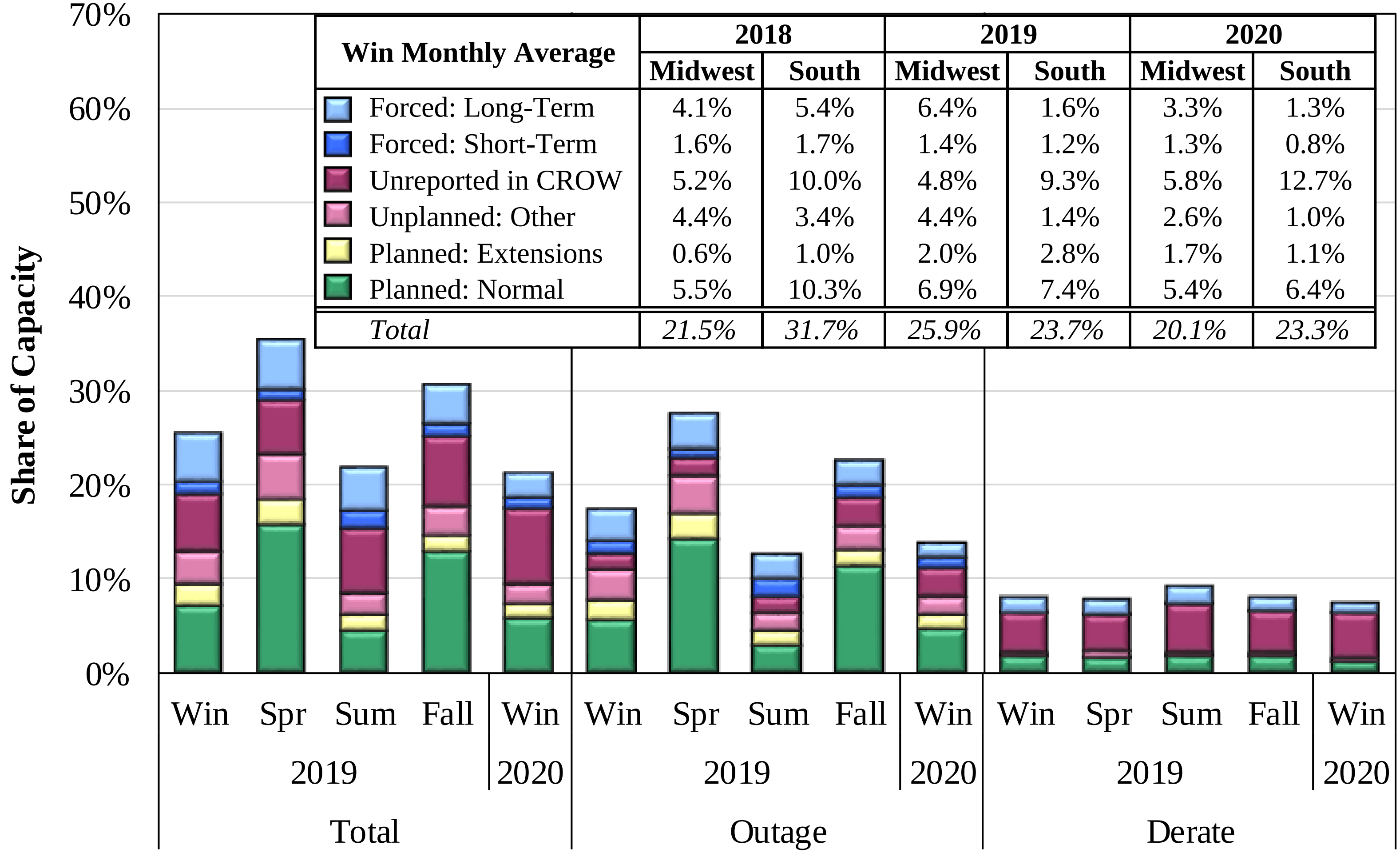


Note: Midwest degree day calculations include four representative cities in the Midwest: Indianapolis, Detroit, Milwaukee and Minneapolis. The South region includes Little Rock and New Orleans.

Capacity, Energy and Price Setting Share Winter 2019 – 2020

Winter	Unforced Capacity				Energy Output		Price Setting			
	Total (MW)		Share (%)		Share (%)		SMP (%)		LMP (%)	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Nuclear	12,225	12,107	10%	9%	16%	19%	0%	0%	0%	1%
Coal	48,775	46,864	38%	37%	47%	34%	48%	45%	86%	91%
Natural Gas	55,240	56,673	43%	44%	24%	34%	51%	52%	96%	98%
Oil	1,691	1,568	1%	1%	0%	0%	0%	0%	0%	0%
Hydro	3,966	4,034	3%	3%	1%	2%	0%	1%	1%	2%
Wind	3,005	3,660	2%	3%	9%	11%	0%	2%	39%	58%
Other	2,678	2,703	2%	2%	2%	1%	0%	0%	2%	1%
Total	**127,580**	**127,608**								

Generation Outage and Derate Rates Winter 2019 – 2020



Win Monthly Average	2018 Midwest	2018 South	2019 Midwest	2019 South	2020 Midwest	2020 South
Forced: Long-Term	4.1%	5.4%	6.4%	1.6%	3.3%	1.3%
Forced: Short-Term	1.6%	1.7%	1.4%	1.2%	1.3%	0.8%
Unreported in CROW	5.2%	10.0%	4.8%	9.3%	5.8%	12.7%
Unplanned: Other	4.4%	3.4%	4.4%	1.4%	2.6%	1.0%
Planned: Extensions	0.6%	1.0%	2.0%	2.8%	1.7%	1.1%
Planned: Normal	5.5%	10.3%	6.9%	7.4%	5.4%	6.4%
Total	*21.5%*	*31.7%*	*25.9%*	*23.7%*	*20.1%*	*23.3%*

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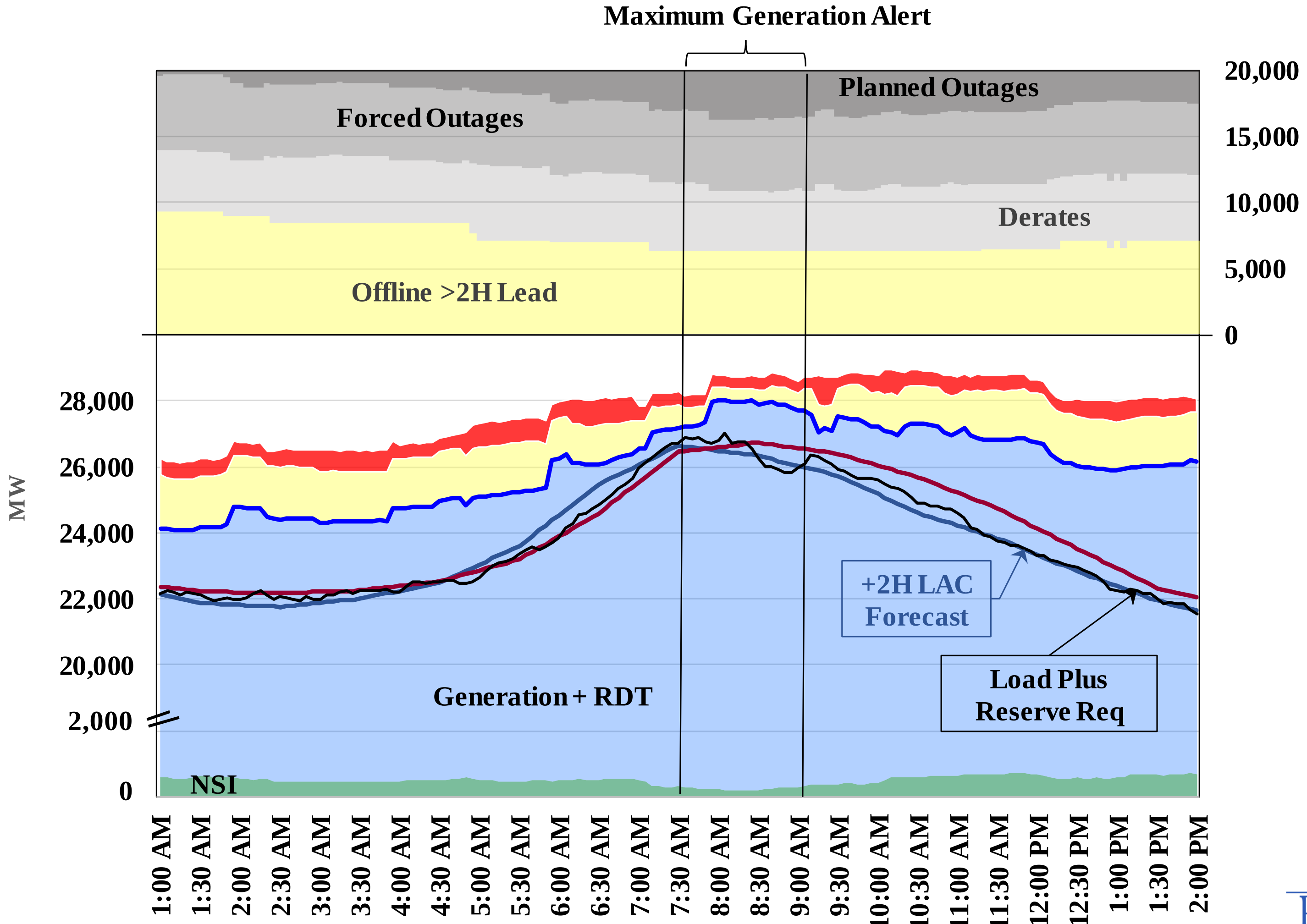
Change in Coal Offer Patterns
Winter 2019 – 2020

	2019		2020		Change
Coal Resources Offered Day-Ahead	**MW**	**%**	**MW**	**%**	**in %**
Must-Run Commitment Status	**34,879**	***79%***	**27,628**	***63%***	*-16%*
Economic Commitment Status	**9,397**	***21%***	**16,093**	***37%***	***16%***
Scheduled Day-Ahead	6,320	*14%*	4,577	*10%*	*-4%*
Not Scheduled Day-Ahead - Offline in RT	3,077	*7%*	11,516	*26%*	*19%*
Not Scheduled Day-Ahead - but Online in RT	1,325	*3%*	1,568	*4%*	*1%*
Total Coal Capacity Offered	**44,276**		**43,720**		

Maximum Generation Alert
MISO South February 21, 2020



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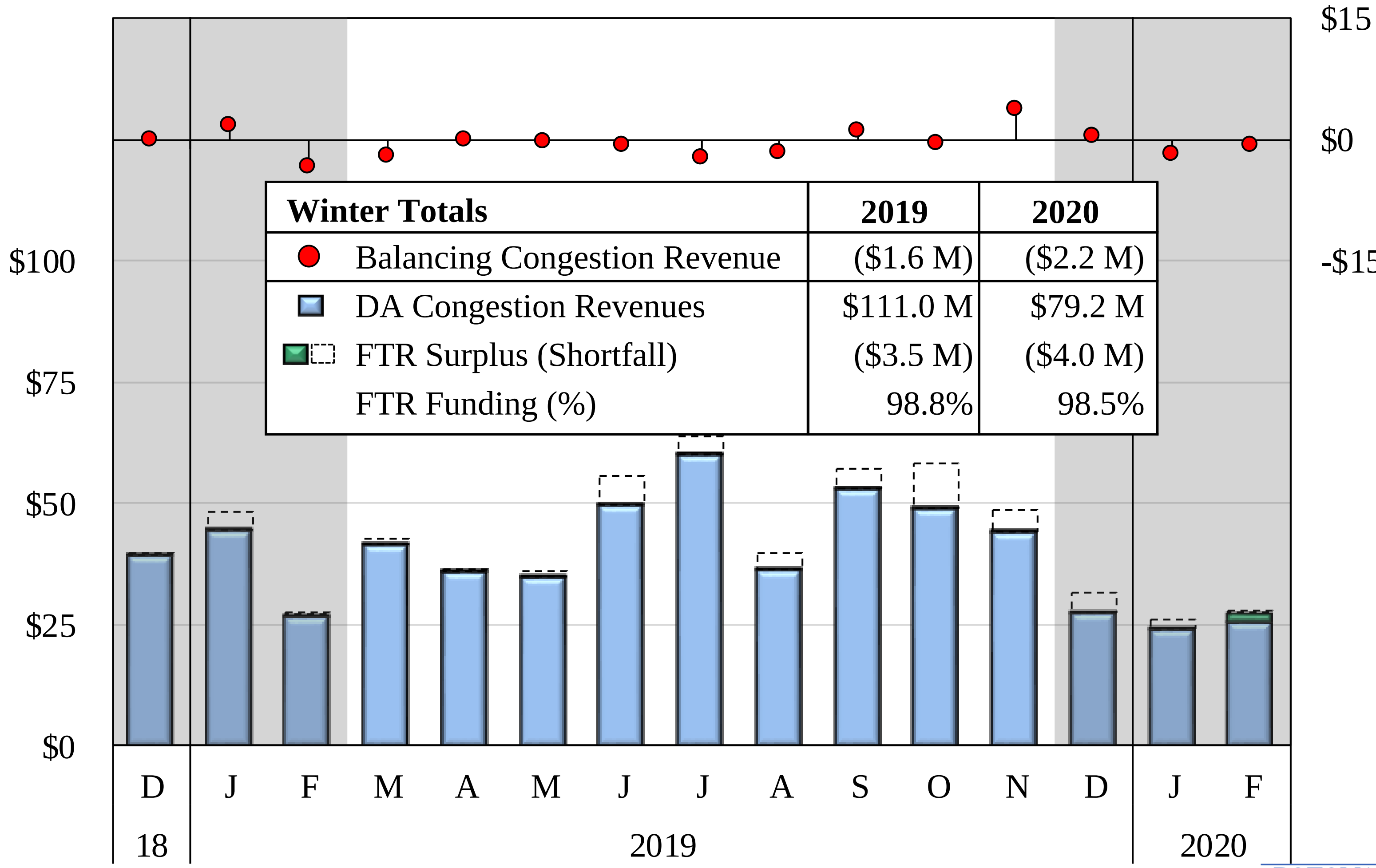
IESO TLRs and Curtailments Called in January and February

Date	TLR Hours	PJM Imports Curtailed (MW/hr)	Max Hourly Ex-Post SMP	Market Participant NSI Losses ($)
01/06/2020	11	1,033	$49	$ (30,170)
01/08/2020	5	837	$100	$ (101,662)
01/11/2020	16	2,004	$371	$ (1,335,473)
01/12/2020	16	3,611	$141	$ (1,117,291)
01/24/2020	14	1,959	$90	$ (383,559)
02/27/2020	10	2,187	$117	$ (487,714)
02/28/2020	8	901	$56	$ (29,860)
Average/Total		**2,024**	**$132**	**$ (3,485,729)**

