Preliminary Assessment of California ISO System Conditions during August Heat Wave

Gridwell Consulting
Policy & Analysis

Prepared for the Western Power Trading Forum

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TABLE OF CONTENTS

INTRODUCTION

Gridwell Consulting has prepared this initial assessment of the August 14 reliability events for the Western Power Trading Forum (WPTF) California Independent System Operator (CAISO) Committee, i.e. the WPTF CAISO Committee. The WPTF is a non-profit organization dedicated to markets, competition, and transparency across the West. The CAISO Committee is a sub-committee specifically and entirely focused on CAISO policies and market transparency.

This preview is of an intended larger report that will provide CAISO Committee members and the broader stakeholder community an *independent* assessment of the system planning and operational conditions that led to these reliability events and shortages. We note that this is an initial assessment and all data and conclusions should be considered preliminary at this time. We plan on providing a deeper dive analysis using this initial assessment and member feedback as direction.

AUGUST 14, 2020

Recap

On August 14, 2020, for the first time since the energy crisis in 2001, the California ISO (CAISO) declared a Stage 3 Emergency.[1] Stage 3 is the CAISO's highest emergency level[2], and is only issued when the CAISO must initiate outages across the state in order to prevent complete grid failure. The timeline for the day is as follows:

- In the early afternoon it became clear that the CAISO expected available resource stack was surprisingly close to their daily forecasted peak load.
- At 3:20 p.m. the CAISO declared a Stage 2 Emergency. [3]
- At 5:00 p.m. CAISO load peaked at 46,777 MW.
- At 6:36 p.m. the CAISO issued the Stage 3 Emergency Notice. The notice reported that the CAISO had insufficient operating reserves and were initiating rotating outages throughout the state to maintain stability of the grid.
- At 8:00 p.m. the sun set, and the state started to cool down significantly. The CAISO lifted Stage 3 conditions at 8:54 p.m.[4]

Table 1 below shows the load and net load (load minus wind and solar) during this period.

[1] "Stage 3 Emergency Declared; rotating power outages have been initiated to maintain grid stability" *California ISO,* 14 Aug 2020, http://www.caiso.com/Documents/Stage-3-Emergency-Declared-Rotating-Power-Outages-Initiated-Maintain-Grid-Stability.pdf.
[2]"Summary of Restricted Maintenance Operations, Alert, Warning, Emergency, and Flex Alert Notices Issued from 1998 to Present" *California ISO,* 14 Aug 2020, http://www.caiso.com/Documents/AWE-Grid-History-Report-1998-Present.pdf.
[3]" The ISO declares Stage 2 Emergency; power outages possible" *California ISO,* 14 Aug 2020, http://www.caiso.com/Documents/The-ISO-Declares-Stage-2-Emergency-Power-Outages-Possible.pdf.
[4] "ISO Stage 3 Emergency declaration lifted; power restored statewide" *California ISO,* 14 Aug 2020, http://www.caiso.com/Documents/ISO-Stage-3-Emergency-Declaration-Lifted-Power-Restored-Statewide.pdf

Table 1: Load conditions during peak 6 hours on August 14

	Hour 16	Hour 17	Hour 18	Hour 19	Hour 20	Hour 21
Peak Load	46,721	46,777	46,243	44,313	42,512	41,578
Peak Net Load	38,270	39,725	42,240	42,158	41,276	40,257

Assessment of system conditions

Gridwell's initial assessment of August 14 points to two foreseeable issues that led to the reliability events. Planners have both 1) not accounted for a sufficient Planning Reserve Margin (PRM) to cover upward ancillary services (AS) requirements and average forced outage rates and 2) over-valued the contribution of hydroelectric, natural gas, and perhaps demand response resources to annual peak reliability. As a direct result the CAISO allowed too much capacity to retire and the CPUC to not authorize enough replacement capacity. A deeper dive into the day may reveal other *operational* issues that could have been resolved to prevent the Stage 3 Emergency. We note that our research also found some particularly interesting impacts related to EIM transfers and real-time pricing.

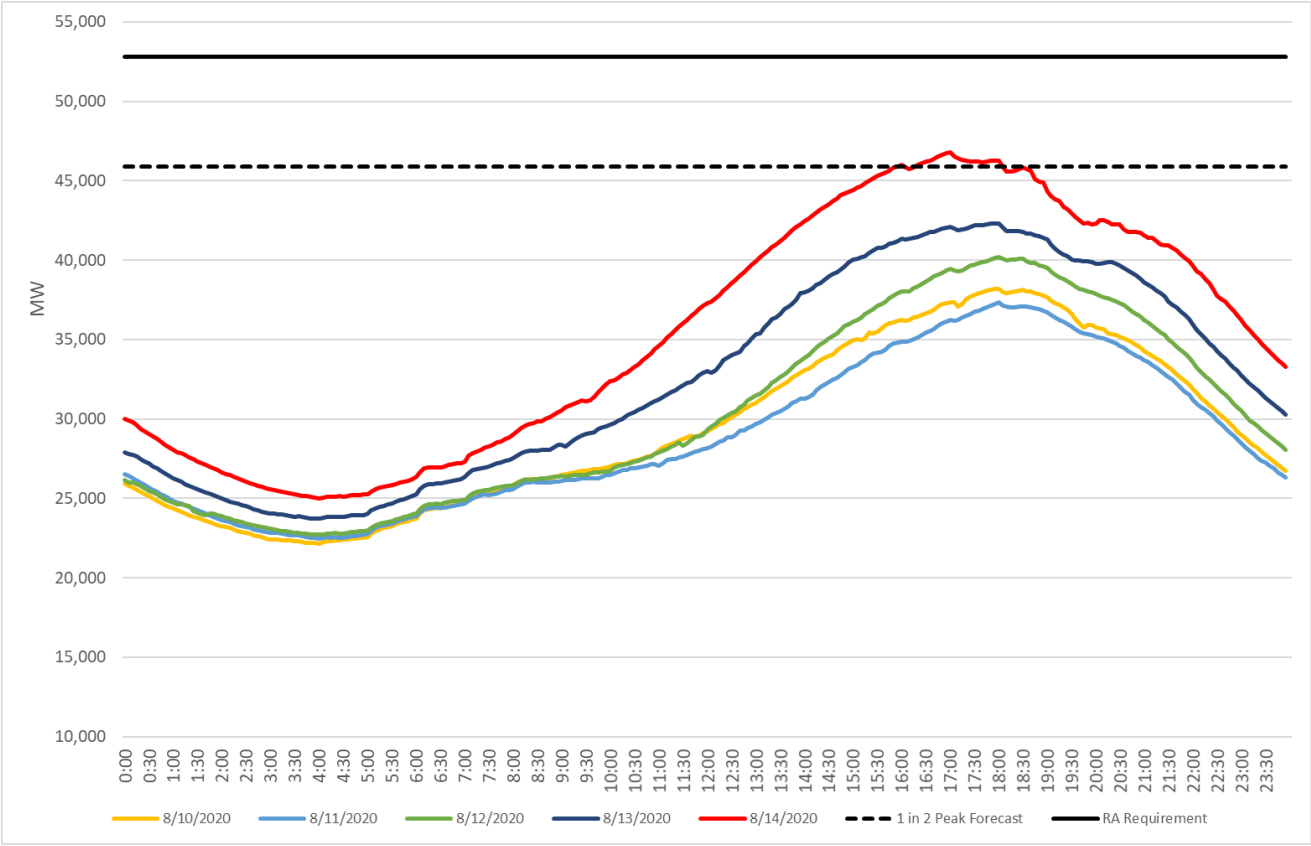
Demand Forecast and Planning Reserve Margin

