Summer 2022 Heatwave Discussion

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Market Surveillance Committee Meeting
General Session
November 21, 2022

Introduction

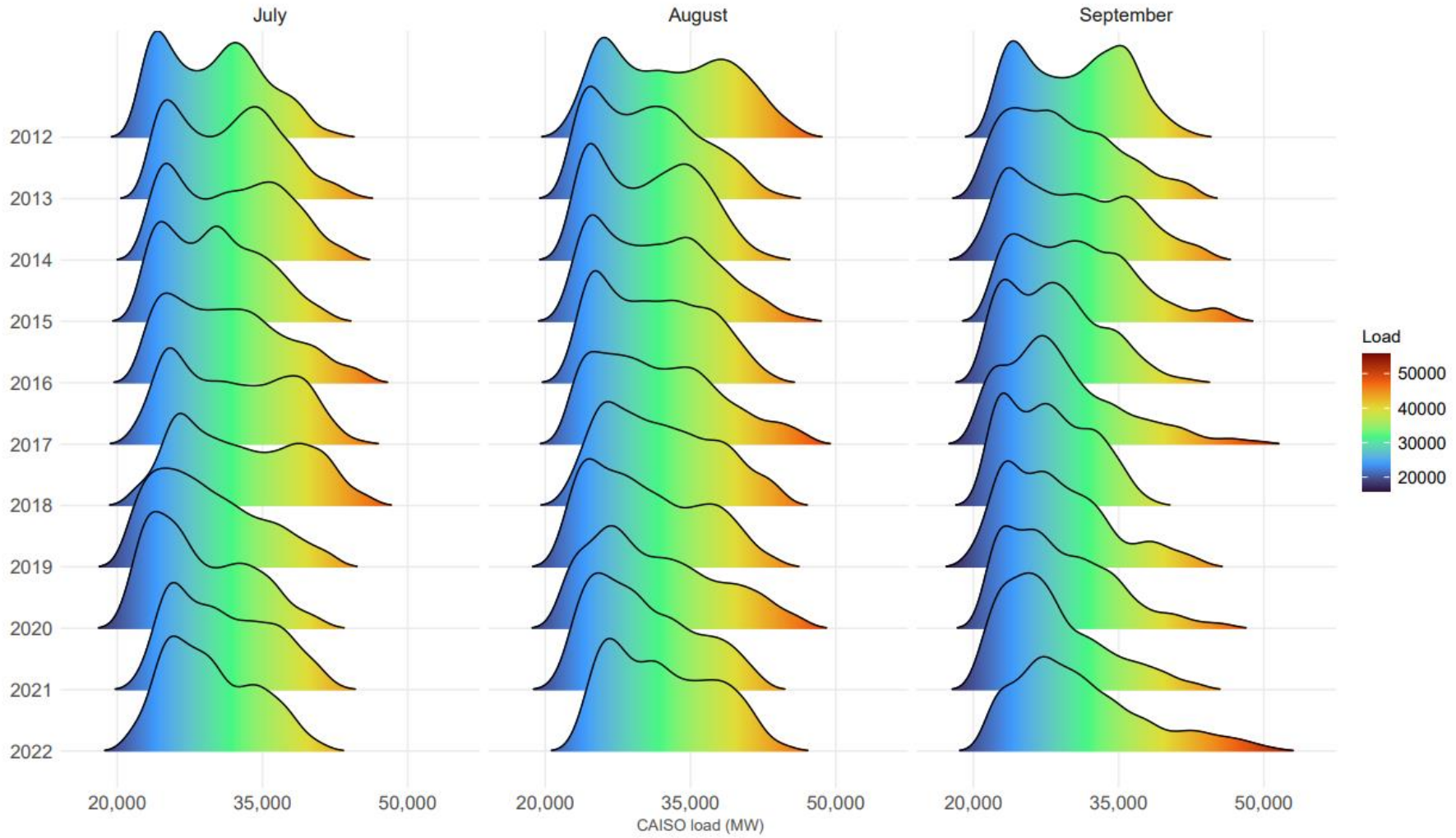
Despite the sustained heat wave and unprecedented load levels, the California Independent System Operator (ISO) did not order rotating outages and maintained reliable system operations at all times during the September heatwave.

- This presentation discusses
  - the heatwave conditions
  - resource sufficiency evaluation
  - storage resources

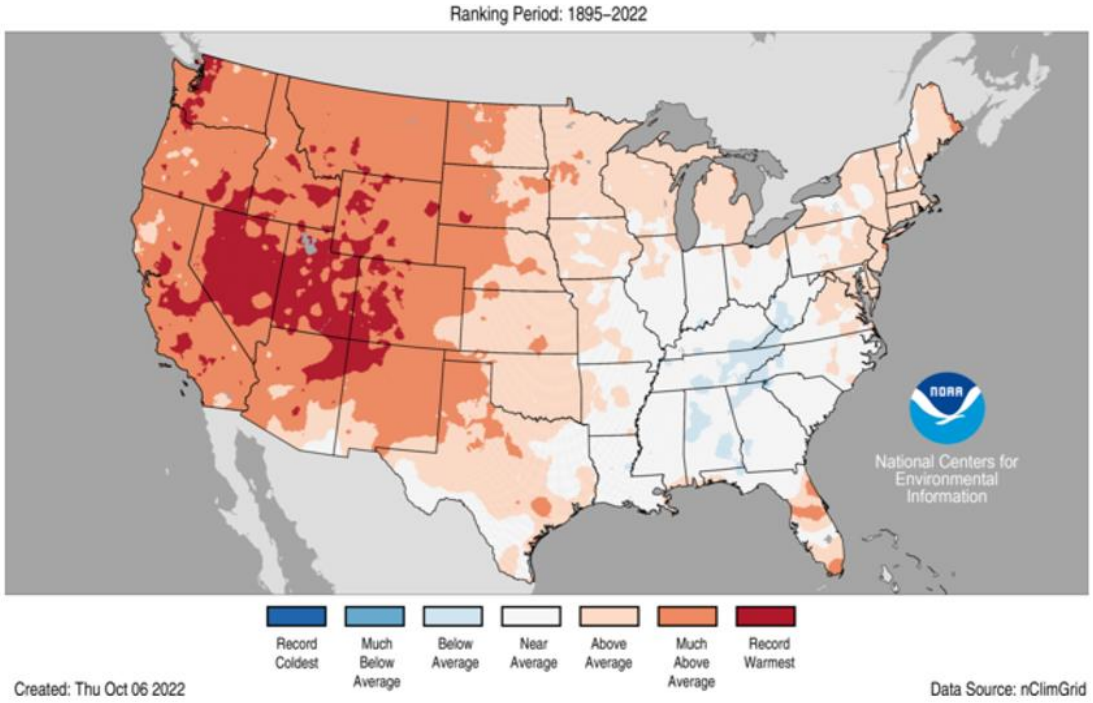
CAISO was able to keep the lights on due to action steps and multiple external factors

1. Increased capacity through resource adequacy procurement
2. Enhanced coordination, awareness, and communications
3. Market enhancements developed and implemented over the past two years
4. The use of new state programs to provide non-market resources to address extreme events
5. Deployment of demand response and calls for conservation efforts, and
6. Geographic diversity of extreme heat across the West

CAISO set a record load of 52,061 MW on Sept. 6



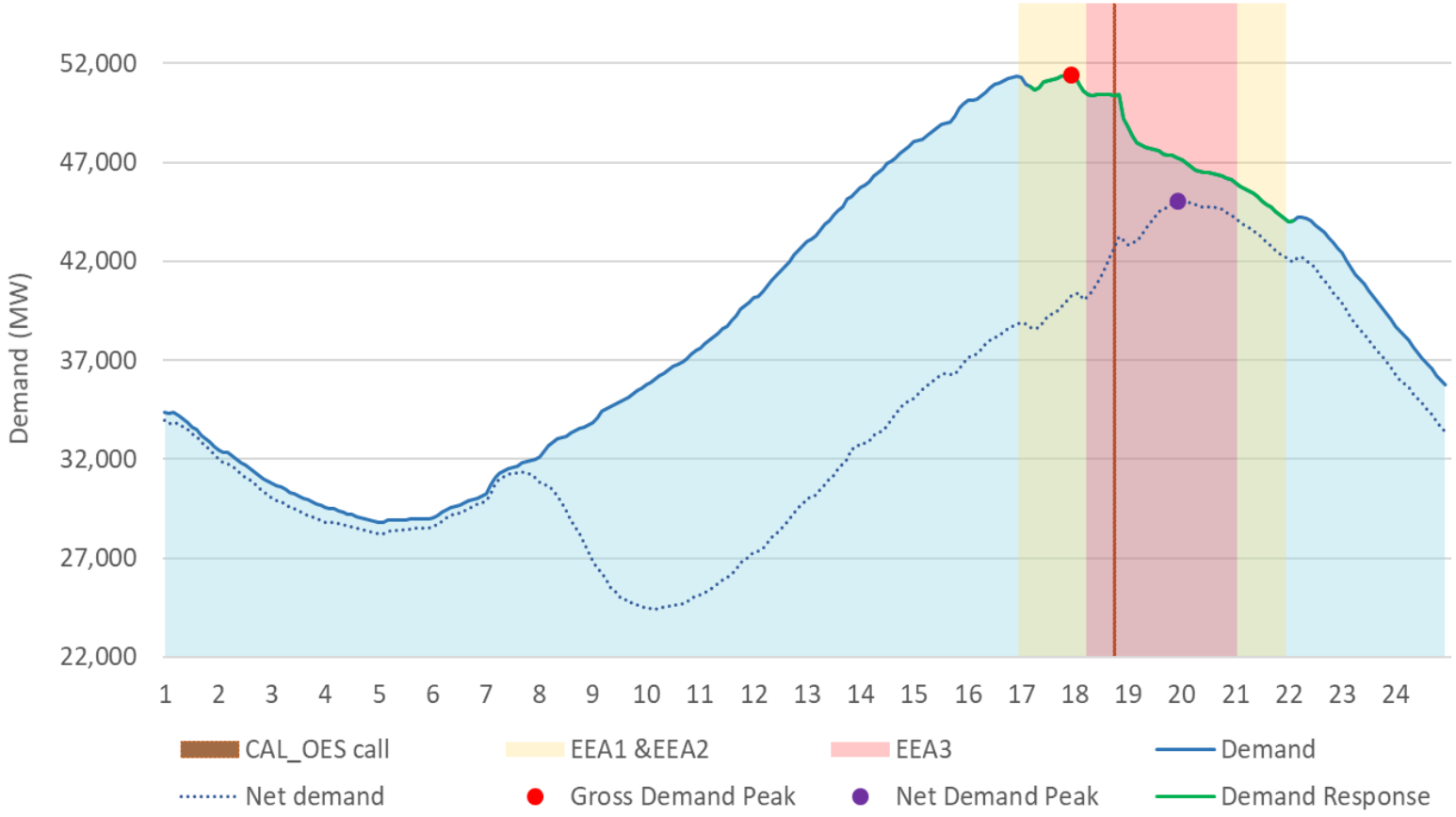
A 10-day shattering heatwave drove record demands



