

Impact of heat wave on grid reliability and initial reflections

September 2022

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About Gridwell Consulting

Analysis and advocacy consulting firm located in Sacramento, California – www.gridwell.com

- Educate, model, advise, and advocate
- Seminars on CAISO market, resource adequacy, and battery storage resources
- Storage optimization and modeling for RFOs, due diligence, and bid strategy
- Interconnection evaluation and contract negotiation services

“All Things CAISO”



About Western Power Trading Forum

- Western Power Trading Forum is a non-profit, trade forum dedicated to competitive markets and transparency at the California ISO and across the West
- [CAISO Committee](#)- paid monthly service for WPTF members that covers CAISO policy and important happenings
- *This presentation does not necessarily represent WPTF members' views*



Disclaimer

- California ISO (CAISO) and the California Public Utility Commission (CPUC) are constantly updating their rules, processes, and market optimization
- This presentation contains information on the current CAISO and CPUC market rules, as of September 2022



Outline

- Impact of heat wave on grid reliability
- Deeper dive
- Preparing for next decade



Heat wave



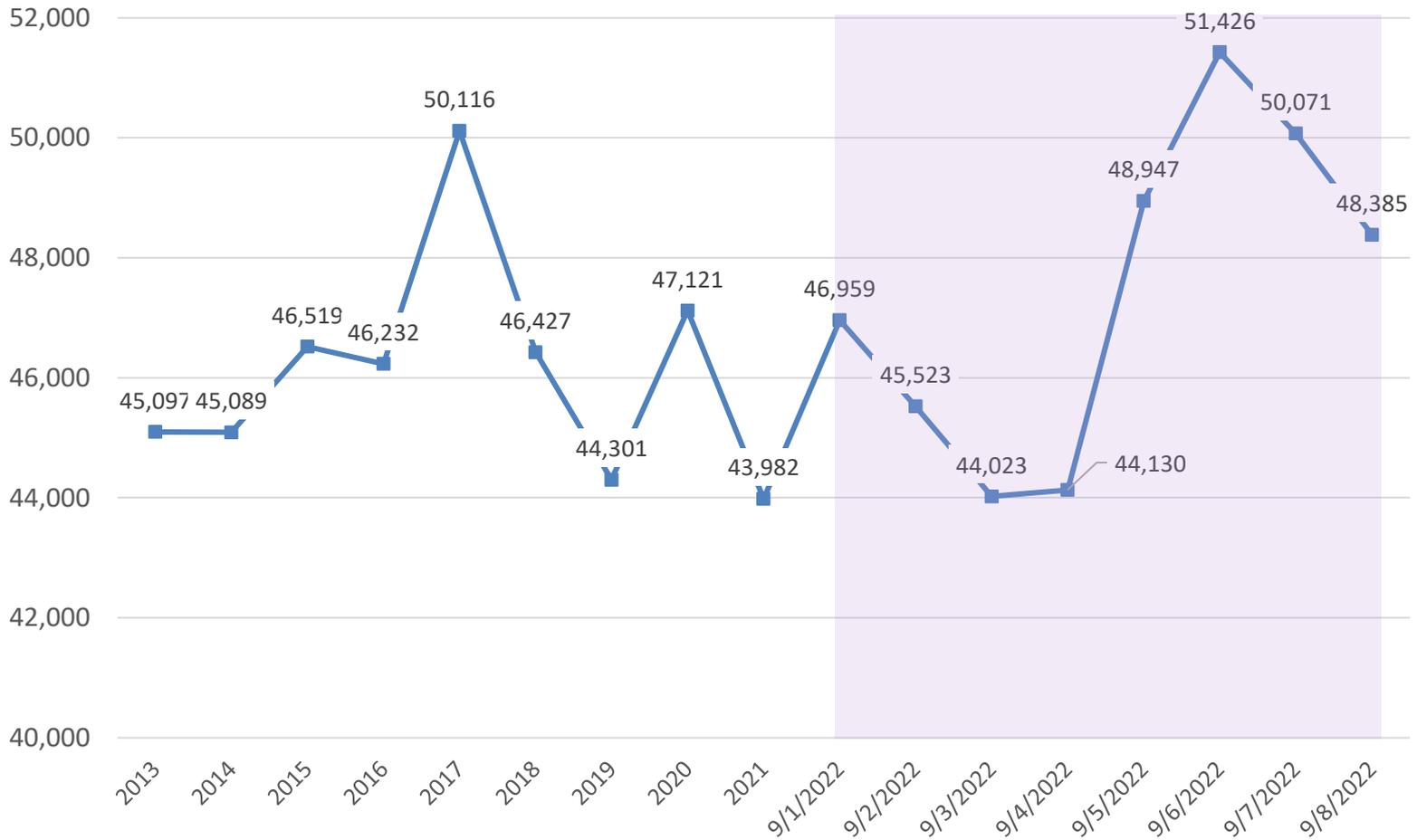
Record breaking heat event

	Redding	Red Bluff	Sacramento Intl AP	Downtown Sacramento	Sacramento Exec AP	Stockton	Modesto	Blue Canyon
Daily Record 9/4	None	None	High (107°)	None	None	High (105°) tied	None	None
Daily Record 9/5	None	None	High (116°)	High (113°)	High (114°)	High (112°)	High (107°)	High (95°) & Warm Low (79°)
Daily Record 9/6	High (115°)	High (114°)	High (116°) & Warm Low (74°)	High (116°) & Warm Low (77°)	High (114°) & Warm Low (73°)	High (115°) & Warm Low (75°)	High (112°)	High (96°) & Warm Low (78°)
Daily Record 9/7	None	None	High (110°) & Warm Low (81°)	High (109°) & Warm Low (80°)	High (107°) & Warm Low (73°)	None	High (tied 107°)	Warm Low (75°)
Daily Record 9/8	High (112°)	High (113°) & Warm Low (79°)	High (114°)	High (113°) & Warm Low (tied 73°)	High (112°)	High (112°) & Warm Low (77°)	High (108°) & Warm Low (79°)	High (91°) & Warm Low (75°)
All-Time September Record	None	None	High (116° on 9/5 & 9/6) & Warm Low (81° on 9/7)	High (113° on 9/5 & 116° on 9/6) & Warm Low (80° on 9/7)	High (114° on 9/5 & 9/6) & Warm Low (73° on 9/6 & 9/7)	High (112° on 9/5 & 115° on 9/6) & Warm Low (77° on 9/8 & 75° on 9/6)	High (112° on 9/6) & Warm Low (79° on 9/8)	High (96° on 9/6) & Warm Low (79° on 9/5)
All-Time Record	None	None	High (116° on 9/5 & 9/6) & Warm Low (81° on 9/7)	High (116° on 9/6)	None	High (tied 115° on 9/6)	None	None
	Records since 1893	Records since 1933	Records since 1990s	Records since 1877	Records since 1941	Records since 1948	Records since 1927	Records since 1943

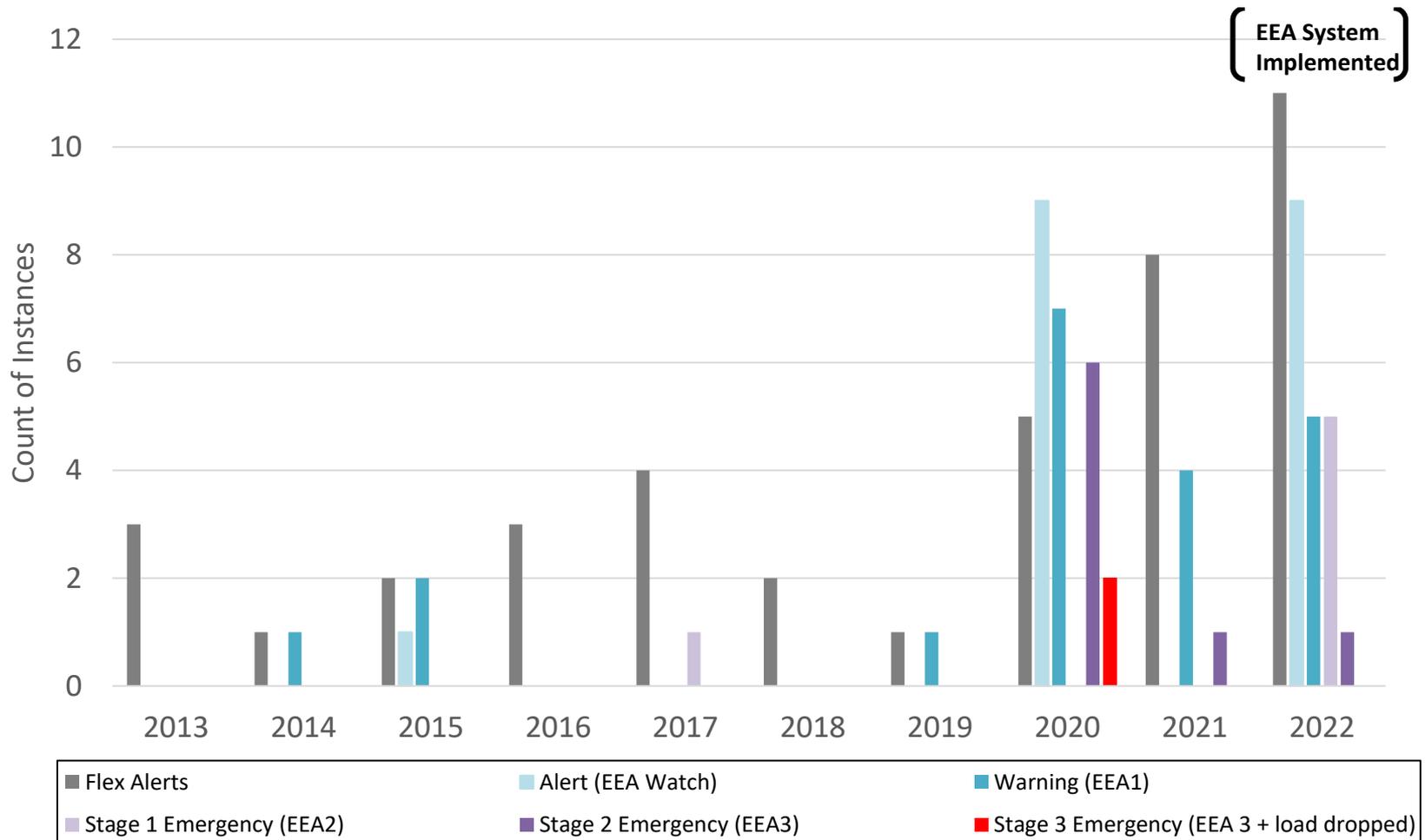
<https://twitter.com/NWSSacramento/status/1568052882192343040/photo/1>



Prior annual peaks compared to heat wave



Grid condition alerts overview



New EEA system implemented on May 1, 2022 led to confusion

Current AWE Levels	Future Emergency Levels
Flex Alert	Flex Alert
Restricted Maintenance Operations	Restricted Maintenance Operations
Transmission Emergency	Transmission Emergency
Alert	EEA Watch
Warning	EEA 1
Warning – triggering DR programs	EEA 2
Stage 1	
Stage 2	EEA 3/EEA 3 – Firm Load Interruption
Stage 3	

<http://www.caiso.com/Documents/Presentation-AWE-NERC-EEA-Training-Apr20-2022.pdf>



On September 6, CAISO called EEA3

EEA 1

Energy Emergency Alert 1

Real-time analysis shows all resources are in use or committed for use, and energy deficiencies are expected. Market participants are encouraged to offer supplemental energy and ancillary service bids. Consumers are encouraged to conserve energy.

EEA 2

Energy Emergency Alert 2

ISO requests emergency energy from all resources and has activated its emergency demand response program. Consumers are urged to conserve energy to help preserve grid reliability.

EEA 3

Energy Emergency Alert 3

ISO is unable to meet minimum Contingency Reserve requirements and controlled power curtailments are imminent or in progress according to each utility's emergency plan. Maximum conservation by consumers requested.



One scheduling coordinator and some media outlets confused arming load/EEA 3 with dropping load

EEA 1

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EEA 3

Energy Emergency Alert 3

ISO is unable to meet minimum Contingency Reserve requirements and controlled power curtailments are imminent or in progress according to each utility's emergency plan. Maximum conservation by consumers requested.

Q: What does it mean to “arm load”?

A: Arming load does not mean dropping load – it means the CAISO is positioned to drop load and may use this positioning to replace non-spinning reserves



