

Slide 1 – Preliminary Observations on the August 2020 California Heat Storm



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December 2020

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Good morning, Mr. Chairman and Commissioners. As announced at the September Open Meeting, Commission staff is presenting its preliminary observations on the California heat storm that occurred from August 14 through August 19. The California Independent System Operator (CAISO) initiated controlled, rotating load shedding on two of those August days – for two hours on August 14 and for 20 minutes on August 15 – and anticipated the potential for additional rotating load shedding on subsequent days. Our slides are also available for download at www.ferc.gov. Next slide.

Highlights

- **Mid-August temperatures reached record highs in California and throughout the West.**
- **Generation resource planning focuses on Peak Load Hours, not Net Peak Load hours, which, on August 14 and 15, were when system conditions were tightest and load was shed.**
- **CAISO invoked demand response throughout the event.**
- **California faced similar conditions in September: high temperatures and tight system conditions.**



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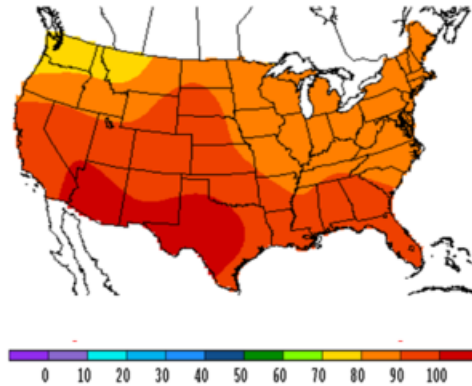
In this presentation, we begin with a description of the conditions that CAISO expected prior to the August heat storm, including weather forecasts and generator availability. Next, we provide a timeline of system conditions, market responses, and reliability actions taken during the August heat storm. We also discuss Resource Adequacy requirements and forecasts in California, along with Resource Adequacy performance across different technology types, as well as demand response performance. Next slide.

Slide 3 – Weather Forecasts for August 14-19, 2020

Weather Forecast for August 14 - 19, 2020

August 14, 2020

- Temperatures 10-20 degrees above normal highs in California.
- Excessive heat warnings throughout much of the Western Interconnection.
- Elevated fire risks threatened transmission lines.
- Low levels of hydro power.
- Lower than forecasted wind output at key times.
- Reduced solar generation due to cloud cover at key times.



https://www.wpc.ncep.noaa.gov/dailywxmap/index_20200814.html



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Weather forecasts called for a significant heatwave over a broad geographic area on August 14 through August 19. This slide provides a representative temperature graphic, showing the high temperatures in the western US on August 14. Over six days, California experienced four out of the five hottest August days since 1985; August 15 was the hottest and August 14 was the third hottest.

Other conditions in California affected potential generation output. Going into the summer, CAISO experienced lower than normal levels of available hydroelectric power. High heat also reduced thermal generation capacity because of reduced efficiency. In addition, during key times on the relevant August dates, high storm clouds covered parts of California and wind diminished below the forecast, which reduced available solar and wind generation. Finally, for most of the days in the August 14-19 period, numerous wildfires threatened the loss of major transmission lines. Next slide.

Slide 4 – Highlights of Significant Events on August 14

Highlights of Significant Events on August 14



- **Forecasted potential reserve shortage - 5 PM through 9 PM**
- **Around 3 PM - a 475 MW Natural Gas generator tripped offline.**
- **3:25 PM - Stage 2 Emergency declared.**
- **4:56 PM - System peak load occurred. Solar generation declining and demand remaining high.**
- **6:38-8:38 PM - Stage 3 Emergency declared.**
 - **CAISO was deficient in meeting its reserve requirement.**
 - **Ordered two phases of controlled load shed of 500 MW each.**



Now, we turn to discuss CAISO's preparations for this heat storm and CAISO's actions from August 14 through August 19. Prior to and during the event, CAISO declared actions for restricting maintenance on generation and transmission, issued alerts to encourage conservation, and requested additional energy and ancillary services bids from market participants.

At 3 p.m. on August 14, as load was increasing toward the daily peak, a 475 MW natural gas generator tripped off-line. In response, CAISO deployed reserves to replace the lost energy and also enabled (but did not yet dispatch) emergency demand response resources in the real-time market. CAISO declared a Stage 2 Emergency at 3:20 p.m. CAISO calls a Stage 2 Emergency when it has taken all mitigating actions and is no longer able to meet its expected energy requirements.

