IMM Quarterly Report: Summer 2022

MISO Independent Market Monitor

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Highlights and Findings: Summer 2022

- The MISO markets performed competitively this summer – market power mitigation was infrequent and conduct was competitive overall.
- Energy prices more than doubled over last summer, and MISO experienced several intervals of shortage pricing during the quarter.
  - ✓ Ongoing supply chain issues continued to constrain coal resource generation.
  - ✓ Gas prices were volatile this quarter and remained high.
  - ✓ Average pricing during shortage intervals more than tripled because MISO eliminated the $200 per MWh step in the ORDC late last year.
- Average load was similar to last year, while peak load rose 2 percent.
  - ✓ Annual peak load of 122 GW occurred on June 21, as higher than normal temperatures footprint-wide led to high cooling demand.
- Transmission congestion doubled because of higher fuel prices and rising wind-related congestion – wind output grew 20 percent.
- Total guarantee payments uplifted to loads rose sharply to more than $100 million because of higher fuel prices and MISO’s out-of-market generator commitments.

Quarterly Summary

Summer		Value	Change[1] Prior Qtr.	Change[1] Prior Year
RT Energy Prices ($/MWh)	🟣	$86.28	*50%*	*124%*
Fuel Prices ($/MMBtu)				
Natural Gas - Chicago	🟣	$7.51	*20%*	*112%*
Natural Gas - Henry Hub	🟣	$7.87	*22%*	*114%*
Western Coal	🟢	$0.96	*3%*	*33%*
Eastern Coal	🟢	$7.14	*41%*	*311%*
Load (GW)[2]				
Average Load	🟢	86.0	*21%*	*0%*
Peak Load	🟢	122.4	*18%*	*2%*
% Scheduled DA (Peak Hour)	🟢	99.1%	97.1%	98.7%
Transmission Congestion ($M)				
Real-Time Congestion Value	🟣	$870.6	*-17%*	*102%*
Day-Ahead Congestion Revenue	🟣	$603.0	*-8%*	*107%*
Balancing Congestion Revenue[3]	🟢	-$4.6	$50.1	$3.7
Ancillary Service Prices ($/MWh)				
Regulation	🟢	$18.89	*8%*	*65%*
Spinning Reserves	🟢	$5.62	*47%*	*67%*
Supplemental Reserves	🟢	$3.06	*547%*	*161%*

		Value	Change[1] Prior Qtr.	Change[1] Prior Year
FTR Funding (%)	🟢	115%	103%	105%
Wind Output (MW/hr)	🟣	7,480	*-42%*	*20%*
Wind Curtailed (MW/hr)	🟣	283	*-78%*	*-11%*
Guarantee Payments ($M)[4]				
Real-Time RSG	🟣	$52.5	*45%*	*17%*
Day-Ahead RSG	🟢	$24.9	*66%*	*61%*
Day-Ahead Margin Assurance	🟢	$24.6	*92%*	*123%*
Real-Time Offer Rev. Sufficiency	🟣	$2.7	*89%*	*144%*
Price Convergence[5]				
Market-wide DA Premium	🟢	-1.0%	1.6%	0.0%
Virtual Trading				
Cleared Quantity (MW/hr)	🟢	21,162	-16%	36%
% Price Insensitive	🟢	62%	54%	44%
% Screened for Review	🟢	3%	3%	2%
Profitability ($/MW)	🟢	$1.3	$1.7	$0.7
Dispatch of Peaking Units (MW/hr)	🟢	2,259	771	2,188
Output Gap- Low Thresh. (MW/hr)	🟢	283	84	209

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.

Highlights for Summer 2022

Volatile Gas Prices, Coal Conservation, and Energy Prices (Slides 13, 15)

- Energy prices more than doubled, driven by much higher natural gas prices and coal conservation measures that impacted the market supply curve.
- Gas prices were volatile, with Henry Hub averaging $7.87 per MMBTU and fluctuating between a high of $9.85 in August and a low of $5.62 in July.
  - ✓ A fire at the Freeport LNG terminal in Texas caused LNG exports to drop by 17 percent; the 3 impacted trains are expected to return to service mid-Fall.
  - ✓ In early August, 4 additional LNG trains went into service at Calcasieu pass.
  - ✓ Natural gas exports to Mexico have grown considerably since 2019, as higher demand in Mexico has been fueled by industrial and power sector growth.
- A mid-June heat dome across the footprint drove high cooling demand.
- Coal resources continued to be very economic based on coal prices relative to natural gas prices, but ongoing supply challenges lowered output.
  - ✓ Coal resource net revenues rose more than $30 per MWh from last year, yet coal generation fell 14 percent due to fuel supply constraints.
  - ✓ Opportunity cost-based references are currently in place for 18.5 GW of coal.

Highlights for Summer 2022

Impacts from CSAPR Group 3 NOx Prices

- In Spring 2021, the EPA finalized the Revised Cross-State Air Pollution Rule (CSAPR) that required 12 states to further reduce nitrogen oxides emissions.
  - ✓ Roughly 50 GW across four MISO states – IL, IN, MI, and LA were impacted by the rulemaking, including 21 GW of coal and 25 GW of gas-fired resources.
  - ✓ Many IL units have also been impacted by the Climate and Equitable Jobs Act that is generally more limiting because it is based on average historical output.
- Units in affected states were initially granted Group 3 NOx allowances.
  - ✓ Prior to April, Group 3 NOx allowances were trading below $10,000 per ton; prices increased sharply this summer to $47,000 per ton in August.
    - – This increased production costs of affected units by around $20 per MWh, despite several suppliers not fully reflecting these costs in their offers.
  - ✓ The effects of these costs on offer prices contributed to higher average energy prices during the quarter. NOx season extends through September.
- The EPA has proposed an additional rulemaking that will expand the program to 25 states next year, and unused allowances this year may be used next year.
  - ✓ The carryover provision likely contributed to the high Group 3 NOx prices.

Highlights for Summer 2022

<u>High Quarterly Congestion (Slides 18-22)</u>

- Day-ahead and real-time congestion costs doubled over last summer – the value of real-time congestion exceeded three quarters of a billion dollars.
  - ✓ Congestion increases are in line with the higher natural gas prices that increased the marginal cost of moving gas-fired resources to manage system-flows.
  - ✓ Much of the congestion occurred in mid to late June when MISO experienced high temperatures and associated load.
    - – On average, MISO managed 42 constraints per day during that time, compared to an average of 25 constraints per day on all other summer days.
  - ✓ Wind output continued to be a significant driver of MISO's congestion, contributing to more than 30 percent of congestion during the quarter.
  - ✓ A single constraint coordinated with SPP accrued 10 percent of all congestion.
- Wide-spread use of ambient-adjusted transmission line ratings and emergency ratings would have produced roughly $100 million in savings this summer.
- FTR surpluses (day-ahead congestion less FTR entitlements) were unusually large, exceeding $160 million during the quarter.
  - ✓ Less transmission capability was made available in the monthly FTR markets partly due to changes in commercial flow assumptions.

Highlights for Summer 2022

SPP Day-Ahead Market Modeling of MISO M2M Constraints (Slide 21)

- The Joint Operating Agreement between MISO and SPP requires:
  - ✓ Coordination of congestion on M2M constraints to achieve reliable and least-cost operations.
  - ✓ Modeling of these constraints in the day-ahead markets to help ensure unit-commitment will enable reliable operations in real-time.
- We have identified concerns that SPP is not activating MISO M2M constraints in its day-ahead market. We find this to be a violation of the JOA.
  - ✓ The IMM and MISO have engaged SPP in discussions on this issue.
  - ✓ SPP is testing alternatives for determining when to activate MISO's M2M constraints in its day-ahead model.
- Failure to model MISO M2M constraints is costly for MISO when SPP commits and schedules resources in its day-ahead market that contribute to severe congestion.
  - ✓ It is likely much more costly for SPP because it allows virtual traders and others to over-schedule these constraints, causing SPP to incur sizable uplift costs to buy back the flow in real-time.
- We will monitor progress on this issue and identify next steps.

Highlights for Summer 2022

MISO Commitment Practices and High Uplift Costs (Slides 23-27)

- We remain very concerned about MISO's out-of-market commitment patterns.
- Nominal real-time RSG costs rose 21 percent over last summer but fell 26 percent on a fuel-adjusted basis due partly to changes made since last year.
- Nonetheless, we continue to show that most of MISO's commitments and the associated RSG costs are not needed.
  - ✓ Less than 10 percent of the RSG from intra-day generator commitments (excluding long-lead time commitments) was ultimately needed.
  - ✓ Another 27 percent appeared to be needed based on forecasts but were ultimately not needed.
- Most other real-time RSG is associated with excess commitments that:
  - ✓ Inefficiently lower real-time energy and reserve prices – including causing STR prices to average close to zero;
  - ✓ Lower day-ahead load scheduling and generator commitments;
  - ✓ Produce substantial RSG costs that are difficult for customers to hedge; and
  - ✓ Lower imports inefficiently from our neighbors.
- Slide 27 shows the simulated effects of addressing these concerns on July 20.

Highlights for Summer 2022

<u>Recommendations to Improve MISO's Commitment Practices</u>

- Eliminate use of the "wind offset" in the look-ahead commitment model.
  - ✓ This parameter allows operators to manually reduce the forecasted wind that LAC expects, causing it to make very poor commitment recommendations.
  - ✓ $1.2 million in RSG was paid units that MISO committed that overloaded constraints because MISO's wind offset caused LAC to not see the congestion.
- Disable the "headroom" requirement in LAC now that MISO has implemented the STR product that eliminates the need for headroom requirements.
- Allow fast-start resources (<30 min) to remain offline and meet STR requirements unless MISO projects shortfalls of online resources.
  - ✓ Starting 30-minute units when they can provide reserves while offline increases RSG and distorts prices without improving reliability.
- Revisit overly conservative commitment rules and procedures that lead to excessive headroom.
- Re-evaluate the Optimal Dispatch Calculator used to determine MISO's performance metrics for its unit commitment decisions.

Highlights for Summer 2022

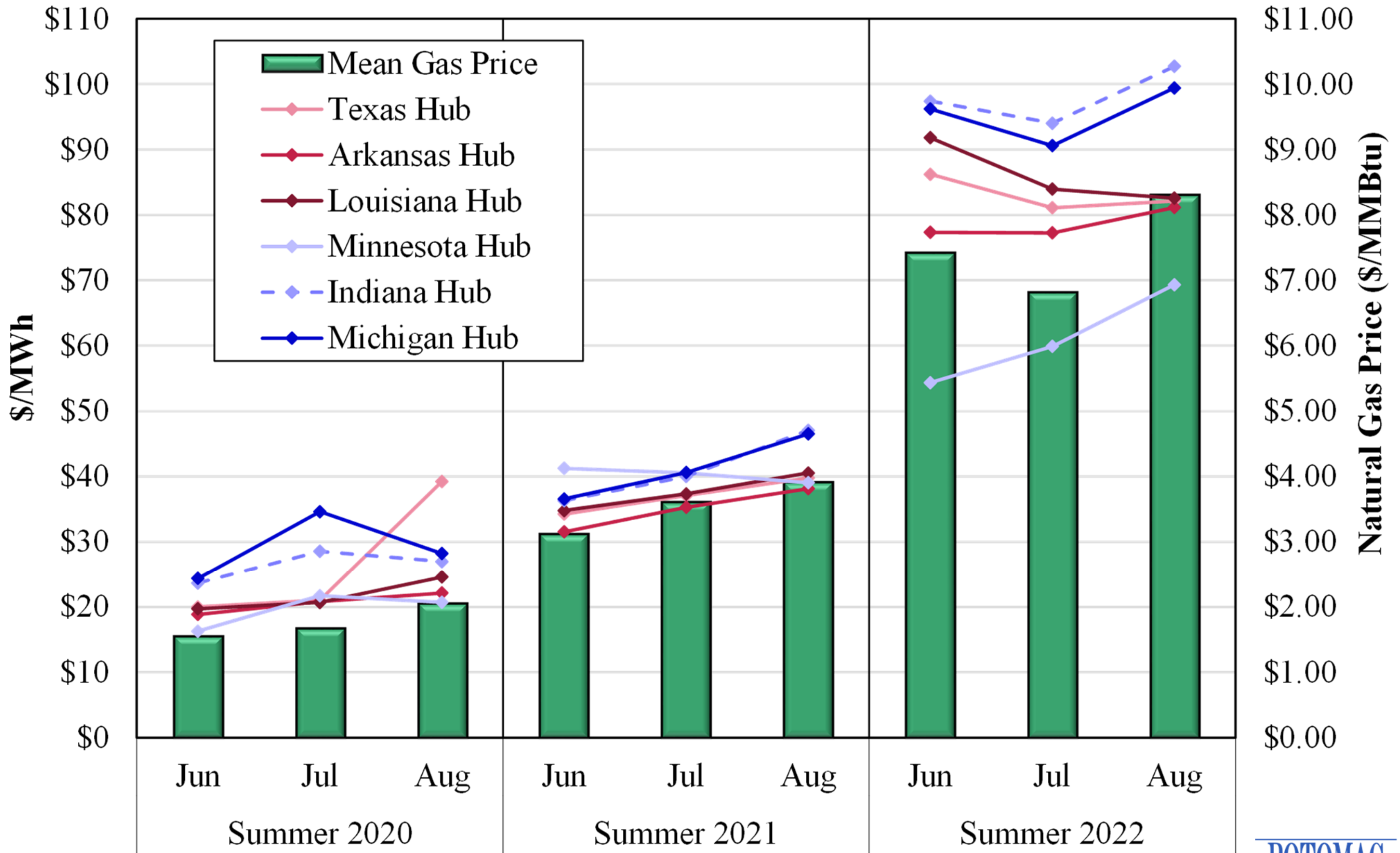
MISO Commitment Practices: July 20 Case Study

- To illustrate how MISO's practices affect the market on a particular day, we performed a simulation on July 20 when RT RSG exceeded $1.4 million
- We eliminated the "wind offset" of as much as 4.4 GW in the LAC, which resulted in significantly different recommendations:
  - ✓ It recommended committing fewer peaking resources.
  - ✓ Since LAC could accurately see the congestion caused by wind, it did not recommend committing resources that overloaded constraints.
    - – MISO committed one unit that stranded others and required $121K in RSG.
- Ultimately, the change in commitment patterns changed the market outcomes. From 10 am to 10 pm, the simulation showed the following changes:
  - ✓ RSG fell from $1.25 Million to $0.5 Million in the simulated case.
  - ✓ Average LMPs rose from $93/MWh to $137/MWh in the simulated case.
- In addition to the sizable RSG reduction, these price effects send signals to:
  - ✓ Bring in more imports; and
  - ✓ Schedule more generation in the following days' day-ahead markets.

Submittals to External Entities and Other Issues

- We responded to several FERC questions related to prior referrals and FERC investigations, and we responded to requests for information on market issues.
  - ✓ We recommended a sanction to MISO for physical withholding by a resource.
- We continue to meet with MISO and a TO working group on Order 881 compliance and related issues on AARs and Emergency Ratings.
- We submitted comments to the RCCTT and the RSC on the latest proposal.
- In July we presented our SOM report highlights and recommendations and the Spring Quarterly Report to the Market Subcommittee.
- We continue to meet with states and stakeholders on the need to reform MISO’s PRA demand curve to satisfy the Reliability Imperative.
  - ✓ In August, we participated in the OMS Resource Adequacy Summit, presenting an analysis of the reliability-based demand curve to the states.
- FERC rejected MISO’s Minimum Capacity Obligation proposal, citing primarily the fundamental concerns and issues we raised in our protest.
  - ✓ Although this is a good outcome, it points to a concern with the market design process – sizable resources were consumed by MISO, participants and the IMM that could have been utilized much more valuably elsewhere.

Day-Ahead Average Monthly Hub Prices Summer 2020–2022



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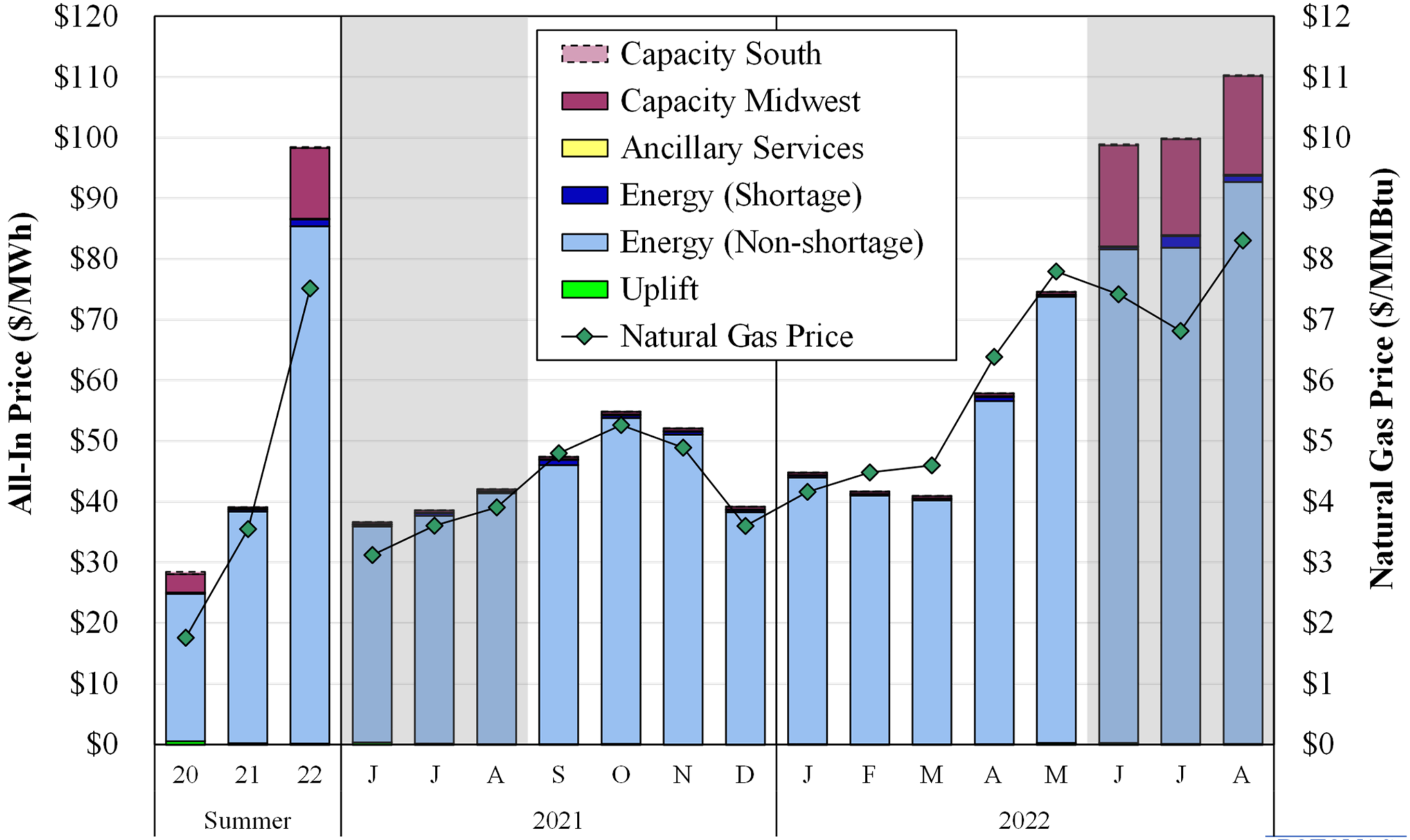
All-In Price
Summer 2020 – 2022



