

IMM Quarterly Report: Summer 2025

Presented to:

Market Subcommittee

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Potomac Economics

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Summer Summary

- MISO's markets performed competitively and mitigation was infrequent
- Energy prices rose 56 percent compared to last summer as gas prices increased by 49 percent and average load rose 2 percent
 - The rise in natural gas prices was partially offset by wind output falling 10 percent, and real-time congestion rose by 37 percent
- Although the peak load was 2 percent lower than last year, periods of hot weather led to a number of emergencies in the Eastern Interconnection
 - MISO experienced less reliability risk than most of the other RTOs in Eastern Interconnection
 - MISO declared one EEA event – the level needed to access emergency supplies – while more than 40 were declared in the Eastern Interconnection
 - Efficient pricing in MISO sustained the energy supplies MISO needed to maintain reliability
- MISO's operational improvements in its out-of-market commitment processes continued to result in very low uplift costs

Quarterly Summary

Summer		Value	Change ¹			Value	Change ¹	
			Prior Qtr.	Prior Year			Prior Qtr.	Prior Year
RT Energy Prices (\$/MWh)	●	\$48.56	38%	56%	FTR Funding (%)	●	101%	101%
Fuel Prices (\$/MMBtu)					Wind Output (MW/hr)	●	6,921	-47%
Natural Gas - Chicago	●	\$2.76	-11%	57%	Wind Curtailed (MW/hr)	●	187	-73%
Natural Gas - Henry Hub	●	\$3.04	-14%	41%	Guarantee Payments (\$M)⁴			
Western Coal	●	\$0.81	0%	2%	Real-Time RSG	●	\$9.6	135%
Eastern Coal	●	\$2.00	5%	17%	Day-Ahead RSG	●	\$9.3	-21%
Load (GW)²					Day-Ahead Margin Assurance	●	\$14.5	12%
Average Load	●	87.4	26%	2%	Real-Time Offer Rev. Sufficiency	●	\$0.6	-41%
Peak Load	●	121.6	23%	-2%	Price Convergence⁵			
% Scheduled DA (Peak Hour)	●	99.2%	99.9%	101.2%	Market-wide DA Premium	●	-0.7%	-1.1%
Transmission Congestion (\$M)					Virtual Trading			
Real-Time Congestion Value	●	\$368.7	-34%	37%	Cleared Quantity (MW/hr)	●	20,745	-19%
Day-Ahead Congestion Revenue	●	\$307.8	-17%	64%	% Price Insensitive	●	57%	52%
Balancing Congestion Revenue ³	●	-\$41.2	-\$10.0	-\$11.9	% Screened for Review	●	2%	2%
Ancillary Service Prices (\$/MWh)					Profitability (\$/MW)	●	\$0.3	\$0.6
Regulation	●	\$17.27	-16%	35%	Dispatch of Peaking Units (MW/hr)	●	3,999	812
Spinning Reserves	●	\$3.40	13%	13%	Output Gap- Low Thresh. (MW/hr)	●	59	22
Supplemental Reserves	●	\$2.54	219%	71%				
Short-Term Reserves	●	\$1.82	458%	371%				

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.

Quarterly Highlights: Summer 2025

Heat Wave and Capacity Event in June

- On June 23 and 24, hot weather across the Eastern Interconnect led to multiple emergency declarations by MISO and its neighbors
 - MISO did not experience operating reserve shortages during these events
- June 23: MISO declared an EEA1 to access emergency capacity
 - Over 4 GW of generation was trapped in the South by the RDT binding
 - MISO dispatched 565 MW of emergency MW in the Midwest, of which 45 percent performed – penalties for non-performance are needed
- June 24: 7 other control areas were in EEA1. MISO declared a Max Gen Warning to allow curtailment of non-firm exports but did not go into EEA
- MISO's emergency pricing and ELMP construct sent efficient price signals that were critical for maintaining its imports
 - Ex post energy prices (from ELMP) were 2.5 times higher than its original ex ante energy prices during the events

Quarterly Highlights: Summer 2025

Heat Wave and Transmission Emergency in July

- Challenging operational conditions occurred in late July, and MISO entered its emergency procedures on two days (July 28-29)
- July 28: MISO experienced a 40-minute operating reserve (OR) shortage due to significant errors in forecasts of load and renewables
 - An impactful 500 kV forced transmission outage in the South during the OR shortage stranded 1.8 GW of generation that was manually dispatched down
 - MISO declared a transmission emergency and RDT flows reversed direction, moving from the Midwest to the South to replace stranded generation
- July 29: MISO declared a transmission emergency related to the major transmission outage that began the prior day.
 - MISO scheduled 780 MW of 6-hr lead-time LMRs to reduce the flows on the affected transmission constraints
 - Just before the LTE began on the 29th, the 500 kV element was restored
 - MISO did not cancel the LTE or cancel LMR schedules due to uncertainty about the line

Quarterly Highlights: Summer 2025

Regional Directional Transfer Constraint (RDT)

- During the summer quarter, flows across the RDT constraint were predominantly in the South to North direction
 - Low wind and a reduction in imports were contributing factors
 - This led to a \$9.31 per MWh average price separation between the regions
 - Congestion on the RDT and Reserve Procurement Enhancement (RPE) constraints totaled \$41 million, an increase of 121 percent over last year
 - MISO frequently derated the RDT to account for differences in modeled and actual flows caused by regulation deployments in the South
 - Because RDT is a contractual constraint that does not reflect any physical limits, MISO should continue to work with the Joint Parties to optimize it
- We recommend MISO reformulate the RDT and RPE Demand Curves to maximize its value while maintaining contract compliance
 - We analyzed market impacts of our recommended RDT and RPE changes
 - MISO would have reduced average energy prices in the Midwest by \$3.48 per MWh and the market costs in the Midwest by \$515 million

Quarterly Highlights: Summer 2025

Net Load Ramp Challenges

- Net load ramp challenges continue to grow with the increasing penetration of solar resources in MISO's footprint
 - Registered solar capacity has grown 44 percent since last summer, while summer peak solar output more than doubled to a new record of 14.1 GW
 - The largest net load ramp period of the day has shifted to later hours – from hour 16 in 2023 to hour 18 in 2025 (because of the solar ramp down)
 - The cumulative evening net load ramp demand has grown sharply from 1000 MW in 2023 to almost 6000 MW in 2025
 - We expect these trends to continue
- MISO experienced 26 operating reserve (OR) shortage intervals
 - The number of shortage intervals doubled over last summer
 - The majority of OR shortages occurred in hour 18 during the net load ramp, which included the 40-minute reserve shortage on July 28

Quarterly Highlights: Summer 2025

Demand Response in MISO

- MISO has made several Tariff filings to improve demand response (DR) participation rules, capacity accreditation, and testing requirements
 - These changes are critical given the amount of DR participation in MISO – 13 GW of LMRs, including 1 GW of Type 1 Demand Response Resources that can participate in MISO's energy and AS markets
 - Many changes have been in response to several recent FERC enforcement actions for market manipulation in MISO
 - MISO still needs to file proposed non-performance penalties
- We evaluated DRR Type 1 performance during the summer quarter
 - Since MISO's elimination of Batch-Load Demand Response (BLDR) participation in November 2024, performance has improved dramatically
 - In general, DRR1 performed well overall this summer
- Beginning in July, DRR Type 1 resources are subject market power mitigation (similar to generating resources). We have worked with DRR providers to establish competitive reference levels for this mitigation

Quarterly Summary of IMM Investigations

- We conducted multiple audits and investigations this quarter, including:
 - 14 units failing to follow dispatch instructions or economic curtailments
 - 3 units for potential uneconomic production
 - 3 units for potential physical withholding
 - 3 impactful unit outages
- We recommended MISO sanction a unit for uneconomic production and are finishing another sanction recommendation
- We referred two market participants for tariff and market violations:
 - Failing to report outage data to GADS for several months that may have impacted MISO's LOLE studies
 - Not following MISO's dispatch instructions during an emergency
- We continued to investigate past DR conduct, including offering load curtailment capability in the capacity market that substantially exceeded the associated load

Submittals to External Entities and Other Issues

- During the Summer Quarter, we:
 - Responded to several FERC questions related to prior referrals and FERC investigations and responded to requests for information on market issues
 - Presented the IMM Spring Quarterly report to the MSC
 - Met with MISO on the Futures assumptions and provided feedback on the base case and alternative cases
- We continued to investigate potential tariff violations in the market-to-market coordination of congestion between SPP, PJM and MISO
- We developed an affidavit to support MISO filing of key improvements to its testing and data requirement for demand resources
- Worked with MISO on the inputs for NERC's Long-Term Reliability Assessment, which should reduce the perceived reliability risks in MISO
 - This should support better decisions by policymakers, including the recent decision by DOE to order a resource to remain online past its retirement
 - This was costly and not needed to meet MISO's reliability requirements

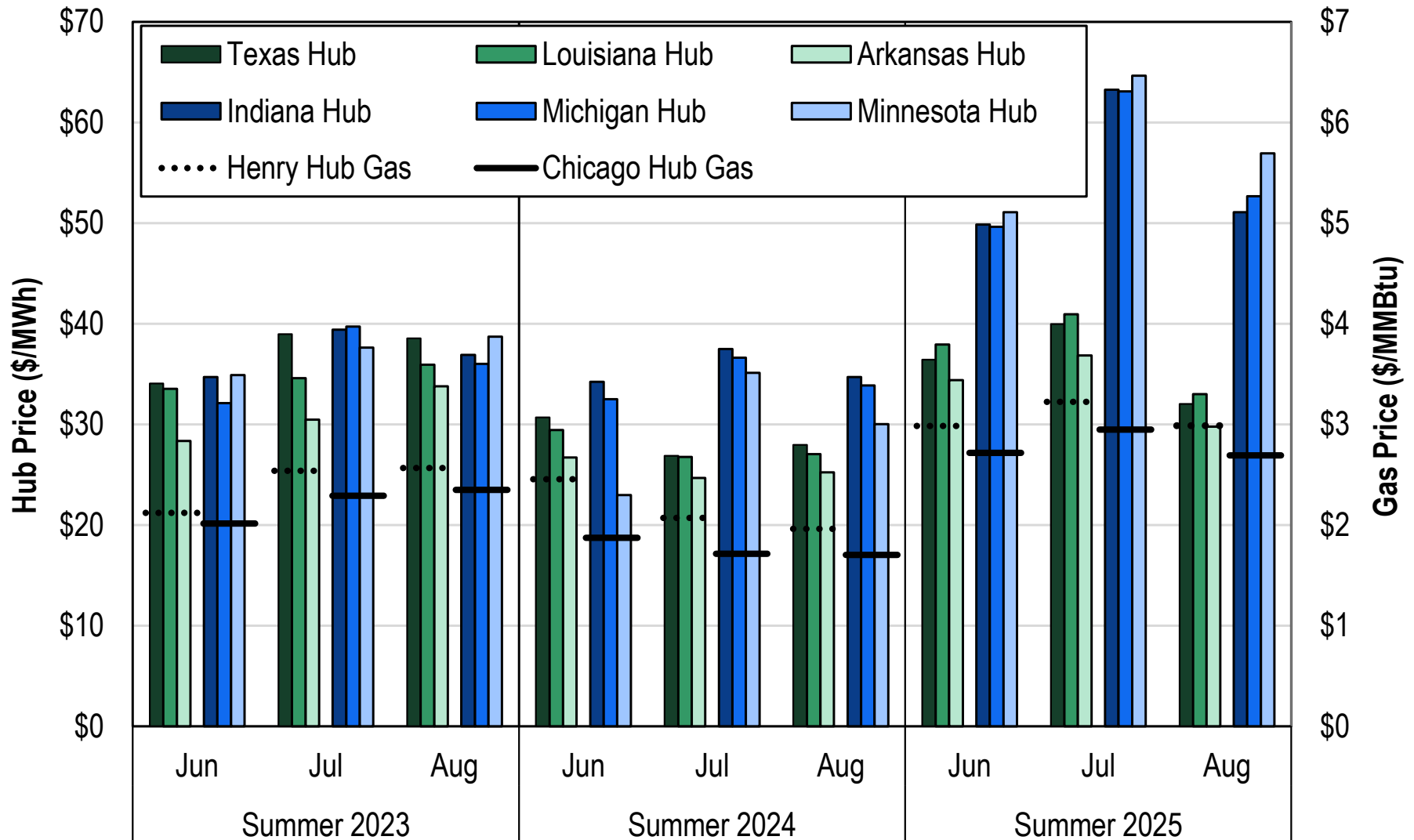
Other Issues

- MISO implemented its Uninstructed Deviation Enhancement (UDE) flag in August to notifies renewables that they are flowing on binding constraints
 - We are working with MISO to develop critical settlement penalties to provide efficient incentives to respond to the flag and follow dispatch instructions
- A deviation from the tariff in the LOLE model affected the RBDCs in the PRA
 - Nonetheless, the PRA set efficient prices that corresponded to MISO's actual reliability standard: one day with loss of load in 10 years or "1-in-10"
 - Unfortunately, a flawed tariff definition in Module A calls for a LOLE calculation that corresponds to a much lower level of reliability, less than 1 day in 5 years
 - MISO has determined it is legally obligated to re-settle with its participants at the lower estimated capacity prices that reflect the lower reliability requirement, but has filed to modify the Module A definition to reflect its 1-in-10 requirement
 - We have worked with MISO to review the estimated price adjustments
 - The resettlements may be legally required but it undermines the integrity of the competitive markets – they will be inconsistent with the information posted prior to the auction that participants used to make resource and contracting decisions