- Multiple cities in California broke 100-year old records for maximum and minimum temperatures

- Using 28 years' worth of weather data, the ISO weighted 3-day temperature through September 6 was a 1-25 year event

Many factors helped prevent the CAISO from ordering rotating outages, including conservation

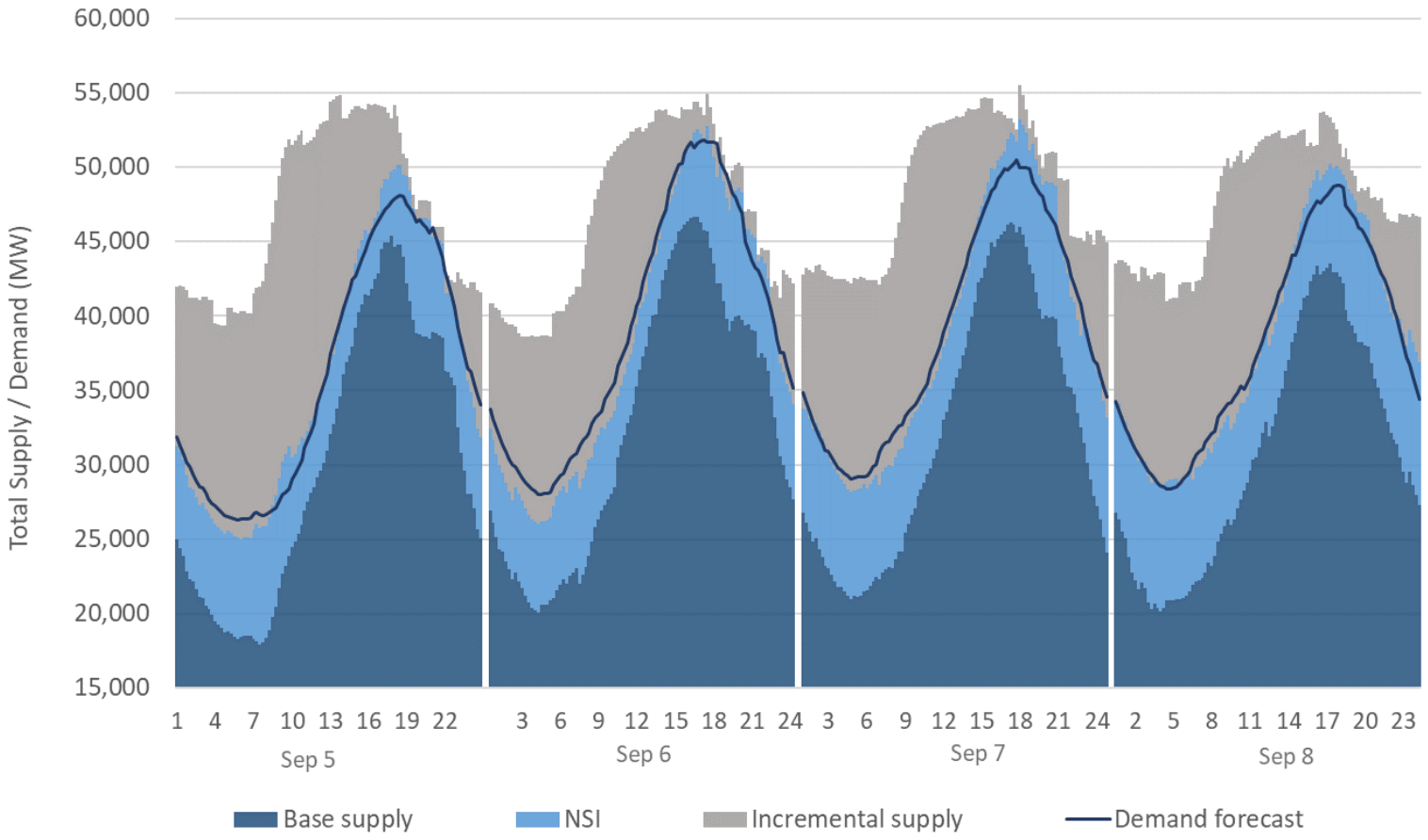


Demand Response and conservation efforts may have reduced demand by up to 1,500 MW

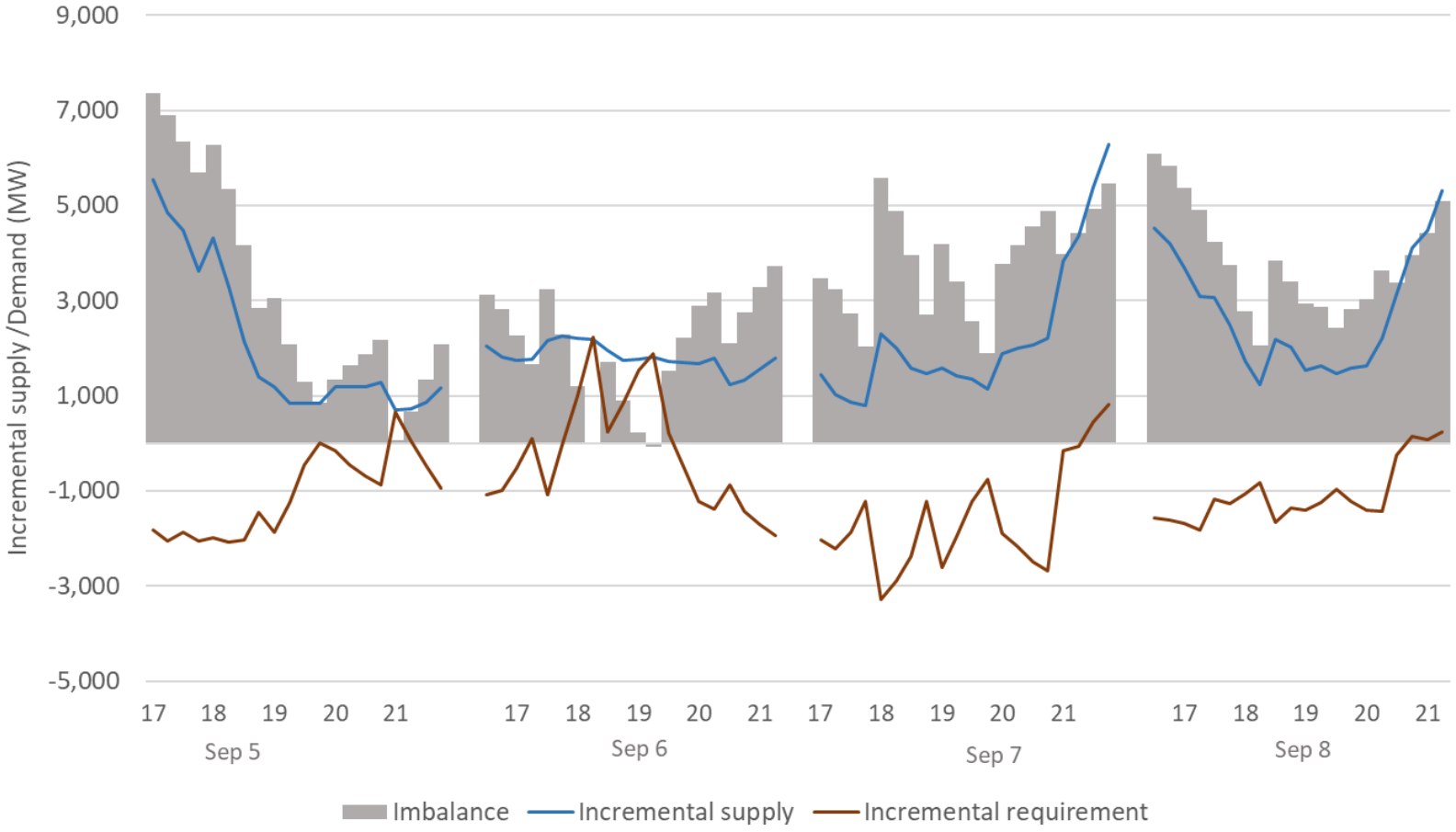
Resource Sufficiency Evaluation

- Given the ongoing developments regarding the capacity test enhancements, this focuses on
  - CAISO area
  - Capacity test