The CAISO administers system RA requirements on behalf of Local Regulatory Authorities (LRA), of which the California Public Utility Commission (CPUC) makes up the vast majority of the total load. All LRAs set a Planning Reserve Margin (PRM) on top of the CEC 1 in 2 peak load forecast and require Load Serving Entities (LSEs) to demonstrate they have at least this much capacity to the CAISO. Because this can be set differently by each LRA, and no LRA has set a higher than 15% PRM, the CAISO requires *at most* 115% of the monthly peak load forecast to be shown as system RA each month.[5]

The week of August 10, 2020 the entire western United States experienced a heat wave and reached the hottest temperatures of the week on Friday, August 14. This caused CAISO peak demand to exceed the CEC 1 in 2 CAISO 2020 peak forecast by 870 MW or 1.9%. Figure 1 below compares the CEC peak forecast demand and CEC peak forecast demand plus a 113% PRM for the CAISO to the *actual* CAISO 5-minute demand on August 14 (heatwave day 1) and four preceding days.

[5] CAISO staff has stated a lower 113% number during the RA Enhancements initiative and this will be an further area of investigation for Gridwell.

Figure 1: August 14, 2020 CAISO 5-minute demand compared to CAISO peak load forecast



Thus, while the demand was high, it was only 1.9% higher than the CEC 1 in 2 peak load forecast. LRAs have a PRM, in part, to account for load forecast error. A common explanation by the CPUC and other California planners is that the PRM should be set at 15% so that 8% extra is for load forecast error and 7% is for resource forced outages.[6] The high load on August 14, even during the peak, was well within this PRM "8%" load forecast error.

On the other hand, forced outages may have been closer to PRM "7%" standard. Figure 2 below breaks down total forced outages on August 14 by resource type. While it is not public which resources were *shown* as RA, Gridwell has determined that of all the resources on forced outage, maybe up to 2,500 MW were qualified to be shown as RA, especially if there was some additional demand response or non-dynamic imports on outage not show in the outage tables. These resources are shown in Figure 3. The total amount potentially on outage still appears significantly under the so-called outage portion of the PRM.

[6] Gridwell notes this is not the only way to set a PRM and that we recommend the state use a more robust calculation method going forward.

