



# Postmortem: A Slightly Different View on the Blackouts

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# Gridwell Consulting

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- Gridwell Consulting is an energy consulting firm located in Sacramento, CA
  - All things CAISO – Resource Adequacy, Energy Market, Interconnection, Transmission, Storage
  - Market design for ISO/RTOs
  - Market analysis
  - Expert Witness and Testimony

[www.gridwell.com](http://www.gridwell.com)

# About Western Power Trading Forum

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- 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

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Things constantly change – this presentation is based on our views as of October 2020

- The joint-agencies provided an excellent assessment of the root causes from their perspective
- Gridwell offers additional perspective and reflection from an industry viewpoint
- Many important considerations to reliability
- Provided by the WPTF CAISO Committee, so focus here is a little more on the CAISO

# Outline

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1. Reactions to the joint-agencies root cause analysis
2. Missing pieces
3. Take-aways & recommendations
4. Questions

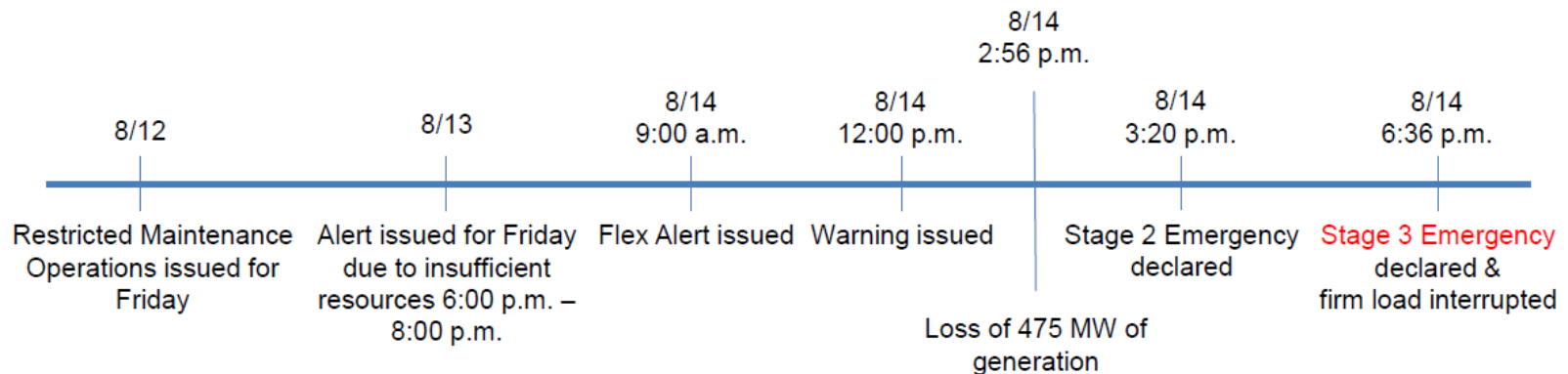
# Topic 1

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## REACTIONS

# Load-shed events in California

- CAISO declared a Stage 3 Emergency at 6:38 pm on August 14 because reserves had fallen below the minimum requirements. These are set by NERC/WECC at 6% of load. To maintain compliance, the CAISO initiated rotating outages for about an hour.
- This affected approximately 492,000 customers for a duration of 15 minutes to 150 minutes.



Source: [California ISO](#)

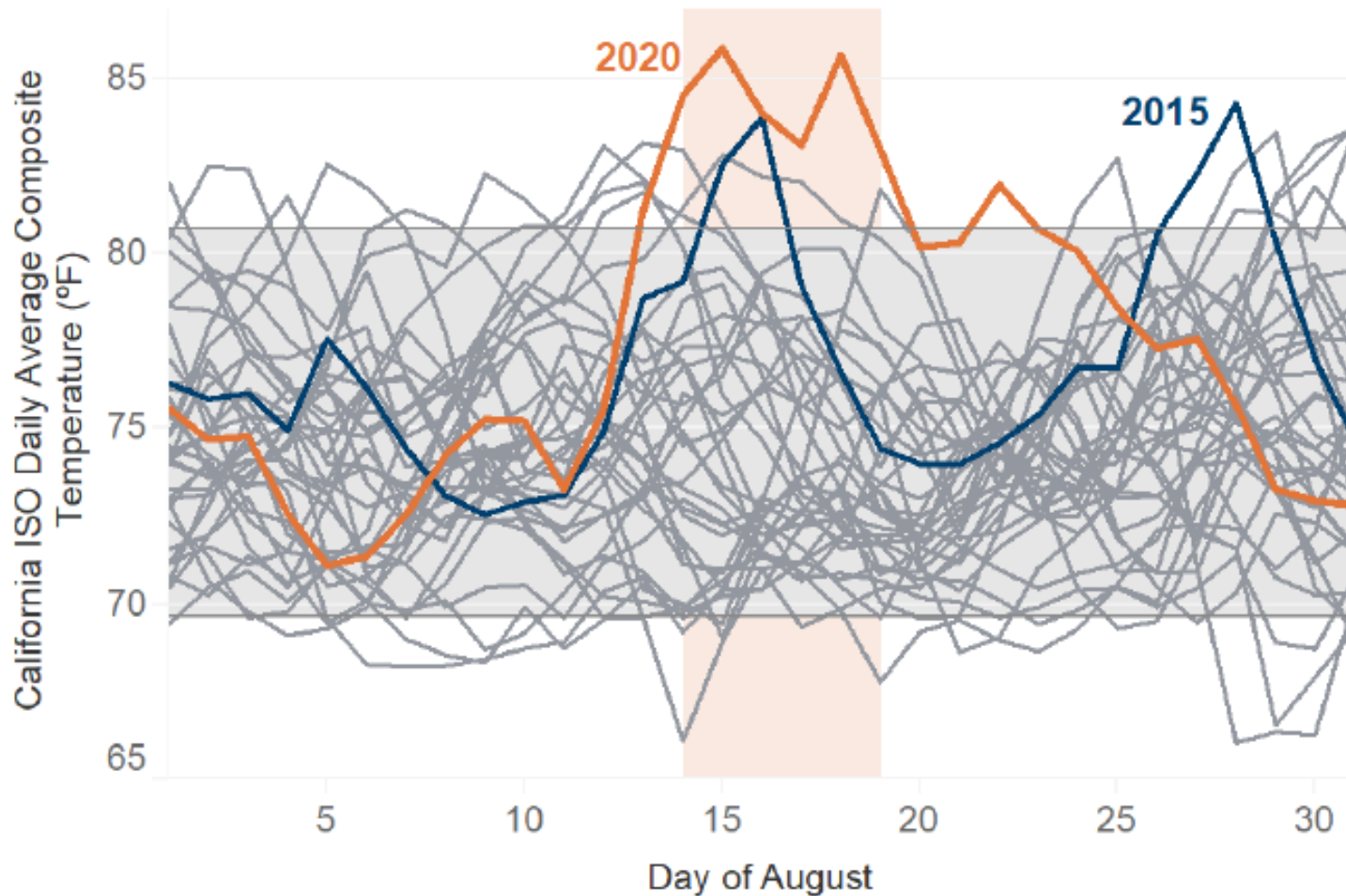
# Preliminary root cause findings

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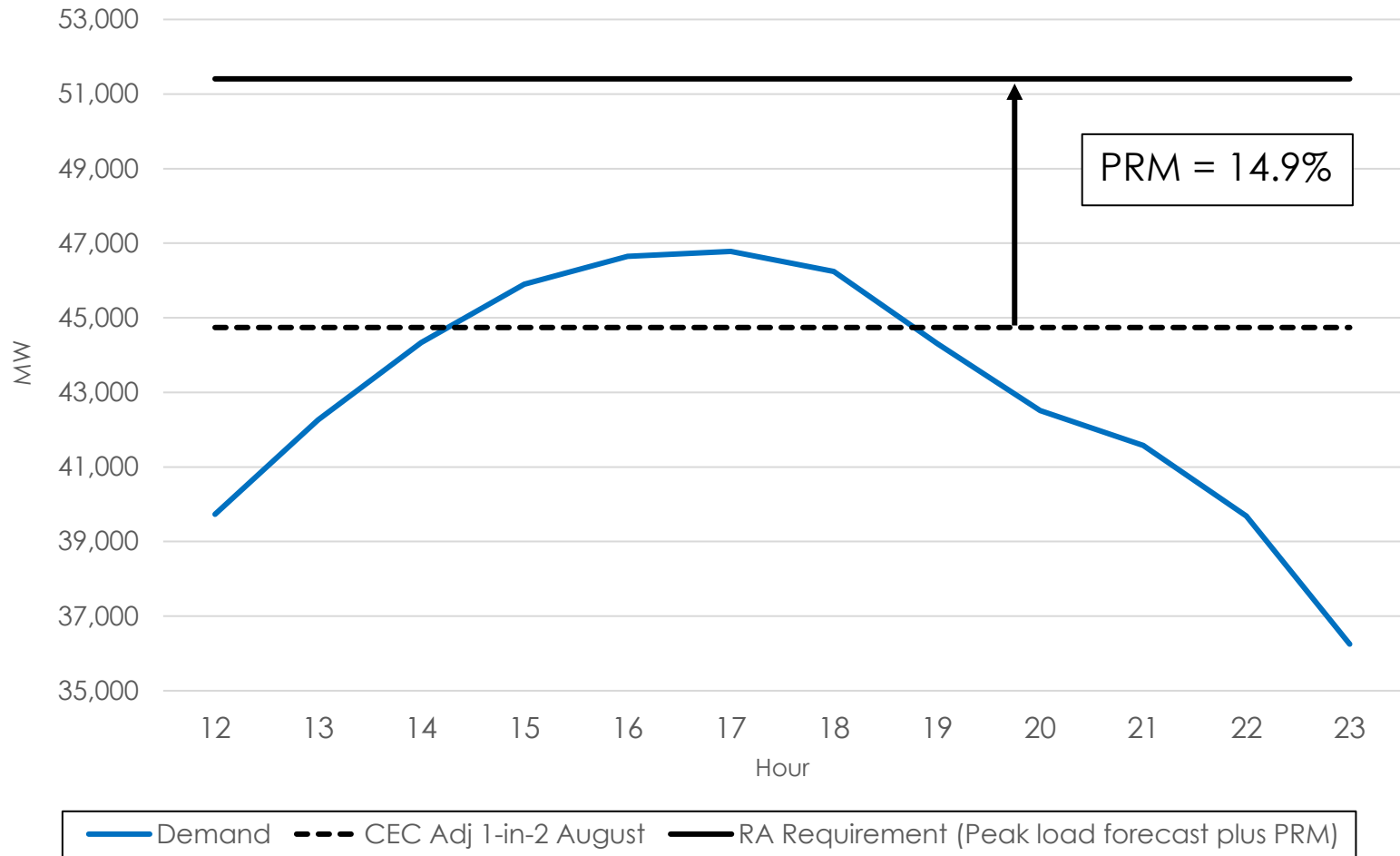
1. There was “an extreme heat storm”
2. Resource planning targets have “not kept pace to lead to sufficient resources that can be relied upon to meet demand in the early evening hours”
3. “Some practices in the day-ahead energy market exacerbated the supply challenges under highly stressed conditions”



