

Heatwave Causes Rotating Outages in California

Newspaper: What went wrong?
My answer: Nothing went wrong.

On August 14 and 15, the Californian Independent System Operator (CAISO) had to order utilities to implement rotating power outages due to increased electricity demand and unexpected loss of production capacity to protect power system stability.

It was the first use of rotating outages in California since 2001.

Due to hot climate and widespread use of air-condition, California has the highest electricity demand in the summer with one demand peak per day. The historical peak on July 24, 2006 was 50,270 MW.

This note presents charts from the period August 14 to 17, 2020.

Friday, August 14, 2020

With a 750 MW unit unavailable and an additional loss of a 500 MW unit, the reserve capacity came below the critical level, and CAISO had to order Stage 3 Emergency from 6:36 p.m.

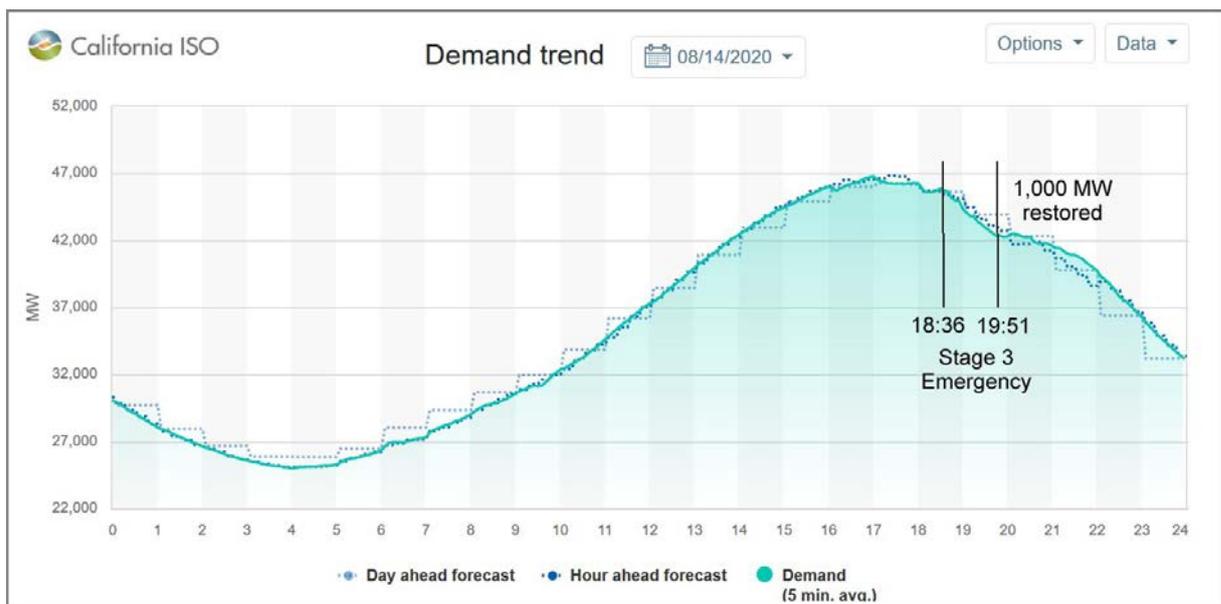


Fig. 1 - Expected and actual demand on Aug 14, 2020

The peak load was 47 GW and the consumption 852 GWh.

The supply side (fig. 2) is dominated by gas fired thermal production (48%). Imported electricity makes up 19%, solar PV 12% and wind energy 2%.

The maximum supply was 47 GW.

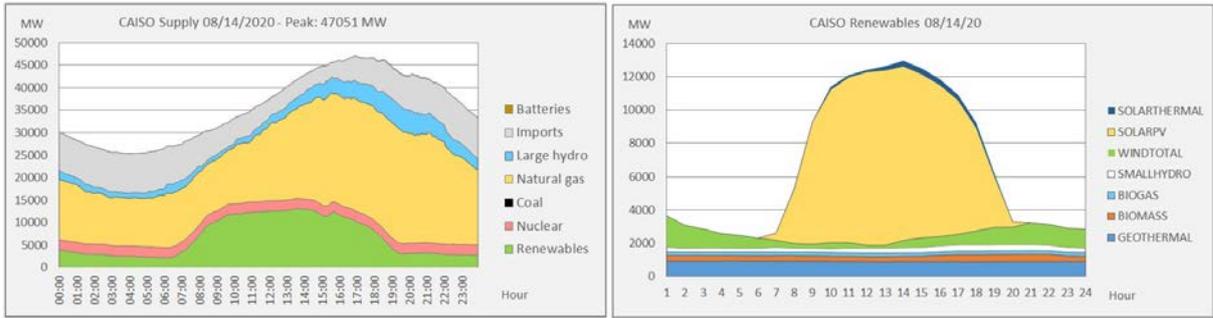


Fig. 2 - Supply breakdown for August 14

The heatwave also struck the neighbouring countries. The heat limited these countries' possibility to send power to California.