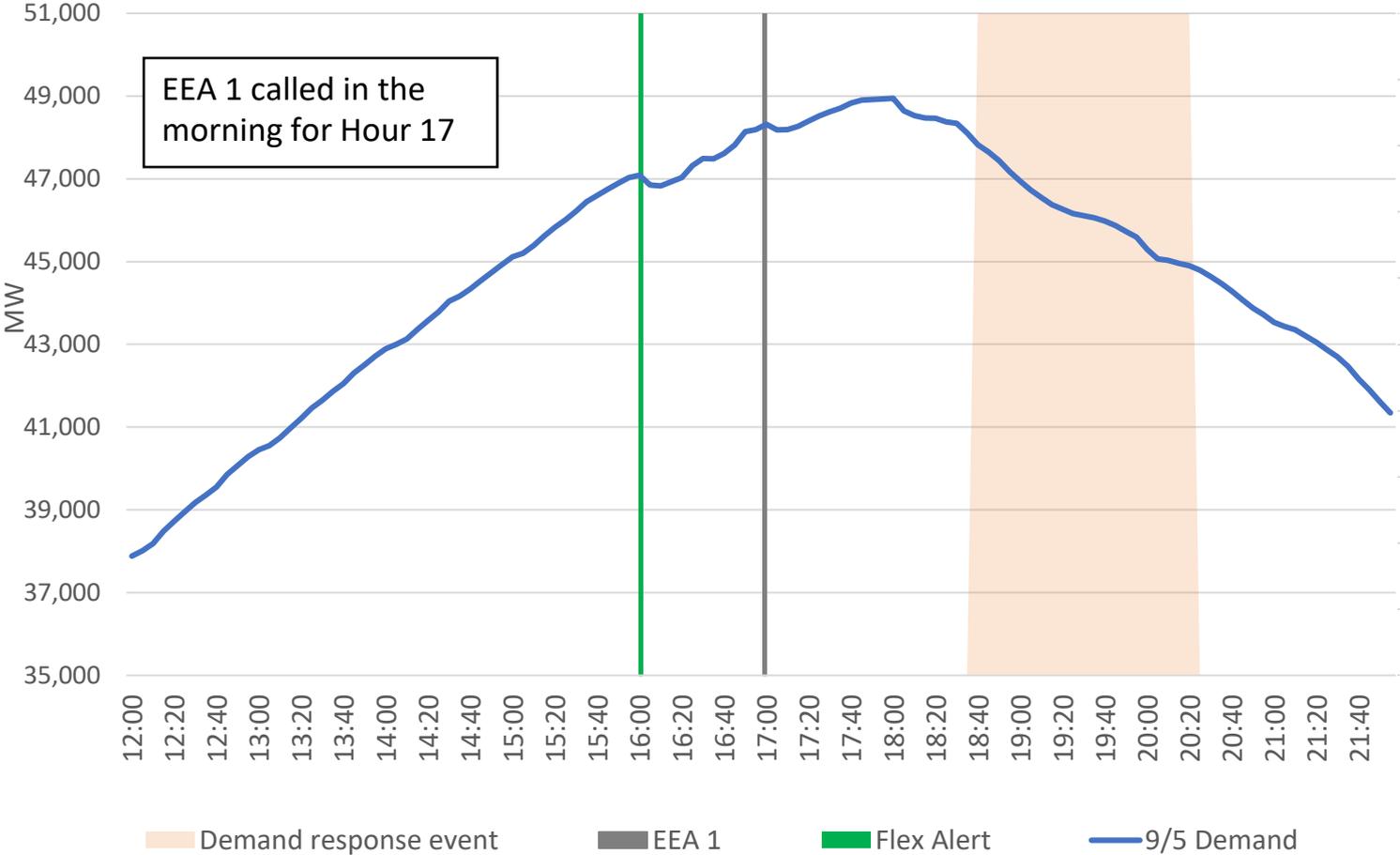
September 5, 2022 Summer Report

Day-Ahead System Summary

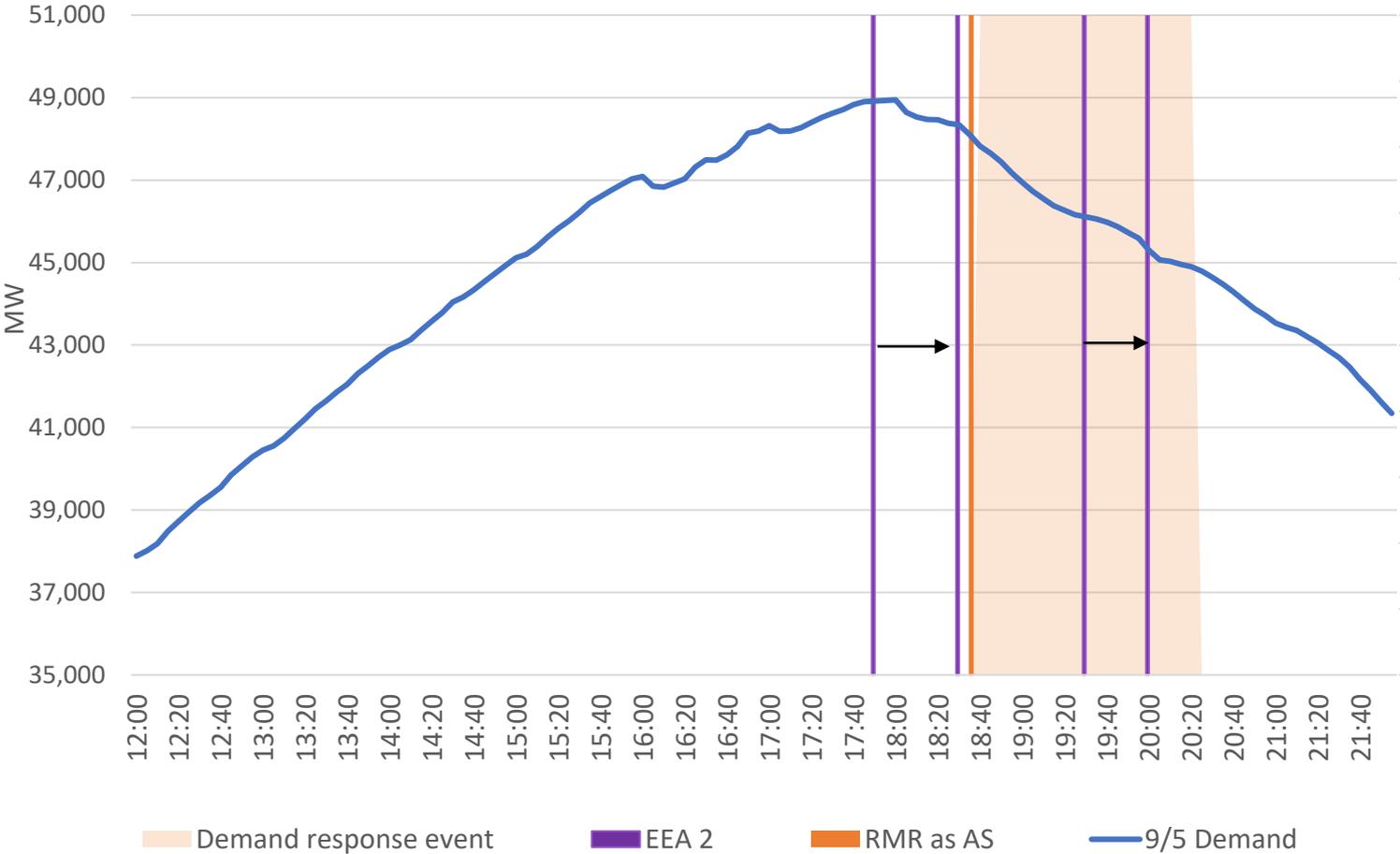
Hour	DA Forecast	DA Net Load Forecast ¹	DA Forecast plus Reserves ²	DA RUC Forecast Adjustment ³	RUC Shortfall with Forecast Adjust ⁴	RUC Shortfall ⁵	RUC Self-Sched (PTK) Export Reduction ⁶
1	32,462	29,666	34,477	528	0	0	0
2	30,541	27,690	32,428	522	0	0	0
3	28,962	26,278	30,757	516	0	0	0
16	46,749	33,998	49,678	5,108	1,233	0	0
17	47,931	36,280	50,936	5,737	3,064	0	0
18	48,967	40,127	52,037	7,689	7,224	0	0
19	48,499	44,890	51,540	6,246	8,291	2,045	0
20	46,602	45,159	49,523	3,372	5,794	2,422	0
21	44,333	42,891	47,112	3,441	4,840	1,399	0
22	41,646	40,231	44,256	3,436	3,755	319	0
23	38,035	36,684	40,417	1,718	0	0	0
24	34,980	33,704	37,163	466	0	0	0