# 1. Extreme heat storm (1 in 35 weather event)



# 8/14 actual demand compared to RA requirement

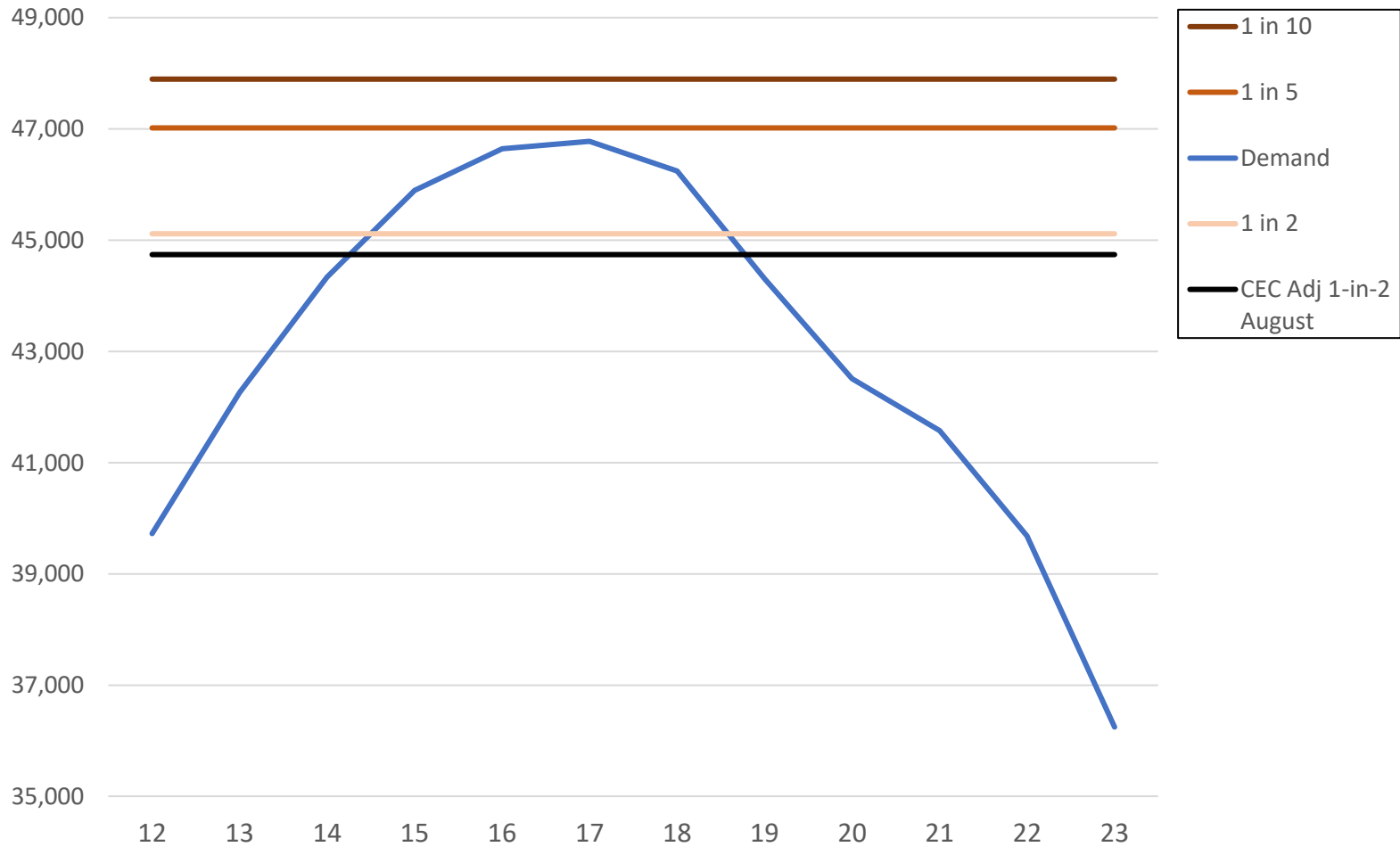


# Heat and demand

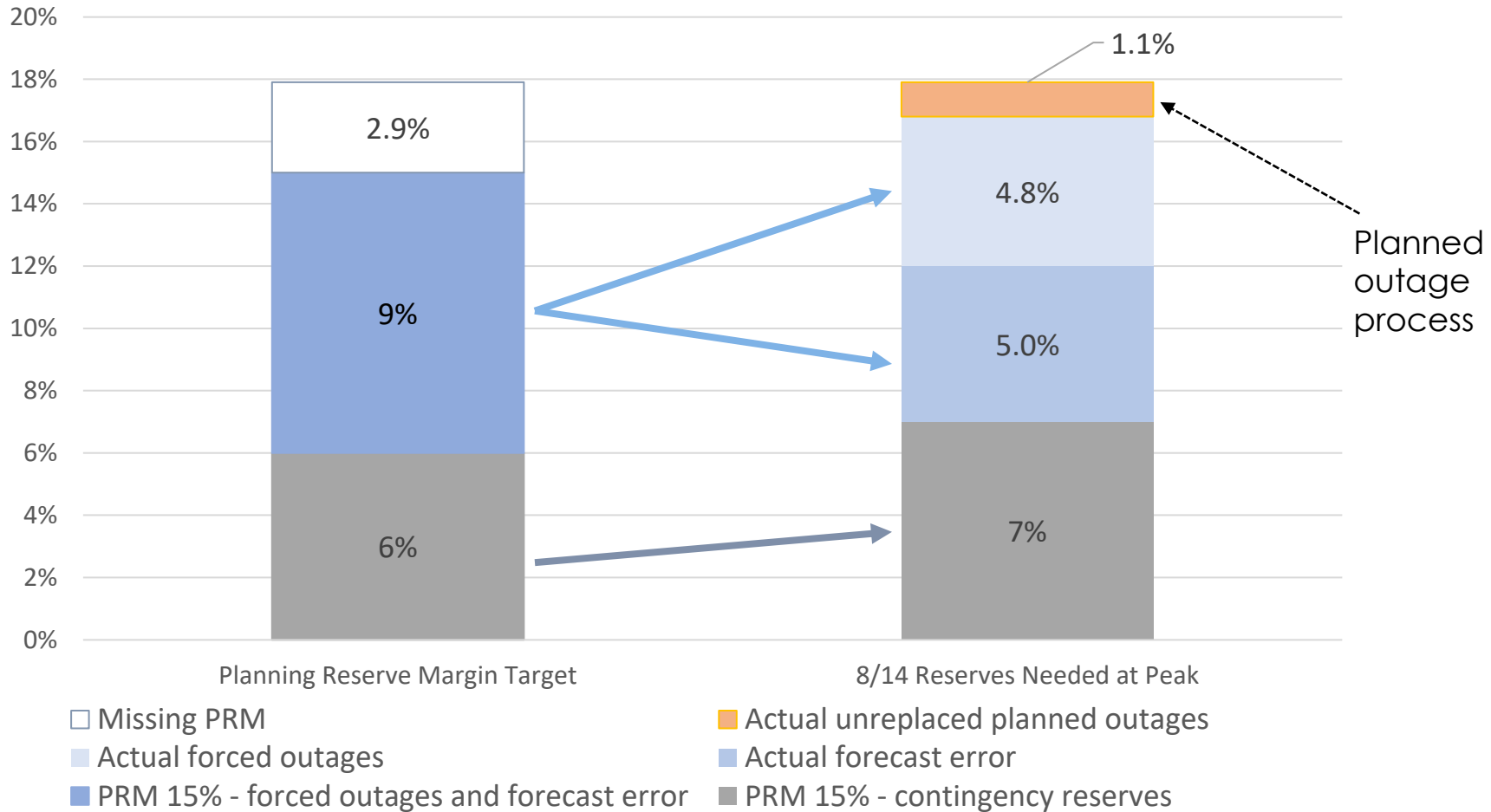
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- RA requirement is made up of CEC forecasted peak load and a planning reserve margin ~15%
- Weather only makes up a portion of why demand changes, so a 1 in 35 heat storm does not translate into a 1 in 35 peak load forecast
- Heat played a role, but would not say it was a main driver of load shed events
- That said, something broke down in the RA requirement -
  - Peak load forecast
  - Planning Reserve Margin

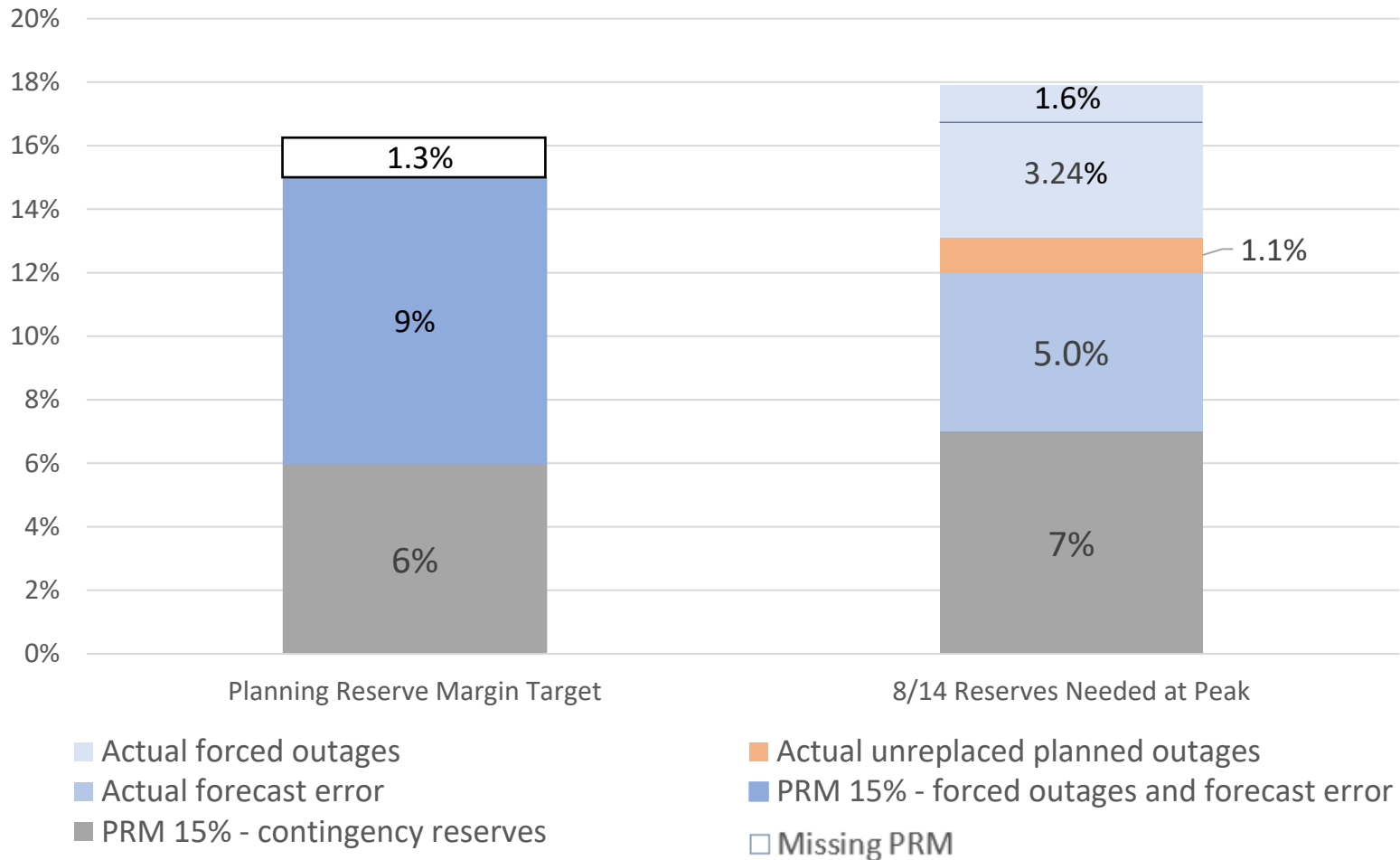
# 8/14 demand compared to CEC forecasts



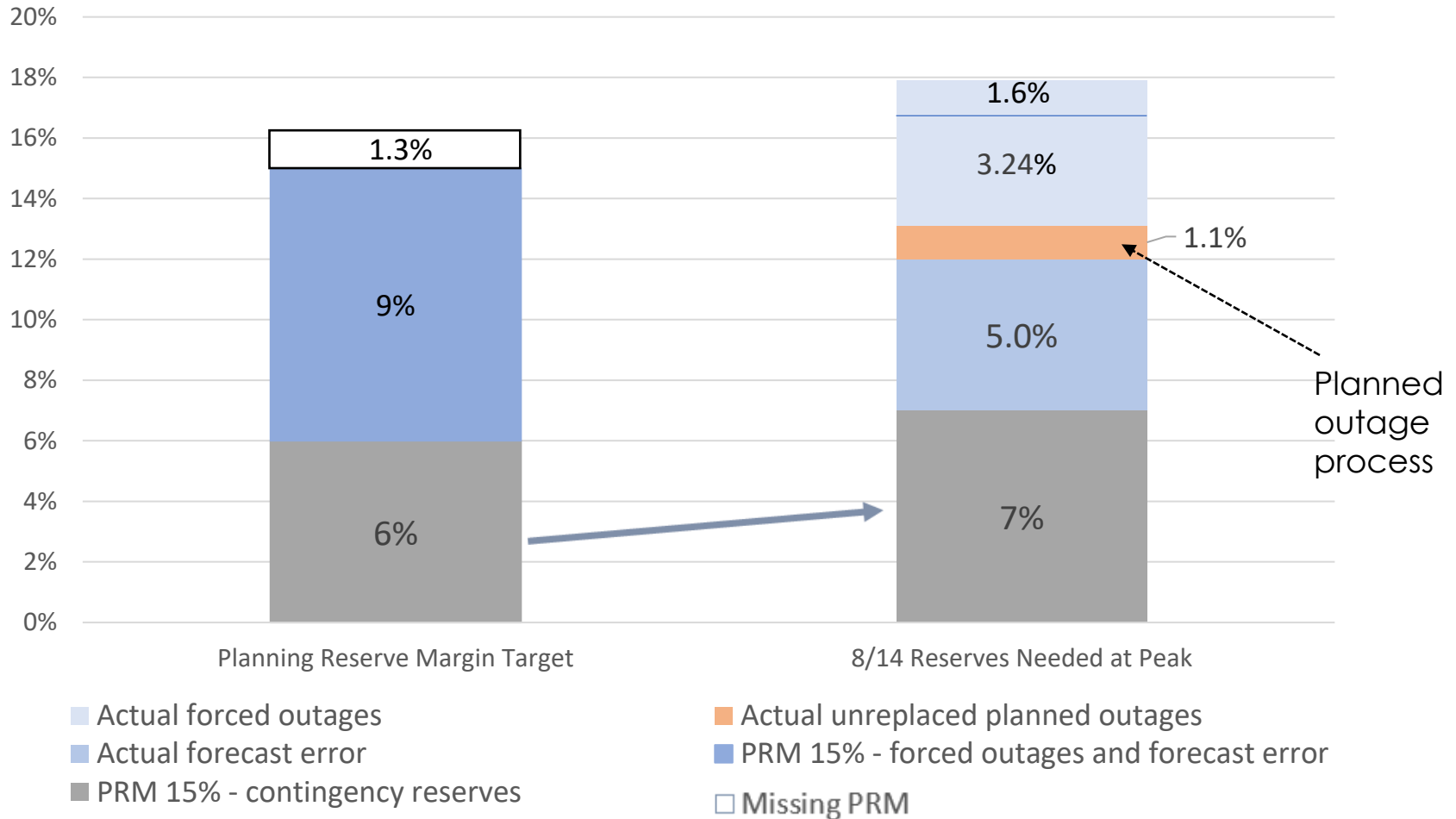
# Planning reserve margin breakdown



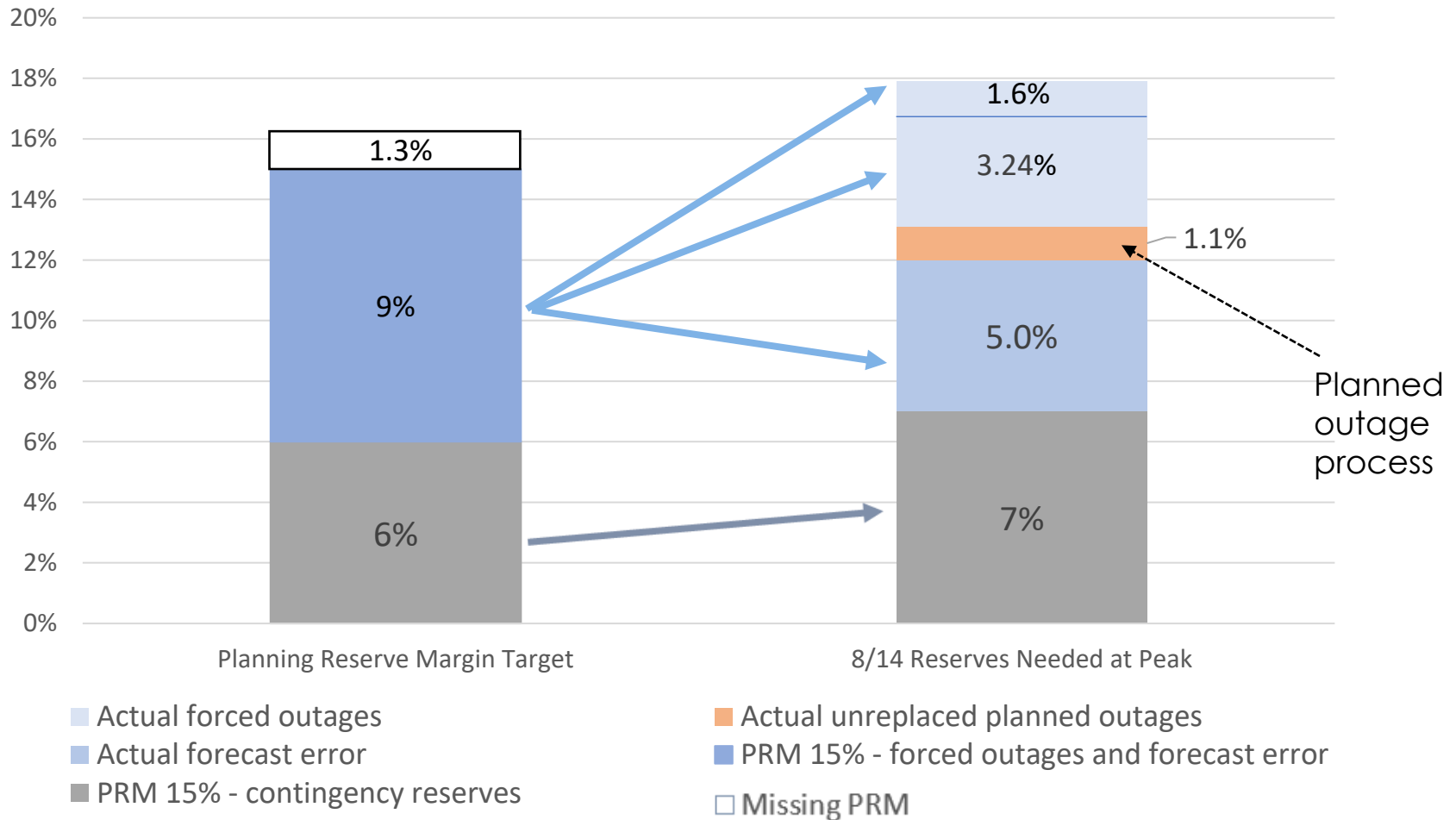
# Scenario 1: Derate *predictably* unavailable thermal capacity upfront