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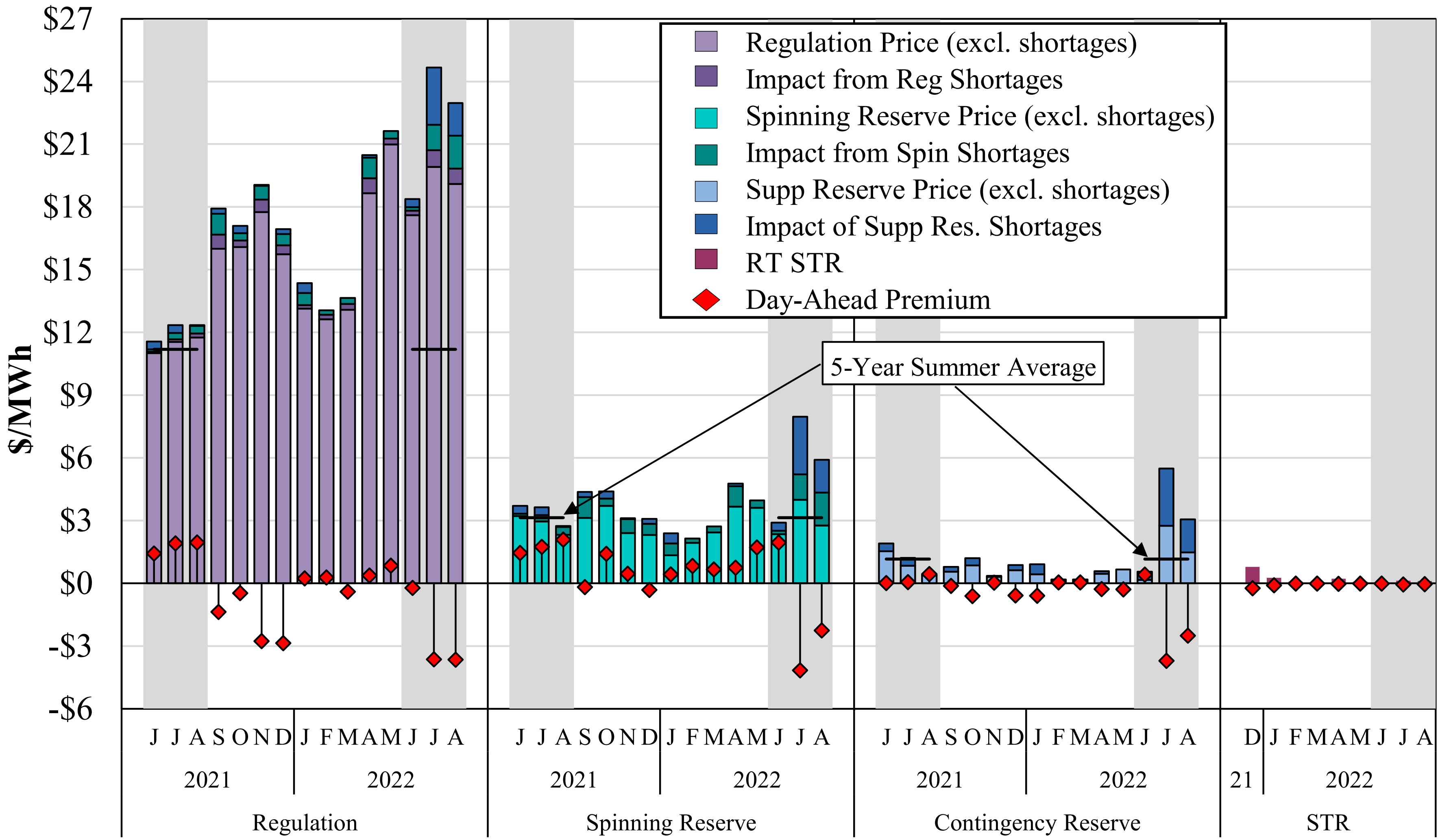
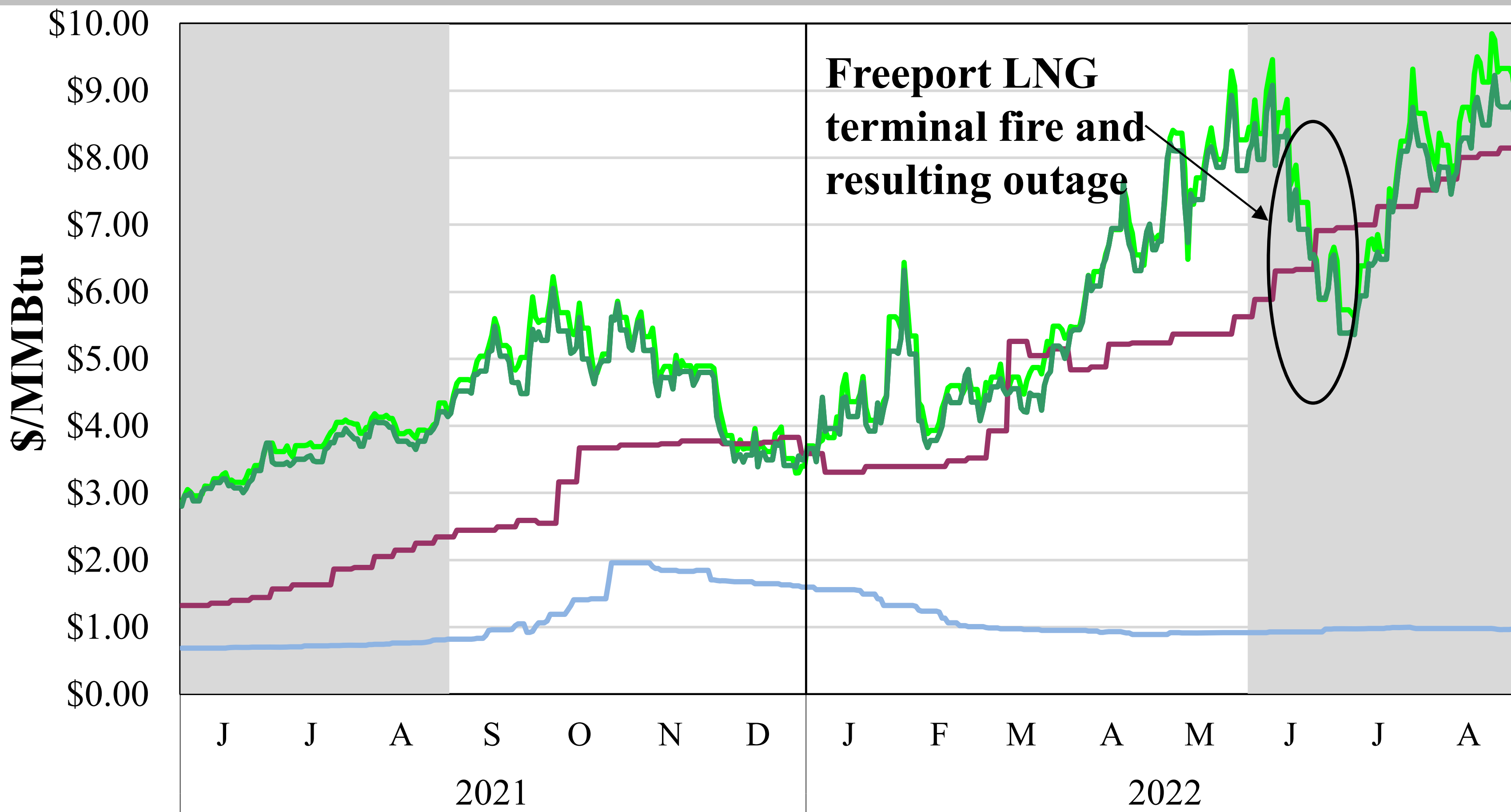
Ancillary Services Prices
Summer 2021–2022



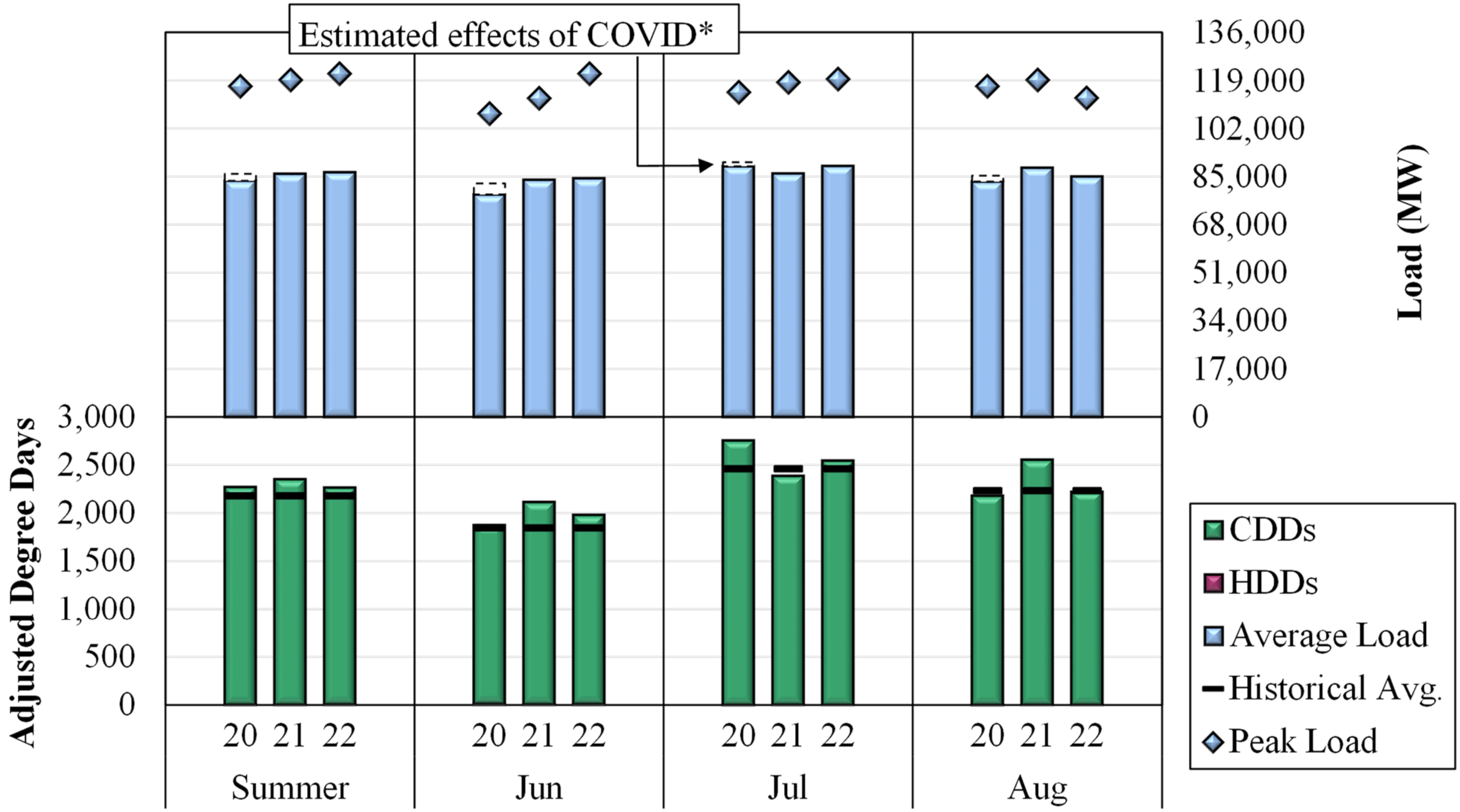
MISO Fuel Prices
2021–2022



Summer Average	2020	2021	2022
Chicago NG	$1.76	$3.55	$7.51
Henry NG	$1.83	$3.68	$7.87

Summer Average	2020	2021	2022
IB Coal	$1.24	$1.73	$7.14
PRB Coal	$0.68	$0.72	$0.96

Load and Weather Patterns
Summer 2020–2022



Notes: Midwest degree day calculations include four reprentative cities: Indianapolis, Detroit, Milwaukee and Minneapolis. The South region includes Little Rock and New Orleans.
*Effects estimated by MISO through back-casting using its load forecasting model.

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Capacity, Energy and Price Setting Share Summer 2021–2022

Summer	Unforced Capacity				Energy Output		Price Setting			
	Total (MW)		Share (%)		Share (%)		SMP (%)		LMP (%)	
	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
Nuclear	11,866	11,701	9%	9%	14%	13%	0%	0%	0%	0%
Coal	46,341	43,123	36%	34%	44%	36%	26%	20%	78%	73%
Natural Gas	58,334	59,901	45%	47%	32%	38%	73%	79%	98%	93%
Oil	1,636	1,474	1%	1%	0%	0%	0%	0%	1%	0%
Hydro	3,696	3,695	3%	3%	1%	1%	1%	1%	1%	3%
Wind	4,304	4,454	3%	3%	8%	9%	0%	0%	53%	48%
Solar	419	1,037	0%	1%	0%	0%	0%	0%	2%	1%
Other	2,603	2,734	2%	2%	1%	2%	0%	0%	6%	3%
Total	**129,199**	**128,120**								

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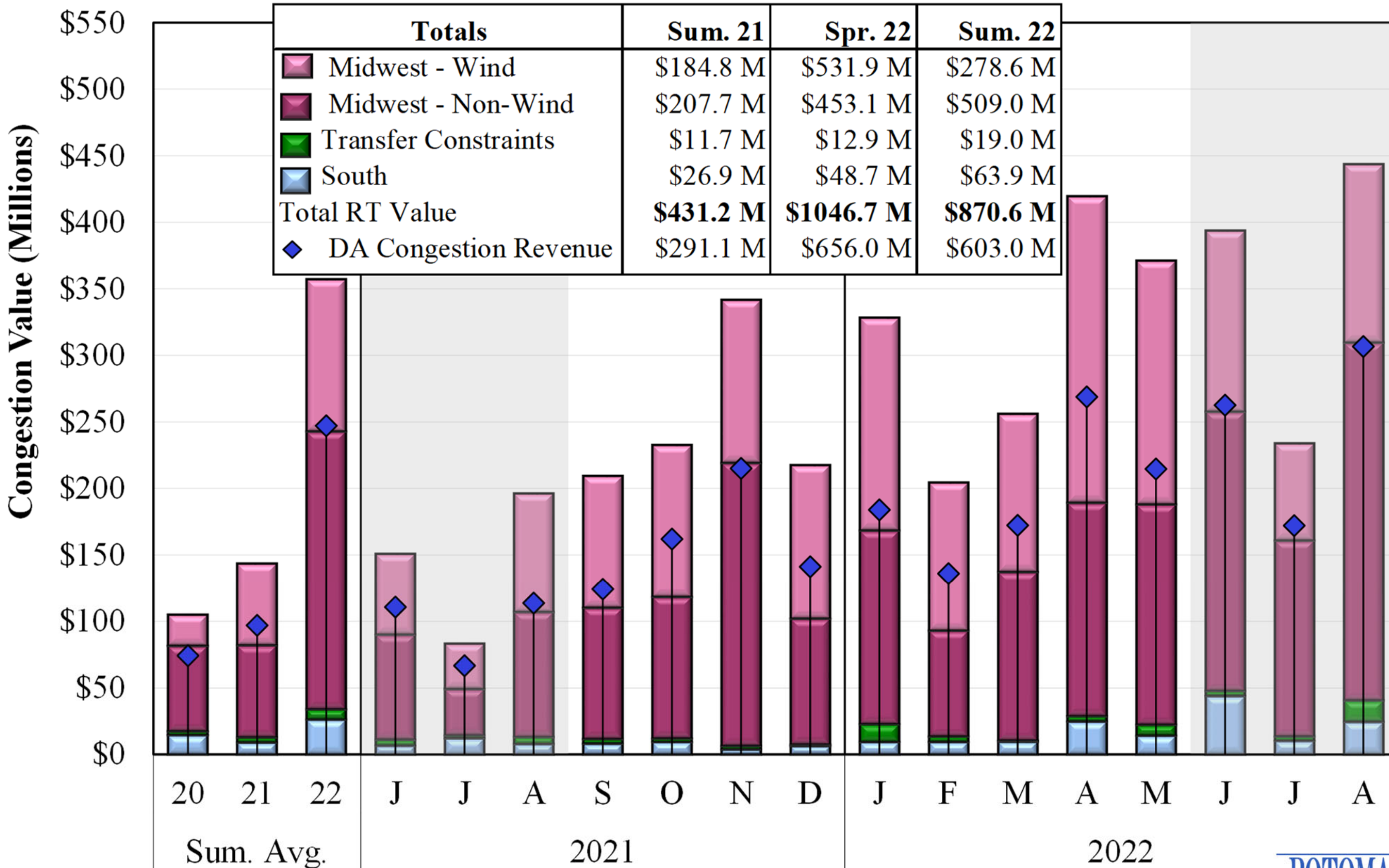
Value of Real-Time Congestion Summer 2021–2022



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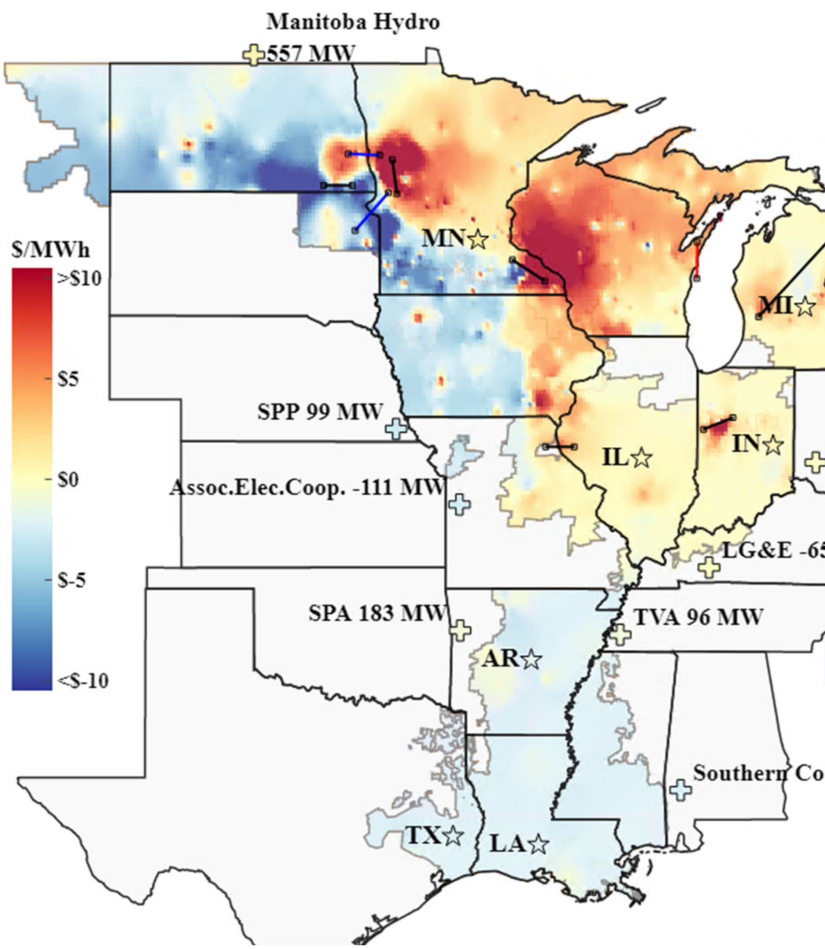
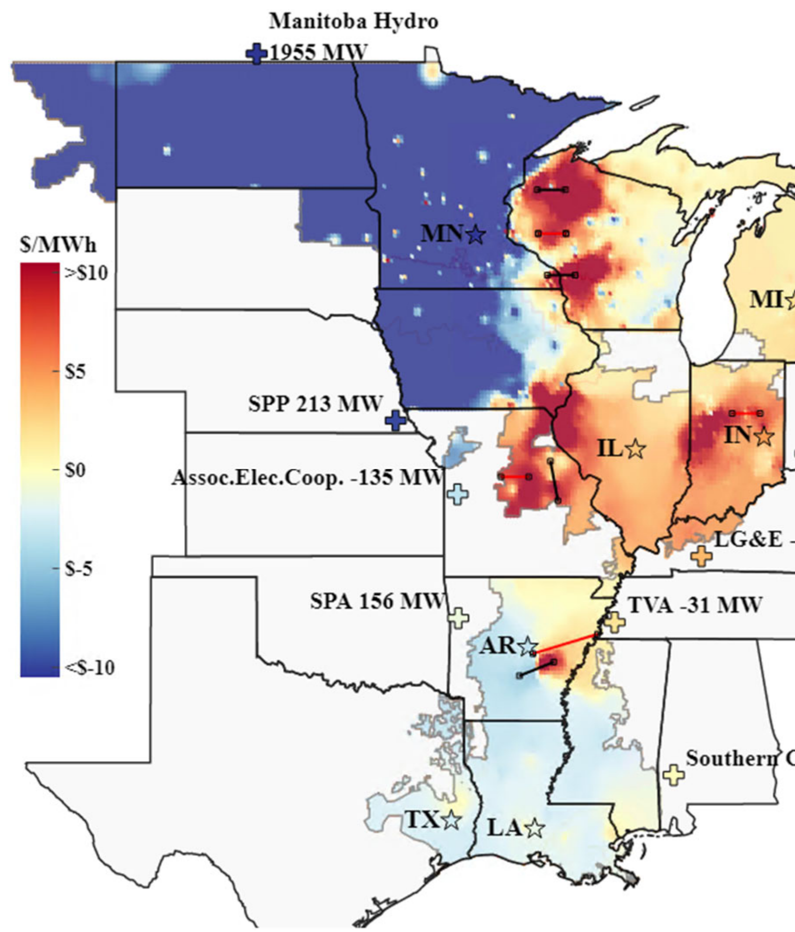
Average Real-Time Congestion Components Summer 2021–2022