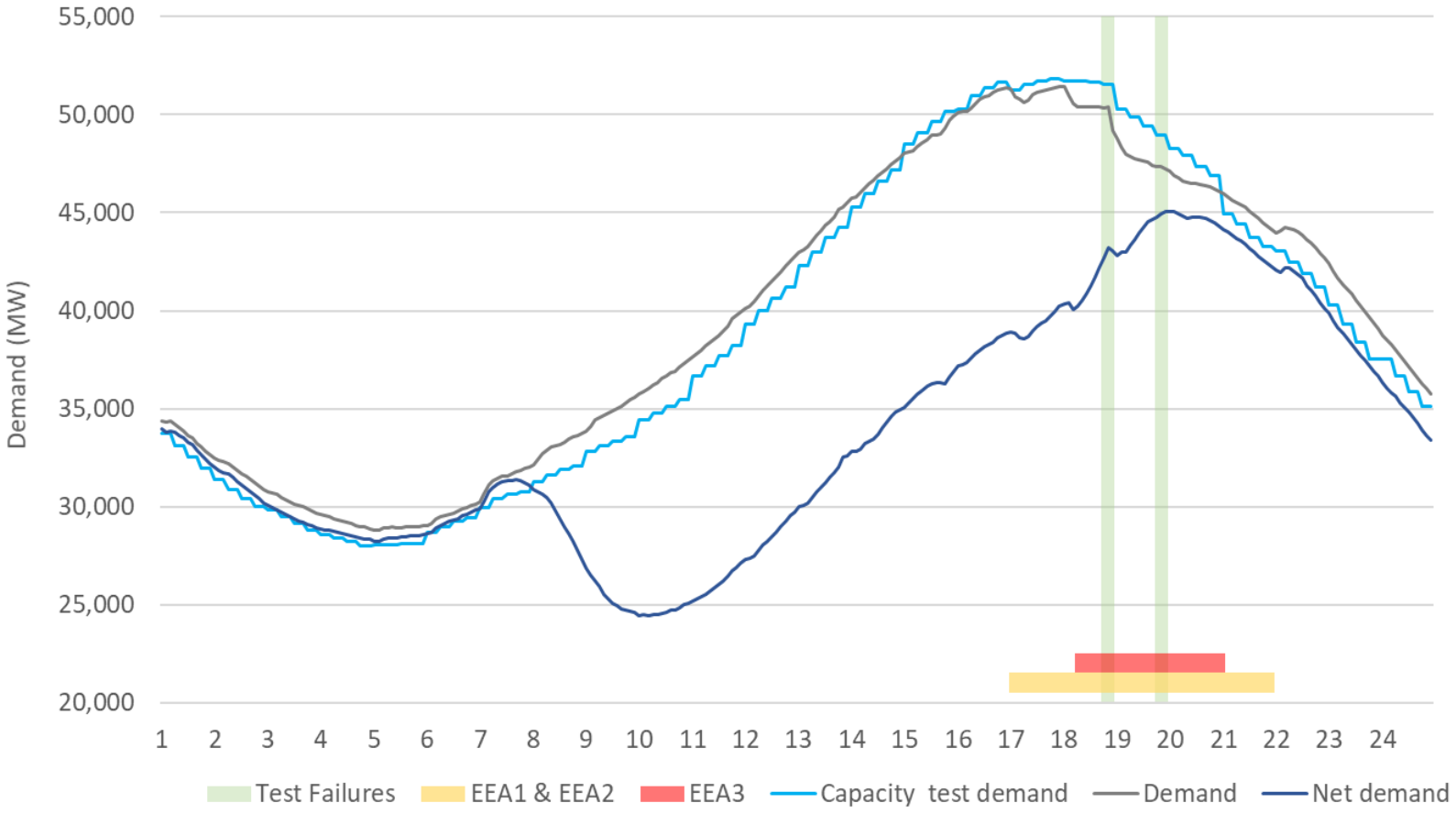
CAISO area reached minimum levels of supply available during peak hours of the heatwave



Incremental supply was lower than incremental requirements in two intervals, leading to capacity test failures

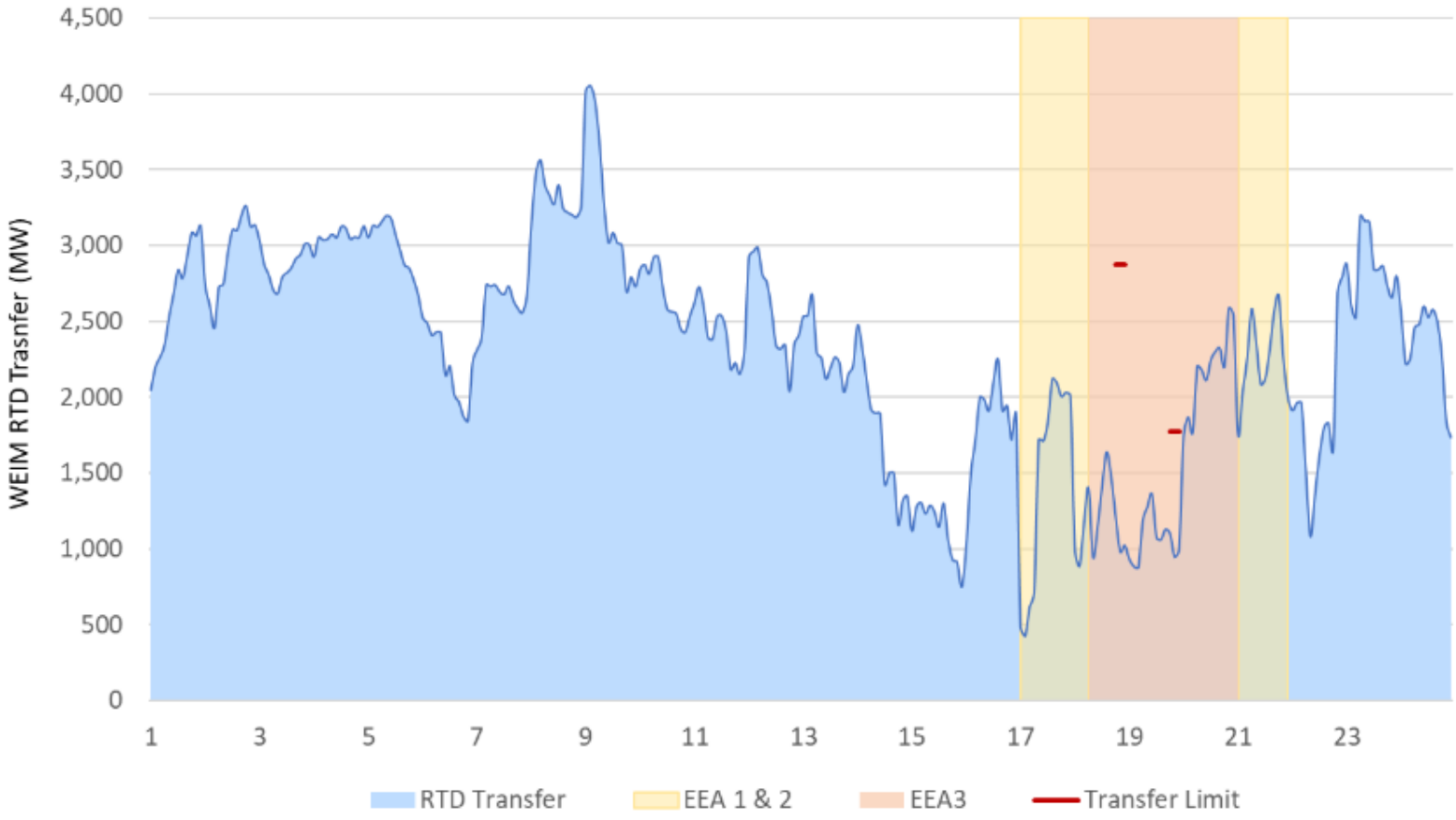


CAISO failed the capacity test in two 15-minute market intervals on Sept. 6 while in energy emergency