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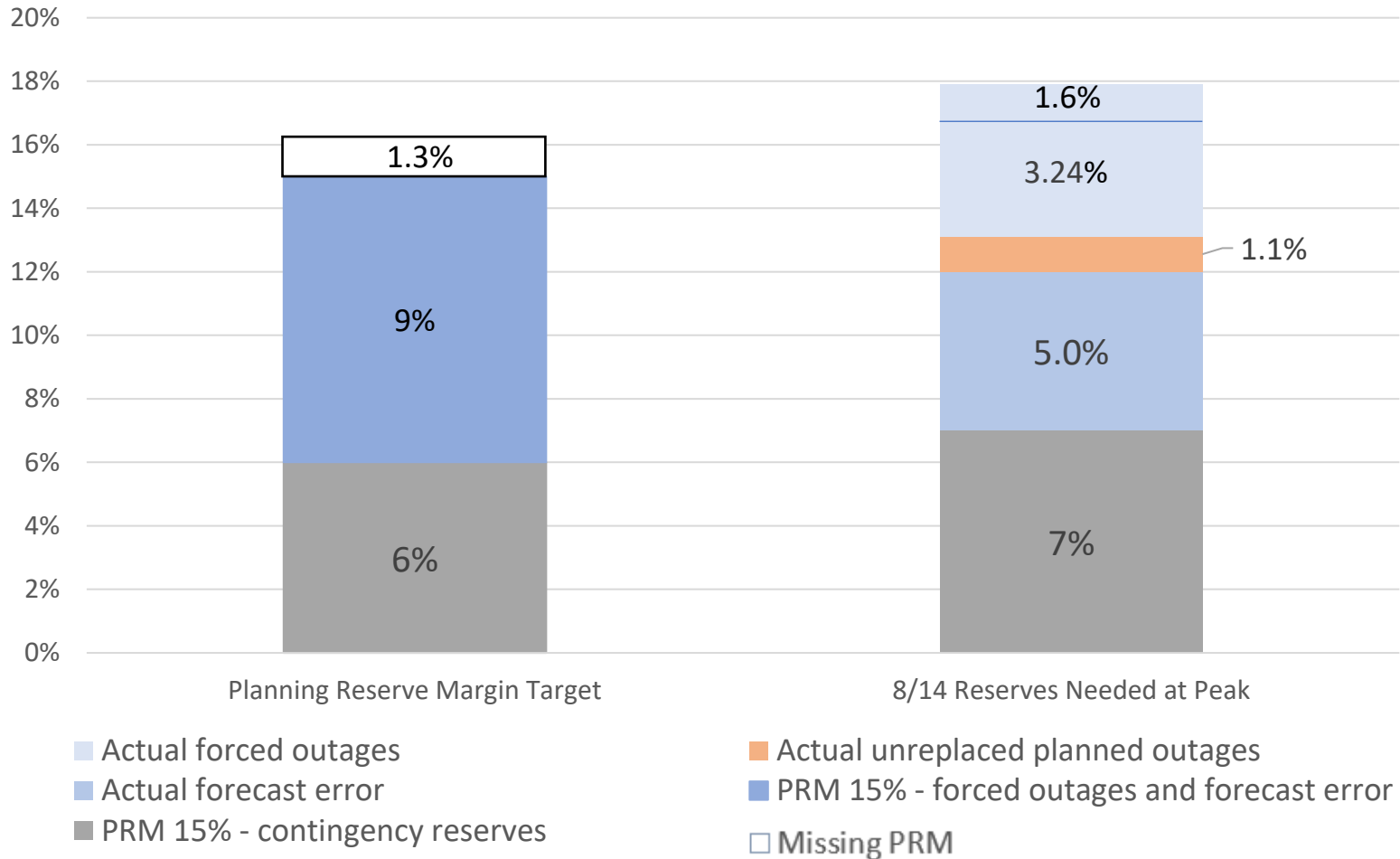


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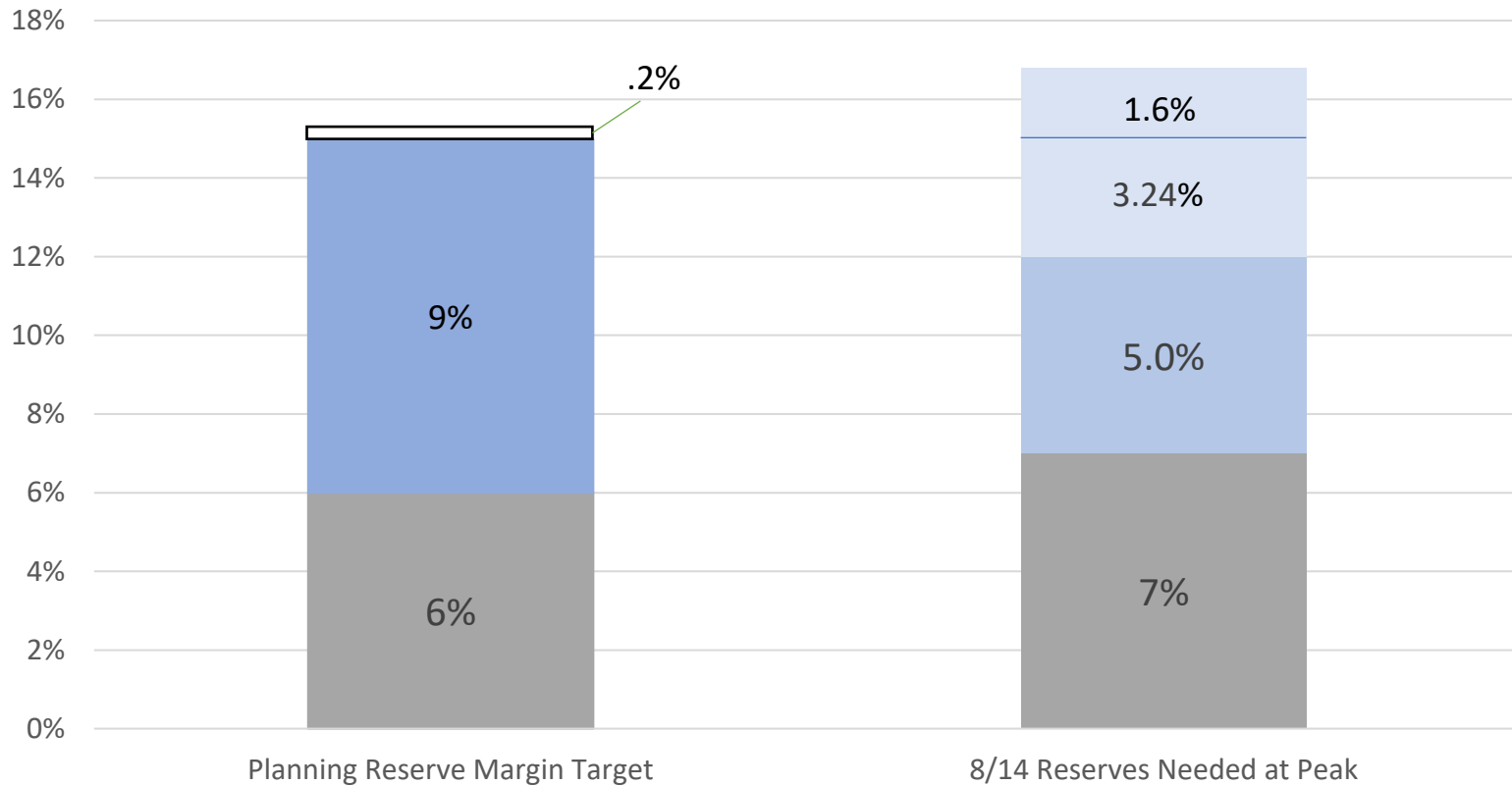




# Scenario 1: Derate *predictably* unavailable thermal capacity upfront



# Scenario 2: Backstop for unreplaced planned outages and derate ambient derate due to temp



□ Missing PRM

■ Actual forced outages

■ PRM 15% - forced outages and forecast error

■ Actual forecast error

■ PRM 15% - contingency reserves

# Root-cause assessment – heat storm

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## Reason for blackout

1. There was an  
extreme heat  
storm



## Narrow implication

The CEC  
demand  
forecast was  
too low



## Gridwell analysis

- RA  
*requirement* is  
too low
- Low hanging  
fruit yields large  
increases in  
reliability
- 1 in 10 LOLE  
study should  
be updated

# Fun history on planning reserve margin

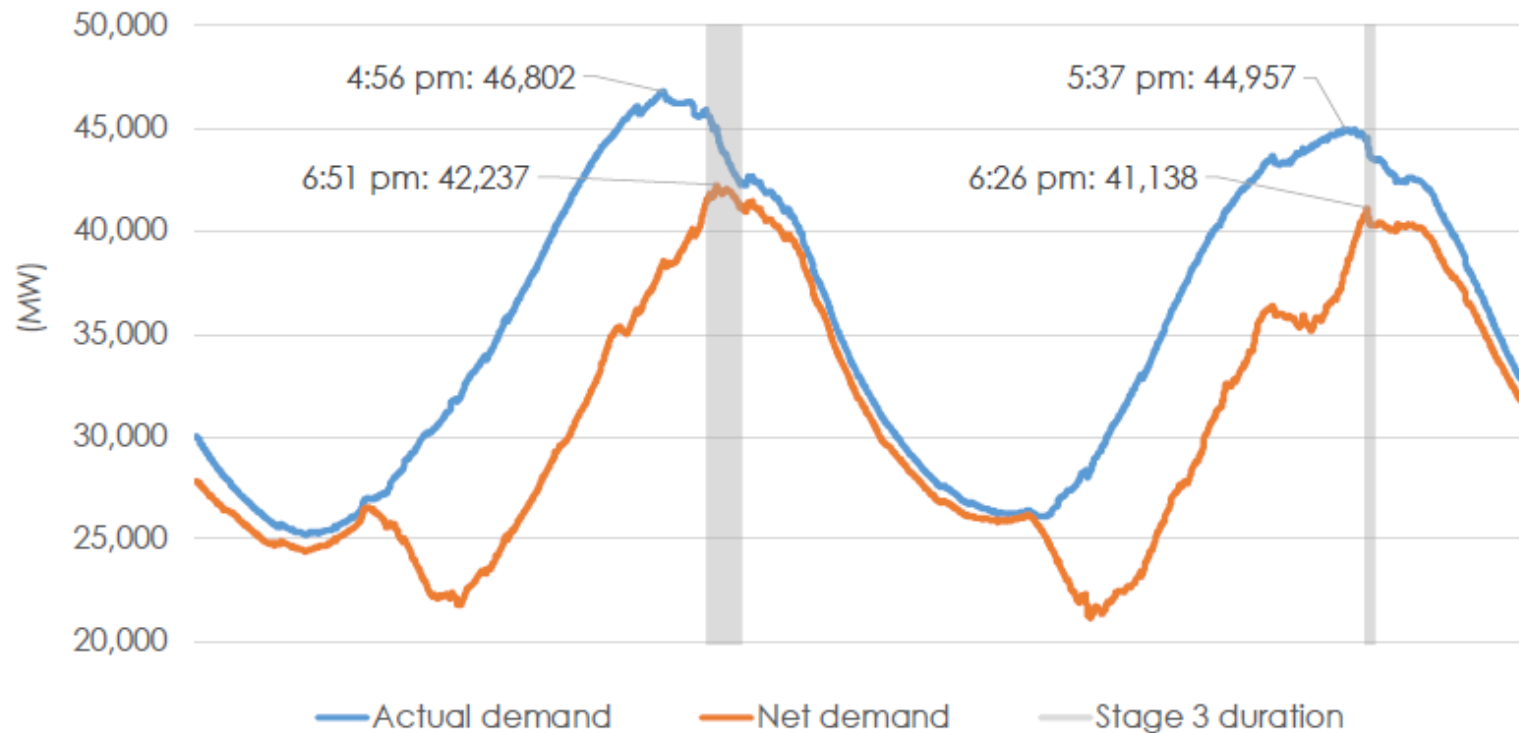
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CAISO/CPUC's last [PRM study](#) from 2010, "Replacing [once-through-cooling] thermal capacity with renewable additions that had a capacity value of only 36% significantly increased the PRM from 8.7% to 27.2%."

- 66% of OTC were replaced by solar
- This implies a needed PRM of 17.97%
- The needed PRM on 8/14 was 17.9%

## 2. Net demand challenges

Figure ES.2: Demand and Net Demand for August 14 and 15

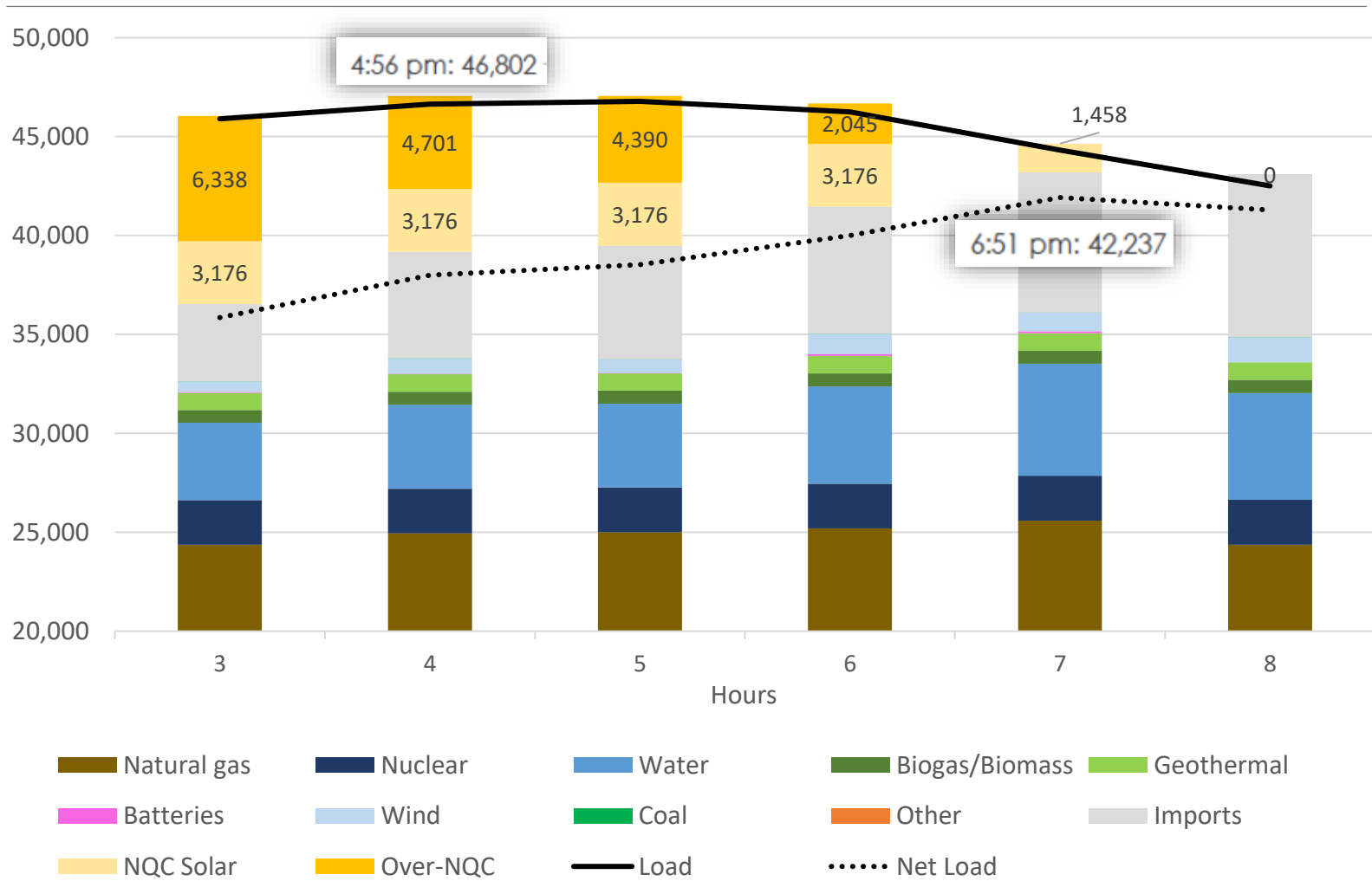


# Net demand (load minus wind + solar)

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- CAISO [presentation](#) and [Q&A](#) emphasized renewables are not the problem, it's planning that needs to be better done
- Gridwell's analysis does not support the need for additional net peak load planning in the short-term
- Fixes to the peak load will inherently solve the net peak load, until
  - 4-hour storage becomes main replacement for thermal capacity