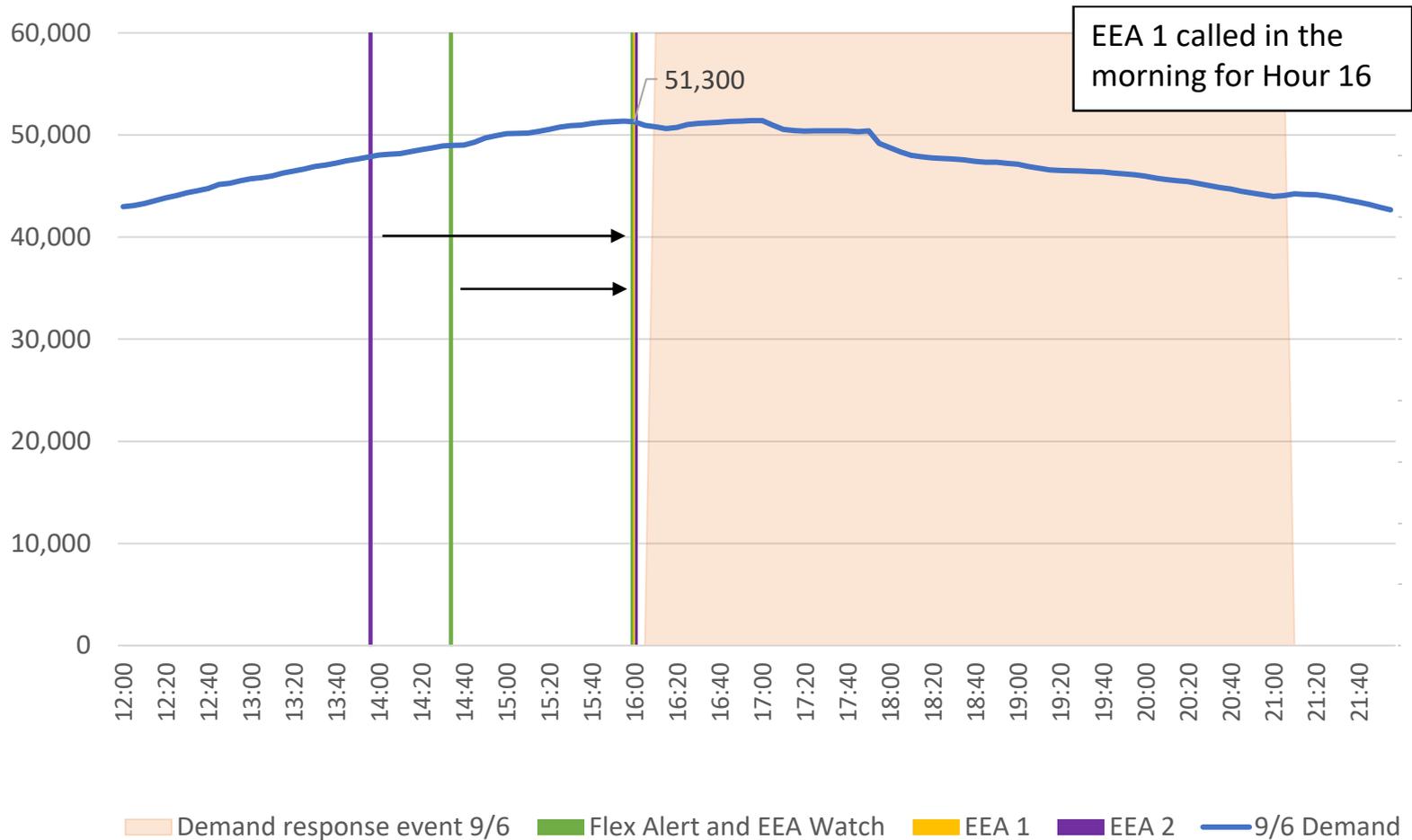
September 5, 2022



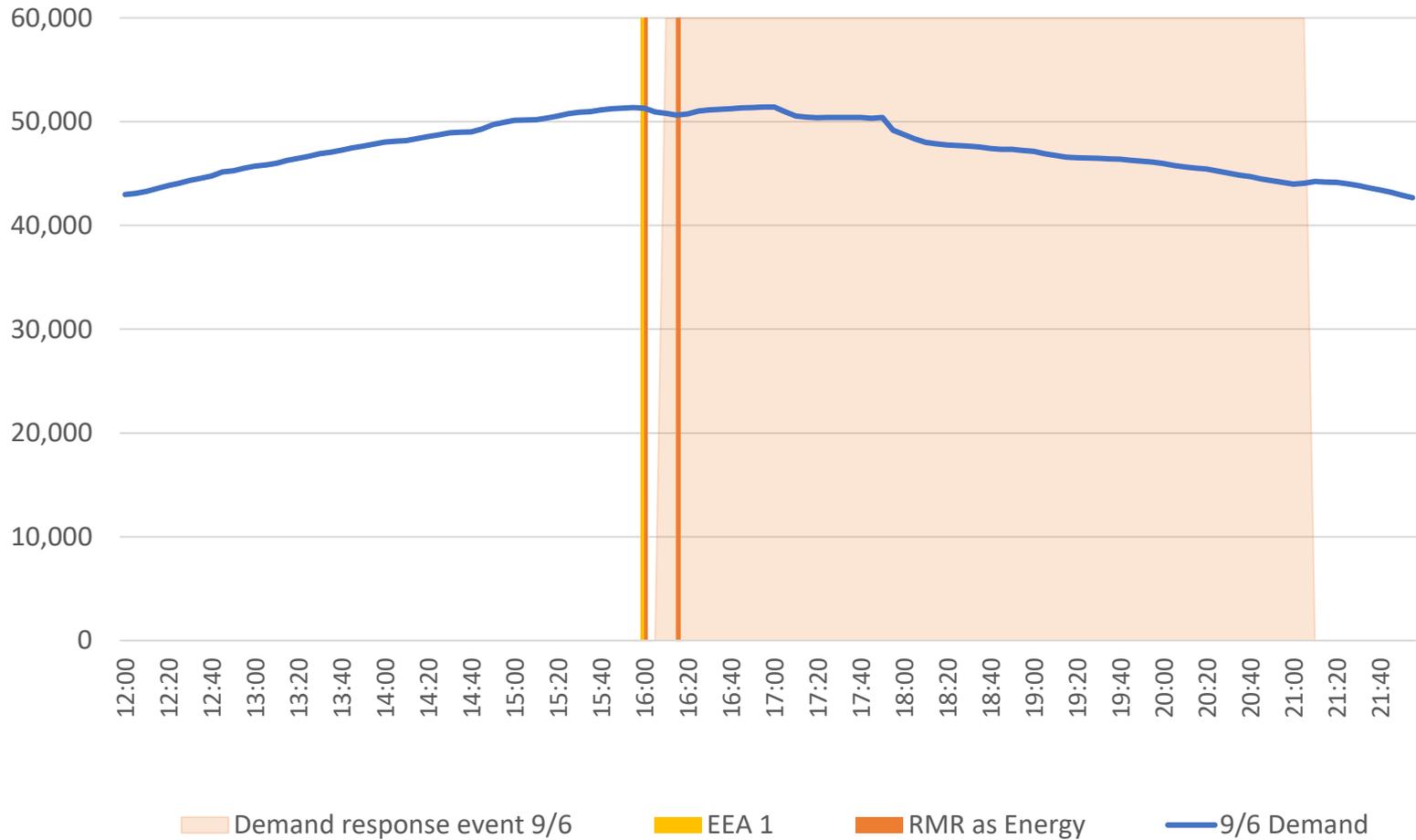
September 5, 2022



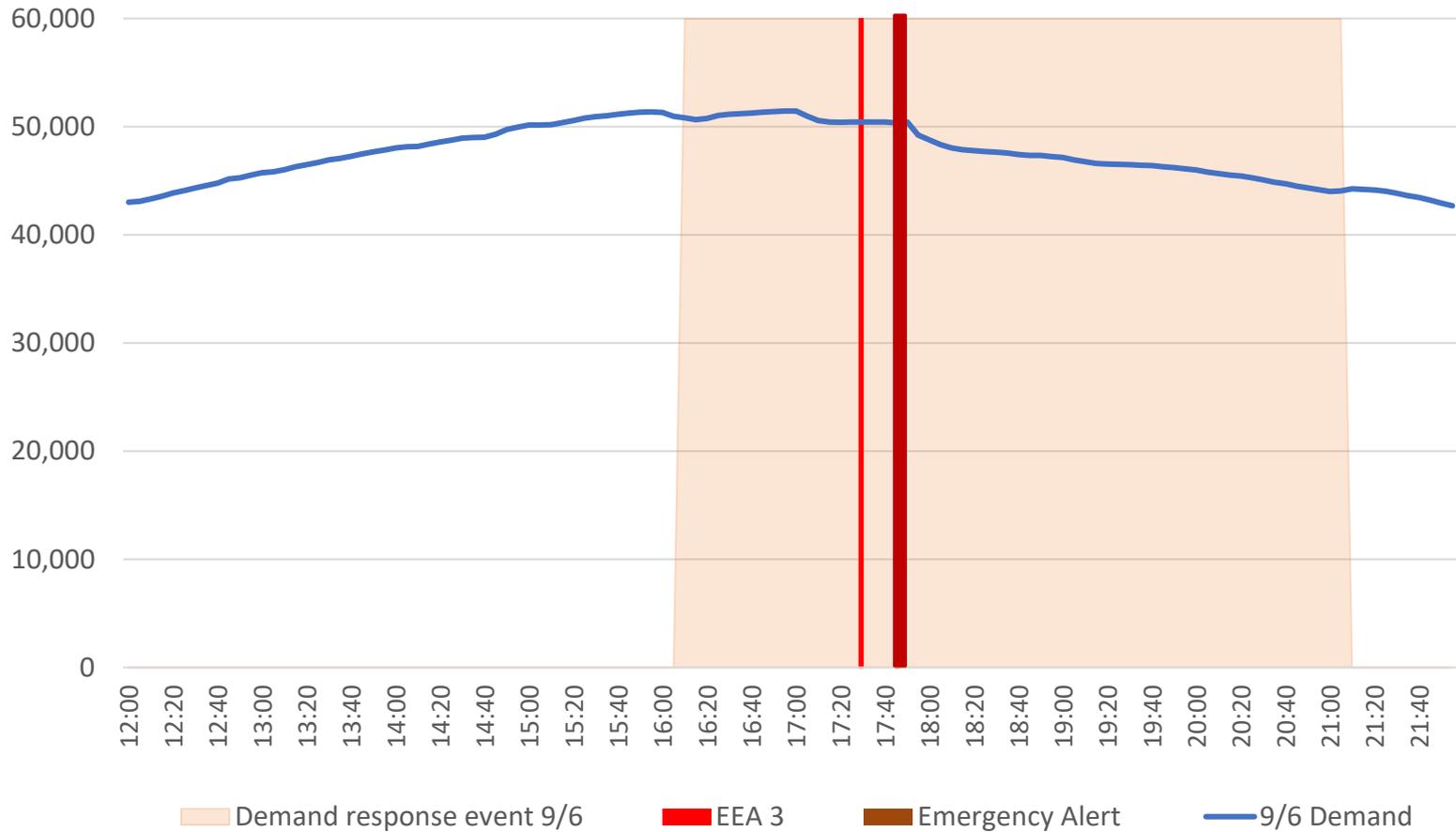
September 6, 2022



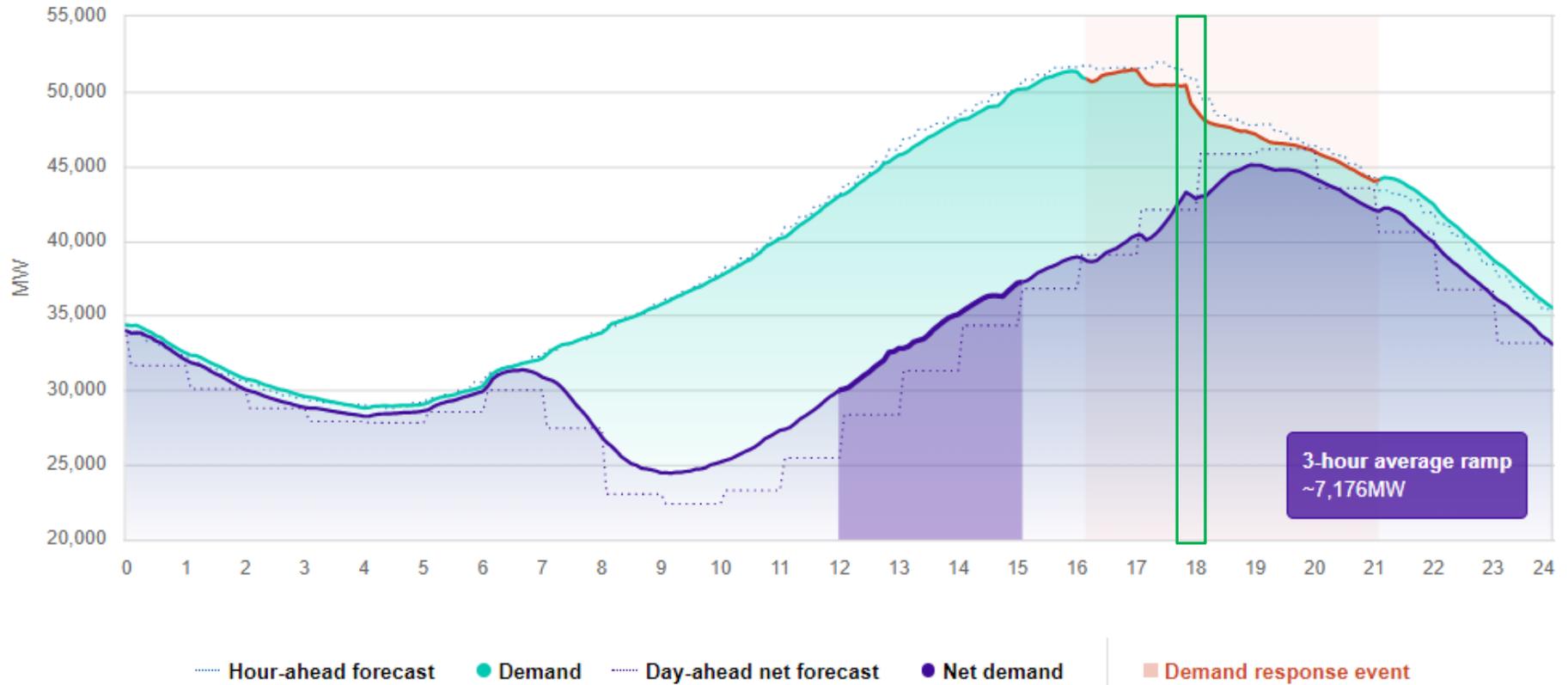
September 6, 2022



September 6, 2022



No outages likely due to conservation and demand response – Sept 6

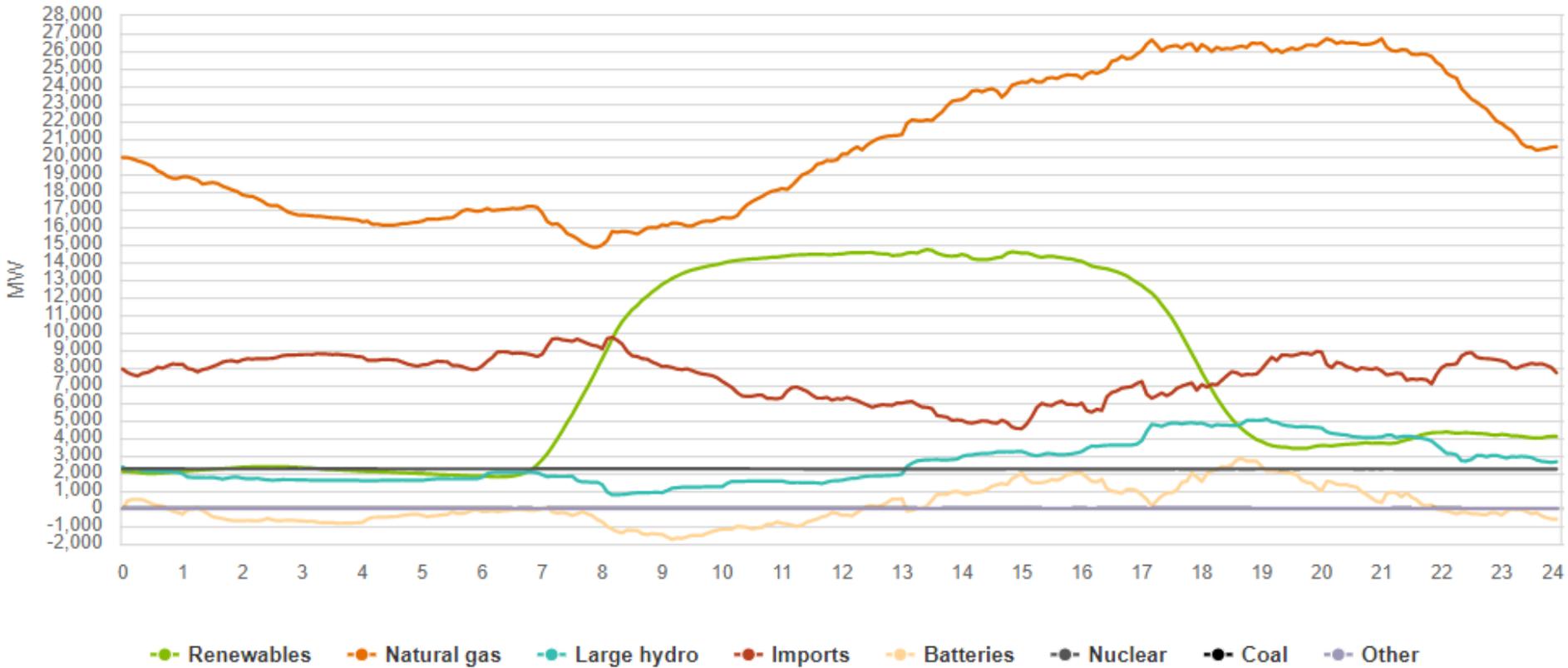


Outages by fuel type – a.m. report

Fuel Type	9/1/2022	9/2/2022	9/3/2022	9/4/2022	9/5/2022	9/6/2022
SUN	266	219	250	291	224	251
BIOGAS	18	17	22	25	26	31
BIOMASS	47	55	55	61	13	37
COAL	1	1	1	1	1	1
DISTILLATE	29	29	29	29	29	29
GEOHERMAL	303	306	308	311	307	315
LESR	666	304	248	272	331	450
NATURAL GAS	2,621	3,366	2,551	3,081	2,338	2,432
OTHER	58	109	13	14	14	55
WATER	1,461	1,473	1,545	1,344	1,364	1,526
WIND	204	233	200	211	221	210
Grand Total	5,673	6,113	5,223	5,639	4,869	5,337