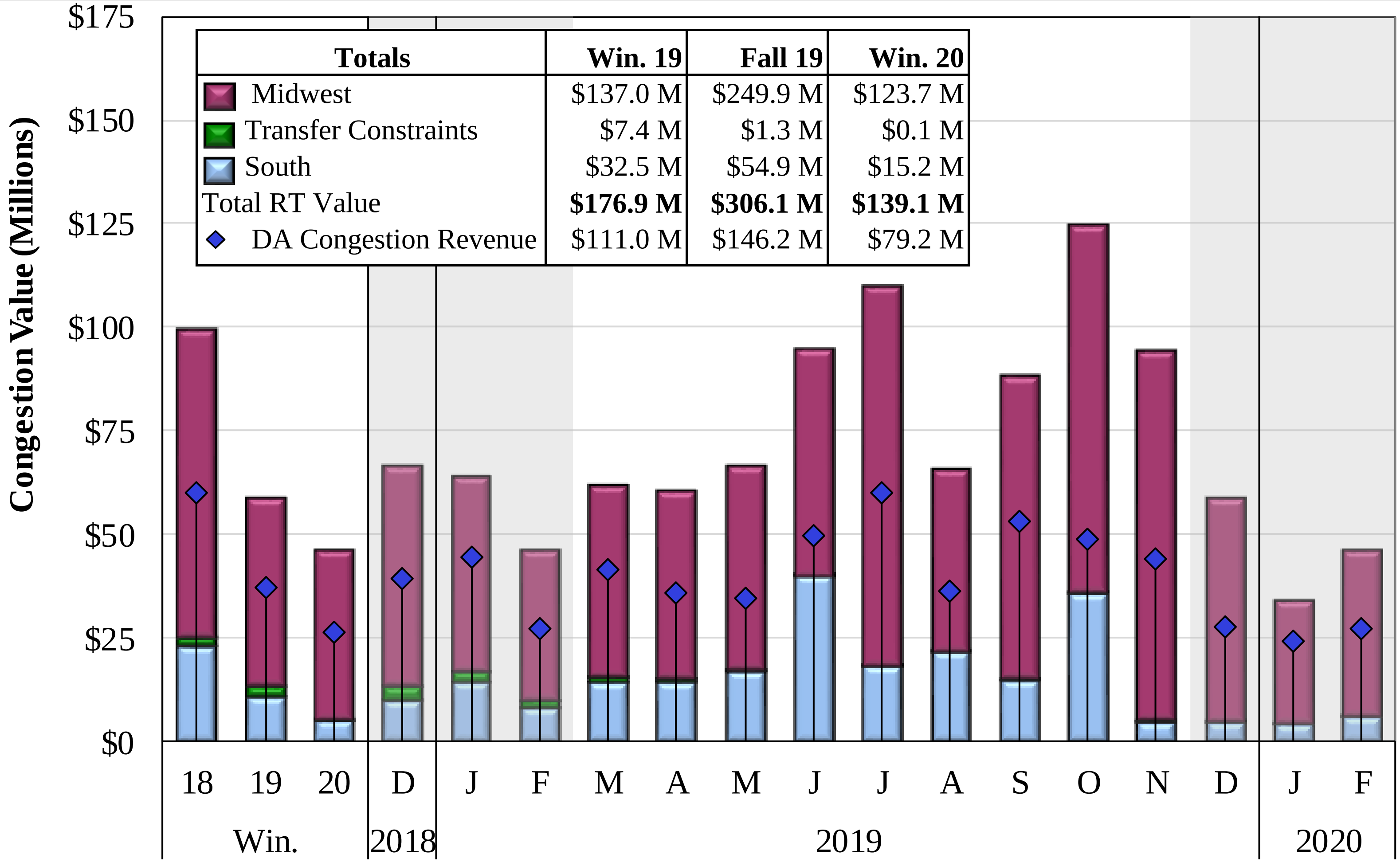
Note: TLR was also called 2/3/2020, but is not shown due to low impacts.

Day-Ahead Congestion, Balancing Congestion and FTR Underfunding, 2018 – 2020



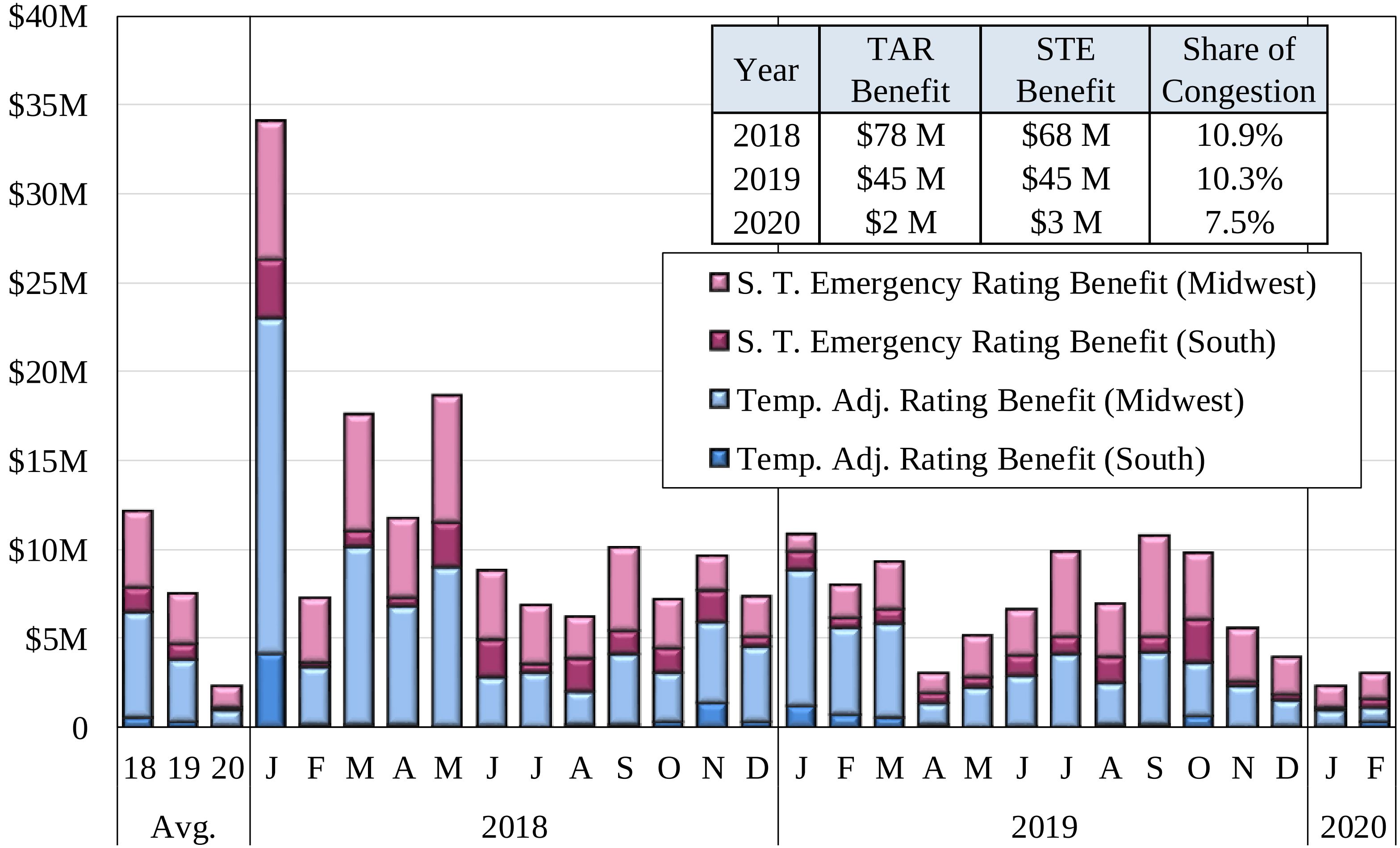
Winter Totals	2019	2020
Balancing Congestion Revenue	($1.6 M)	($2.2 M)
DA Congestion Revenues	$111.0 M	$79.2 M
FTR Surplus (Shortfall)	($3.5 M)	($4.0 M)
FTR Funding (%)	98.8%	98.5%

Value of Real-Time Congestion Winter 2018 – 2020



Totals	Win. 19	Fall 19	Win. 20
Midwest	$137.0 M	$249.9 M	$123.7 M
Transfer Constraints	$7.4 M	$1.3 M	$0.1 M
South	$32.5 M	$54.9 M	$15.2 M
Total RT Value	**$176.9 M**	**$306.1 M**	**$139.1 M**
DA Congestion Revenue	$111.0 M	$146.2 M	$79.2 M

Transmission Ratings Benefits 2018 – 2020



Year	TAR Benefit	STE Benefit	Share of Congestion
2018	$78 M	$68 M	10.9%
2019	$45 M	$45 M	10.3%
2020	$2 M	$3 M	7.5%

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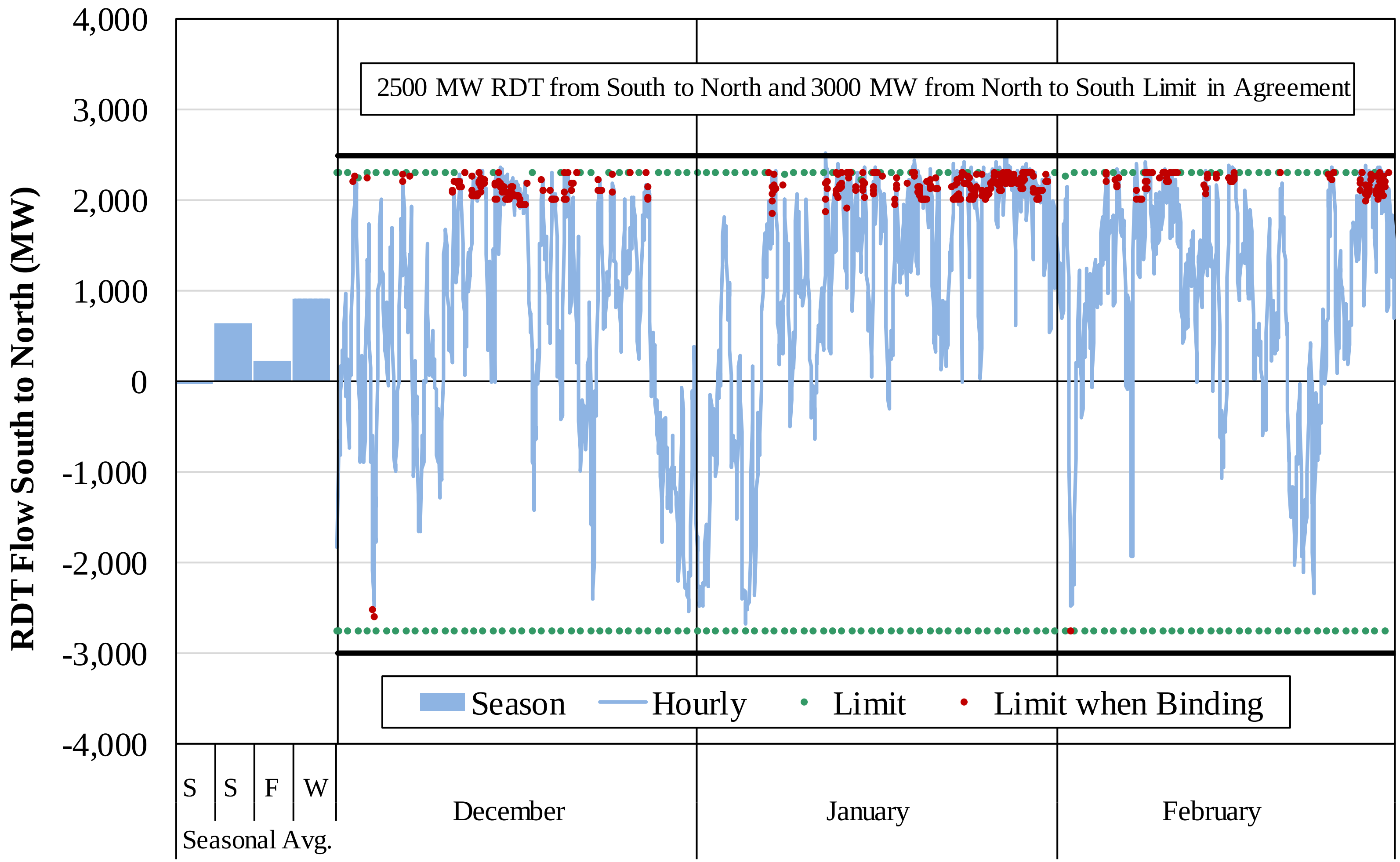
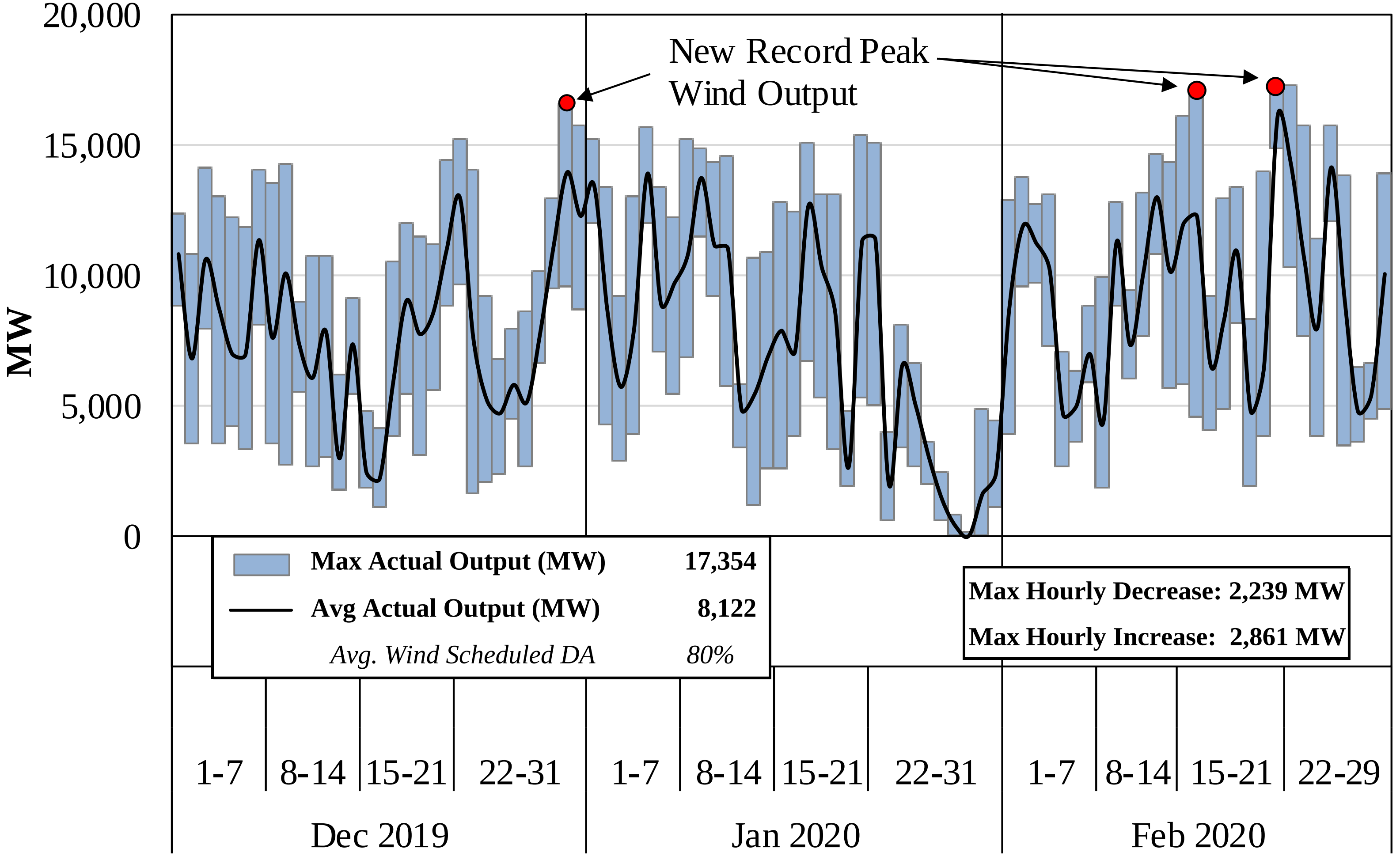
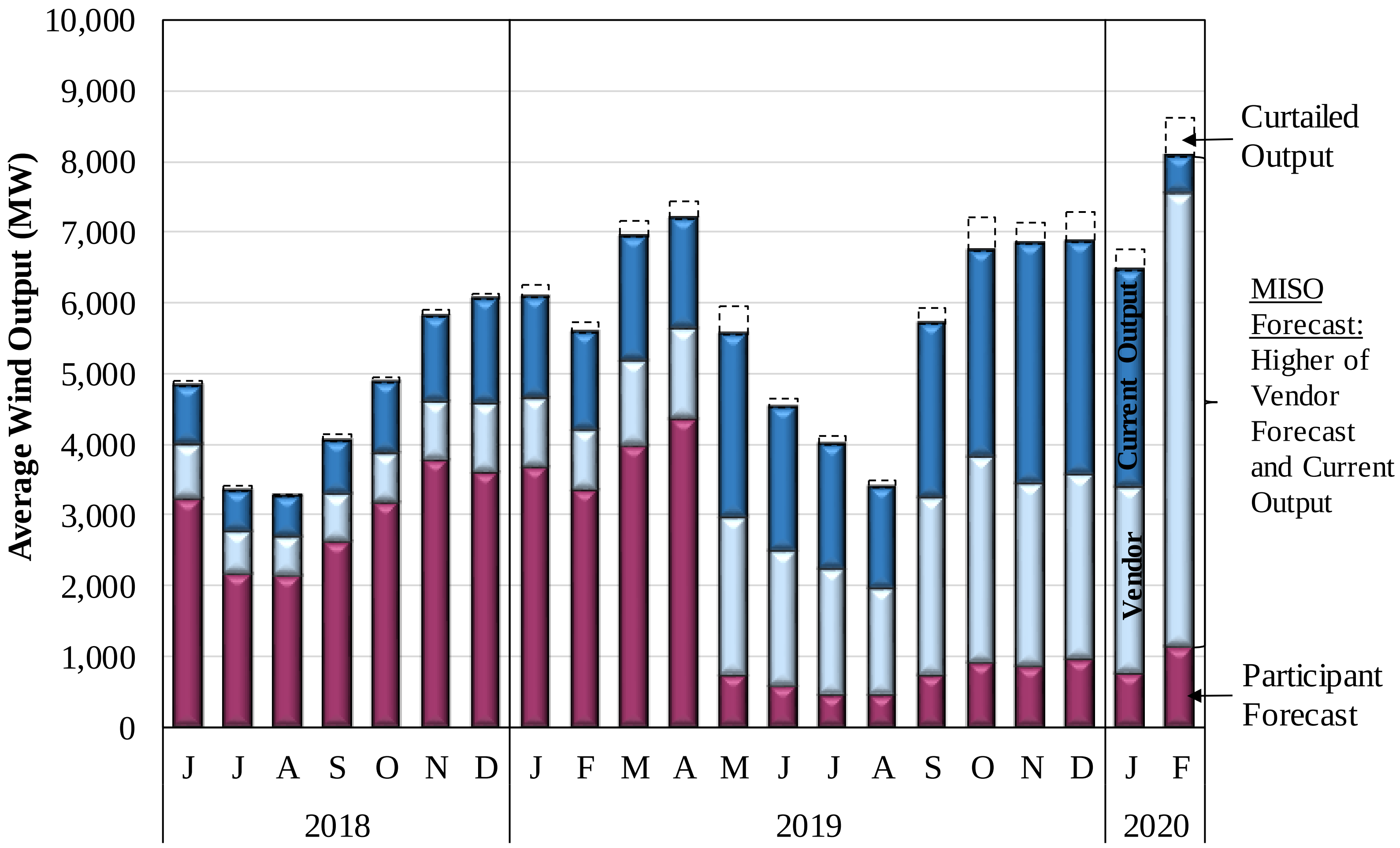
Real-Time Hourly Inter-Regional Flows
Winter 2020