At 4:56 p.m., CAISO reached its peak system load of 46.8 GW. At 5 p.m., CAISO manually dispatched approximately 800 MW of emergency demand response, which is required to respond within 40 minutes. Nonetheless, CAISO determined that it was not able to meet its spinning reserve requirement and declared a Stage 3 Emergency from

6:38 p.m. to 8:38 p.m. CAISO calls a Stage 3 Emergency when it is unable to meet minimum contingency reserve requirements and load interruption is imminent or in progress.

As solar production declined without load decreasing, CAISO grid operators could not resolve the reserve deficiency by procuring and dispatching additional generation, as all available generation was already online. At 6:38 p.m., CAISO ordered two phases of controlled load shedding of 500 MW each to maintain the required reserves needed to provide stability to the power system and prevent uncontrolled outages. The two load shedding phases were implemented on a pro rata basis across the CAISO footprint in three distribution utility companies. CAISO remained in a Stage 2 Emergency until 9:00 p.m. to ensure the reserve requirements could be met. Next slide.

Highlights of Significant Events on August 15



- **Similar conditions to Friday.**
- **2 - 3 PM - Solar generation declined by 1,900 MW. Immediate dispatch of emergency Demand Response (891 MW).**
- **5 - 6 PM - Unexpected decline of 1,200 MW wind generation. Peak occurs at 6 PM. Loss of 248 MW. Stage 2 Emergency declared.**
- **6:28 PM - Stage 3 Emergency declared. All generation was online and solar generation declining. 500 MW of controlled load shed.**
 - **Canceled 20 minutes later when wind increased by over 500 MW.**



CAISO expected again to face stressed system conditions on August 15. A potential shortfall of reserves was forecast to occur between 5:00 p.m. and 9:00 p.m. CAISO again requested additional energy and ancillary services bids and requested voluntary conservation efforts. However, challenging conditions began earlier than expected in the day. Between 2:00 p.m. and 3:00 p.m., cloud cover reduced solar generation by 1,900 MW. Reserves were at minimum requirements.

By 3:00 p.m., CAISO ordered an immediate dispatch of 891 MW of emergency demand response. This differed from Friday, when the emergency demand response was first enabled and later dispatched.

Between 5:00 p.m. and 6:00 p.m., wind generation decreased unexpectedly by 1,200 MW. Shortly after 6:00 p.m., a natural gas generator unexpectedly ramped down from 394 MW to 146 MW and CAISO declared a Stage 2 Emergency at 6:15 p.m. The generator ramping down was later determined to be a result of dispatch error.

By 6:28 p.m., CAISO declared a Stage 3 Emergency because all available generation was

online, solar generation was declining, and reserve requirements were not able to be maintained. CAISO ordered 500 MW of controlled load shedding to meet the needed reserves and maintain grid reliability. But, 20 minutes later, CAISO cancelled the Stage 3 Emergency because wind production had increased by over 500 MW. To ensure reserve requirements could be met, the Stage 2 Emergency remained in effect until 8:00 p.m. Next slide.

Slide 6 – Highlights of Significant Events on August 16-18

Highlights of Significant Events on August 16-18



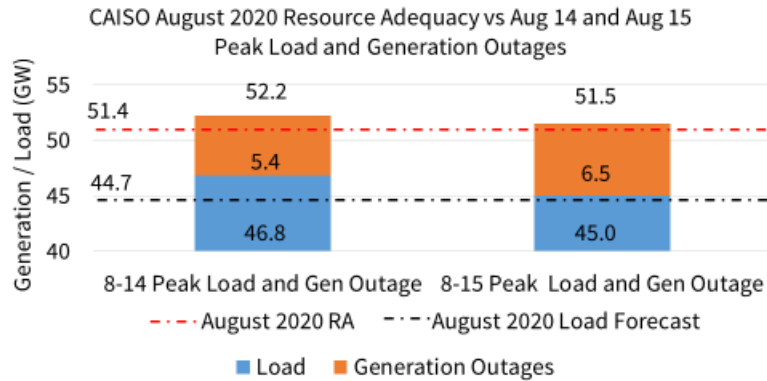
- **Heat storm continued. Storms and wildfires throughout region.**
- **Sunday – Governor declared State of Emergency, freeing up resources.**
- **Monday – Governor’s Executive Order further extended resource availability.**
 - **3:30 PM – 6:30 PM - Stage 2 Emergency in effect.**
- **Tuesday –**
 - **2 PM – 7:45 PM - Stage 2 Emergency in effect.**