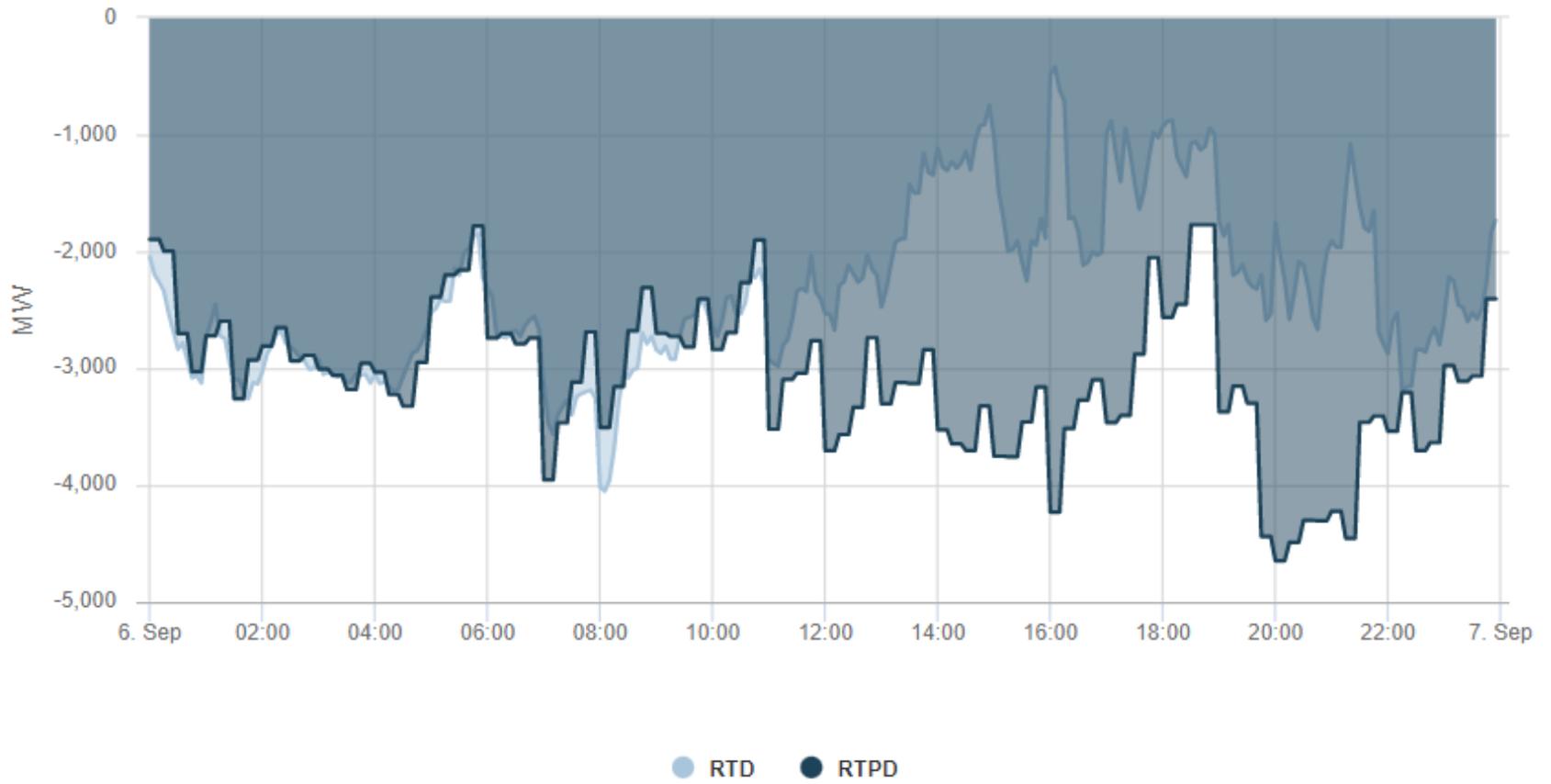


Event highlights continued need for gas resources and market imports



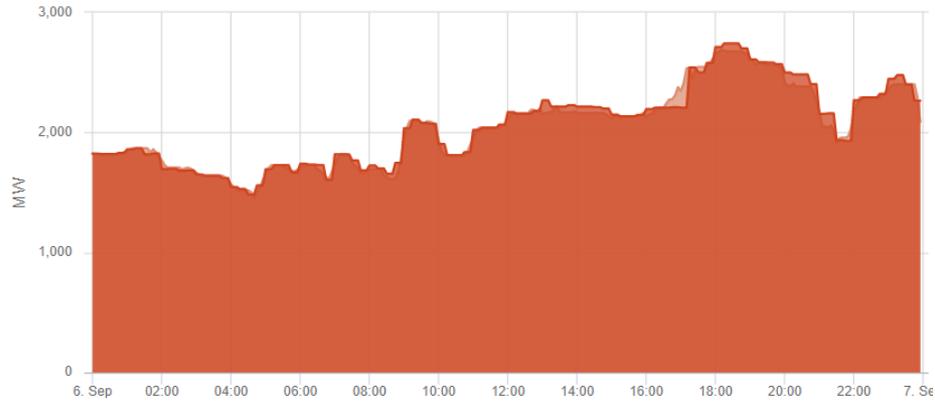
CAISO EIM transfers

CAISO EIM Transfers i

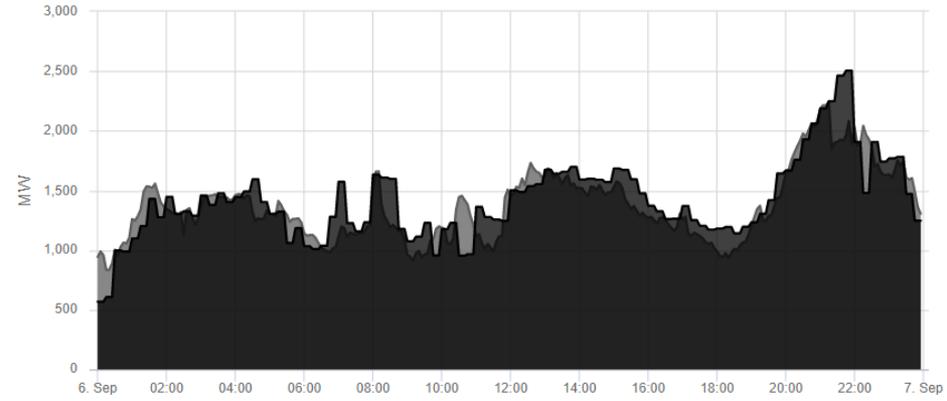


EIM transfers

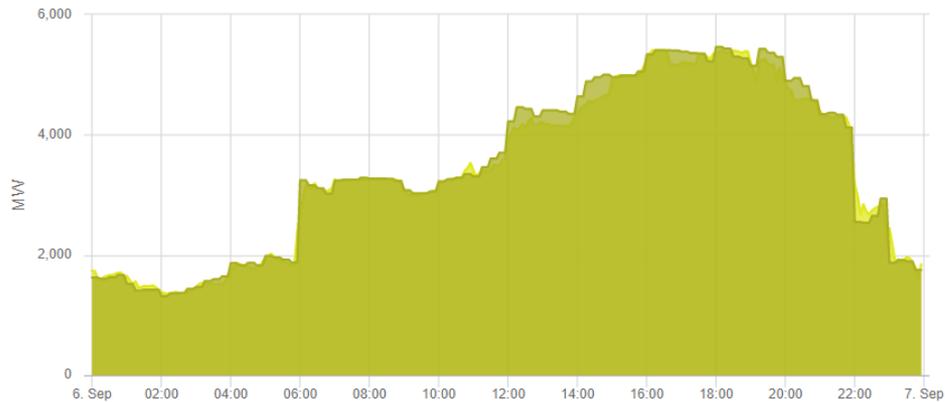
BCHA EIM Transfers ⓘ



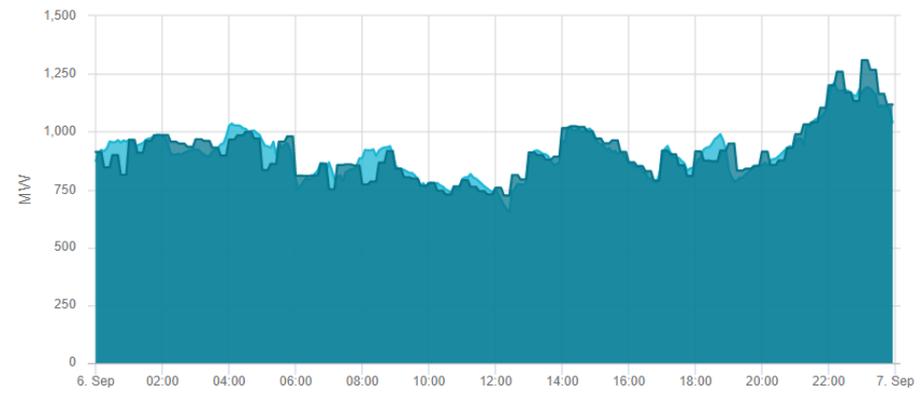
AZPS EIM Transfers ⓘ



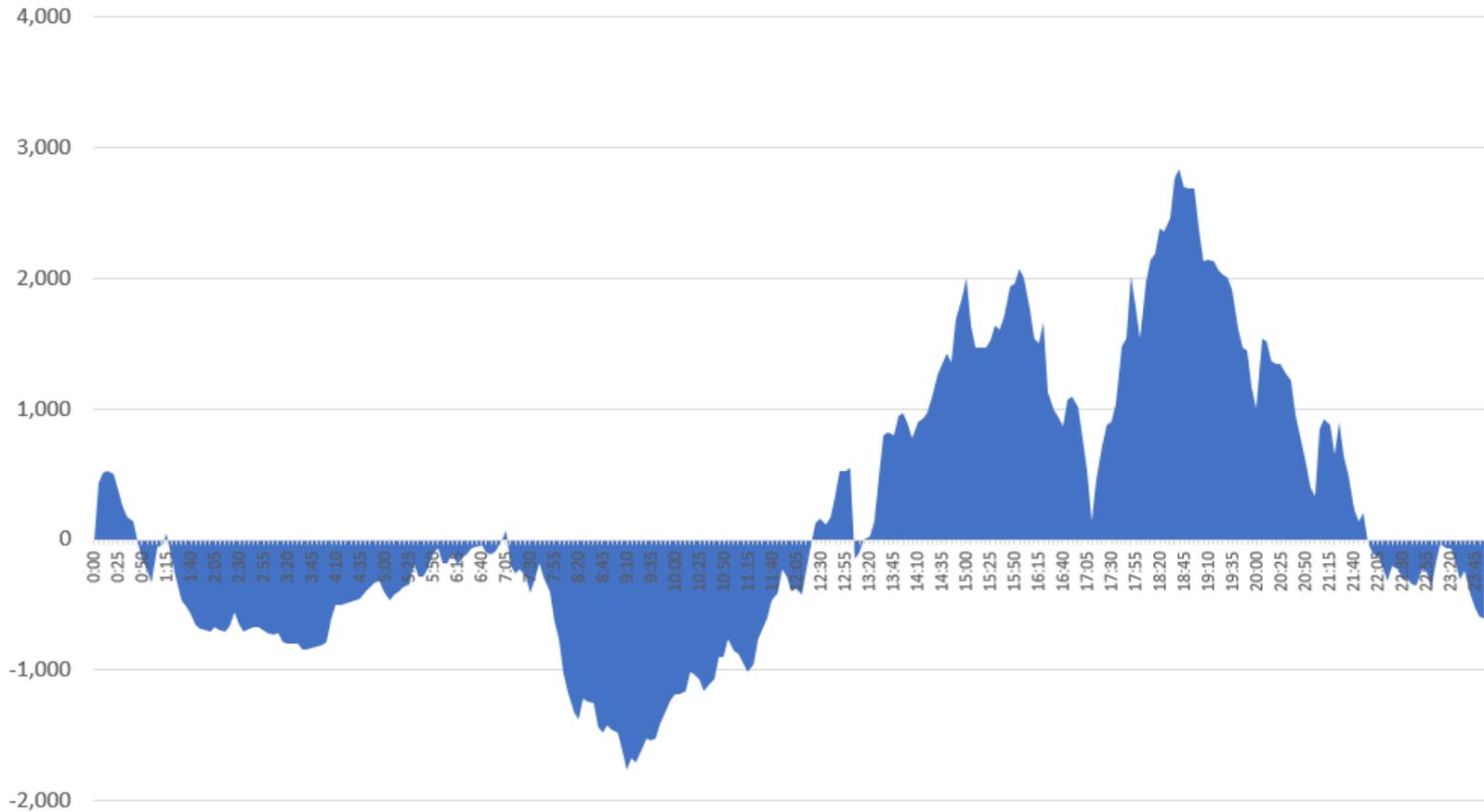
BPAT EIM Transfers ⓘ



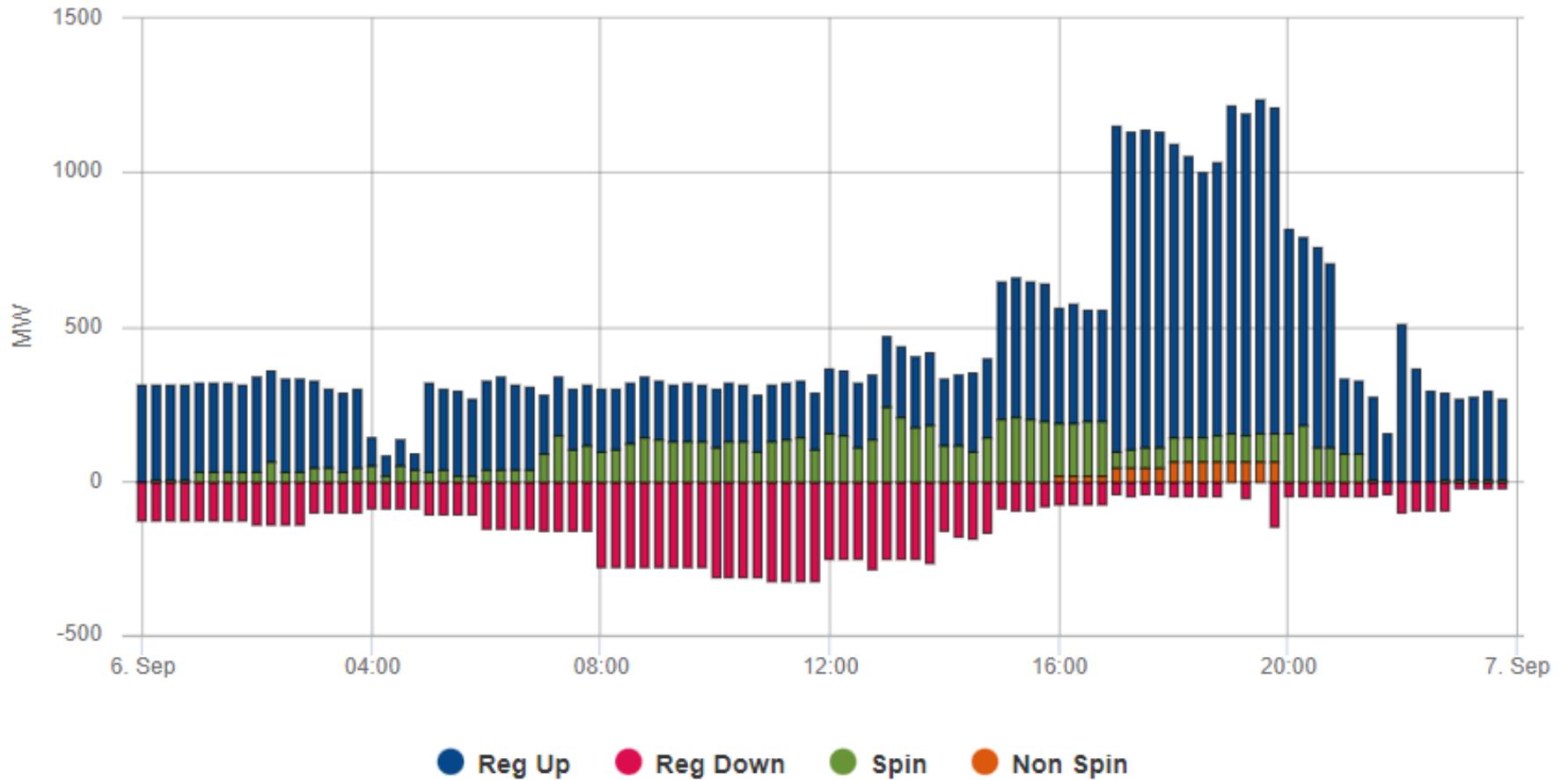
PNM EIM Transfers ⓘ



Net battery dispatch



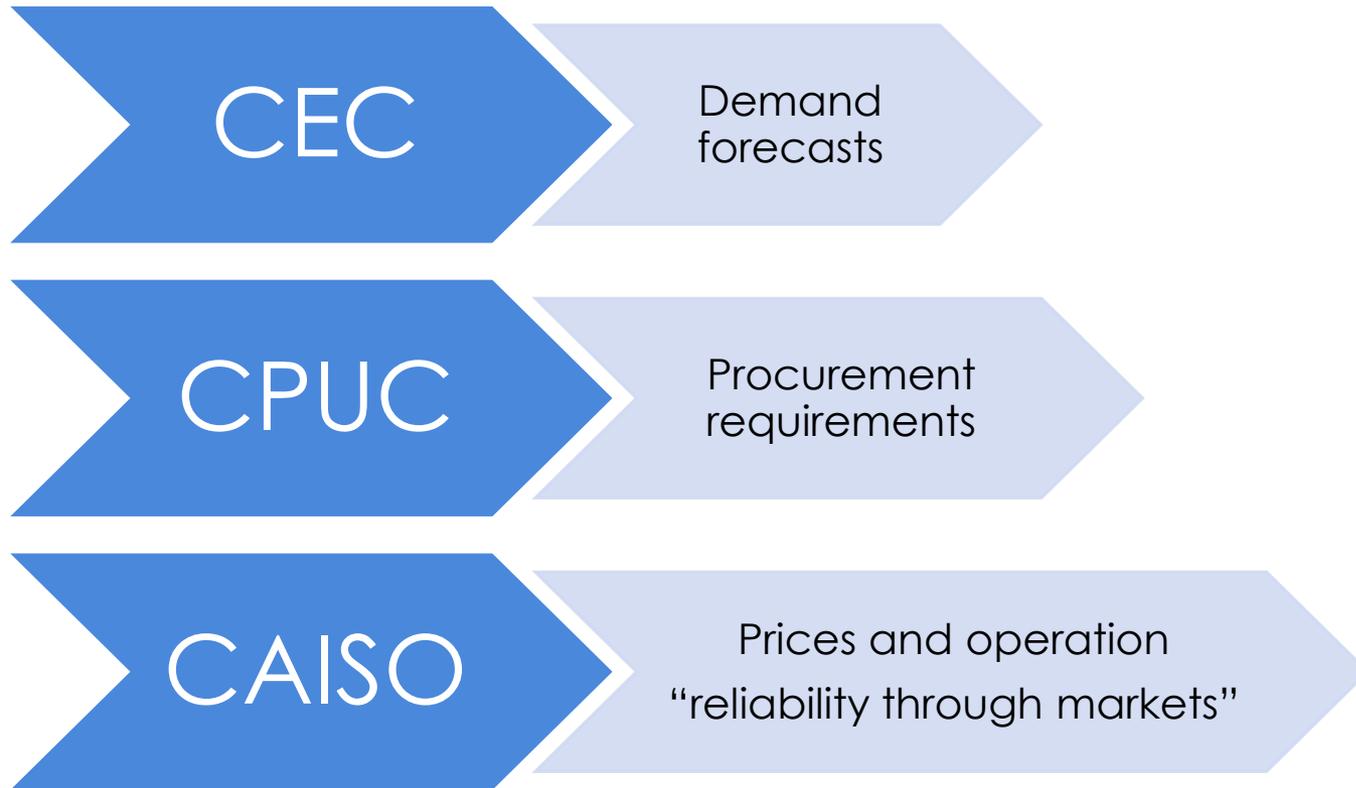
Battery AS provision





Deeper Dive

Deeper dive



California Energy Demand Forecasts

- CEC produces CA Energy Demand Forecast
 - Set of forecasts used in the CPUC oversight of energy procurement and CAISO TPP