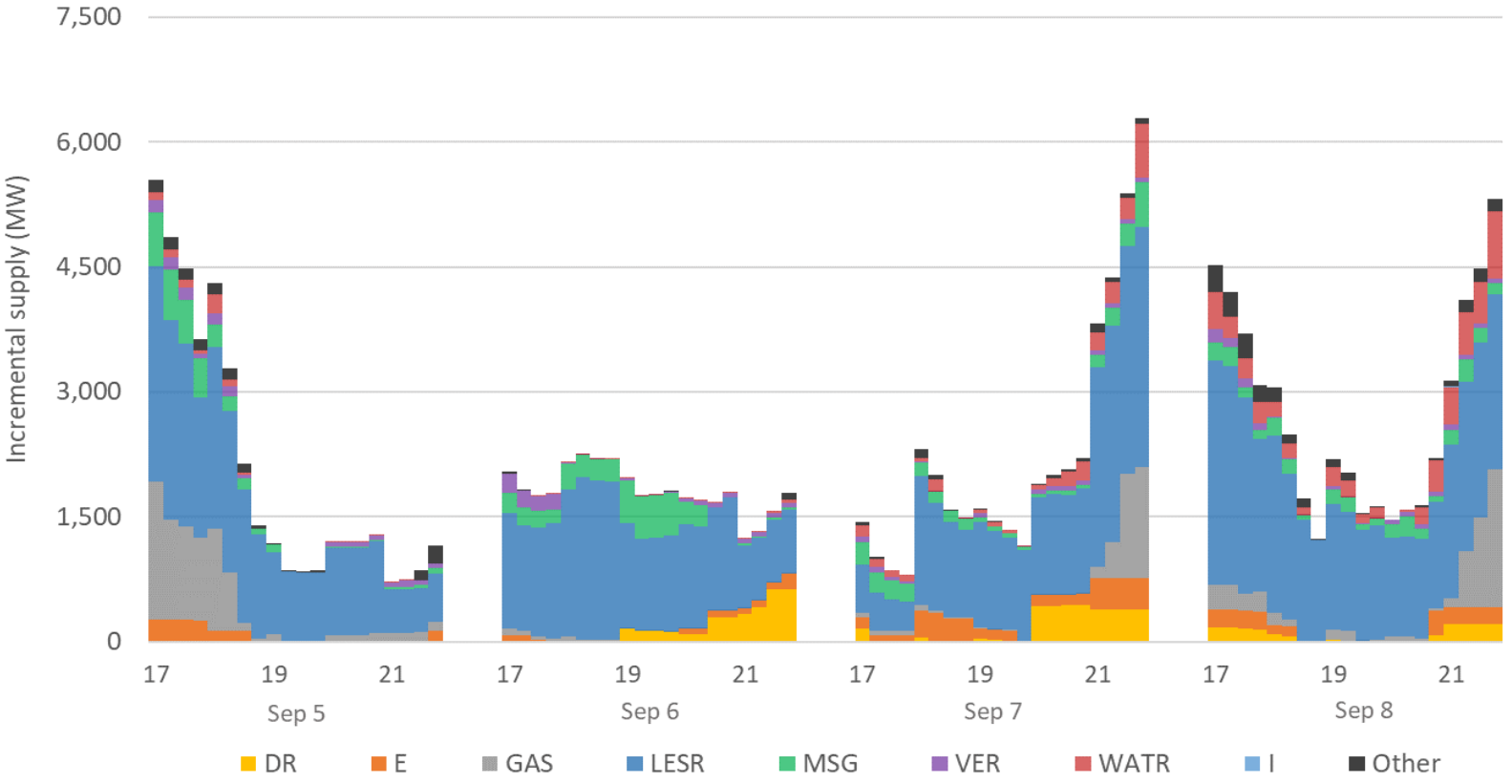


All energy conservation effort decreased the load obligation

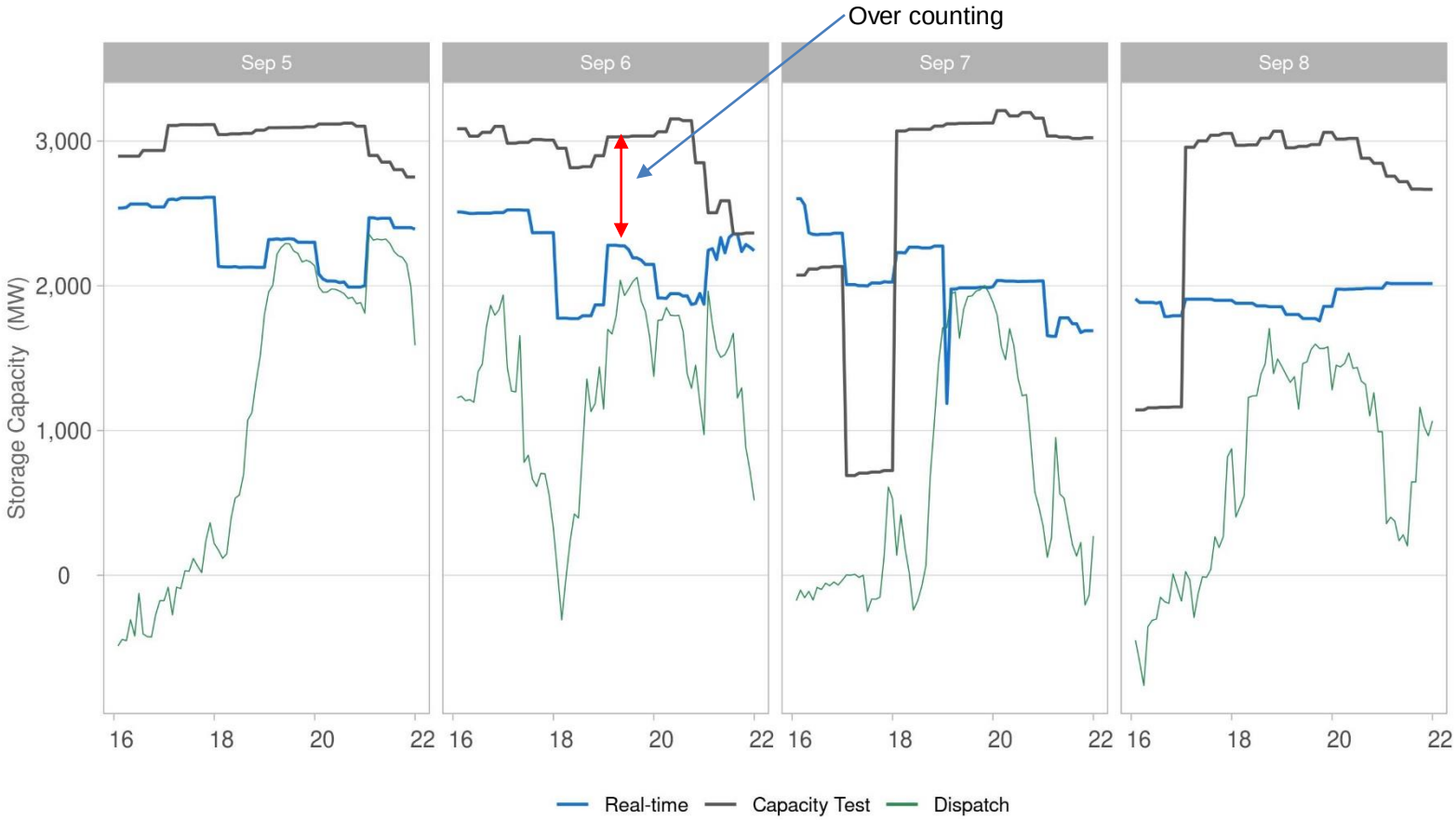
The consequence of the failures were *de minimis is* given the levels of transfers optimally available



The capacity test projected available supply even during the critical hours of the emergency



A significant portion of the available capacity was incorrectly estimated from Storage resources



The main contributor was that capacity to support ancillary services, such as regulation up, was incorrectly accounted as available supply. This issue has been corrected.

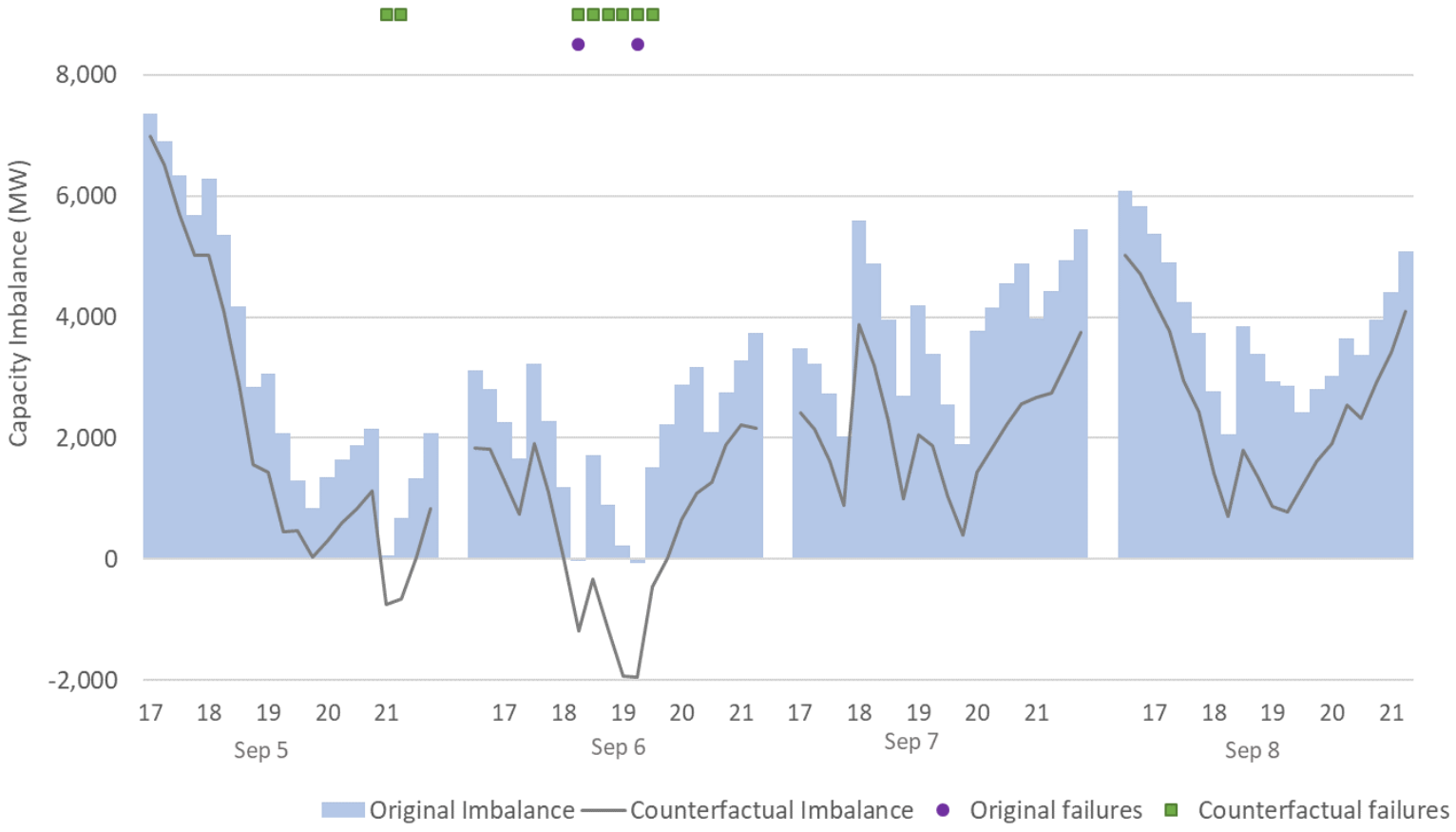
Several issues impacted the capacity test resulting in over- and under-counting of available supply

- Calculation of MSG units capacity
  - Units coming from outages were still considered in the test due to staled start-up record. Over-counting
  - Upward transitions were not considered in the test due to complexities on possible permutations. Under-counting
- DC losses model as exports realized until the real-time market and, thus, are not considered in the test. Under-counting

