

McCULLOUGH RESEARCH

ROBERT F. MCCULLOUGH, JR.
PRINCIPAL

Fire and Ice: Electric Reliability Failures in California and Texas

Robert McCullough
Jean-Carl Ende
Joshua Crawford
Anthony Nacrelli
McCullough Research

“Some say the world will end in fire,
Some say in ice.
From what I’ve tasted of desire
I hold with those who favor fire.
But if it had to perish twice,
I think I know enough of hate
To say that for destruction ice
Is also great
And would suffice.”

- *Robert Frost*

This past week saw calls for energy conservation from the two most populous states in the U.S. – Texas and California – as the states’ grid operators were once again faced with the prospect of rolling blackouts. This would have been the second case of rolling blackouts for each of the operators in under a year: with the California Independent System Operator (CAISO) implementing rolling blackouts on the 15th and 16th of August 2020, and the Energy Reliability Council of Texas (ERCOT) doing so on the 15th-18th of February 2021. These warnings raise the question as to why the two systems appear so fragile in their effort to meet extreme weather events – both during extreme cold and extreme heat and why published reliability evaluations are so at odds with actual operations.

Since 2005, the final arbiter of reliability in the U.S. has been the North American Electric Reliability Corporation (NERC). Although NERC has the authority to enforce reliability standards, it has evolved into a passive reporting role. The chart below represents their most recent annual report on reliability in the U.S. and Canada:

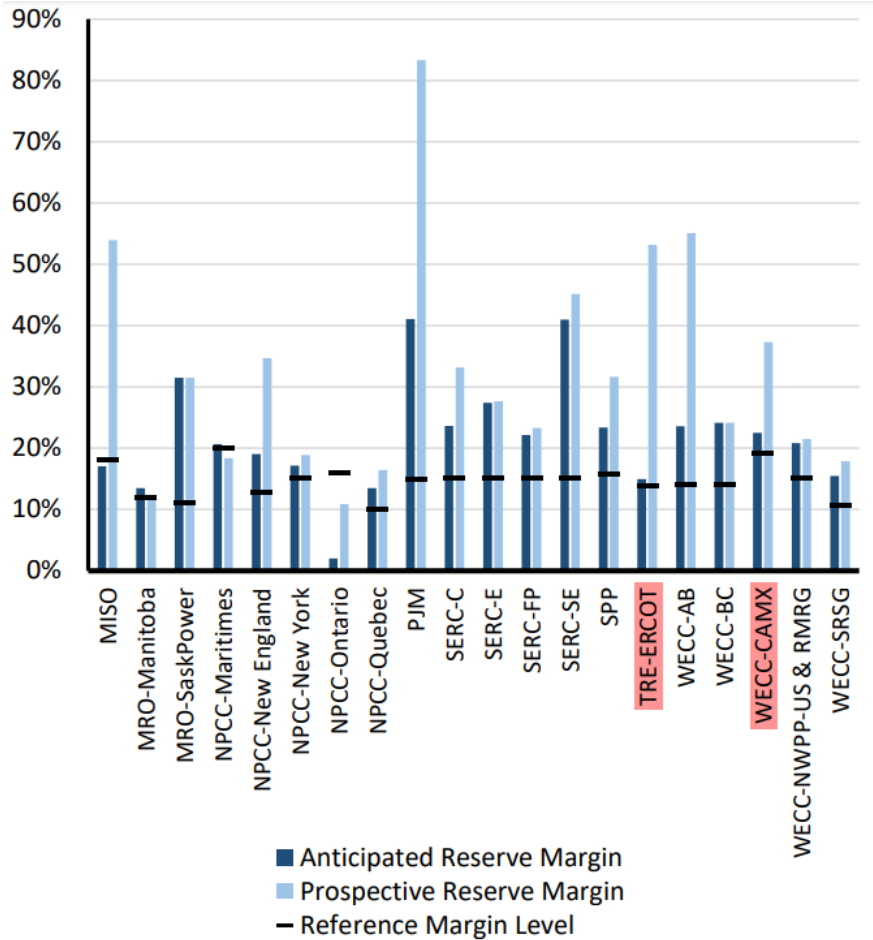


Figure 1: Anticipated and Prospective Reserve Margins for 2025 Peak Season by Assessment Area

1

NERC’s report indicates a significant disconnect between actual reliability in Texas (highlighted above as “TRE-ERCOT”) and California (“WECC-CAMX”). In both cases NERC indicates that the required reserve margin for adequate reliability has been met. This is signified by the column representing the anticipated reserve margin in the area being taller than the black bar. It also notes that reserve margins in PJM are running three to six times their required levels – in spite of PJM testimony at FERC to the contrary.