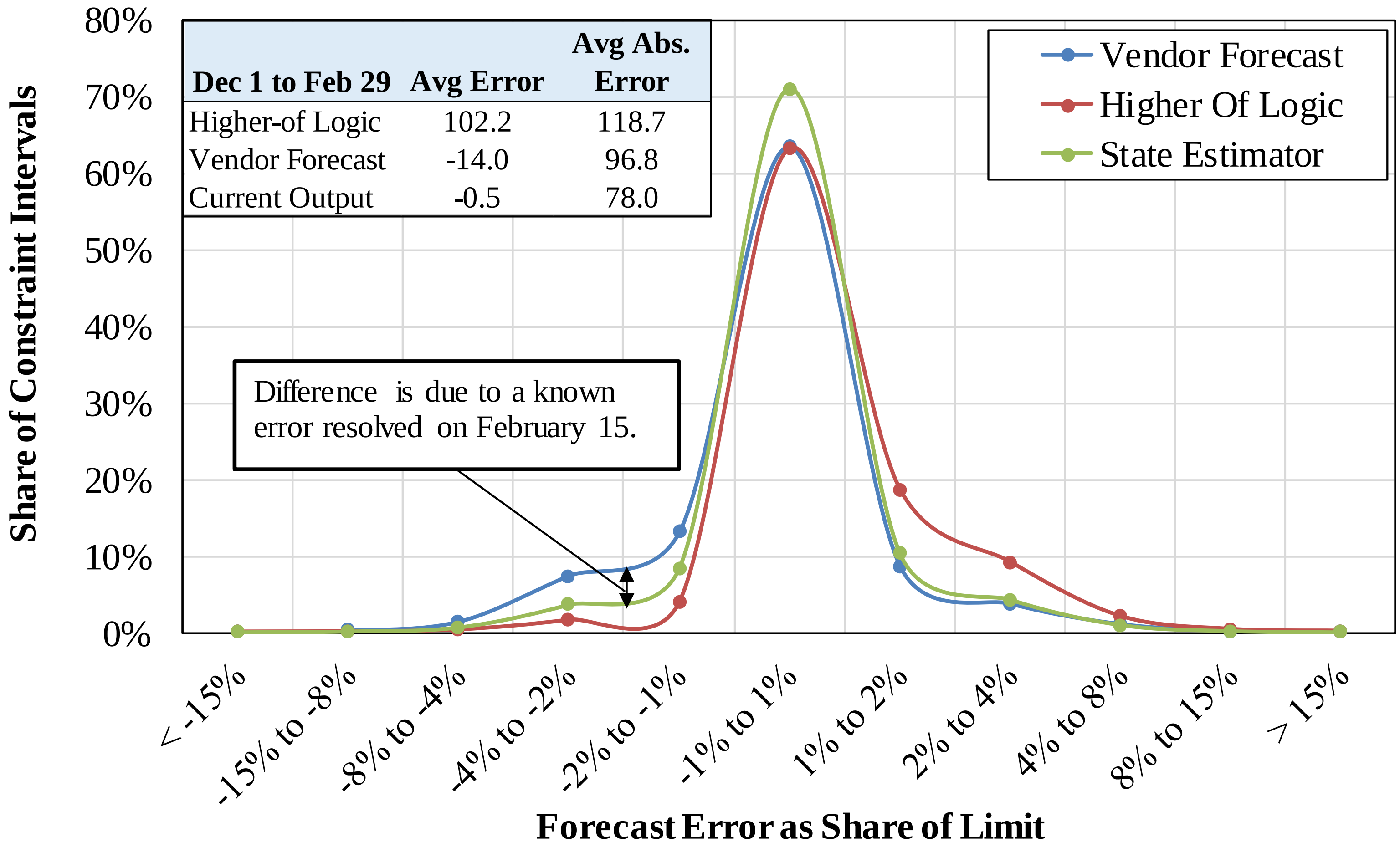
Wind Output in Real-Time
Daily Range and Average



Average Wind Forecasts by Source 2018 – 2020

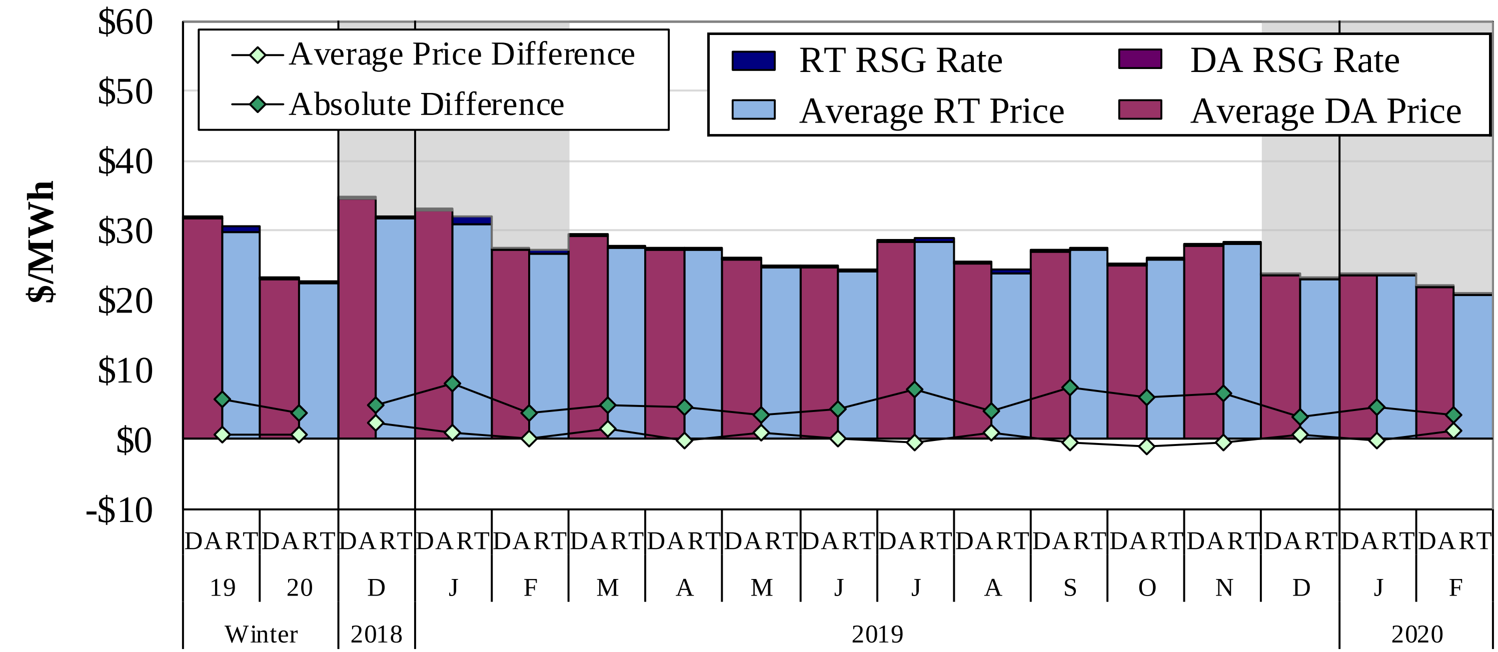


Wind Forecasting Error Congestion Impacts December 1, 2019 – February 29, 2020



Dec 1 to Feb 29	Avg Error	Avg Abs. Error
Higher-of Logic	102.2	118.7
Vendor Forecast	-14.0	96.8
Current Output	-0.5	78.0

Day-Ahead and Real-Time Price Convergence Winter 2018 – 2020



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

	Winter 19	Winter 20	D 2018	J	F	M	A	M	J	J	A	S	O	N	D	J 2020	F 2020
Indiana Hub	4	3	7	3	1	5	-1	4	1	-1	4	-2	-4	-2	3	0	6
Michigan Hub	0	2	5	-6	0	4	-2	3	1	-5	4	1	-4	-1	3	-1	6
Minnesota Hub	0	3	4	-4	-1	4	0	4	2	-3	6	1	0	2	5	-4	7
WUMS Area	3	2	7	1	1	7	-12	6	-6	-11	6	4	-3	5	5	-1	3
Arkansas Hub	0	3	4	0	-3	5	1	6	8	-1	2	-2	-4	-3	4	1	4
Texas Hub	2	4	3	1	1	7	0	9	1	5	-18	1	-16	-1	4	1	6
Louisiana Hub	2	0	4	3	0	15	9	11	10	0	6	2	1	-3	2	1	-2

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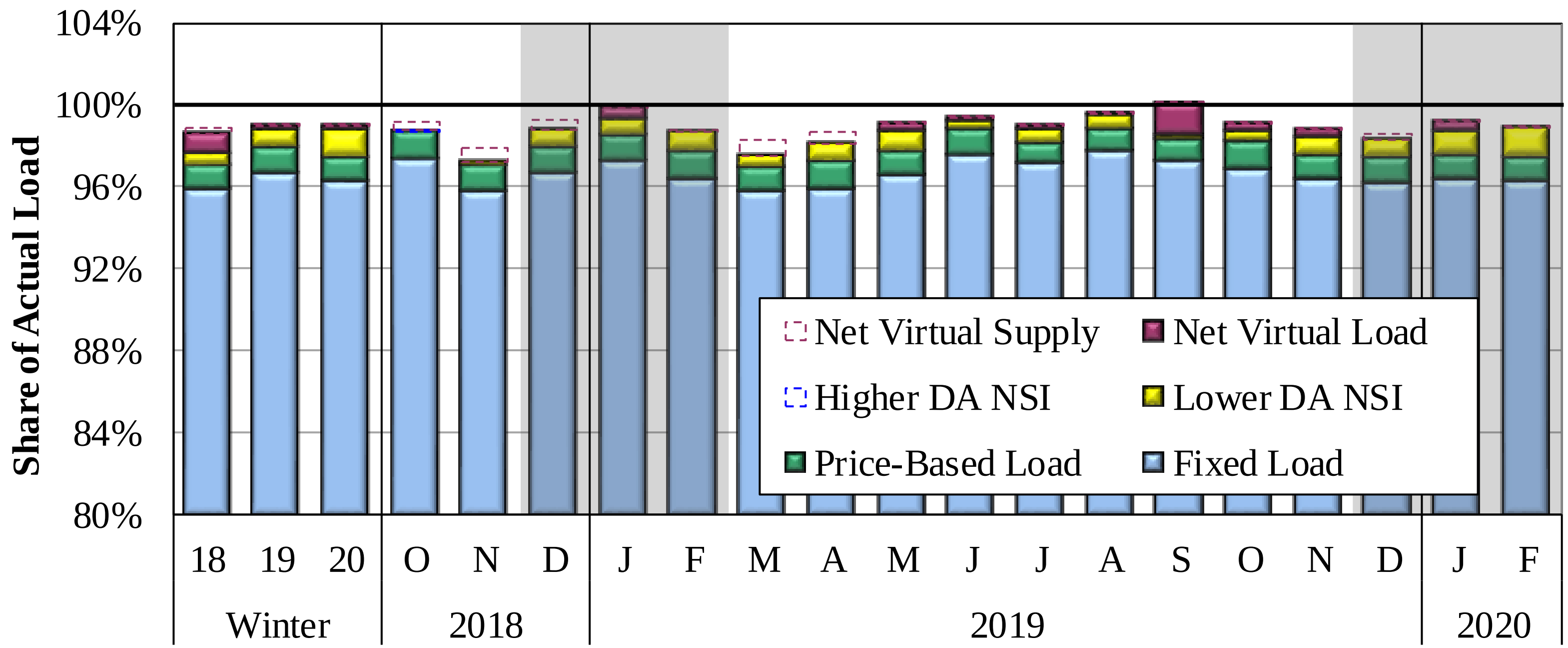
Day-Ahead Peak Hour Load Scheduling Winter 2018 – 2020



Share of Actual Load (%)

All Hours	98.7	98.9	99.2	99.1	97.5	98.8	99.7	98.8	98.1	98.5	99.0	99.6	99.9	100.1	100.0	98.9	98.5	98.2	99.5	99.0
Peak Hours Midwest	98.2	98.5	99.2	98.1	97.1	98.7	99.2	97.9	97.1	97.4	98.8	98.8	98.6	99.7	99.9	99.0	98.2	98.5	99.6	98.9
Peak Hours South	101.9	100.8	98.8	102.5	100.1	102.2	102.6	100.8	99.3	99.9	98.5	100.9	100.2	98.9	100.2	100.6	100.7	99.1	99.2	98.5