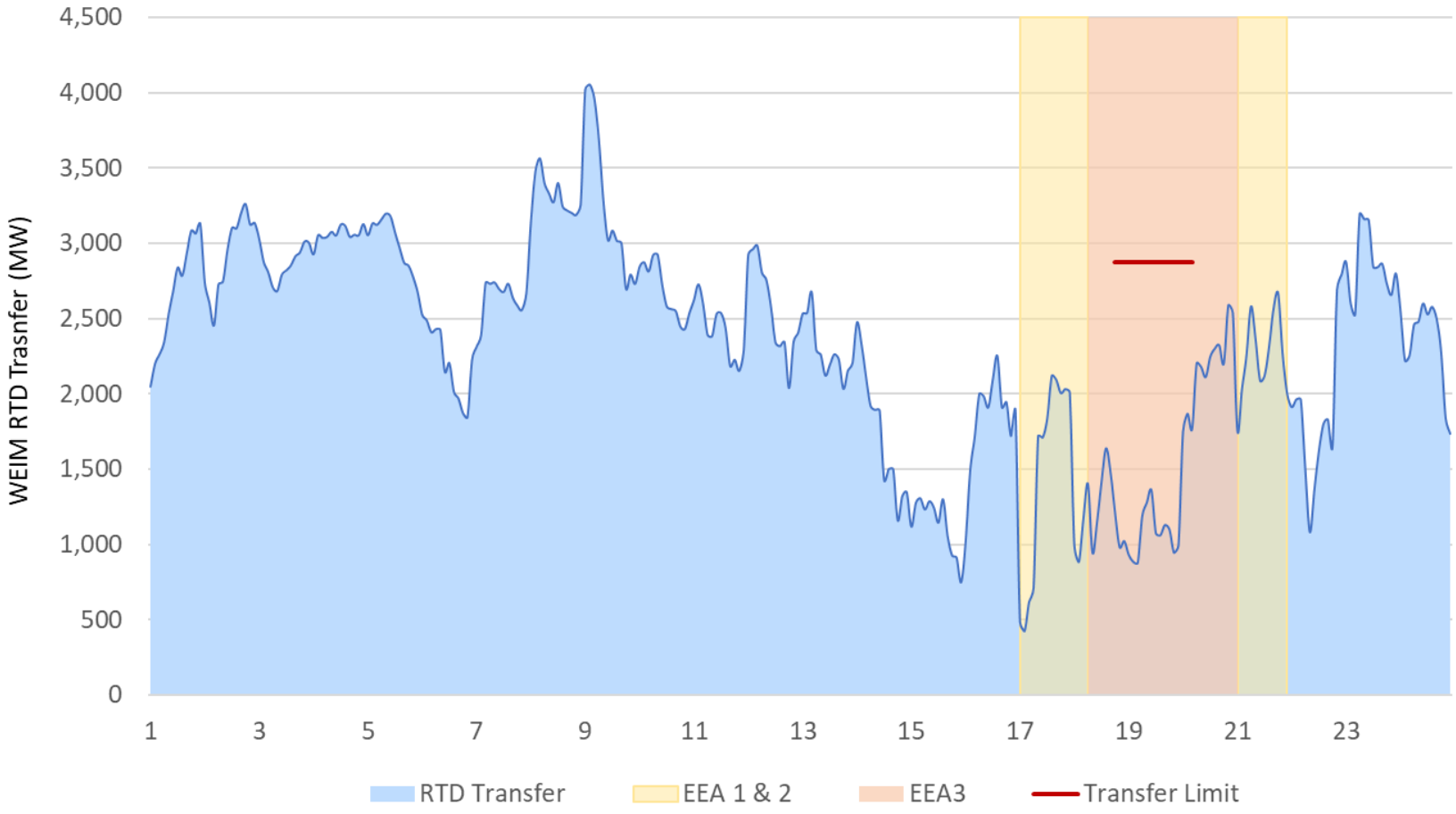
Several issues impacted the capacity test resulting in over- and under-counting of available supply

- Imports and export reductions
  - Up to 460 MW of cleared imports considered in the test were curtailed after the fact by other areas. The test used the data known at that time. Over-counting
  - Export reductions projected in the market were not utilized in the test. Over-counting
  - Emergency imports and exports were inconsistently considered in the test due to their timing. Over- or under-counting
- Load arming in EEA3 resulted in additional supply in real-time not seen in the test. Under-counting

CAISO area would have failed four more intervals on Sept 6 if not for the miscalculations of capacity

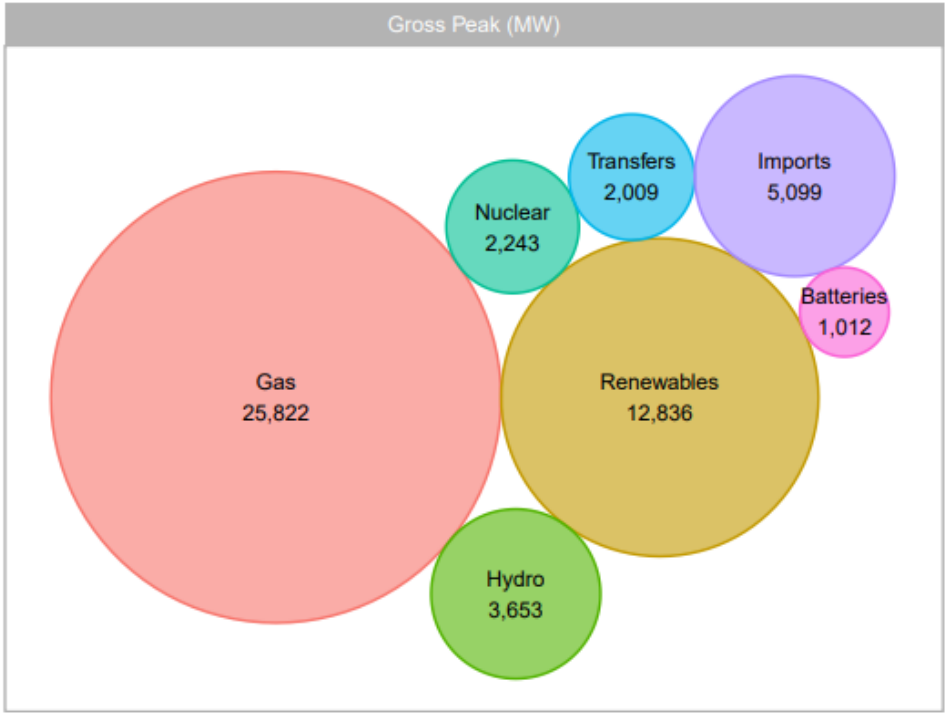


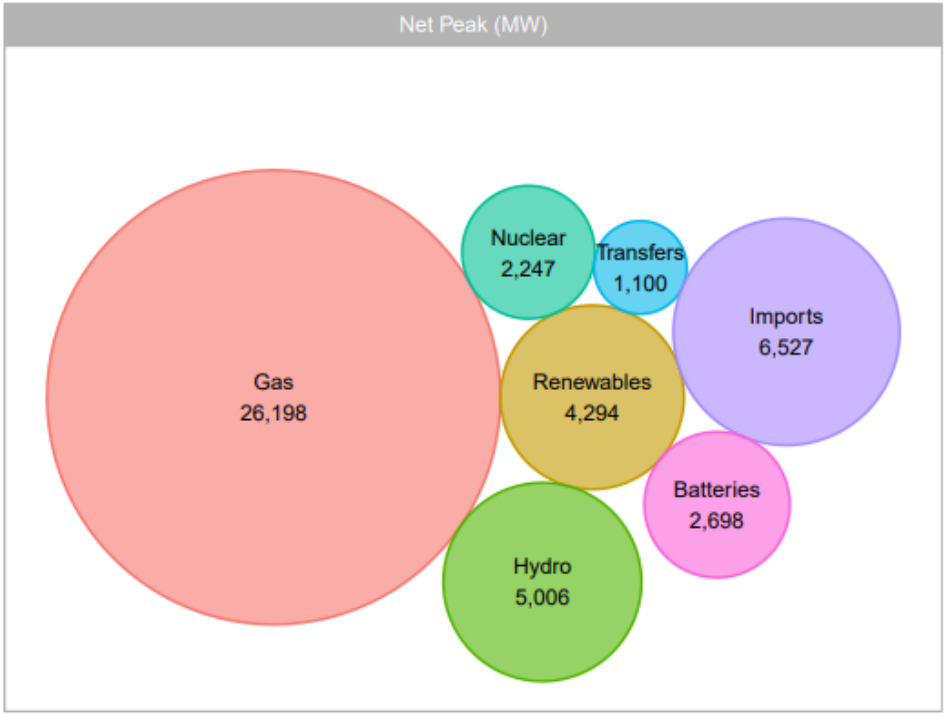
The additional capacity test failures would have been immaterial to the real-time transfers since transfers were already cleared at much lower values