However, as warnings issued last week in Texas and California indicated, reserves are not adequate – even before the onset of what is likely to be a very hot summer.

¹ 2020 Long-Term Reliability Assessment, NERC, December 2020, page 13.

Both the independent system operators share in their use of complex computer systems for dispatching and pricing electricity, their high levels of forced outages, their reliance on market participants as the governors and administrators of the system, and perhaps most importantly, their lack of transparency. They differ in a number of respects: Texas lacks interconnections with other regions and has adopted a unique market scheme that uses system emergencies as incentives for new capacity. California is integrated into neighboring regions and is subject to FERC regulation.

Webpage and report titles such as the *February 2021 Extreme Weather Event* (ERCOT) and the *Mid-August 2020 Heat Storm* (CAISO), give the impression that the ISOs' recent failures may be explained away as mere Acts of God. However, a review of the events suggests that problems related to the ISOs' market designs, governance, and incentive structures deserve a sizeable portion of the blame.

The California ISO (CAISO):

CAISO's recent conservation warning was, yet again, not shared by every balancing authority in California. Los Angeles did not experience power outages during the August heat storm, and the Balancing Authority of Northern California (BANC) did not call for energy conservation this last week. This points to the probability that CAISO's recent calls for energy conservation may stem from some of the ISO's more chronic problems. Historically, the ISO has struggled with flawed operational data, poor capacity planning, and high rates of forced generation outages.

One reason CAISO has faced problems with insufficient capacity is their poor capacity planning. The California ISO has historically included expected imports as a piece of their total estimated capacity. The term used to describe this behavior is called "leaning on the neighbors." However, imports are not made under firm contracts, and are most necessary when they are least available (e.g., during a severe weather event). Moreover, the presence of very few lines connecting the ISO to other operators means that effects of transmission outages are more acute between grids than within them.

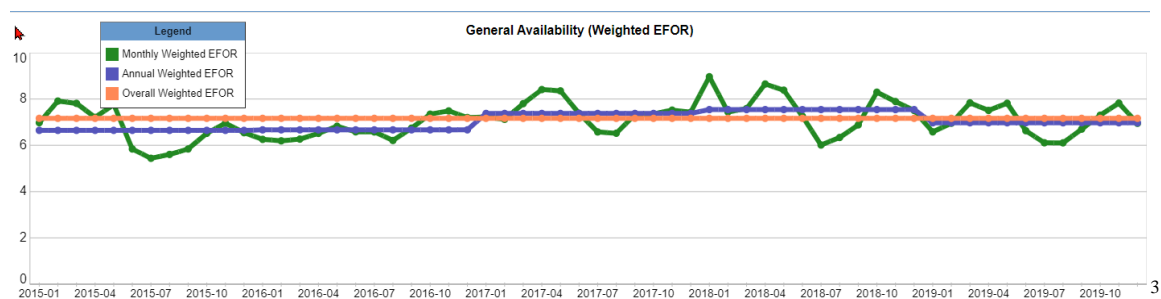
This strategy of leaning on the neighbors has proven ineffective at maintaining grid reliability during warm weather events. A report on the causes of the August rotating outages in California states the following:

The climate-change induced extreme heat storm across the western United States resulted in the demand for electricity exceeding the existing electricity resource planning targets. The existing resource planning processes are not designed to fully address an extreme heat storm like the one experienced in mid-August.²

² Preliminary Root Cause Analysis, Mid-August 2020 Heat Storm, CAISO/CPUC/CEC, October 6, 2020, Page 43.

Translated into normal English, this paragraph effectively says that leaning on neighbors does not work if the weather is bad. A better paragraph might have said, “leaning on neighboring systems without firm capacity and transmission contracts is expensive and undependable.”

Finally, the CAISO has had a history of high levels of forced outages. During the August heat storm CAISO had 13.8% of its generation offline—a large number when compared to the nationwide averages provided by NERC’s generation outage data base (see figure below).