Saturday, August 15, 2020

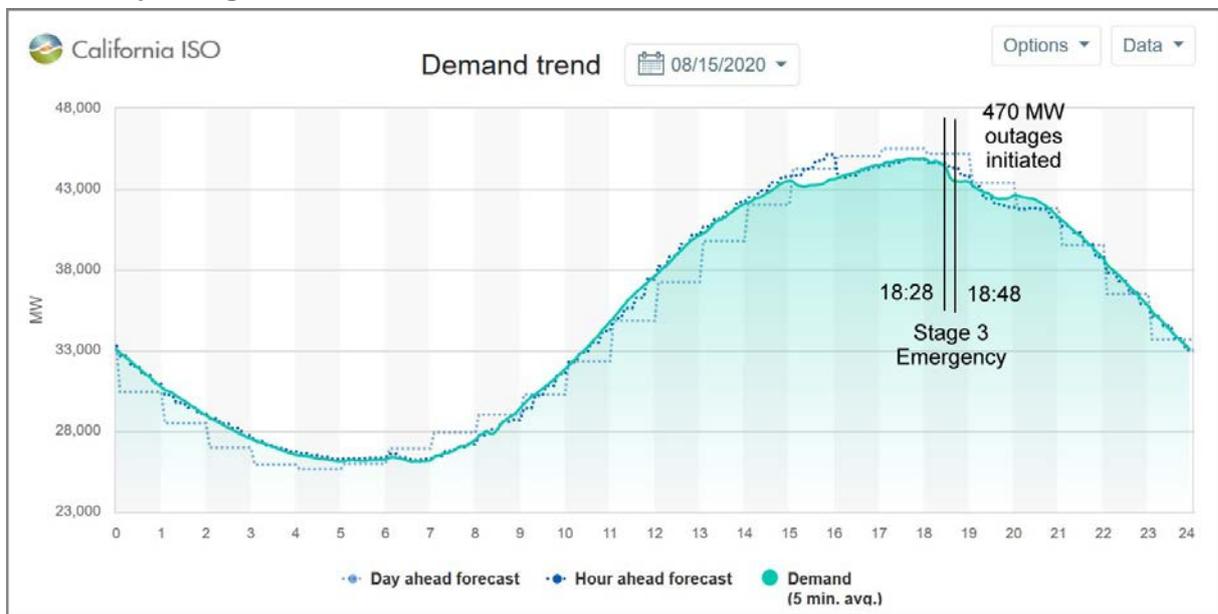


Fig. 4 - Expected and actual demand on Aug 15, 2020

Saturday had a lower peak demand than Friday, but due to additional loss of production capacity, CAISO had to order Stage 3 Emergency from 6:28 p.m.

Peak supply was 45.3 GW.

The total consumption was 849 GWh, of which natural gas provided 49%, import 20%, solar PV 9% and wind energy 3%.

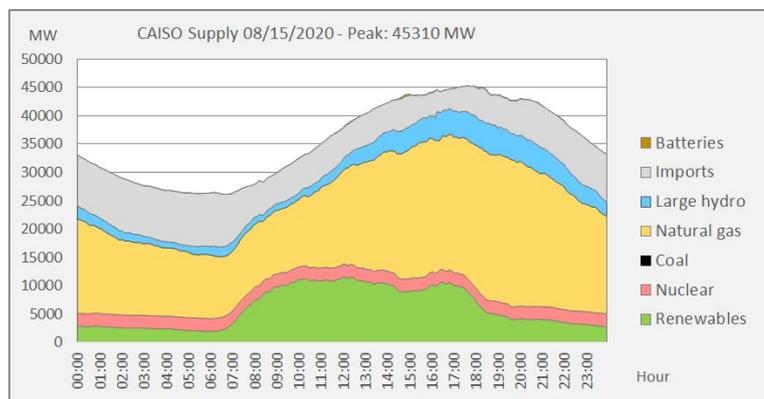


Fig. 3 - Supply breakdown for August 15

Monday, August 17, 2020

On Sunday, August 16, CAISO issued a statewide Flex Alert, a call for voluntary electricity conservation, beginning Sunday and extending through Wednesday. The Flex Alerts are in effect from 3 p.m. to 10 p.m. each day.

The call from CAISO continues:

A persistent, record-breaking heatwave in California and the western states is causing a strain on supplies, and consumers should be prepared for likely rolling outages during the late afternoons and early evenings through Wednesday. There is not a sufficient amount of energy to meet the high amounts of demand during the heatwave.

However, consumers can actively help by shifting energy use to morning and nighttime hours and conserving as much energy as possible during the late afternoon and evening hours. Consumer conservation can help lower demand and avoid further actions including outages, and lessen the duration of an outage.

Consumers are urged to lower energy use during the most critical time of the day, 3 p.m. to 10 p.m., when temperatures remain high and solar production is falling due to the sun setting.