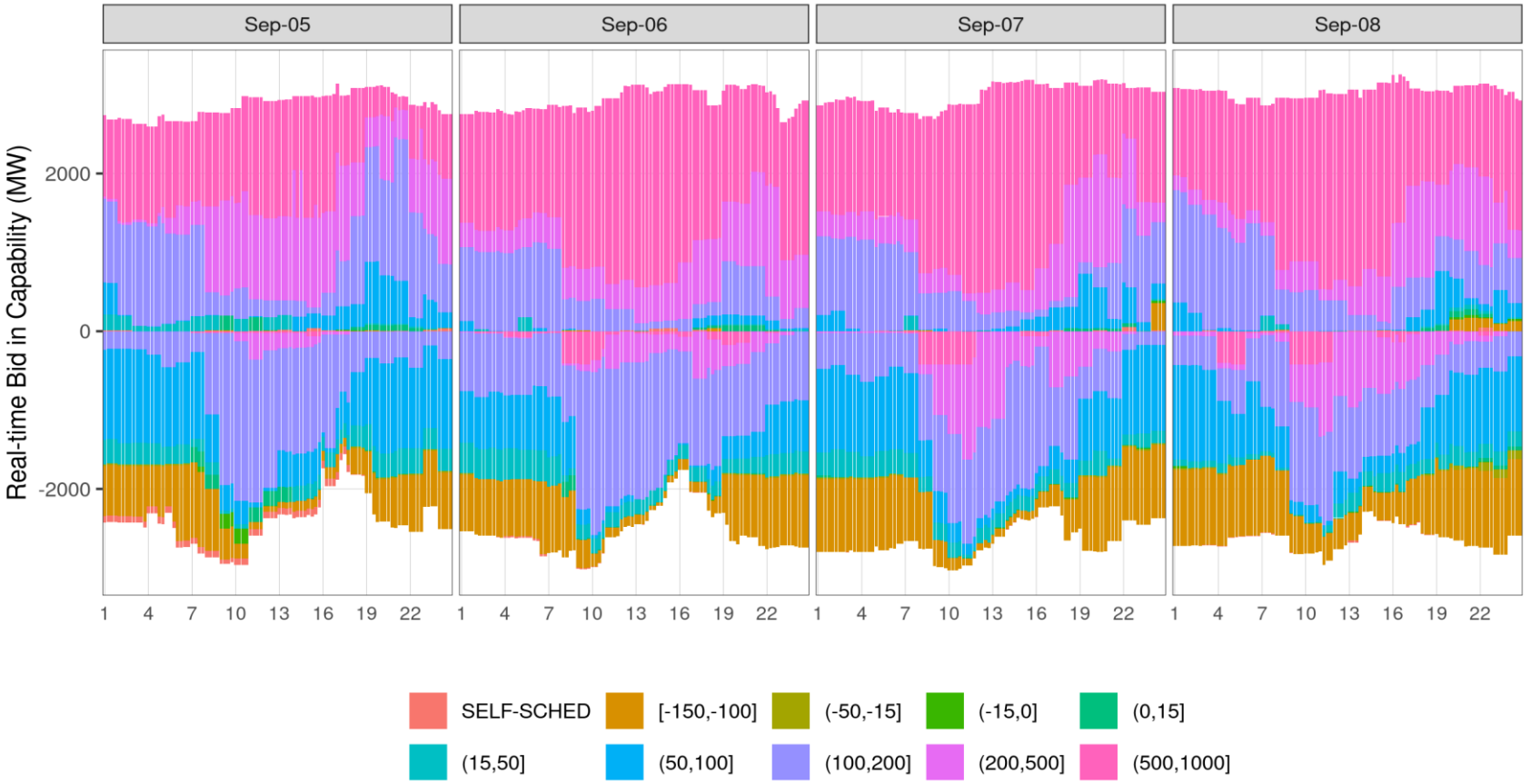
STORAGE RESOURCES

Storage resources contributed to meet demand peaks of Sept 6

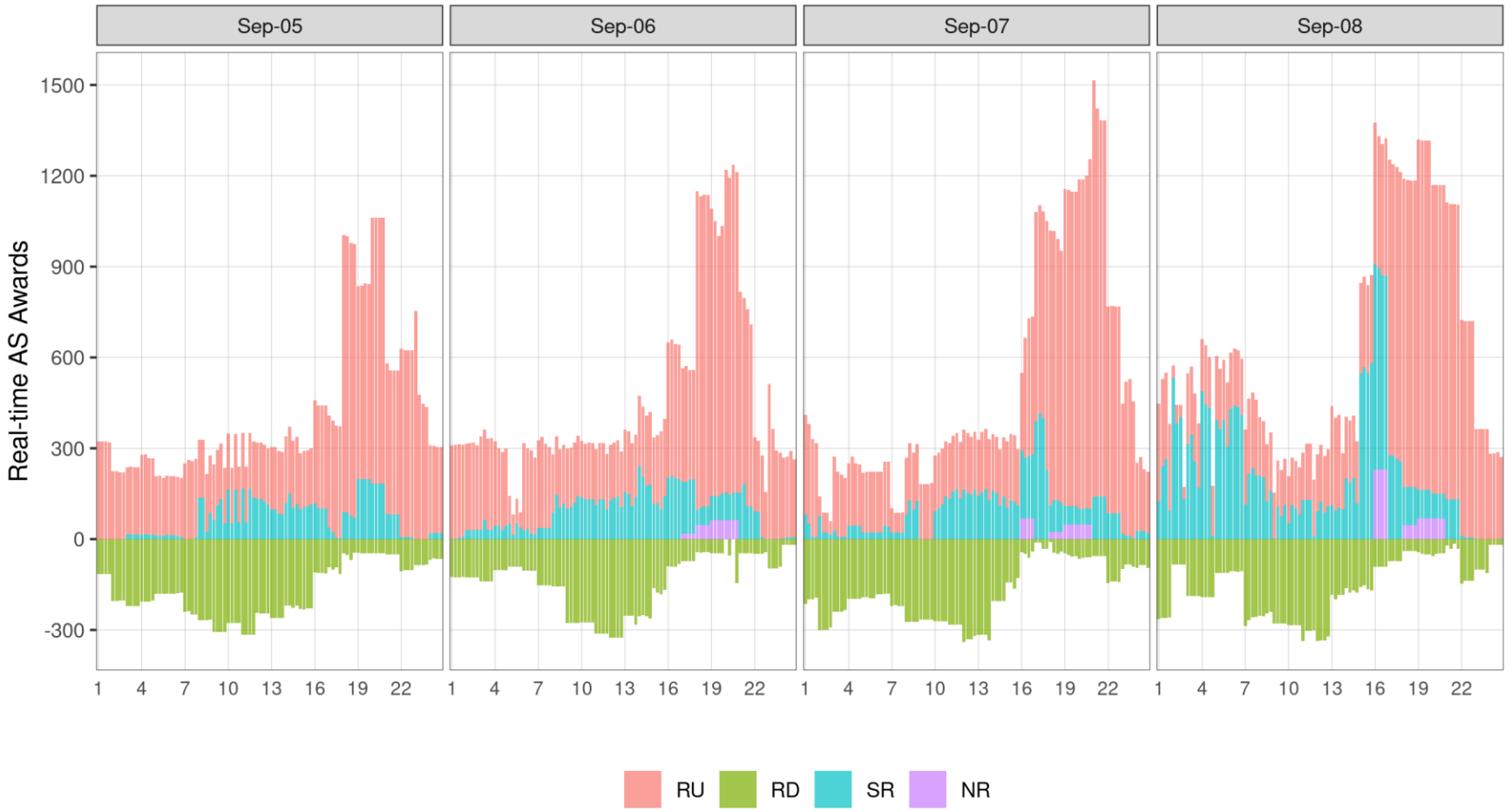




Real-time bids of storage resources adjusted through the heatwave and were bound at the bid cap of $1,000MWh

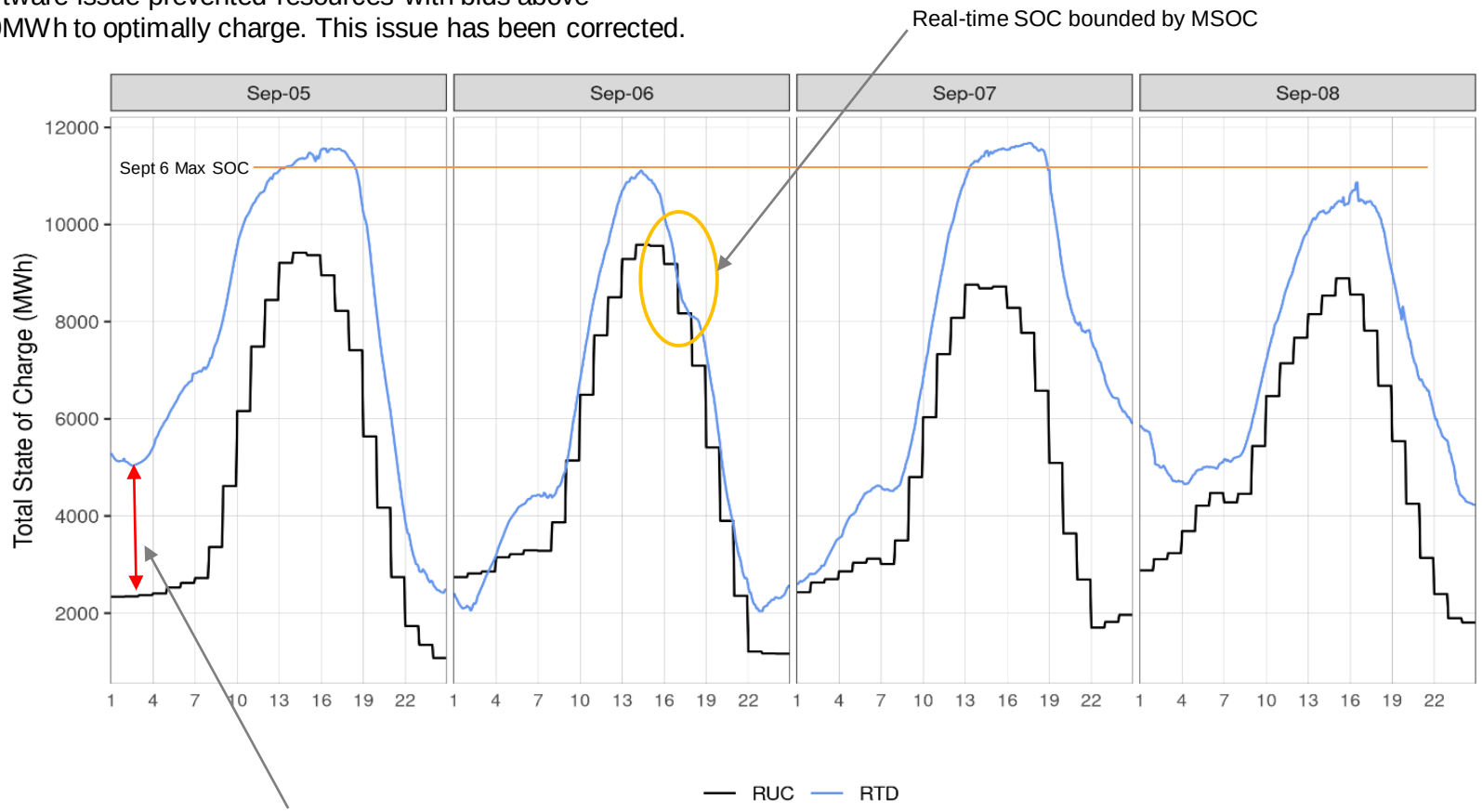


Storage resources carried a significant share of regulation requirements

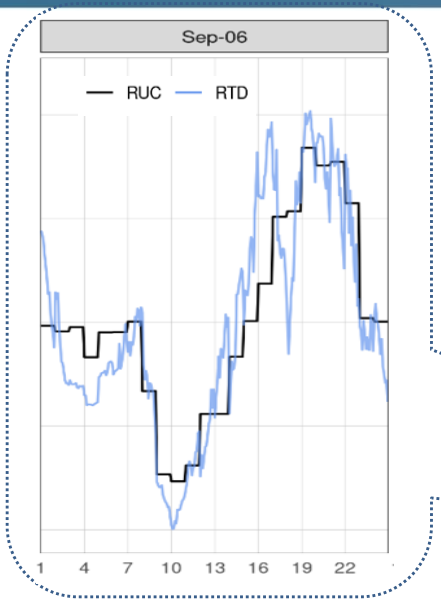


September 6 observed a lower maximum SOC relative to adjacent days

A software issue prevented resources with bids above $150MWh to optimally charge. This issue has been corrected.