CAISO’s load forecasts are also terribly conservative. A traditional forecasting approach is to plan for a worst-case scenario. CAISO’s forecasts have depended on average forecasts – a very poor approach given recent experience.

With higher-than-normal numbers of breakdowns and far too much expectation of aid from neighboring regions, California’s problems are far from force majeure.

The Electrical Reliability Council of Texas (ERCOT):

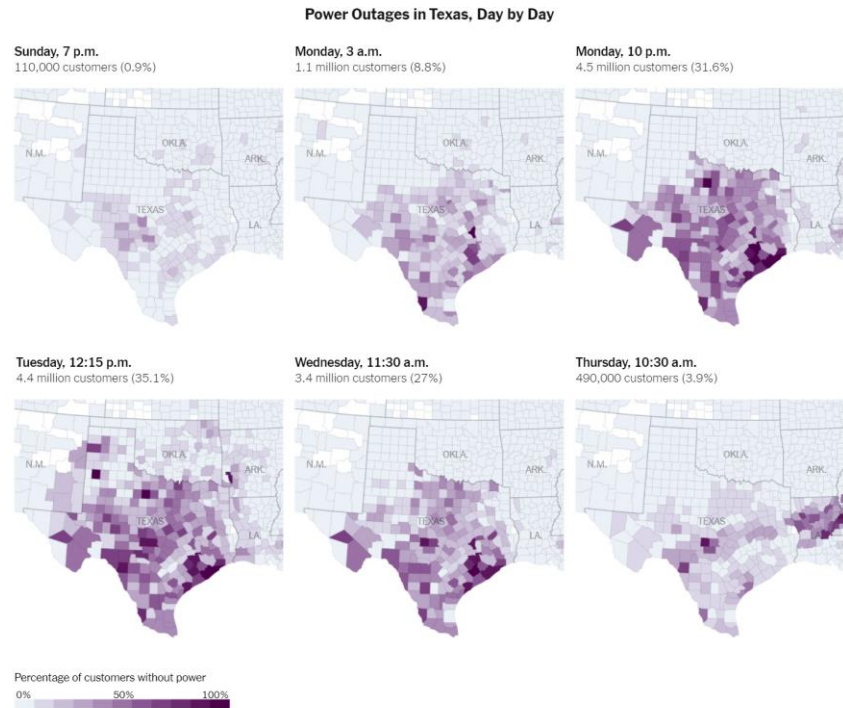
ERCOT’s recent calls for energy conservation also highlight the grid operators loose hold on the state’s grid. ERCOT stood out this February as the most severe failure in a region which bore the brunt of winter storms. Though weather was severe, a similar experience in the state ten years ago, as well as less serious consequences from surrounding states, point to larger issues within the ISO.

³ <https://www.nerc.com/pa/RAPA/Pages/GeneralAvailabilityReview.aspx>

Fire and Ice: Electric Reliability Failures in California and Texas

June 21, 2021

Page 5



Source: PowerOutage.us | Figures reflect outages in Texas and exclude neighboring states.

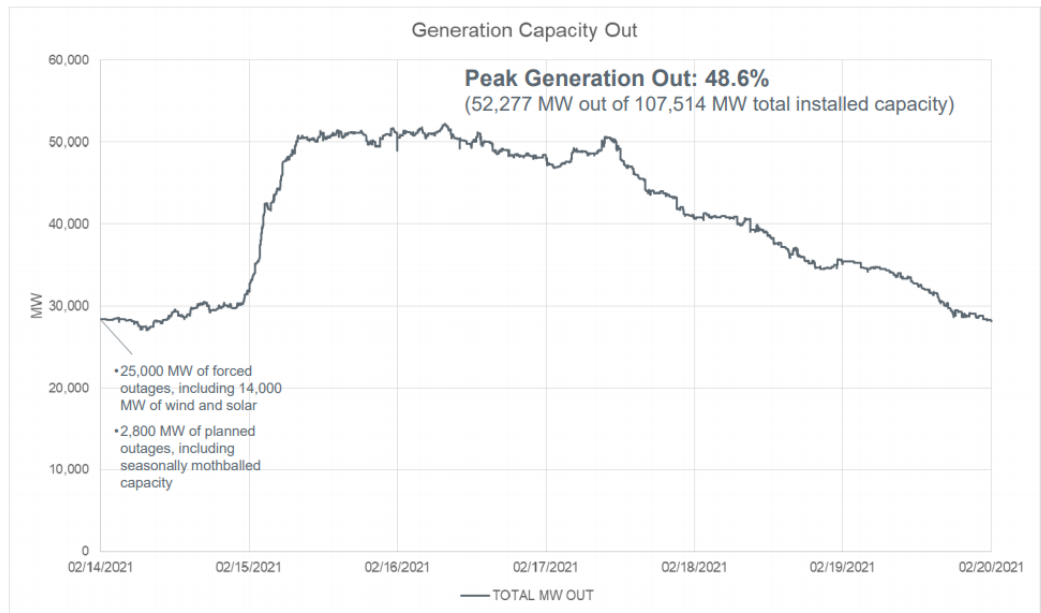
There are a few major problems that contribute to the problems in Texas; reliance on scarcity pricing as a substitute for the capacity market, a lack of coordination between electric and natural gas regulators, and a large number of generation failures.