From August 16 through August 18, CAISO continued to face high loads and severe weather conditions, which moderated on August 19. On August 16, Governor Newsom declared a State of Emergency and issued an Executive Order to conserve energy. CAISO called emergency demand response on August 16, 17, and 18. On August 17 and 18, CAISO declared Stage 2 Emergencies. On all three days, actual load was lower than forecasted primarily because of state-wide conservation efforts. Next slide.

Slide 7 – The Peak Loads and Generation Outages on August 14-15 Were Higher Than Planned

The Peak Loads and Generation Outages on August 14-15 Were Higher Than Planned



Source: CAISO and Preliminary Root Cause Analysis Mid-August 2020 Heat Storm report, October 6, 2020
 Note: Bar elements not plotted to scale.



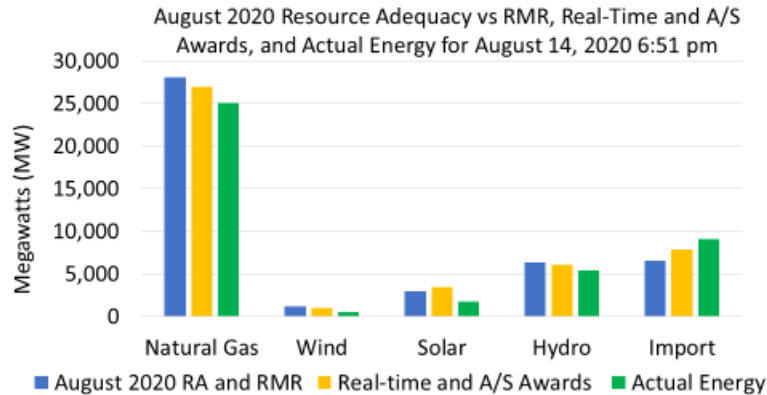
We turn now to highlight several issues raised by the August event, starting with Resource Adequacy. On this slide, we compare the actual load and generation outages on August 14 and August 15 to the planning values. As background, the California Public Utilities Commission (CPUC) establishes system Resource Adequacy requirements for most of the load serving entities in CAISO based on a California Energy Commission (CEC) 1-in-2 year peak demand forecast with a 15% Planning Reserve Margin. The August heat event was the hottest since 1985 and peak load was about 2 GW above the 1-in-2 year load forecast on August 14.

CAISO’s 15% Planning Reserve Margin accounts for a 6% requirement to meet operating reserves. The remaining 9% of the Planning Reserve Margin accounts for unplanned events such as generation outages, insufficient imports, and higher-than-average peak electricity demand. Obligations for the load serving entities are determined on a monthly basis by the CPUC. For the month of August, demand was forecasted at 44.7 GW and, thus, the total Resource Adequacy obligation, with the added 15% Planning Reserve Margin, was 51.4 GW.

The August 2020 Resource Adequacy requirement is shown here with the red dotted line. The actual load is shown in blue and generation outages are shown in orange. The August 14 and 15 actual peak loads exceeded the load forecast for August 2020 of 44.7 GW, as shown by the black dotted line. Furthermore, the generation outages on both days exceeded the 9% reserve requirement that accounts for plant outages. On August 15, total plant outages were close to the 15% total reserve requirement. Next slide.

Slide 8 – Generation Did Not Meet Expected Resource Adequacy Levels from Most Resource Types

Generation Did Not Reach Expected Resource Adequacy Levels From Most Resource Types



Source: CAISO and Preliminary Root Cause Analysis Mid-August 2020 Heat Storm report, October 6, 2020
 Note: Actual Energy from Natural Gas, Hydro and Imports do not reflect capacity reserved for Ancillary Services. Solar and wind do not provide Ancillary Services.



This slide compares actual energy output of Resource Adequacy and Reliability Must Run (RMR) resources with their RMR obligations and Resource Adequacy forecasts. This slide focuses on the net peak hour – the hour in which load minus renewable energy was highest, on August 14, and covers all resource categories. It shows that energy output was lower than the RMR obligations and Resource Adequacy forecasts across all resource categories, except for imports. As background, Resource Adequacy planning sets an expected energy level for resource types for every hour across the month, while output from each resource type varies across each day and even throughout the day, particularly by wind and solar resources. RMR units are obligated to run for reliability reasons.