Quarterly Market Results: Summer 2025

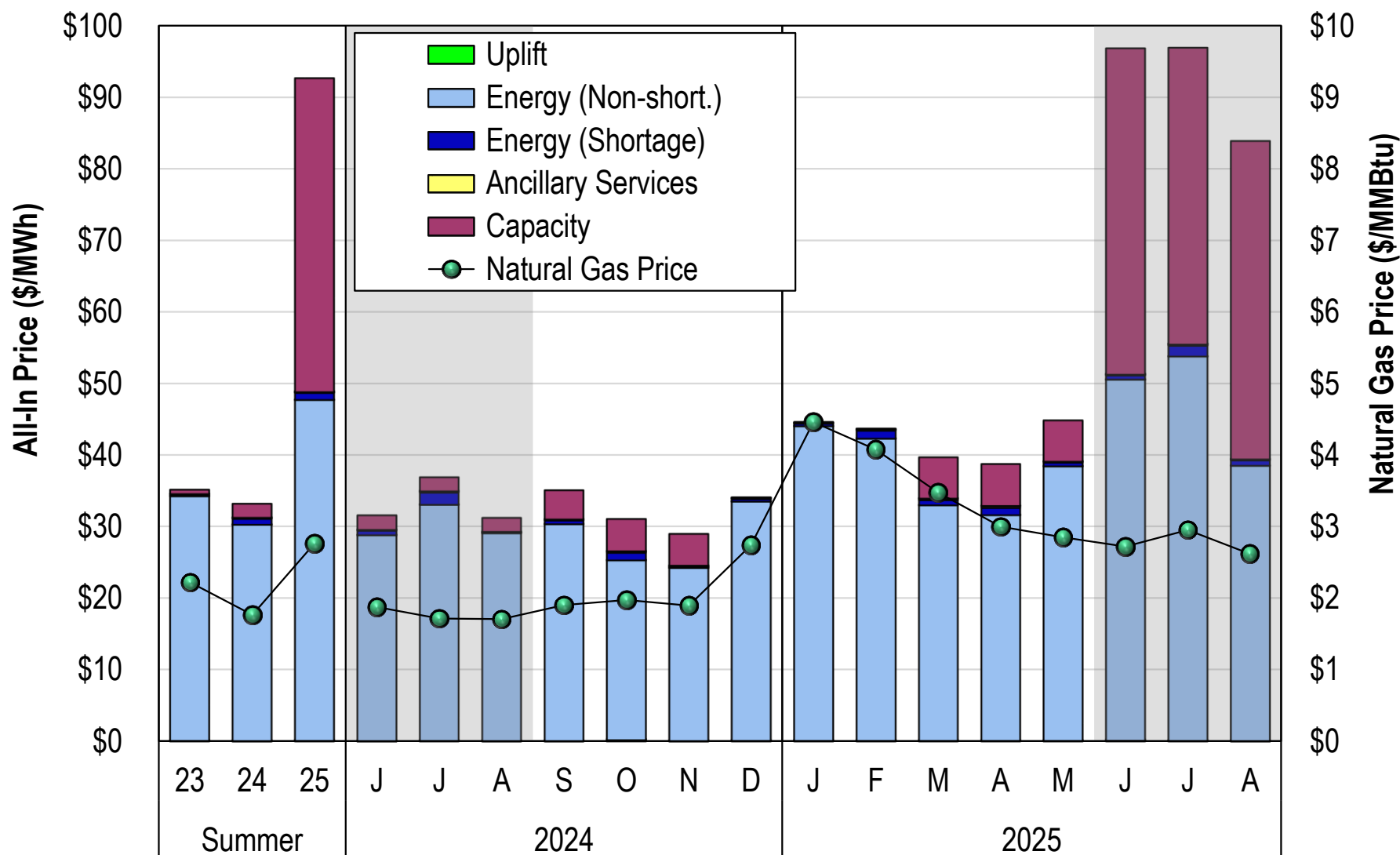
Day-Ahead Average Monthly Hub Prices

Summer 2023 – 2025



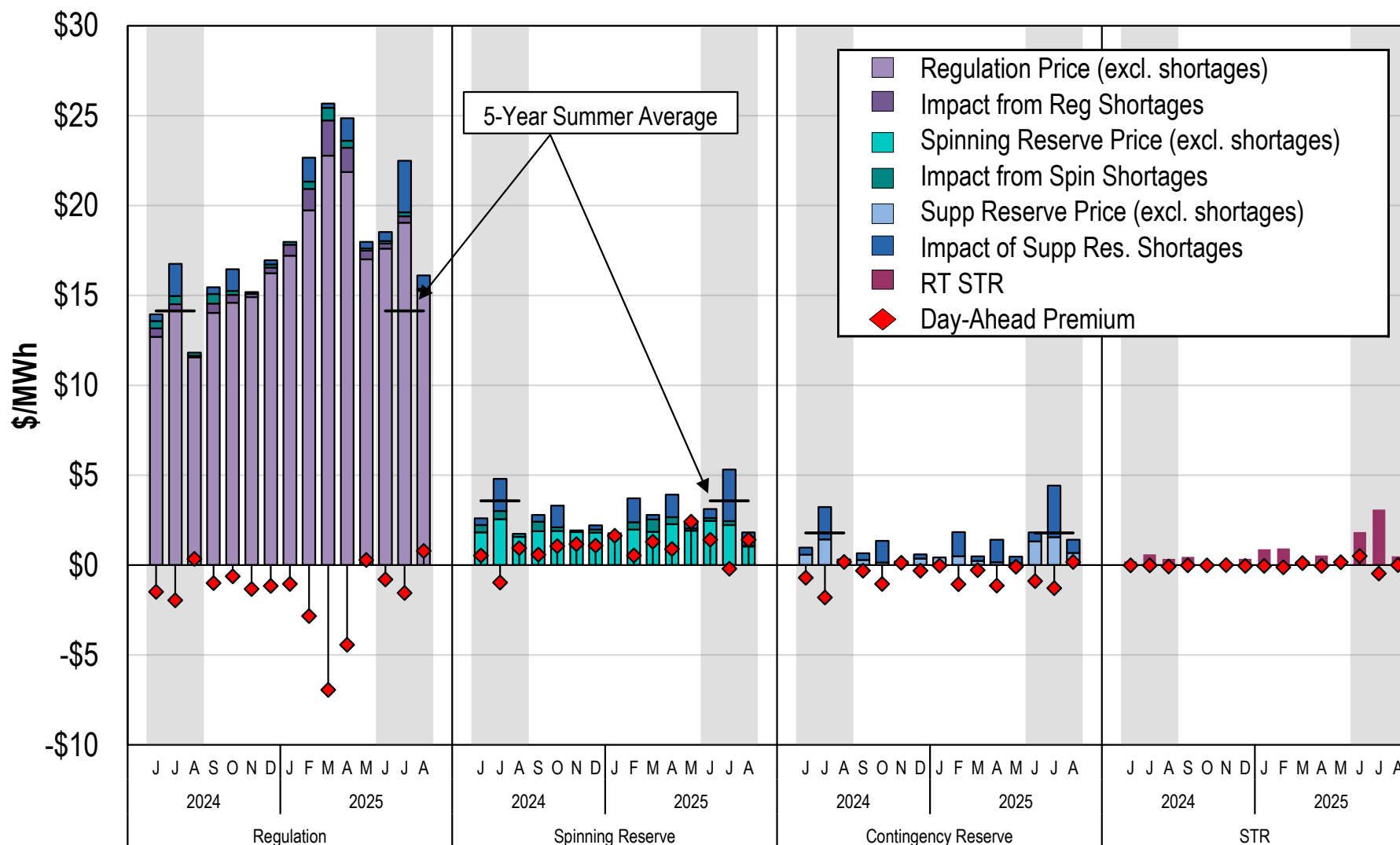
All-In Price

Summer 2023 – 2025



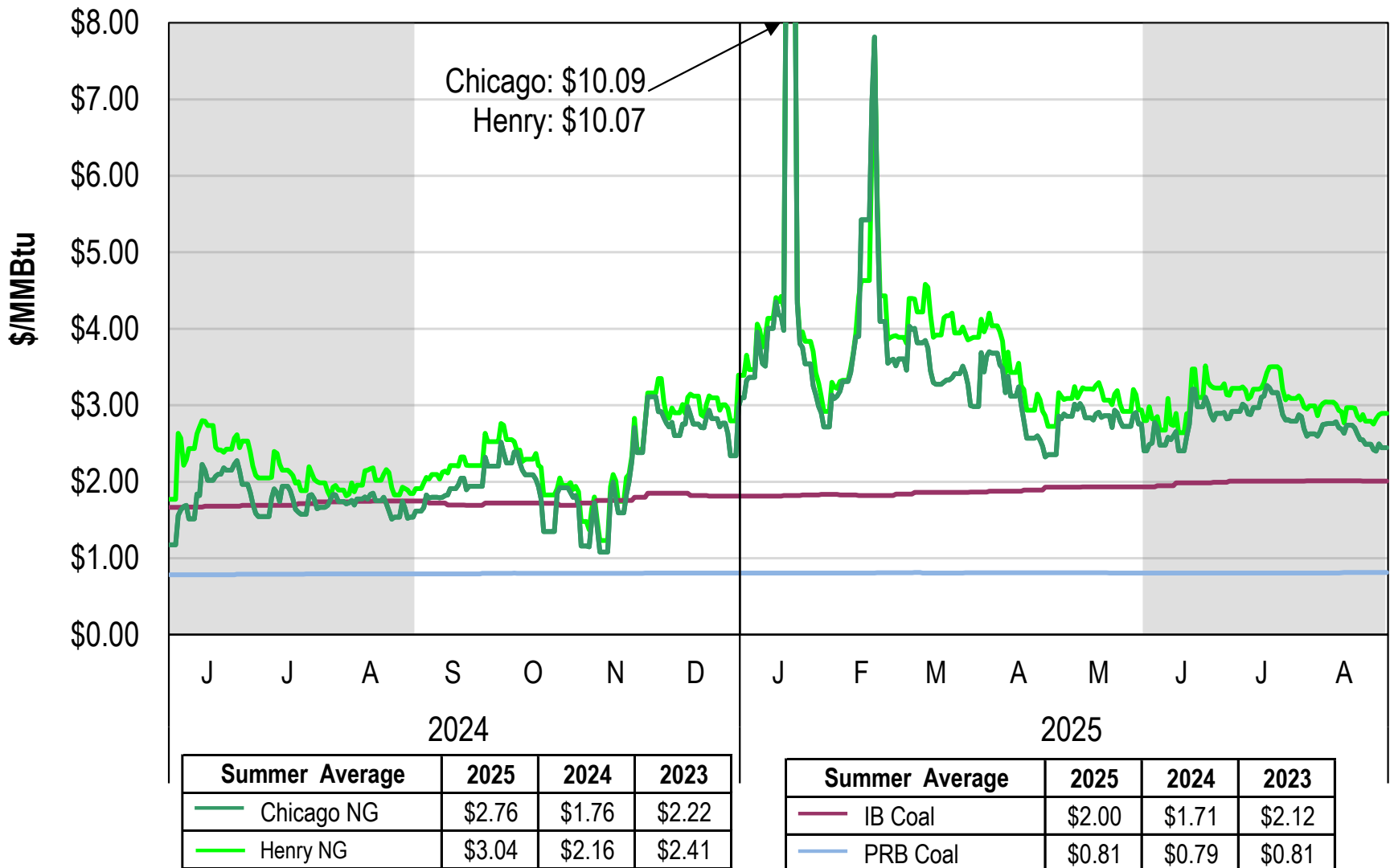
Ancillary Services Prices

Summer 2023 – 2025



MISO Fuel Prices

2023 – 2025



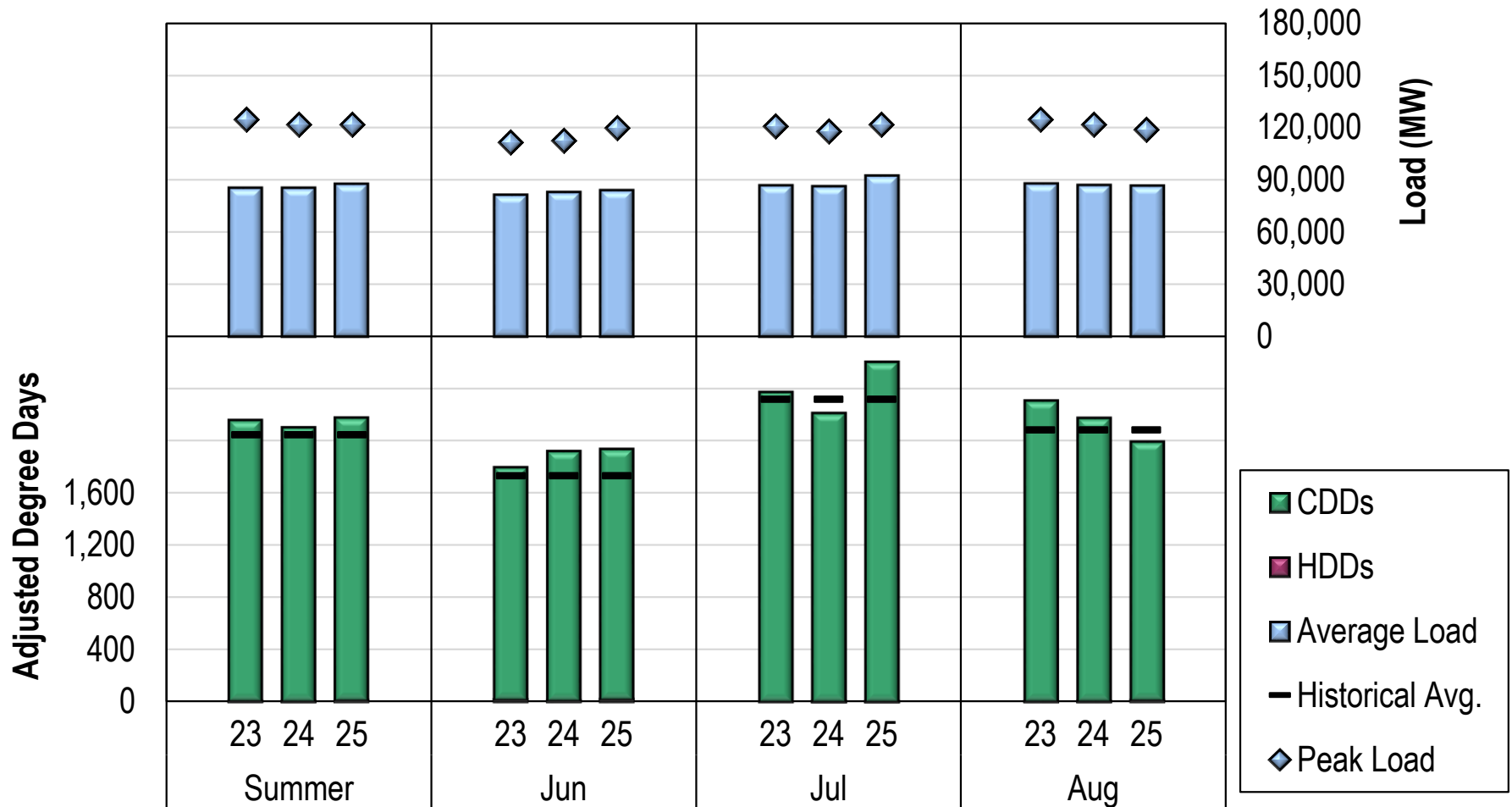
Capacity, Energy and Price Setting Share

Summer 2024 – 2025

Summer	Unforced Capacity				Energy Output		Price Setting			
	Total (MW)		Share (%)		Share (%)		SMP (%)		LMP (%)	
	2024	2025	2024	2025	2024	2025	2024	2025	2024	2025
Nuclear	10,892	11,162	8%	8%	14%	13%	0%	0%	0%	0%
Coal	38,792	37,176	30%	28%	28%	30%	36%	23%	83%	70%
Natural Gas	62,584	62,655	48%	47%	42%	41%	63%	75%	93%	93%
Oil	1,312	1,215	1%	1%	0%	0%	0%	0%	1%	0%
Hydro	3,979	3,992	3%	3%	2%	1%	1%	1%	3%	3%
Wind	5,865	6,715	5%	5%	10%	9%	0%	0%	51%	44%
Solar	4,299	7,502	3%	6%	3%	6%	0%	0%	14%	17%
Other	1,758	2,511	1%	2%	2%	1%	0%	2%	5%	7%
Total	129,482	132,928								

Load and Weather Patterns

Summer 2023 – 2025



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

Highest Daily Temperatures

Summer 2025

	Hist. Avg.	Jun-2025				Jul-2025			
		22	23	24	25	27	28	29	30
Minneapolis	82	95	87	82	72	92	87	86	81
Des Moines	85	95	91	78	90	93	90	92	80
Detroit	82	94	95	94	80	91	88	88	85
Indianapolis	84	90	92	92	90	89	88	95	92
Chicago	84	95	95	96	88	89	93	93	83
Little Rock	91	94	93	94	94	95	98	99	99
New Orleans	91	94	95	90	92	94	97	97	95
Houston	93	93	90	91	83	93	95	96	96

Notes: Pink Background Means High Temperature Above Historical Average By At Least 8 Degrees Fahrenheit.

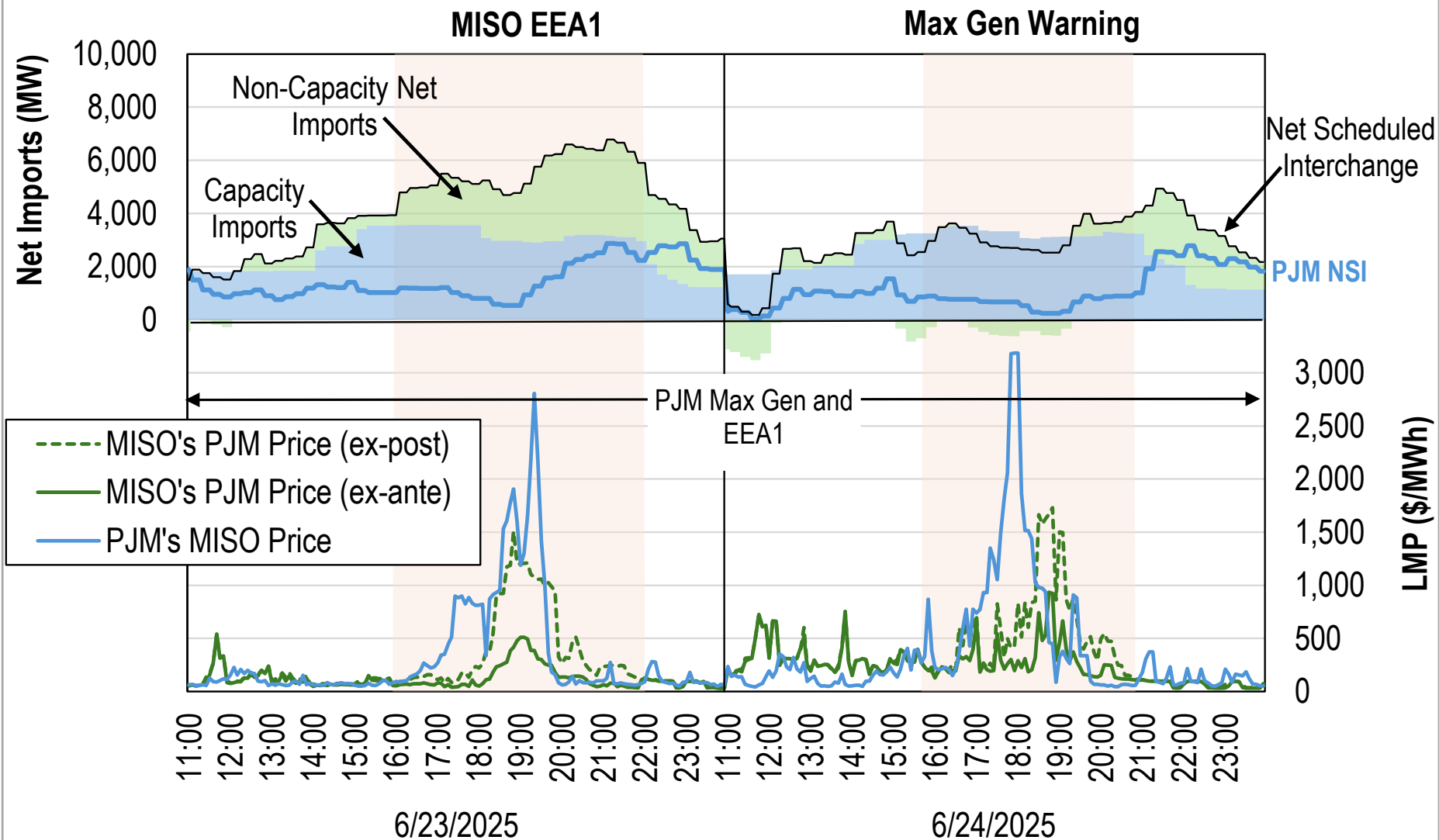
Eastern Interconnect Emergency Declarations

Highest Daily Declaration by Balancing Area Summer 2025

	Jun-2025				Jul-2025						
	22	23	24	25	15	16	24	25	28	29	30
MISO	Cons. Ops	EEA1 Midwest	Max Gen Warning Midwest	Cons. Ops	Cons. Ops		Capacity Advisory		Max Gen Alert	Max Gen Warning	Severe Weather Alert
PJM	Hot Weather Alert	EEA1	EEA1	EEA1	EEA1	EEA1	EEA1	EEA1	EEA1	EEA1	EEA1
SPP			EEA1			Weather Advisory				Resource Advisory	Resource Advisory
IESO	Severe Weather Alert	Cons. Ops	EEA1		Cons. Ops		Cons. Ops		EEA1	EEA1	
TVA	Cons. Ops	Cons. Ops	EEA1	Cons. Ops			Cons. Ops	Cons. Ops	Power Supply Alert	Power Supply Alert	Power Supply Alert
VACAR		EEA2	EEA1	EEA1					EEA1	Cons. Ops	Cons. Ops
NYISO			EEA1	EEA1						EEA1	
ISO-NE			EEA1								

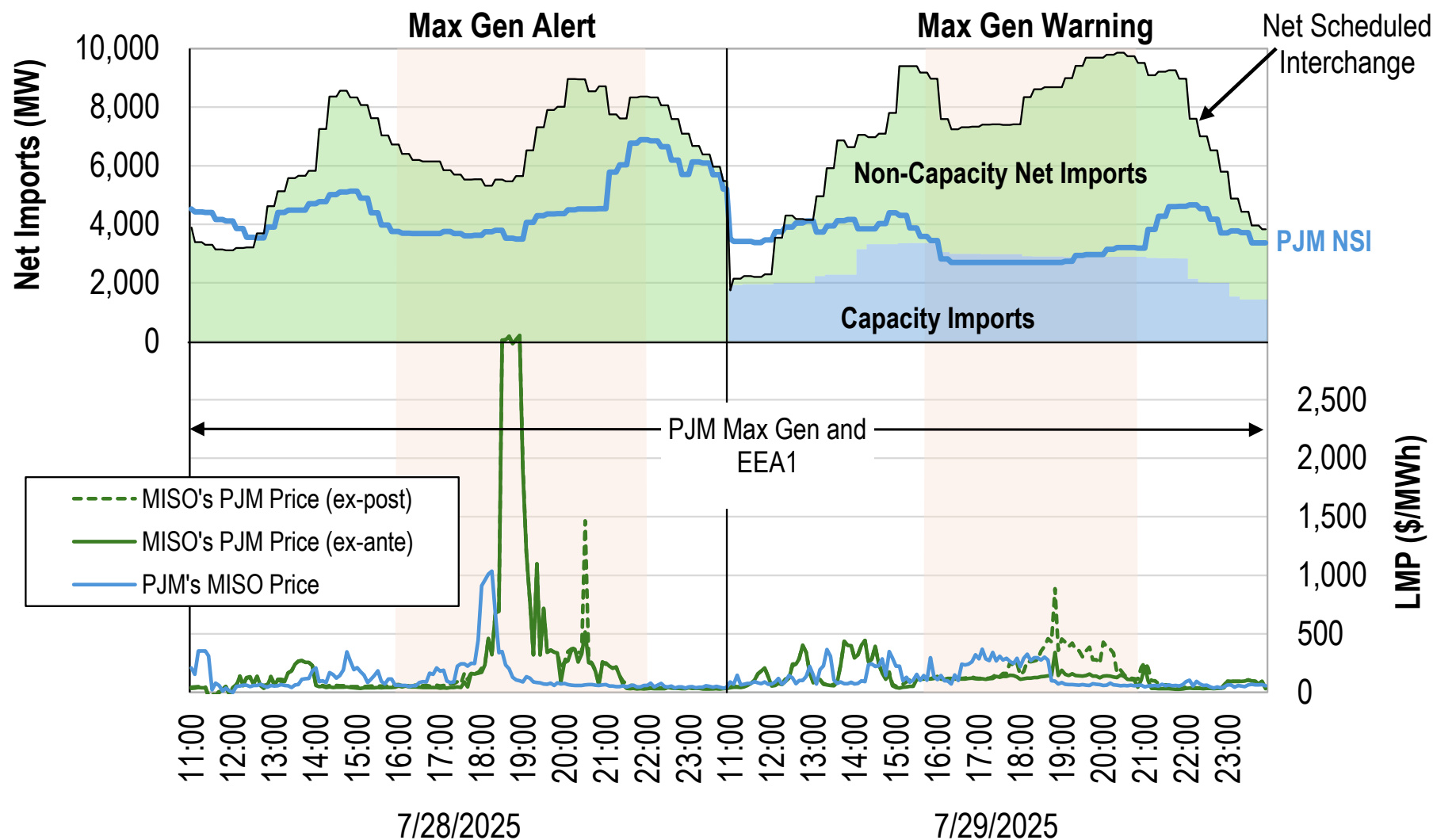
June 23-24 MISO EEA1 and Max Gen Warning