Paid to fail – incentivized negligence

ERCOTs use of the Operating Reserves Demand Curve as a substitute for a capacity market raises electricity prices under tight grid conditions. Though intended to incentivize the construction of new power plants, the policy has incentivized negligence on the part of the existing generation, and left ERCOT with a chronically low reserve margin.

ERCOT’s system is operated on a unique “price of failure” basis. In Texas, market participants can expect substantial rewards if an emergency occurs. Prices are set to a level during system emergencies sufficient to incentivize further plant investments. The current price is \$9,000/MWh – an arbitrary price calculated from a consultant’s report some years ago. Absent system emergencies, ERCOT would not provide much of an incentive to build new resources.

⁴ Popovich, N. , Wallace, T., Penney, V., & Reinhard, S. (2021, Feb 18). Mapping the winter storm’s impact. *The New York Times*. <https://www.nytimes.com/interactive/2021/02/16/us/winter-storm-texas-power-outage-map.html>



5

However, even if ERCOT did have sufficient capacity this would not have made much of a difference, as an estimated 48.6% of their generation fleet was knocked off line during the winter event. Lack of weatherization, and poor integration of the natural gas and electricity systems are the proximal causes for these failures. However, the fact these problems have not been solved since the last “100-year storm”—which occurred 10 years ago—can likely be traced back to the perverted incentives which the scarcity pricing system provides.

Unfortunately, the shift to emergency pricing may also be considered “incentivized negligence”, because it rewards existing major generation owners to not generate during emergencies. For example, the largest single outage in the February event in Texas was at the 2,000 MW South Texas Project, which lost one unit due to the failure of a minor sensor. At 300 times normal pricing, the South Texas Project only generating at 50% of capacity earned \$9 million an hour. If the emergency had been averted, the plant would have only earned \$60,000 an hour. This means that it may not be optimal to maintain and weatherize all equipment, if a minor problem that reduces generation by 50% can provide enormous profit potential.

Communication Failures on Critical Infrastructure

Unlike California, ERCOT is not subject to FERC regulation. Instead, a cursory level of regulatory review occurs at the Texas Public Utilities Commission—and to a lesser extent the Texas

⁵ Magness, B. (2021). *Review of February 2021 Extreme Cold Weather Event – ERCOT Presentation* [PowerPoint Slides]. ERCOT.com. http://www.ercot.com/content/wcm/lists/226521/Texas_Legislature_Hearings_2-25-2021.pdf