Summer 2021



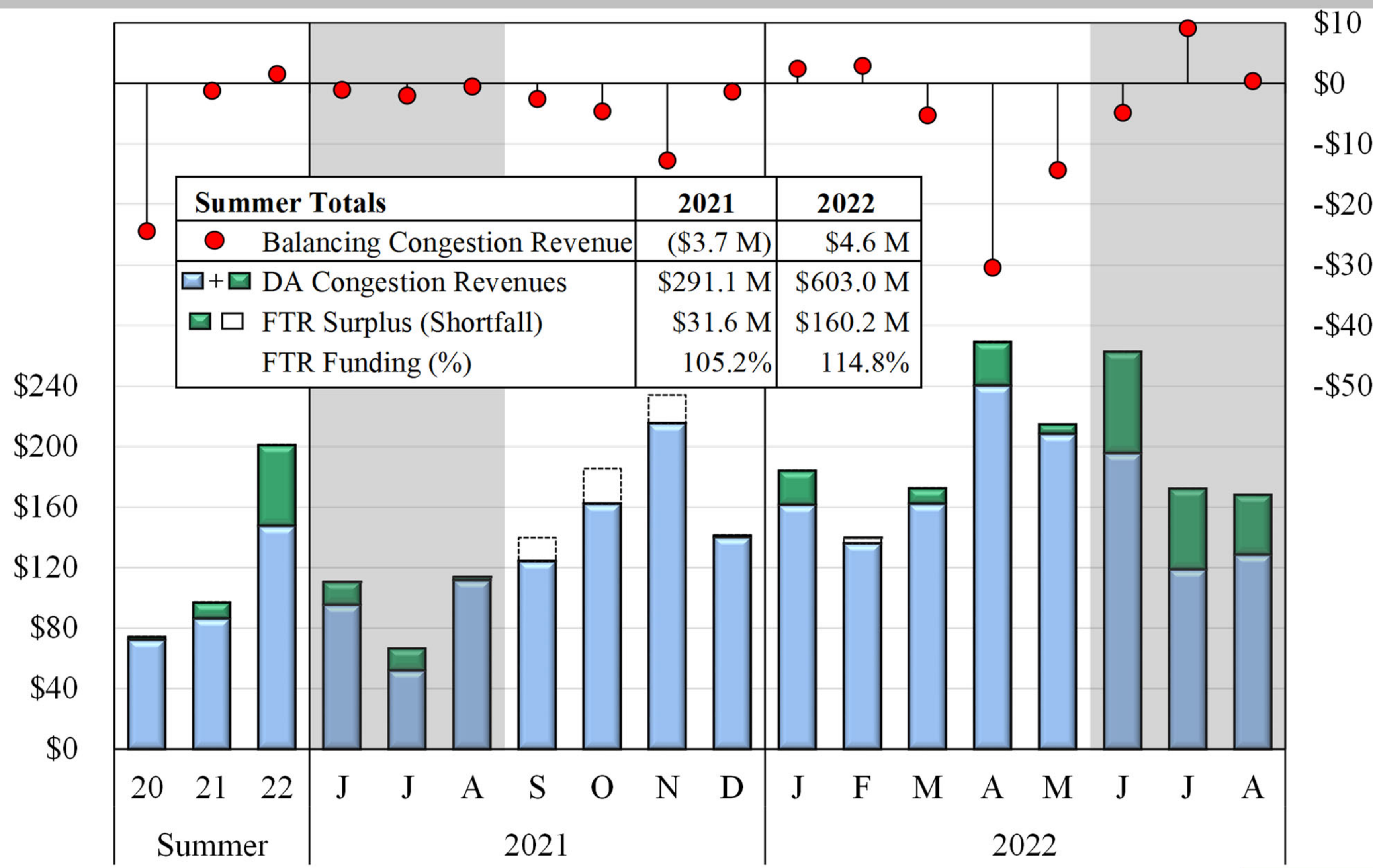
Hub	Prices
AR	$-1.85
IL	$0.20
IN	$0.55
LA	$-2.08
MI	$0.15
MN	$1.38
TX	$-2.16

Summer 2022



Hub	Prices
AR	$-3.30
IL	$3.06
IN	$4.92
LA	$-1.49
MI	$2.10
MN	$-17.79
TX	$-2.53

Day-Ahead Congestion, Balancing Congestion, and FTR Underfunding



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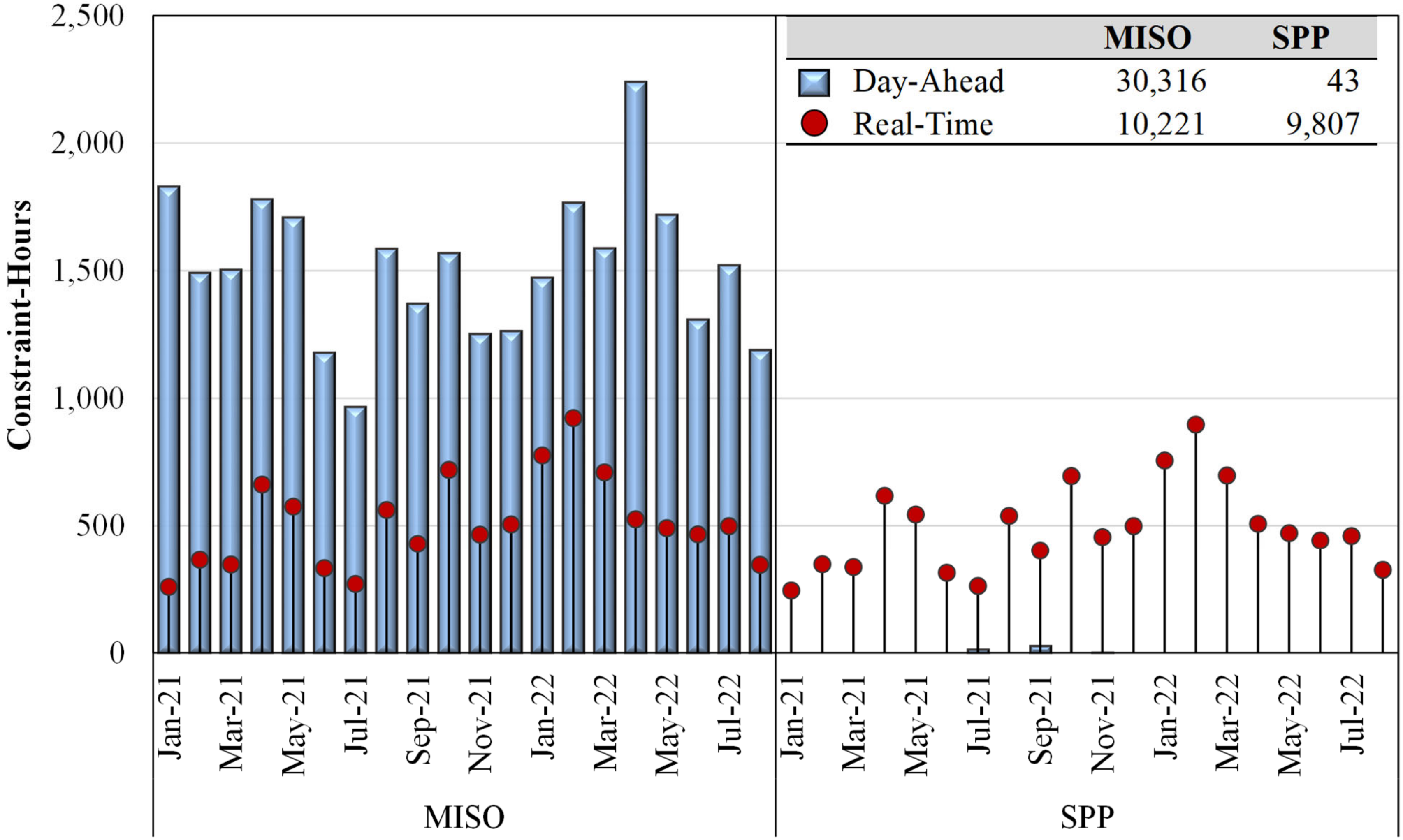
Day-Ahead and Real-Time Binding of MISO M2M Constraints



Benefits of Ambient-Adjusted and Emergency Ratings Summer 2021–2022

Summer		Savings ($ Millions) Ambient Adj. Ratings	Savings ($ Millions) Emergency Ratings	Savings ($ Millions) Total	# of Facilites for 2/3 of Savings	Share of Congestion
2021	**Midwest**	$22.7	$19.96	$42.7	15	10.5%
	South	$0.5	$1.52	$2.0	2	7.6%
	Total	**$23.2**	**$21.5**	**$44.7**	**17**	**10.3%**
2022	**Midwest**	$56.1	$47.73	$103.8	12	13.2%
	South	$0.4	$4.04	$4.5	2	6.7%
	Total	**$56.6**	**$51.8**	**$108.3**	**14**	**12.7%**

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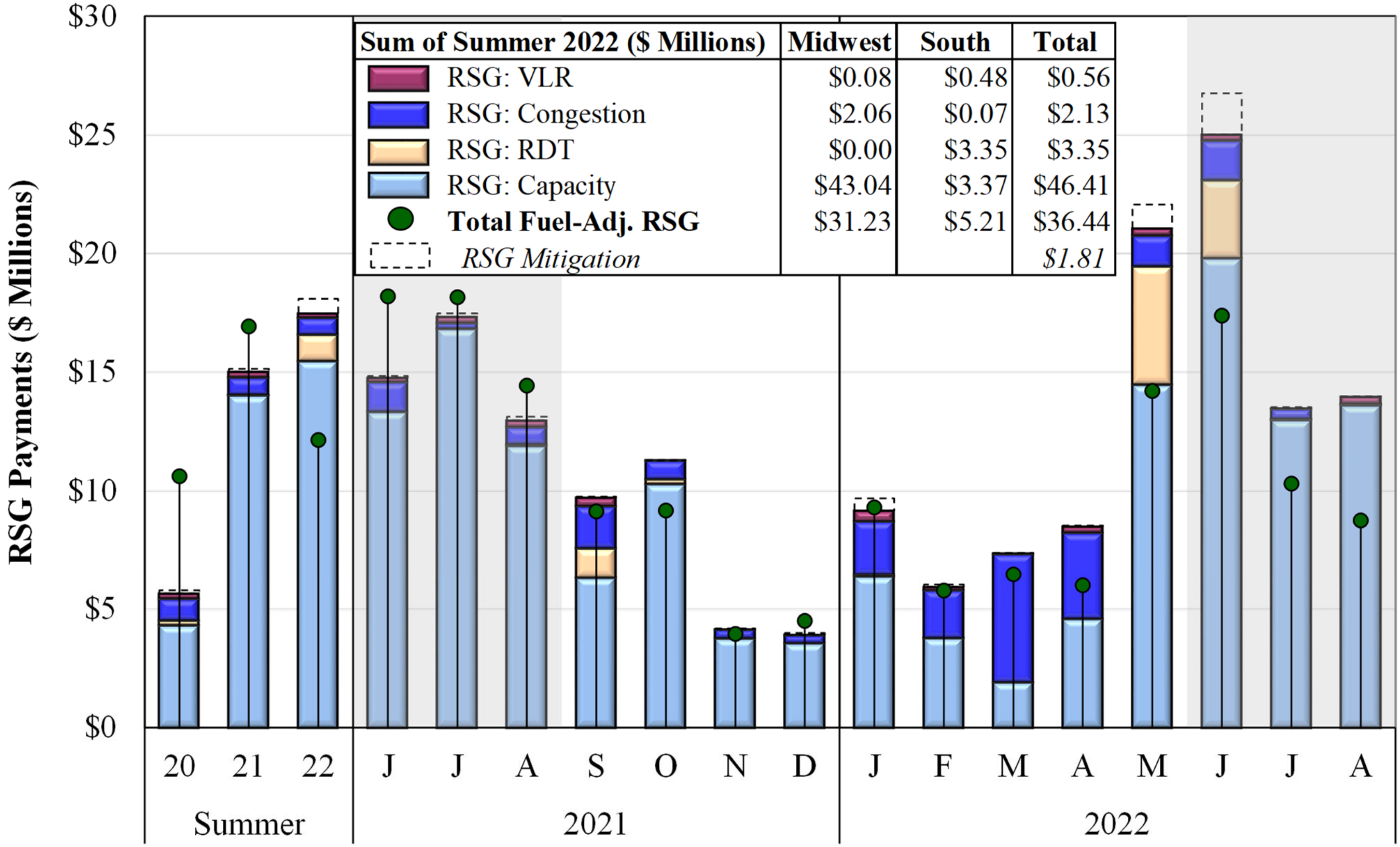
Real-Time RSG Payments Summer 2021–2022



Sum of Summer 2022 ($ Millions)	Midwest	South	Total
RSG: VLR	$0.08	$0.48	$0.56
RSG: Congestion	$2.06	$0.07	$2.13
RSG: RDT	$0.00	$3.35	$3.35
RSG: Capacity	$43.04	$3.37	$46.41
Total Fuel-Adj. RSG	$31.23	$5.21	$36.44
RSG Mitigation			*$1.81*

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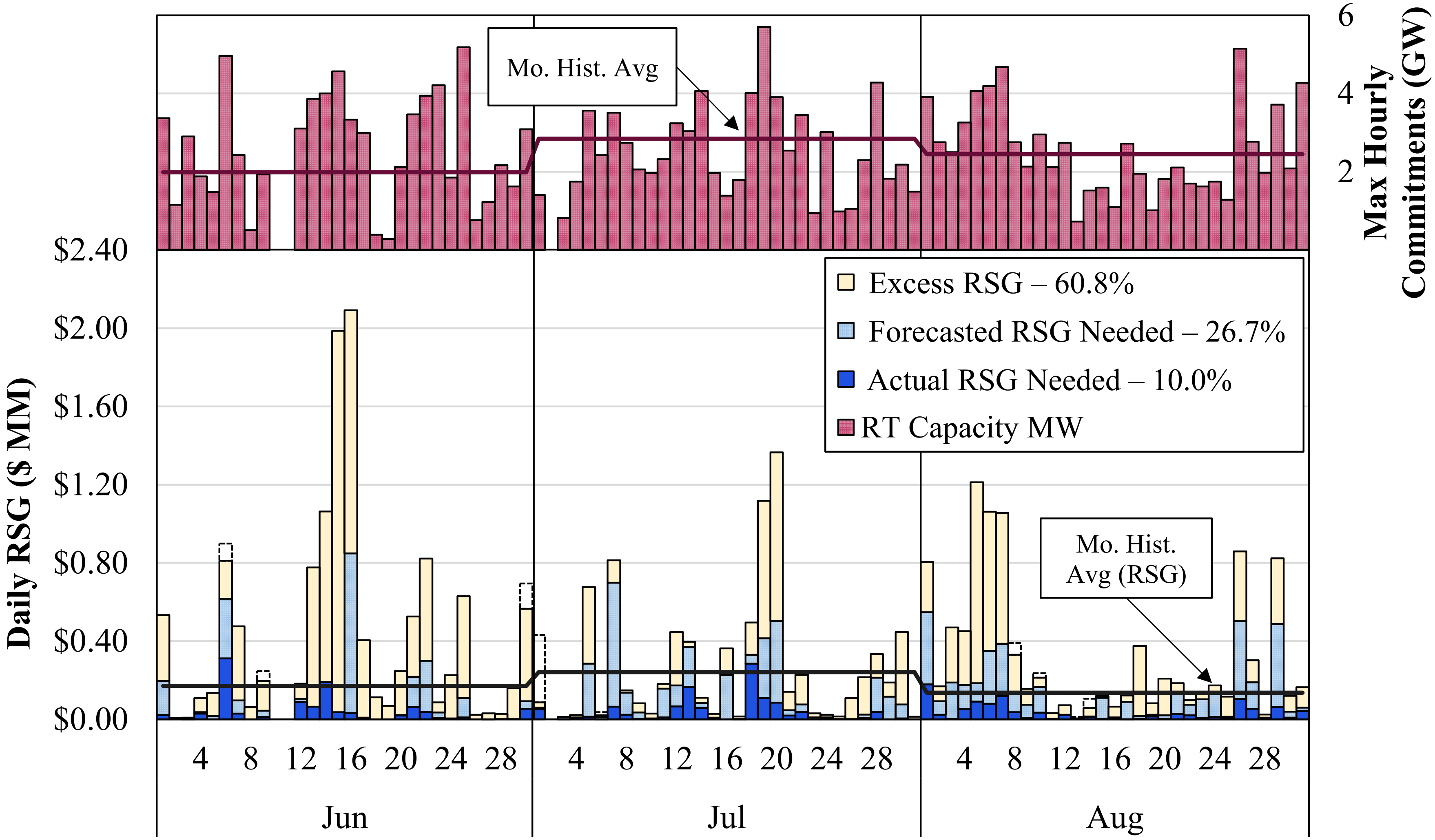
Real-Time Capacity Commitment and RSG



* 2.5% of the RSG could not be classified due to gaps in market data and is shown in the transparent bars.

Feedback Effects of Out-of-Market Commitments

Out-of-Market Commitments

Depressed Real-time Prices

Higher RSG Costs

Totaled $53 MM this Summer

Lower Net Imports

Lower Day-Ahead Scheduling

Averaged 99% of Net Load

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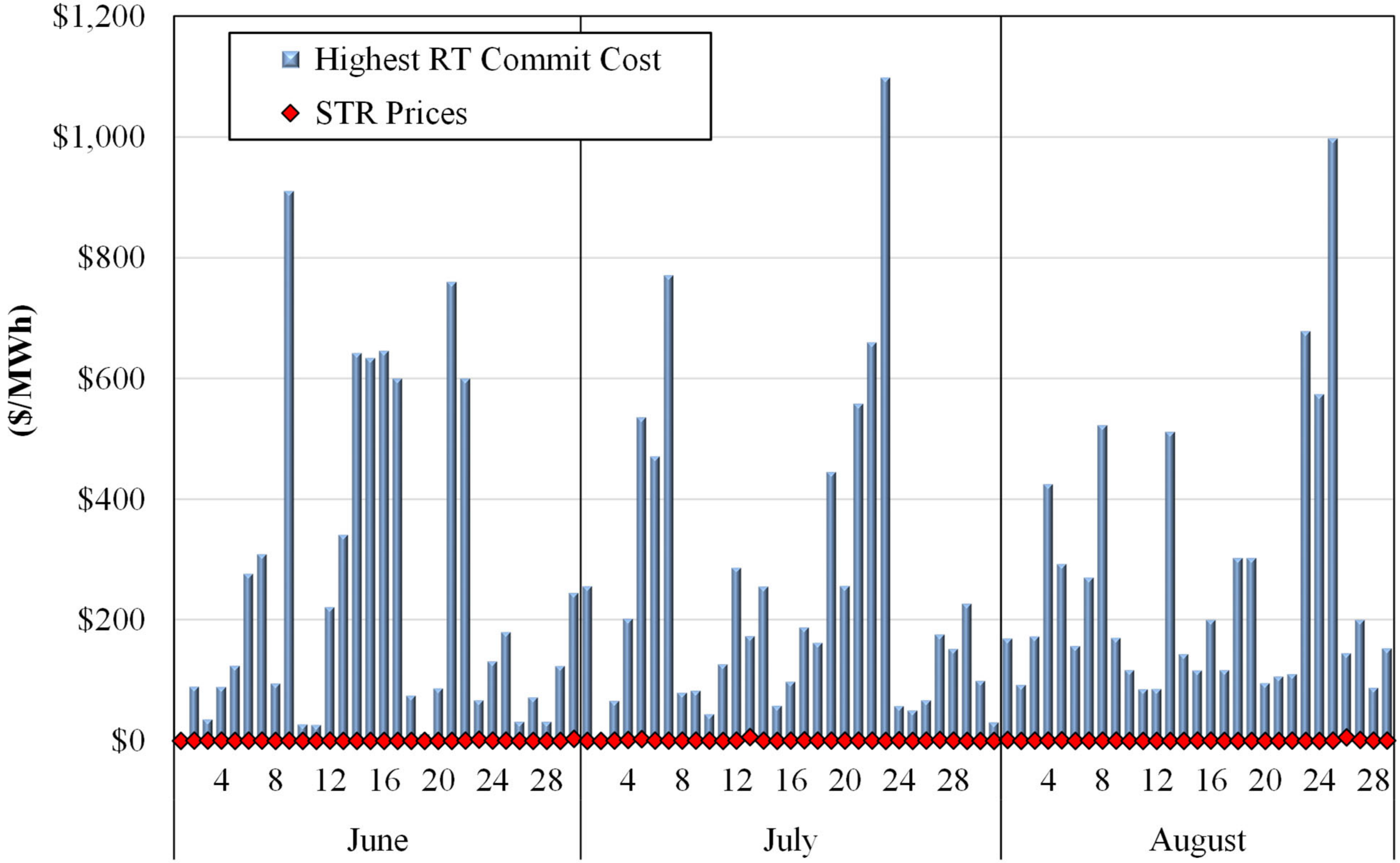
Real-Time Commitment Cost Versus Short-Term Reserve Prices



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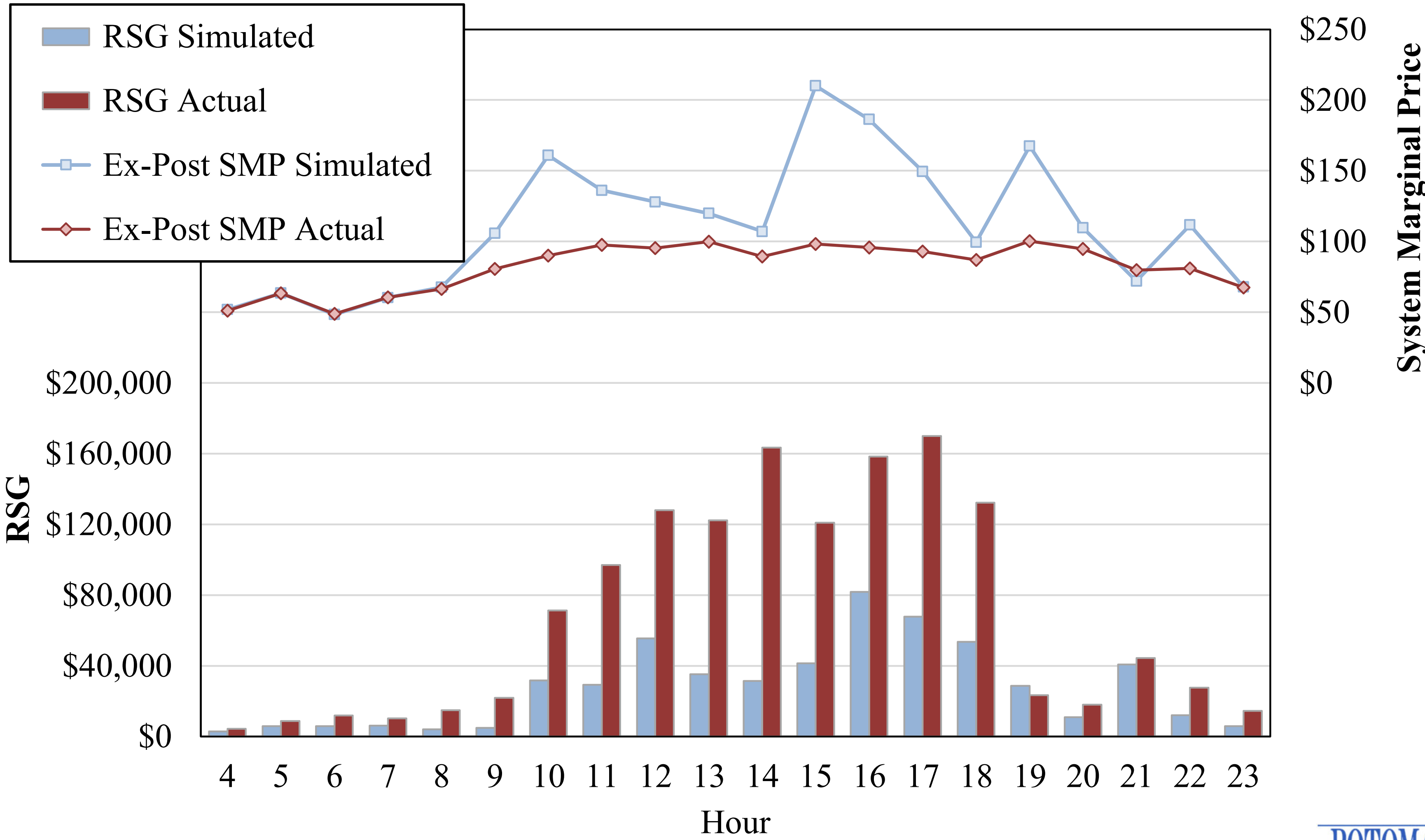
Alternative Commitment Case Study: July 20, 2022