Extended periods of heat also can cause generator equipment failures that can lead to more serious unplanned losses of power.



Fig. 5 - The flex alert seems to have reduced the peak level by about 5 GW

On fig. 5, CAISO has indicated the estimated conservation. Due to this result, CAISO avoided issuing new Stage 3 Emergency orders. The rotating blackouts Friday and Saturday seem to have convinced the consumers that voluntary demand reductions are better than power cuts.

What went wrong?

We have discussed demand side management (DSM) for many years. DSM was supposed to be used for peak shaving and load shifting, when necessary.

The San Diego Union-Tribune

California experiences first rotating power outages in 19 years. What went wrong?

There is no fair reason to install production capacity for covering extreme and rare demand peaks. Such capacity is unreasonably expensive. The loss of convenience during these few hours cannot justify the additional cost. The case demonstrates that the potential for conservation is considerable.

Nothing went wrong in California.

CAISO and the Californian utilities have prepared the necessary procedures. By using demand curtailments CAISO maintains the full control of the power system and prevents loss of control with system collapse and full blackout. This is just "care in due time" (direct translation of a Danish saying).

Similar procedures may exist in Europe, but I did not find them. With increasing shares of fluctuating electricity production and insufficient transmission systems, an increasing number of critical situations might occur in Europe. Therefore, the European TSOs should inform their producers and consumers about their emergency preparations.

CAISO's prepared range of calls

CAISO has a number of possible calls for utilities, producers and consumers depending on available capacity reserves:

- Flex Alert: Voluntary conservation of energy
- Restricted Maintenance Operations
- Alert: anticipates operating reserve deficiencies
- Warning anticipates activation of electricity reserves
- Transmission emergency
- Stage 1 Emergency calls for immediate conservation
- Stage 2 Emergency requires CAISO intervention in the market
- Stage 3 Emergency: load interruption is imminent or in progress

These measures have been used in the following numbers:



Summary of Restricted Maintenance Operations, Alert, Warning, Emergency, and Flex Alert Notices Issued from 1998 to Present

| | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|-----------------------------------|------|------|------|------|------|------|------|------|------|
| Flex Alert* | N/A | N/A | 20 | 26 | 1 | 0 | 6 | 7 | 18 |
| Restricted Maintenance Operations | 8 | 12 | 77 | 168 | 18 | 10 | 16 | 13 | 16 |
| Transmission Emergency | N/A | N/A | N/A | N/A | N/A | N/A | 6 | 5 | 0 |
| Alert | 7 | 2 | 34 | 180 | 3 | 0 | 1 | 0 | 1 |
| Warning | 8 | 6 | 85 | 181 | 4 | 0 | 2 | 2 | 5 |
| Stage 1 Emergency | 7 | 4 | 55 | 70 | 2 | 1 | 1 | 1 | 3 |
| Stage 2 Emergency | 5 | 1 | 36 | 65 | 1 | 0 | 0 | 2 | 1 |
| Stage 3 Emergency | 0 | 0 | 1 | 38 | 0 | 0 | 0 | 0 | 0 |
| Voluntary Load Reduction Program | N/A | 3 |

| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|-----------------------------------|------|------|------|------|------|------|------|------|------|
| Flex Alert* | 6 | 3 | 0 | 0 | 2 | 2 | 3 | 1 | 2 |
| Restricted Maintenance Operations | 18 | 10 | 6 | 7 | 15 | 23 | 9 | 8 | 10 |
| Transmission Emergency | 4 | 0 | 6 | 2 | 2 | 0 | 0 | 1 | 0 |
| Alert | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Warning | 3 | 1 | 2 | 1 | 1 | 0 | 0 | 1 | 2 |
| Stage 1 Emergency | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stage 2 Emergency | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stage 3 Emergency | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | 2016 | 2017 | 2018 | 2019 | 2020 | TOTALS |
|------------------------------------|------|------|------|------|------|--------|
| Flex Alert* | 3 | 4 | 2 | 1 | 2 | 109 |
| Restricted Maintenance Operations | 11 | 10 | 18 | 2 | 3 | 488 |
| Transmission Emergency | 0 | 1 | 2 | 3 | 1 | 33 |
| Alert | 0 | 0 | 0 | 0 | 6 | 236 |
| Warning | 0 | 0 | 0 | 1 | 5 | 310 |
| Stage 1 Emergency | 0 | 1 | 0 | 0 | 0 | 146 |
| Stage 2 Emergency | 0 | 0 | 0 | 0 | 4 | 115 |
| Stage 3 Emergency | 0 | 0 | 0 | 0 | 2 | 113 |
| 1-Hour Probable Load Interruptions | 0 | 0 | 0 | 0 | 1 | 1 |

NOTES: "No Touch" (as shown on previous "Detail" sheets) was replaced with "Restricted Maintenance Operations" in 2002