# Solar contribution to peak and net peak on August 14



# Root-cause assessment – net peak load

## Reason for blackout

2. Resource planning targets do not account for early evening hours

## Narrow implication

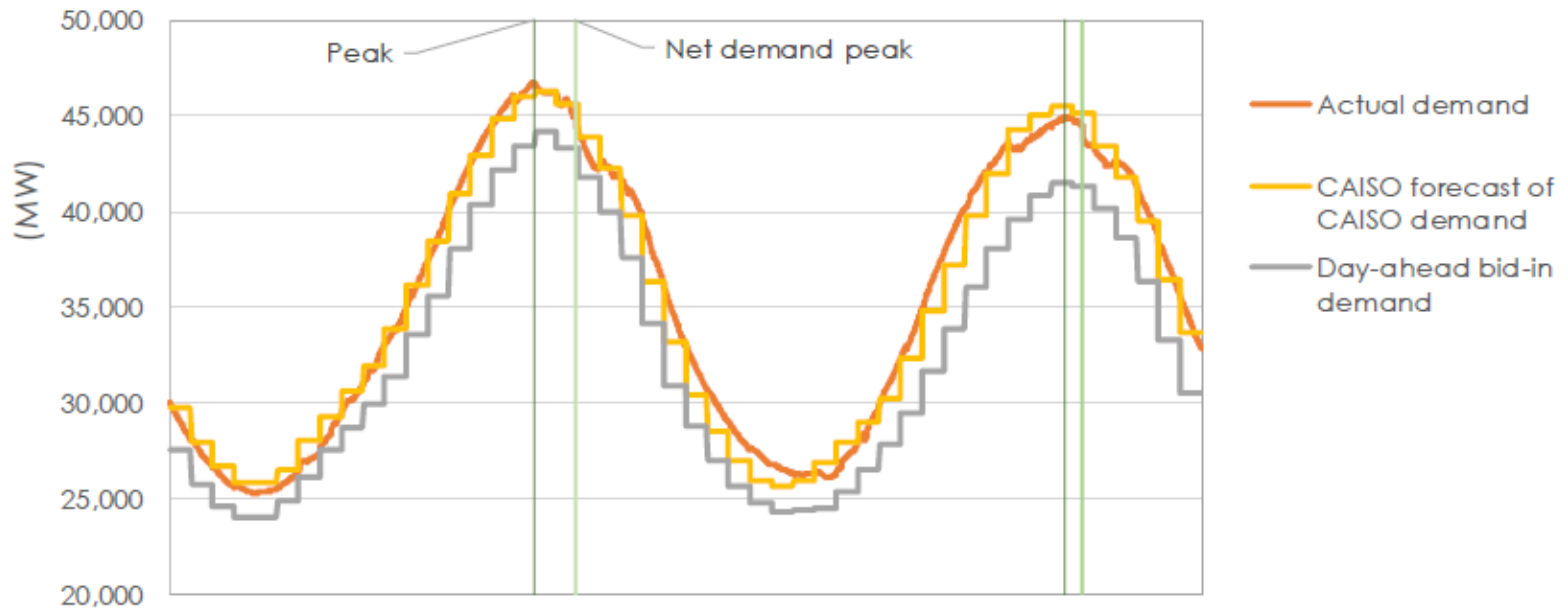
RA targets should be created for net peak load

## Gridwell analysis

- 4-hour storage as a solo solution concerning
- Current RA counting rules for solar seem appropriate to meet net peak demand



# 3. Day-ahead practices exacerbated supply challenges



Day-ahead bid-in demand below actual:

	<u>8/14</u>	<u>8/15</u>
At peak:	3,386	3,434
Time of net demand peak:	1,792	3,219

# Day-ahead market

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- Integrated Forward Market (IFM)
  - Virtual and physical bid-in demand cleared against virtual and physical bid-in supply
  - Financial market
- Residual Unit Commitment (RUC)
  - Adjusted physical supply cleared against adjusted CAISO forecast of CAISO demand
  - Reliability market

# Day-ahead market challenges

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- Load under-scheduled in the IFM, which caused relatively higher amount of exports to be scheduled
- RUC, due to implementation defect, when clearing adjusted physical supply against CAISO forecast of CAISO demand, relaxed the system power balance constraint
  - Thus, rather than cutting exports in RUC, these were allowed to flow through to real-time as higher priority self-schedules

# Root-cause assessment

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## Reason for blackout

3. There were challenges in the day-ahead market



## Narrow implication

Load is inappropriately under-scheduling



## Gridwell analysis

Market systems need periodic auditing

# Overall reaction preliminary results

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- Joint agencies provided strong foundation and data for agencies and industries to continue assessment
- General observations
  - Focused on Resource Adequacy rather than longer-term planning challenges
  - No indication that issues are quick to resolve
  - Will continue to rely on imports and large amounts of storage/hybrids coming online

# Topic 2

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## MISSING PIECES

# Notable missing pieces

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1. Energy market pricing
  - Imports and Energy Imbalance Market
2. Resource planning improved coordination

# 1. CAISO and EIM BAA Real-time Energy Prices

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- Accurate price formation is key in any functioning competitive market
  - As supply tightens, one would expect prices to increase, signaling the need for additional supply
- External suppliers react to CAISO market signals when making the decision as to where to sell energy (e.g., into CAISO BAA or elsewhere via bilateral market)
- In the EIM, CAISO market prices also “compete” with the EIM BAA market prices for additional transfers

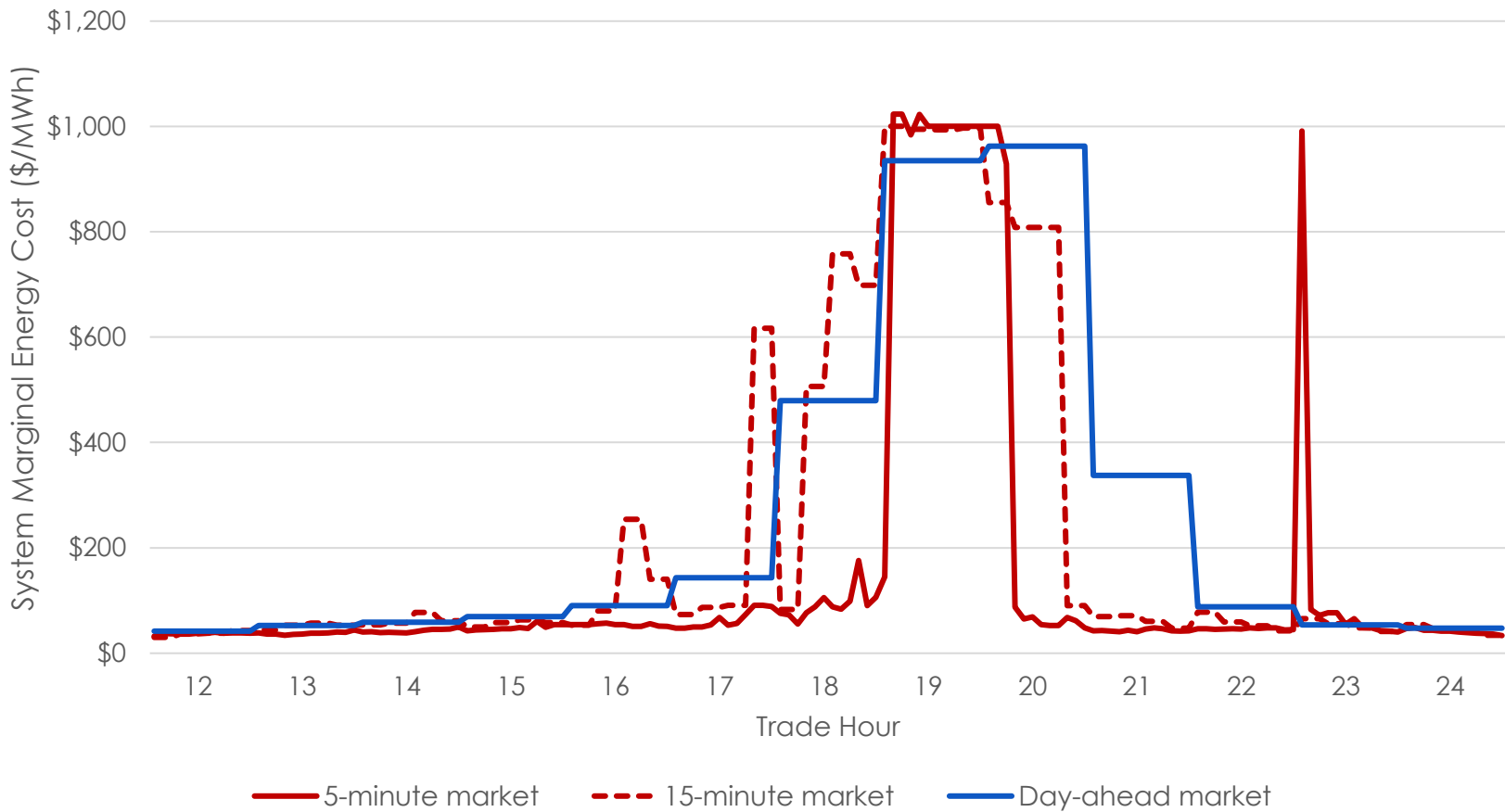


# EIM Transfers into CAISO BAA

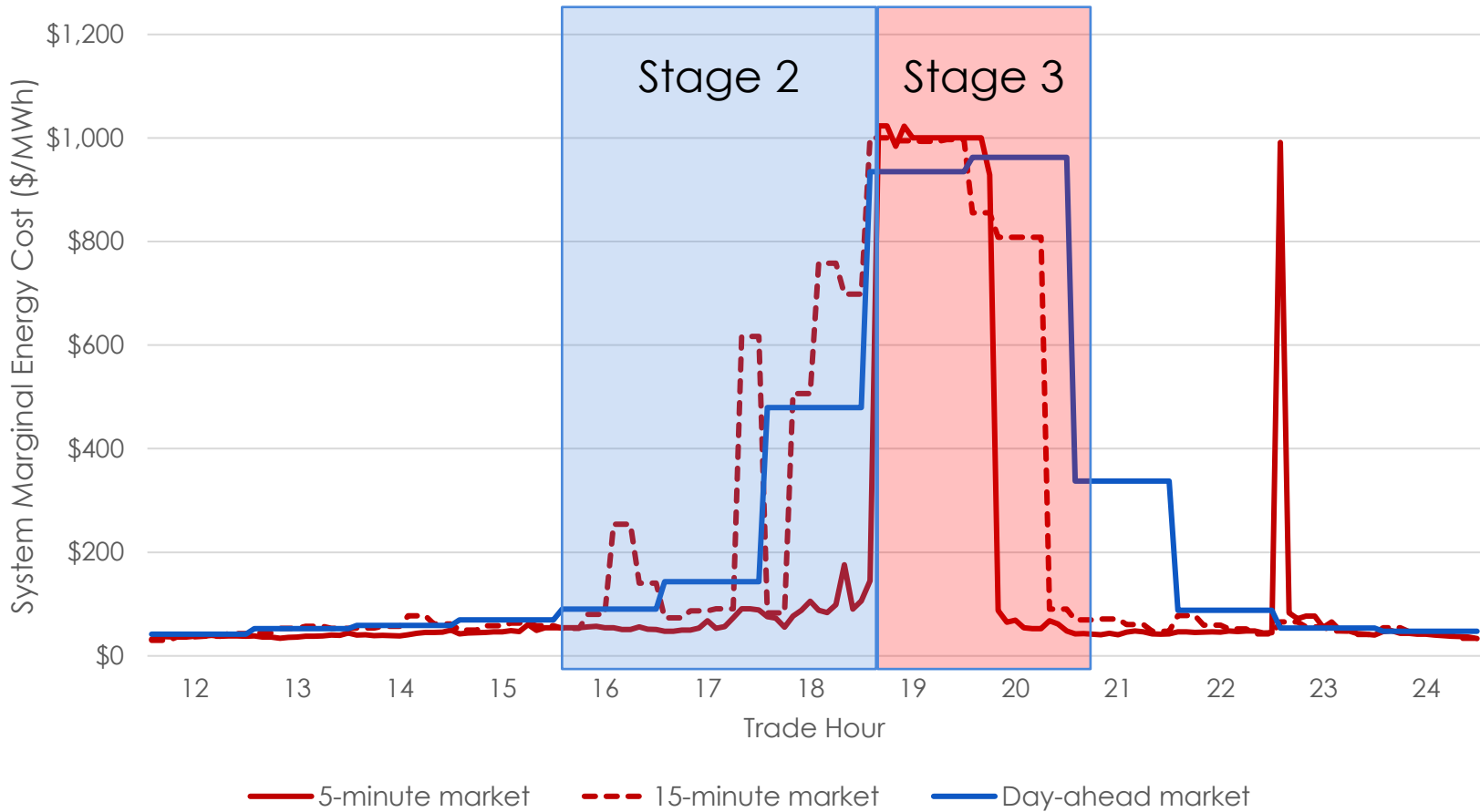
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- Prior discussion as to whether or not the CAISO BAA failing flex ramp up sufficiency test impacted supply into CAISO
  - Imposes an “import” transfer limit
  - CAISO has shown (and Gridwell verified) that 5-minute EIM Transfers into CAISO BAA were below the imposed limit
- EIM Transfers into CAISO BAA seemed to be higher on Aug 14 than prior week
- But don't forget, EIM transfers are price responsive
  - Price differences between EIM and CAISO BAAs
  - Differences between 15-minute and 5-minute prices