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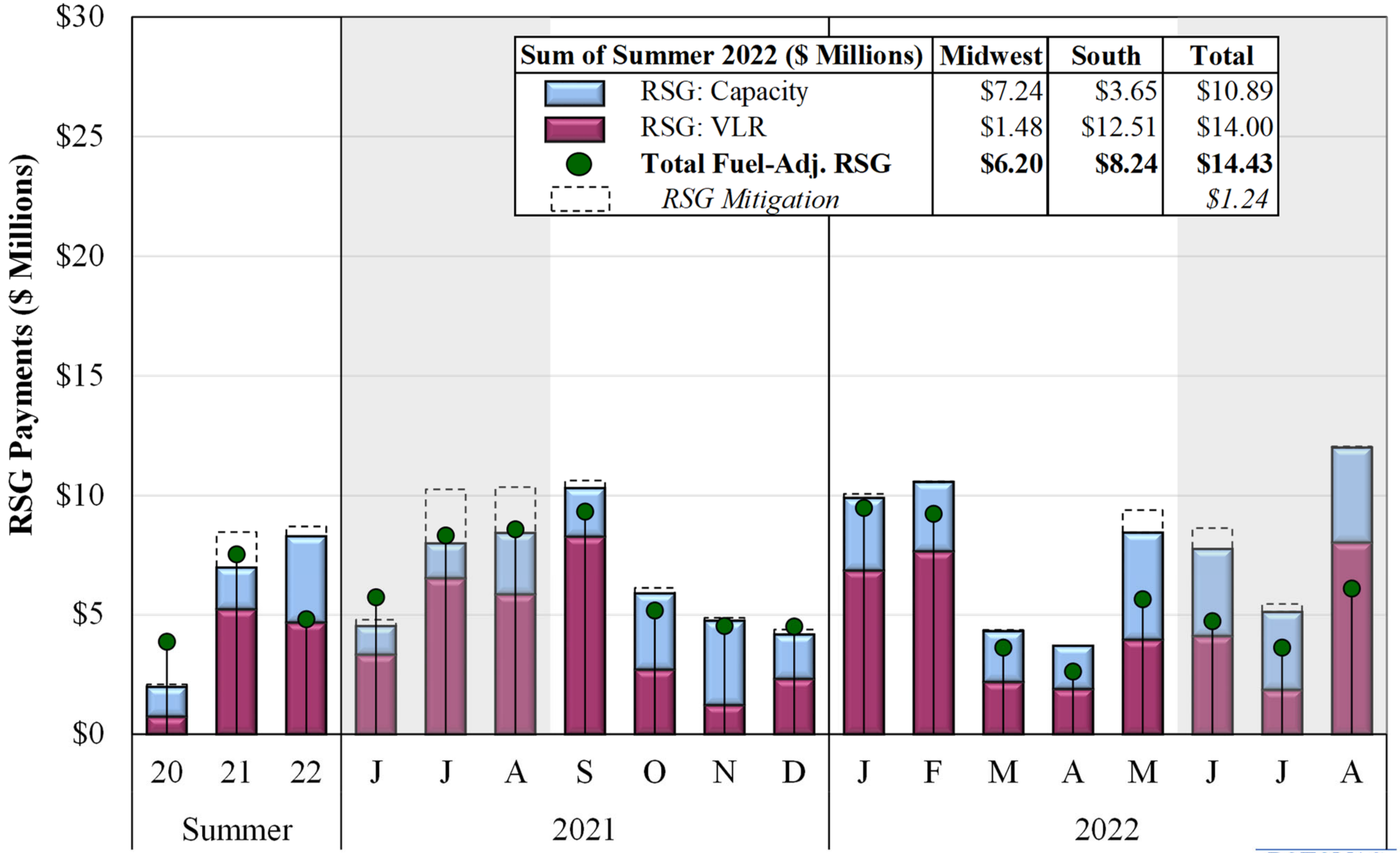
Day-Ahead RSG Payments Summer 2021–2022



Sum of Summer 2022 ($ Millions)	Midwest	South	Total
RSG: Capacity	$7.24	$3.65	$10.89
RSG: VLR	$1.48	$12.51	$14.00
Total Fuel-Adj. RSG	**$6.20**	**$8.24**	**$14.43**
RSG Mitigation			*$1.24*

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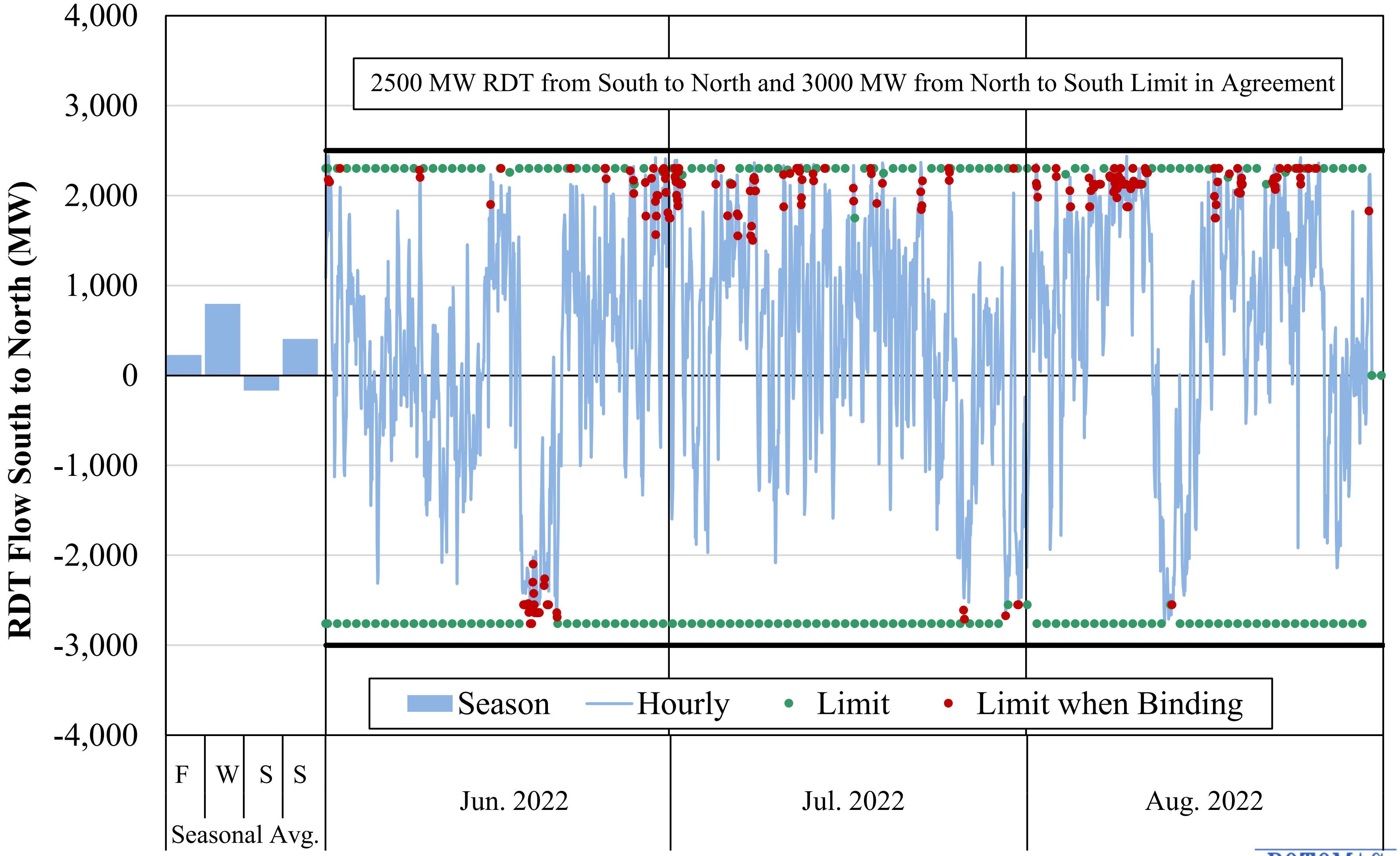
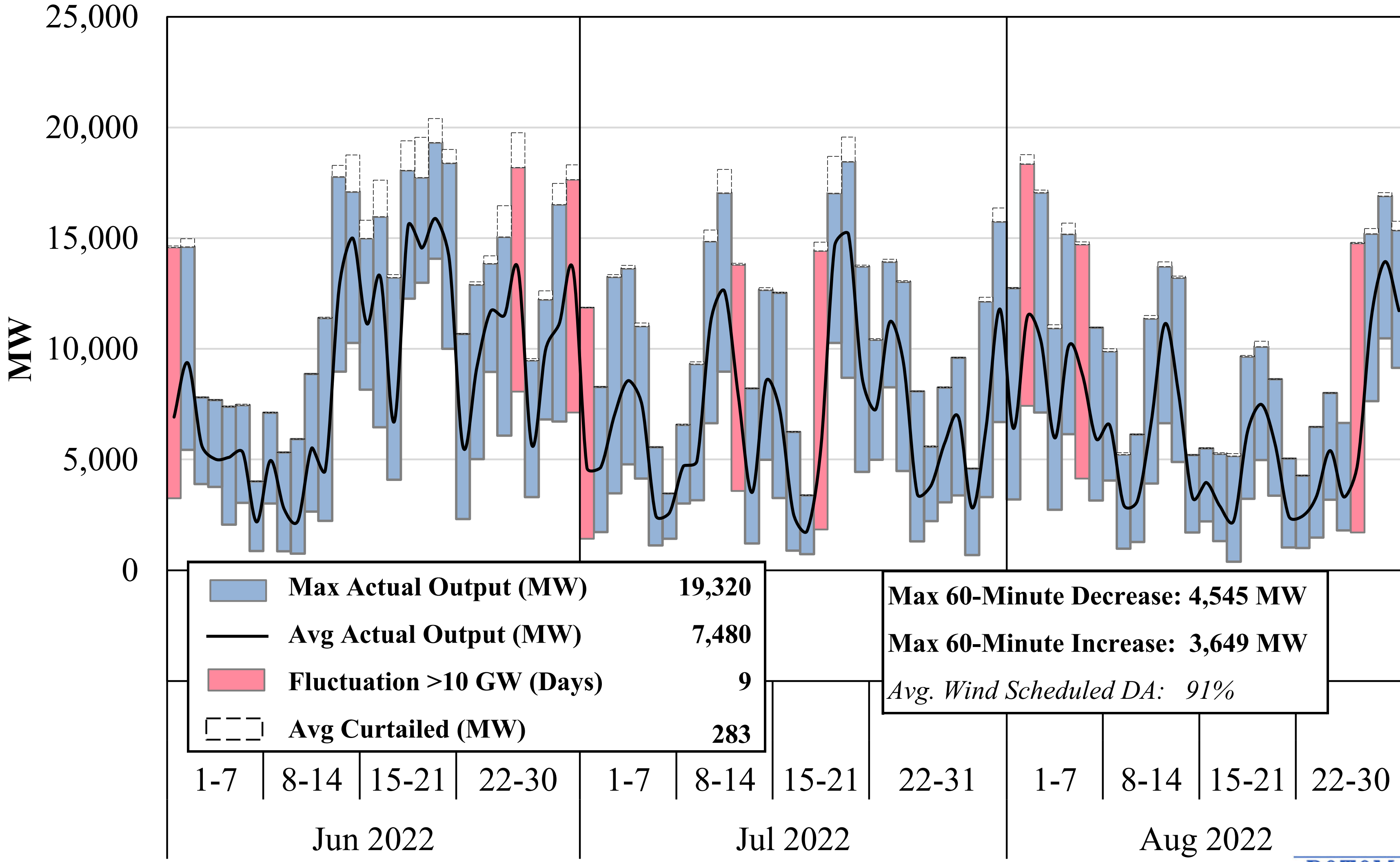
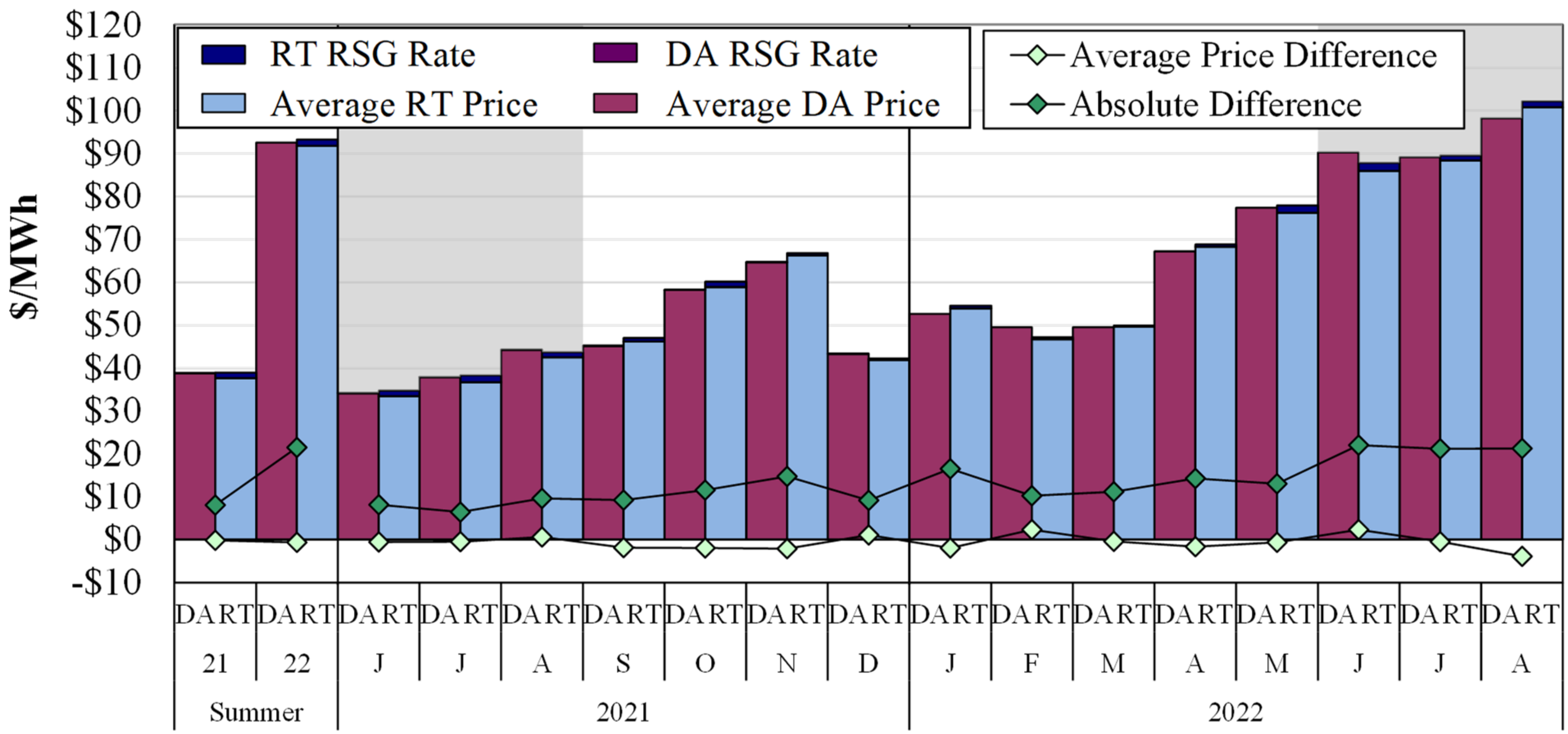
Real-Time Hourly Inter-Regional Flows Summer 2022



Wind Output in Real Time
Daily Range and Average



Day-Ahead and Real-Time Price Convergence Summer 2021–2022



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

Indiana Hub	0	-1	-2	-1	1	-4	-3	-3	3	-4	5	-1	-2	-1	3	0	-4
Michigan Hub	-1	0	-3	0	1	-3	-1	-1	1	-3	6	3	-3	5	5	-1	-3
Minnesota Hub	-1	1	-5	1	1	-7	-2	2	0	3	8	8	2	-1	10	-3	-5
Arkansas Hub	0	-3	1	-5	3	-5	-2	5	-2	-2	3	3	3	6	3	-5	-7
Texas Hub	2	-2	4	-1	3	-4	2	6	-1	-4	4	4	1	9	4	-2	-8
Louisiana Hub	3	-1	2	0	8	-5	3	3	-1	-3	5	4	4	8	5	0	-7

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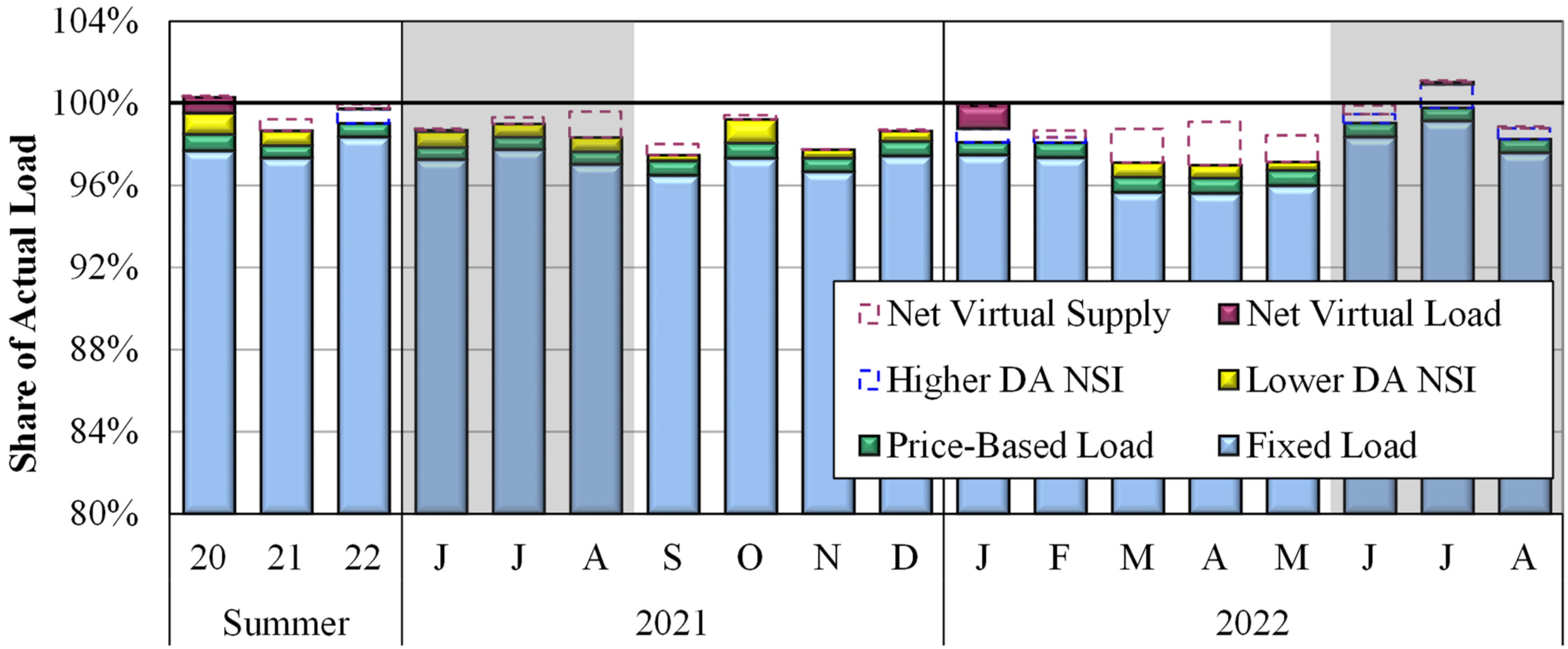
Day-Ahead Peak Hour Load Scheduling Summer 2021–2022