Figure 2: CAISO Total Planned and Forced Outages

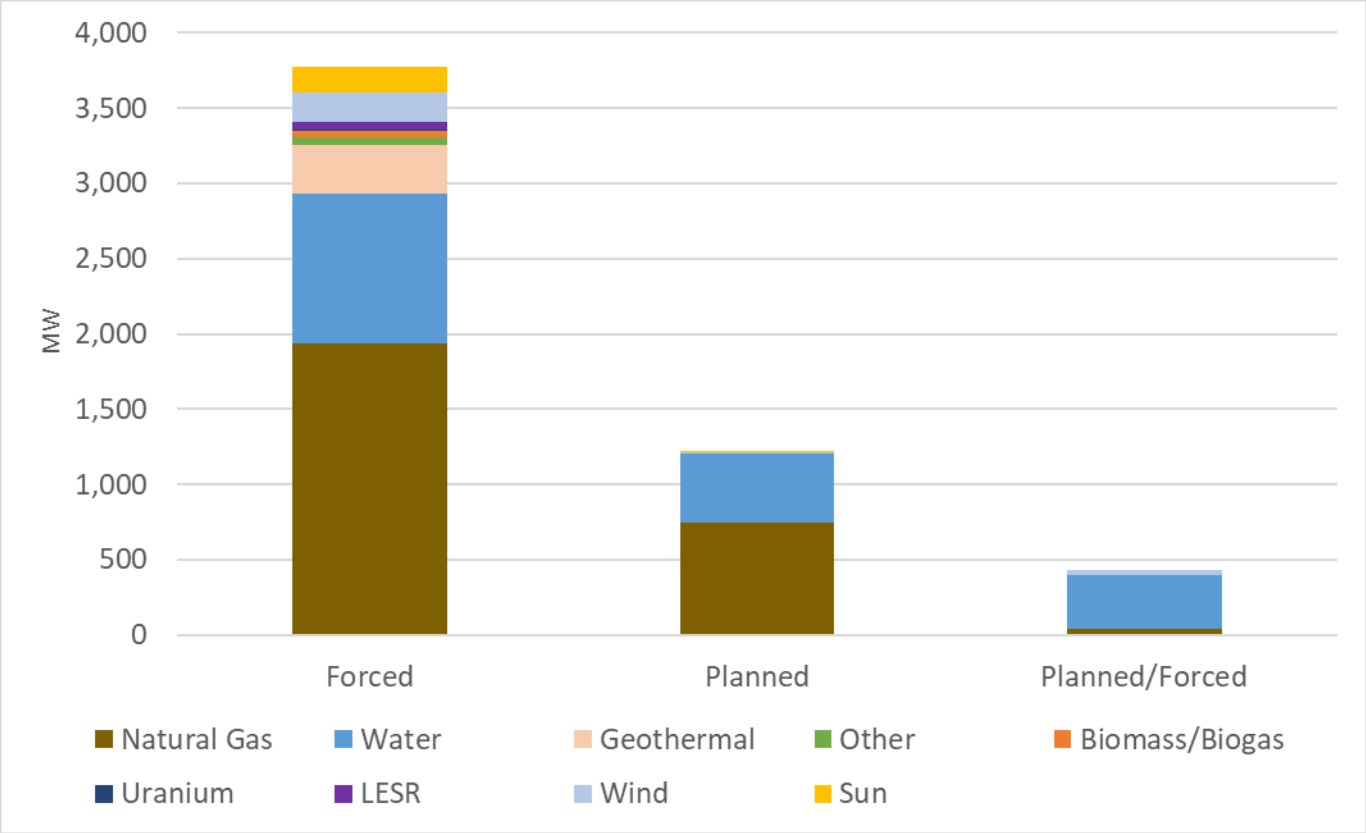
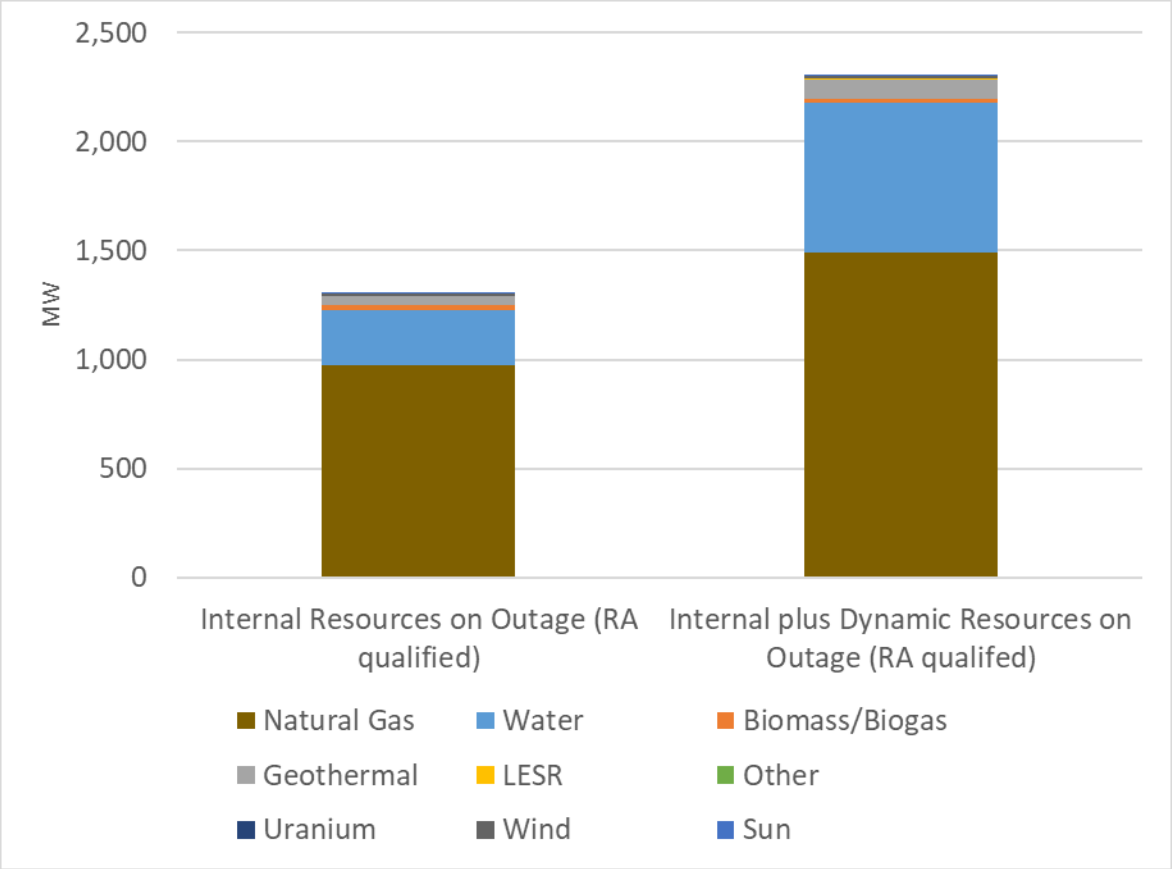