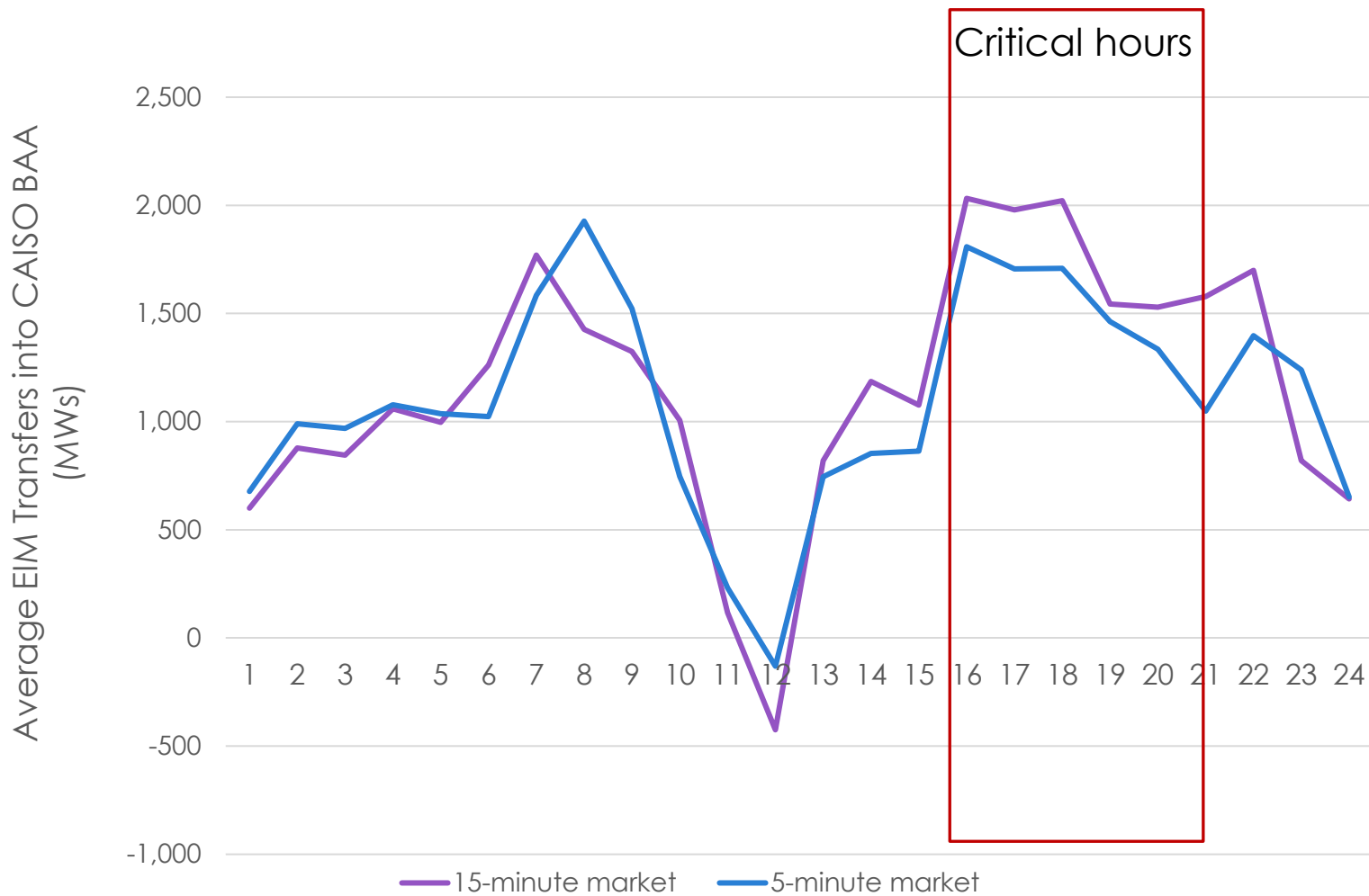
# CAISO 5-min prices diverge from day-ahead and 15-minute prices



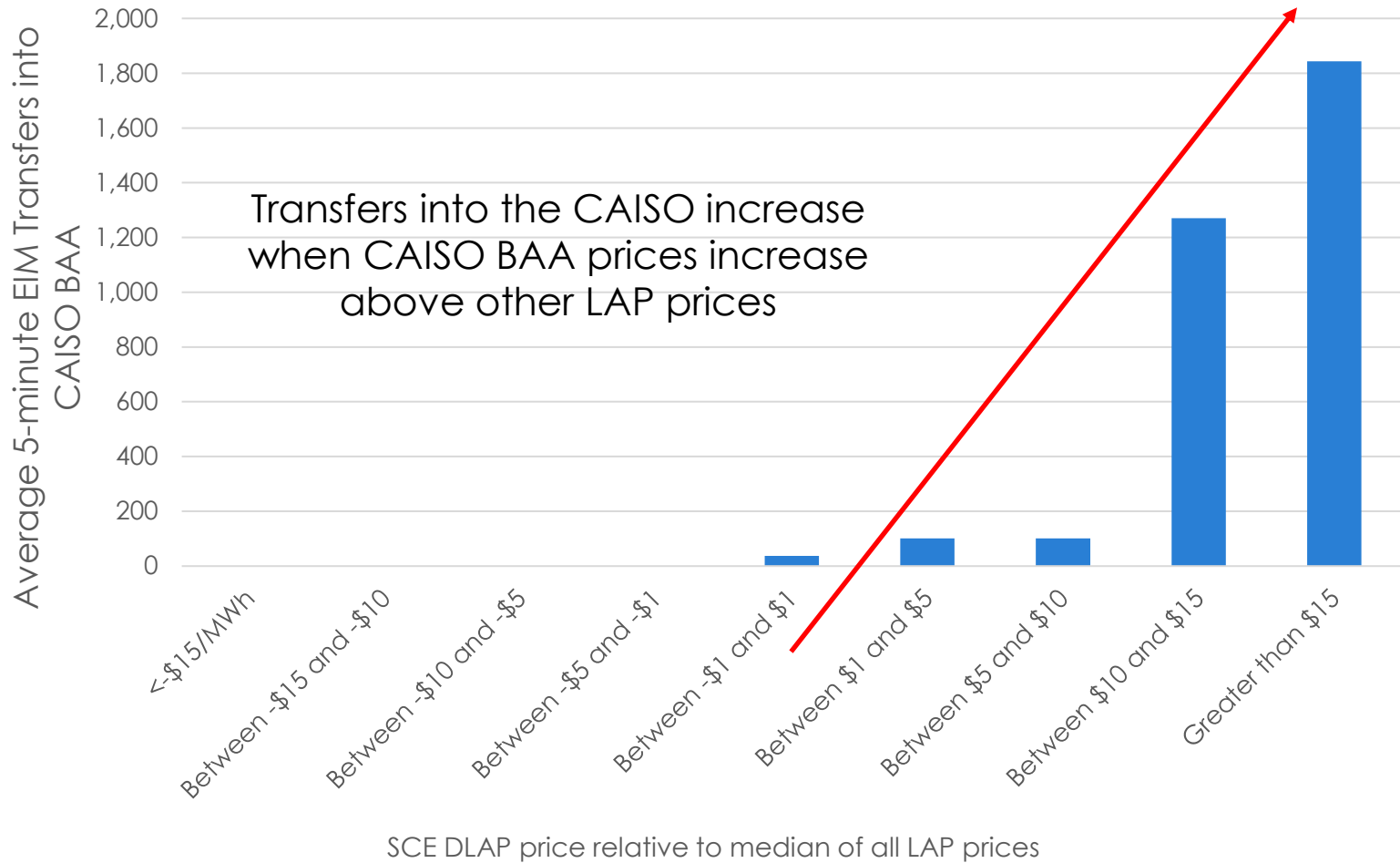
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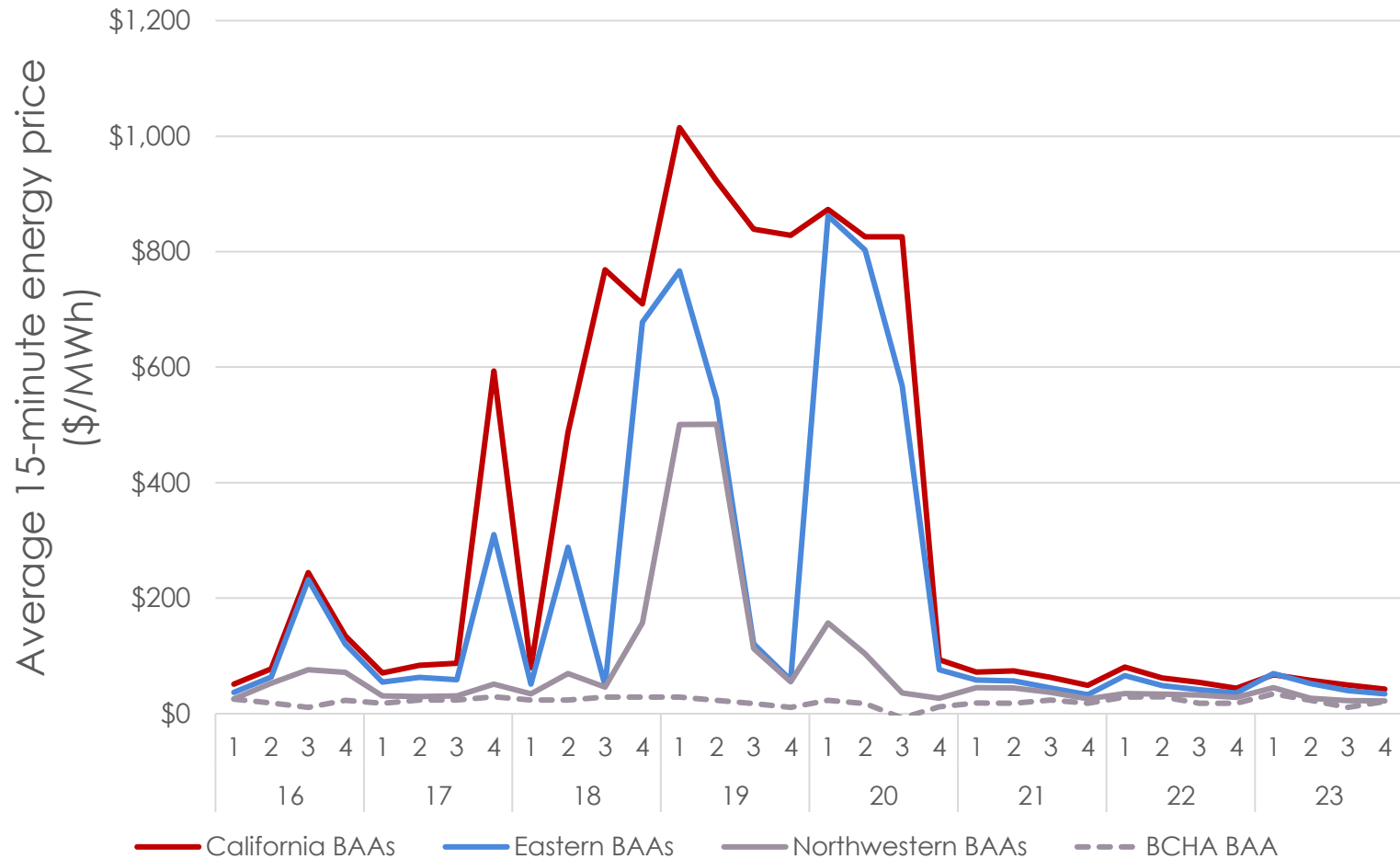
# However, the 5-minute market was dec'ing EIM transfers on August 14, 2020



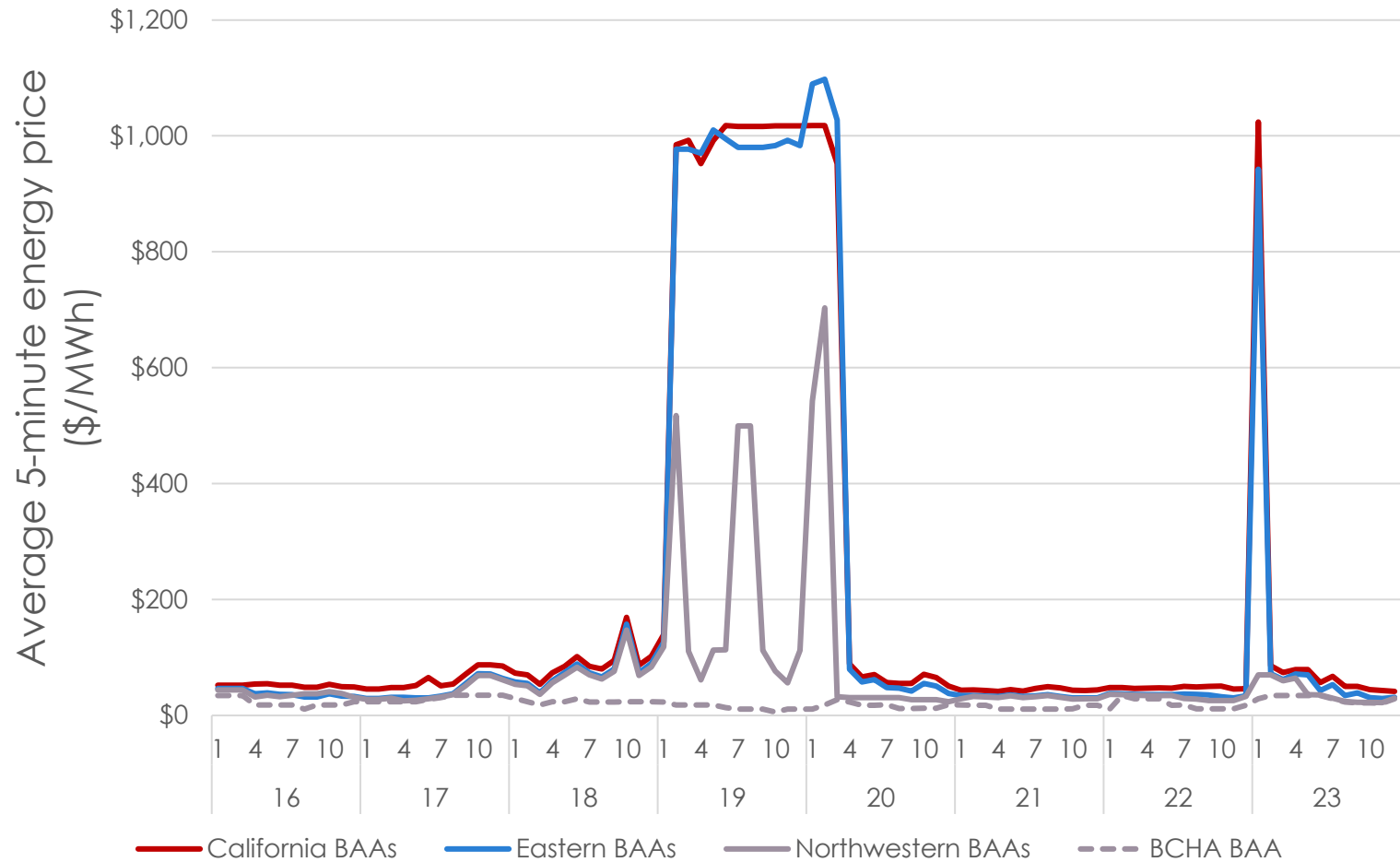
# EIM Transfers into CAISO BAA are price responsive