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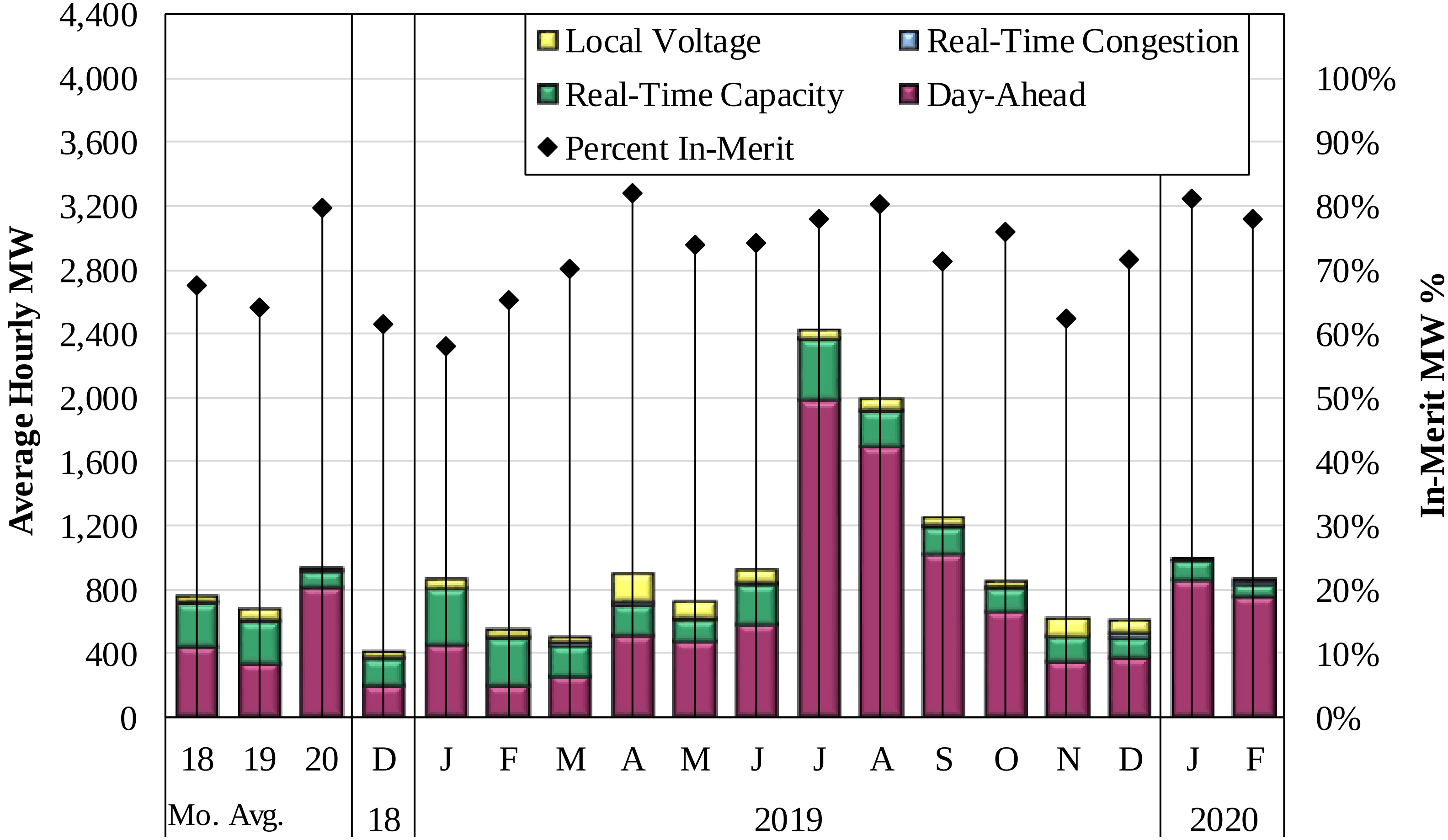
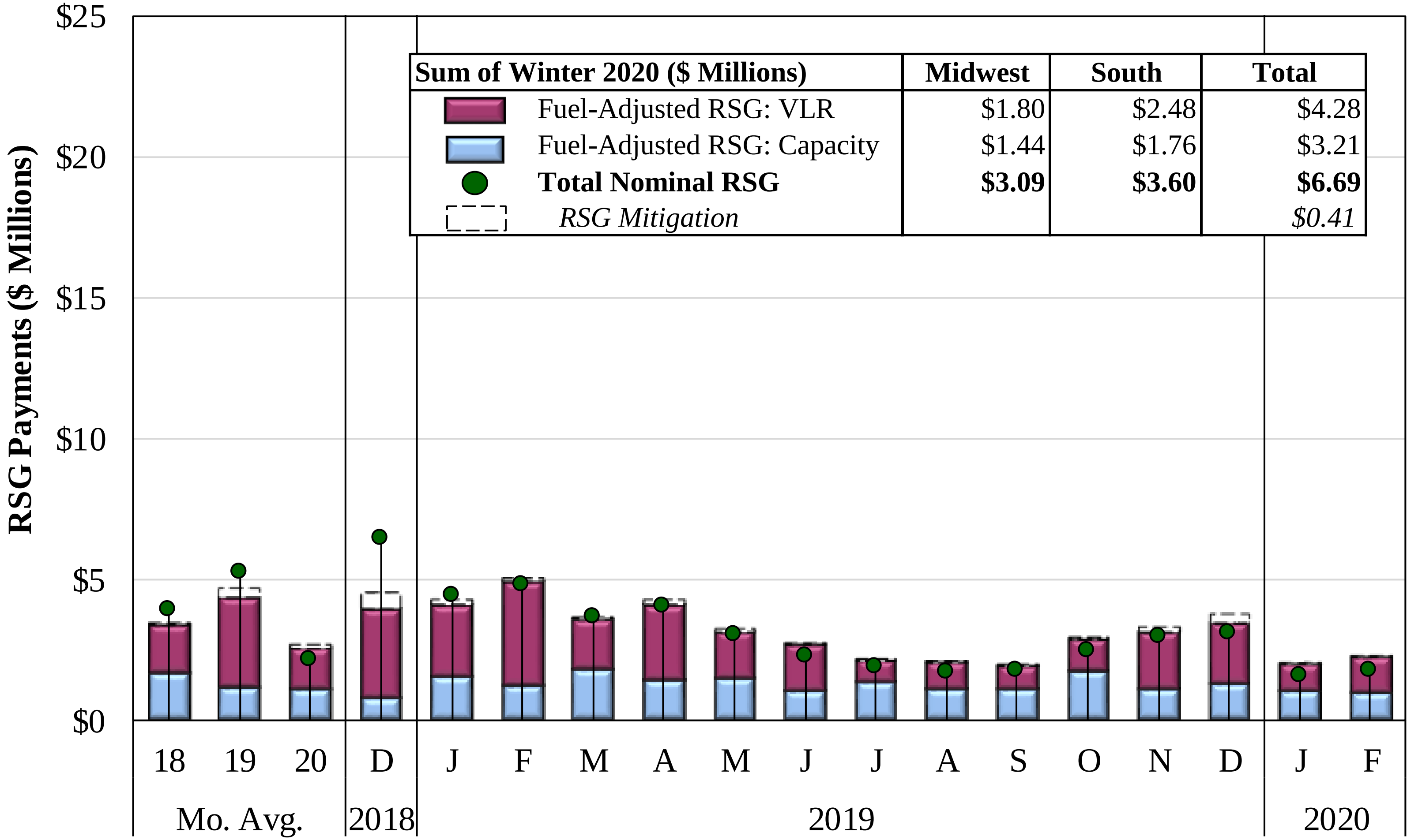
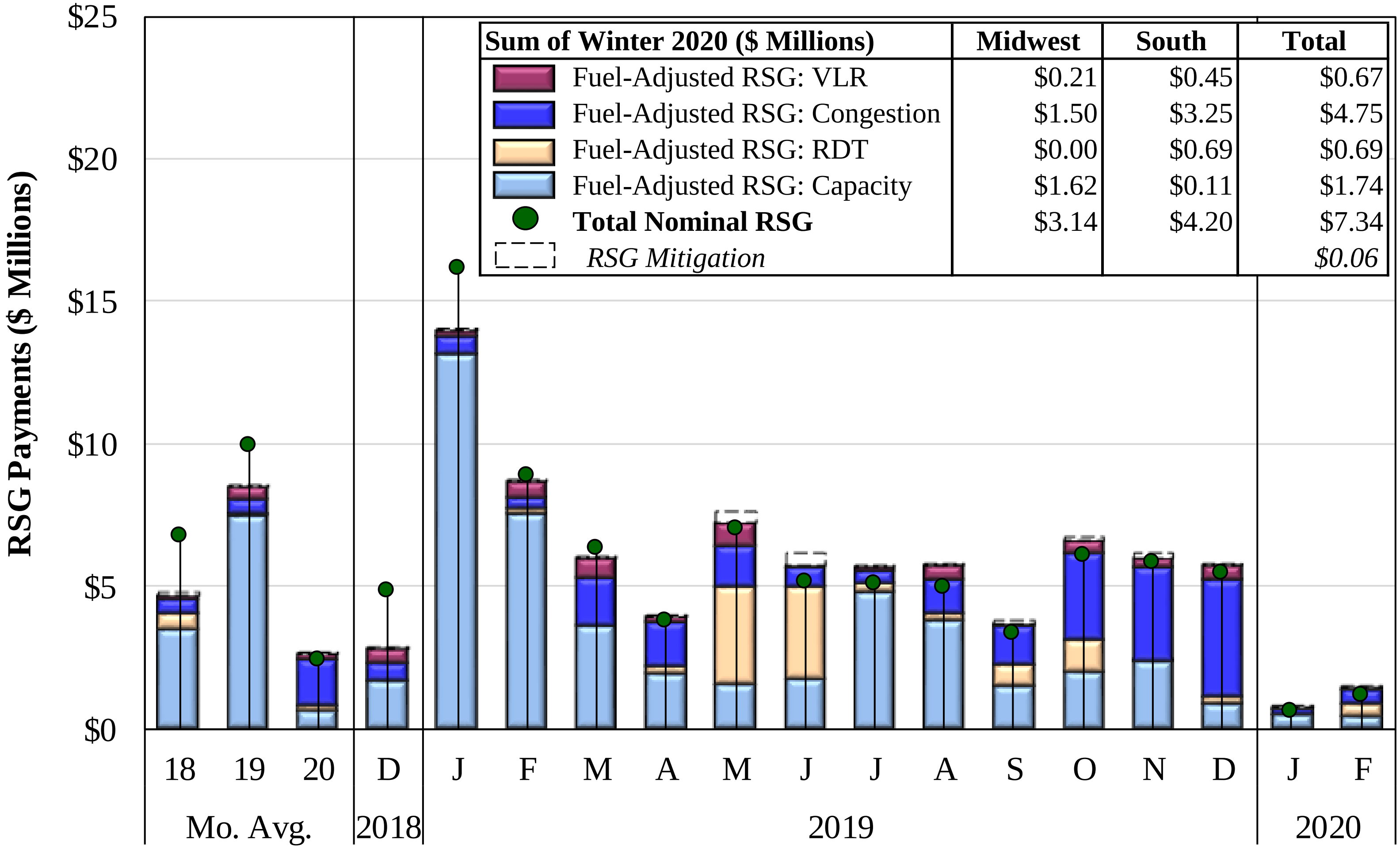
Peaking Resource Dispatch
Winter 2018 – 2020



Day-Ahead RSG Payments
Winter 2018 – 2020



Real-Time RSG Payments Winter 2018 – 2020



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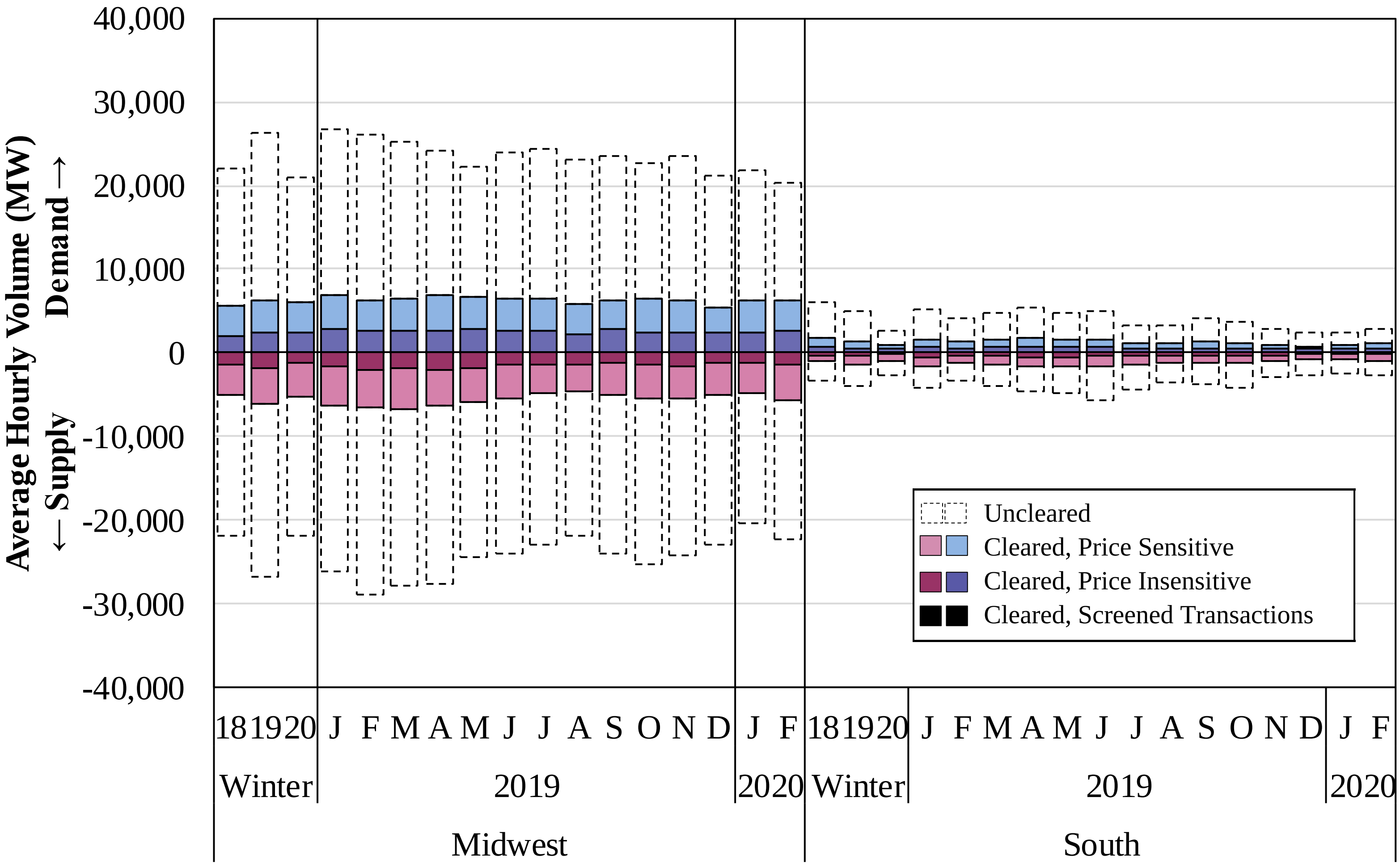
Virtual Load and Supply
Winter 2018 – 2020