 - Acknowledges challenges in forecasting due to frequent, extreme weather events, historic drought conditions, and wildfires that change weather and energy usage patterns
 - Updated forecasts to account for climate change, fuel switching (gas to electric), transportation electrification
- CEC produced three demand cases 2022 - 2035:

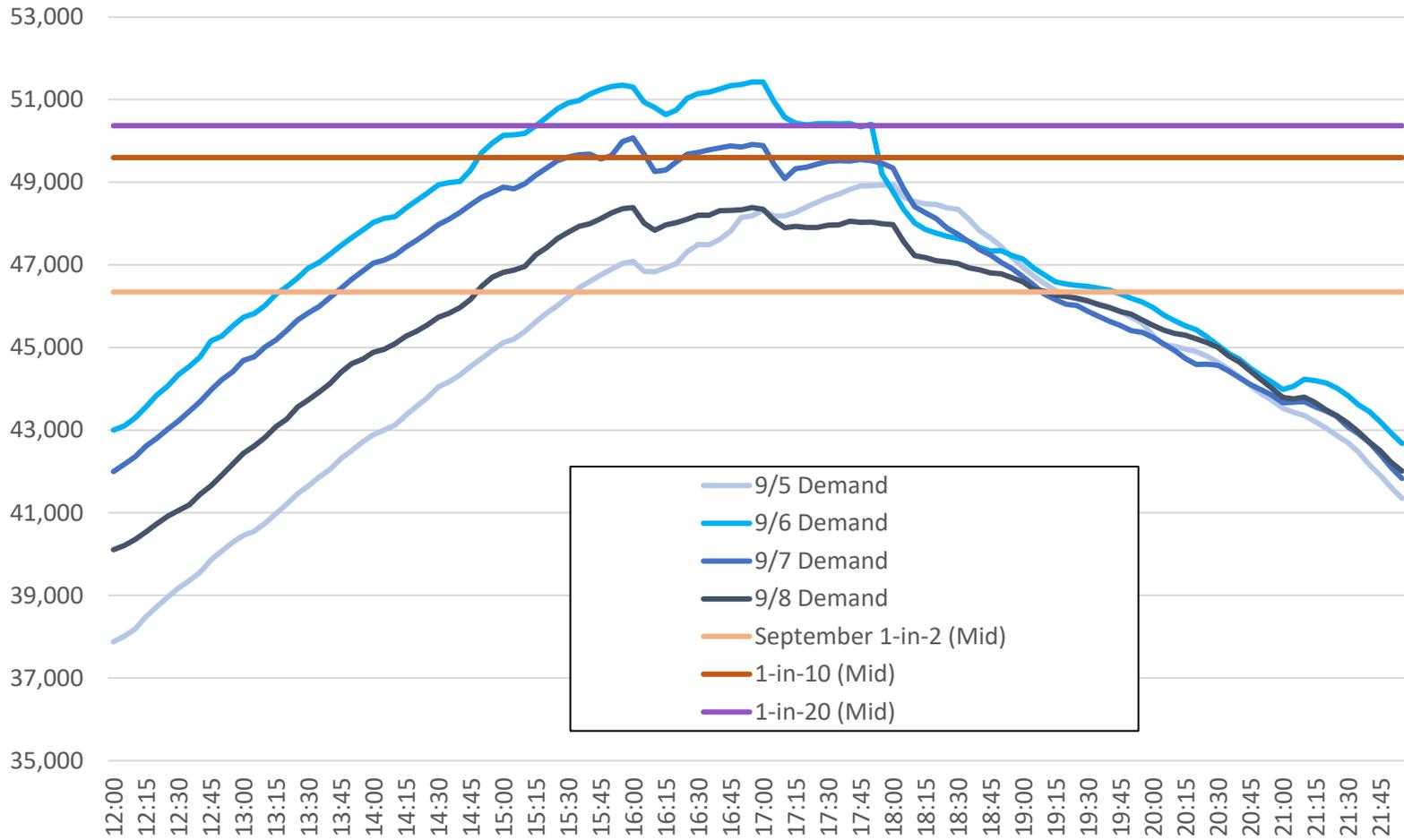
High-energy demand case incorporates relatively high economic/demographic growth, relatively low energy rates, higher adoption of ZEVs, lower self-generation, and climate change impacts.

Low-energy demand case includes lower economic/demographic growth, higher assumed rates, low adoption of ZEVs, higher self-generation impacts.

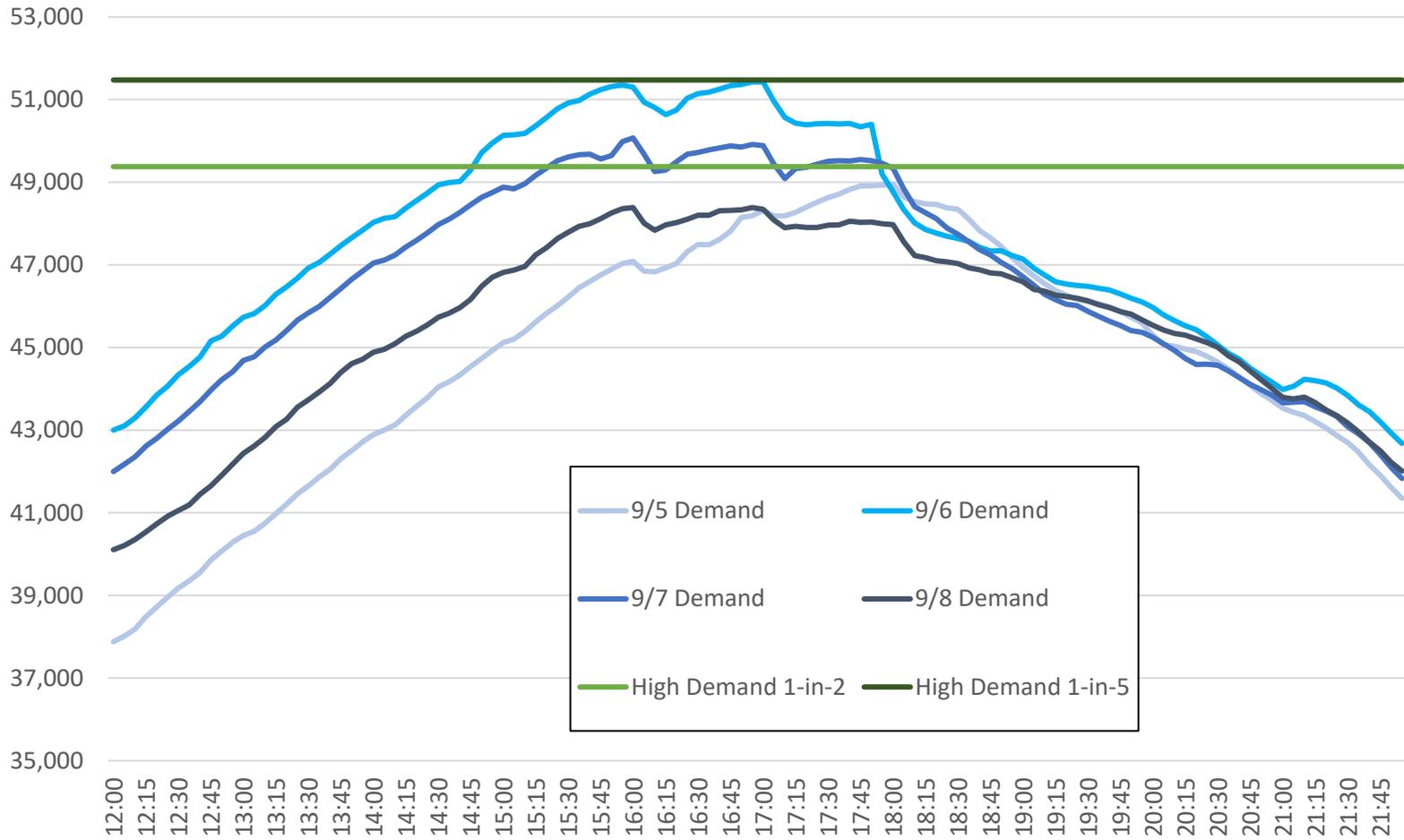
Mid-energy demand case uses input assumptions at levels between the high and low cases.



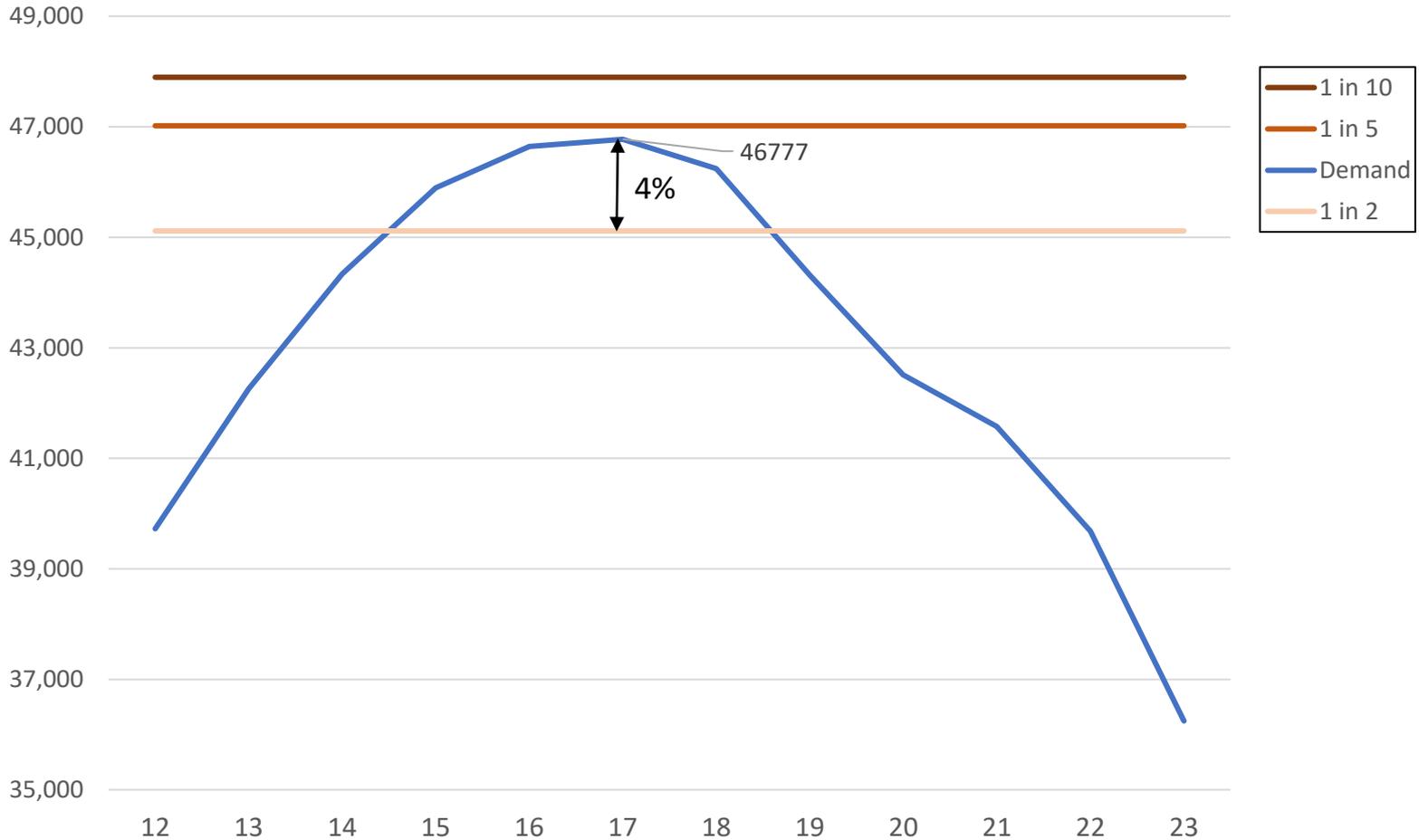
Real time demand compared to CEC forecasts