# 15-minute Load Aggregation Point Prices: August 14, 2020



# 5-minute Load Aggregation Point Prices: August 14, 2020



# Several factors that may contribute to price divergence in CAISO BAA

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- 15-minute market co-optimizes with ancillary services
  - Allows prices to gradually increase as conditions tighten when procuring additional A/S
  - Includes A/S Scarcity Pricing Mechanism
- Operator adjustments in the 15-minute market
- Imports are cleared in the Hour-ahead and 15-minute markets
  - Come in as self-schedules in the 5-minute market



# Current CAISO policy development will adversely impact price formation

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- FERC Order 831 will only allow prices to rise to \$2,000/MWh under limited conditions
  - Mute much needed price signal and deter additional voluntary import supply
  - Market will relax the CAISO power balance constraint, but keep prices at the “last cleared economic offer” unless shortage is more than 233 MWs
  - In practice, may be in A/S shortage conditions AND energy shortages but prices will remain at the last cleared marginal energy offer

# Current CAISO policy development will adversely impact price formation

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- System Market Power Mitigation will suppress market prices during tight supply conditions
  - Proposed test has the tendency to result in false positives, applying mitigation when uncompetitive conditions do not exist
  - Test would have been triggered ~50% of 15-minute intervals from HE13-21 on August 14, 2020
- Absent scarcity pricing reform, CAISO prices will be unable to attract additional supply, especially during west wide heat wave events

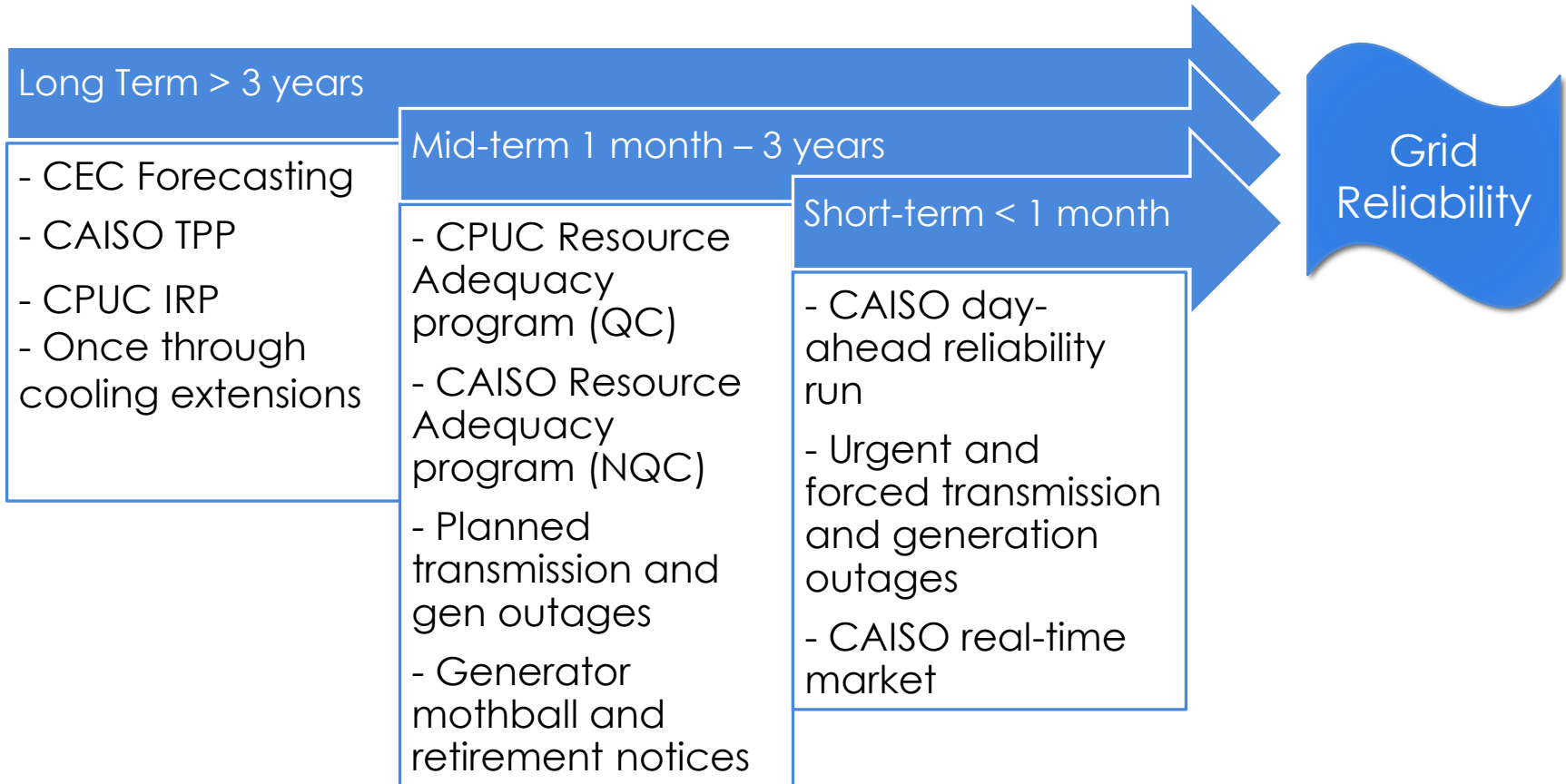
# Missing piece conclusion

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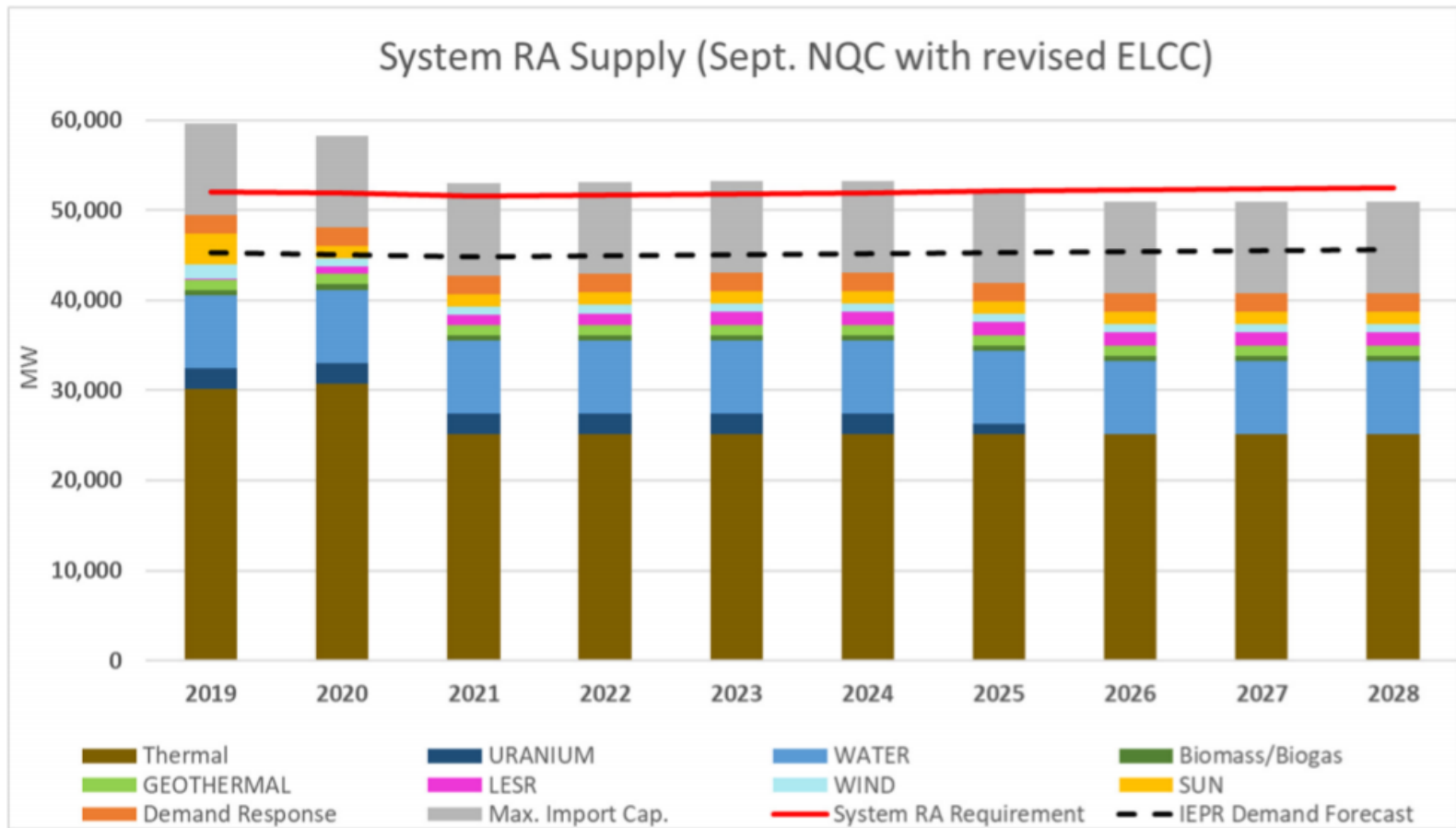
- Energy markets matter
- Price formation matters

## 2. Reliability planning timelines

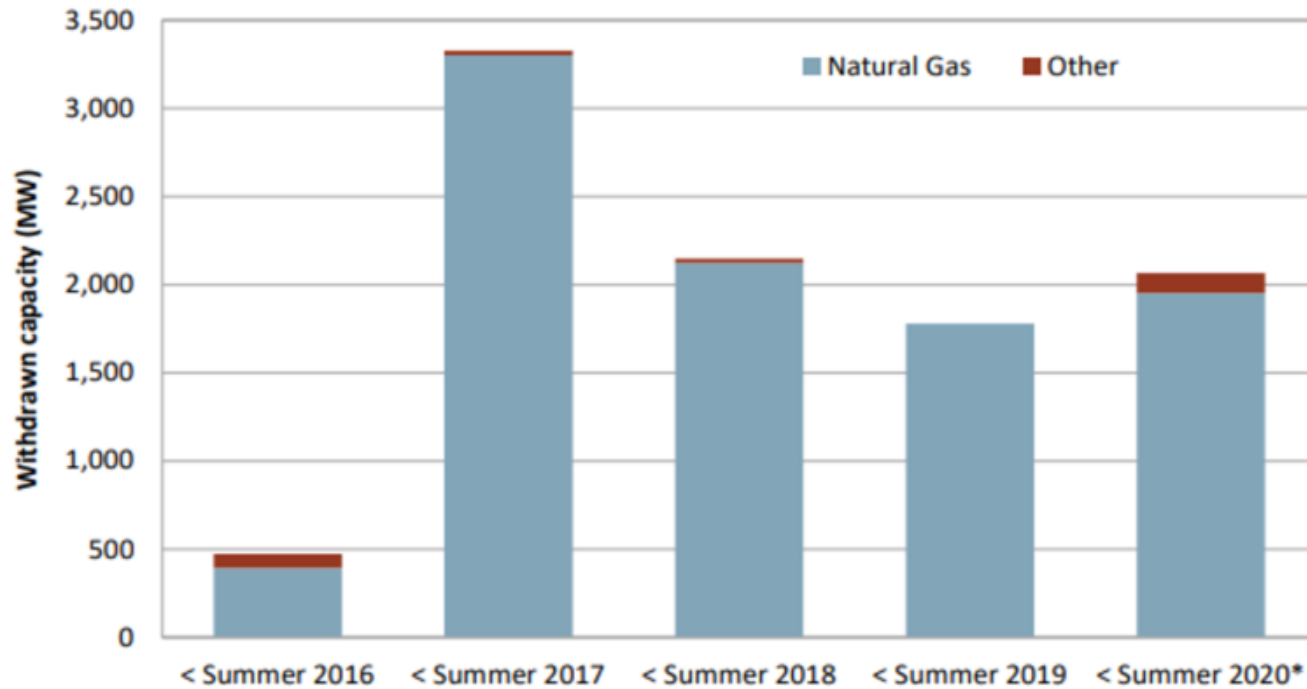
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# Foreseeable capacity shortage



# Natural gas retirements

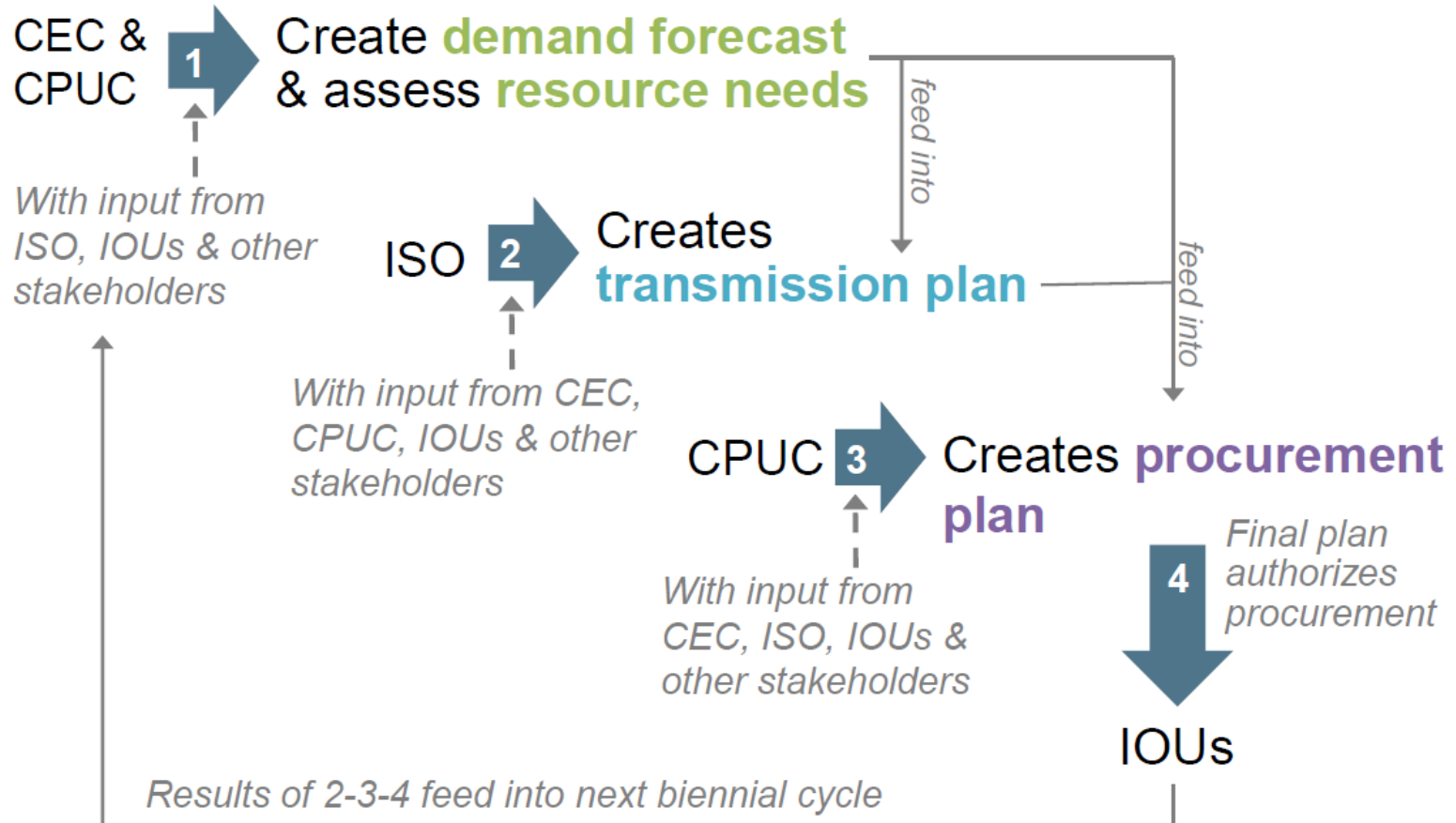


OTC Retirement (Based on NQC)	
< Summer 2016	335
< Summer 2017	2,927
< Summer 2018	430
< Summer 2019	840
< Summer 2020	1,070