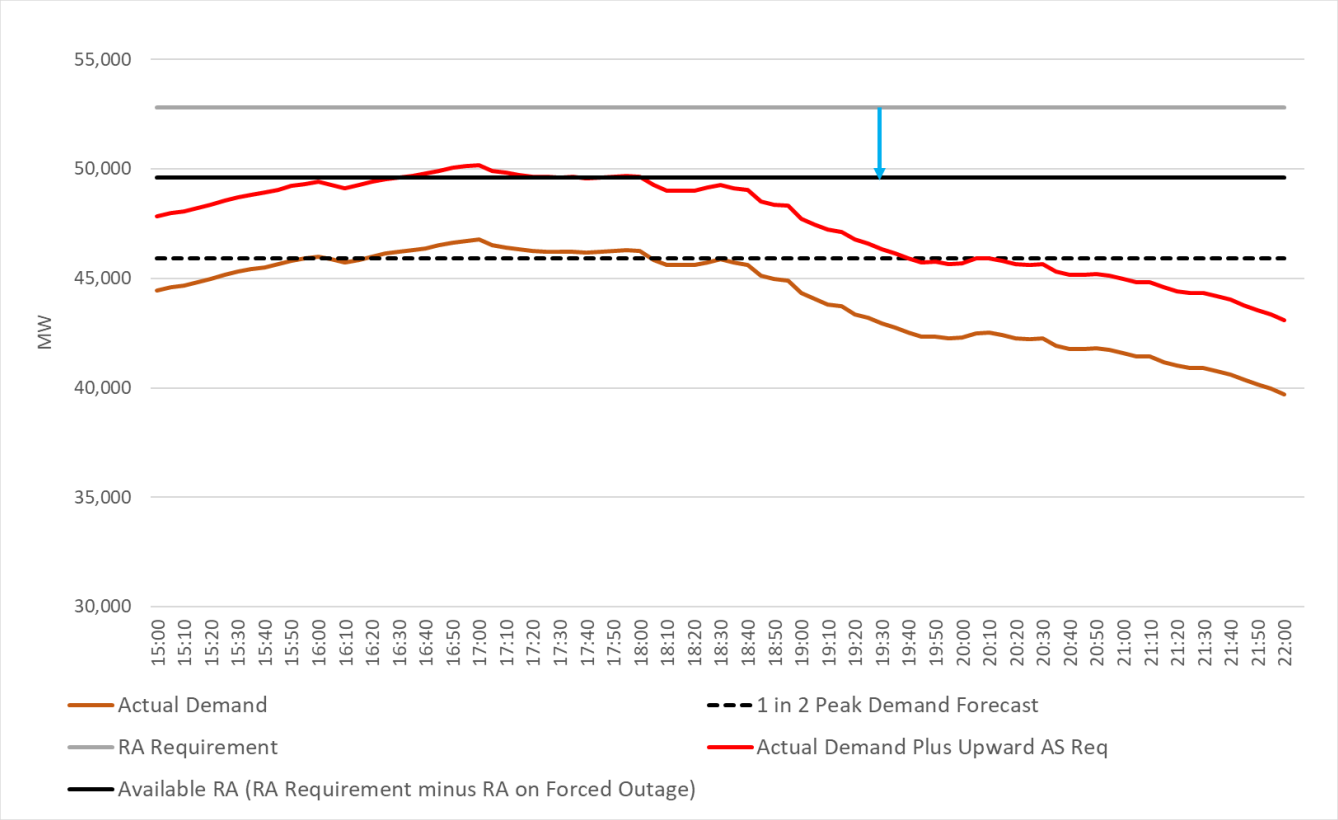
Figure 3: CAISO Planned and Forced Outages Eligible to Provide Resource Adequacy



On the CAISO BOG call on August 17, CAISO staff noted that forced outages were the lowest they have been in two years. This may indicate that a higher PRM may be needed to account for historical average forced outage rates. That said, given that the combined forced outage rate and load forecast error were well within the RA requirement total PRM buffer, Gridwell does not believe the load or *unexpected* forced outages were a primary driver of grid instability. In fact, given the heat wave and Covid-19 events, it appears that the CEC did a particularly good job forecasting peak load on August 14.

Figure 4 shows the assumed available RA compared to peak demand on August 14. The solid grey line is the August RA requirement or amount load serving entities must show to the CAISO as firm capacity in August. The blue error to the solid black line shows a 6% discount for RA resources on forced outage. Thus, the solid black line should be the amount of RA available (absent a tripped generator) on August 14. The brown line is actual CAISO demand, which is only very slightly higher than the 1 in 2 CEC peak load forecast. The red line shows the total amount of capacity needed by the CAISO when including upward operating reserves.

Figure 4: Available RA compared to Peak Demand on August 14, 2020



Where the red line crosses the black line, the CAISO reserves are structurally insufficient; in other words, in these hours the CAISO does not have enough contracted RA capacity to meet system needs. Making matters worse, during this time an additional 475 MW generator tripped offline for periods of the day.[7] This caused the CAISO to dip and deplete much of its upward AS reserves. Gridwell believes this figure demonstrates the intersection between actual operational needs and the planning reserve margin should be more closely examined within a larger root cause analysis.