Impact of Emergency / ELMP Pricing on Net Imports



July 28-29 MISO Max Gen Alert and Warning

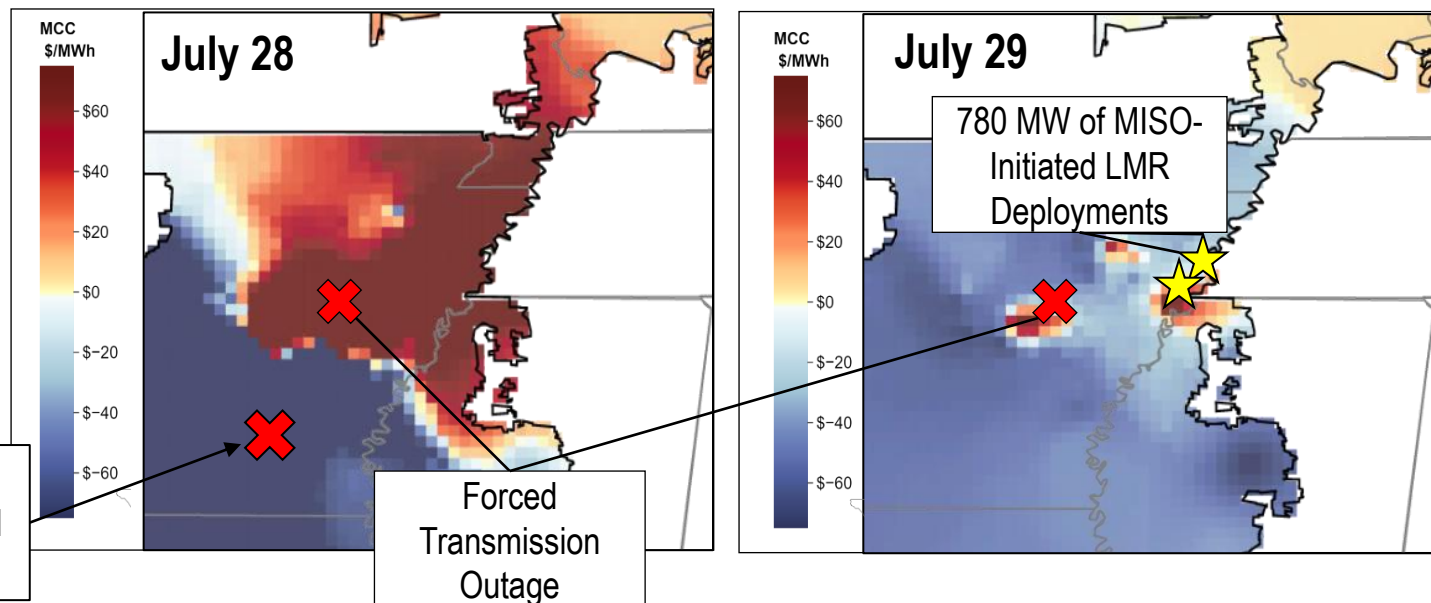
Net Imports and MISO Pricing



July 28-29

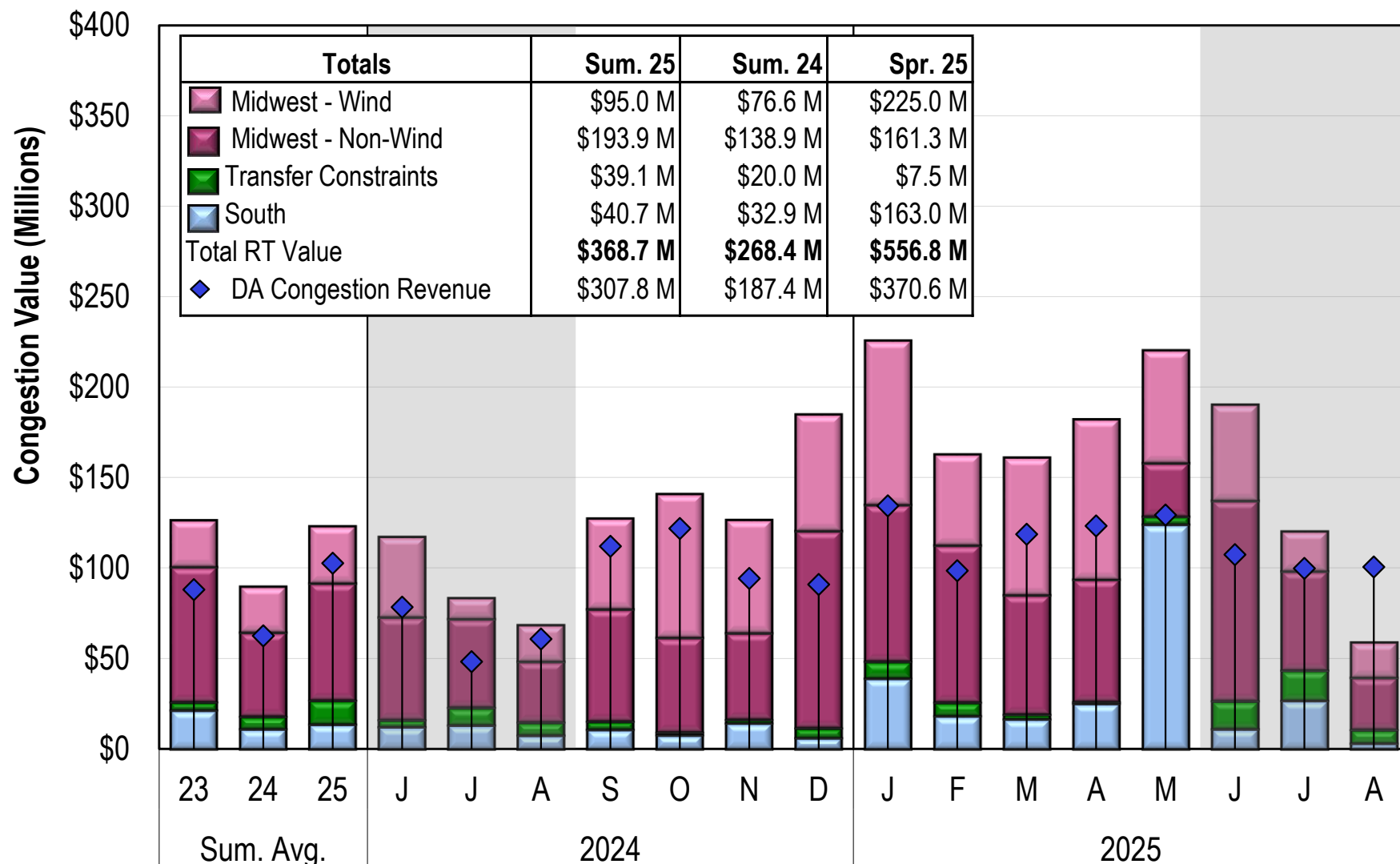
Forced Transmission Outage and LTE in the South

- 7/28: 0800 - 7/29 2200 System wide Conservative Operations and Hot Weather Alert
- 7/28: 1200 - 7/29 2200 Capacity Advisory System wide
- 7/28: 1400 – 2200 Max Gen Alert
- 7/29: 0815 - 2000 EST Transmission Advisory for EAI area.
- 7/29: 1600 - 2000 EST Local Transmission Emergency in the Northeast portion of Arkansas and the Western portion of Mississippi. LMRs were scheduled in advance of the LTE. Line returned to service just before LMRs were scheduled to curtail.