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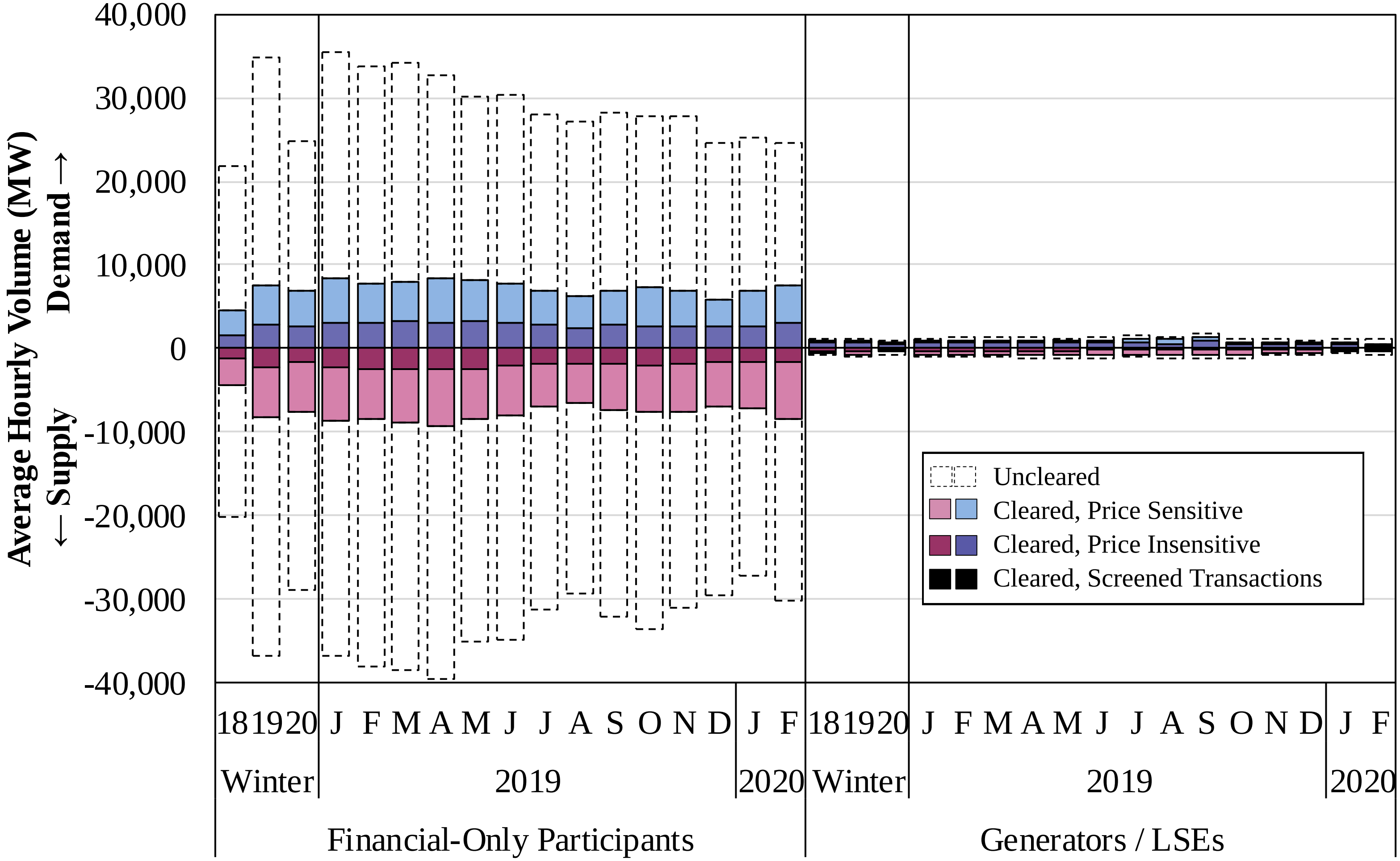
Virtual Load and Supply by Participant Type Winter 2018 – 2020



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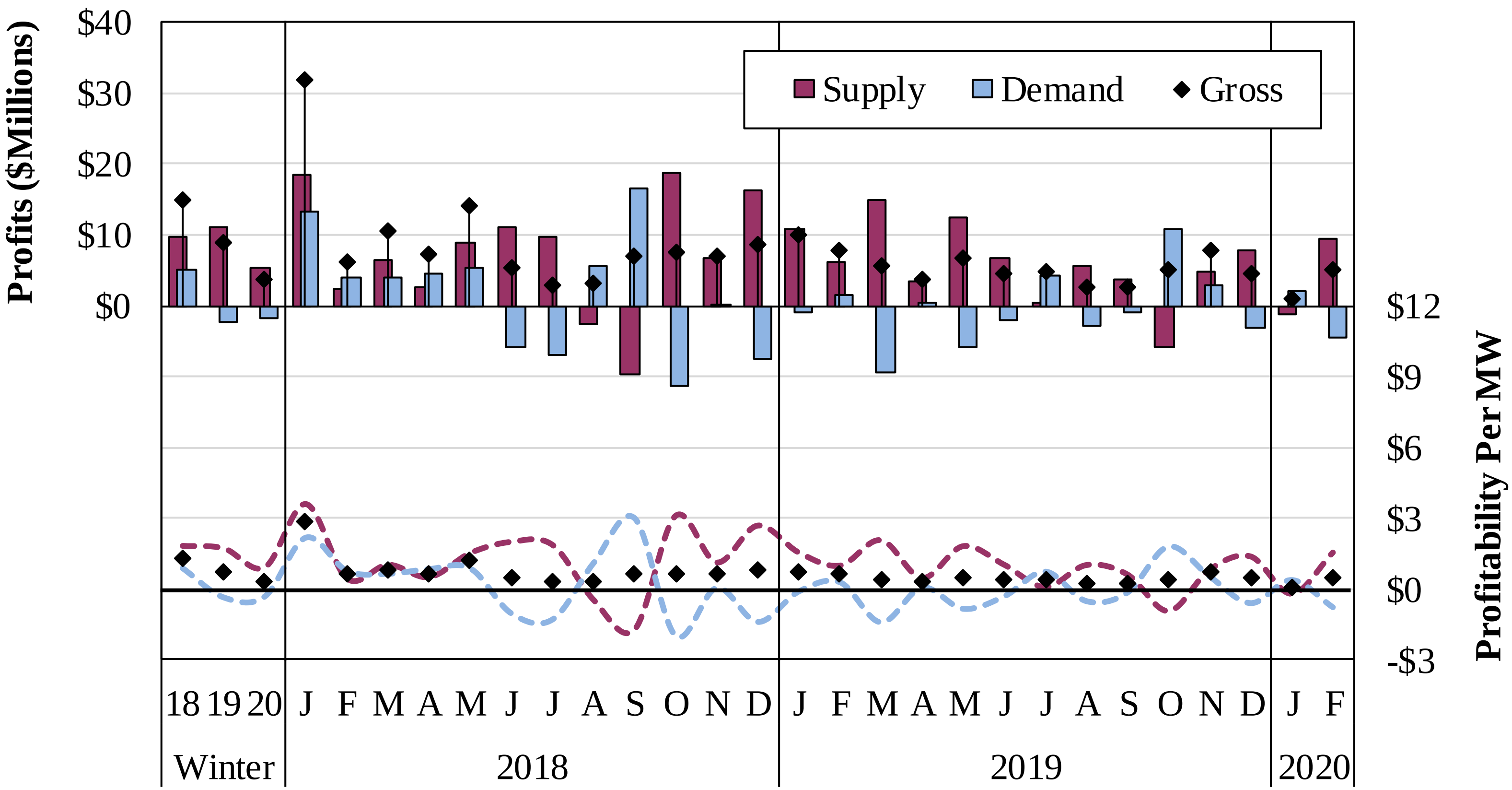
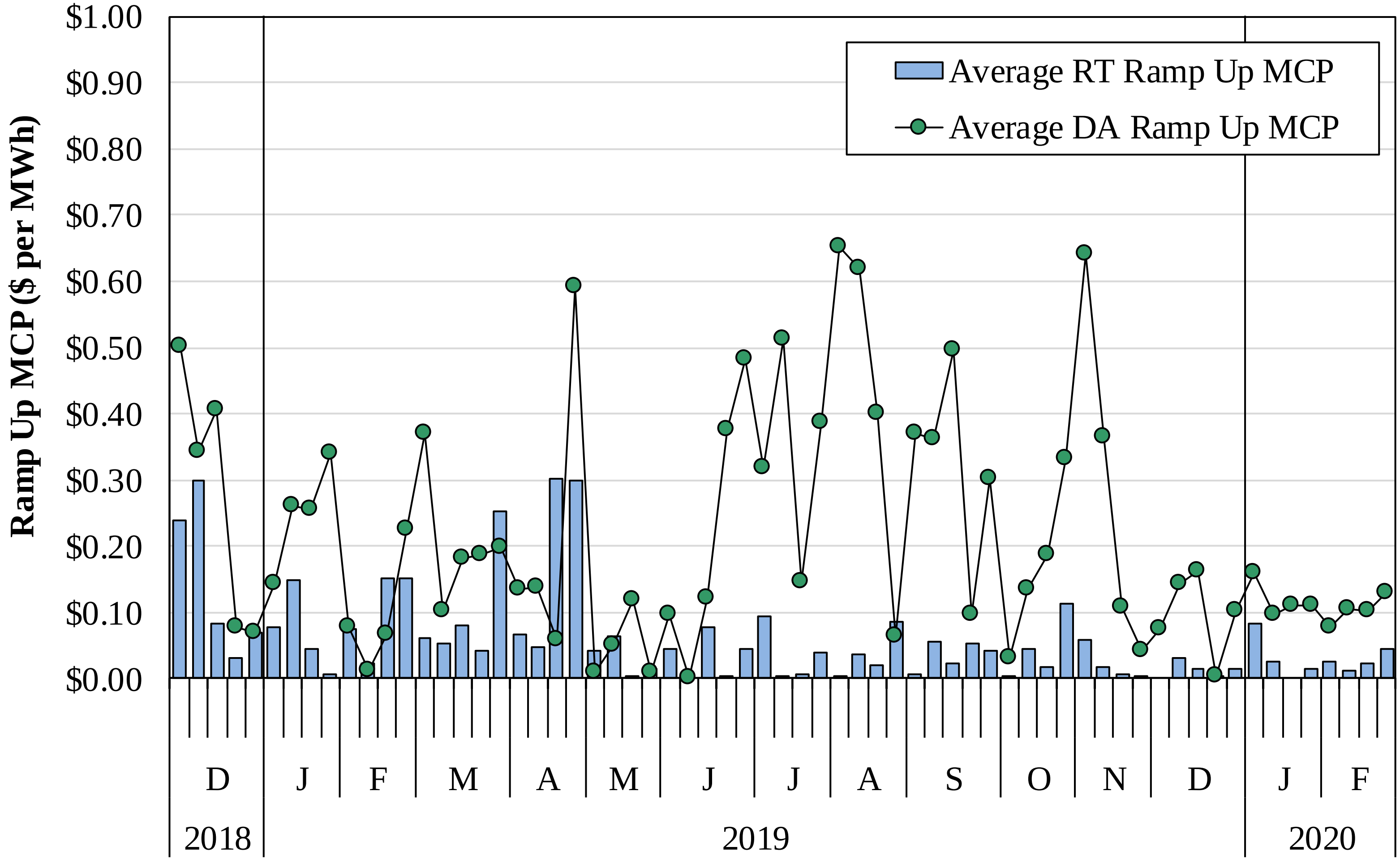
Virtual Profitability
Winter 2018 – 2020



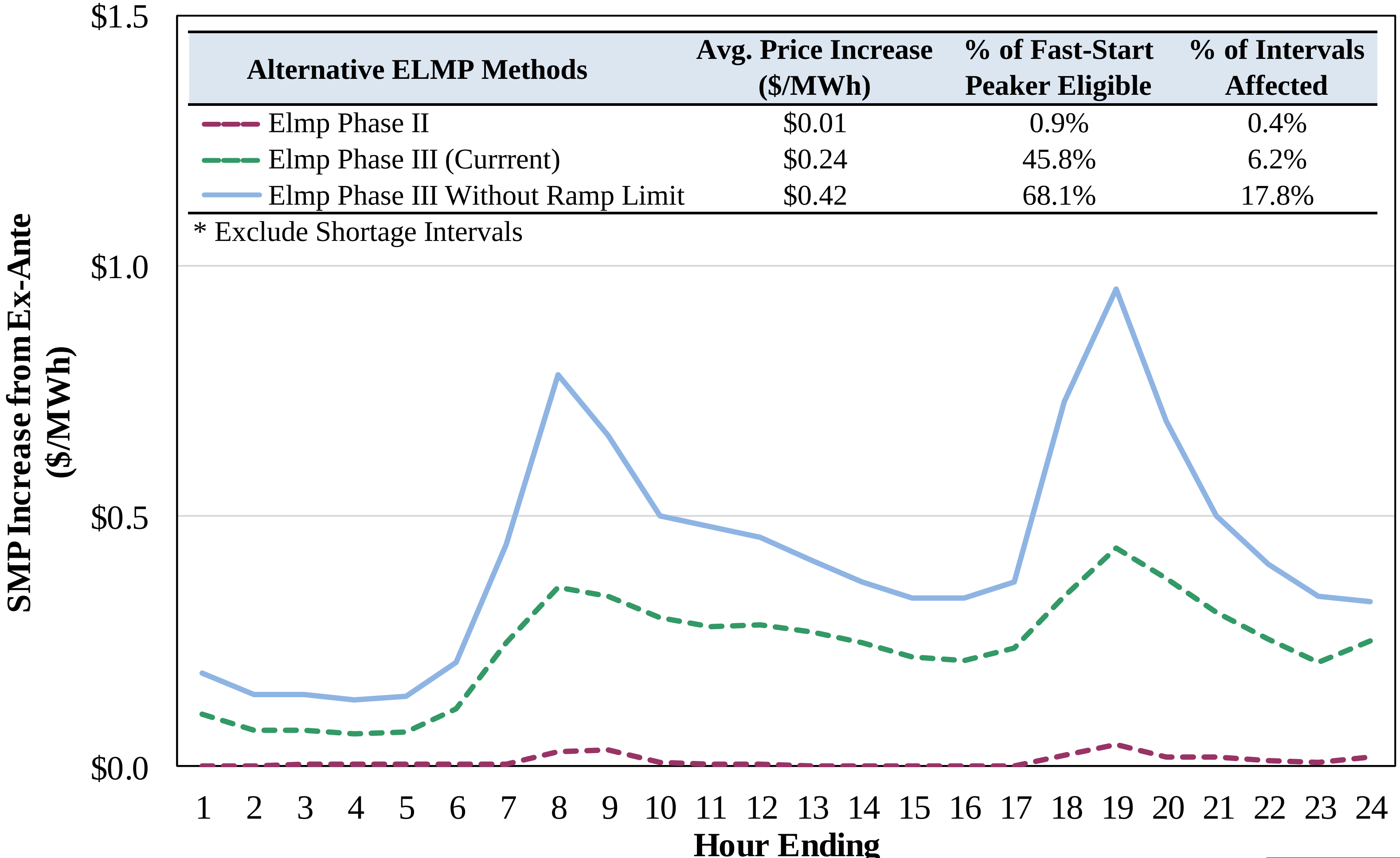
Percent Screened

Supply	0.4	0.2	0.1	1.0	0.2	0.3	0.3	0.5	0.5	0.4	0.1	0.3	0.4	0.4	0.3	0.2	0.1	0.3	0.3	0.2	0.2	0.3	0.2	0.4	0.3	0.3	0.1	0.2	0.1
Demand	1.2	1.0	0.5	2.2	0.6	1.1	1.1	3.0	2.6	2.3	0.8	1.3	1.9	1.1	0.6	1.7	0.6	0.8	0.9	1.0	1.4	1.1	0.5	1.6	1.1	0.9	0.7	0.4	0.5
Total	0.8	0.6	0.3	1.6	0.4	0.7	0.7	1.8	1.6	1.4	0.5	0.8	1.2	0.7	0.4	1.0	0.4	0.5	0.6	0.6	0.8	0.7	0.3	1.0	0.7	0.6	0.4	0.3	0.3

