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23 Feb 2021 | 16:30 GMT

What the Texas-Freeze Fiasco Tells Us About The Future of the Grid

Depending on your point of view, the Texas blackouts were caused by deregulation, green energy, or an isolated electrical grid

By **Robert Hebner**

Photo: Joe Raedle/Getty Images

Winter Storm Uri brought snow, ice, and the coldest sustained temperatures recorded in Texas in decades. In the midst of the deep freeze, on 18 February, icicles sprouted on a roadside sign in Kileen, Tex.

"Don't Mess with Texas" started life as part of an anti-litter campaign, back in 1985, and soon became an internationally recognized slogan. Too bad nature cares not a whit about slogans. In mid-February, a wintry blast hit the state, leaving more than 4 million people without power, most of them in homes not designed to shelter against bitter cold. The prolonged icy temperatures triggered a public health emergency and killed several dozen people in the state, according to press accounts.

So what actually happened, and why? The first question is a lot easier to answer than the second. What everyone agrees on is that the whole state experienced record cold, preceded by ice storms, which were followed by snow. Central Texas, for example, recorded the coldest temperatures in more than three decades and the most snow—about 15 centimeters—in more than seven decades. Moreover, the number of hours below freezing was in the triple digits—in a state in which dips below freezing very seldom last more than a few hours.

And bad things happened to the grid. Ice storms caused tree limbs to fall onto distribution lines, causing power outages. Wind turbines were taken off line due to icing of their blades. Distribution of natural gas to power plants was shut off or curtailed when key components in the gas system froze up. Even a nuclear plant had a cold-weather-related failure. At the South Texas Project Electrical Generating Station in Bay City, Texas, a 1,300-megawatt unit went off line on 15 February after a pressure sensor in a feedwater line malfunctioned.

At the same time, the frigid weather triggered soaring demand for electricity. Unfortunately, some plants were off line for maintenance and others were unavailable because of the cold. As the crisis went on, and on, nervous grid operators recognized that surging demand would outstrip supply, causing major parts of the state's grid—or perhaps its entire grid—to collapse.

So, at 1:25 a.m. on 16 February, about two days after the storm spread across the state, operators began implementing rolling blackouts to assure power-system stability. But they soon ran into problems, because the curtailment area was so large. Some places, including Austin, the state's capitol, found that in order to reduce the load by the amount mandated by the state's electrical authority, they had to shut down all electrical feeders except the ones feeding critical loads, such as water treatment plants and hospitals. So, the "rolling" blackouts weren't rolling at all; for nearly all residential customers in and around Austin, once the power was turned off, it stayed off.

Now to the second question: *Why* did the Texas grid crumble? The weather-triggered problems led to a tidal wave of instant pundits picking over the very limited data to support their preferred theory as to the root cause of the problem. Against renewables? Then obviously the whole sorry episode could be blamed on the iced-over wind turbines. Anti-fossil fuels? In that case, the maximizing of profits by those plant operators was clearly the fundamental cause. Microgrid proponents said there would not have been a problem if Texas had more microgrids.

Image: ERCOT

Most of Canada and the United States is covered by just three synchronous electrical grids: one in the East, one in the West, and one that covers most of Texas.

And there were twists here, too, related to a couple of unusual technical and economic aspects of the Texas electrical system. Most of the United States and Canada are covered by just three synchronous electrical grids. There's one for the eastern part of the continent, one for the western part of the continent, and a relatively tiny one that covers most of Texas. That Texas grid is operated by an organization called the Electric Reliability Council of Texas (ERCOT). Not everyone thinks it's a good idea for Texas to have its own grid, so for these folks, the lack of synchronous connections to the rest of the U.S. was the problem.

Also, since 1999, Texas has had a deregulated, energy-only market structure, which means that suppliers get paid only for the electricity they produce and sell, and the market is not regulated by the Federal Energy Regulatory Commission. So there were also calls for a transition to a forward-capacity-market structure in which suppliers are paid not only for what they sell but also to maintain the capacity to produce more than they sell. A few observers claimed that a capacity market would have avoided the fiasco.

Focusing on the technical claims and counter-claims for the moment, it is obvious that engineers around the world know how to make wind turbines and fossil-fuel power plants that continue to work under prolonged winter stress. So why were these tried-and-true engineering approaches not implemented?

To understand the reason, you first have to consider a fundamental role of State utility commissions, which is to assure that the people of the State get the lowest-cost electricity with acceptable reliability. It's always possible to invest more money and get a more reliable electrical system. So, it's a mostly non-technical judgement call to properly balance the cost of enhanced reliability against the risk of an unusual calamity. It is this logic that leads to, for example, Buffalo, New York, having considerably more snow plows per kilometer of paved road than San Antonio, Texas.

Photo: ERCOT

The Texas electrical grid is controlled by the Electric Reliability Council of Texas (ERCOT) from a control room in Taylor, Texas.

Not wanting a crisis to go to waste, some are proposing significant structural changes. For example, the grid covering much of Texas is connected to the rest of the US power grid and the Mexican power grid via five direct-current links. Some observers saw an opportunity to renew calls for Texas to merge its grid with one or both of the other major continental grids. This could be accomplished by building new high-voltage transmission lines, either AC or DC, tapping into other parts of the country. These would expand the existing electricity import-export market for Texas and better integrate Texas's grid with the other two, adjacent grid systems.

This won't be a near-term solution. The time required to build transmission lines is measured in years and the cost will likely exceed US $1 million per mile ($620,000 per km). And this transmission-expansion idea competes with alternatives: distributed generators fueled by propane or natural gas; and storage facilities based on batteries or fuel cells capable of powering a single house or a retail, industrial, or commercial facility.

There are some intriguing transportation-related options for enhanced grid resilience now becoming available, too. These are linked to emerging technologies for the electrification of transportation. The U.S. Department of Transportation, for example, unveiled a fuel-cell-powered-electric transit bus last year that could provide emergency power to a drug store, a supermarket, or some other critical establishment. It was cost effective for periods up to two weeks compared with leasing a generator. Ford made news on 18 February when it asked its dealers to loan out stocks of its new F-150 hybrid truck, versions of which are equipped with generators capable of putting out 7.2 kilowatts. In October 2019, the US Departments of Energy and Defense offered up to $1 million to develop a military vehicle with a similar purpose.

A vital fact made very visible by the Texas situation is that population centers increasingly rely on interacting systems. In Texas, the weather disrupted both transportation and electricity. These disruptions in turn affected the water supply, telecommunications, emergency response, the food supply, the availability of gasoline, and healthcare—including COVID-19 vaccinations. For years, to aid in planning and event management, academics, companies, cities and states have been developing models to predict the interconnected effects of disasters in specific locations. Recently, the Department of Energy, via its laboratories, has addressed this issue. Better models could help officials prevent major fiascoes in some cases, or, when that's not possible, react better during crises by giving managers the tools needed for real-time management of complex, interdependent systems.

Now, in Texas, given the high levels of publicity, political involvement, and consumer anger, it's a pretty safe bet that the needle will very soon be moved toward higher cost and more reliability. In fact, Texas's Governor, Greg Abbott, has proposed requiring the implementation of established winterizing technology.

There will be exhaustive, detailed, after-action analysis once past the immediate crisis that will probably uncover crucial new details. For now, though, it seems pretty clear that what happened in Texas was likely preventable with readily accessible and longstanding engineering practices. But a collective, and likely implicit, judgment was made that the risk to be mitigated was so small that mitigation would not be worth the cost. And nature "messed" with that judgment.

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