Share of Actual Load (%)

All Hours	100.9	99.5	99.3	98.9	99.7	99.8	98.3	99.2	97.8	98.9	98.9	97.8	97.3	97.5	97.6	99.2	99.8	98.7
Peak Hours Midwest	99.6	97.6	98.8	97.6	98.3	96.9	97.0	98.7	97.6	99.0	99.8	98.1	96.5	96.0	96.2	98.2	99.7	98.3
Peak Hours South	101.7	101.4	99.3	101.6	100.9	101.8	99.3	100.2	101.4	101.3	98.8	100.0	98.8	99.1	99.0	99.7	99.7	98.6

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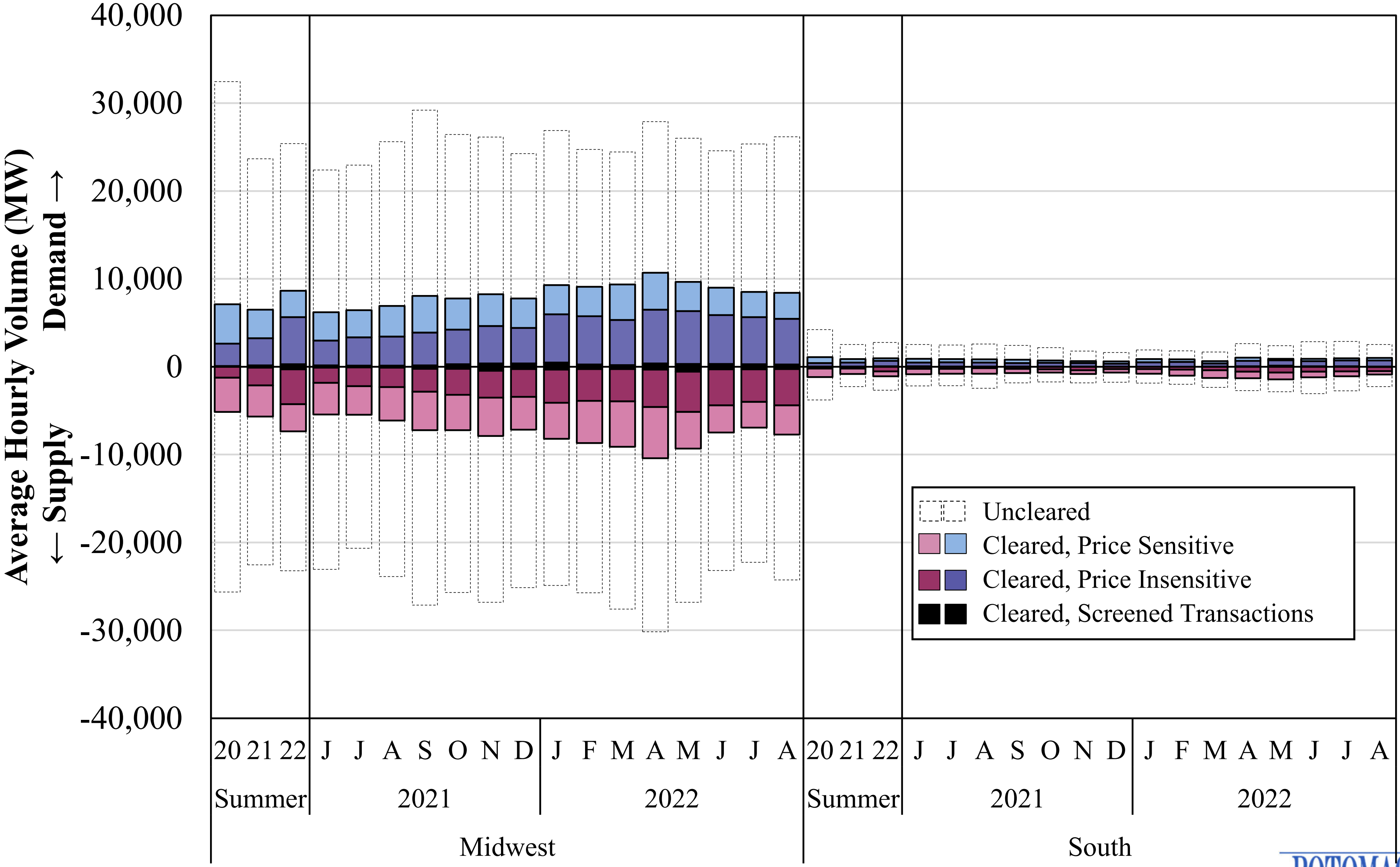
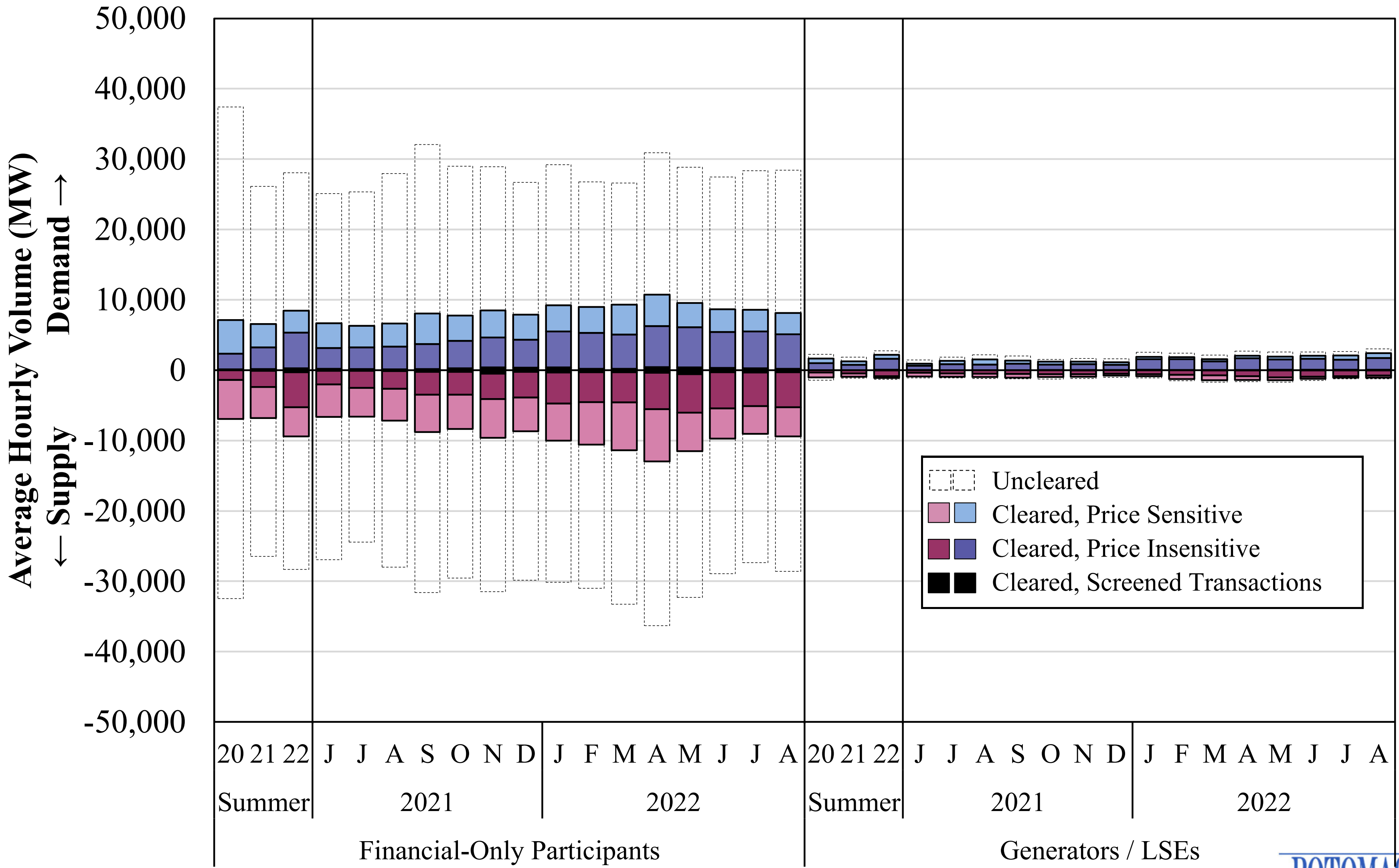
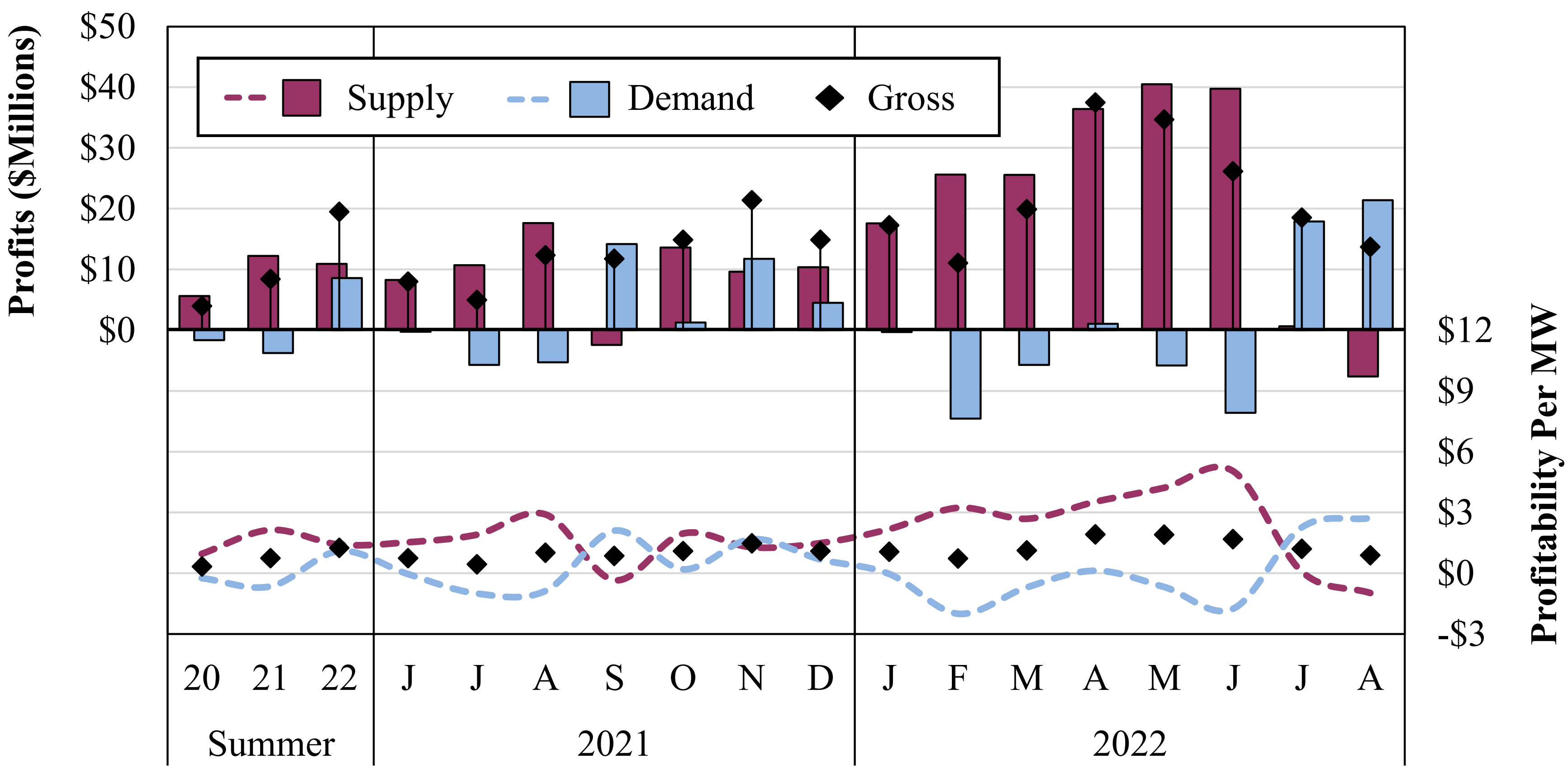
Virtual Load and Supply
Summer 2021–2022



Virtual Load and Supply by Participant Type
Summer 2021–2022



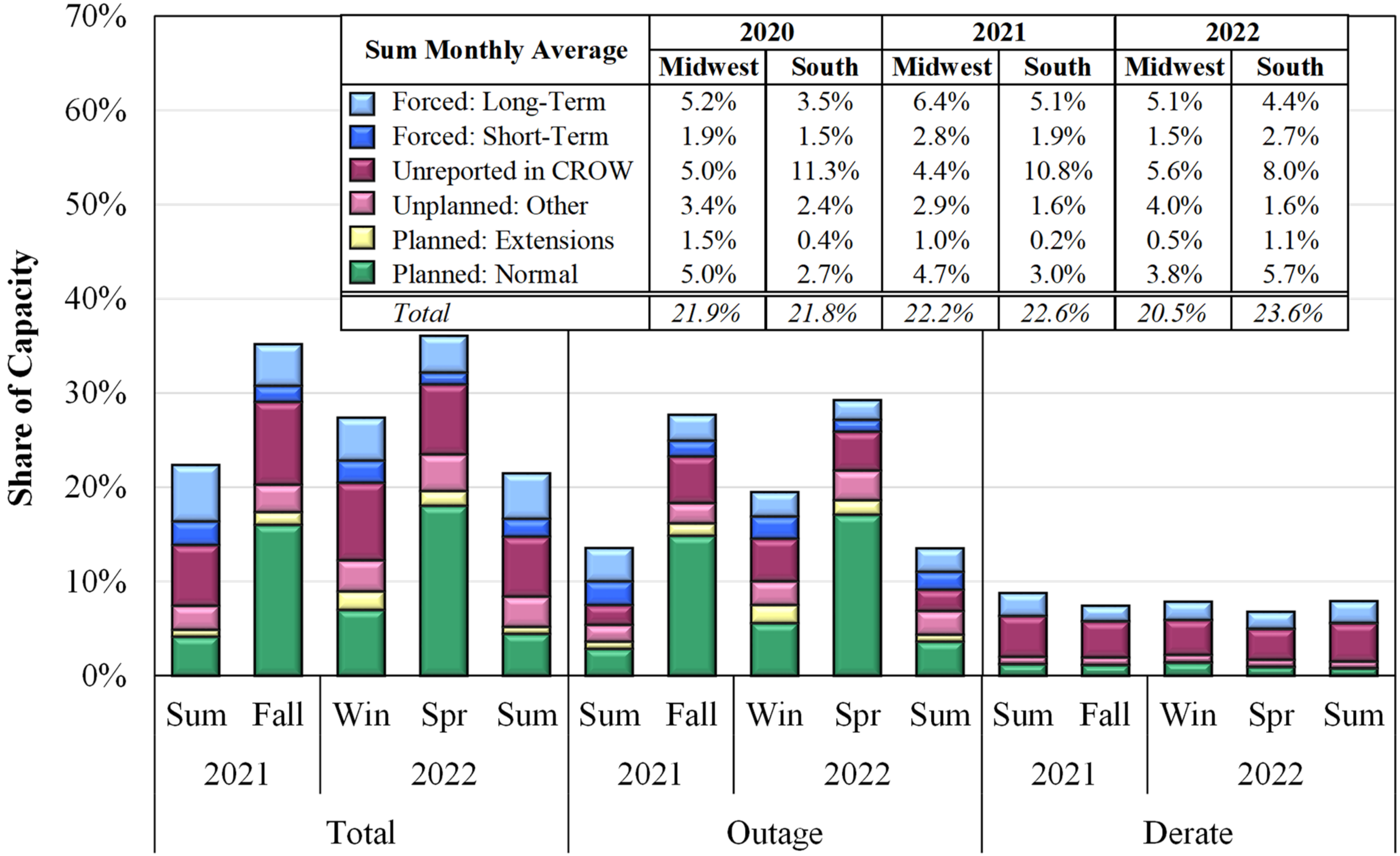
Virtual Profitability
Summer 2021–2022



Percent Screened

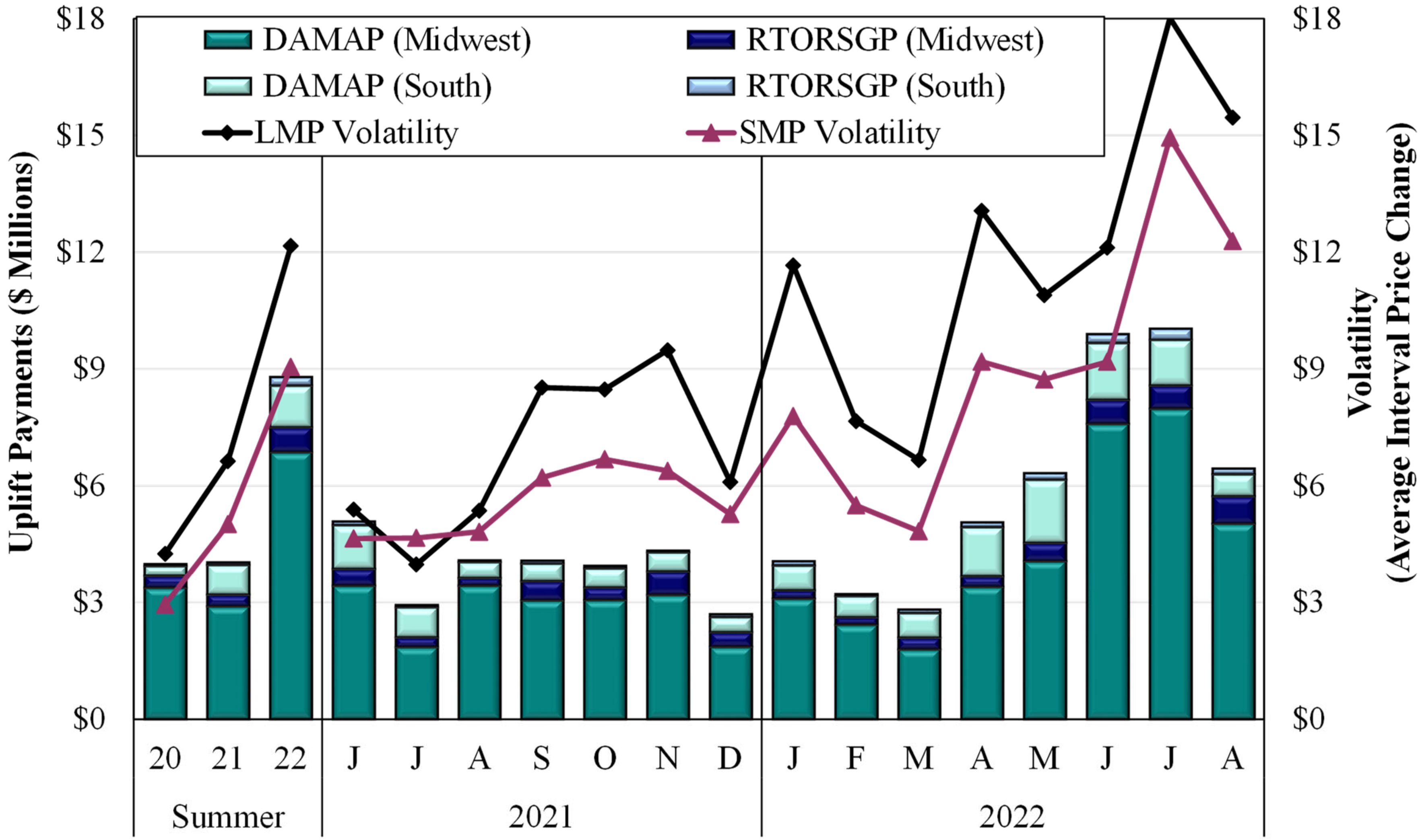
Supply	0.4	1.5	3.3	1.4	1.4	1.6	2.8	2.7	4.9	2.9	3.3	2.6	2.4	3.0	4.9	2.9	3.7	3.2
Demand	1.3	2.2	3.2	3.0	2.0	1.6	1.7	3.5	4.3	4.5	4.4	2.3	1.9	3.8	3.8	3.7	3.2	2.5
Total	0.9	1.8	3.2	2.2	1.7	1.6	2.3	3.1	4.6	3.7	3.9	2.5	2.2	3.4	4.4	3.3	3.4	2.9

Generation Outages and Deratings Summer 2021–2022



Sum Monthly Average	2020		2021		2022	
	Midwest	South	Midwest	South	Midwest	South
Forced: Long-Term	5.2%	3.5%	6.4%	5.1%	5.1%	4.4%
Forced: Short-Term	1.9%	1.5%	2.8%	1.9%	1.5%	2.7%
Unreported in CROW	5.0%	11.3%	4.4%	10.8%	5.6%	8.0%
Unplanned: Other	3.4%	2.4%	2.9%	1.6%	4.0%	1.6%
Planned: Extensions	1.5%	0.4%	1.0%	0.2%	0.5%	1.1%
Planned: Normal	5.0%	2.7%	4.7%	3.0%	3.8%	5.7%
Total	*21.9%*	*21.8%*	*22.2%*	*22.6%*	*20.5%*	*23.6%*