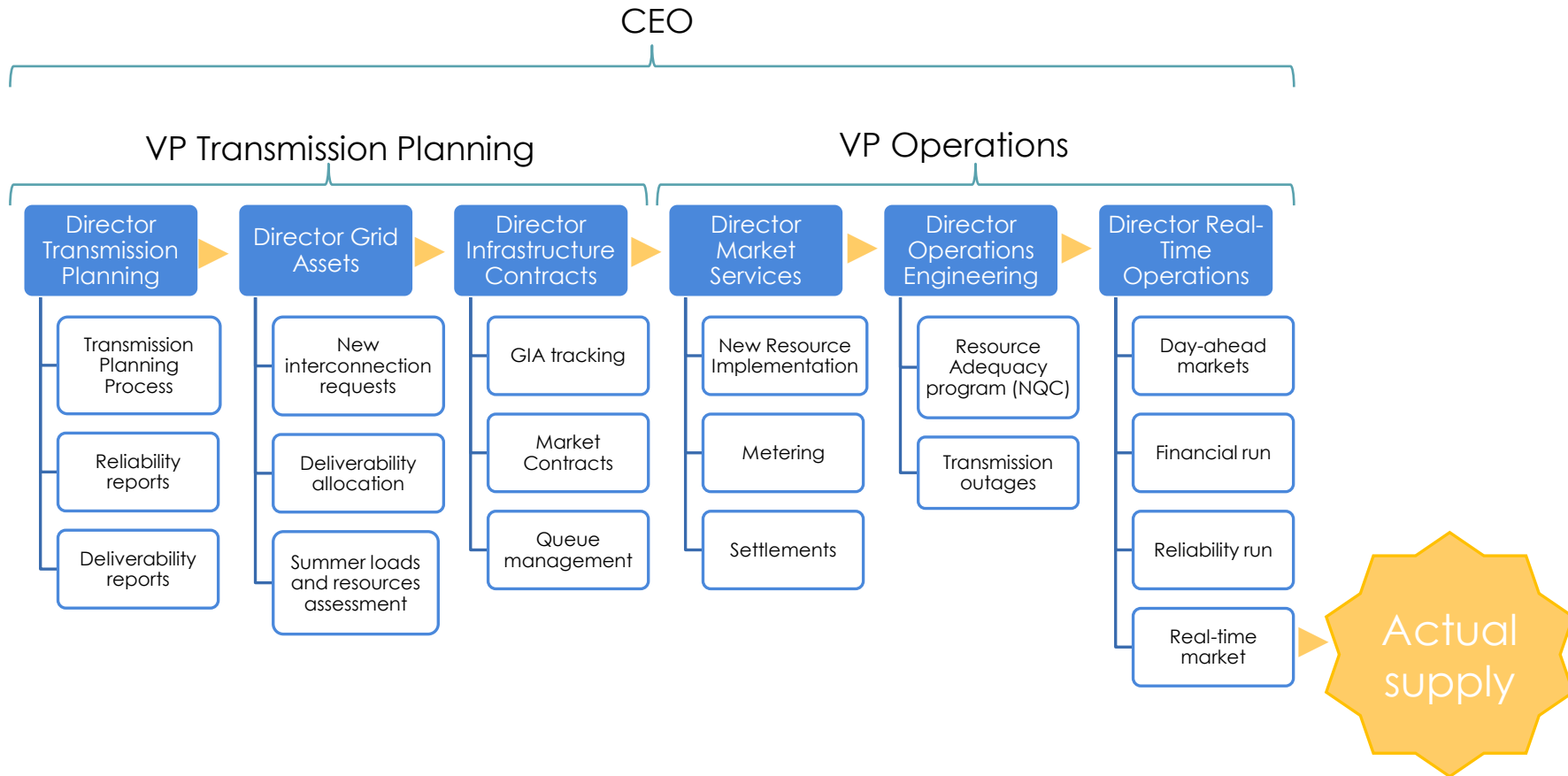
SOURCE: DMM 2019 Annual Report

- 5,602 MW of OTC retirements; ~1,900 MWs repowered with natural gas
- 9,800 MWs of retirement; 98% natural gas from 2015 - 2020

# Reliability planning is complicated and is across the agencies

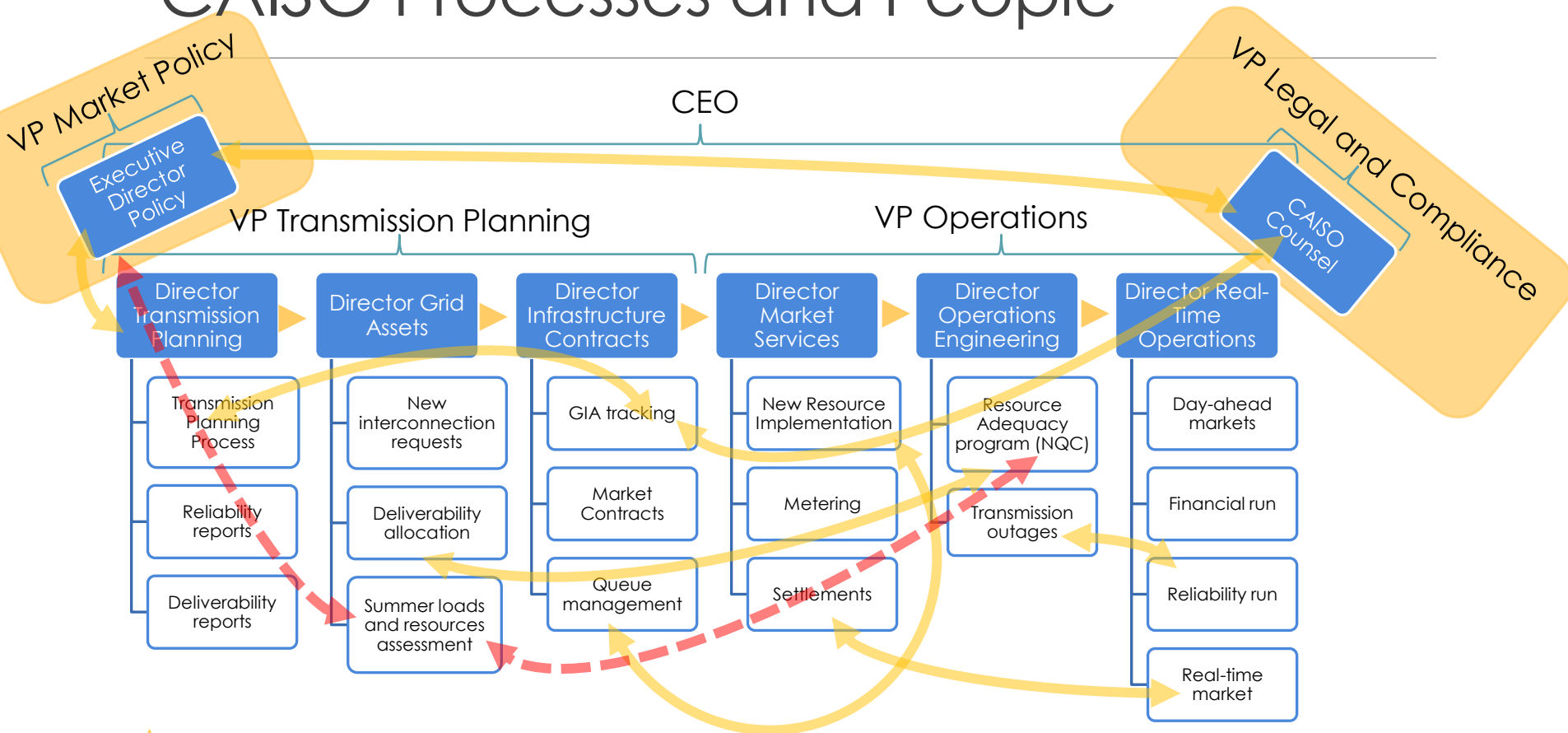


# How Reliability Planning Translates to CAISO Processes and People





# How Reliability Planning Translates to CAISO Processes and People



- ⚠ Complex to navigate issue resolution (customers and agencies)
- ⚠ Different scope and vocabulary across reports and systems
- ⚠ Missing links

# CAISO NQC List

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## WHAT IT IS

- Portion of a resource that may count on an RA plan

## WHAT IT IS NOT

- An indication that any individual resource will be available in the future
- A guarantee that the capacity is online or available
- A comprehensive list of expected resources or imports

# Uses for NQC list...

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- CPUC uses the NQC list for long-term planning
  - OTC retirement assessment
  - Integrated Resource Planning Model
- Developers/asset owners use the NQC list as input into supply/demand studies to determine whether to invest in capacity increasing upgrades, dynamic transfers, or retire
- This is causing gaps in planning and development

# Topic 3

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TAKE-AWAYS & RECOMMENDATIONS

# Root-cause initial recommendations

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1. Update the resource and reliability planning targets to better account for heat storms and a transitioning resource mix during critical hours of grid need;
2. Ensure that generation and storage projects are on-time;
3. Expedite additional resources that can be online by 2021, (demand response)
4. Coordinate additional procurement by non-CPUC jurisdictional entities;
5. Enhance CAISO market practices to ensure they accurately reflect the actual balance of supply and demand during stressed operating conditions

# Root cause CAISO market design enhancements

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1. Fix CAISO market to minimize the export of capacity that could be related to RA resources during reliability events
2. With CPUC refine the counting rules for hydro resources, DR, renewable, use limited resources, and imports
3. Enhance the day-ahead market design to ensure reliable load and supply scheduling
4. Redesign of CAISO RA market rules to ensure planned outages do not create unnecessary reliability risk and that performance penalties are sufficient to ensure compliance
5. Develop a process to evaluate monthly RA supply plans with backstop if necessary

# Short-term goals to keep lights on

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1. Incent market imports and EIM imports during critical periods
2. Incent existing generators with deliverability headroom to make capacity improvements
3. Incent resources outside the CAISO BAA to set up dynamic transfers and provide RA
4. Embrace marginal RA improvements over radical redesigns
5. Provide storage and hybrid easy on-boarding so that as a new technology they can respond in critical periods

# Gridwell recommendations to keep the lights on

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1. Embrace transparency – there cannot be price discovery (or financing) without transparency
2. Take a “do not harm” approach to price formation and fast-track scarcity initiative
3. Restart RA Enhancements initiative with issue paper focused on reliability
4. Provide sandbox environment for future storage and hybrid scheduling coordinators





Thank you! Questions?

# Appendix

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# My favorite CA load-shed articles

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- [What's Ailing California's Electric System](#) by Cheryl Lafleur
- EIM transfer concern; explained [here](#)
- Scott Miller [blog](#) on blame game
- New York Time [Article](#) on blackouts—because I'm quoted and it's the NYT
- [Gridworks](#) excellent assessment
- It wasn't convergence bids fault - [Bloomberg](#)

# Key links

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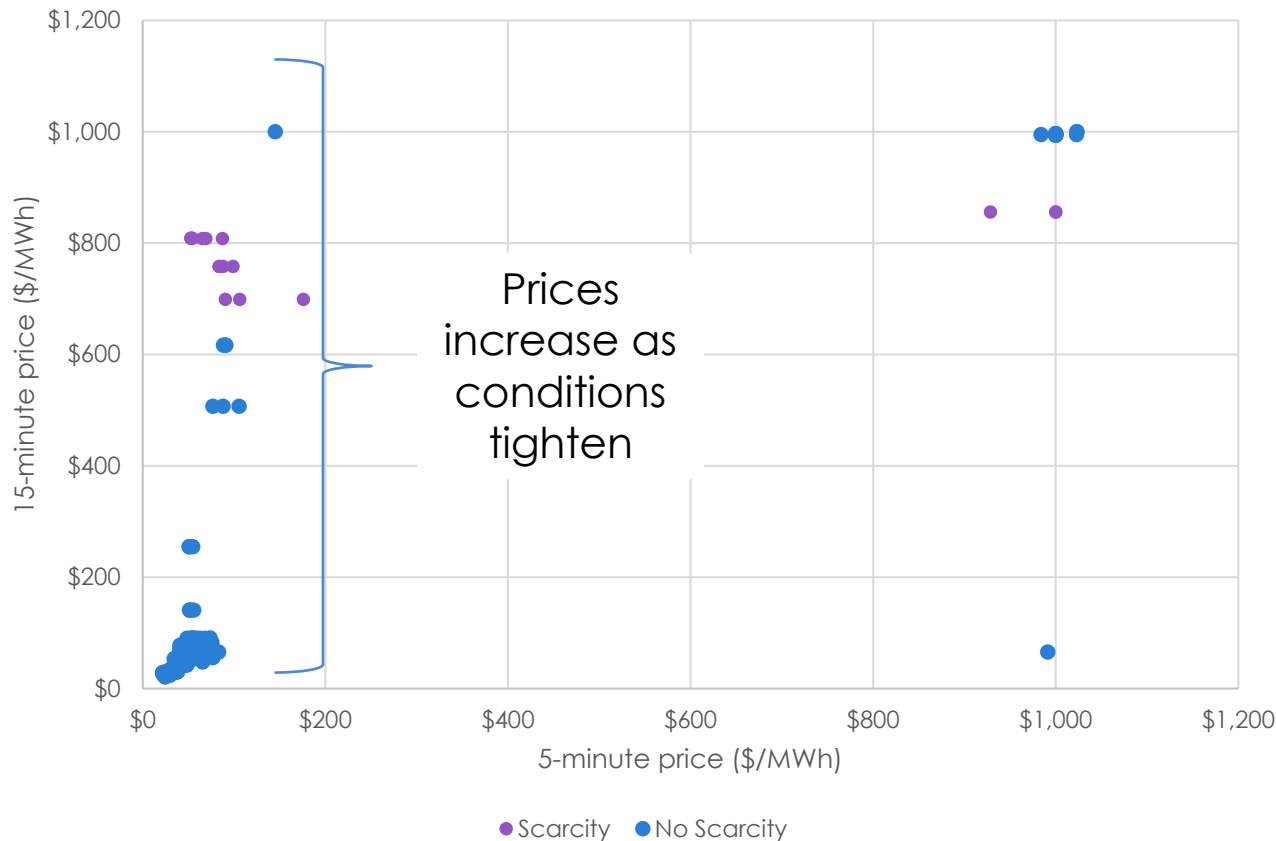
- CAISO [presentation](#) on preliminary root cause
- Joint-agency root cause [report](#)
- Summer Loads and Assessment [2019](#) & [2020](#)
- CAISO Tariff [Section 40](#)
- Reliability Requirements [BPM](#)
- Reliability Requirements [webpage](#)
- CPUC RA [Guide](#)
- CPUC Compliance [Materials](#)