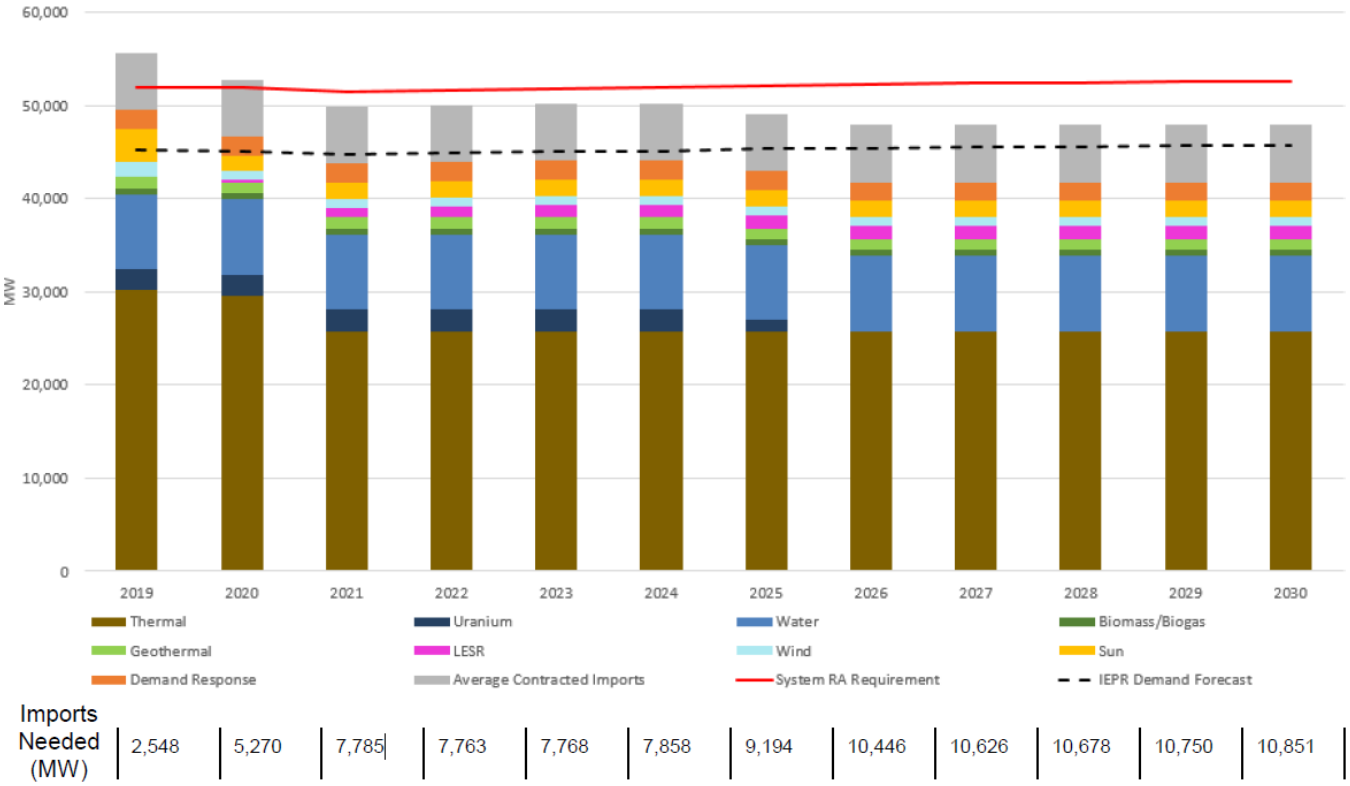
CAISO Resource Supply

The following section evaluates the CAISO supply stack in two ways. First, it looks at what the CPUC (and thus the CAISO) have been using as their assumptions to make decisions about the resource fleet. These foundational assumptions go on to inform evaluations of peak supply assumptions as they compare to actual peak supply availability. Second, this section evaluates the response of particular technology types during the August 14, 2020 reliability event.

[7] Noted during August 17 CAISO public Board briefing

Figure 5 shows the CPUC's peak load and supply expectations, including needed imports and demand response, from 2019 through 2030.[8] Gridwell notes that the CPUC has used September values, not August, as it has been assumed that September will have the tightest supply conditions. Even in 2020 there was an expectation of very tight system conditions, and in 2021, absent OTC resource extensions, the expectation is of a supply deficit.

Figure 5: CPUC Assumed Available Capacity from 2019 – 2030 During Peak Load Conditions

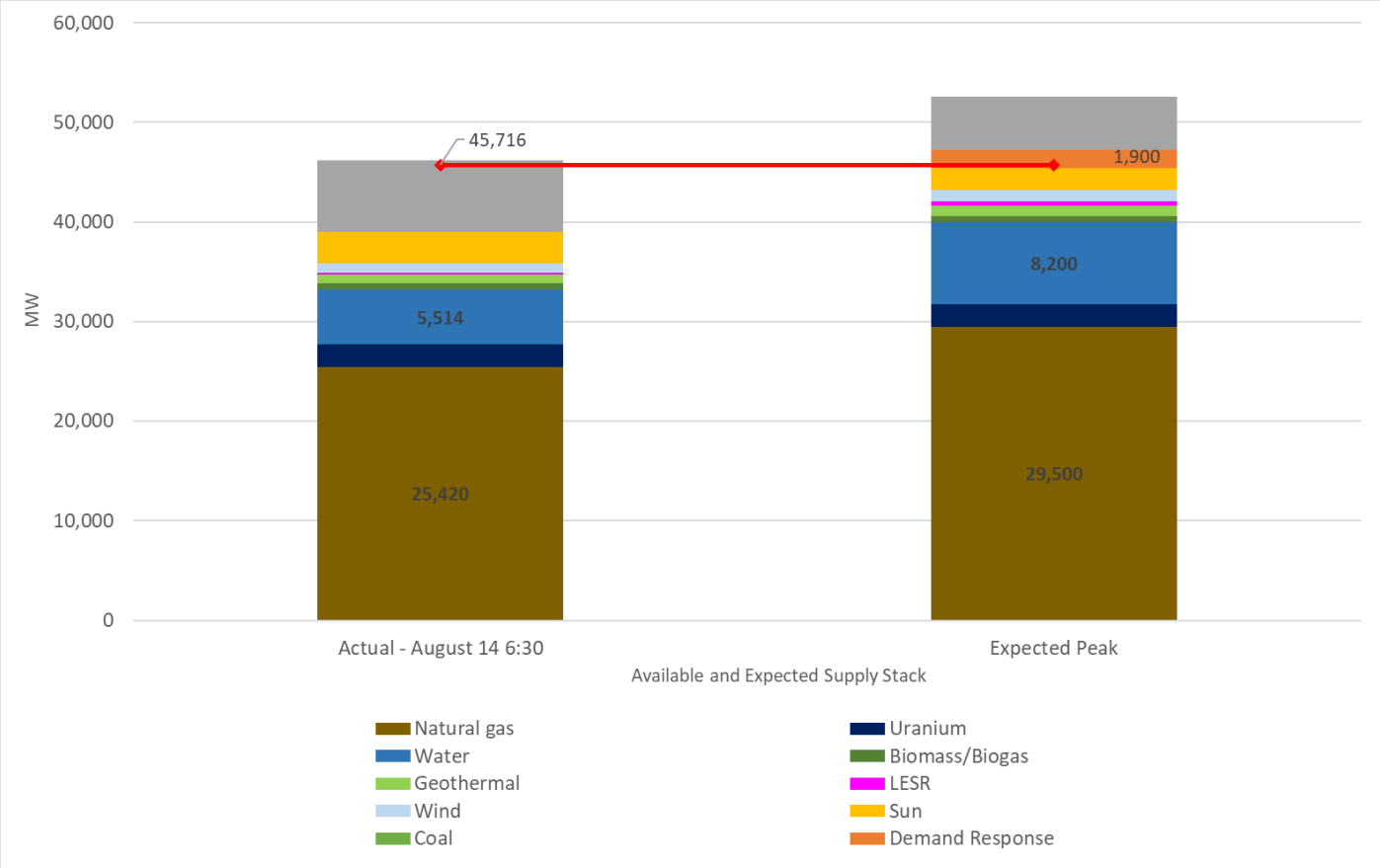


Imports Needed (MW)	2,548	5,270	7,785	7,763	7,768	7,858	9,194	10,446	10,626	10,678	10,750	10,851

Figure 6 shows the difference between planning 2020 expectations and what load and supply were during Stage 3 conditions. The stacked bar chart on the right is a replication of the 2020 stacked bar chart in Figure 5.