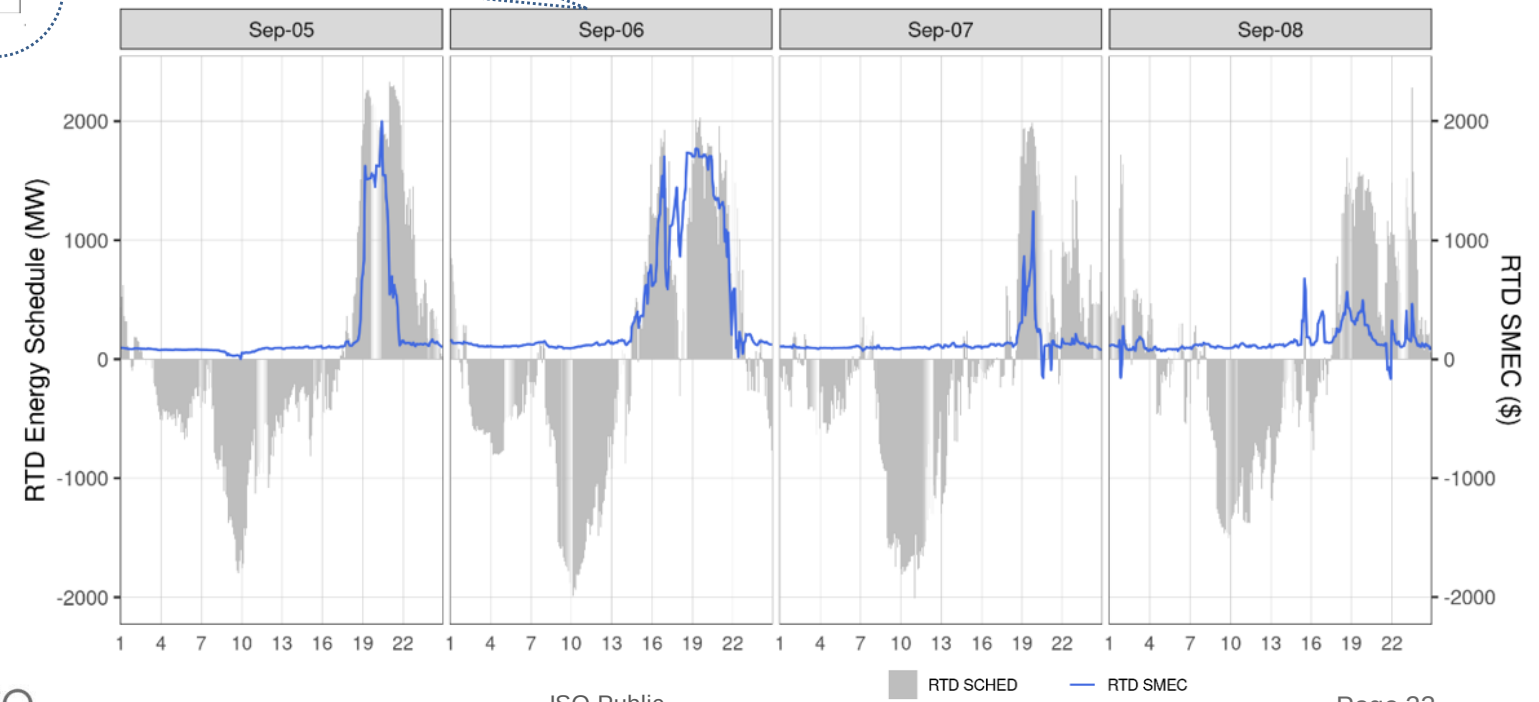


The initial day-ahead state of charge can be very different to what realizes in real-time. It will influence what MSOC is imposed in real-time

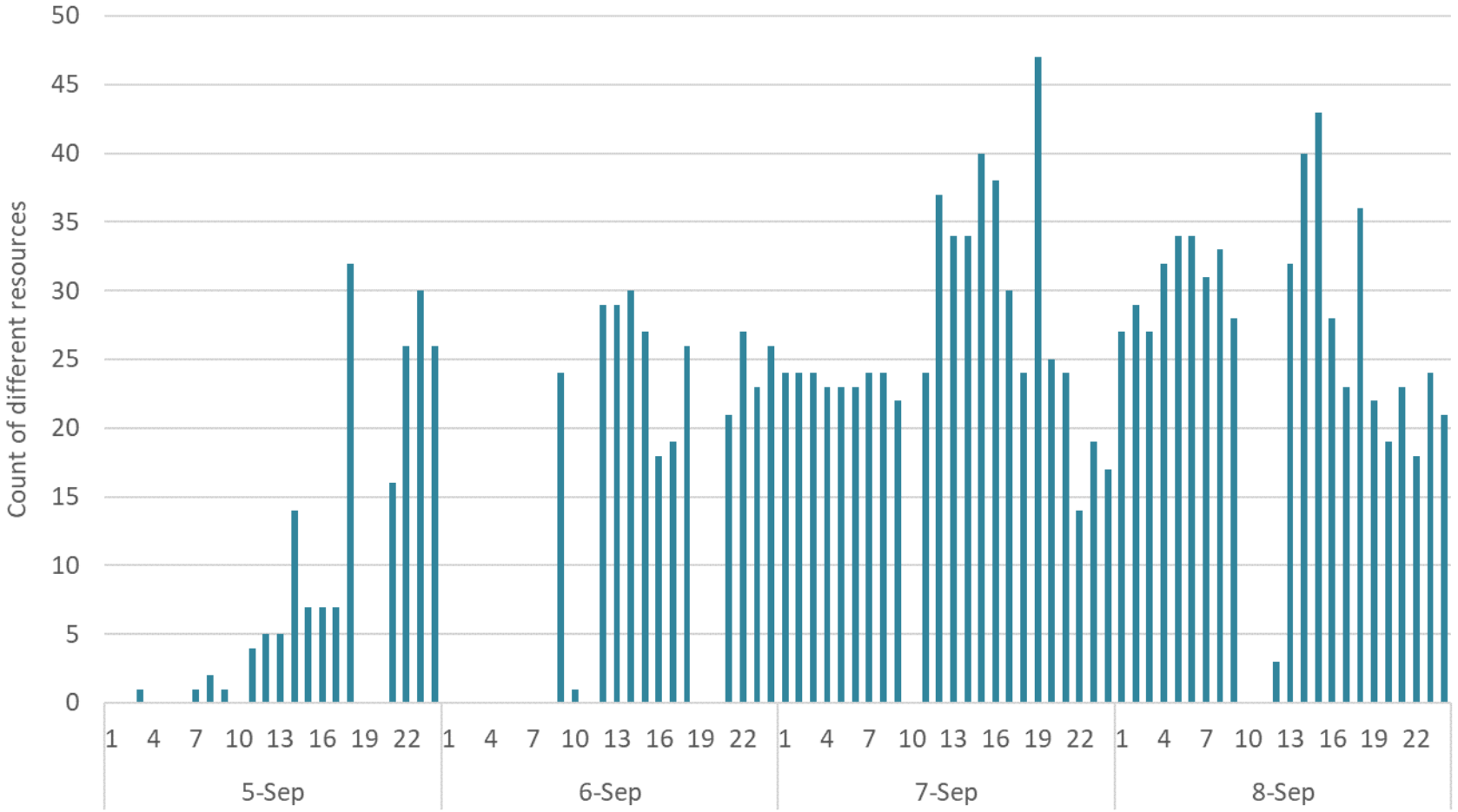


Storage resources started to discharge early on Sept 6 as prices quickly increased making resources economical

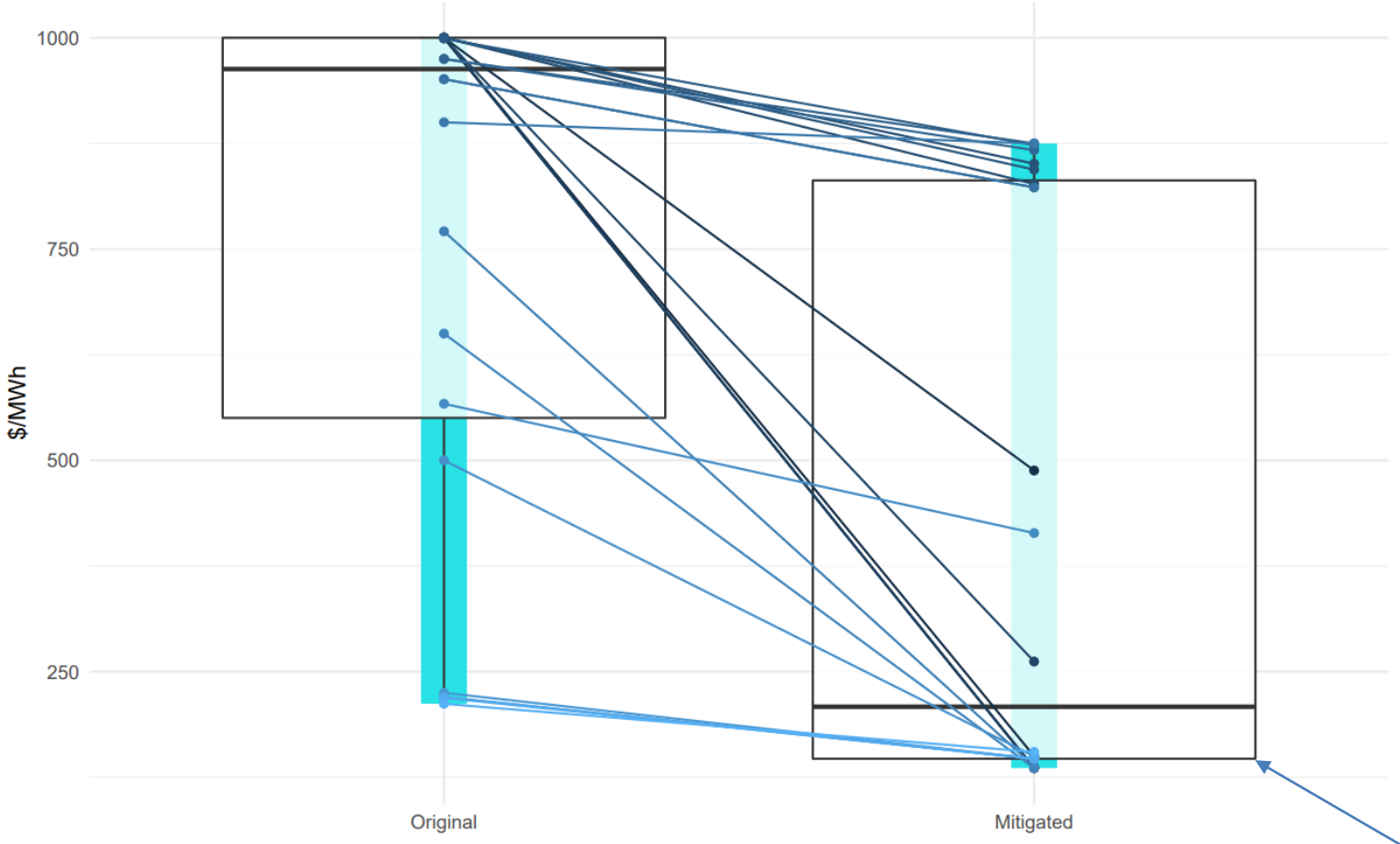
RTD dispatches can only look ahead for next 50 minutes.
RTD multi-interval optimization can only optimize through that horizon