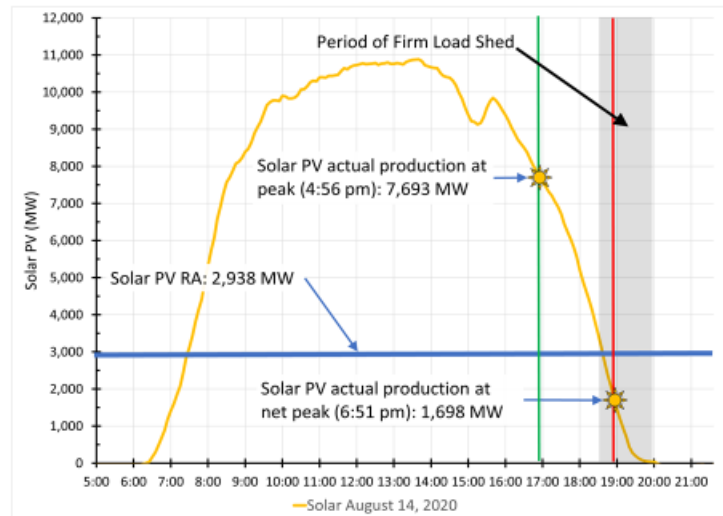
The blue bars show the sum of the August Resource Adequacy planned capacity of a certain type of resource and capacity of resources that have obligations (or RMR). The yellow bars show the Real-Time Energy and Ancillary Services Awards. The green bars show actual energy output from those resource types but do not reflect the capacity of Ancillary Services provided by a resource category.

According to the Preliminary Root Cause Analysis Report by the CAISO, CPUC, and CEC, natural gas generators that had experienced forced and planned outages were not replaced to maintain Resource Adequacy margins. This lowered the reserve margins that are intended to address other forced outages. Hydropower resources bid roughly at their Resource Adequacy requirements. However, the actual energy production during the net demand peak on August 14 was 40% less for solar (1,200 MW) and 57% less (640 MW) for wind.

While imports contributed more than planned by the August Resource Adequacy plan, import bids were fewer in the Day-Ahead Market because of the de-rate on the California-Oregon Intertie. The California-Oregon Intertie is a significant north-to-south transmission link between California and the Pacific Northwest and had been undergoing tower repairs since May 2020, which limited flows below normal, expected conditions and thus increased congestion on the line. Next slide.

Slide 9 – Significant Variations in Solar PV Generation Occurred during the Peak and Net Peak Load Periods

Significant Variations in Solar PV Generation Occurred during the Peak and Net Peak Load Periods



Source: CAISO and Preliminary Root Cause Analysis Mid-August 2020 Heat Storm report, October 6, 2020



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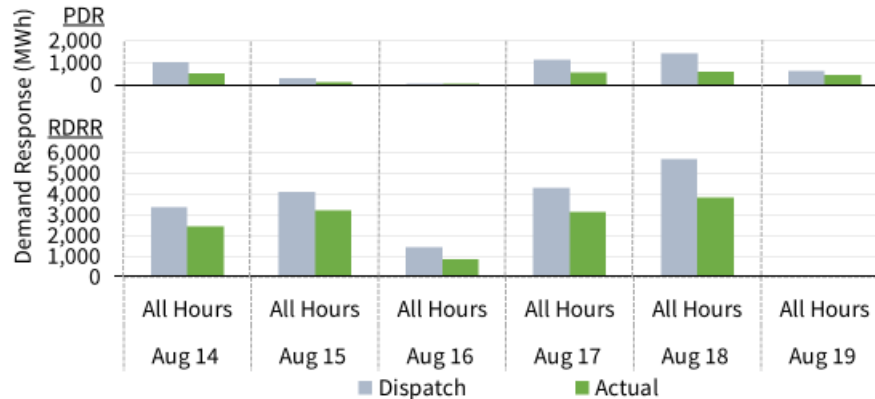
This slide further illustrates how Resource Adequacy planning levels differ from actual output, with a focus on the differences between output at peak load and output at net peak load on August 14. Resource Adequacy planning has traditionally focused on ensuring sufficient supply for the peak hour during the peak load day. The net peak load occurs when load without renewable generation is highest—generally in the early evening when load remains high but solar generation is declining. Resource Adequacy planning may not adequately address conditions when a significant resource, such as solar PV, is no longer available because of its intermittency. For instance, at net peak load, solar PV output is declining while load earlier served by behind-the-meter solar is increasing.