[8] This was presented at a SACCWIS meeting in a presentation recommending the extension of certain Once-Through-Cooling gas resources. This is the committee that makes recommendations to the California Water Board about Once-Through-Cooling retirements and is made up of a member from all main California Regulatory Bodies, including the CAISO, CPUC, CEC, Coastal Commission, etc. https://www.waterboards.ca.gov/water_issues/programs/ocean/cwa316/saccwis/

Figure 6: Actual August 14 Supply Compared to 2020 Planning Expectations by Resource Type



We note that both natural gas and hydro are significantly below their respective planning expectations. Figure 7 shows the CAISO supply stack during the 5-minute peak of each hour the evening of August 14.

Figure 7: Actual August 14 Supply by Resource Type during Peak Hours

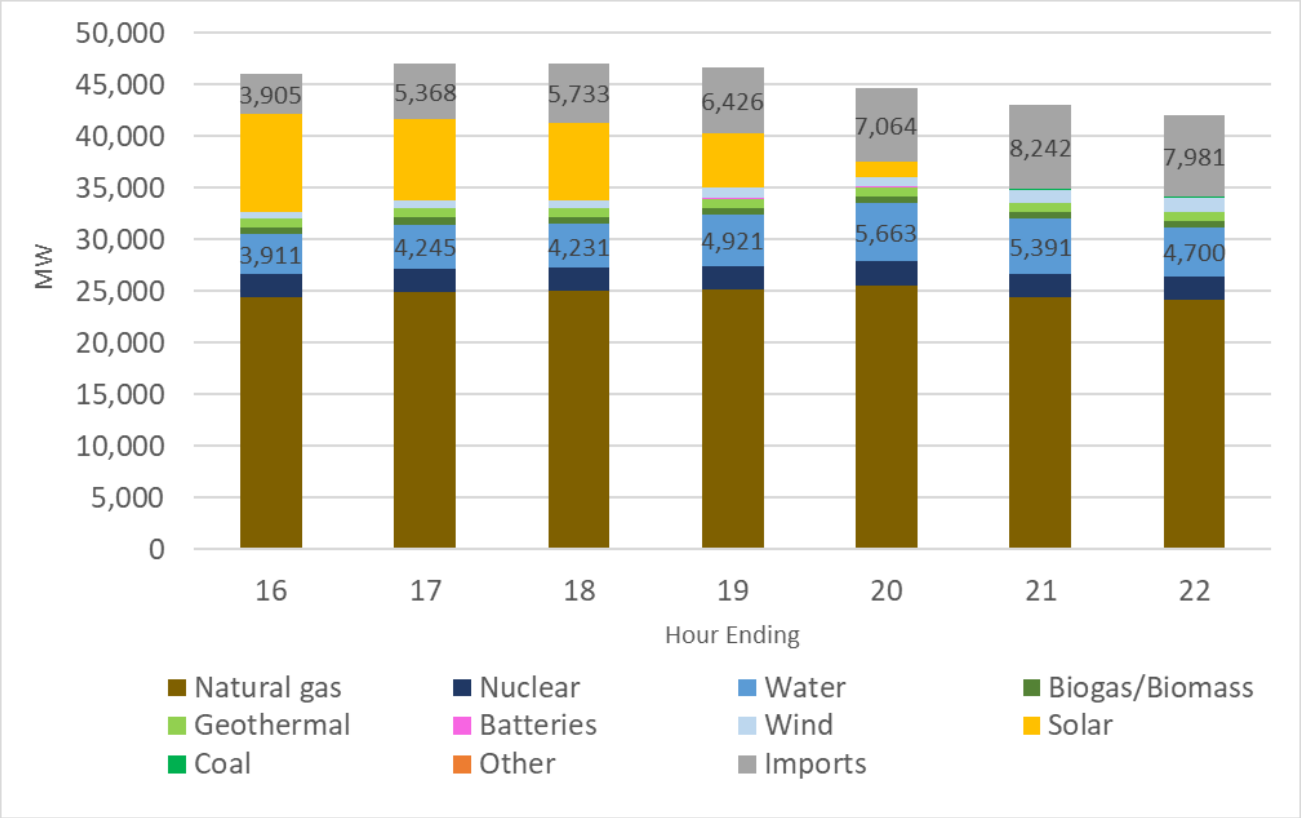
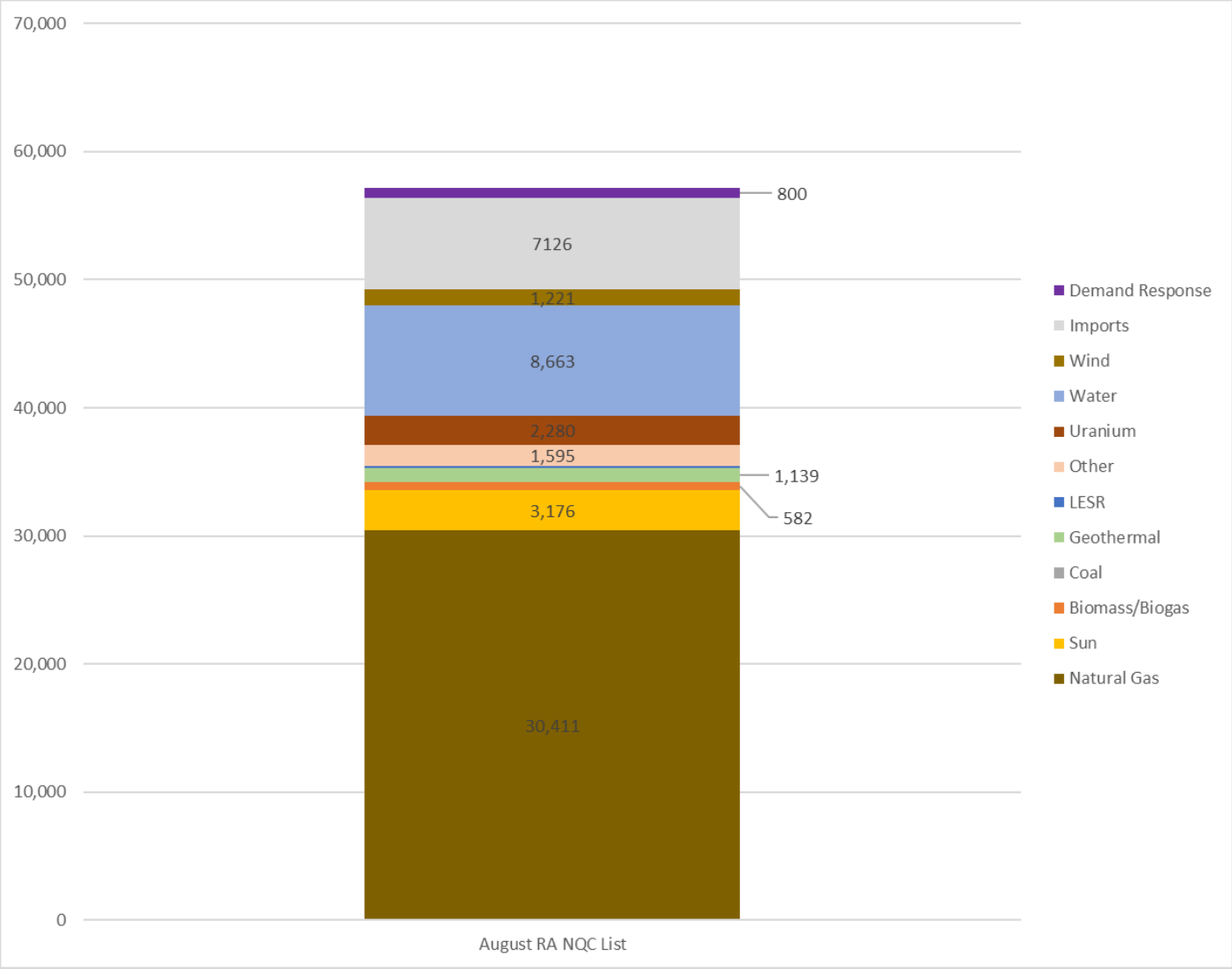