Multiple storage resources became in merit after mitigation



With mitigation multiple resources were considered for clearing at lower prices



Sample for price change due to mitigation for Sept 6, HE14

Box plots show distribution of prices for original and mitigated bids

Early discharges were driven by economics when resources were in merit across the optimized horizon

	Actuals	161	160	157	162	-2	-2	-2	124	-95	-166
Hour	Interval										
16	11	**161**									
16	12	163	**163**								
17	1	0	0	**0**							
17	2	0	94	0	**0**						
17	3	0	0	0	0	**0**					
17	4	30	0	0	0	33	**158**				
17	5	163	8	0	0	163	163	**-166**			
17	6	163	158	0	92	163	163	-166	**-166**		
17	7	163	163	64	162	163	119	-166	-166	**-120**	
17	8	163	163	163	163	163	163	-166	-166	-55	**-166**
17	9		163	162	163	163	130	-117	-166	-55	-166
17	10			163	163	163	71	-55	-117	-55	-110
17	11							-110	-55	-55	-110
17	12							-166	-110	-55	-110
18	1							-166	-166	-3	-8
18	2							-166	-166	-3	-166
18	3								-166	-3	-34
18	4									-3	-8
18	5										-8

A

B

C

First RTD run to see HE18 in the horizon

Dispatches are in MW
Green entry: Binding interval
Other entries: advisory intervals

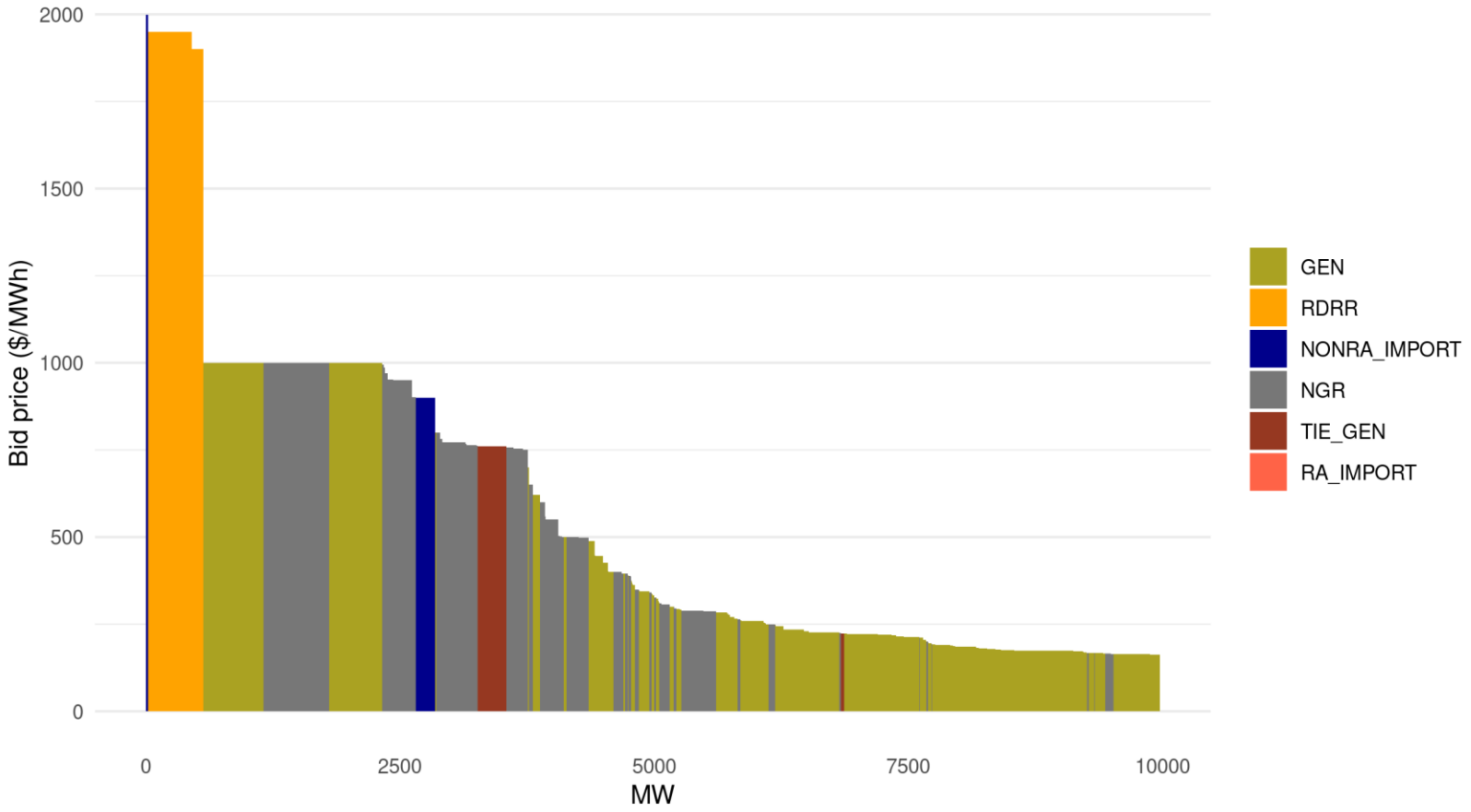
The multi-interval horizon was too short to foresee and position resources more in advance

Dispatches were driven to meet SOC constraints and regulation procurement

Hour	Interval									
16	11	**402**								
16	12	388	**388**							
17	1	388	388	**371**						
17	2	388	380	371	**387**					
17	3	388	380	371	387	**385**				
17	4	386	380	371	387	382	**368**			
17	5	372	379	371	387	369	355	**378**		
17	6	359	366	371	380	355	341	390	**395**	
17	7	345	353	366	366	342	331	402	405	**394**
17	8	331	339	353	353	328	318	415	413	398
17	9		326	339	339	314	307	423	418	402
17	10			326	326	301	301	427	422	406
17	11							436	426	410
17	12							448	434	414
18	1							460	447	415
18	2							472	459	415
18	3								471	415
18	4									415
18	5									
	MSOC			326				472		

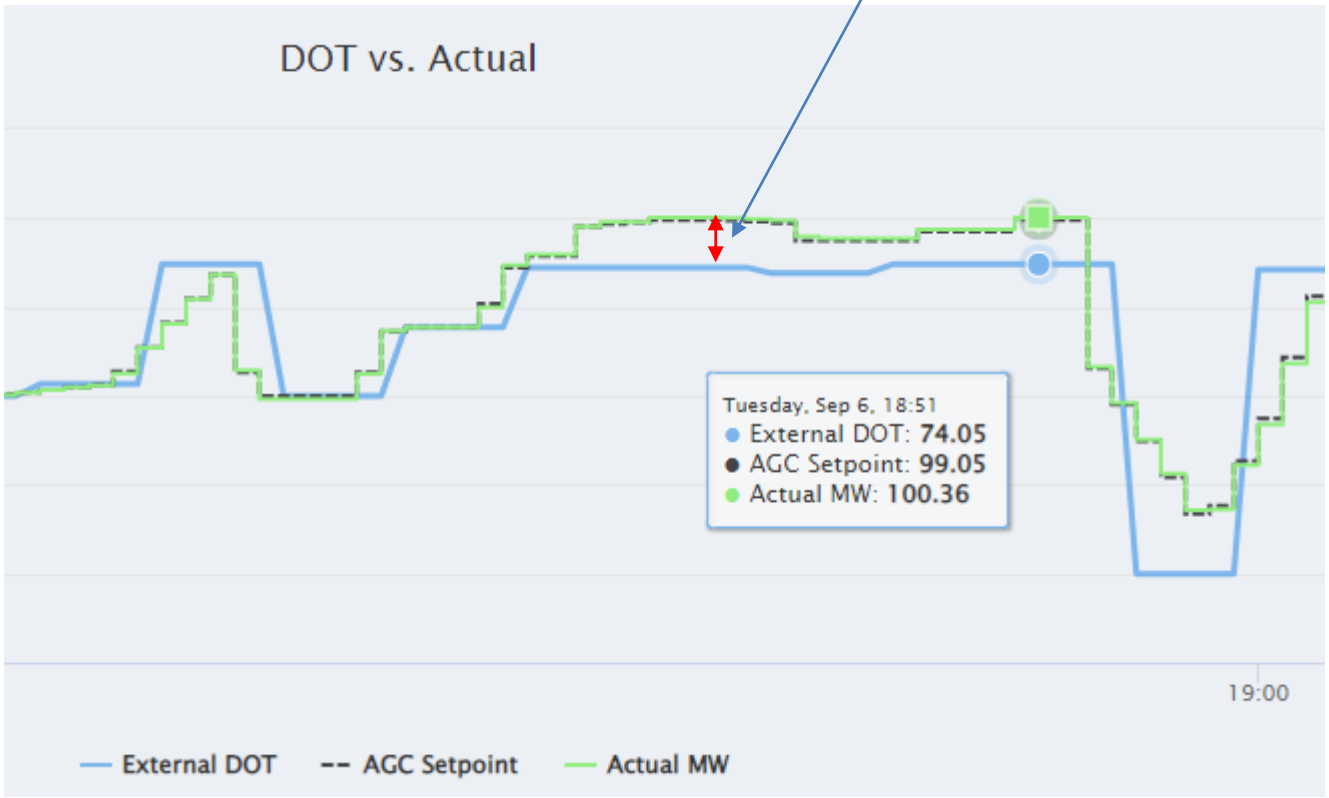
First RTD run to see the MSOC=472 in the horizon

Storage bids capped at $1,000 even when bid caps increased to $2,000 and clearing prices were above $1,000



Resources on regulation depleted SOC faster than projected by RTD

Following AGC signal uses up more SOC and changes RTD projections



Several storage resources were manually dispatched to maintain state of charge