Price Volatility Make Whole Payments Summer 2021–2022



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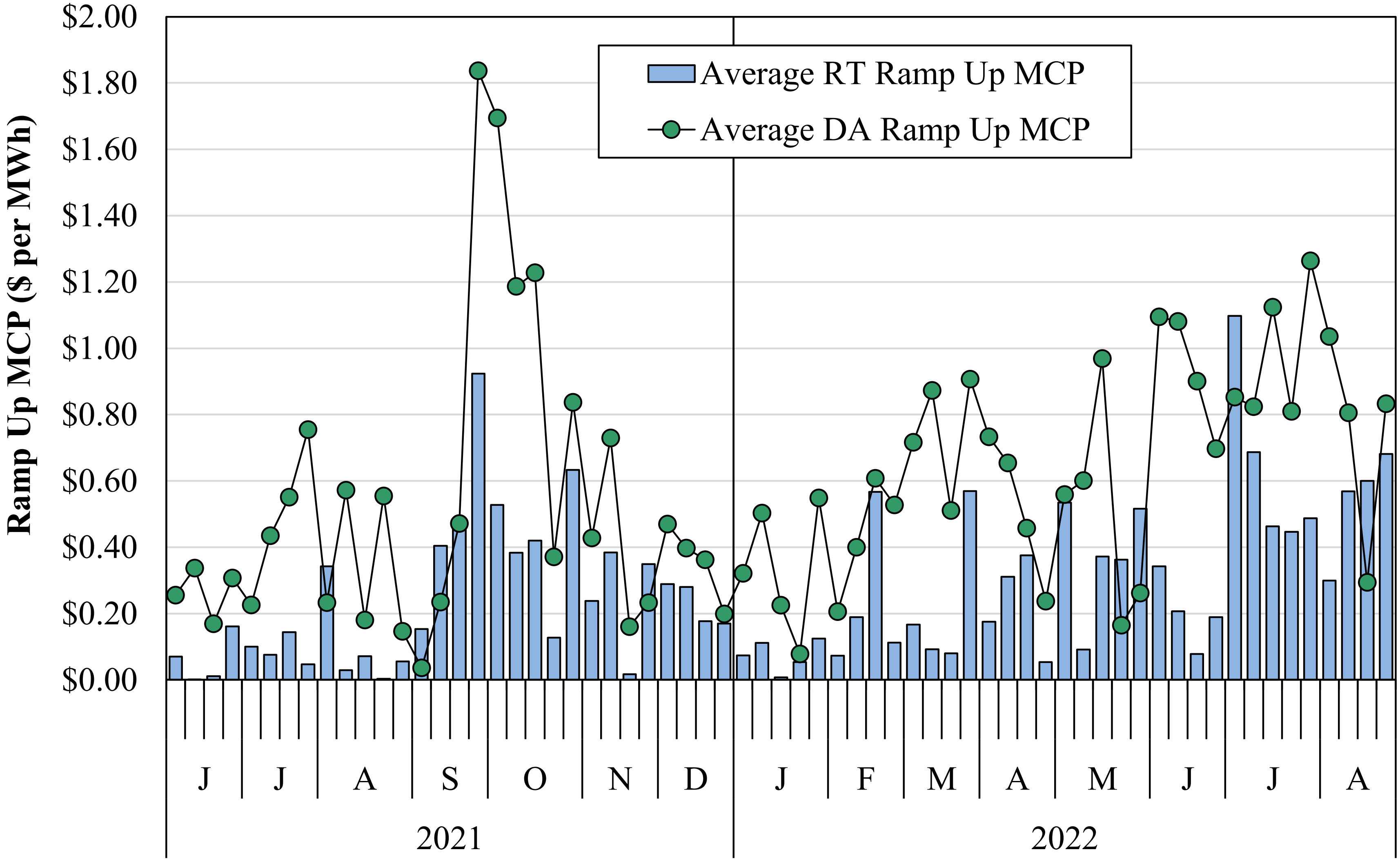
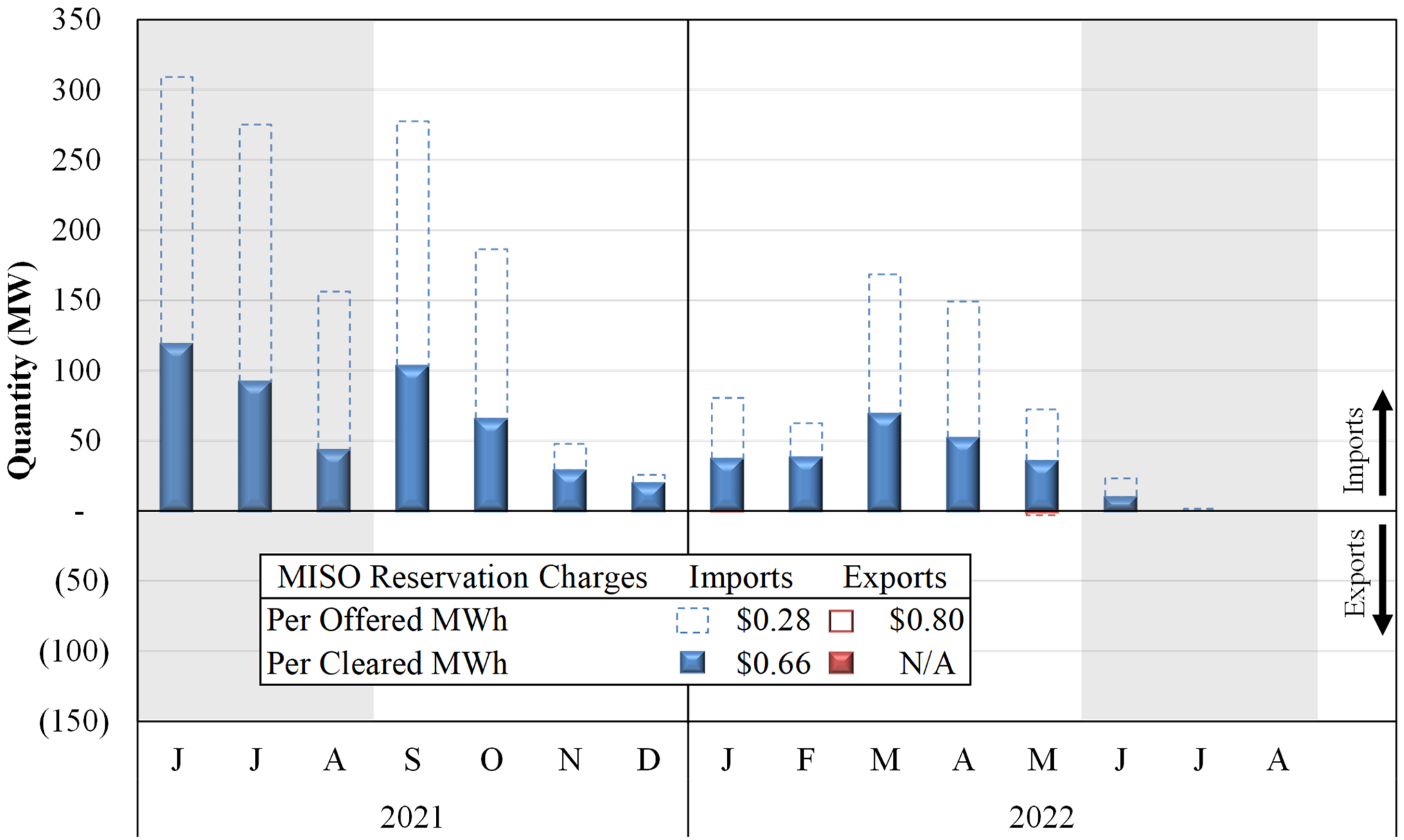
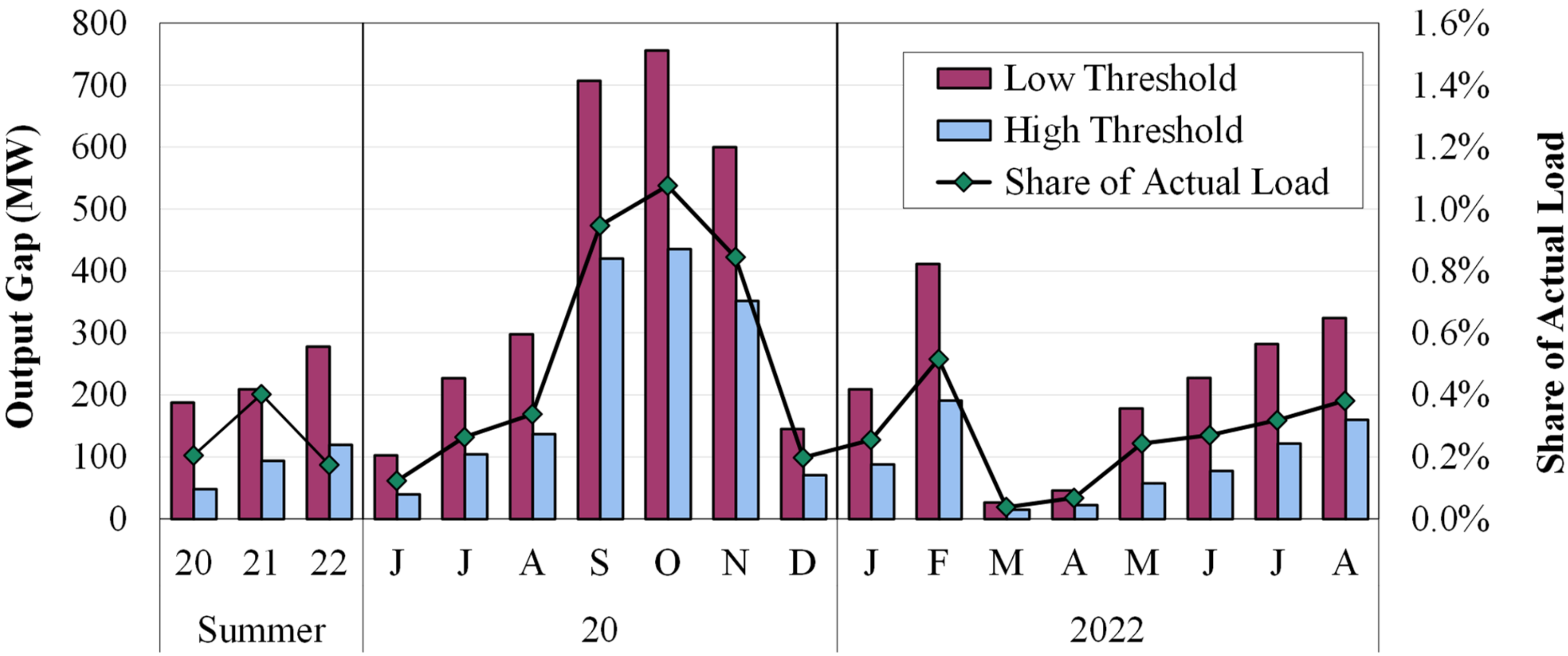
Day-Ahead and Real-Time Ramp Up Price Summer 2021–2022



Coordinated Transaction Scheduling (CTS) Summer 2021–2022



Monthly Output Gap
Summer 2021–2022



Low Threshold Results by Unit Status (MW)

Offline	22	27	175	8	27	46	129	103	35	9	22	24	17	20	103	118	184	224
Online	166	183	103	96	201	252	577	652	565	136	188	387	11	27	75	110	98	100

High Threshold Results by Unit Status (MW)

Offline	19	22	108	7	22	38	98	62	19	7	21	20	12	17	51	67	110	146
Online	29	71	12	33	82	100	322	373	333	64	67	171	4	6	7	10	12	14

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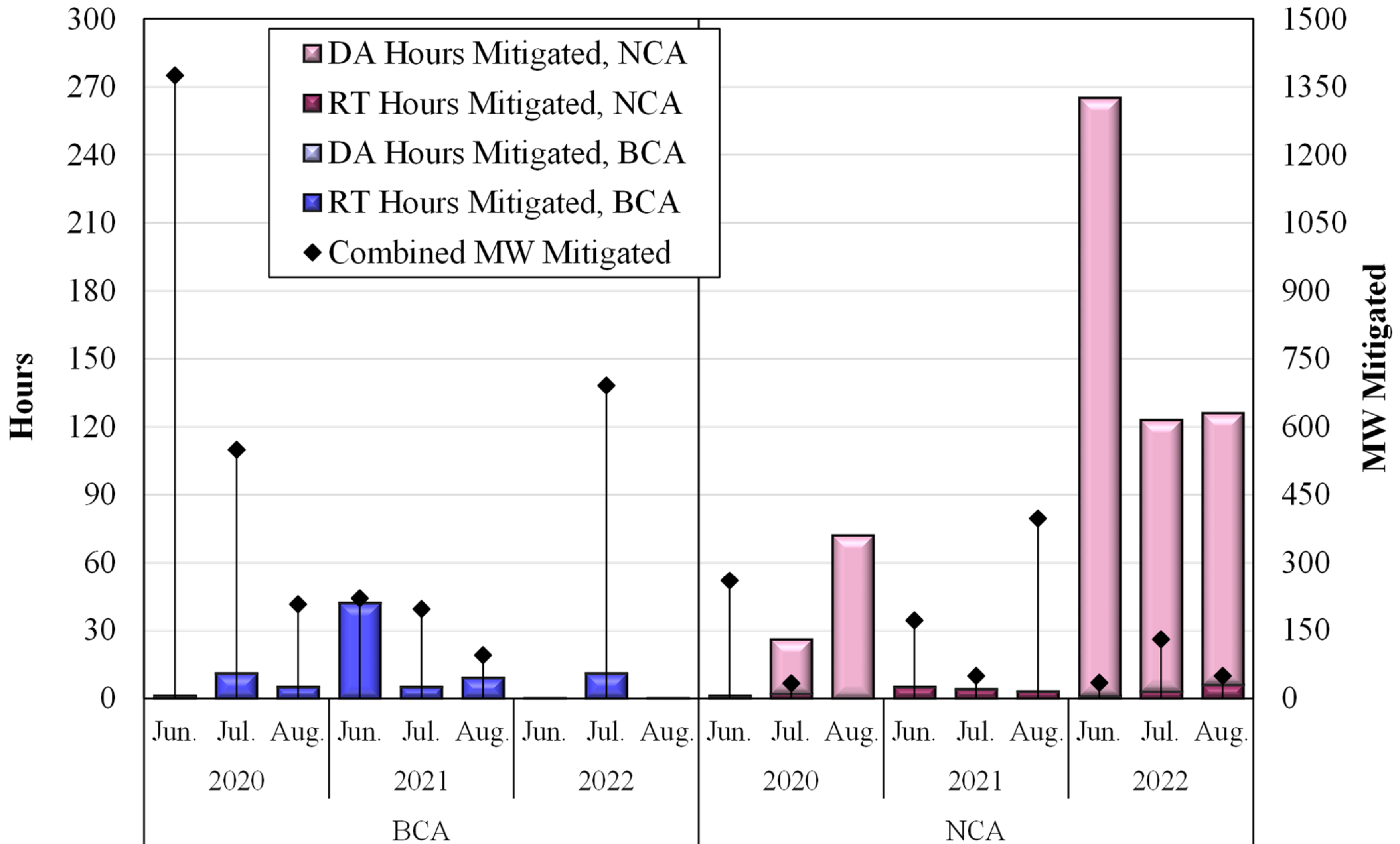
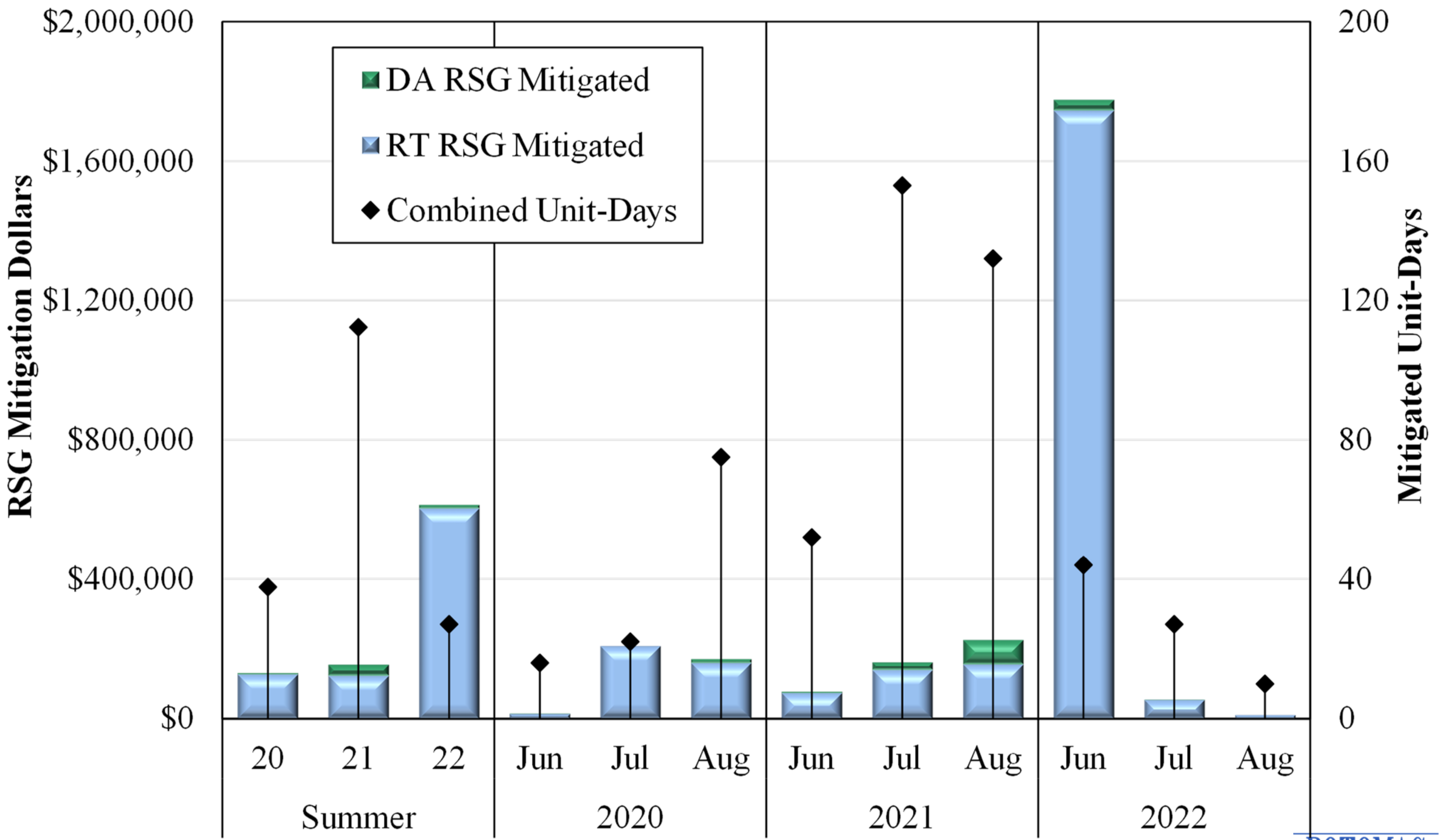
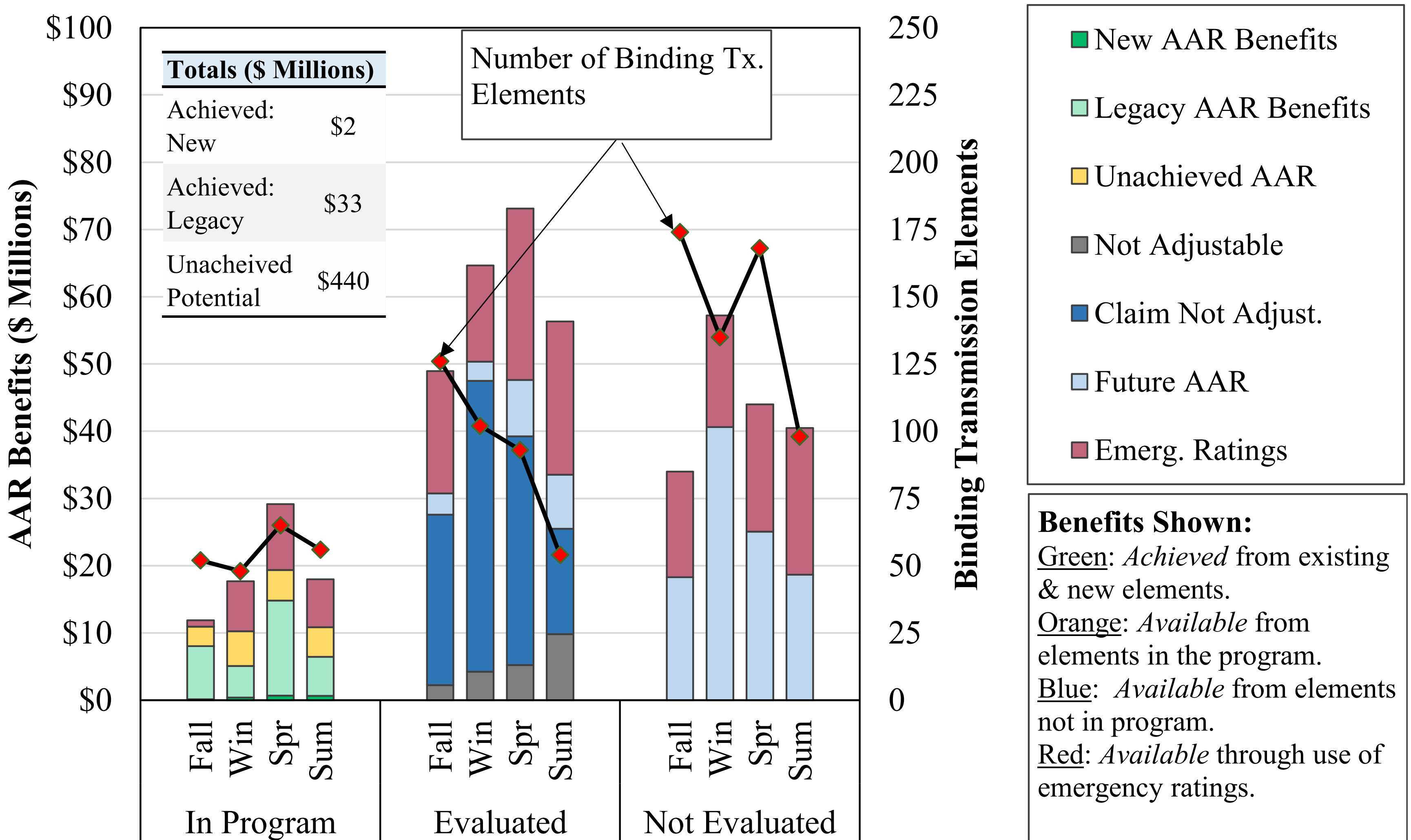
Day-Ahead And Real-Time Energy Mitigation Summer 2021 and 2022



Day-Ahead and Real-Time RSG Mitigation Summer 2021 - 2022



Benefits of AARs and Emergency Ratings Fall 2021 – Summer 2022



Benefits Shown:
Green: *Achieved* from existing & new elements.
Orange: *Available* from elements in the program.
Blue: *Available* from elements not in program.
Red: *Available* through use of emergency ratings.