Value of Real-Time Congestion

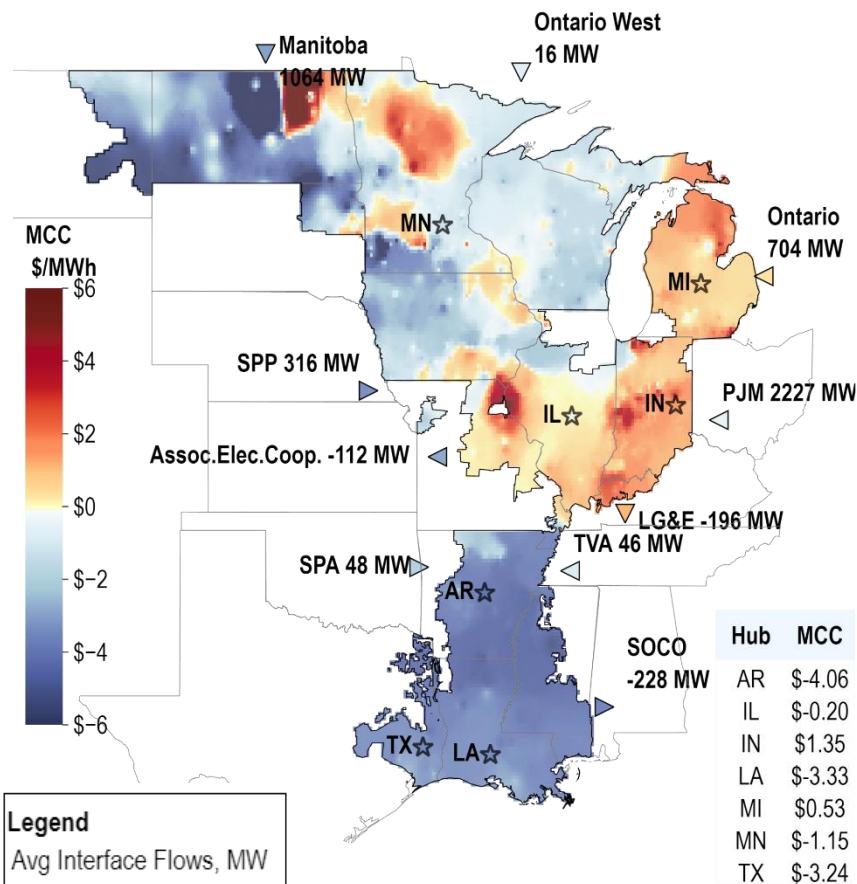
Summer 2023 - 2025



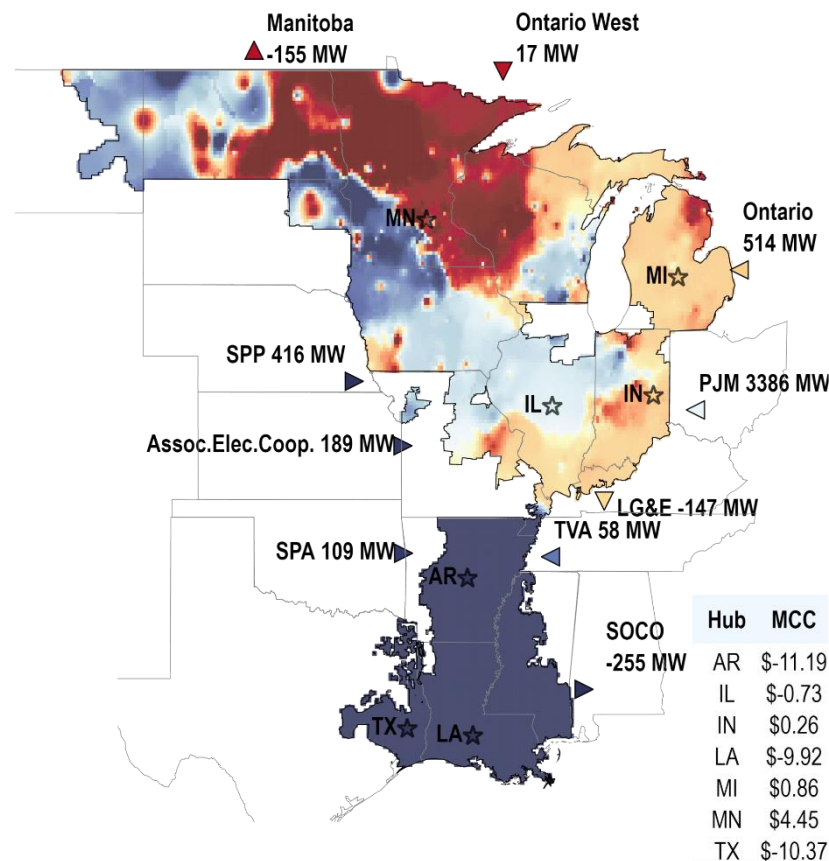
Average Real-Time Congestion Components

Summer 2024 – 2025

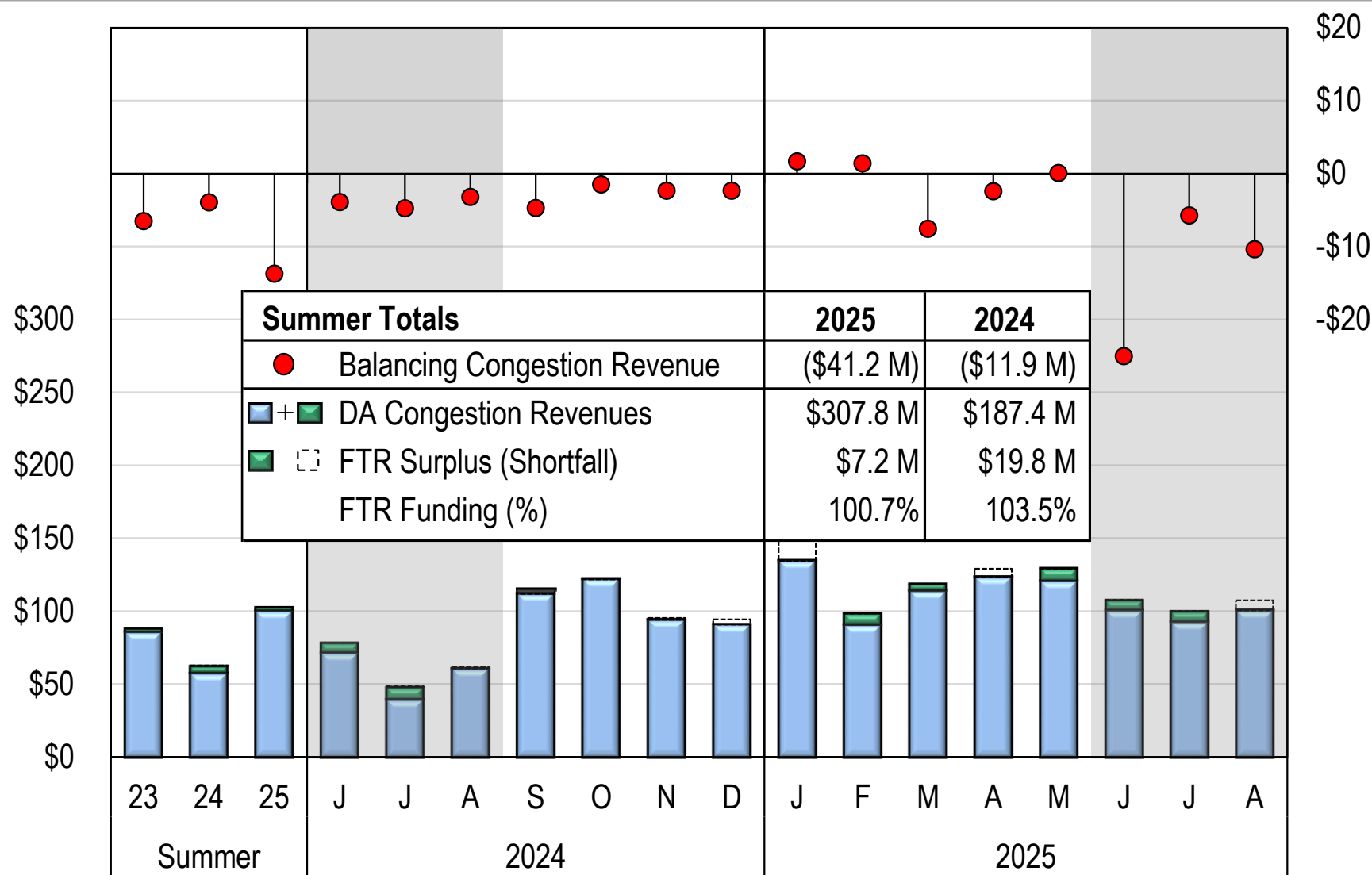
Summer 2024



Summer 2025

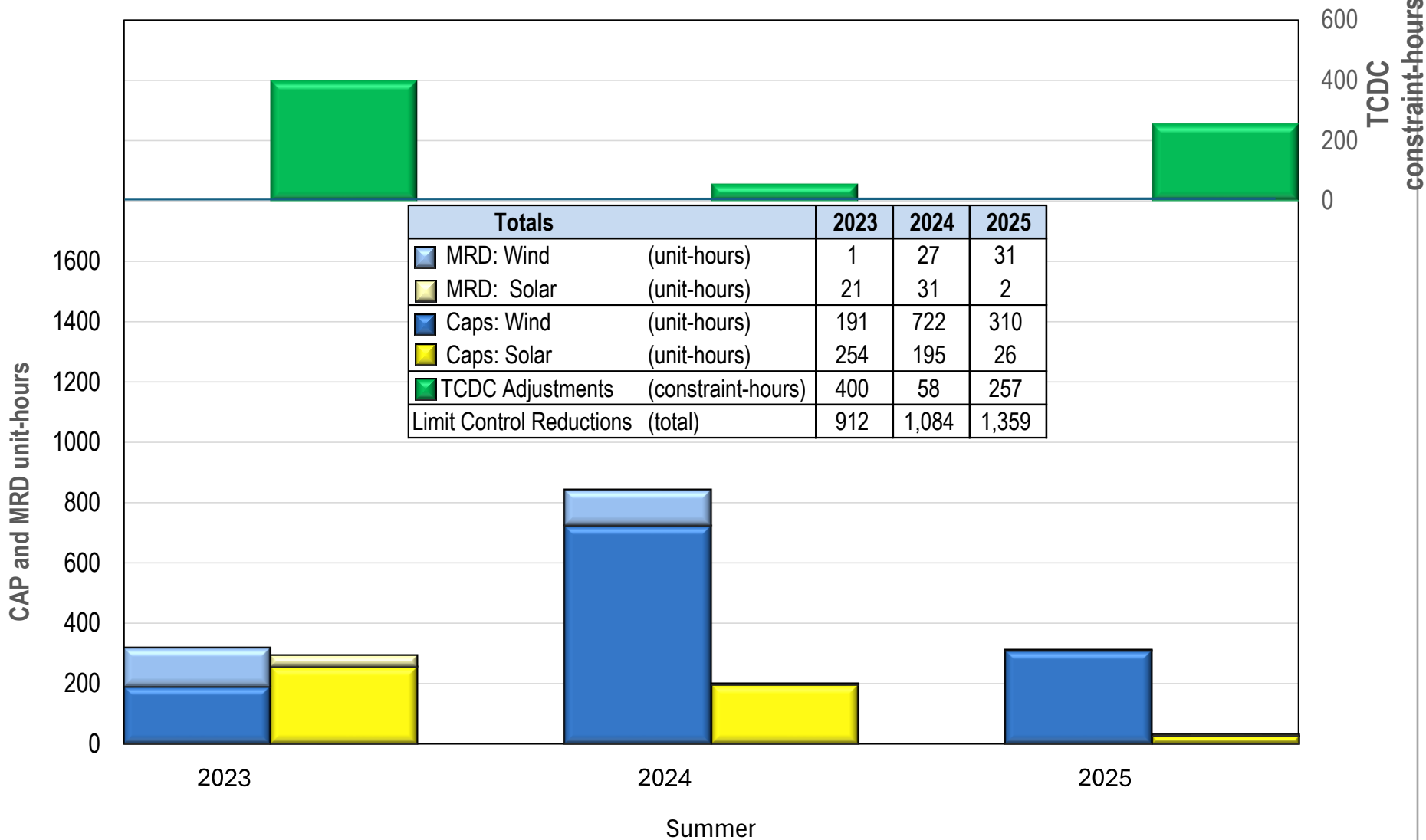


Day-Ahead and Balancing Congestion and FTR Funding



MISO Operator Actions for Congestion Management

Summer 2023 – 2025



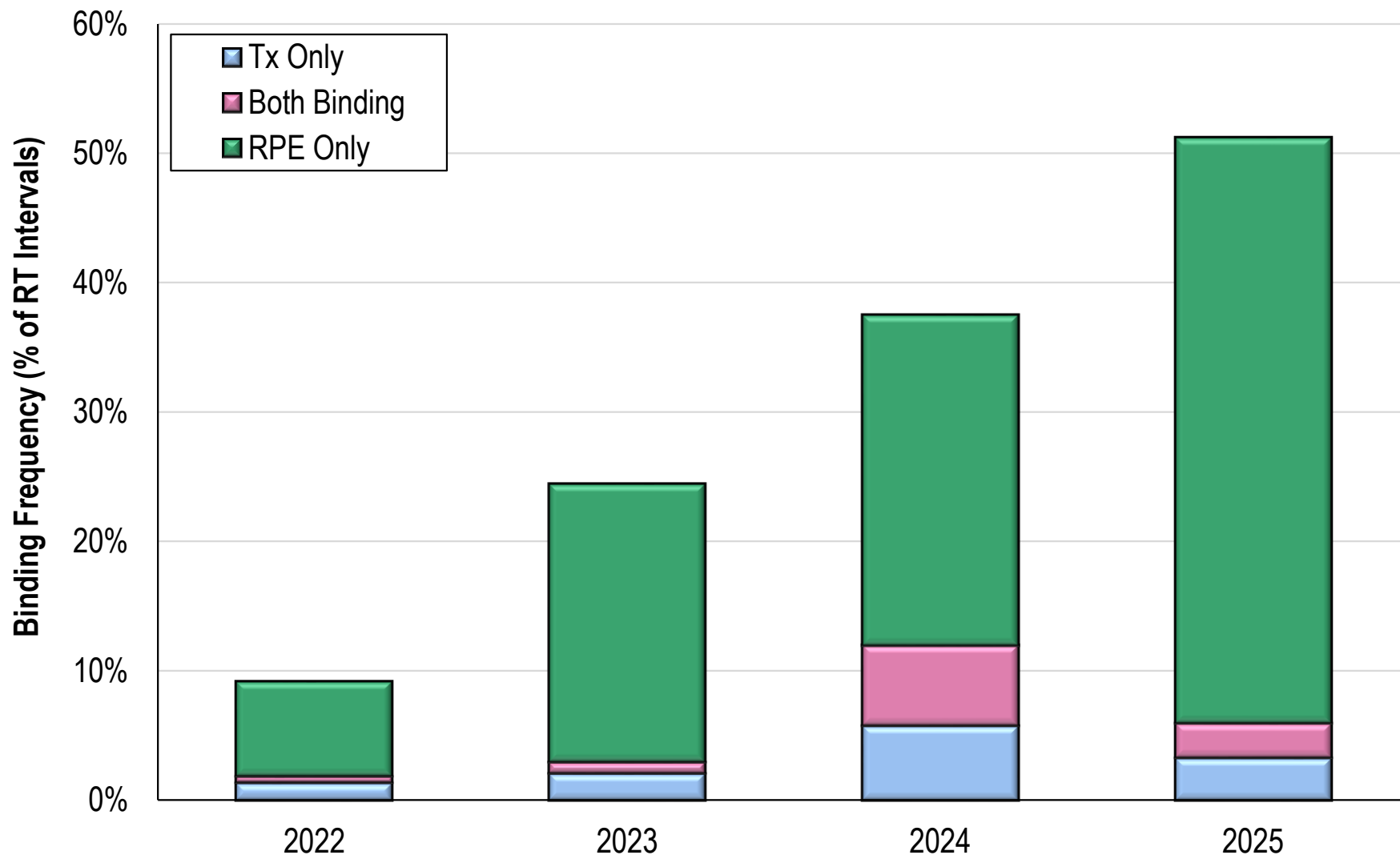
Benefits of Ambient-Adjusted and Emergency Ratings

Summer 2024 – 2025

		Savings (\$ Millions)			# of Facilities for 2/3 of Savings	Share of Congestion
		Ambient Adj. Ratings	Emergency Ratings	Total		
2024	Midwest	\$11.1	\$12.33	\$23.4	17	9.9%
	South	\$0.5	\$1.62	\$2.1	1	6.4%
	Total	\$11.6	\$13.9	\$25.5	18	9.5%
2025	Midwest	\$15.2	\$17.49	\$32.7	14	9.3%
	South	\$0.2	\$1.43	\$1.6	2	4.4%
	Total	\$15.4	\$18.9	\$34.3	16	8.9%

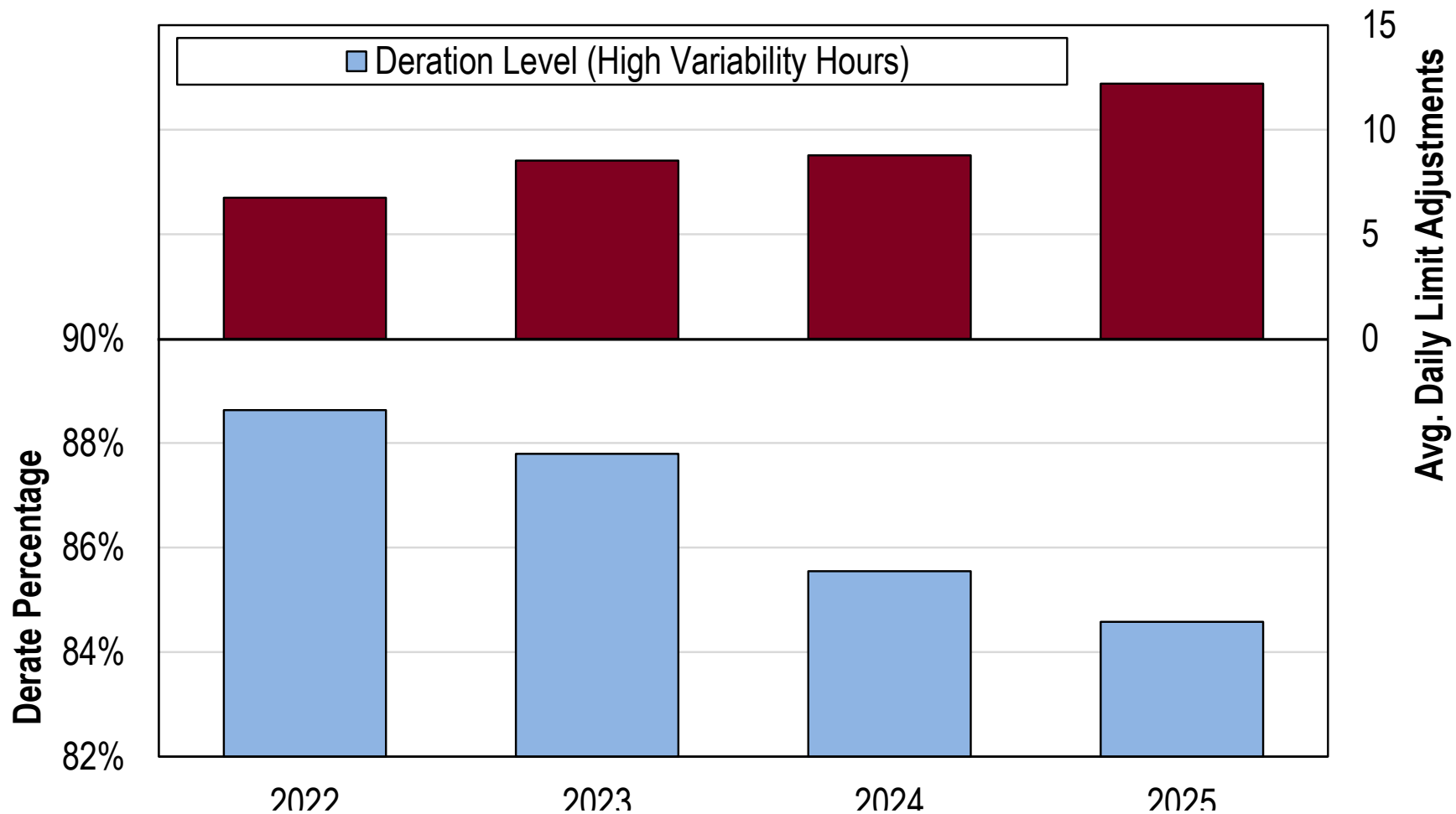
RDT Congestion

Historical Binding Frequency (Q3 thru 8/23 only)



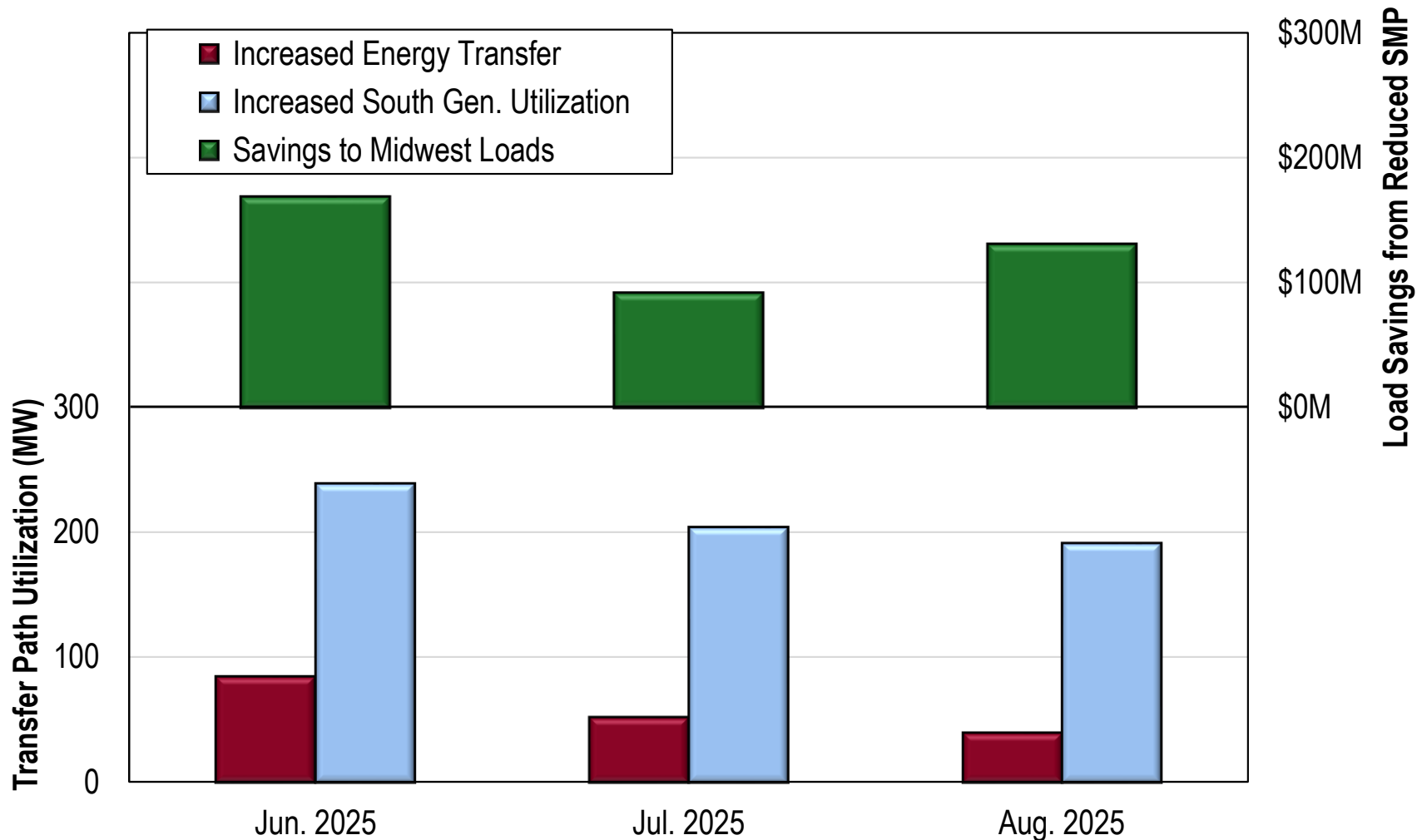
RDT Congestion

Historical Derate Behavior (Q3)