Day-Ahead and Real-Time Ramp Up Price 2018 – 2020



Evaluation of ELMP Assumptions Winter 2020

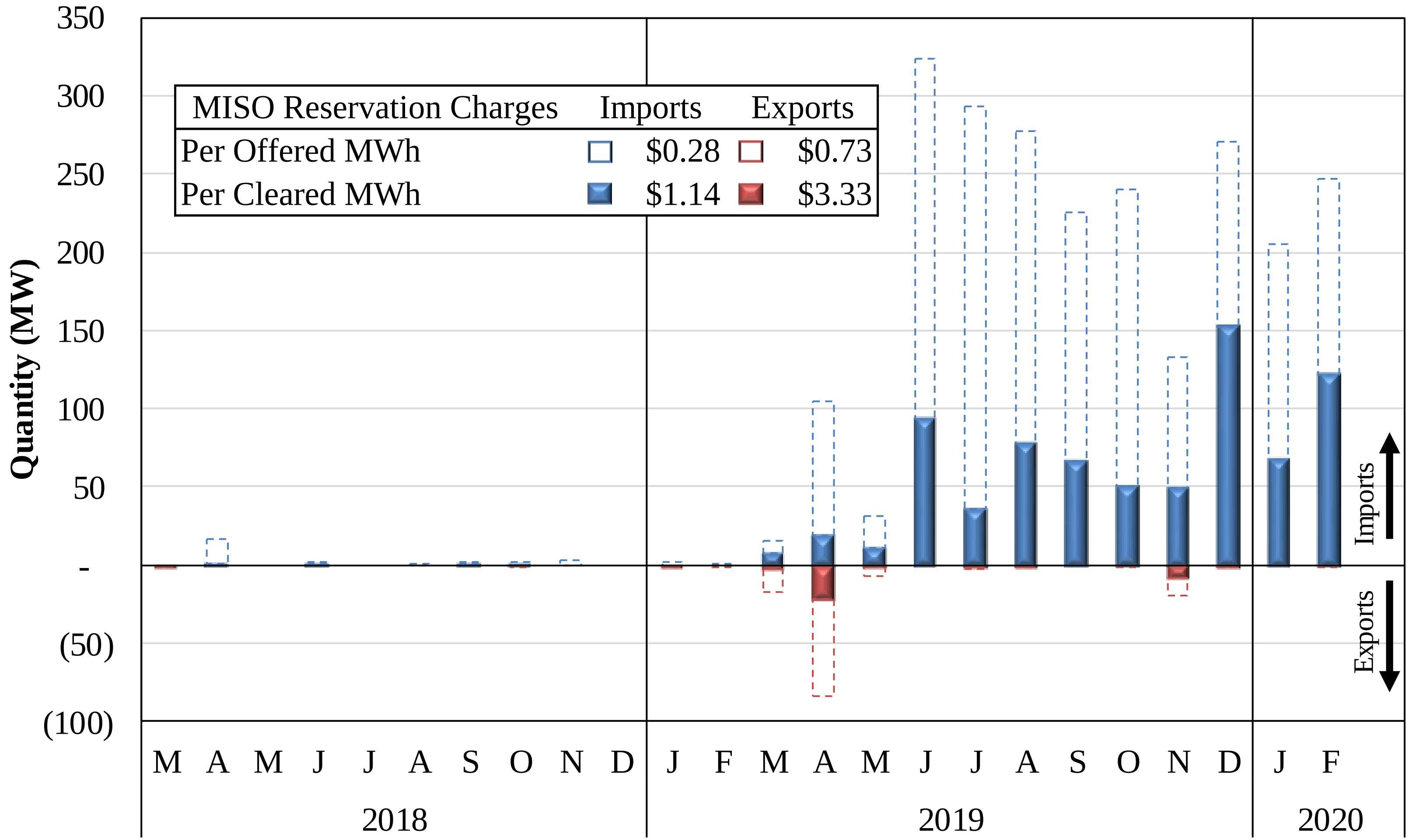


Alternative ELMP Methods	Avg. Price Increase ($/MWh)	% of Fast-Start Peaker Eligible	% of Intervals Affected
Elmp Phase II	$0.01	0.9%	0.4%
Elmp Phase III (Currrent)	$0.24	45.8%	6.2%
Elmp Phase III Without Ramp Limit	$0.42	68.1%	17.8%

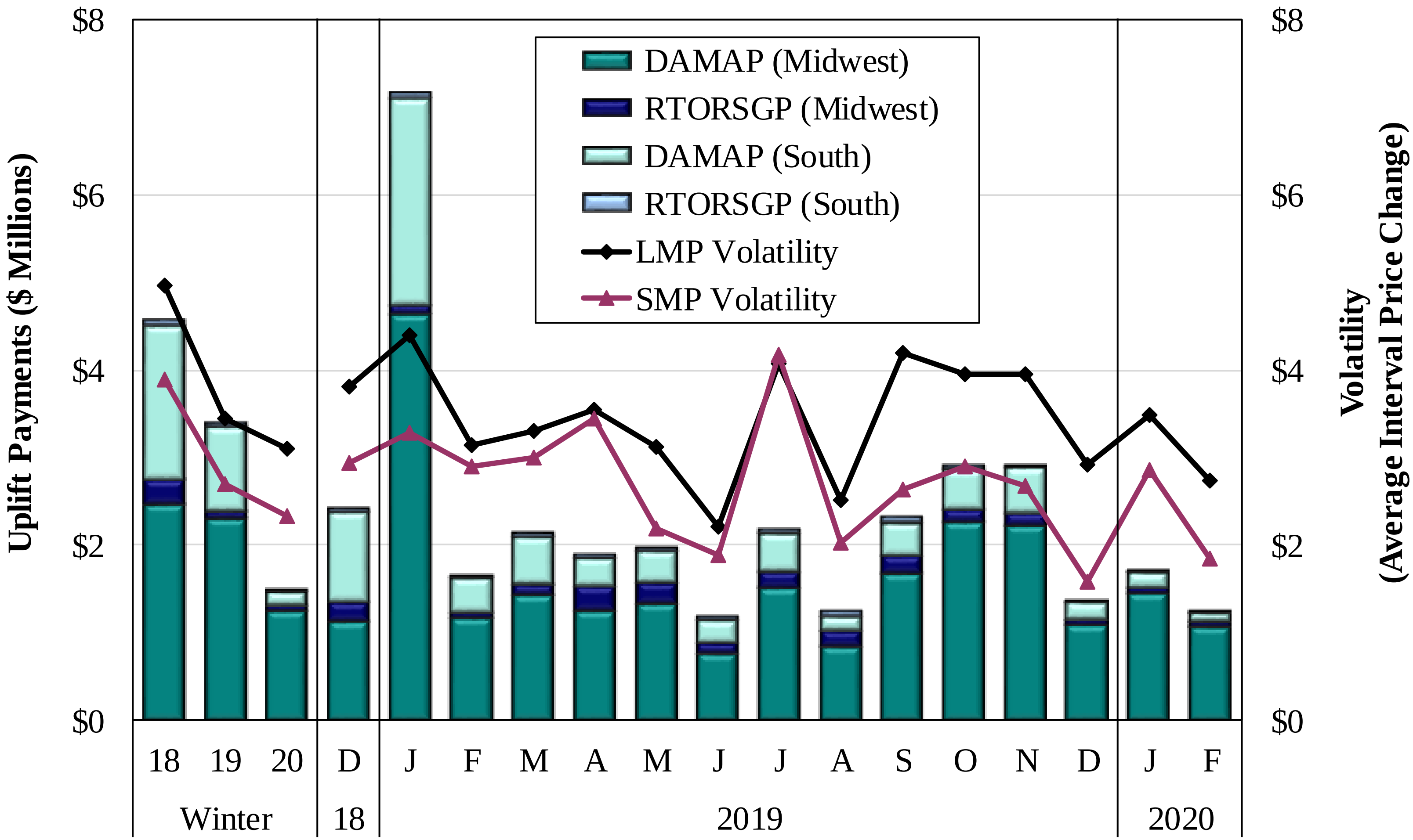
* Exclude Shortage Intervals

POTOMAC ECONOMICS

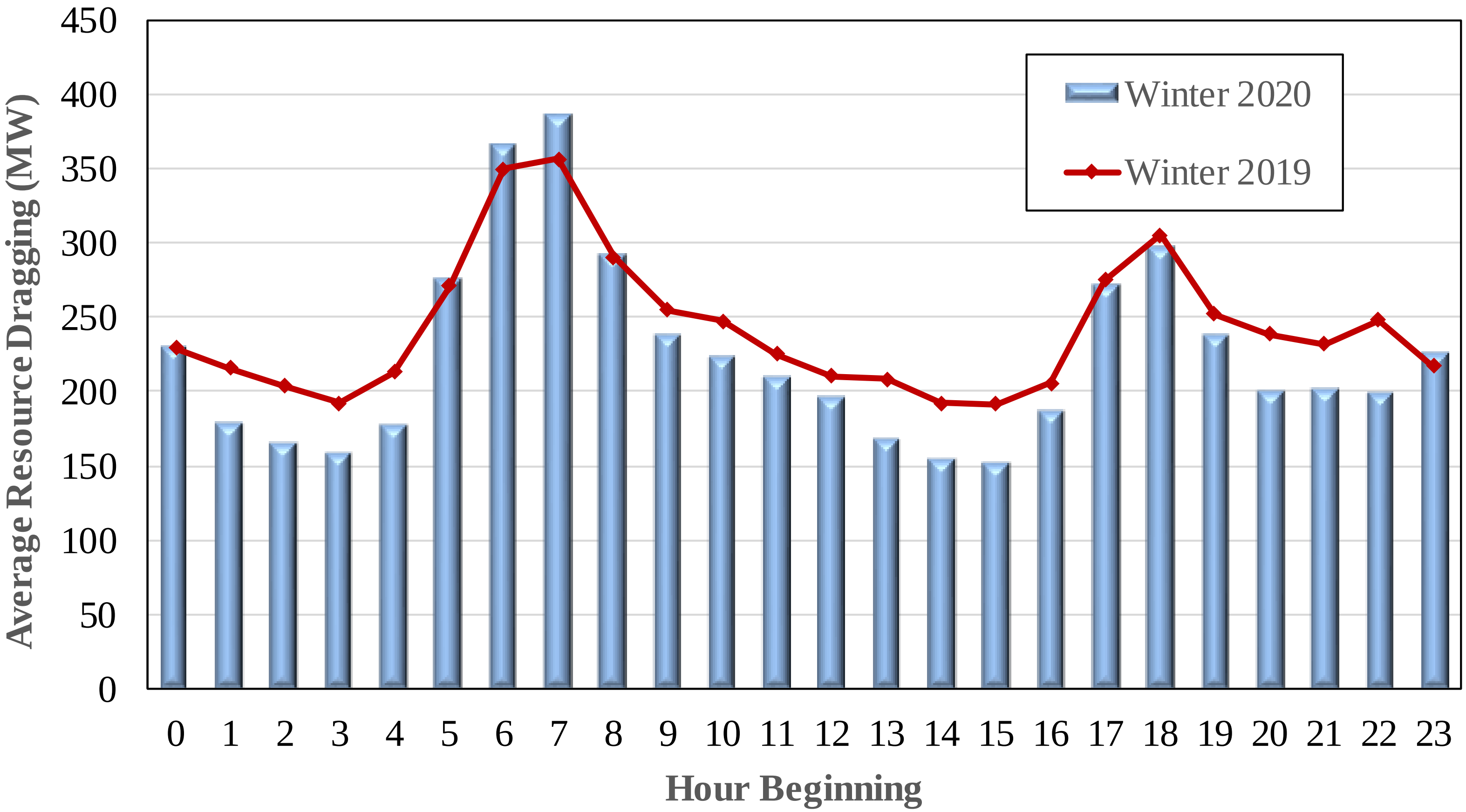
Coordinated Transaction Scheduling (CTS) 2018 – 2020



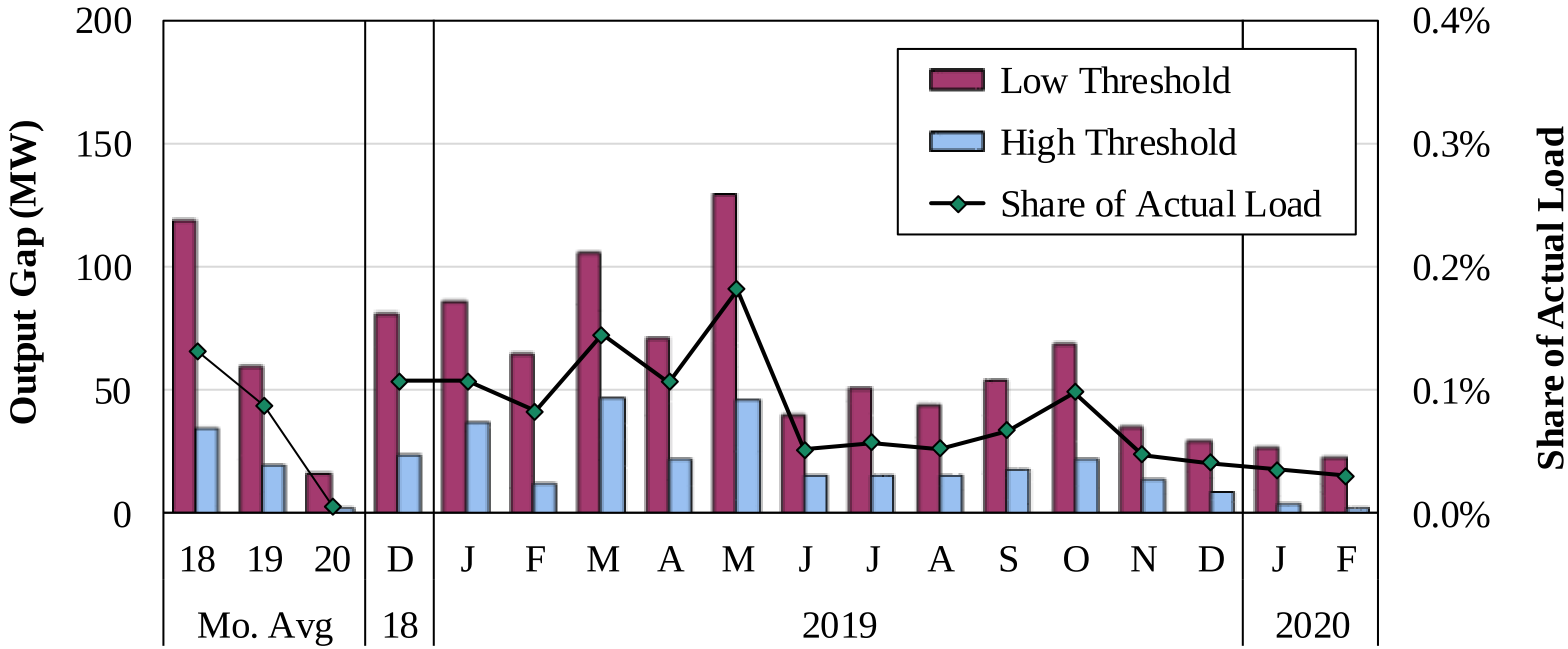
Price Volatility Make Whole Payments Winter 2018 – 2020



Average Resource Dragging by Hour



Monthly Output Gap Winter 2018 – 2020



Low Threshold Results by Unit Status (MW)