Figure 8 shows RA capacity on the August NQC list by resource type. A review of the list shows that retired natural gas plants are on the August NQC list. This is why the natural gas that was actually online on August 14 is different than planning assumptions. It is notable that both wind and solar were well within planning assumption during the peak load of August 14. A deeper dive is needed to see how the supply stack changed over time during the Stage 3 Emergency and particularly during the *net* peak load.

Figure 8: August RA capacity by resource type from NQC list (public statements for DR and imports)



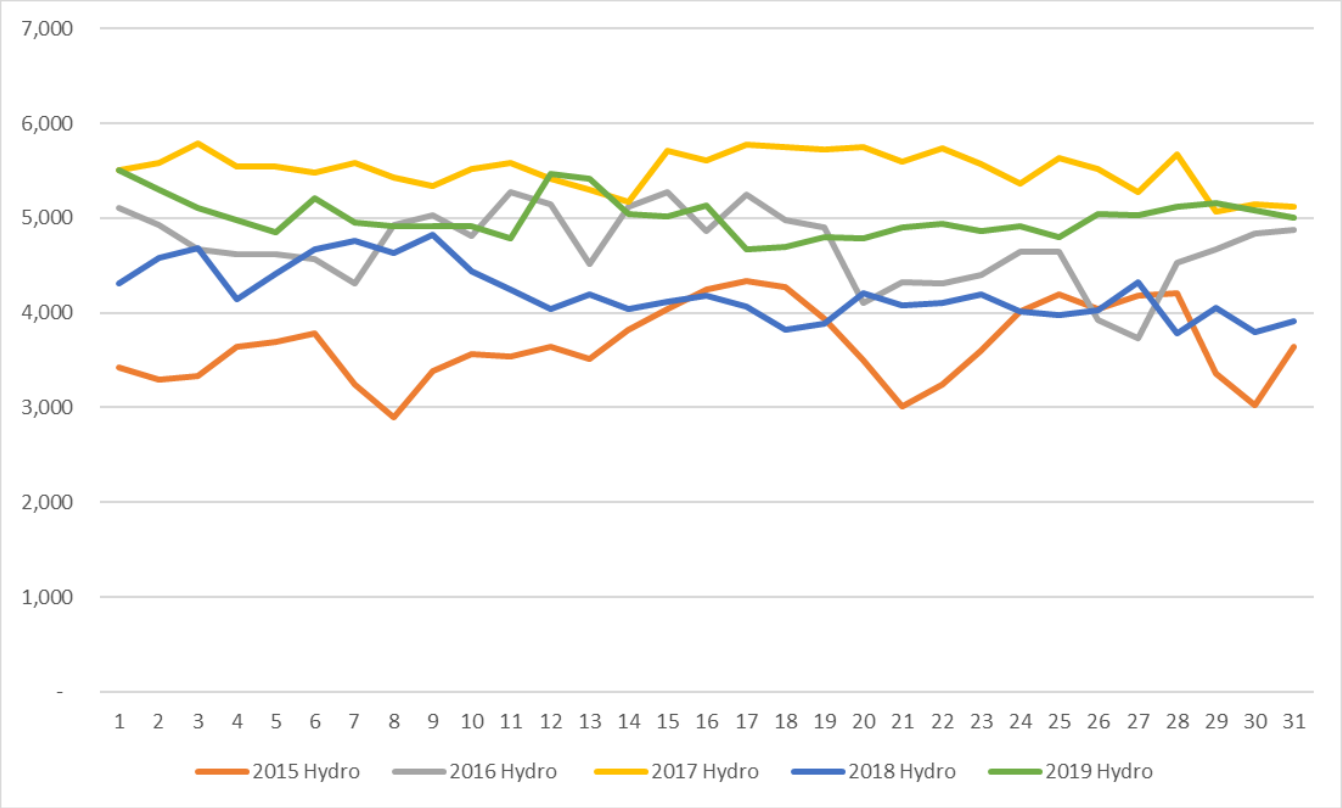
The large mismatch between planning and operational space appears to be natural gas and hydroelectric capacity.