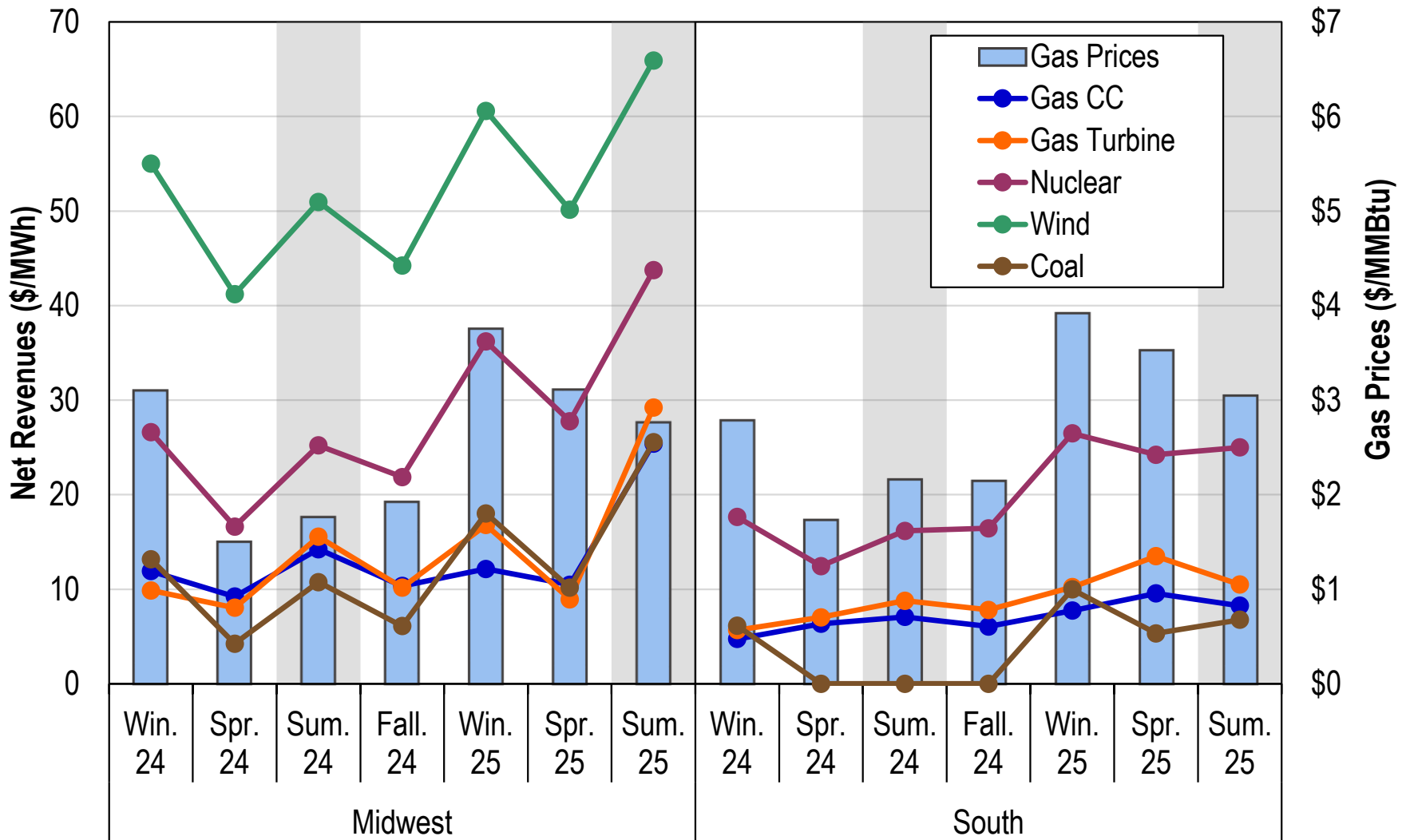
RDT Congestion

Simulated Benefits from Proposed TCDC



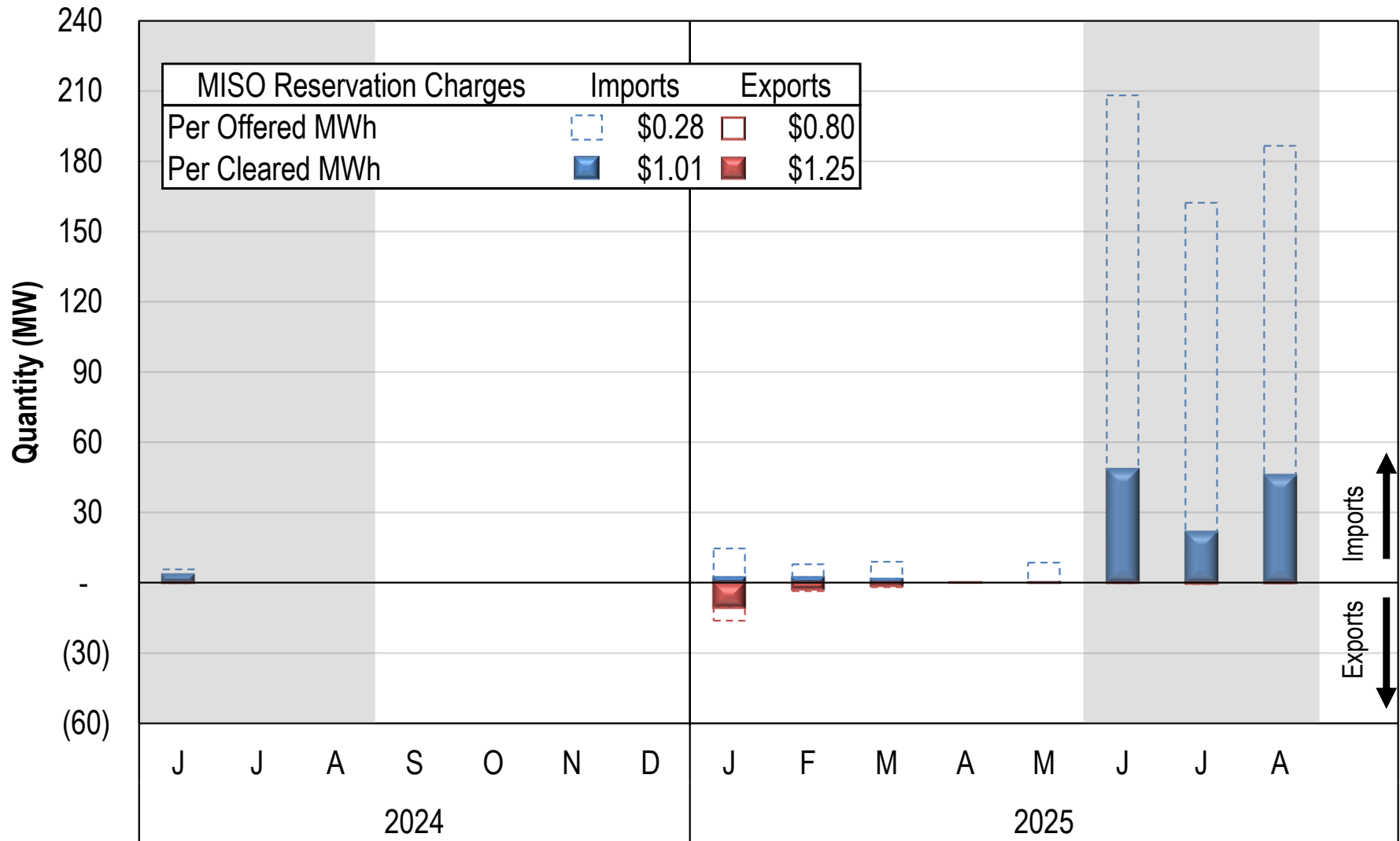
Net Revenues by Technology

2023 - 2025



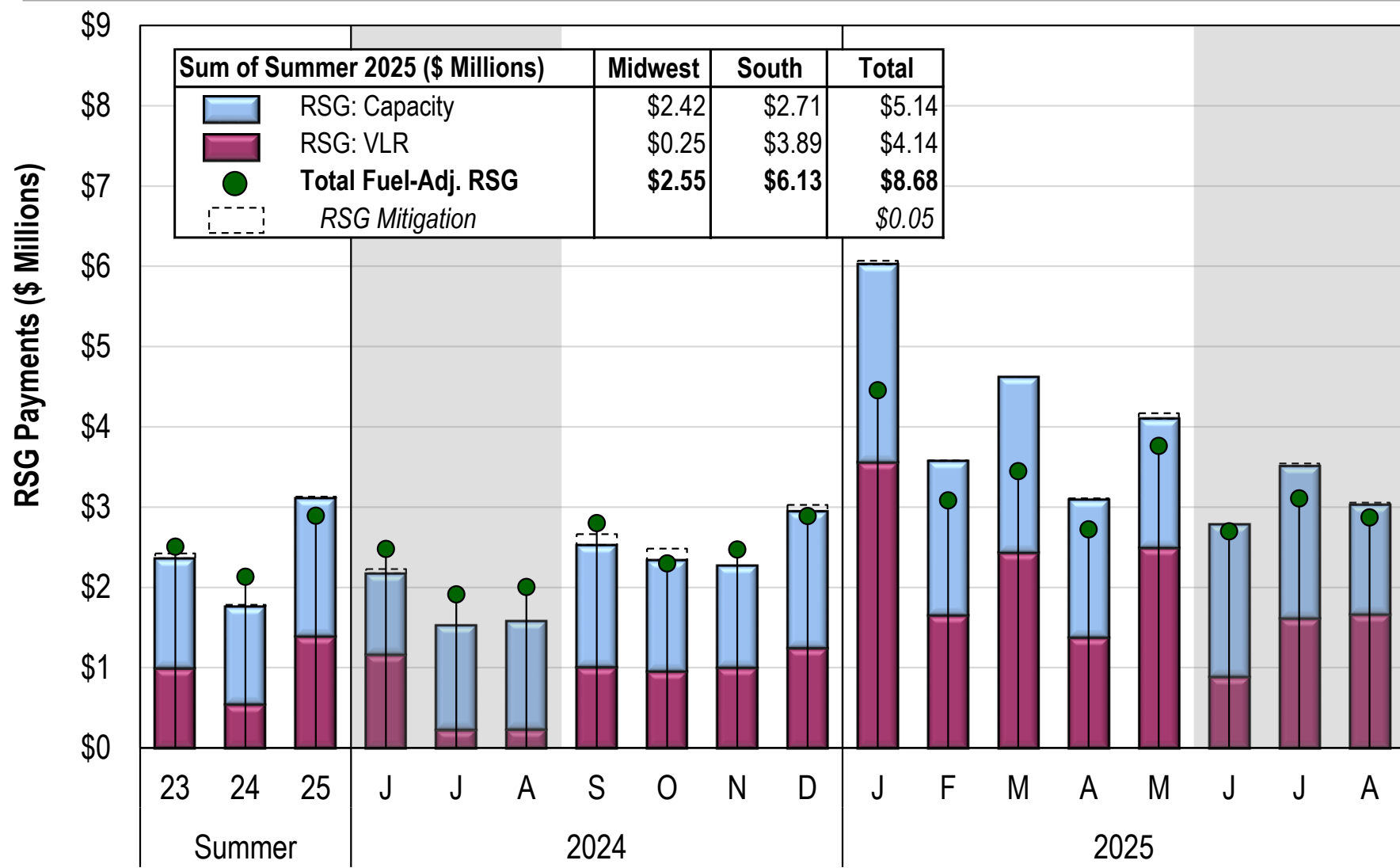
Coordinated Transaction Scheduling (CTS)