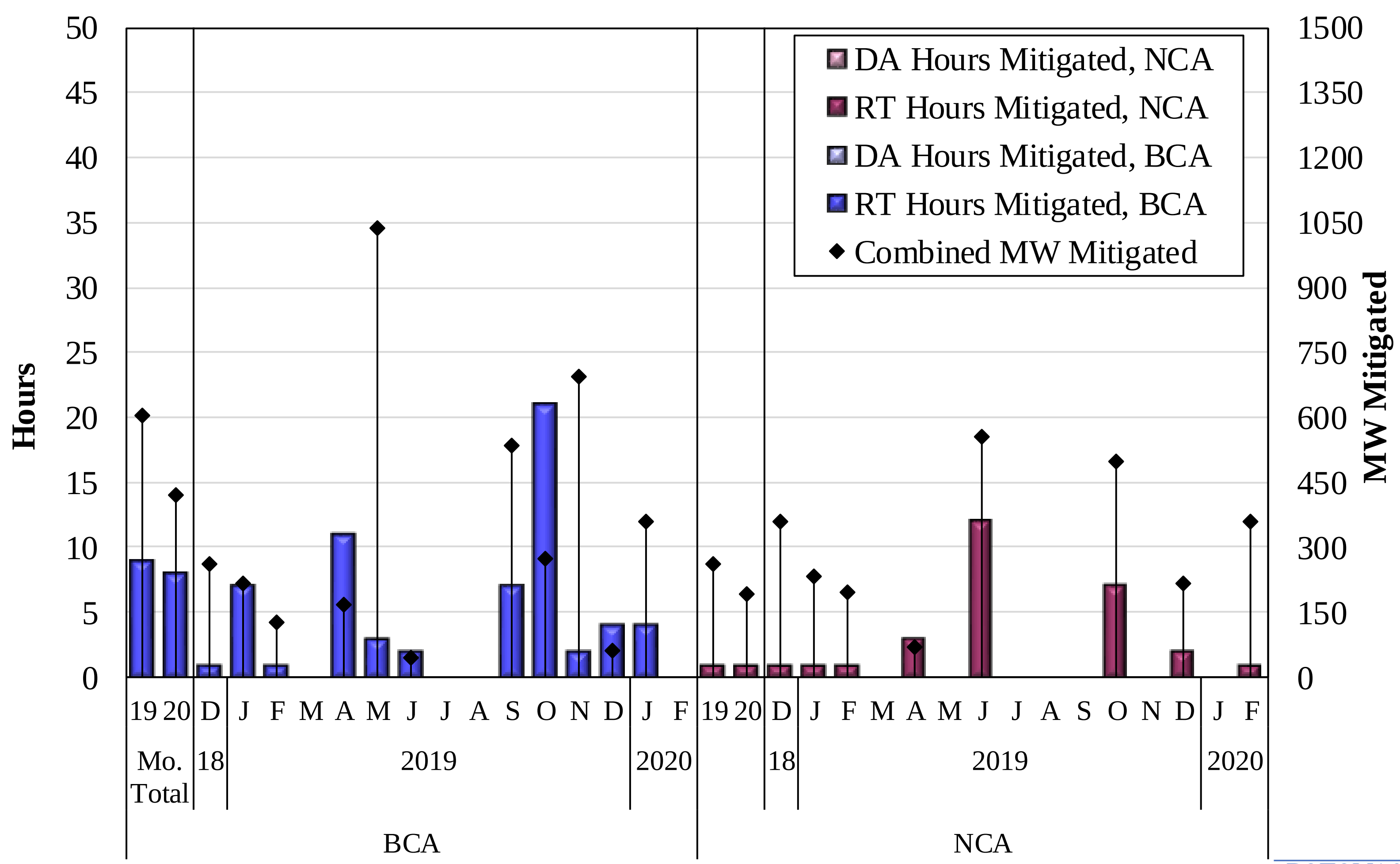
	18	19	20	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F
Offline	15	12	2	3	30	2	31	12	15	8	9	9	10	15	10	5	0	0
Online	122	66	25	78	56	63	75	60	114	33	42	36	45	54	25	25	27	23

High Threshold Results by Unit Status (MW)

	18	19	20	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F
Offline	10	9	2	3	24	2	28	8	10	7	9	8	8	11	10	5	0	0
Online	30	15	4	21	13	11	19	15	36	9	8	7	10	12	4	4	5	3

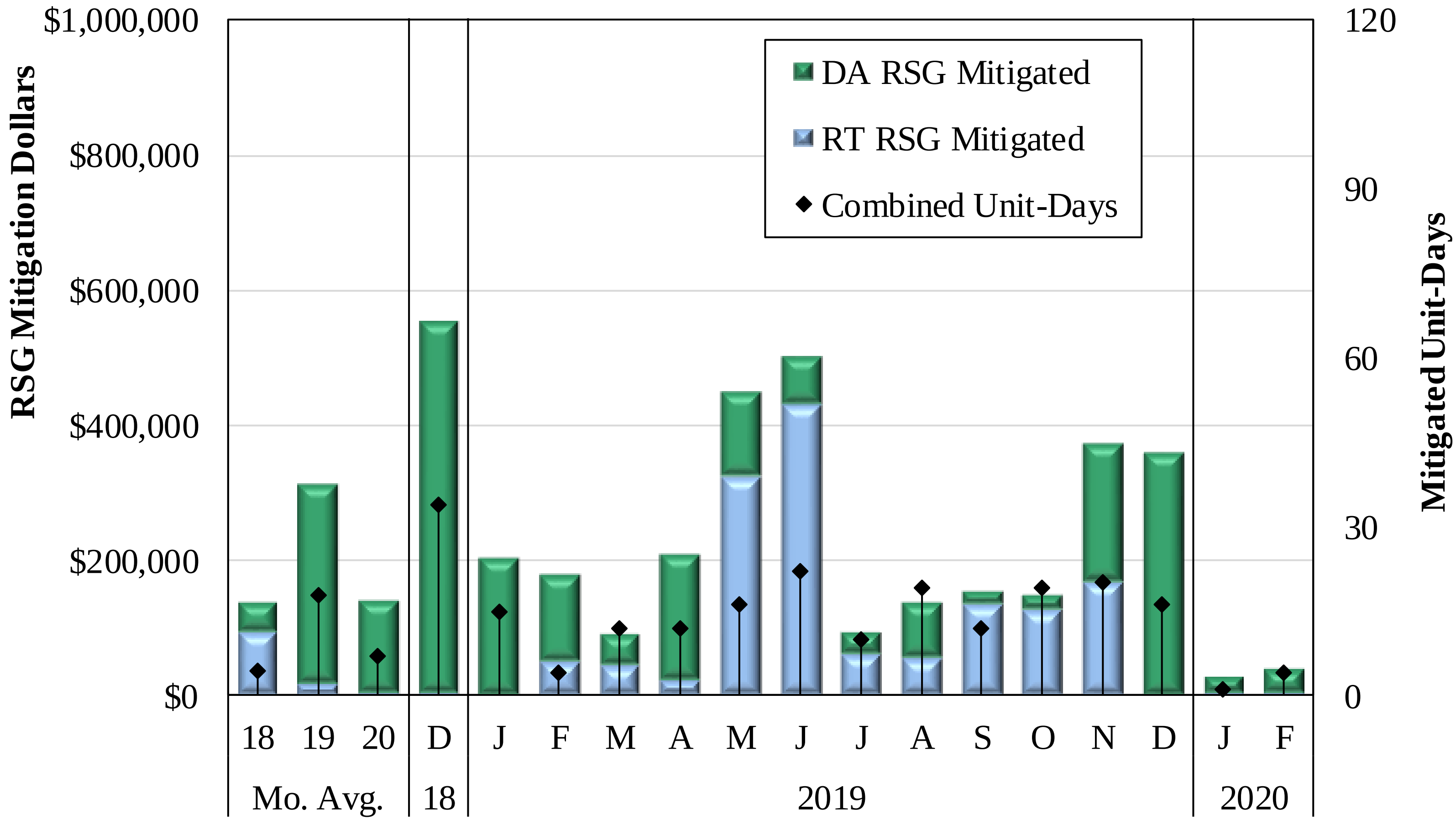
POTOMAC ECONOMICS

Day-Ahead And Real-Time Energy Mitigation 2018 – 2020



POTOMAC ECONOMICS

Day-Ahead and Real-Time RSG Mitigation Winter 2018 – 2020

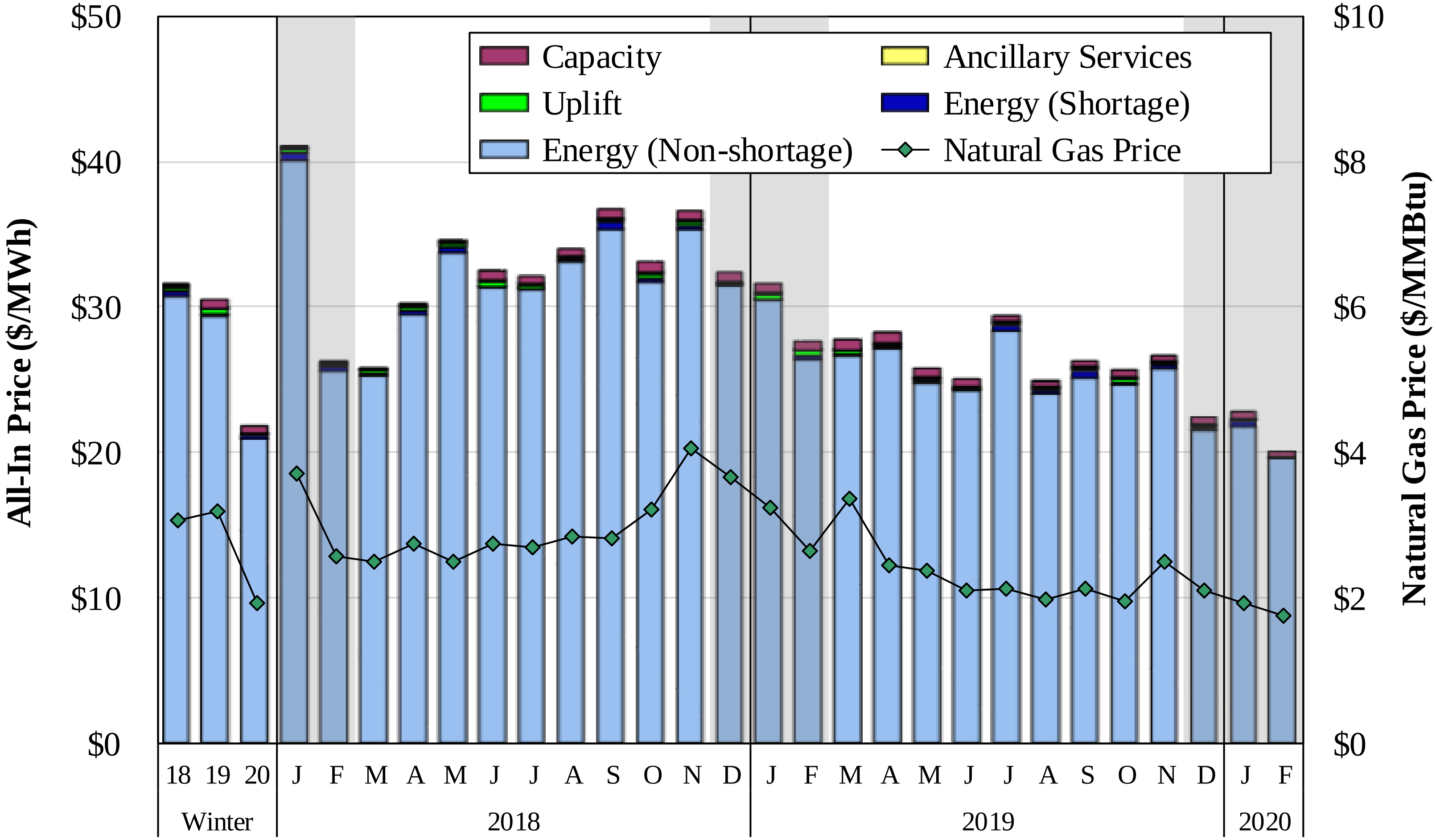


List of Acronyms

AAR	Ambient-Adjusted Ratings
AMP	Automated Mitigation Procedures
BCA	Broad Constrained Area
CDD	Cooling Degree Days
CMC	Constraint Management Charge
CTS	Coordinated Transaction Scheduling
DAMAP	Day-Ahead Margin Assurance Payment
DDC	Day-Ahead Deviation & Headroom Charge
DIR	Dispatchable Intermittent Resource
HDD	Heating Degree Days
ELMP	Extended Locational Marginal Price
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
ORDC Curve	Operating Reserve Demand
PITT	Pseudo-Tie Issues Task Team
PRA	Planning Resource Auction
PVMWP	Price Volatility Make Whole Payment
RAC	Resource Adequacy Construct
RDT	Regional Directional Transfer
RSG	Revenue Sufficiency Guarantee
RTORSGP	Real-Time Offer Revenue Sufficiency Guarantee Payment
STE	Short-Term Emergency
SMP	System Marginal Price
SOM	State of the Market
TLR	Transmission Line Loading Relief
TCDC	Transmission Constraint Demand Curve
VLR	Voltage and Local Reliability
WUMS	Wisconsin Upper Michigan System

Figures Reproduced for Markets Committee Discussion

All-In Price
Winter 2018 - 2020



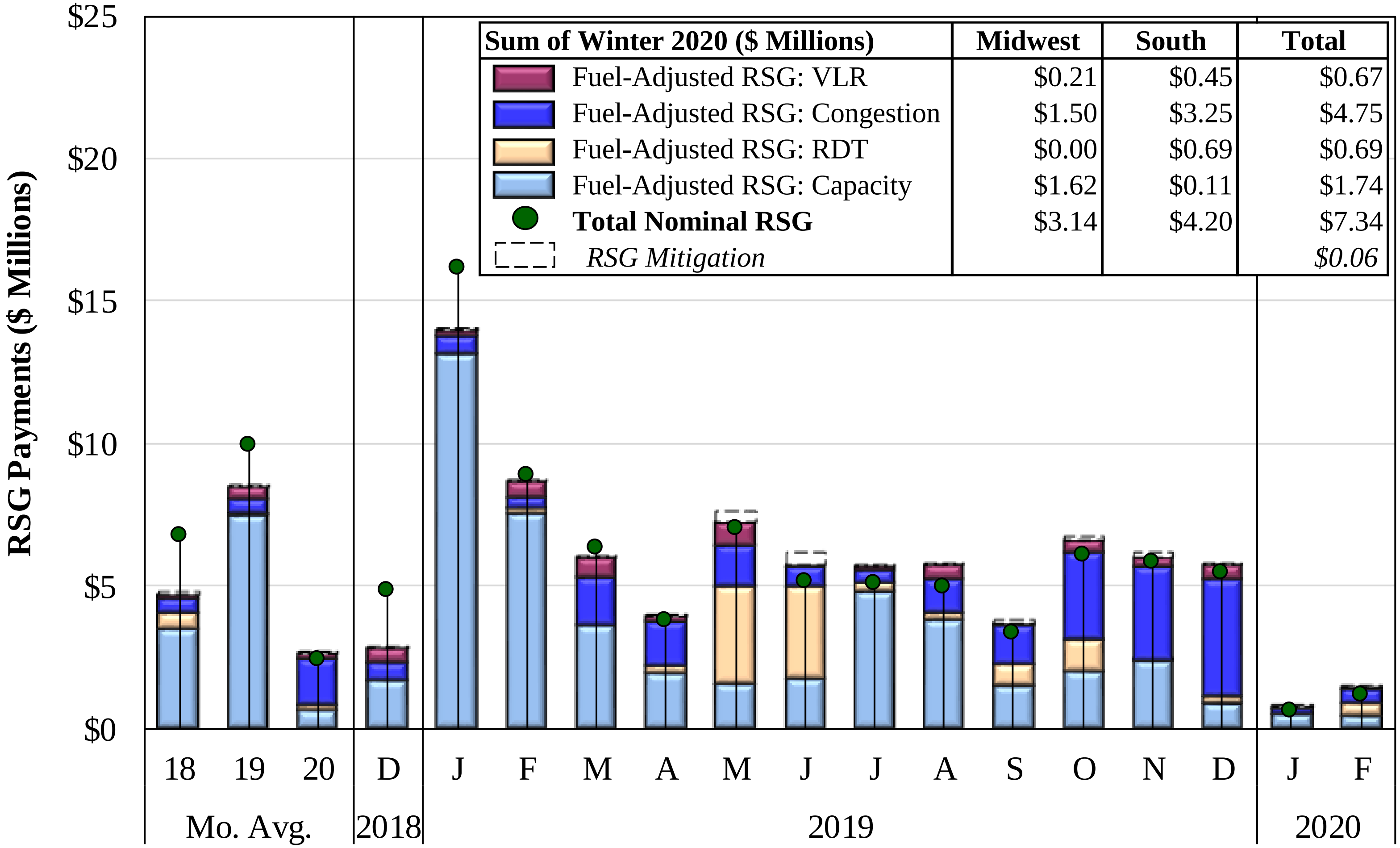
Capacity, Energy and Price Setting Share Winter 2019 – 2020

