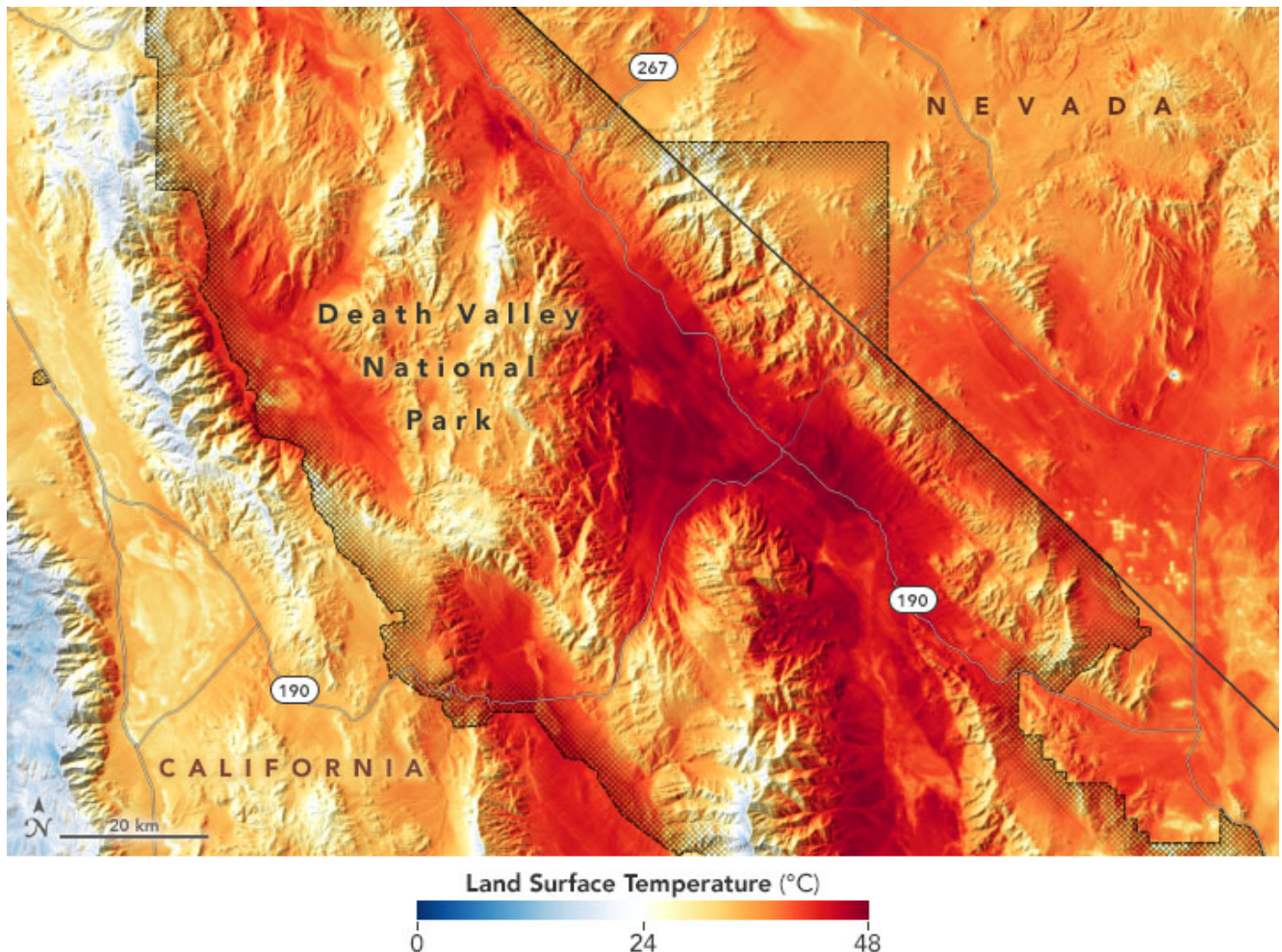


Report details causes of recent California rolling blackouts



Enlarge / August 14 and 15 saw a heatwave drive rolling blackouts. And then on August 16, a station in Death Valley hit 130°F...

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In mid-August, just before dry lightning storms ignited a series of fires that would break records in California, an intense heatwave resulted in rolling blackouts on two