For planning purposes, the planned Resource Adequacy amount for solar PV resources was 2,938 MW for all hours in the month, but that amount does not reflect hour-by-hour output. During the peak load on August 14 at 4:56 pm, represented by the green vertical line, solar generation produced 7,693 MW, which is 4,755 MW greater than its planned Resource Adequacy amount. By contrast, at the net peak load, 6:51 pm, represented by the red vertical line, solar PV generation produced 1,698 MW, which is

1,240 MW less than the planned Resource Adequacy amount (42 percent unavailability).
Next slide.

Slide 10 - Demand Response Fell Below Dispatch Levels

Demand Response Fell Below Dispatch Levels



Source: CAISO

Note: PDR refers to Proxy Demand Response, which is bid into the CAISO markets. RDRR refers to Reliability Demand Response Resources, which are also bid into the CAISO markets but only dispatched after a warning notice or during system emergencies.



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This slide shows that demand response performance fell below dispatch targets during the August 2020 heat wave. Specifically, it shows the performance of the two categories of demand response programs in the CAISO market: Proxy Demand Resource (PDR) and Reliability Demand Response Resource (RDRR). The PDR program enables market participants to bid as supply in the wholesale Energy and Ancillary Services markets. By contrast, the RDRR program is a market participation model for reliability-based load curtailment, enables bids in the real-time Energy markets, and may only be made eligible for dispatch by CAISO after the issuance of a warning notice or during a system emergency. The RDRR program is presented in the other slides as “Emergency Demand Response.”

The Dispatch values on this slide indicate the CAISO demand response dispatch instruction. The Actual values indicate the demand response performance based on meter readings or settlement data.

Overall, on average over the six days, August 14 through 19, demand response resources provided 67 percent of the total MWh of demand response that they were dispatched to provide. RDRRs, which comprise the majority of the available demand response capacity, provided 71 percent of the MWh of demand response that they were dispatched to provide between August 14 and August 19. There are neither established

performance metrics nor comparable historical data to evaluate this 71 percent figure for RDRR. PDRs provided 50 percent of the demand response that they were dispatched to provide over the same period—August 14 through 19. Comparison of PDR performance is similarly difficult because, while PDR has been regularly dispatched, its performance varies dramatically. Next slide.

Slide 11 - Conclusion



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Overall, the August heat storm brought to light several potential shortcomings associated with California planning processes, operating protocols, and market design. Staff is now examining those issues as are CAISO, state entities, WECC and other stakeholders. Today's presentation is part of staff's efforts to examine those issues. In item E-3 on today's agenda, the Commission will consider a draft Order to Show Cause to CAISO in Docket No. EL21-19 that establishes a proceeding under section 206 of the Federal Power Act to determine whether the CAISO's Tariff is unjust and unreasonable and should therefore be revised given the heat events of August 14-19, 2020, and whether any tariff and market reforms should be implemented in time for next summer.

CAISO and California stakeholders started to address operational issues as the August heat storm progressed; CAISO increased calls for conservation and took actions to lower demand and increase generation. CAISO continues to examine further ways to improve methods for communicating the need for conservation when the need arises.

Also during the heat storm, CAISO addressed market issues related to exports by suspending convergence bidding for the trade dates of August 18 through August 21. During that time, convergence supply bids along with the under-scheduling of load had made it appear that more supply was available, thereby allowing a level of exports that

may not have been physically supportable. Several weeks later, in similar high-heat conditions over the Labor Day weekend, CAISO further revised its approach to limit market export schedules to what was physically supportable. CAISO continues to examine issues related to under-scheduling.

As to planning and reliability, CAISO, the CPUC, the California Energy Commission, and other stakeholders are examining such issues, including the resource adequacy issues related to net peak load. They also are examining whether to increase Resource Adequacy requirements to better account for weather events.

Chairman and Commissioners, this concludes our presentation. We are happy to answer your questions.