Real time demand compared to CEC forecasts



8/14/2020 demand compared to CEC forecasts

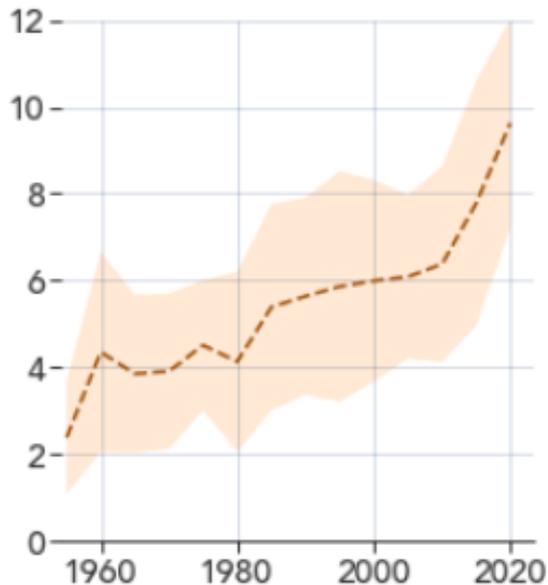


Heatwave trends indicate maybe we should use High Demand forecast

More, Longer, and Hotter

Heatwaves affecting inland, urban California are on the rise

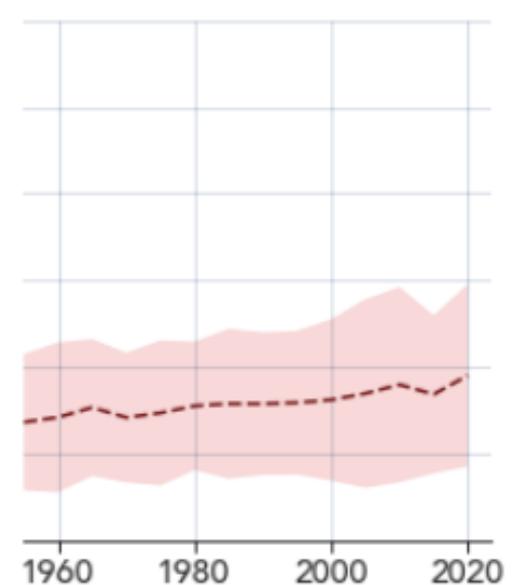
Heatwaves per year



Heatwave duration (days)



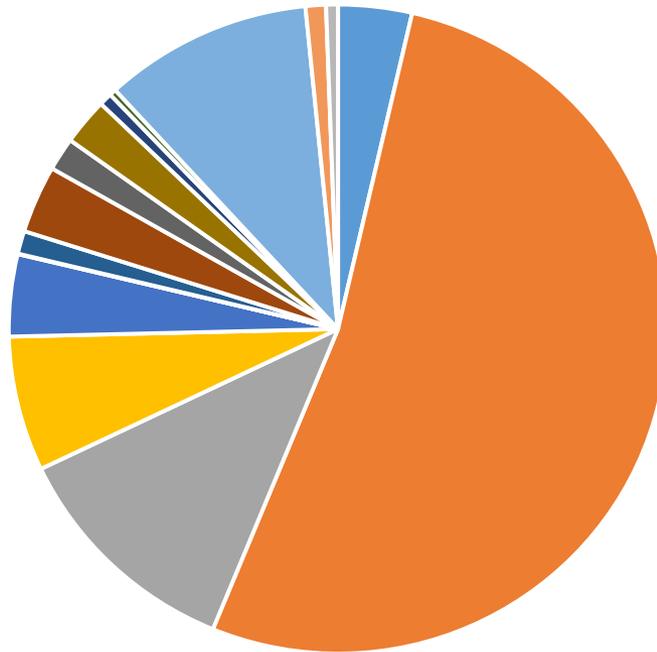
Heatwave intensity (°C)



<https://earthobservatory.nasa.gov/images/147256/california-heatwave-fits-a-trend>



All Qualified Resource-Specific September RA

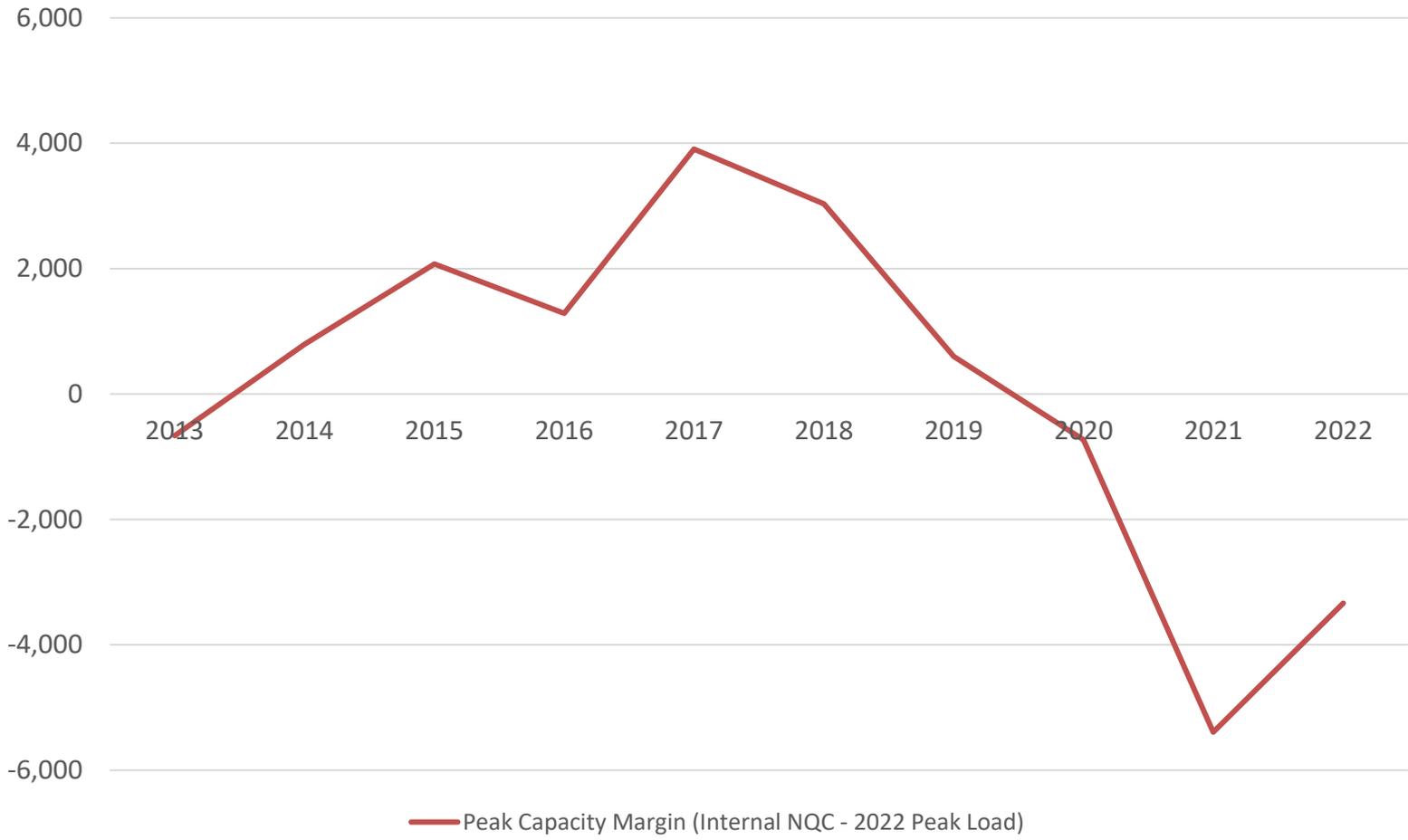


Resource Type	2022
Natural gas	29,358
Hydro	6,533
Batteries	3,753
Nuclear	2,280
Coal	13
Other	639
Solar	1,877
Wind	917
Geothermal	1,297
Biomass	354
Biogas	184
Specified Imports	5,720
DRAM/LIP	558
PDR	326
Total	53,810

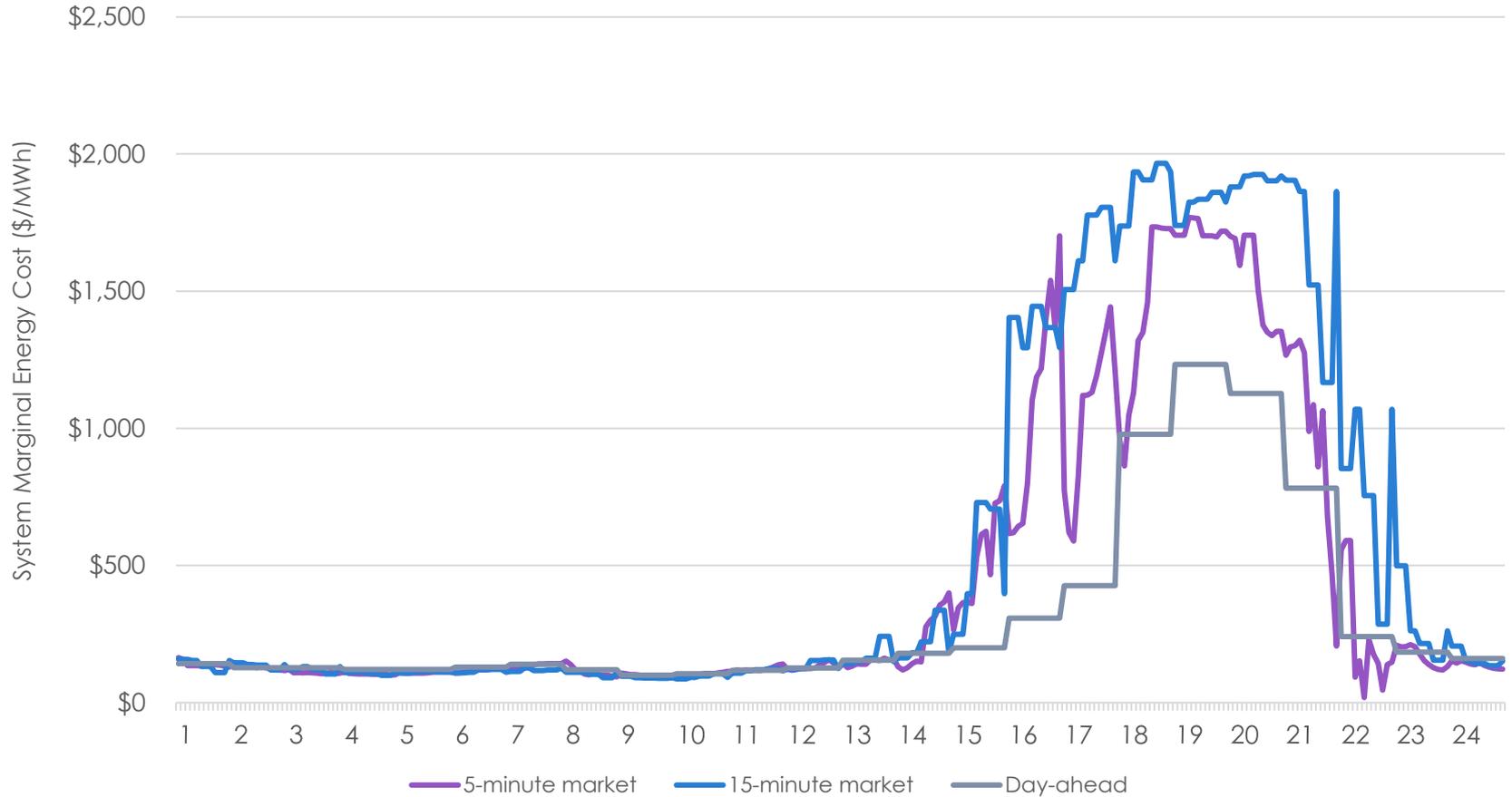
- Resource Type
- Natural gas
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- Other
- Solar
- Wind
- Geothermal
- Biomass
- Biogas
- Specified Imports
- DRAM/LIP
- PDR



Increased reliance on imports (specified and non-specified)

