WHITE PAPER

Texas Winter Storm 2021: Demonstrates urgency for long duration energy storage

In February 2021, Texas experienced an unprecedented severe winter storm event across the state. More than 4 million Texans were left without power under extreme cold conditions as the Electric Reliability Council of Texas (ERCOT) was forced to shed load for nearly 71 hours over a period of three days to prevent the statewide grid from collapsing. Why did this happen and how do we avoid it happening in the future?

The Texas Event

On February 16, real demand on the Texas grid reached 76.8 GW as temperatures plummeted and heating demand spiked. In contrast, ERCOT's emergency scenarios only forecasted a winter peak of 67 GW. Further complicating the situation, 49% of the generation fleet became unavailable due to the severity of the winter storm. A 1.3 GW nuclear unit was taken offline when frozen water caused the unavailability of a safety system and 13 GW of wind turbines were rendered non-operational from icing. The largest share of unplanned outages was 18 GW of thermal generation, exacerbated by a large volume of planned maintenance occurring in preparation for the state's scorching summer months.

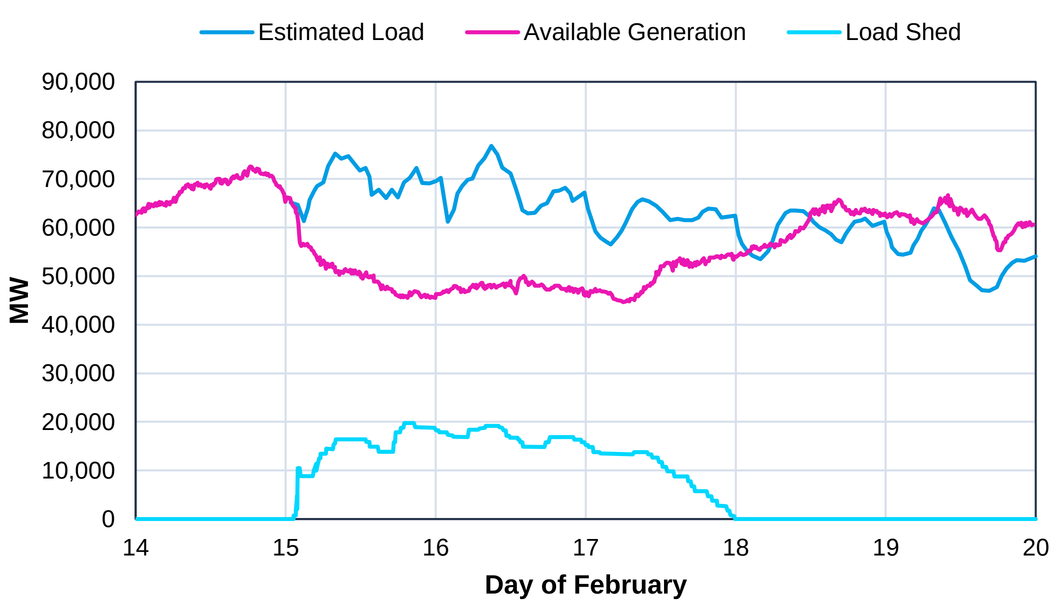

Figure 1: Available generation and estimated load without load shed during the event. Data courtesy of ERCOT.

ERCOT estimates that 9.3 GW of thermal unavailability was due to constraints on the gas supply as freezing temperatures hit gas infrastructure and generation competed with domestic supply. The Public Utility Commission of Texas was forced to raise electricity prices to $9,000 / MWh in an attempt to close the gap between supply and demand. As a result, ERCOT reports that the system was 4 minutes and 37 seconds from a total blackout. Without reliable generation that could serve the load over long periods of time, the only solution at that moment was to cut off load.

Reliability in the Future Electricity System

This event in Texas happened less than a year after California's rolling blackouts, which were caused by wildfires. Over the past 10 years, both states have taken huge strides in deploying renewable. These events serve as examples of the importance of reliable generation in the face of extreme weather events, and the increasing use of renewable resources aimed at mitigating the climate change that drives them. As states continue to deploy more renewables to serve their load, they will need clean firming capacity to deal with intermittency and contingency events.

Long duration energy storage is a key solution to providing firm capacity. It is designed to reliably serve load over extended periods, providing peaking capacity, backup power and firming of intermittent renewable generation using clean energy. These systems can be sited in constrained areas without requiring an external fuel supply that can be a source of failure, which was the problem we saw in Texas, providing local utilities with critical optionality during emergency events that allows them to take mitigating actions.

The most widely adopted energy storage technology over the past five years is lithium-ion battery storage, an efficient and fast-responding resource for up to four hours of continuous discharge. However, the Texas event lasted 71 hours, well beyond the capabilities of lithium-ion. Longer duration energy storage technologies are required to address such an event.

Long duration energy storage consists of established technologies including pumped-hydro, compressed-air energy storage, liquid-air energy storage, flow batteries and gravity storage. These long duration technologies are most cost-effective at eight or more hours of discharge, which maximizes their contribution to reliability relative to conventional thermal generators. These technologies are especially important for systems relying on more intermittent renewables. In emergencies like the Texas event, the number of hours available is critical to minimizing its scale and magnitude. It can be the difference between a few hours of targeted brownouts and widespread blackouts. Every additional MW and minute of generation can buy precious time for downed generators to come back online and contingencies to be put in place.

In addition to providing clean peaking capacity and backup power to the grid, long duration energy storage is more conducive when paired with wind energy, which is abundant in Texas. Wind turbine production profiles generally exhibit wider peaks and troughs than solar, requiring longer discharge durations for firming the dispatch.

We must heed the lessons of the Texas and California events and recognize the crucial role of long duration energy storage as a complement to renewables, ensuring the resilience and reliability of electricity supply. Policymakers and utilities looking to a zero carbon future should favor solutions that will support continued decarbonization as well as reinforce grid reliability and resiliency.

Sources

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