Summer 2024 – 2025



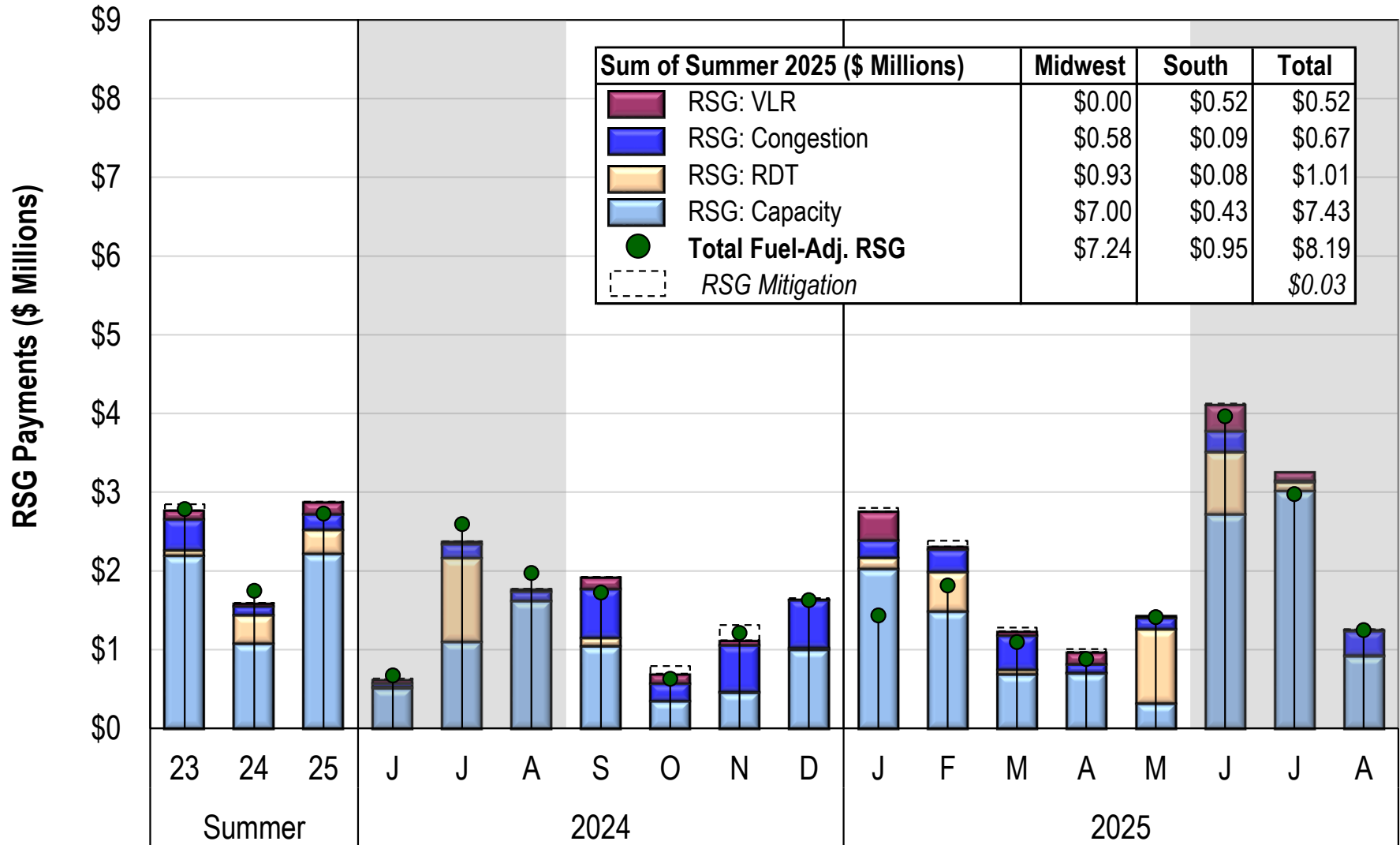
Day-Ahead RSG Payments

Summer 2023 – 2025



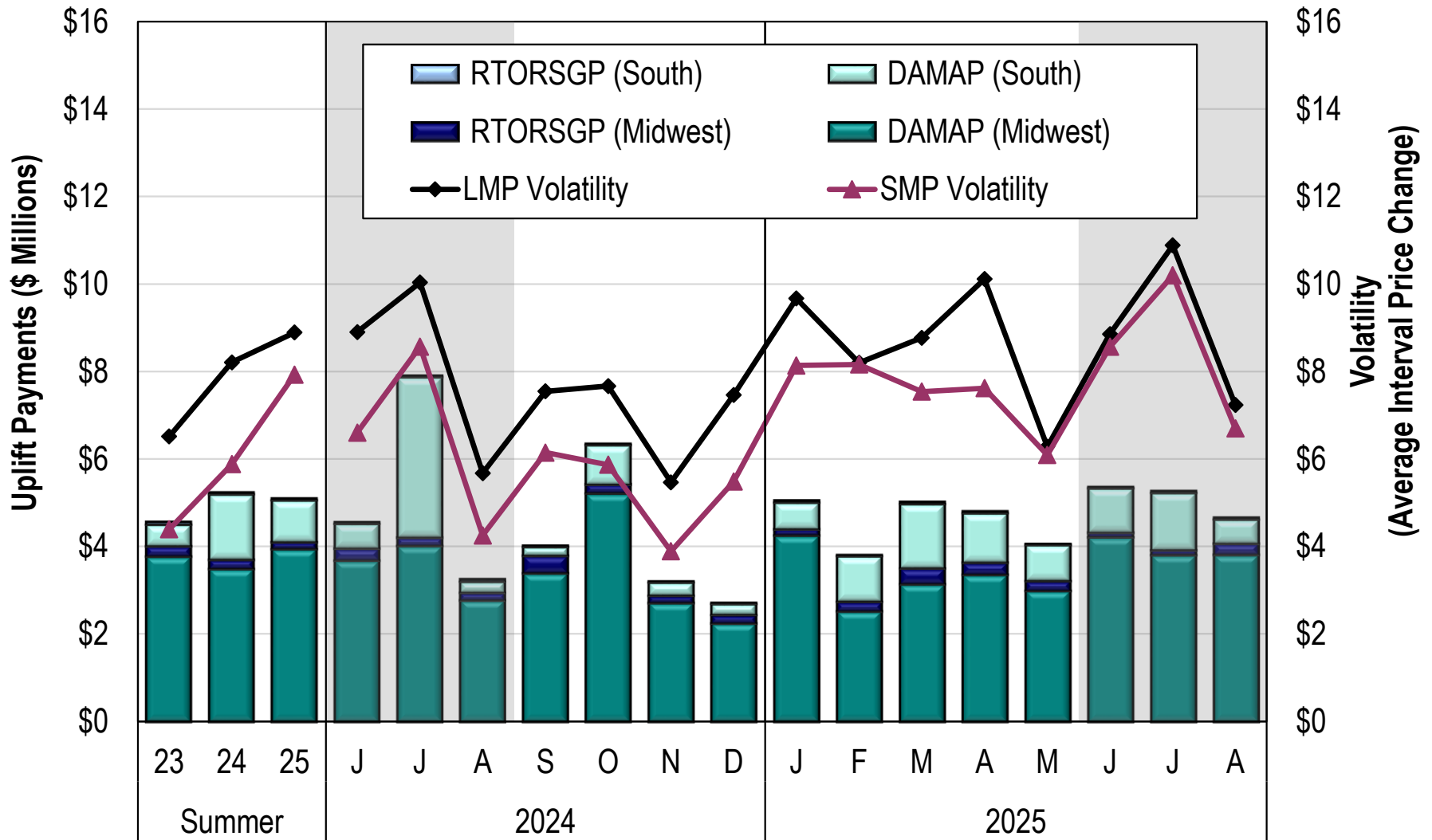
Real-Time RSG Payments

Summer 2023 – 2025



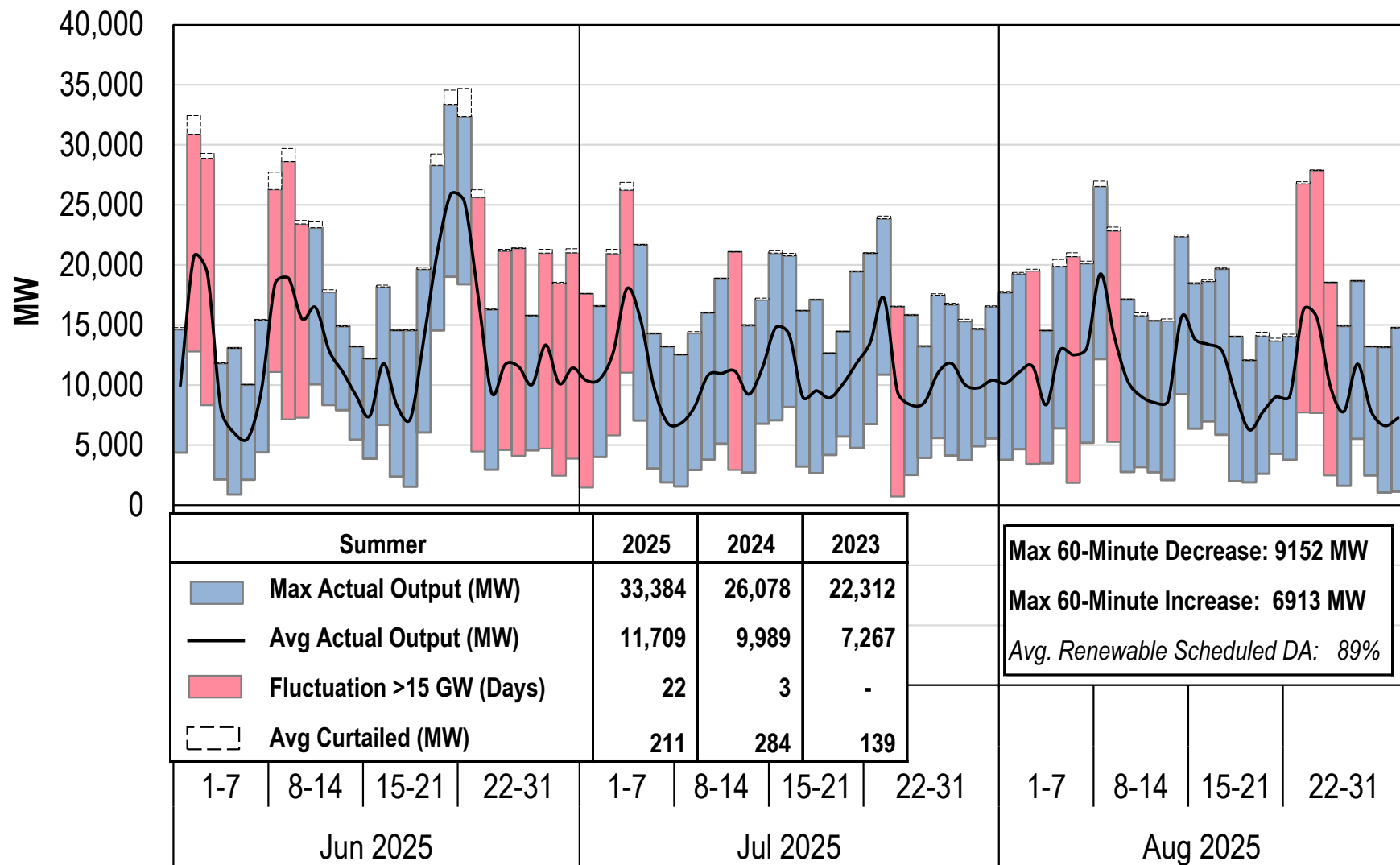
Price Volatility Make Whole Payments

Summer 2023 – 2025



Wind and Solar Output in Real Time

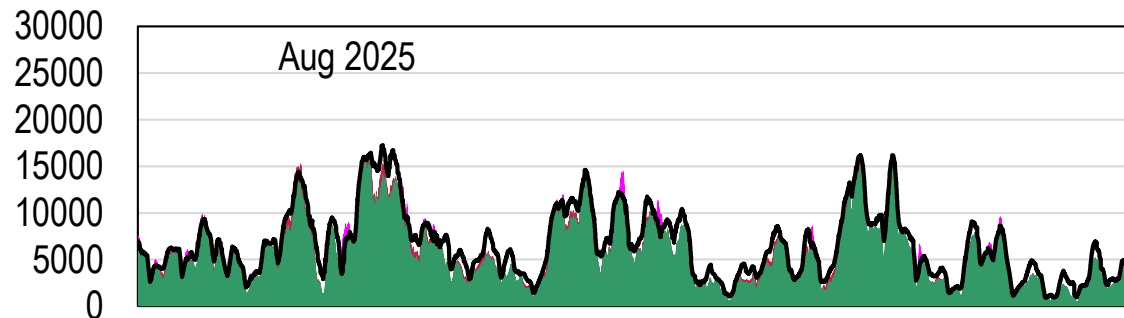
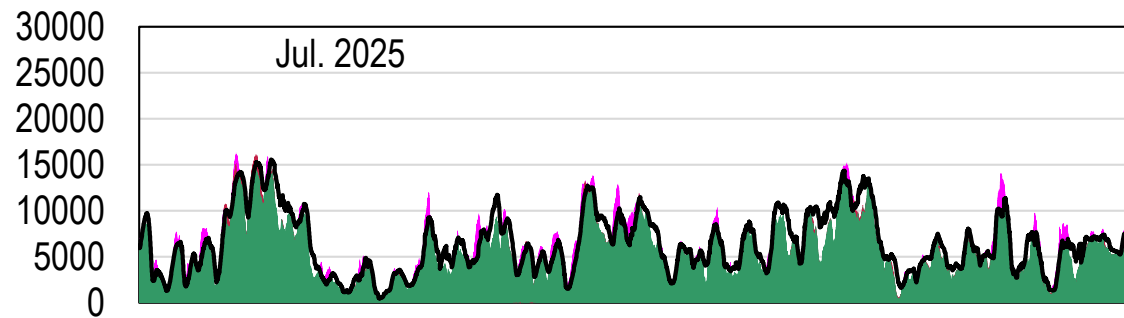
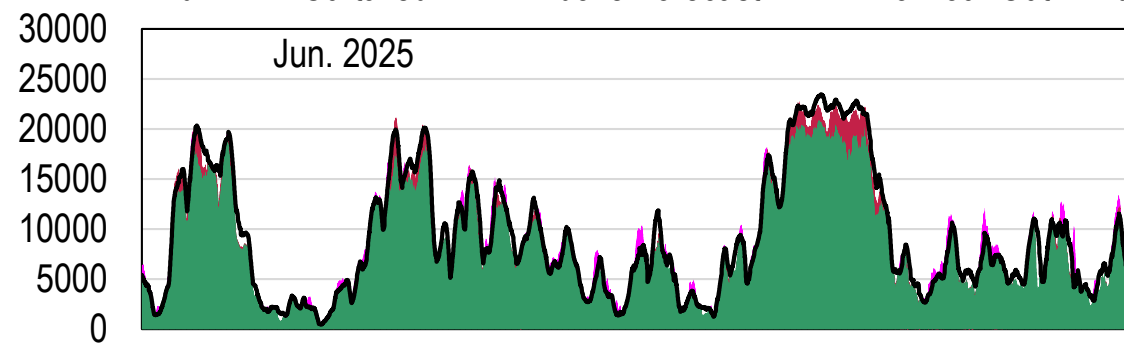
Daily Range and Average



Wind Forecast and Actual Output

Summer 2025

■ Wind
 ■ Curtailed
 ■ Above Forecast
 — 2-3 Hour Out Wind Forecast

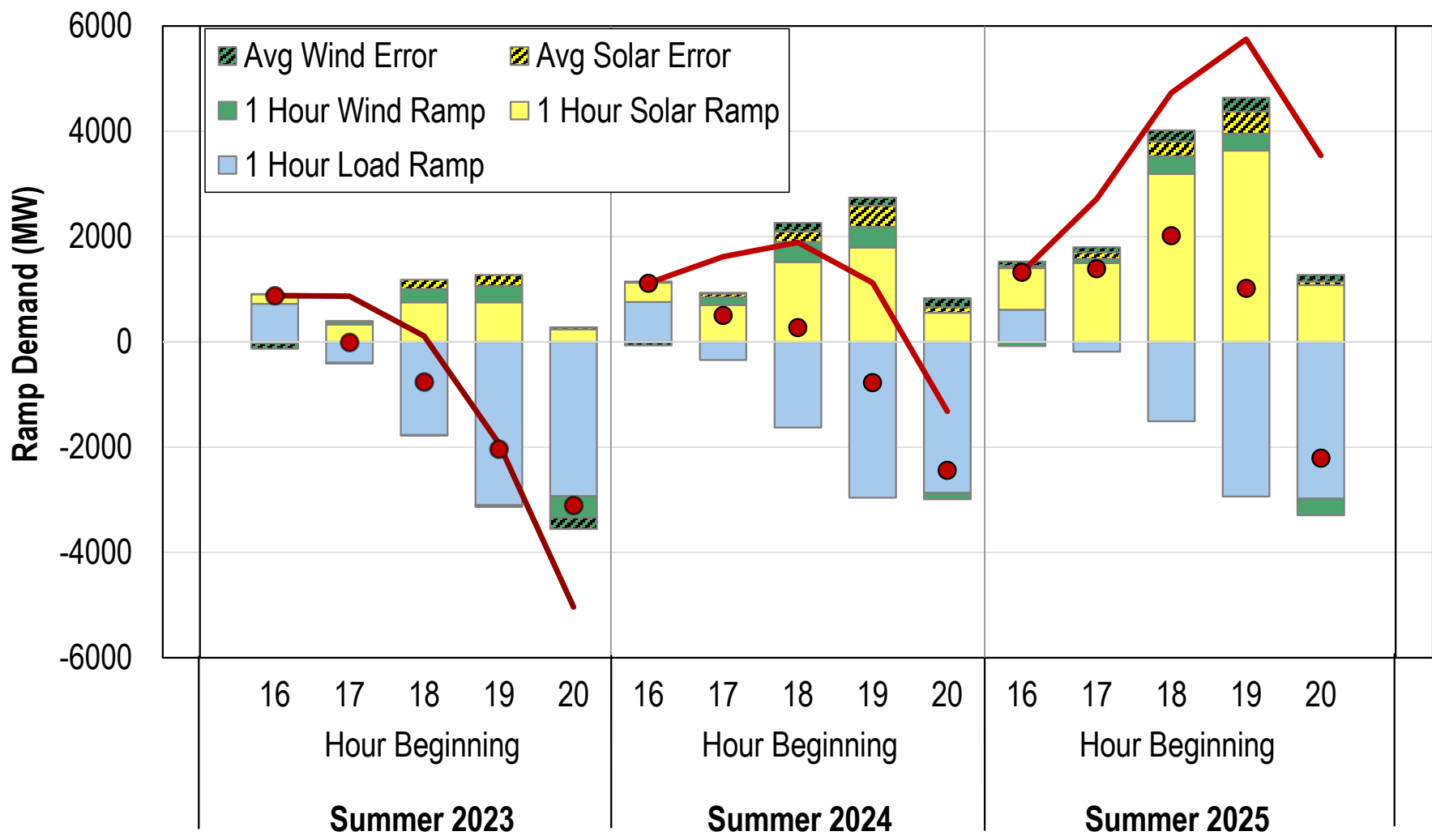


Summer 2025	
Real-Time Wind (MW)	6,921
Day-Ahead Wind (MW)	6,405
Avg Curtailments (MW)	187
Forecast Errors (%)	8.5%
Absolute Errors (%)	16.6%

Summer 2024	
Real-Time Wind (MW)	7,710
Day-Ahead Wind (MW)	7,218
Avg Curtailments (MW)	265
Forecast Errors (%)	1.8%
Absolute Errors (%)	16.5%

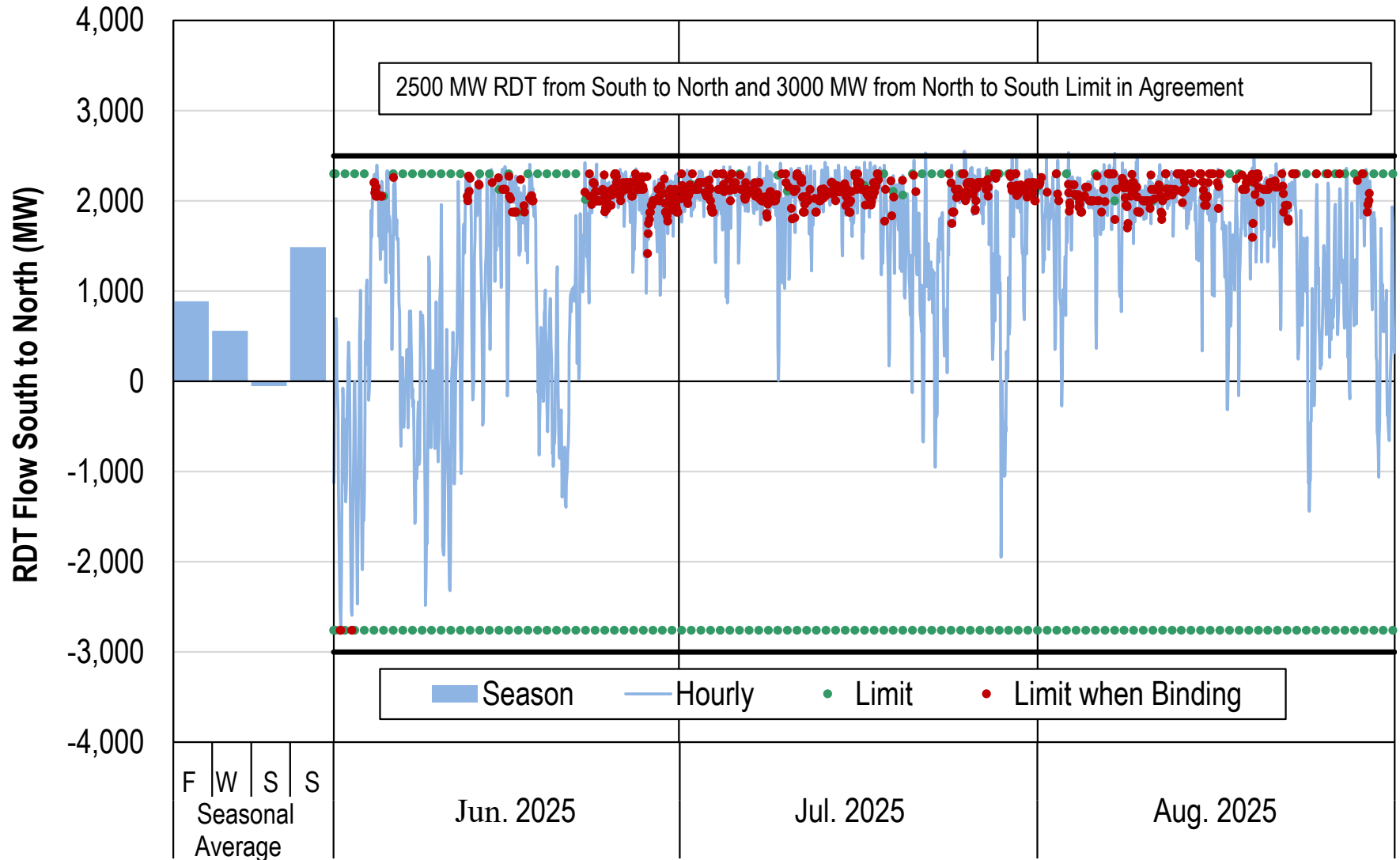
Spring 2025	
Real-Time Wind (MW)	13,113
Day-Ahead Wind (MW)	11,584
Avg Curtailments (MW)	692
Forecast Errors (%)	1.5%
Absolute Errors (%)	7.8%

Evening Hours Net Load Ramp



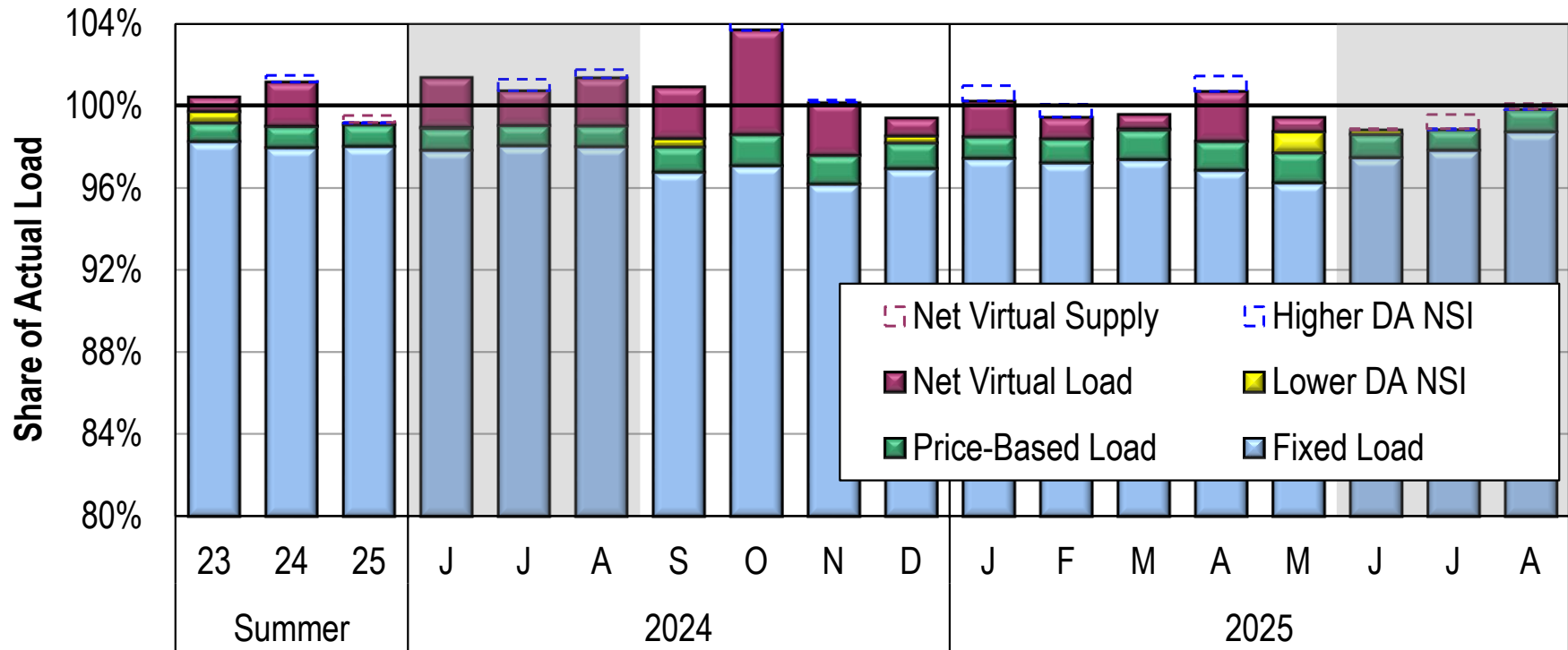
Real-Time Hourly Inter-Regional Flows

Summer 2025



Day-Ahead Peak Hour Load Scheduling

Summer 2023 – 2025

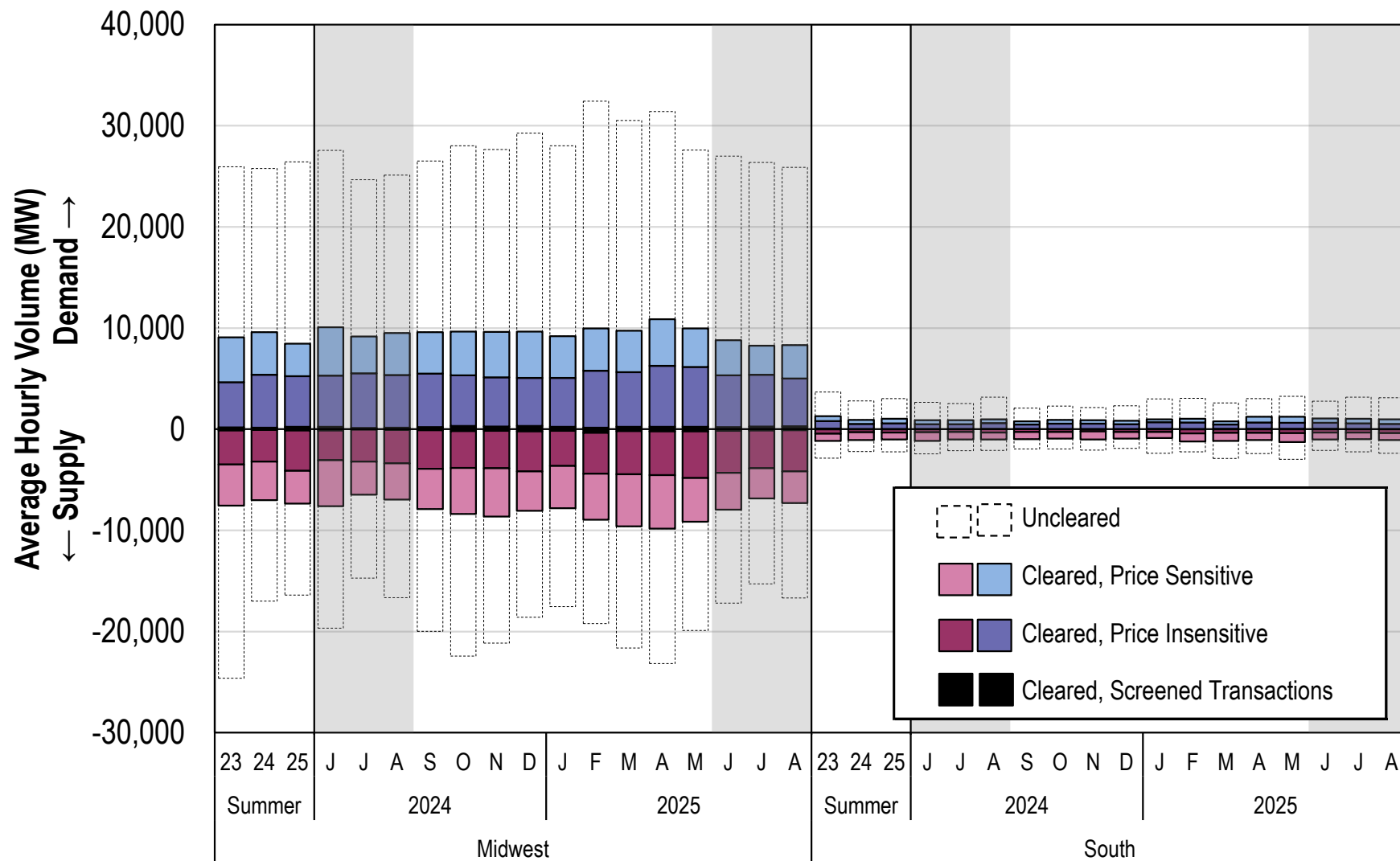


Share of Actual Load (%)