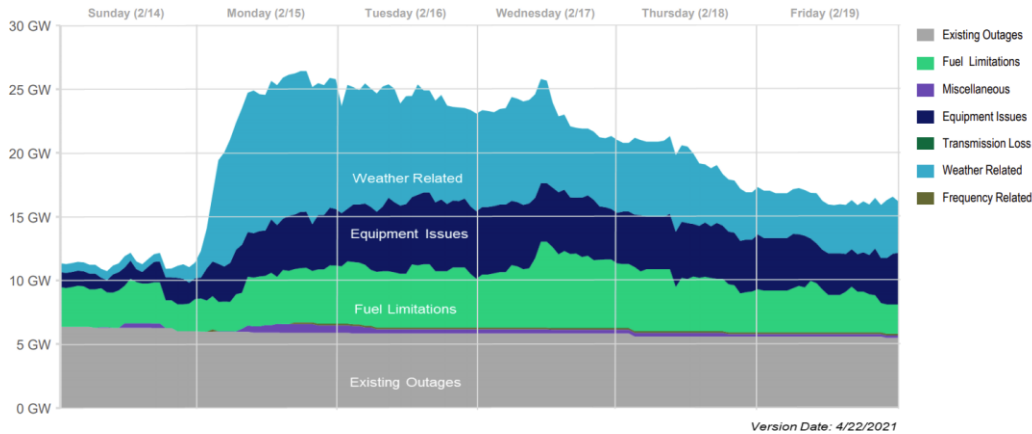
Railroad Commission, which regulates natural gas. A combination of “protocols” (2,000 pages), Texas PUC orders (it is impossible to quantify the number of pages), and Texas laws (again, impossible to quantify) “govern” ERCOT’s activities. However, extensive evidence from the February outages indicate that these policies are poorly understood and are implemented in an ad hoc fashion.

ERCOT has been silent on the actual cause of the frequency drop in February. It is possible that the problem may have resulted from the implementation of their load management program at 1:07 A.M. Rolling Blackouts are ordered by ERCOT, communicated to distribution and transmission entities, and then rolled out to substations. Exemptions to rolling blackouts require the submission of paper forms at the distribution and transmission entities or at the Texas PUC. Apparently, few were applied for and not all applications were honored. ERCOT has stated that it does not know who was interrupted at that time, but there is substantial evidence to suggest natural gas shortages were related to ERCOT’s untested critical infrastructure facility filings.

In principle, all critical infrastructure – including hospitals, police, prisons and utilities, like natural gas and water – filed documents declaring their critical nature with either the transmission entities, balancing authorities, ERCOT, or in the case of water districts, the Texas PUC. Our review indicates that these filings were either not made or not processed by the appropriate recipients. It is not clear if there exists a comprehensive operable list of critical infrastructure facilities that must not have their power shut off, or indeed whether ERCOT took such a list into consideration during the February event.

For natural gas, compressor stations counting on electricity to transport fuel to generators were allowed to go dark. These problems were reported by the Texas pipelines. Additionally, press coverage has indicated cases of transmission and distribution providers reactivating the natural gas infrastructure. There are also reports of critical infrastructure facilities filing with load curtailment programs, volunteering to be shut off during a minor frequency loss event. Even ERCOT reported a significant amount of natural gas fired power plant outages due to “Fuel Limitations”.

Net Generator Outages or Derates for Natural Gas Generators by Cause



The chart above is also unclear what falls under the umbrella of “Weather Related” or “Equipment Issues”. It is likely that some of those reports were also due to unexpected power loss among critical infrastructure facilities

A parallel process affected Texas water districts. Our spot check indicates that many water districts did not file their critical facility requests with the Texas PUC. However, we also found that even some of those that did file the request were interrupted during the cold spell. This resulted in residents being placed on a “boil water” notice for days—and in some cases weeks—as sanitation and waste processing facilities shut down.

Conclusions

Our analysis suggests that the fragility of the two grids may be explained by ineffective oversight and distorted incentives in the case of Texas, and a broken and expensive capacity planning system in the case of California. In both cases, these poor planning decisions are likely the result of unreliable political judgements made by unskilled stakeholder committees. Additionally, due to implausible levels of secrecy at both of these ISOs, their decisions are generally not subject to public criticism.

⁶ Electrical Reliability Council of Texas [ERCOT]. (2021). *Update to April 6, 2021 Preliminary Report on Causes of Generator Outages and Derates During the February 2021 Extreme Cold Weather Event* [PowerPoint Slides]. ERCOT.com. http://www.ercot.com/content/wcm/lists/226521/ERCOT_Winter_Storm_Generator_Outages_By_Cause_Updated_Report_4.27.21.pdf

The changing nature of our climate promises to make historical weather patterns unfit for projecting the severity of weather-related events. In the face of increasingly extreme weather patterns, it is clear the current system is not working. With Texas' grid failing in February, individual system operators in Texas have clearly been unprepared for cold weather events. The past year's failures and the recent calls for electricity conservation at CAISO and ERCOT leave major questions about grid reliability as we enter the summer cooling season.