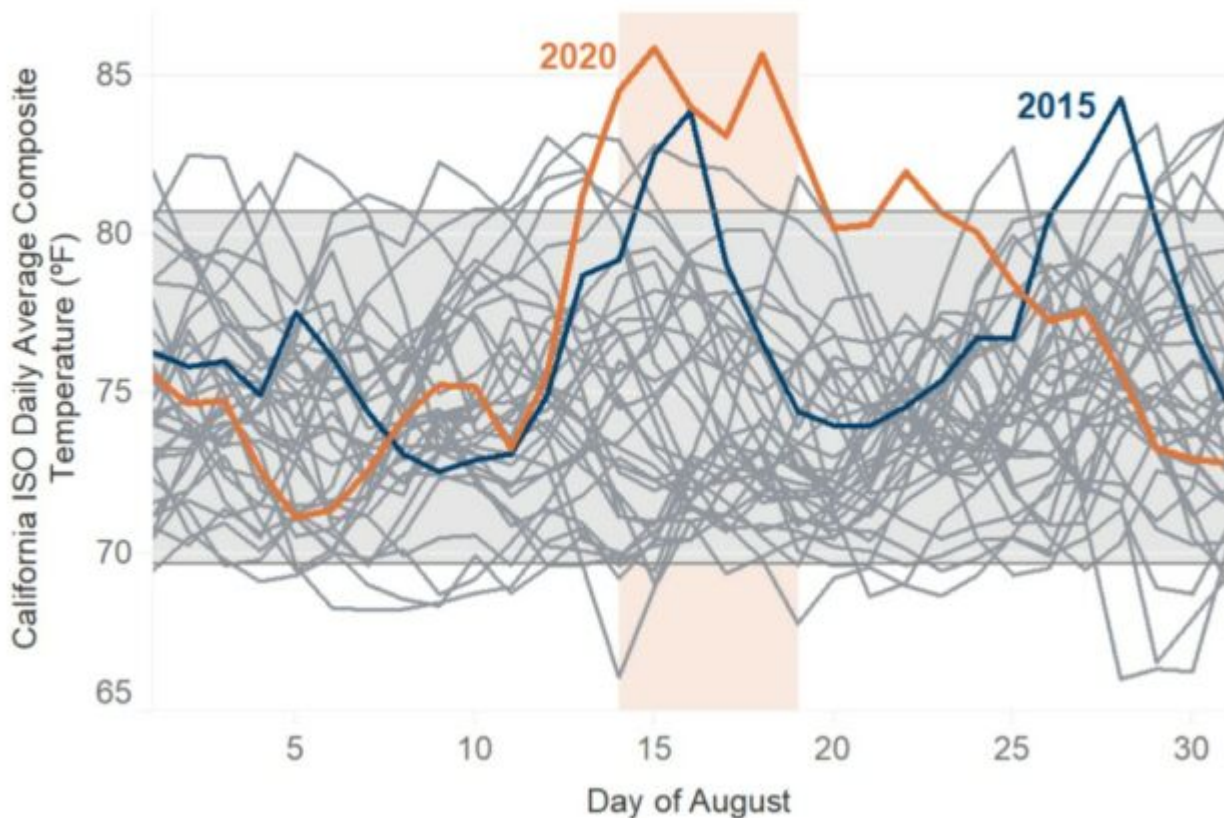
consecutive days. The trouble came in the evening, when solar generation drops off, leading some to claim this was the consequence of relying on renewable electricity. But it's not that simple, as the outages could have been avoided. A new "preliminary root cause analysis" report from two state commissions and the California Independent System Operator that runs the grid presents a clearer picture of what went wrong.

The rolling outages affected a few hundred thousand people starting around 6:30pm on both August 14 and 15. They were actually the result of the grid's rules: once the remaining reserve generation falls below six percent of current demand, the grid operator is required to institute rolling blackouts.

The report blames the need for outages on three things: extreme and widespread hot weather, a failure to update peak-demand forecasting practices as solar generation grows, and mistakes on the grid market that led to some plants exporting power when it was actually needed in-state.

First up, the weather that precipitated the shortage: It was indeed remarkably hot, which drove demand up to power air conditioning from the afternoon into the evening. The report puts it at about a 1-in-35-year heatwave. Grid planning accounts for extremes to an extent, but oversizing potential supply for every possible event can push costs to astronomical levels, so there are limits. And those limits are changing, as the report describes this as a "climate change-induced extreme heat storm." There has not been a formal scientific study of this weather event, but trends in extreme heat are clear in a warming climate.

Figure ES.1: August Temperatures 1985 - 2020



Enlarge / Average temperatures on August 14 and 15 (and so electricity demand for cooling) were exceptional.