Winter	Unforced Capacity				Energy Output		Price Setting			
	Total (MW)		Share (%)		Share (%)		SMP (%)		LMP (%)	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Nuclear	12,225	12,107	10%	9%	16%	19%	0%	0%	0%	1%
Coal	48,775	46,864	38%	37%	47%	34%	48%	45%	86%	91%
Natural Gas	55,240	56,673	43%	44%	24%	34%	51%	52%	96%	98%
Oil	1,691	1,568	1%	1%	0%	0%	0%	0%	0%	0%
Hydro	3,966	4,034	3%	3%	1%	2%	0%	1%	1%	2%
Wind	3,005	3,660	2%	3%	9%	11%	0%	2%	39%	58%
Other	2,678	2,703	2%	2%	2%	1%	0%	0%	2%	1%
Total	**127,580**	**127,608**								

Change in Coal Offer Patterns Winter 2019 – 2020

Coal Resources Offered Day-Ahead	2019 MW	2019 %	2020 MW	2020 %	Change in %
Must-Run Commitment Status	**34,879**	***79%***	**27,628**	***63%***	***-16%***
Economic Commitment Status	**9,397**	***21%***	**16,093**	***37%***	***16%***
Scheduled Day-Ahead	6,320	*14%*	4,577	*10%*	*-4%*
Not Scheduled Day-Ahead - Offline in RT	3,077	*7%*	11,516	*26%*	*19%*
Not Scheduled Day-Ahead - but Online in RT	1,325	*3%*	1,568	*4%*	*1%*
Total Coal Capacity Offered	**44,276**		**43,720**		

Real-Time RSG Payments Winter 2018 - 2020



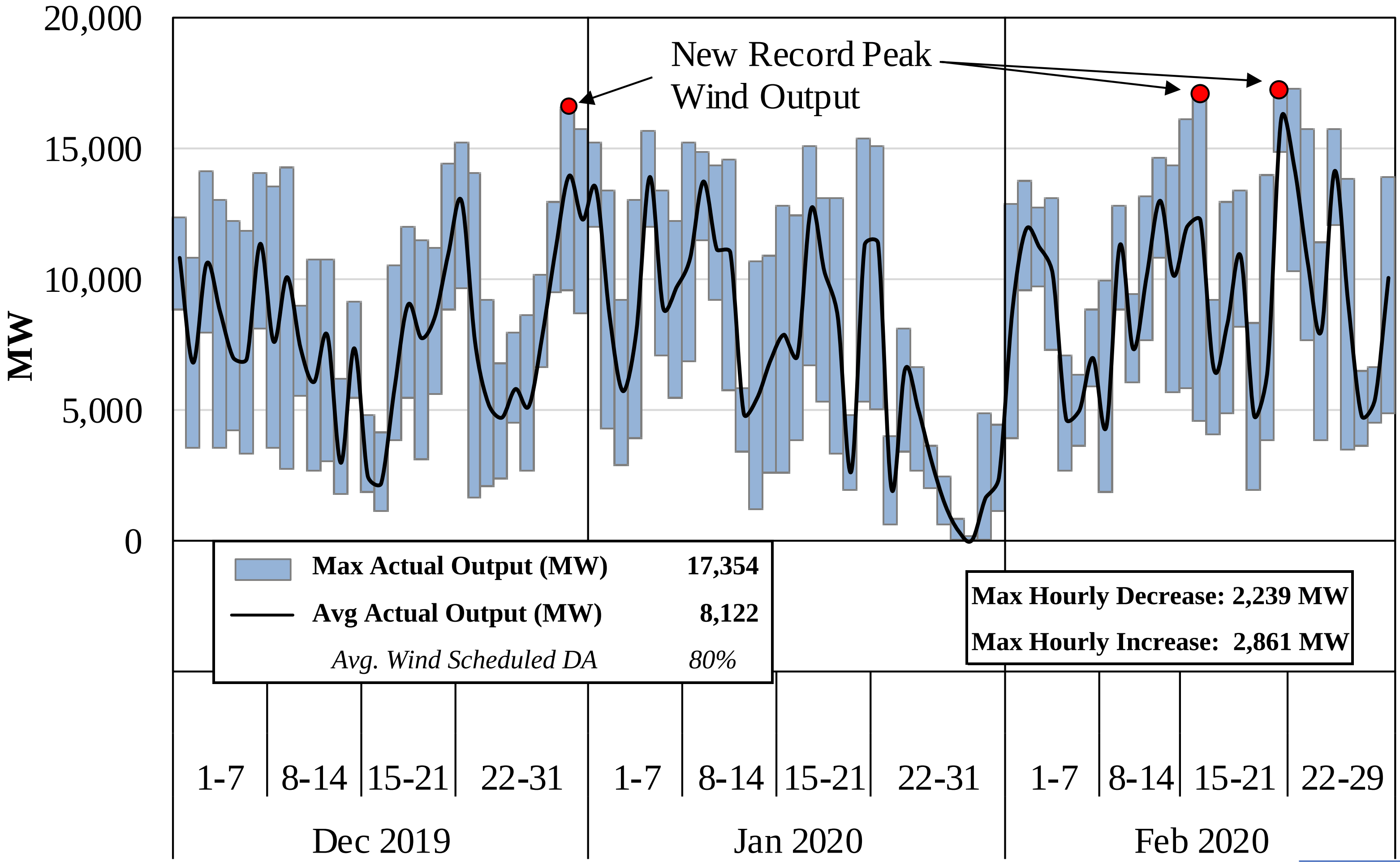
IESO TLRs and Curtailments Called in January and February

Date	TLR Hours	PJM Imports Curtailed (MW/hr)	Max Hourly Ex-Post SMP	Market Participant NSI Losses ($)
01/06/2020	11	1,033	$49	$ (30,170)
01/08/2020	5	837	$100	$ (101,662)
01/11/2020	16	2,004	$371	$ (1,335,473)
01/12/2020	16	3,611	$141	$ (1,117,291)
01/24/2020	14	1,959	$90	$ (383,559)
02/27/2020	10	2,187	$117	$ (487,714)
02/28/2020	8	901	$56	$ (29,860)
Average/Total		**2,024**	**$132**	**$ (3,485,729)**

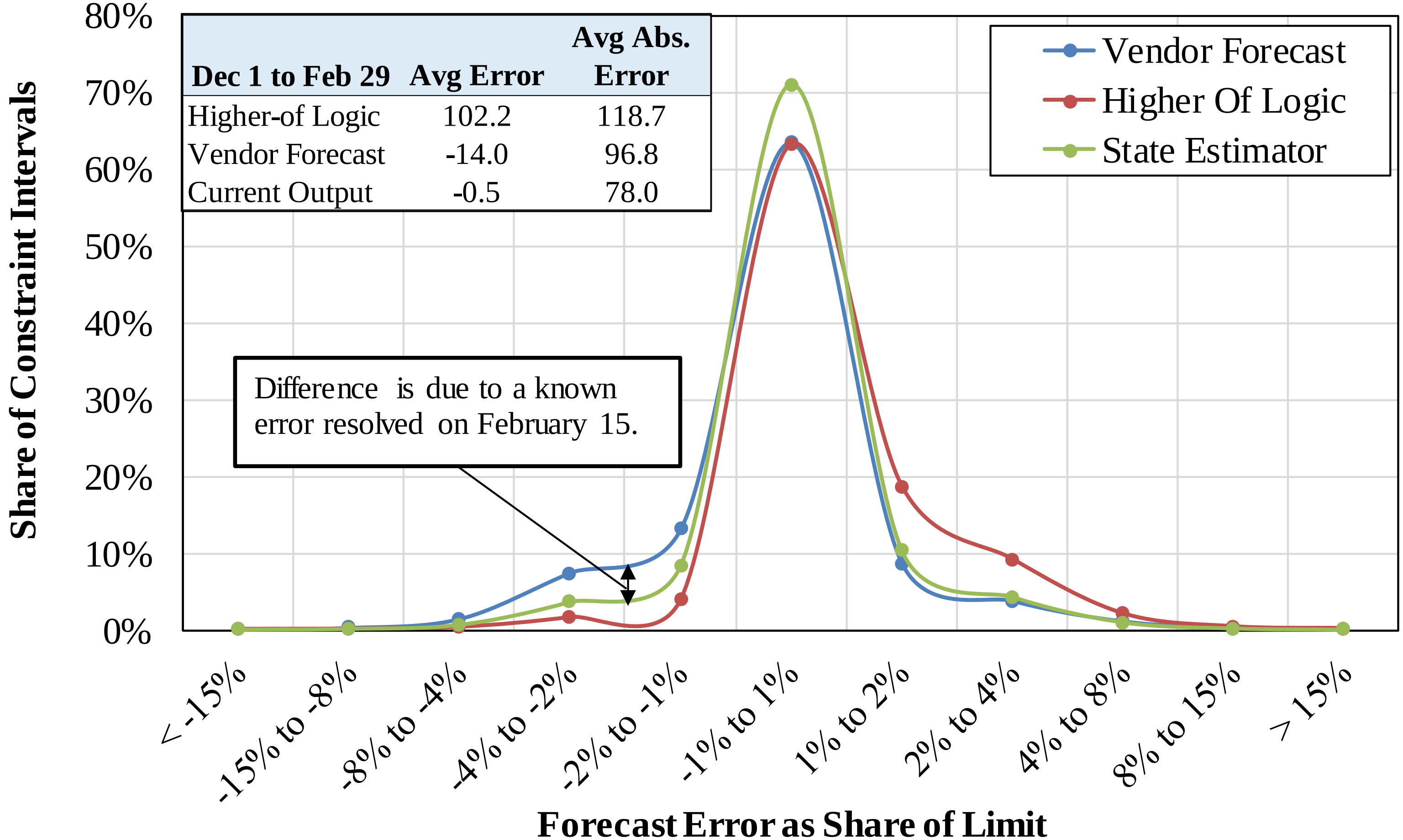
Note: TLR was also called 2/3/2020, but is not shown due to low impacts.

POTOMAC ECONOMICS

Wind Output in Real-Time
Daily Range and Average

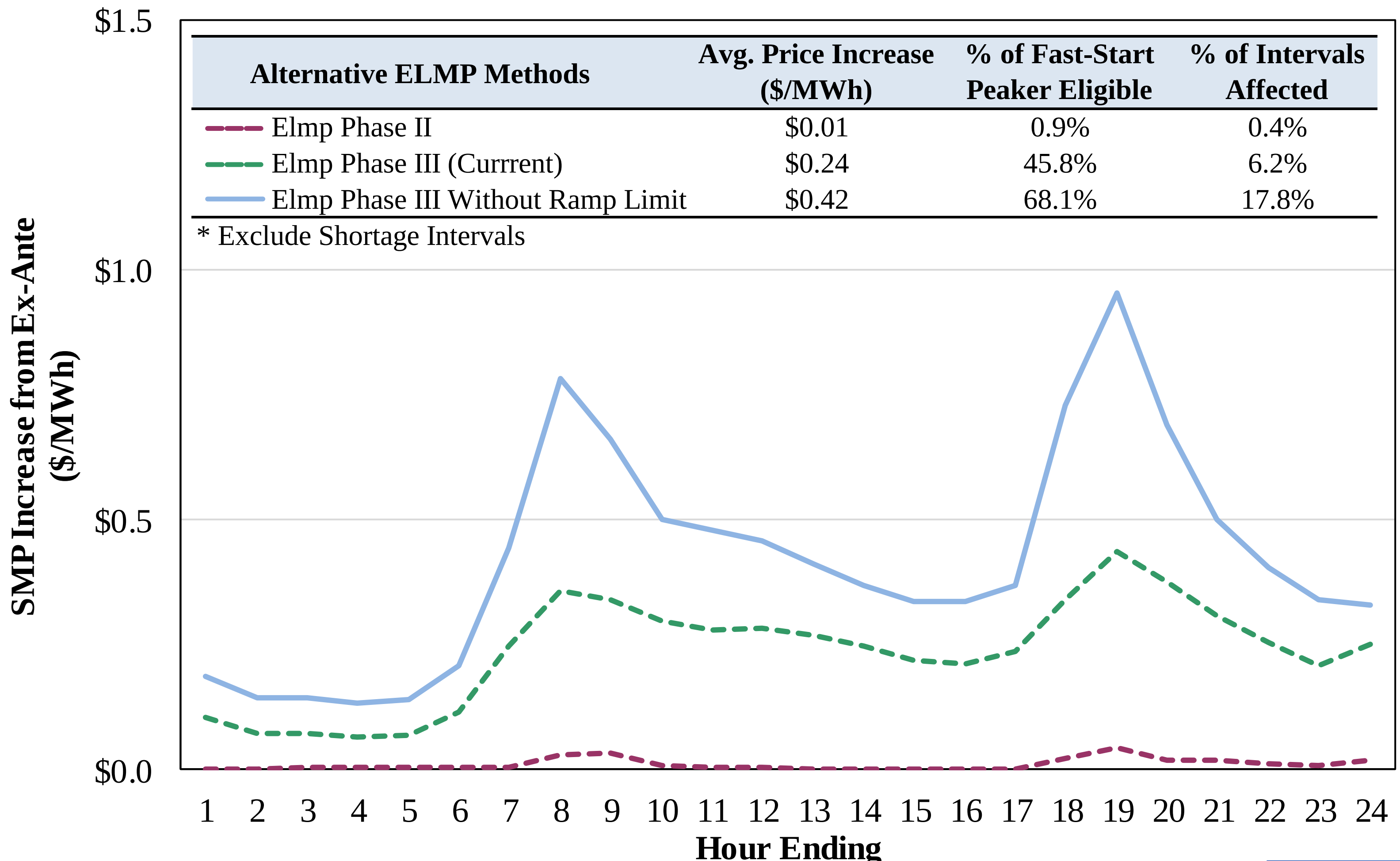


Wind Forecasting Error Congestion Impacts December 1, 2019– February 29, 2020



Dec 1 to Feb 29	Avg Error	Avg Abs. Error
Higher-of Logic	102.2	118.7
Vendor Forecast	-14.0	96.8
Current Output	-0.5	78.0

Evaluation of ELMP Assumptions
Winter 2020



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Elmp Phase III Without Ramp Limit	$0.42	68.1%	17.8%

* Exclude Shortage Intervals

Submittals to External Entities and Other Issues

- We responded to FERC questions related to prior referrals and FERC investigations and we continued to meet with FERC on a weekly basis.
- We continued to provide comments related to the FERC Technical Conference on Grid Enhancing Technologies.
- We provided comments on MISO’s RAN initiatives related to LMR accreditation and LOLE modeling.
- We participated in RASC meetings to discuss ICAP deliverability issues.
  - ✓ We have been consulting with MISO and participants in the Resource Adequacy Subcommittee to address the flaw in MISO’s deliverability rules.
- We provided an update on development of improvements to the market power mitigation measures in Module D of the Tariff to the MSC.
- We presented several new initiatives to stakeholders at the Integrated Roadmap workshop and provide comments on overall prioritization.
  - ✓ These will also appear as recommendations in the IMM SOM.

Submittals to External Entities and Other Issues

- We continued working with the SPP MMU and MISO on the Tier 1 items prioritized for study and have begun planning for Tier 2 items.
  - ✓ Two initial Tier 1 reports have been completed and drafts have been provided to the States: Joint Dispatch Study and Rate Pancaking Study.
  - ✓ The Tier 1 study of market-to-market coordination has been delayed because of SPP data limitations – we hope to complete the study in early April.
  - ✓ We have also begun work on the Tier 2 Interface Pricing report and hope to complete this report in April as well.
- In February, we presented a summary of MISO South market results and issues to the Entergy Regional State Committee.