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 Operating Reserve Demand Curve
- 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
- SMP System Marginal Price
- SOM State of the Market
- STE Short-Term Emergency
- STR Short-Term Reserves
- TLR Transmission Loading Relief
- TCDC Transmission Constraint Demand Curve
- VLR Voltage and Local Reliability
- WUMS Wisconsin Upper Michigan System

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Slides Reproduced for the Markets Committee

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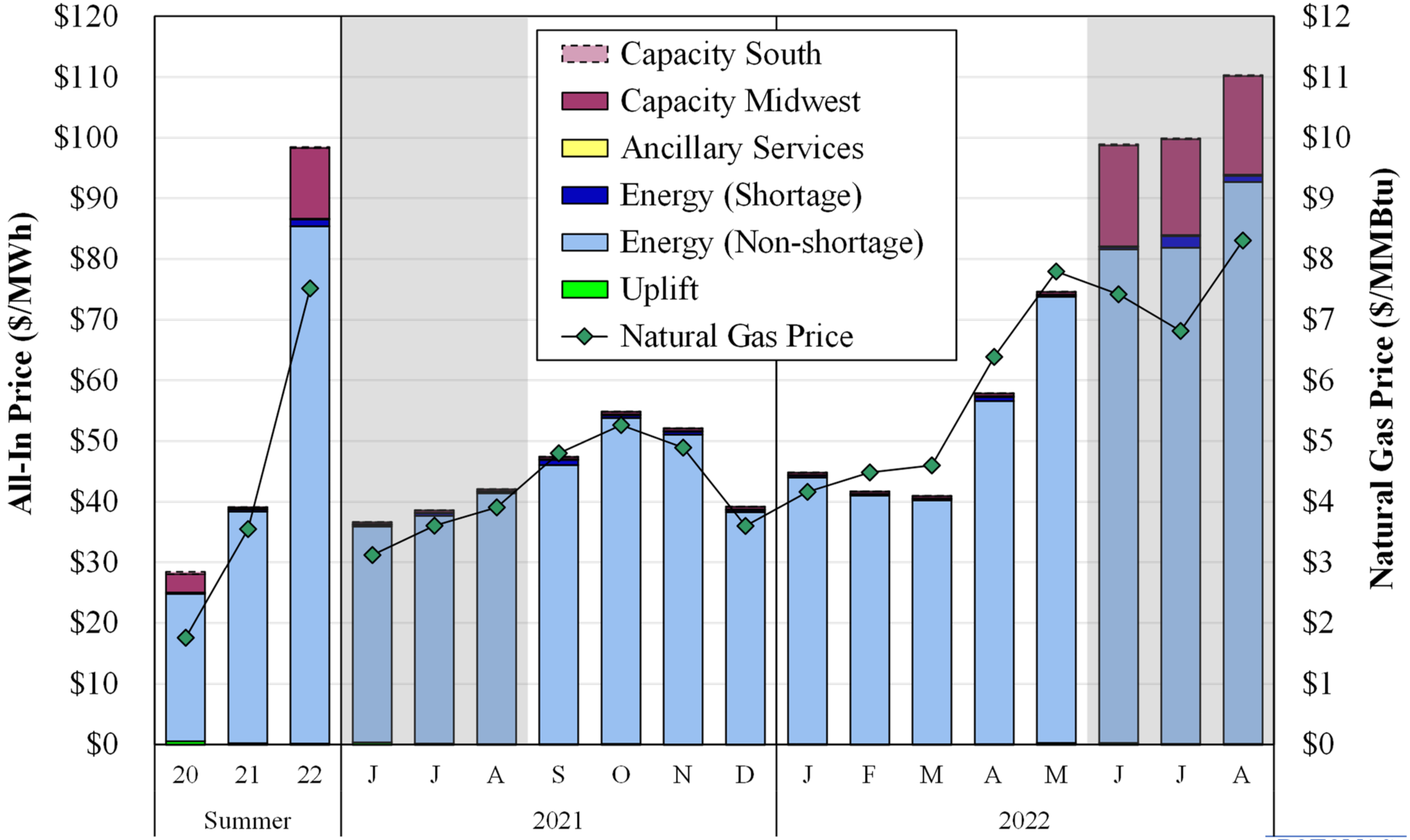
All-In Price
Summer 2020 – 2022



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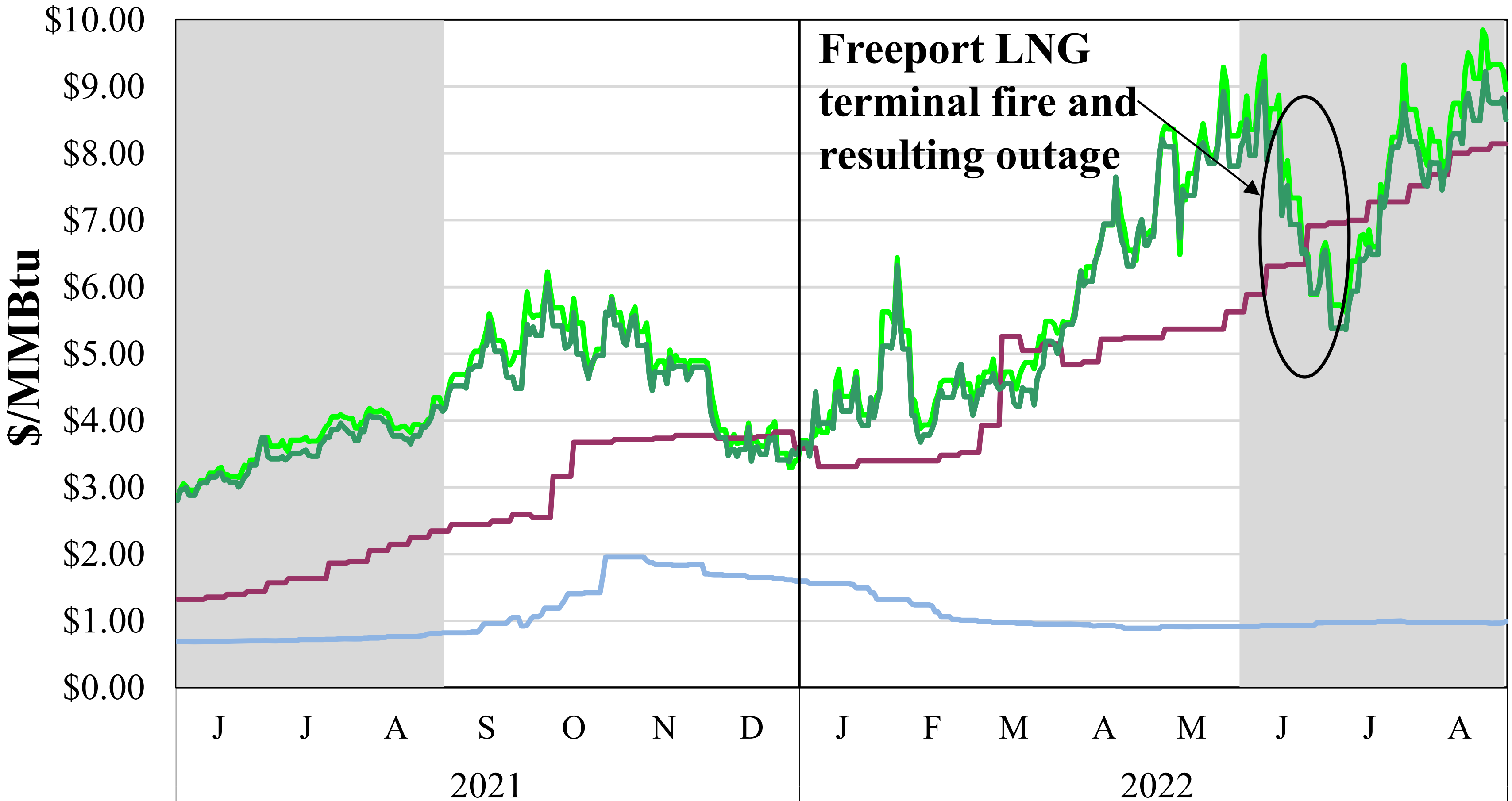
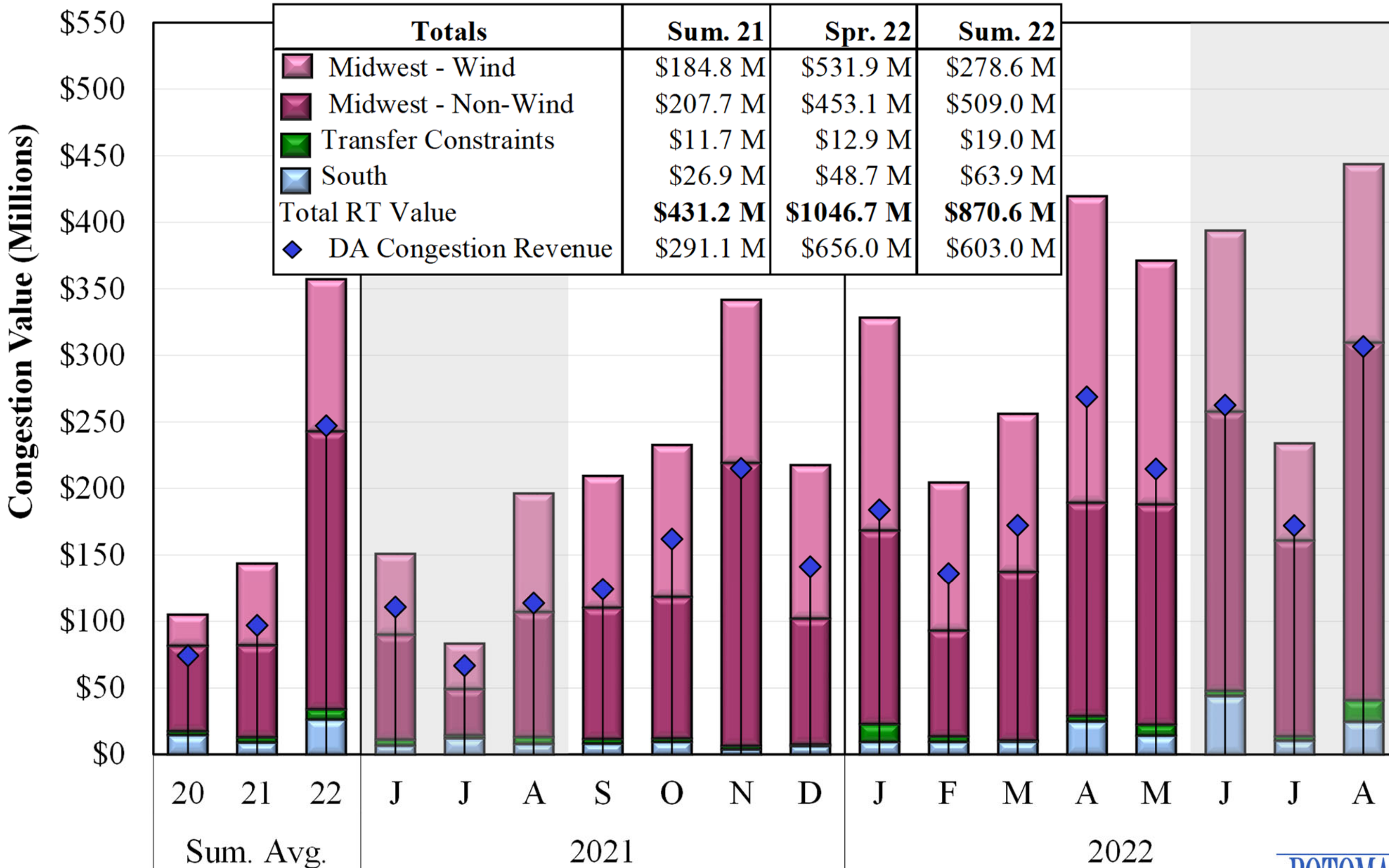
MISO Fuel Prices 2021–2022



Summer Average	2020	2021	2022
Chicago NG	$1.76	$3.55	$7.51
Henry NG	$1.83	$3.68	$7.87

Summer Average	2020	2021	2022
IB Coal	$1.24	$1.73	$7.14
PRB Coal	$0.68	$0.72	$0.96

Value of Real-Time Congestion Summer 2021–2022



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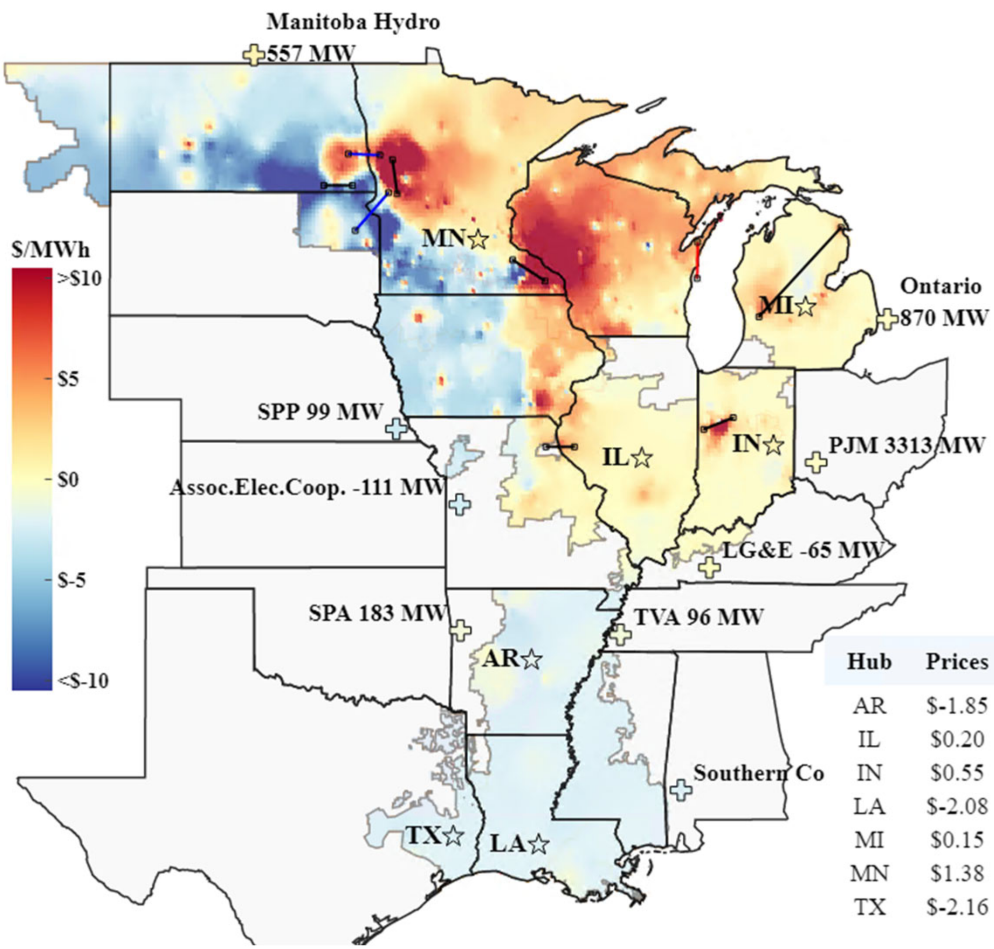
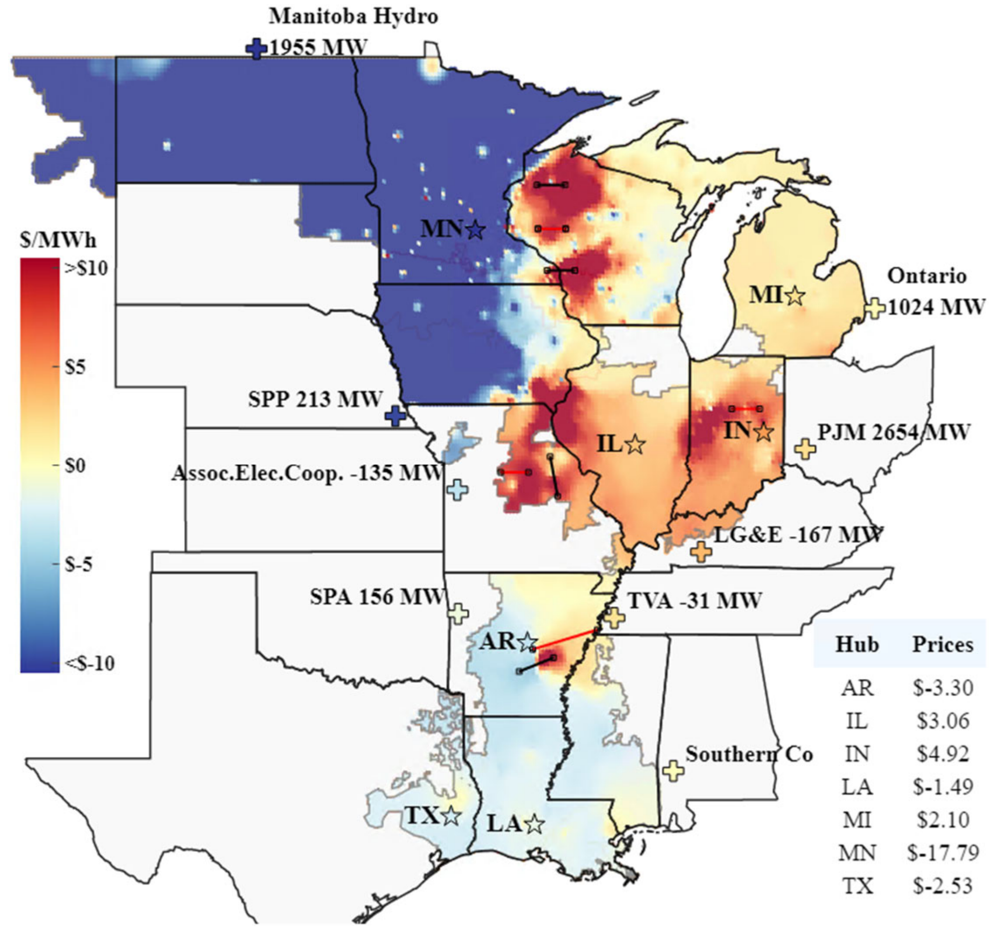
Average Real-Time Congestion Components Summer 2021–2022