# Key acronyms

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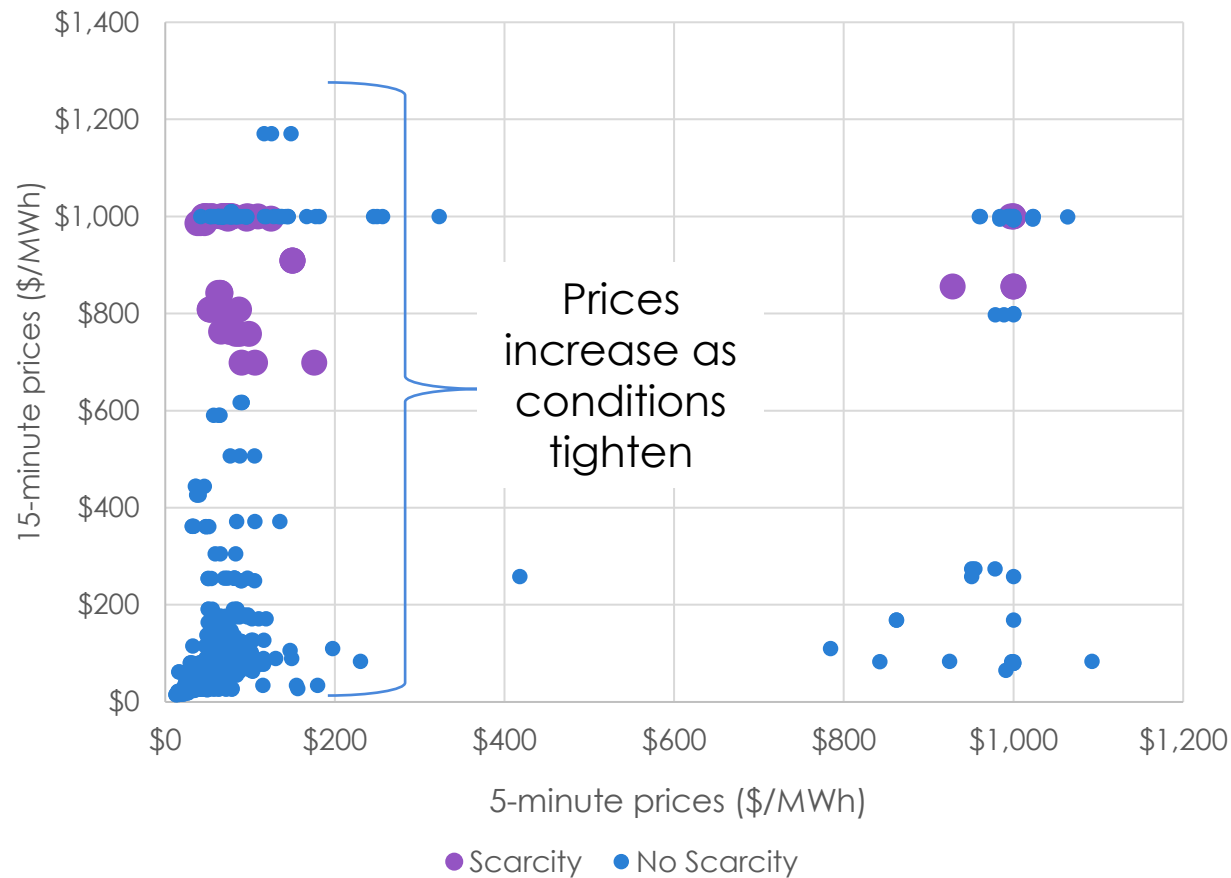
- CCA – Community Choice Aggregator
- CPM – Capacity Procurement Mechanism
- EIM – Energy Imbalance Market
- IOU – Investor Owned Utility
- LSE – Load Serving Entity
- LRA – Local Regulatory Authority
- MIC – Maximum import Capacity
- NQC – Net Qualifying Capacity
- PRM – Planning Reserve Margin
- QC – Qualifying Capacity
- UCAP – Unforced Capacity

# 15-minute prices gradually increase, unlike 5-minute prices 8/14



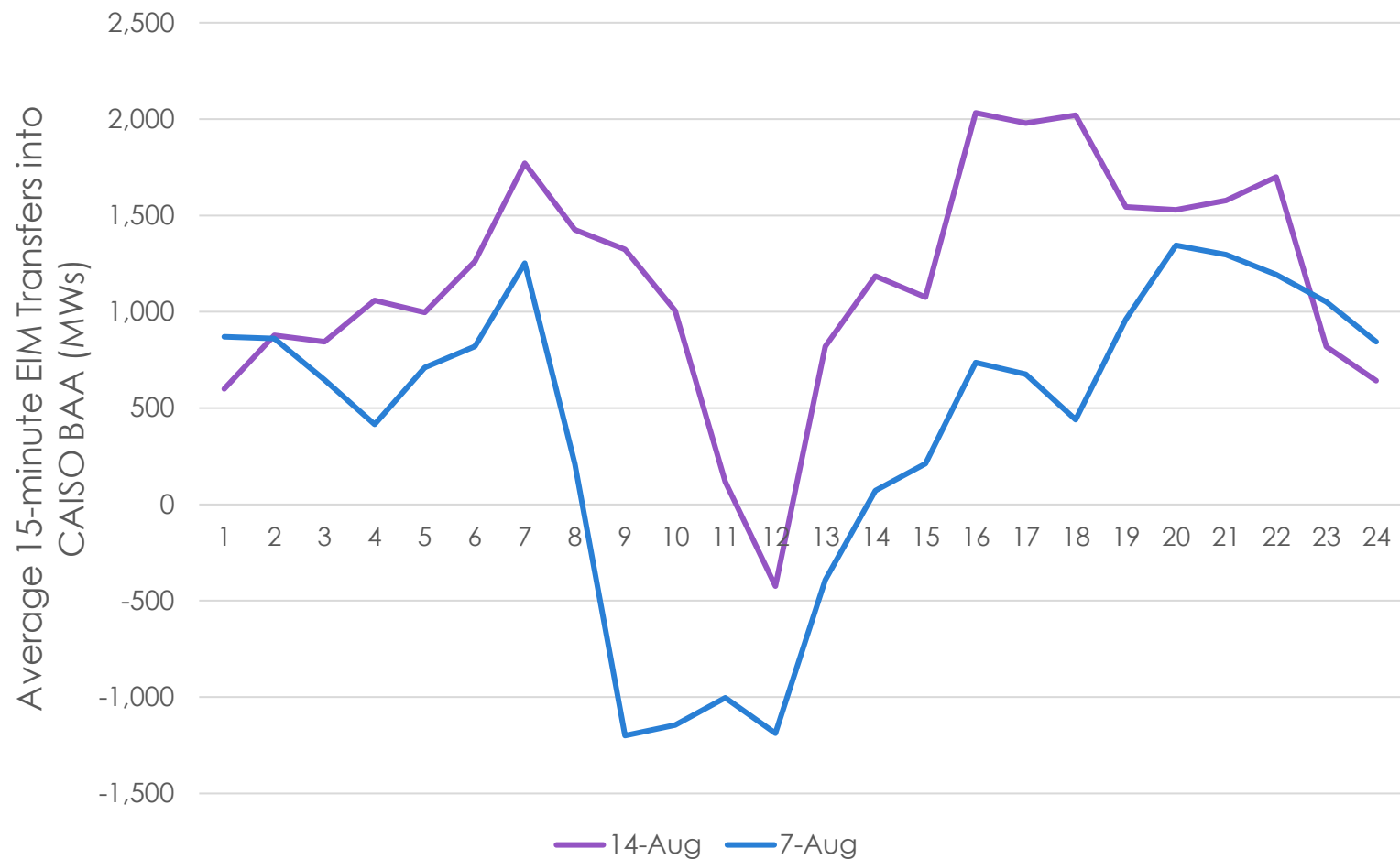
- 15- and 5-minute prices diverged during tight system conditions
- 15-minute market prices reflect scarcity conditions through the A/S Scarcity Pricing Mechanism
- 5-minute prices tend to “jump” from <\$200/MWh to \$1,000/MWh

# Ancillary Service Scarcity Events correlated with price divergence 8/13 – 8/18



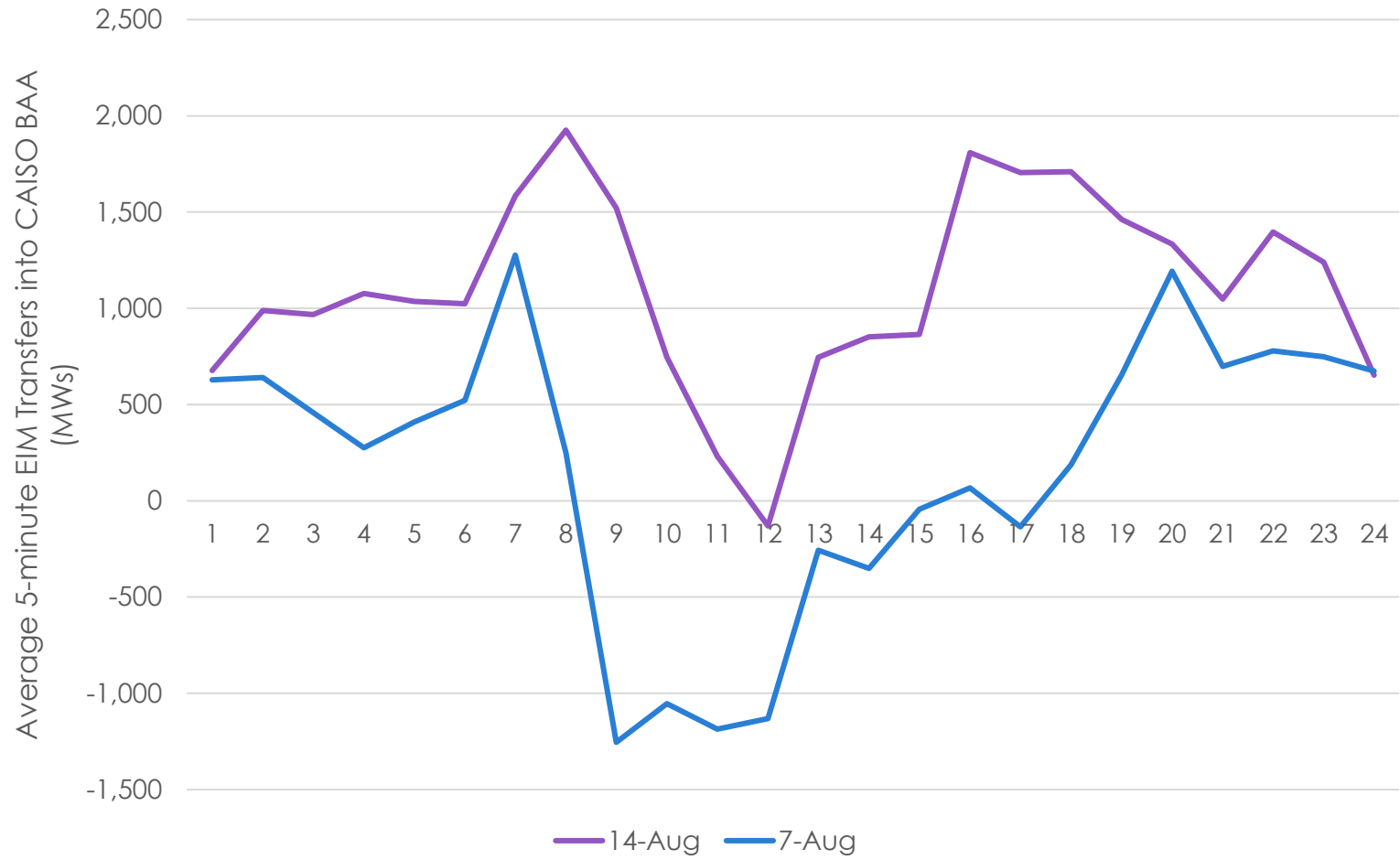
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# 15-minute EIM transfers into CAISO increased on August 14<sup>th</sup> than prior week

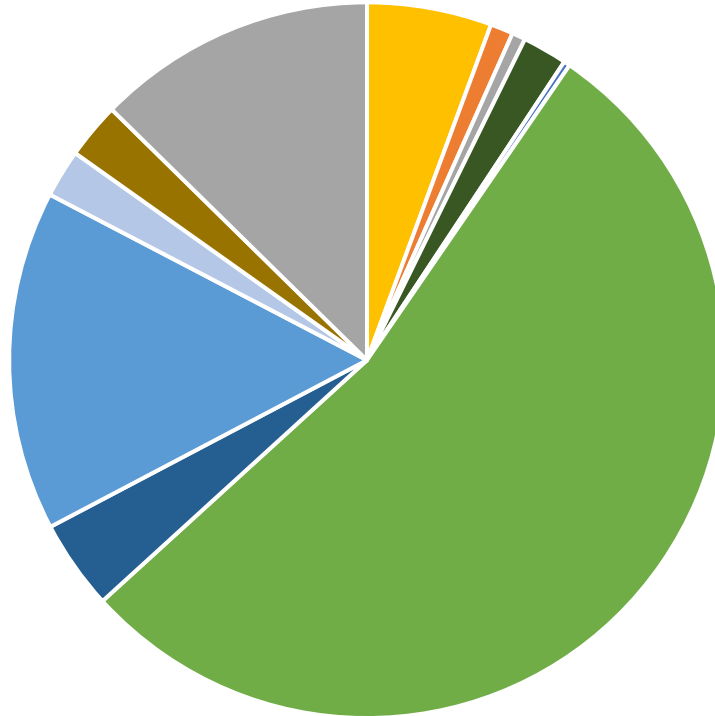




# 5-minute EIM transfers into CAISO BAA increased on August 14<sup>th</sup> than prior week



# August NQC by resource type



Resource Type	August NQC	Percentage
Solar	3,176	6%
Biomass/biogass	582	1%
Other	343	1%
Geothermal	1,139	2%
Battery	159	0%
Natural Gas	30,246	54%
Nuclear	2,280	4%
Hydro	8,663	15%
Wind	1,221	2%
PDR	1,427	3%
Imports	7,126	13%
<b>Total</b>	<b>56,362</b>	<b>100%</b>

- Solar
- Biomass/biogass
- Other
- Geothermal
- Battery
- Natural Gas
- Nuclear
- Hydro
- Wind
- PDR
- Imports