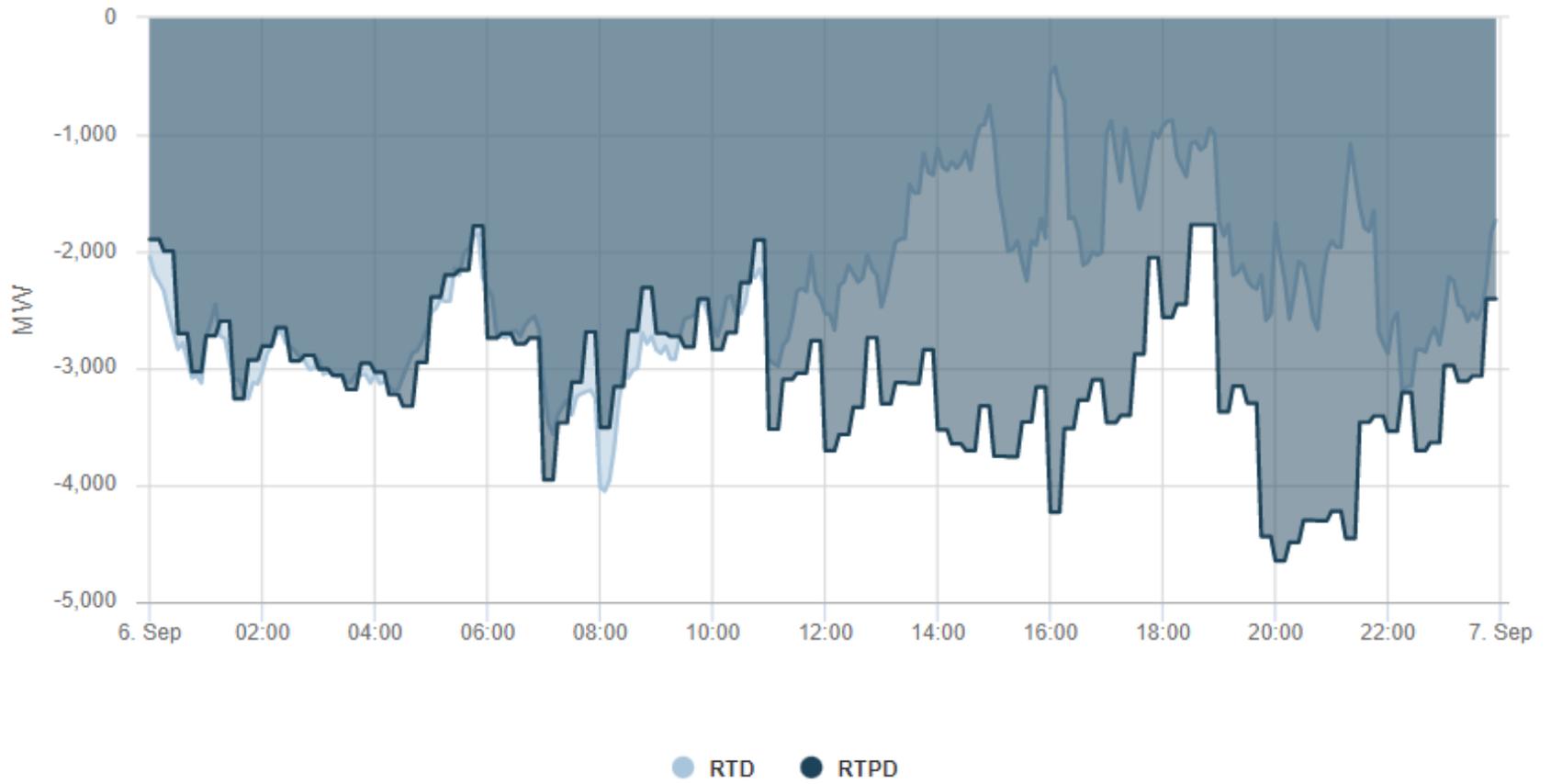


CAISO 5-minute consistently below 15-minute prices: Sept 6, 2022

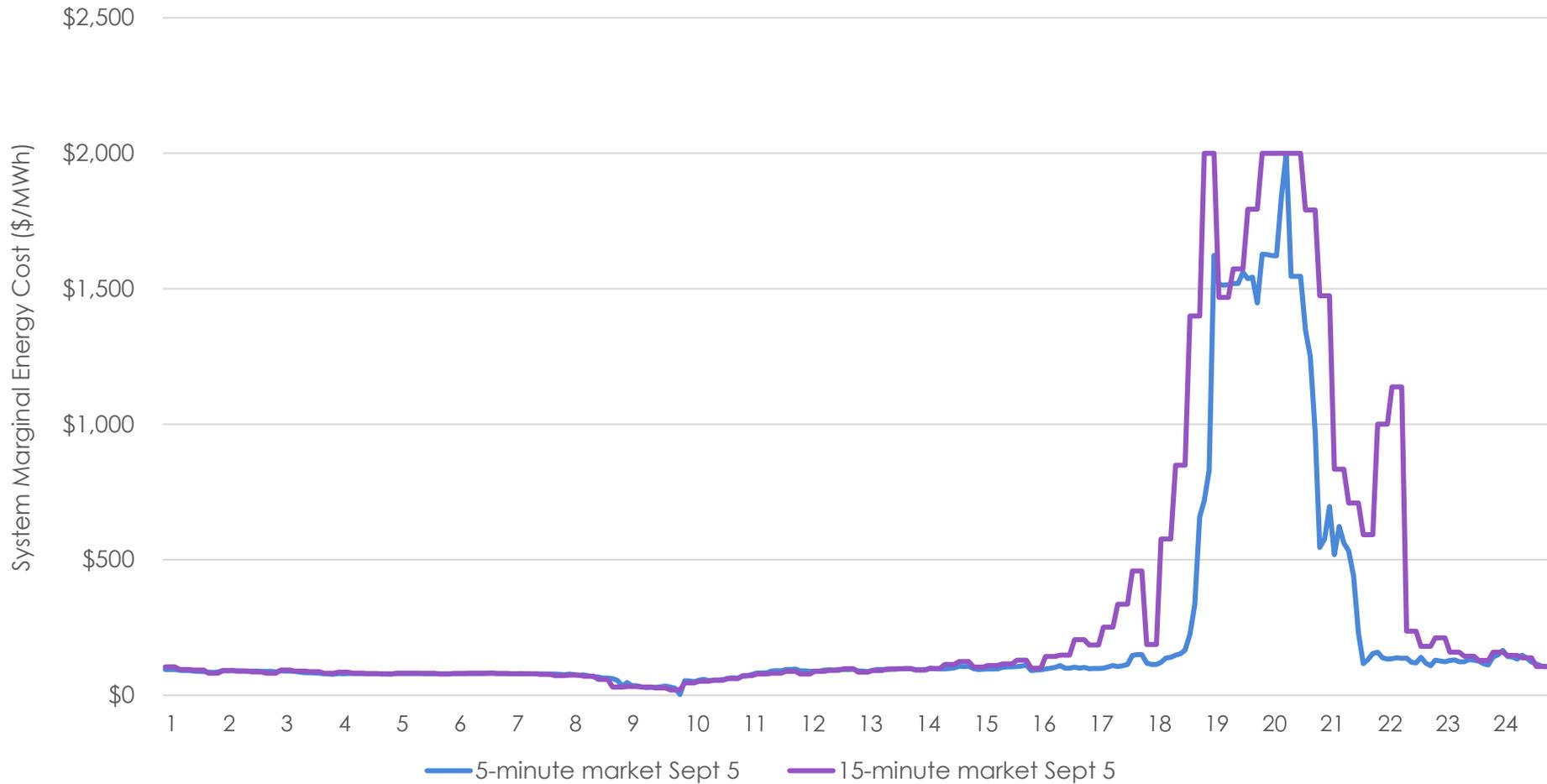


CAISO EIM transfers

CAISO EIM Transfers i



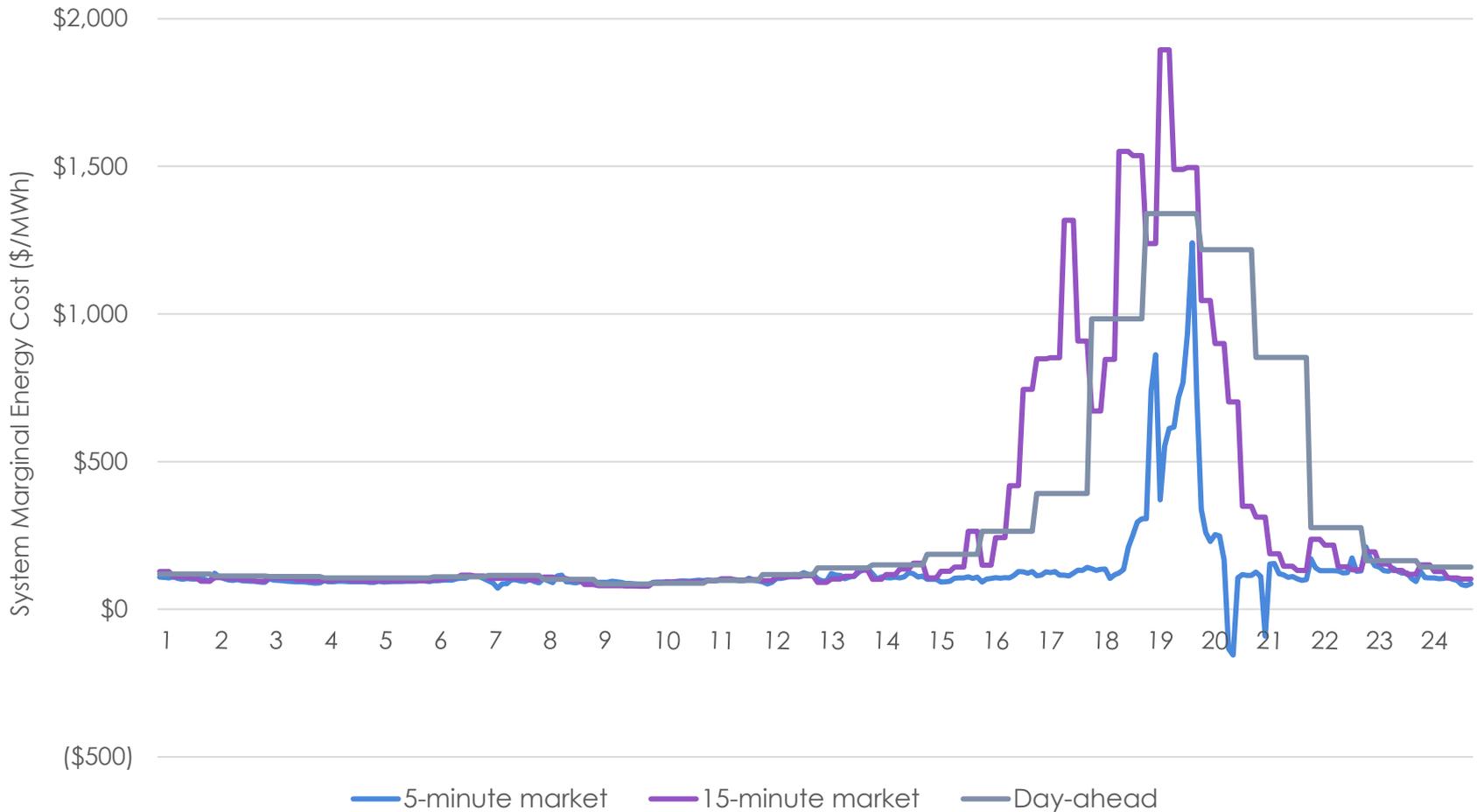
CAISO prices reached \$2,000/MWh only in 15-minute market during EEA2*



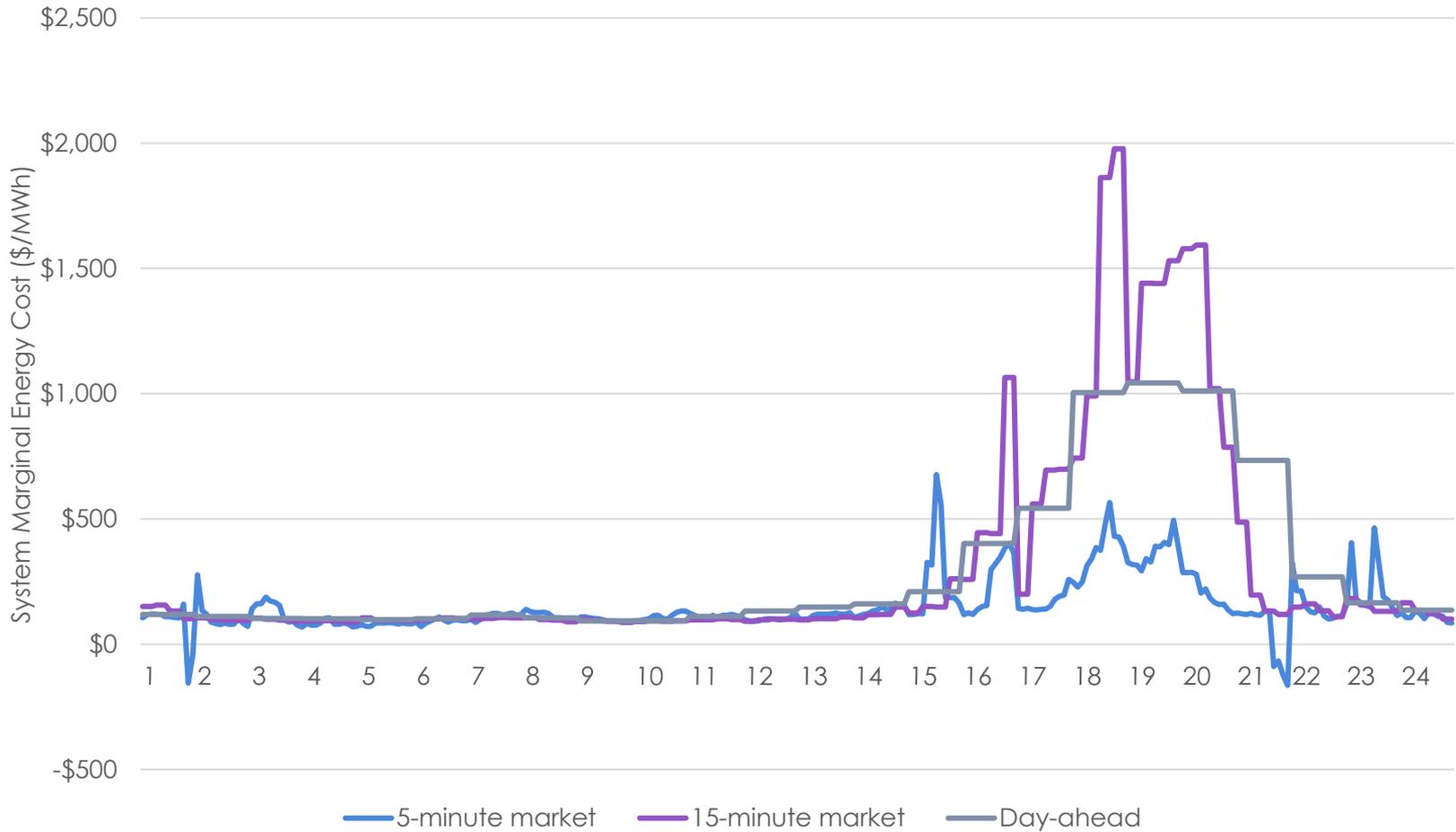
*Referring to system marginal energy cost (SMEC); nodal prices did exceed \$2,000/MWh due to congestion.