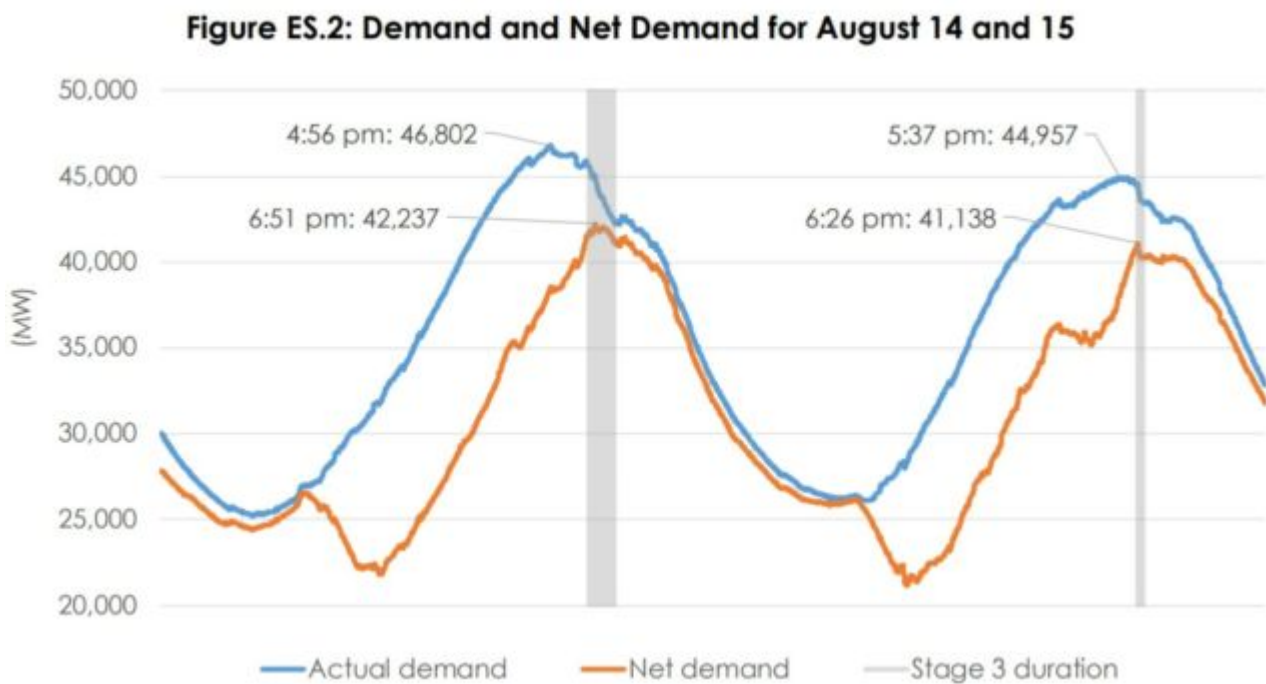
Equally important is that most of the West was in the same hot, high-pressure weather system. With demand up everywhere, there wasn't enough available generation in neighboring states to import extra (more on that in a moment). Hot weather also imposes limitations on combustion plant operations—they just don't work as efficiently—and transmission line capacity.

The second item on the report's list relates to demand forecasting. Grid operators have historically focused on lining up supply to meet the peak of demand, since that should handle the rest of the day. But the pinch came *after* the peak in this case, at a time when solar generation was dropping off its high point for the day but air conditioners were still rumbling. The report refers to this as the "net demand peak"—that is, the peak of total demand minus solar and wind generation. As solar generation grows as a share of generation in California, this point has increasing importance, but it

hasn't been front-and-center in planning practices.

On August 14, for example, peak demand was 46,800 megawatts just before 5:00. By 7:00, demand had dropped by about 4,600 megawatts, but wind and solar generation had dropped by 5,400 megawatts.

There's more going on here. Solar and wind production in this window were a little lower than expected, owing to a dip in winds and high cloud cover. Due to drought conditions, hydroelectric generation is down this year. Natural gas plants also generated 1,400-2,000 megawatts less than expected because of heat impacts and other problems. What's more, 400 megawatts of pre-planned gas plant outages hadn't been substituted for.



Enlarge / Demand (blue) and demand minus solar and wind generation (yellow) over August 14 and 15. The periods of rolling blackouts are shown in the gray bars.

Imports from out of state were also lower than usual, of course, even though *some* extra supply came through when an emergency request went out. Apart from the demand elsewhere, this was also due to a transmission line connecting California to the Pacific Northwest going down, limiting transfers.

Another important strategy for these tight supply events is to reduce demand. That includes specific agreements that can be called upon as well as the general calls for public conservation that went out in California and some neighboring states. In total, utilities got about 80 percent of their coordinated demand reduction to come through, shaving around 1,000 megawatts off early evening demand.

The report's third focus is the way the market behaved in the lead up to the rolling blackouts. In several ways, the market messed up where it could have helped. The demand forecast made on the previous day underestimated peak demand by about 3,400 megawatts, for one. And the bidding process by which generators sell their electricity told some California plants they could export their power to other markets.

A rare failure like this typically requires many problems to stack up at the same time, and that seems to have been the case. The report notes that when California's weather cranked up the heat again on August 17-19, blackouts were avoided. This was in part due to some temporary alterations of the bidding process, greater availability of imported electricity, and greater demand reduction.

Looking ahead longer term, the report highlights some things that need to improve. The planning process needs to adapt to current grid conditions. The daily forecasts and bidding procedures could use tightening up, as well. But adding grid-scale storage would make everything a lot easier by smoothing out supply through the evening hours. That will only become more true as the share of renewables grows—and not just in bad-luck weather extremes.

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