Hydro

It is unsurprising that the RA capacity value of hydro not only varies widely from year to year, but always is significantly over-stated compared to maximum energy output in some months. August is one of these months. Figure 9 shows maximum daily hydroelectric production in August for the last 5-years. Small hydro would potentially add another 250 MW to these totals each day. Additionally, hydroelectric resources frequently provide reserves. The Department of Market Monitoring has ancillary service awards broken out by type. Hydro historically has never provided more than 700 MW of ancillary services, so Figure 8 may potentially be

understating hydroelectric resources' availability by 1,000 MW. Even accounting for this, the CAISO and CPUC are still over-stating the amount of hydroelectric capacity available by over 2,000 MW.

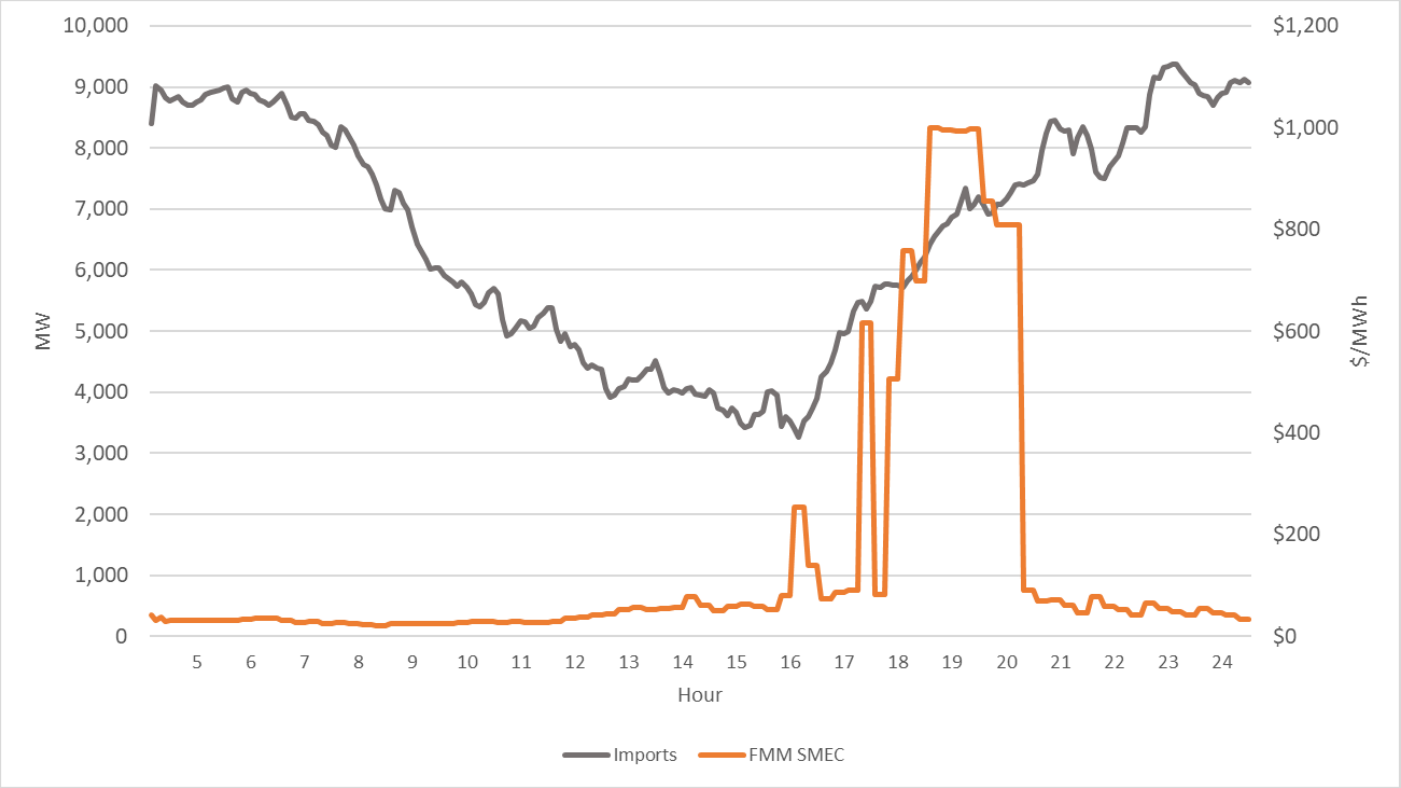
Figure 9: Peak daily large hydroelectric production



Imports

Finally, the CAISO frequently expresses concerns about imports, specifically by evaluating if they can be considered as reliable as internal generation. Figure 10 shows imports online compared to the fifteen-minute price. Imports likely were quite reliable on August 14. In fact, it appears imports showed up in excess of RA requirements and the CAISO was leaning on market imports to keep the lights on.

Figure 10: CAISO non-EIM imports compared to the Fifteen-Minute System Marginal Energy Price



Next Steps

Gridwell believes that a root cause analysis should focus on the intersection between planning assumptions and operational needs. Pricing impacts, EIM imports, and the role of storage will be particularly relevant.

Questions?

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