All Hours	101.2	101.8	100.3	101.4	102.0	101.9	100.7	100.4	99.2	99.5	100.2	99.1	98.1	99.8	99.5	99.6	100.6	100.5
Peak Hours Midwest	99.9	101.9	98.8	102.6	101.3	101.9	101.7	105.1	100.5	99.6	100.1	100.0	99.1	100.1	99.2	98.4	98.5	99.4
Peak Hours South	101.8	100.4	100.9	100.7	99.9	100.6	100.2	103.1	100.5	100.7	100.5	102.5	102.5	103.1	101.5	101.4	99.1	102.1

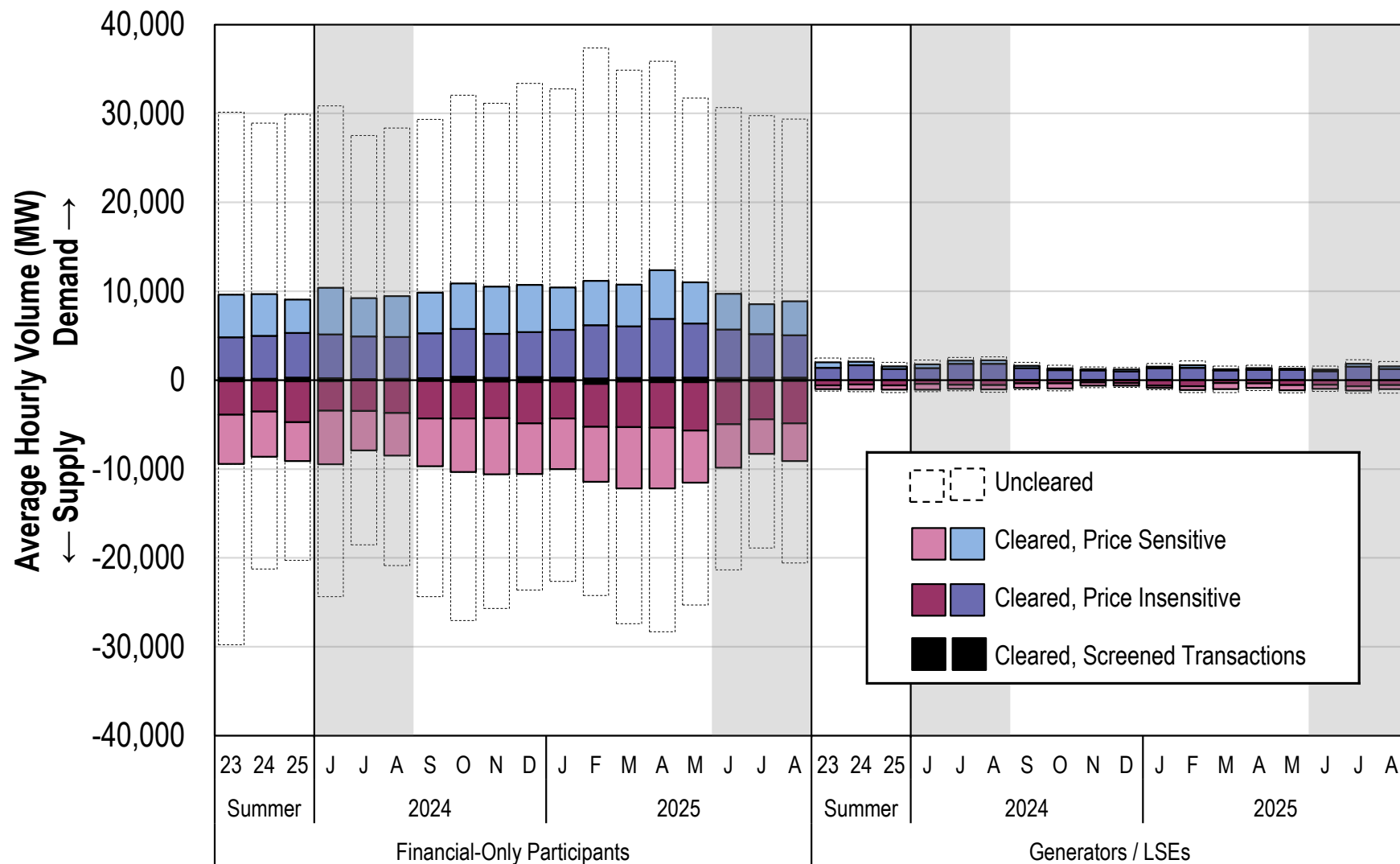
Virtual Load and Supply

Summer 2023 – 2025



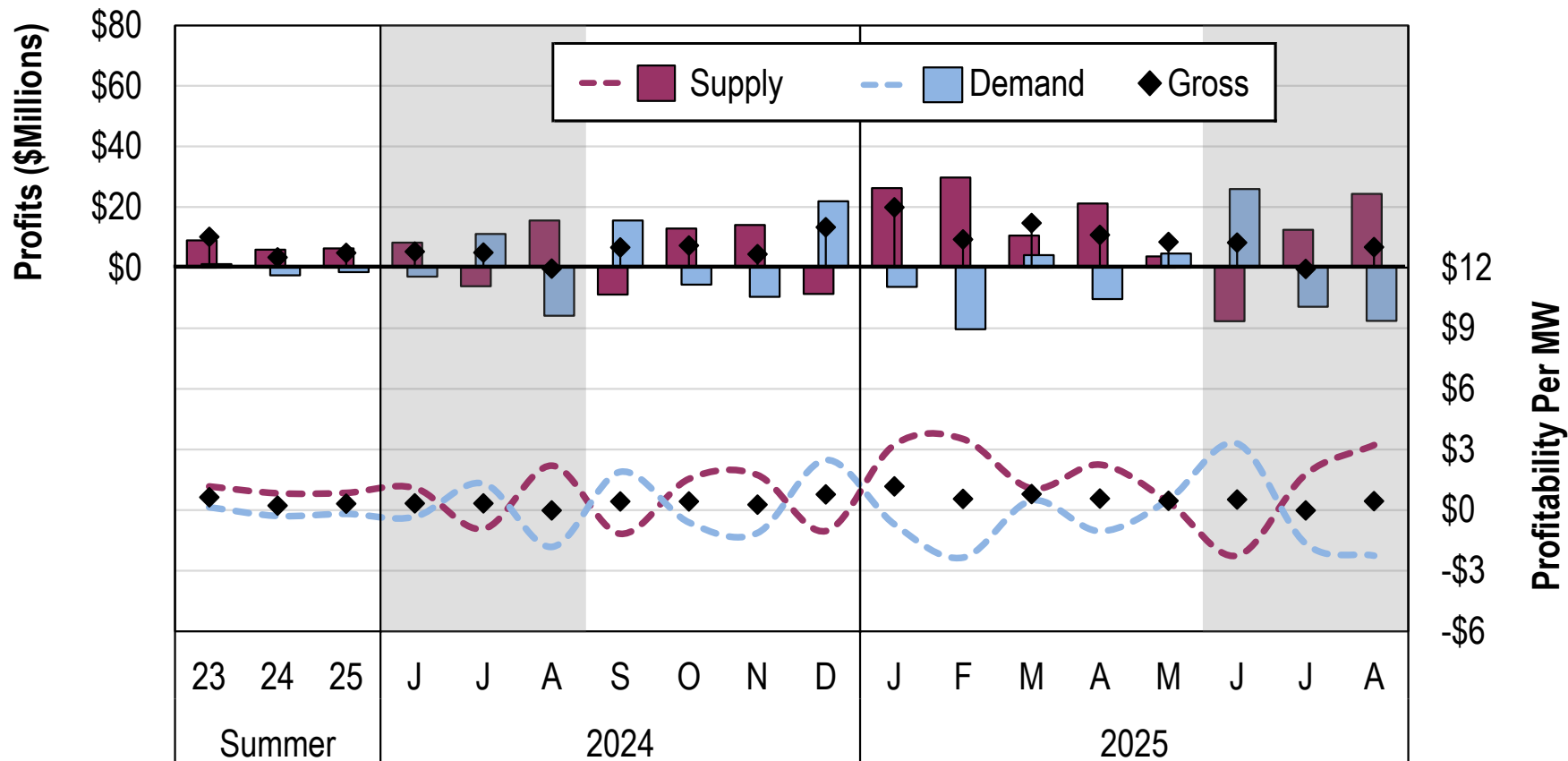
Virtual Load and Supply by Participant Type

Summer 2023 – 2025



Virtual Profitability

Summer 2023 – 2025

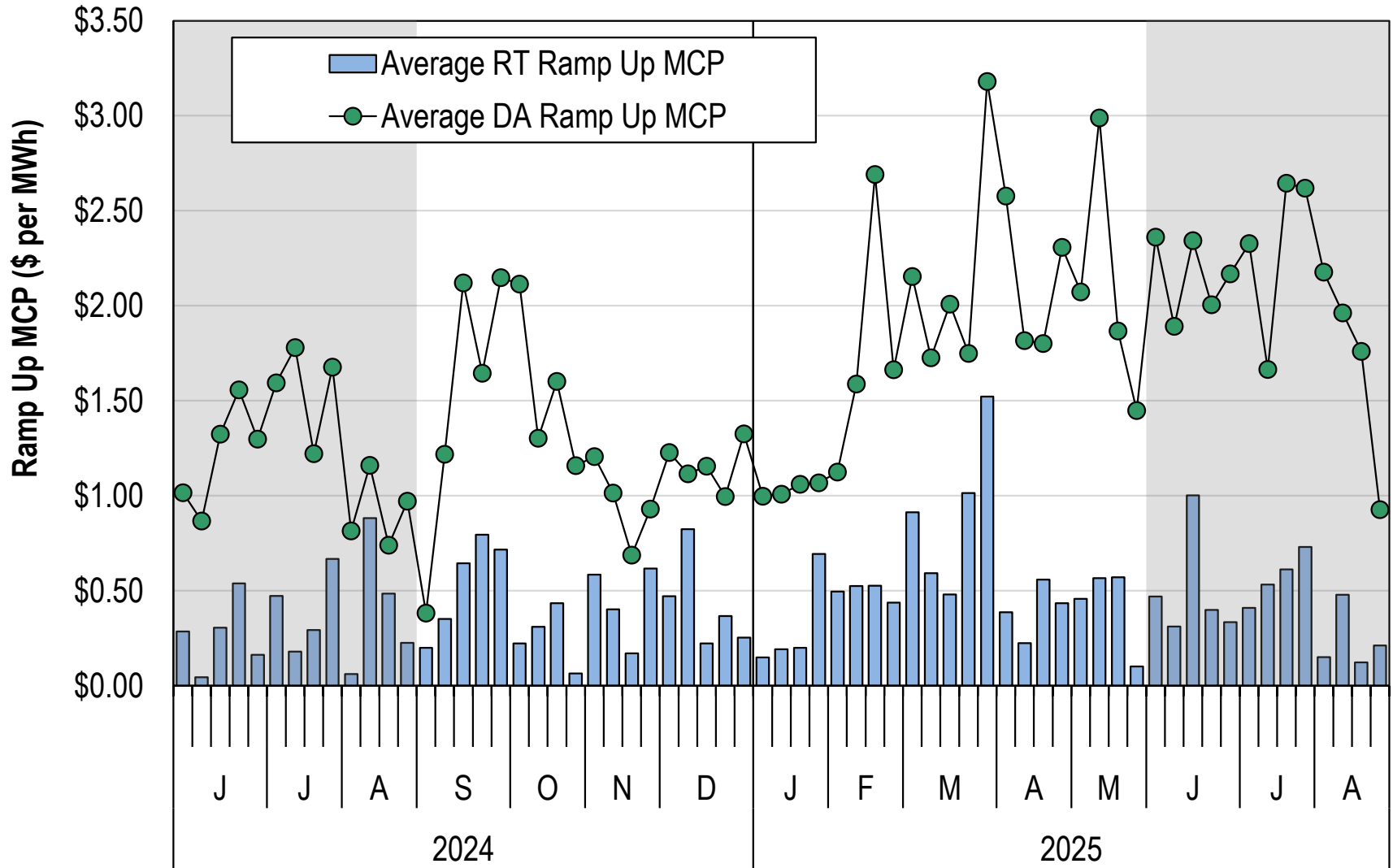


Percent Screened

Supply	1.2	1.0	1.5	1.5	0.7	0.8	0.9	1.9	1.5	2.0	1.7	3.6	1.4	1.9	1.8	1.7	1.7	1.2
Demand	2.5	1.6	2.7	2.2	1.2	1.5	1.9	3.3	2.4	3.1	2.5	1.5	2.3	2.3	2.4	2.4	2.8	3.0
Total	1.9	1.4	2.1	1.9	1.0	1.2	1.4	2.6	1.9	2.6	2.1	2.5	1.9	2.1	2.1	2.0	2.3	2.1

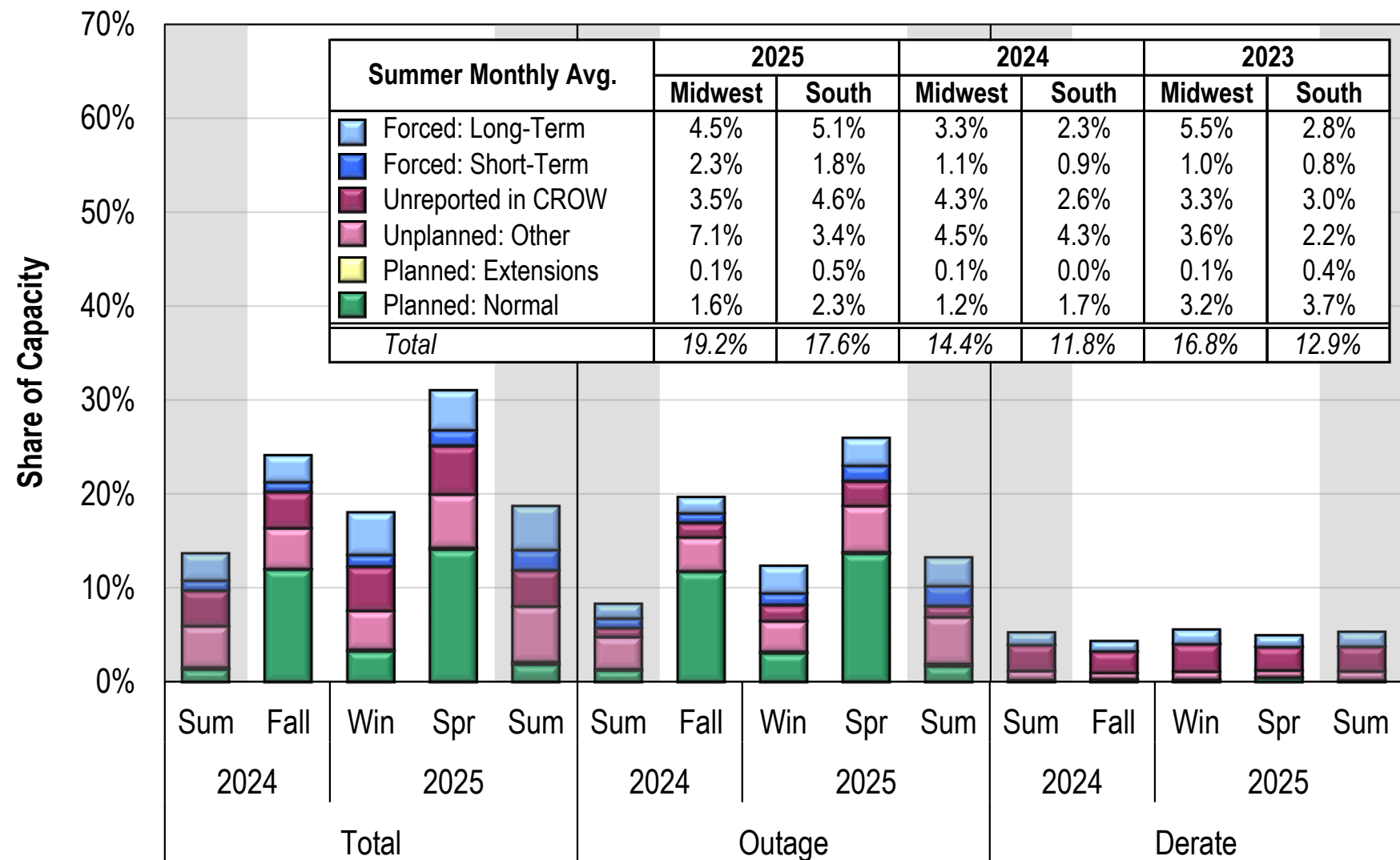
Day-Ahead and Real-Time Ramp Up Price

Summer 2024 – 2025



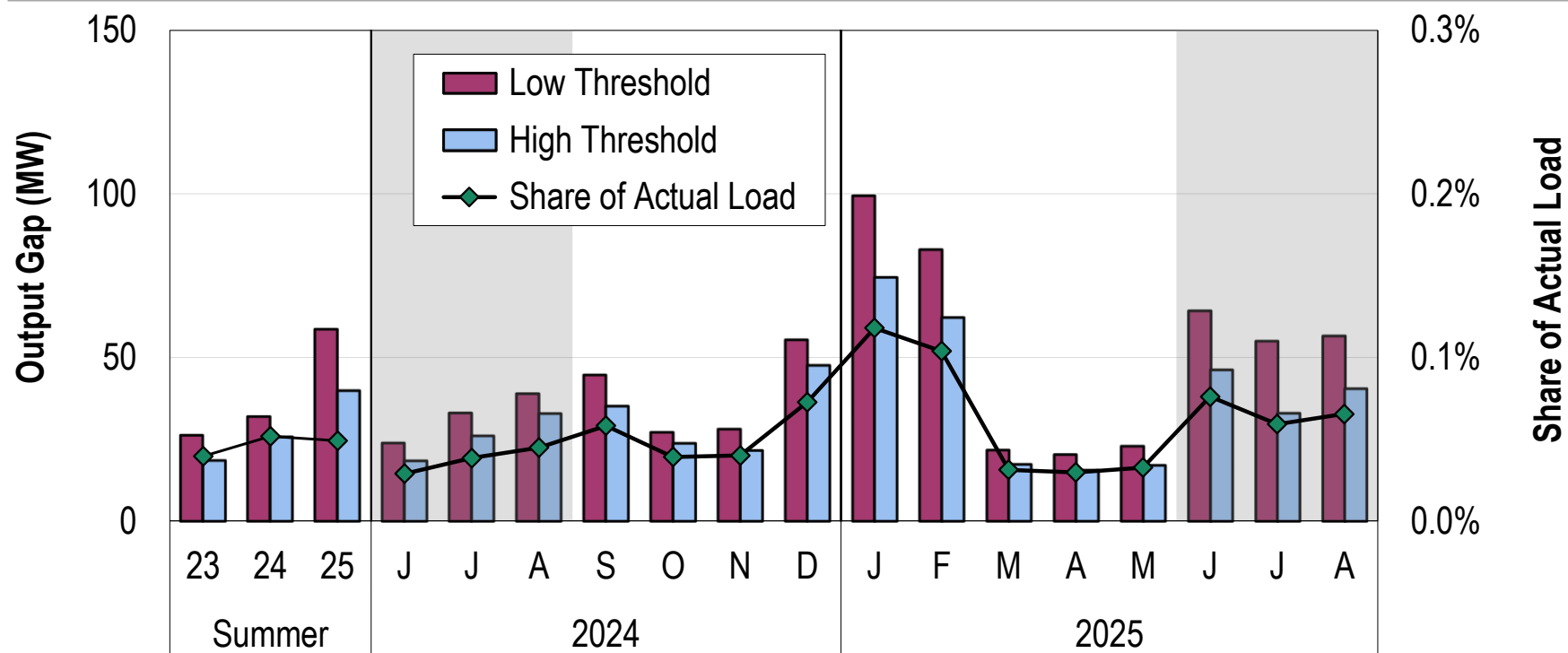
Generation Outages and Deratings

Summer 2023 – 2025



Monthly Output Gap

Summer 2023 – 2025



Low Threshold Results by Unit Status (MW)