Summer 2021



Hub	Prices
AR	$-1.85
IL	$0.20
IN	$0.55
LA	$-2.08
MI	$0.15
MN	$1.38
TX	$-2.16

Summer 2022



Hub	Prices
AR	$-3.30
IL	$3.06
IN	$4.92
LA	$-1.49
MI	$2.10
MN	$-17.79
TX	$-2.53

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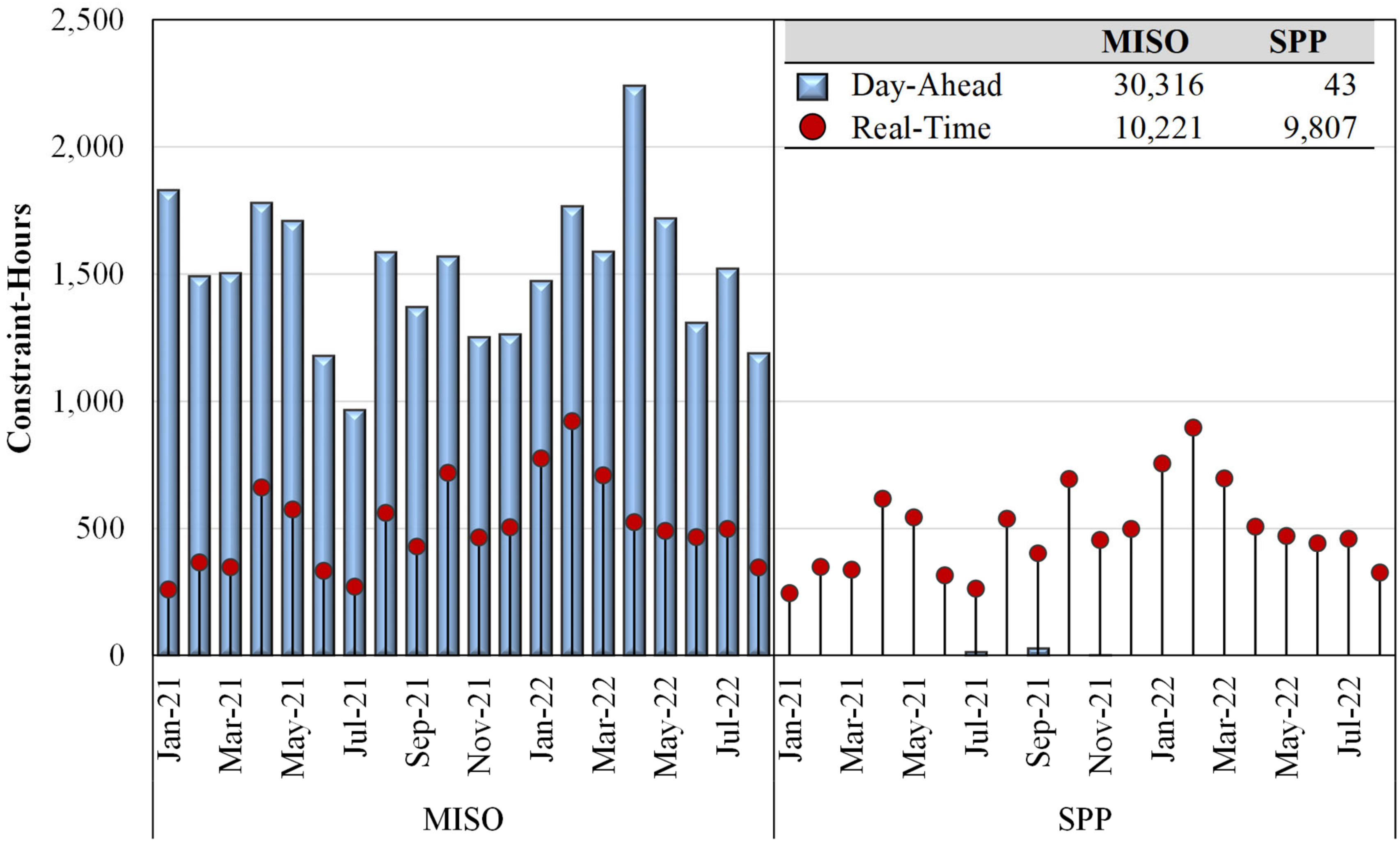
Day-Ahead and Real-Time Binding of MISO M2M Constraints



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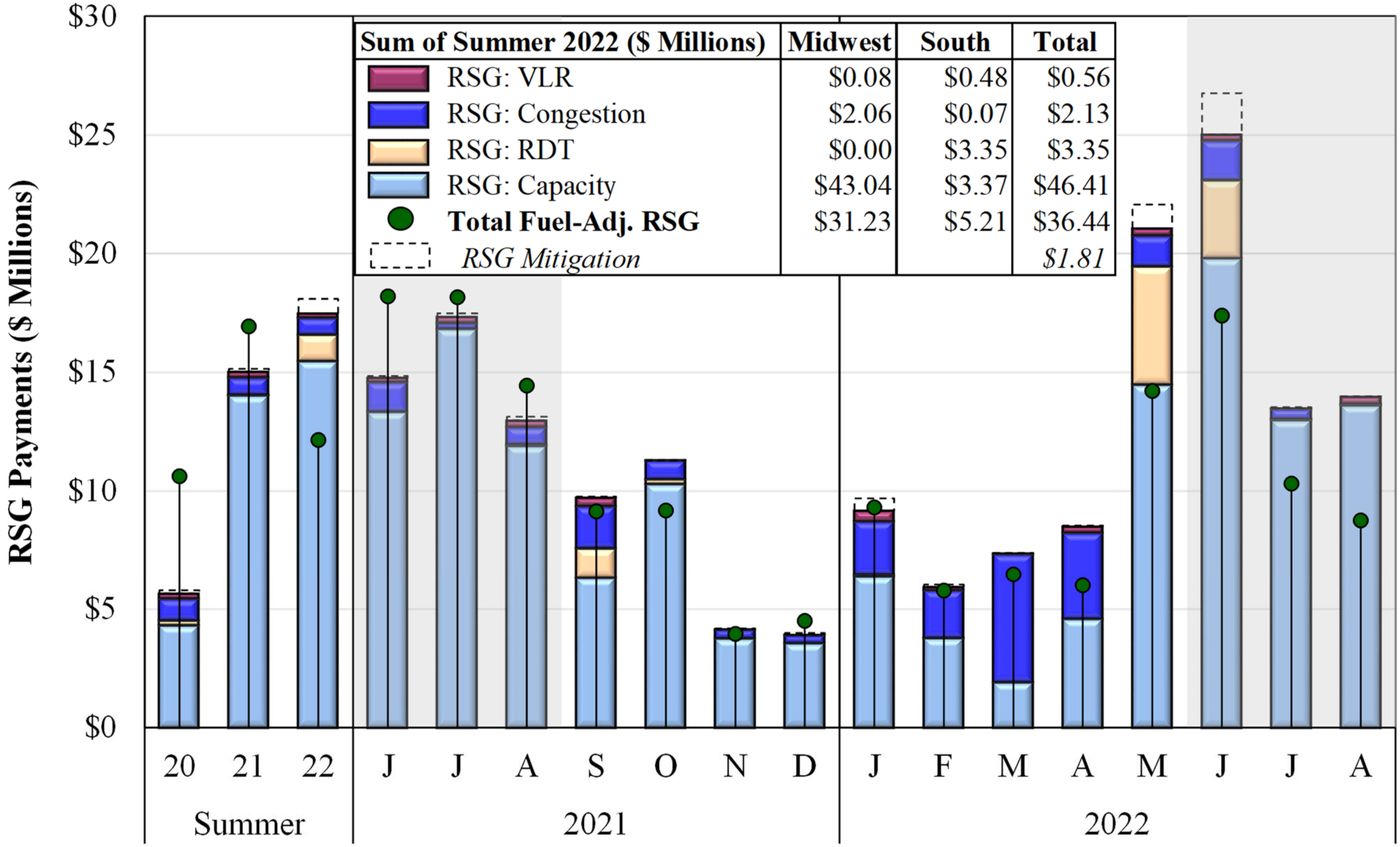
Real-Time RSG Payments
Summer 2021–2022



Sum of Summer 2022 ($ Millions)	Midwest	South	Total
RSG: VLR	$0.08	$0.48	$0.56
RSG: Congestion	$2.06	$0.07	$2.13
RSG: RDT	$0.00	$3.35	$3.35
RSG: Capacity	$43.04	$3.37	$46.41
Total Fuel-Adj. RSG	$31.23	$5.21	$36.44
RSG Mitigation			*$1.81*

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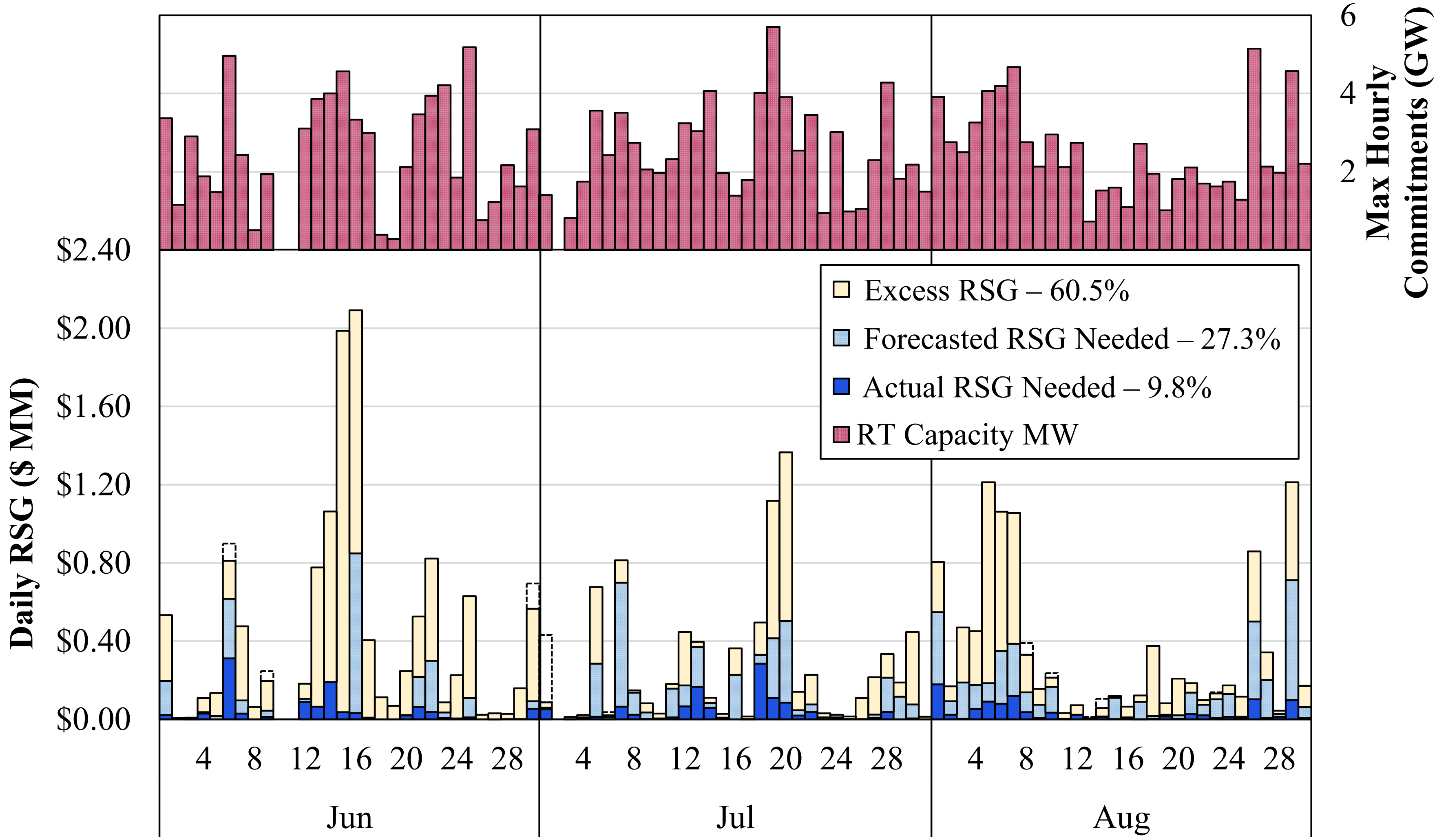
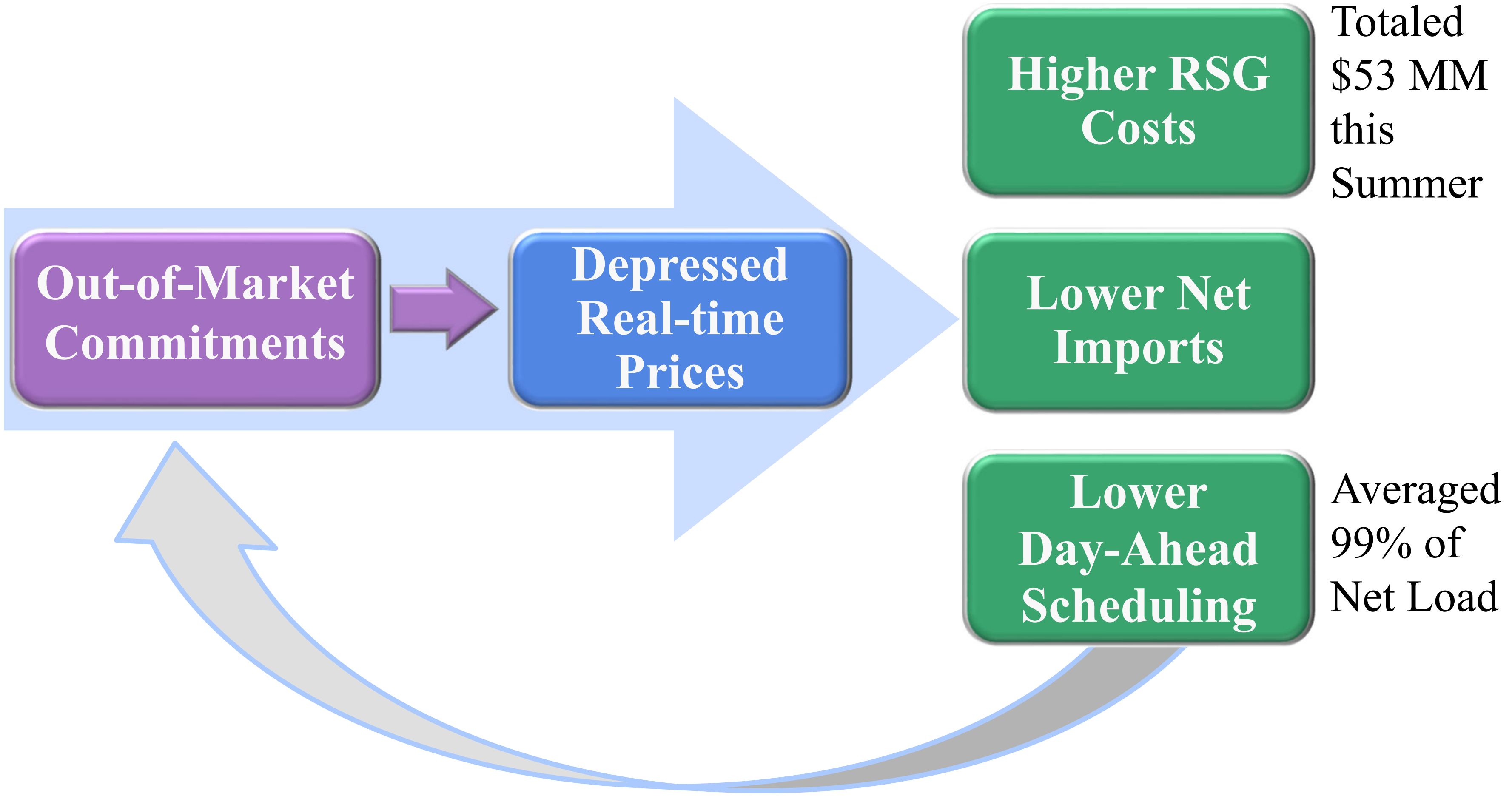
Real-Time Capacity Commitment and RSG



* 2.4% of the RSG could not be classified due to gaps in market data and is shown in the transparent bars.

Feedback Effects of Out-of-Market Commitments



Highlights for Summer 2022

<u>MISO Commitment Practices: July 20 Case Study</u>

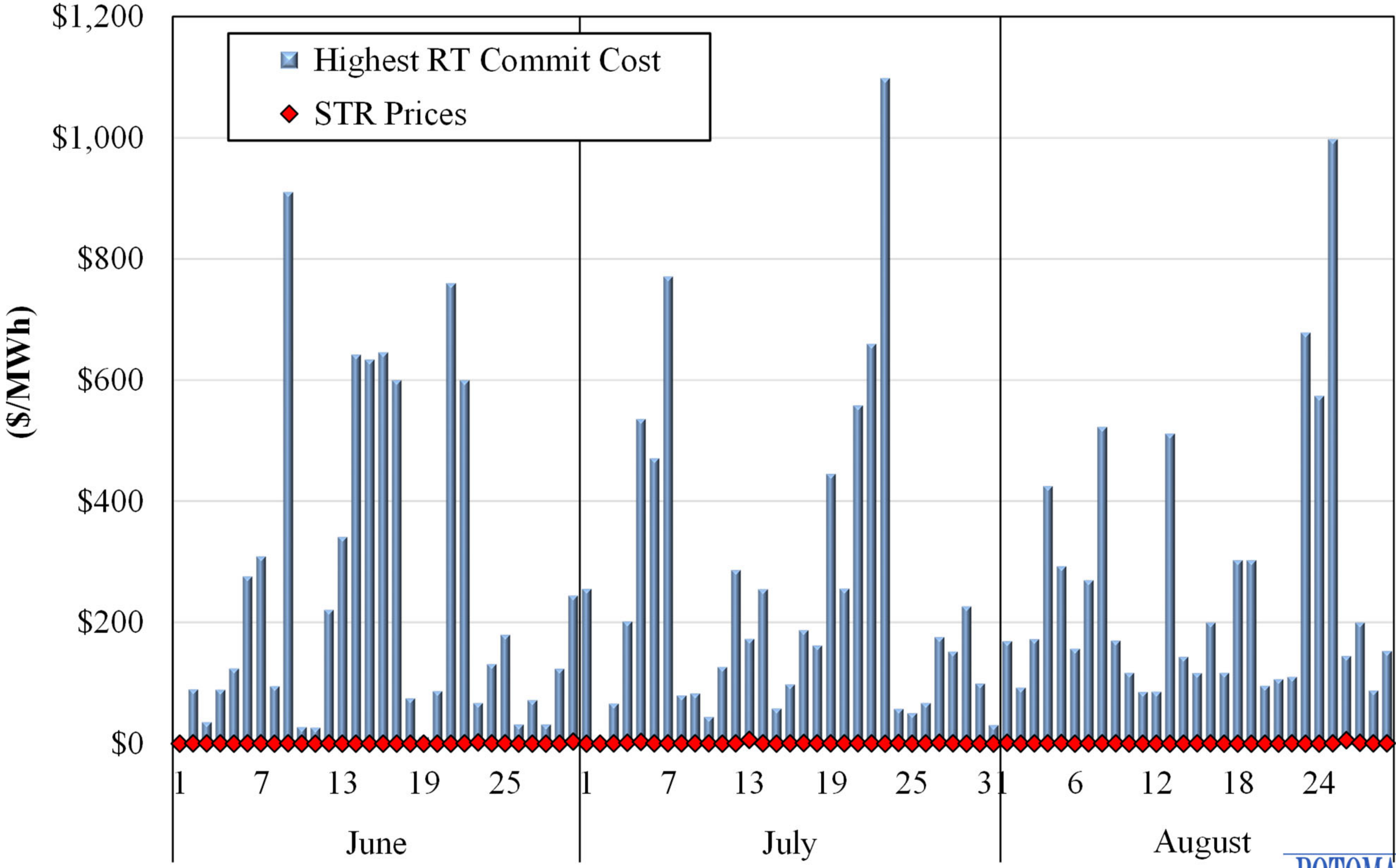
- To illustrate how MISO's practices affect the market on a particular day, we performed a simulation on July 20 when RT RSG exceeded $1.4 million
- We eliminated the "wind offset" of as much as 4.4 GW in the LAC, which resulted in significantly different recommendations:
  - ✓ It recommended committing fewer peaking resources.
  - ✓ Since LAC could accurately see the congestion caused by wind, it did not recommend committing resources that overloaded constraints.
    - – MISO committed one unit that stranded others and required $121K in RSG.
- Ultimately, the change in commitment patterns changed the market outcomes. From 10 am to 10 pm, the simulation showed the following changes:
  - ✓ RSG fell from $1.25 Million to $0.5 Million in the simulated case.
  - ✓ Average LMPs rose from $93/MWh to $137/MWh in the simulated case.
- In addition to the sizable RSG reduction, these price effects send signals to:
  - ✓ Bring in more imports; and
  - ✓ Schedule more generation in the following days' day-ahead markets.

Highlights for Summer 2022

<u>Recommendations to Improve MISO's Commitment Practices</u>

- Eliminate use of the "wind offset" in the look-ahead commitment model.
  - ✓ This parameter allows operators to manually reduce the forecasted wind that LAC expects, causing it to make very poor commitment recommendations.
  - ✓ $1.2 million in RSG was paid units that MISO committed that overloaded constraints because MISO's wind offset caused LAC to not see the congestion.
- Disable the "headroom" requirement in LAC now that MISO has implemented the STR product that eliminates the need for headroom requirements.
- Allow fast-start resources (<30 min) to remain offline and meet STR requirements unless MISO projects shortfalls of online resources.
  - ✓ Starting 30-minute units when they can provide reserves while offline increases RSG and distorts prices without improving reliability.
- Revisit overly conservative commitment rules and procedures that lead to excessive headroom.
- Re-evaluate the Optimal Dispatch Calculator used to determine MISO's performance metrics for its unit commitment decisions.

Real-Time Commitment Cost Versus Short-Term Reserve Prices



Submittals to External Entities and Other Issues

- We responded to several FERC questions related to prior referrals and FERC investigations, and we responded to requests for information on market issues.
  - ✓ We recommended a sanction to MISO for physical withholding by a resource.
- We continue to meet with MISO and a TO working group on Order 881 compliance and related issues on AARs and Emergency Ratings.
- We submitted comments to the RCCTT and the RSC on the latest proposal.
- In July we presented our SOM report highlights and recommendations and the Spring Quarterly Report to the Market Subcommittee.
- We continue to meet with states and stakeholders on the need to reform MISO's PRA demand curve to satisfy the Reliability Imperative.
  - ✓ In August, we participated in the OMS Resource Adequacy Summit, presenting an analysis of the reliability-based demand curve to the states.
- FERC rejected MISO's Minimum Capacity Obligation proposal, citing primarily the fundamental concerns and issues we raised in our protest.
  - ✓ Although this is a good outcome, it points to a concern with the market design process – sizable resources were consumed by MISO, participants and the IMM that could have been utilized much more valuably elsewhere.