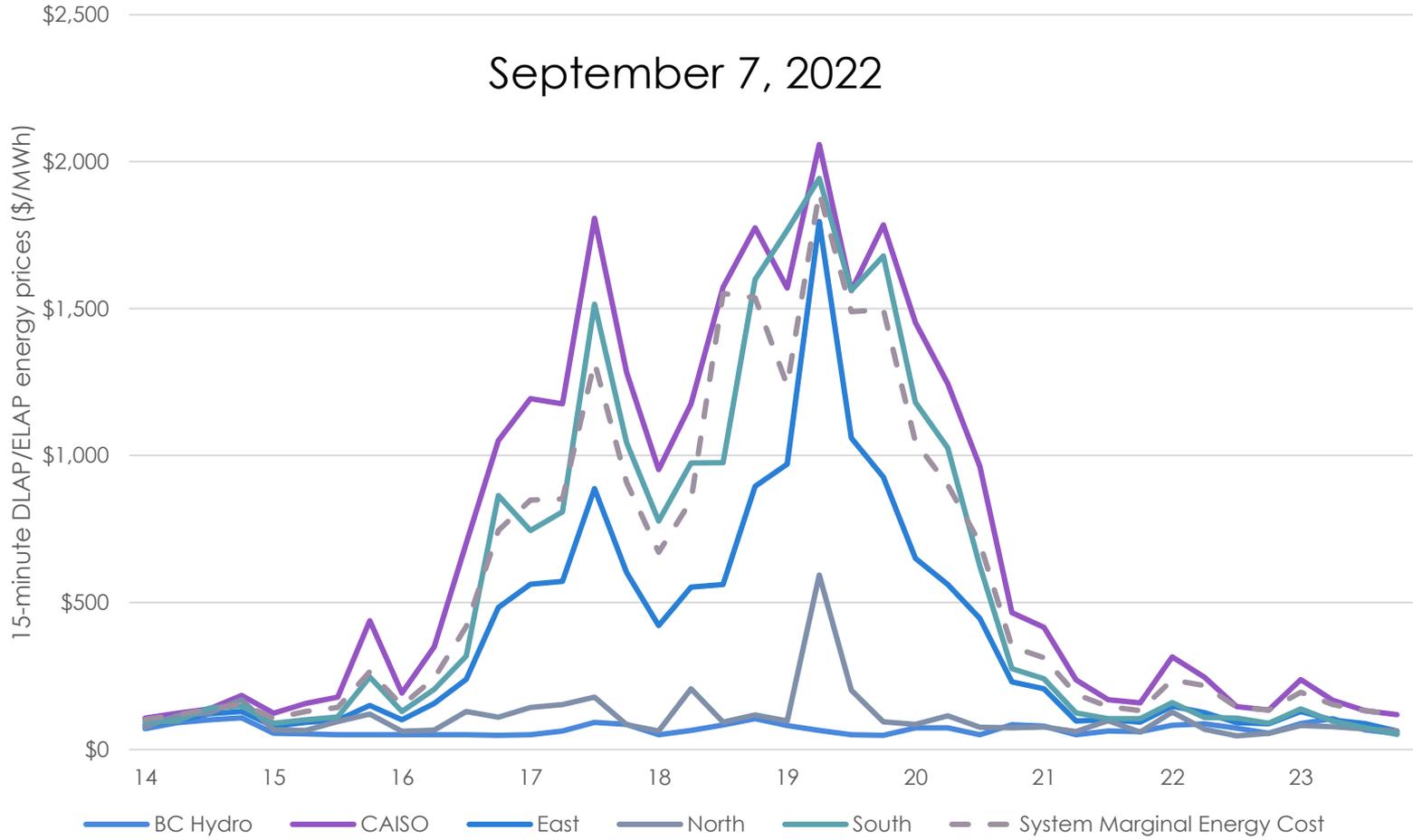
CAISO 5-minute prices were negative during EEA2 conditions: Sept 7, 2022



CAISO 5-minute prices drastically diverge from 15-minute prices: Sept 8, 2022

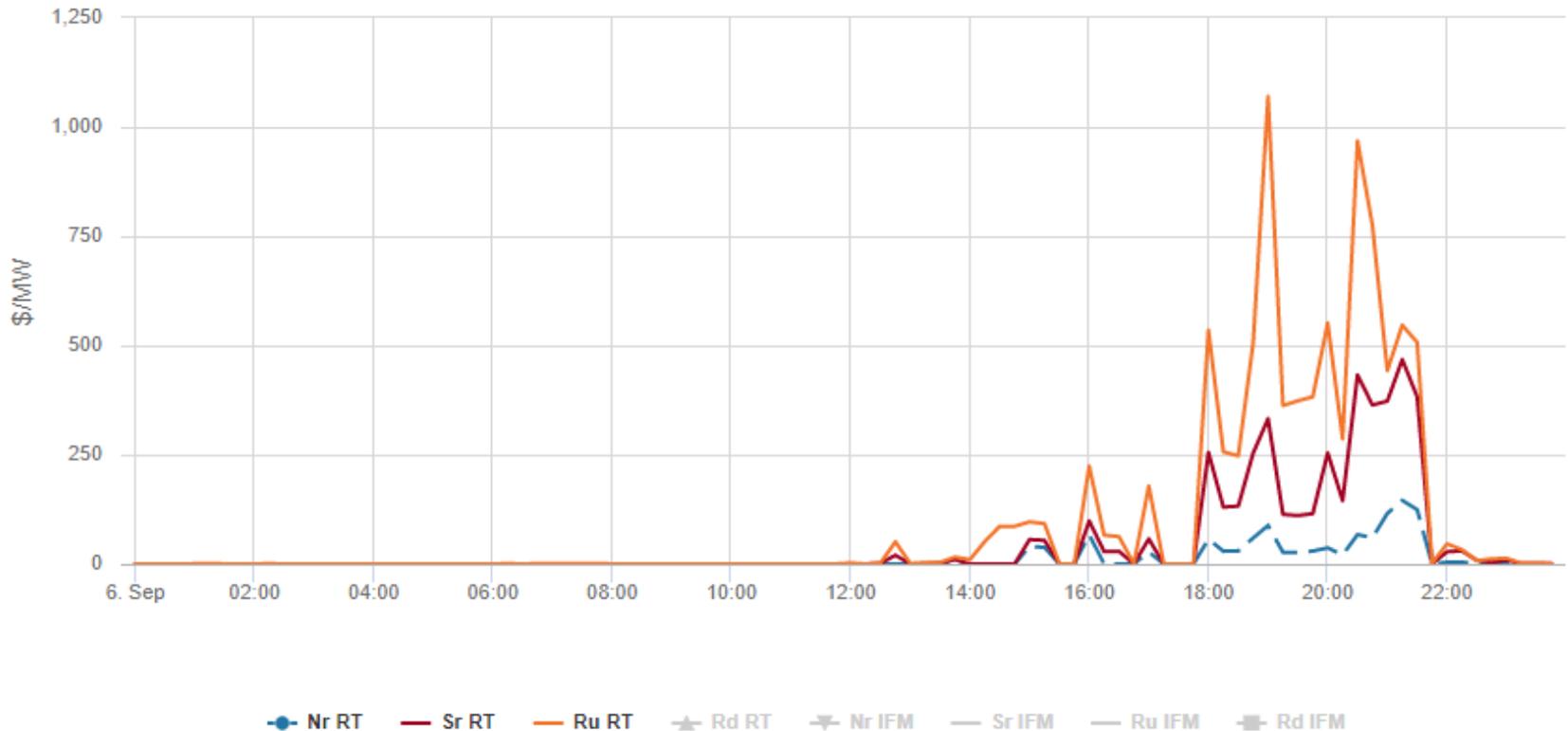


Congestion impacted northern BAAs more than others, driving down prices



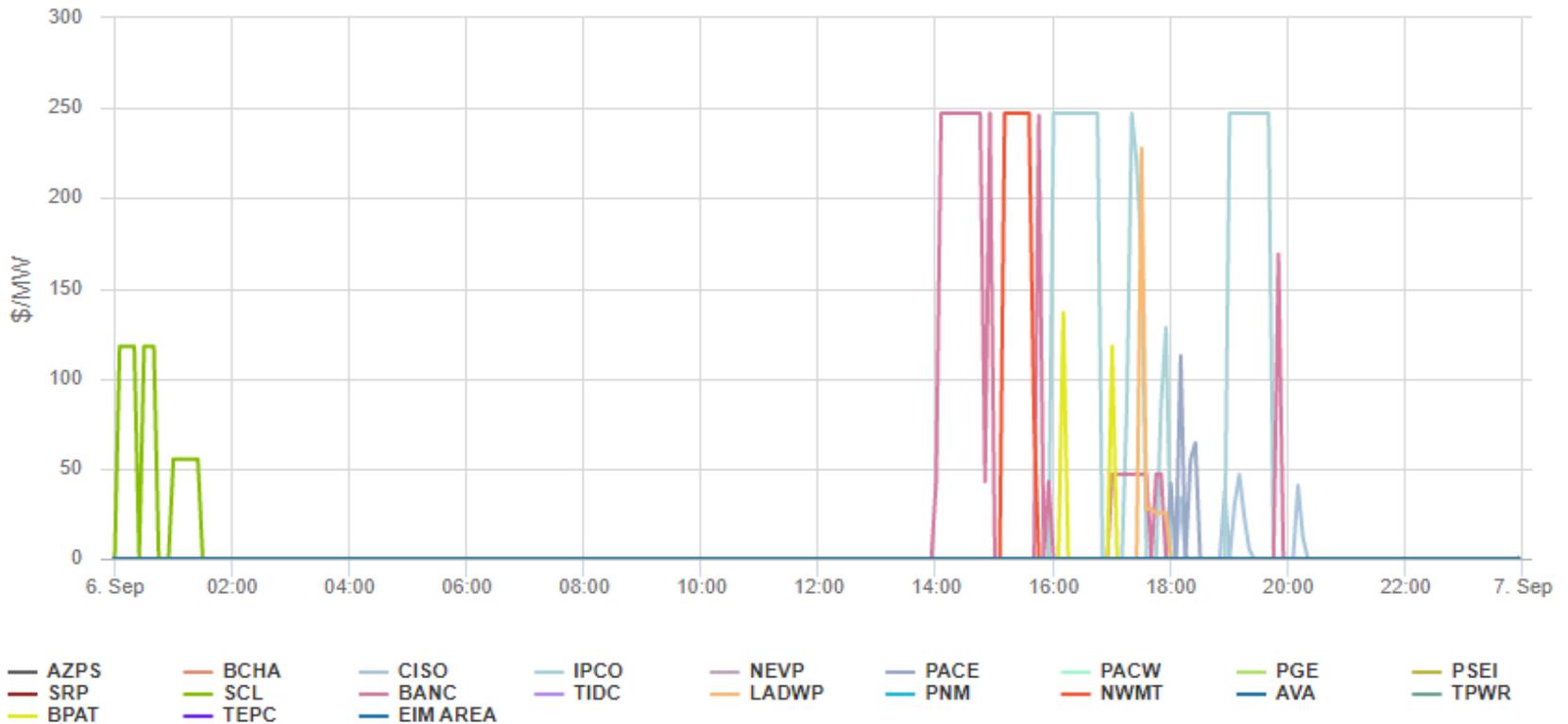
Ancillary Service real-time prices elevated during critical hours: Sept 6, 2022

AS Average Prices [i](#)

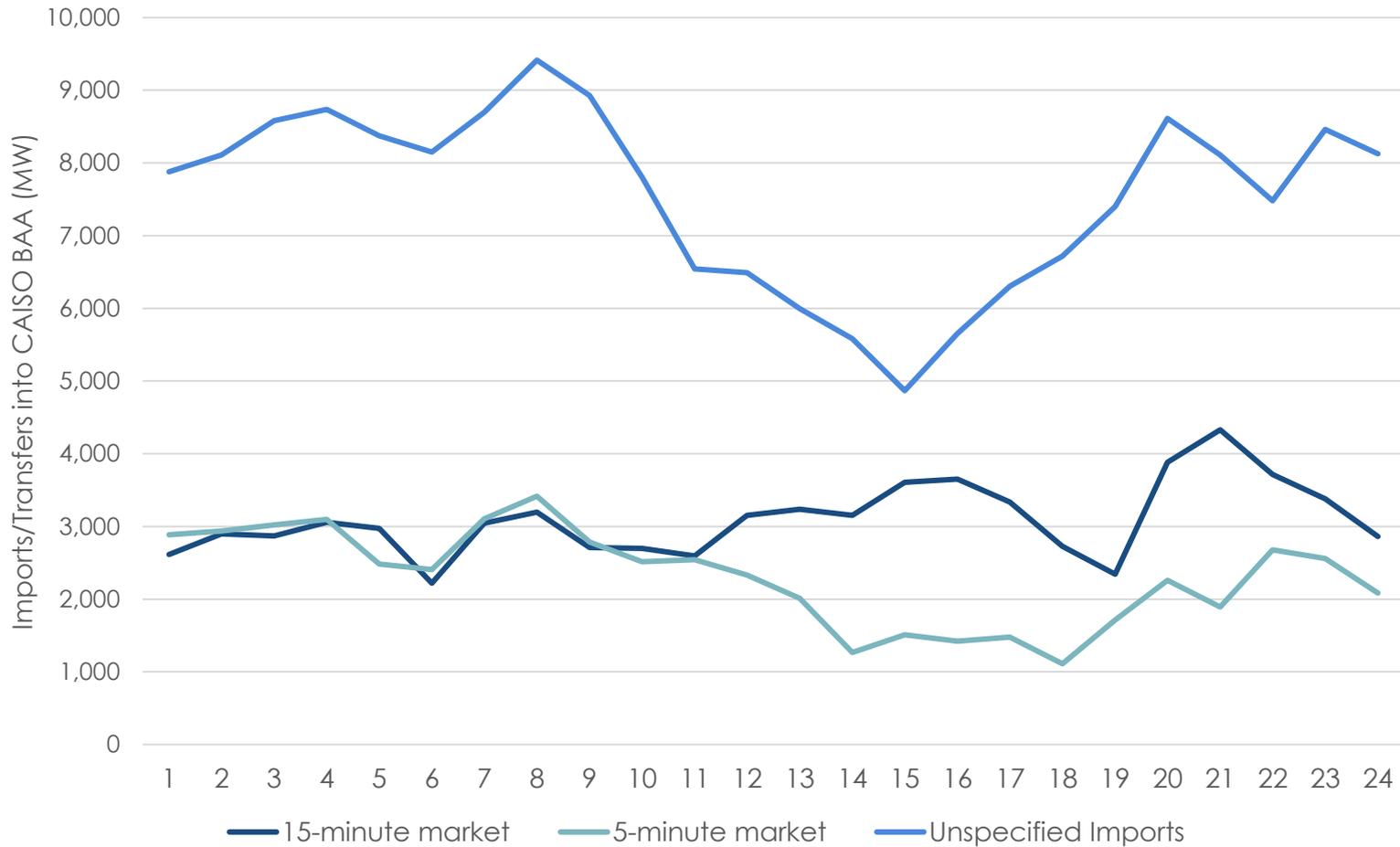


Flex Ramp Up prices reached \$250/MW: Sept 6, 2022

RTD Flex Ramp Up Prices i



CAISO BAA was dec'ing ELM transfer in the 5-minute market: Sept 6, 2022



Price formation initial observations

- Drivers of negative system market energy cost components (SMEC) during emergency conditions
 - Significant amount of exceptional dispatches
- Drivers of SMEC only reaching \$2,000/MWh in 15-minute market during EEA2
 - Pricing impacts of FMM export cuts, out of market actions
- Drivers of 5-minute prices continuing to come in below 15-minute prices
 - Demand response bidding and ability to set marginal prices, not co-optimizing A/S in the 5-minute market, lower load due to out of market and consumer actions



A close-up photograph of an electric vehicle (EV) charging port. The port is blue and has a yellow and black charging cable plugged into it. The interior of the port is illuminated with a warm, golden light. The background is dark and out of focus, showing the rear wheel and tire of the vehicle.

Preparing for next
decade

Next decade

- Resource adequacy planning
 - Evolving process and forecasts
- Intertie liquidity and general availability of imports
- Gas fleet retirements





Thank you! Questions?

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