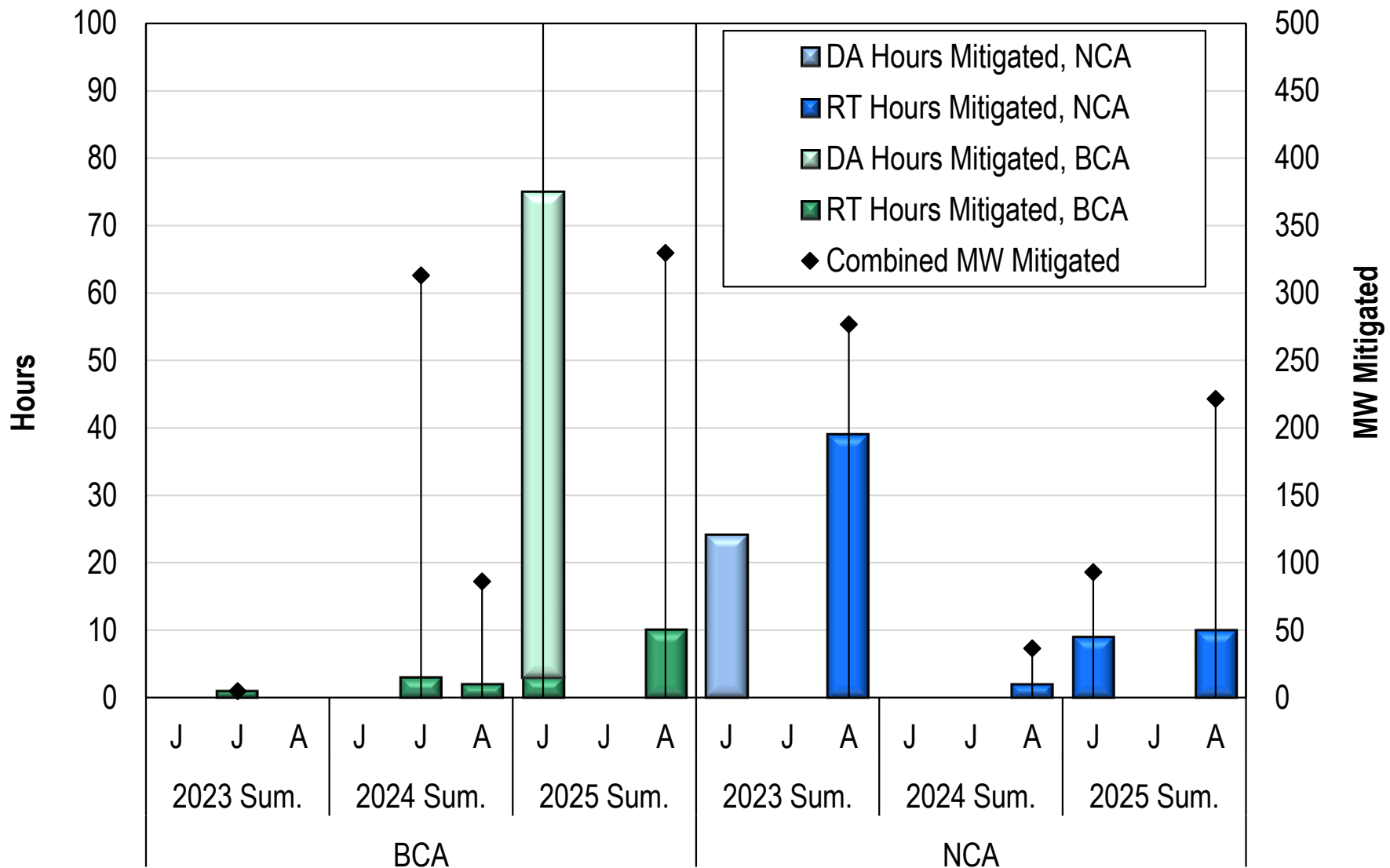
Offline	17	25	39	18	25	31	37	22	24	49	71	62	13	13	16	42	31	43
Online	9	7	20	6	8	7	8	6	4	7	28	21	9	8	7	22	24	13

High Threshold Results by Unit Status (MW)

Offline	14	21	31	14	22	29	31	20	19	44	66	56	12	11	13	35	24	34
Online	4	4	9	5	4	4	4	4	3	3	9	6	5	4	5	11	9	6

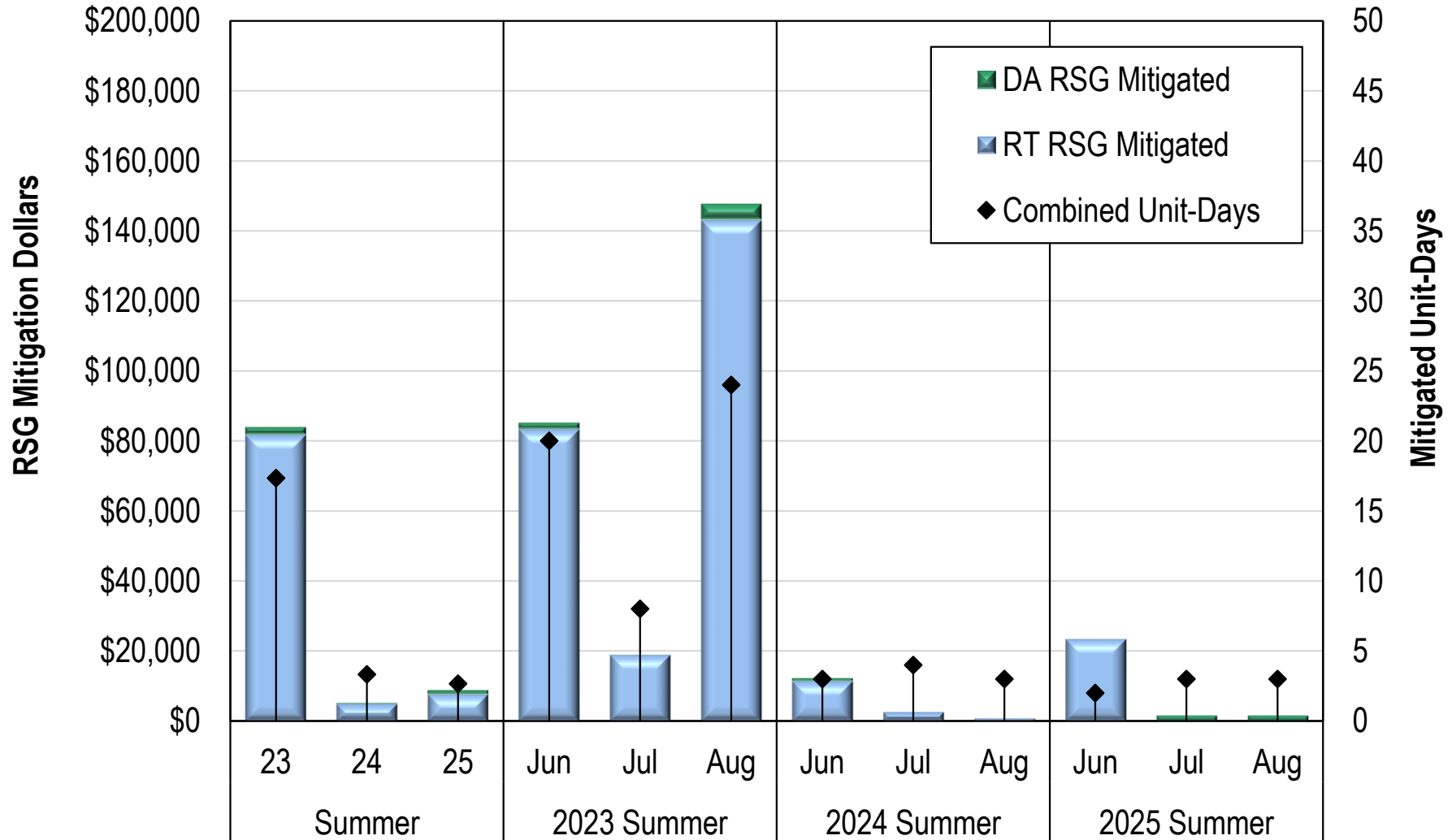
Day-Ahead And Real-Time Energy Mitigation

Summer 2023 - 2025



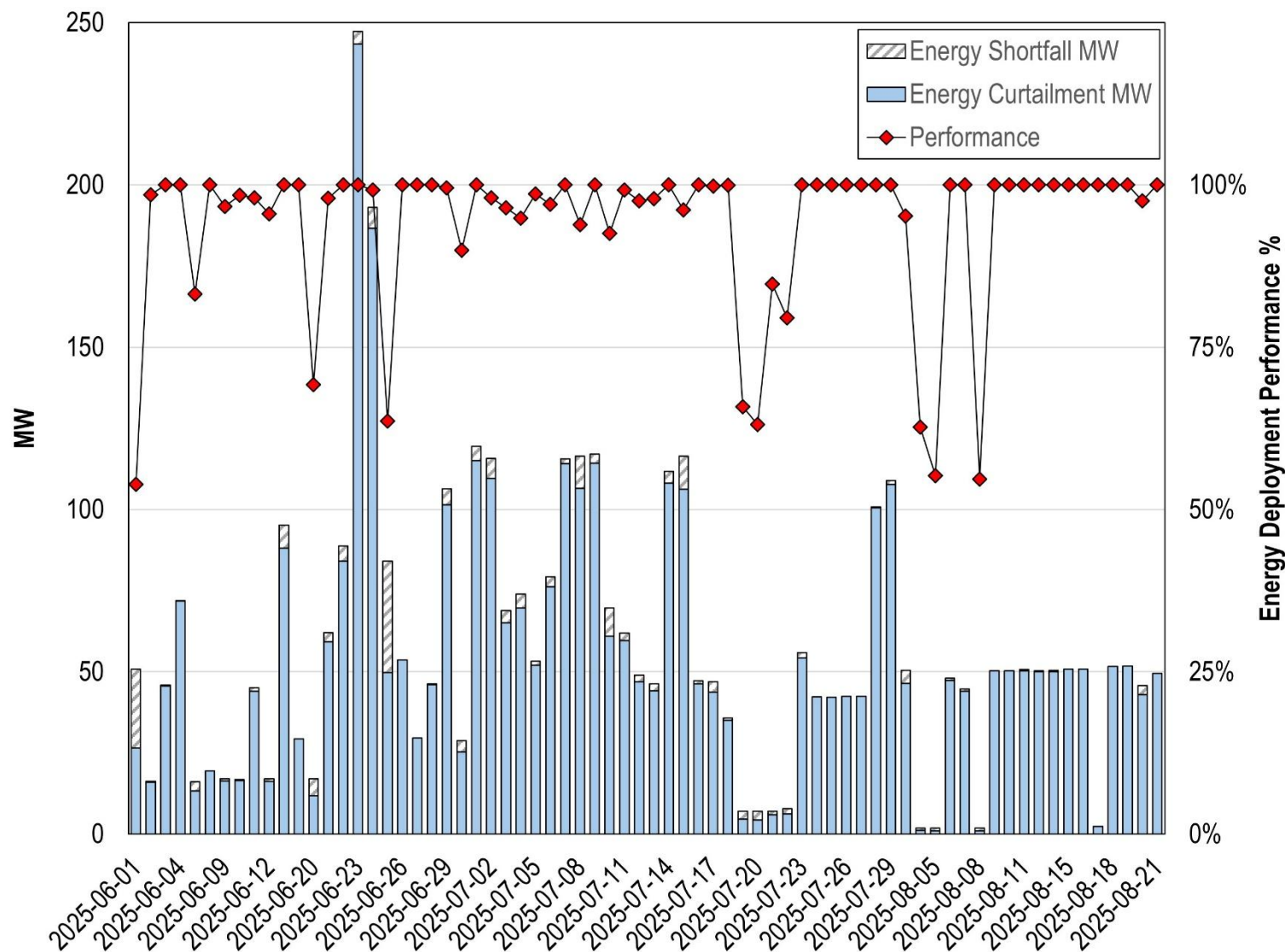
Day-Ahead and Real-Time RSG Mitigation

Summer 2023 - 2025



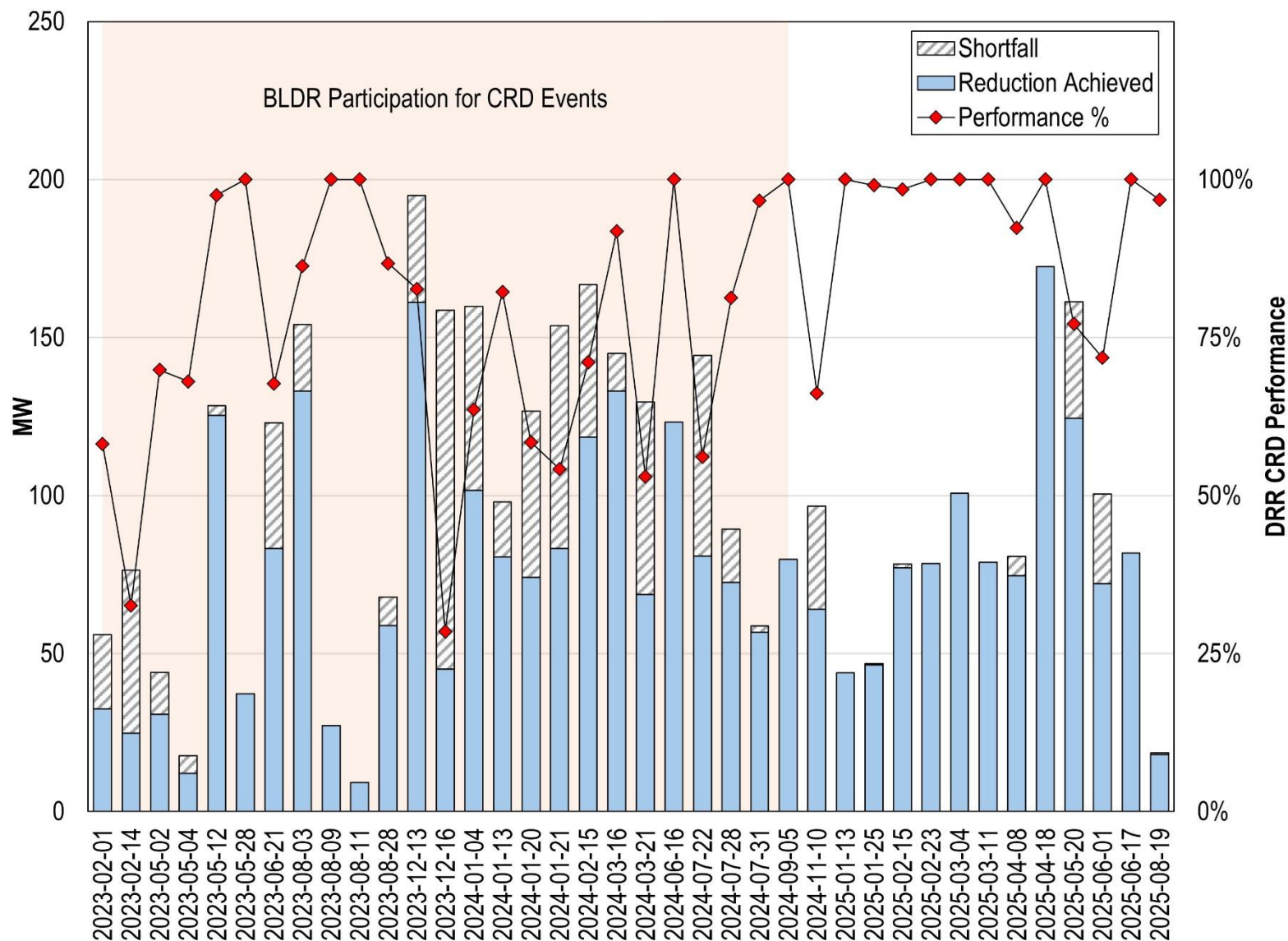
DRR Performance

Energy Market Summer 2025



* Based on settlement data as of September 2, 2025.

DRR Performance in Contingency Reserve Deployments



List of Acronyms

• AAR	Ambient-Adjusted Ratings	• ORDC	Operating Reserve Demand Curve
• AMP	Automated Mitigation Procedures	• PITT	Pseudo-Tie Issues Task Team
• BCA	Broad Constrained Area	• PRA	Planning Resource Auction
• CDD	Cooling Degree Days	• PVMWP	Price Volatility Make Whole Payment
• CMC	Constraint Management Charge	• RAC	Resource Adequacy Construct
• CTS	Coordinated Transaction Scheduling	• RDT	Regional Directional Transfer
• DAMAP	Day-Ahead Margin Assurance Payment	• RSG	Revenue Sufficiency Guarantee
• DDC	Day-Ahead Deviation & Headroom Charge	• RTORSGP	Real-Time Offer Revenue Sufficiency Guarantee Payment
• DIR	Dispatchable Intermittent Resource	• SMP	System Marginal Price
• HDD	Heating Degree Days	• SOM	State of the Market
• ELMP	Extended Locational Marginal Price	• STE	Short-Term Emergency
• JCM	Joint and Common Market Initiative	• STR	Short-Term Reserves
• JOA	Joint Operating Agreement	• TLR	Transmission Loading Relief
• LAC	Look-Ahead Commitment	• TCDC	Transmission Constraint Demand Curve
• LSE	Load-Serving Entities	• UD	Uninstructed Deviation
• M2M	Market-to-Market	• VLR	Voltage and Local Reliability
• MSC	MISO Market Subcommittee	• WUMS	Wisconsin Upper Michigan System
• NCA	Narrow Constrained Area		