CRA Insights:
Energy

CRA Charles River Associates

February 19, 2021

Initial thoughts on the winter 2021 power outages in Texas

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Laptop screens of energy professionals around the world are currently glowing with colorful maps of Texas. One popular map tracks customer outages by county,[1] highlighting in dark red the parts of the state actively feeling the effects of inadequate power supply during extreme cold. Another popular map is a wholesale electricity price map,[2] showing sustained prices of $9,000 per megawatt-hour, also in dark red. While it is too soon to analyze the specific causes of the outages and the related costs, or to provide specific prescriptions for future reforms, in this *Insights* we offer a high-level perspective about the situation in Texas. We answer several key questions that we have received or anticipate from clients. Beyond this discussion, our thoughts are with those affected by the power outages in Texas and elsewhere.

What is happening in Texas?

Details of what is currently occurring in Texas, or at least what is publicly knowable, have been extensively reported on by news outlets, though not always accurately. At a high level, extreme cold weather and storms have led to controlled outages (also known as load shedding events) across the state, accompanied by extremely high wholesale electricity prices for the power that is being provided. The outages are noteworthy on a societal level due to their extent and duration, particularly in a location ill-equipped to deal with such outages during extreme cold. The outages are also noteworthy from an energy economics perspective due to their cause. These outages are largely a result of inadequate electricity generation supply.

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1 https://poweroutage.us/area/state/texas

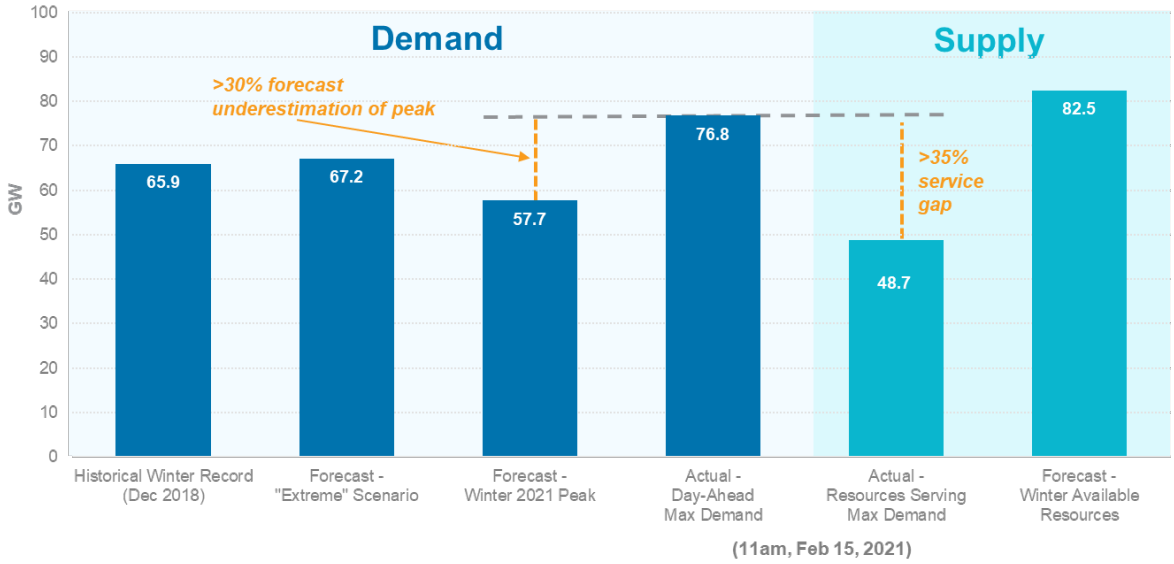
2 http://www.ercot.com/content/cdr/contours/rtmLmp.html

Both sides of the supply-demand balance are relevant:

- Demand – Electricity demand during this period is far exceeding expectations for this winter. Last fall, the Texas market operator, the Electric Reliability Council of Texas (ERCOT), estimated the 20/21 winter would see a peak demand of 57.6 GW. Even the "extreme scenario" heading into the winter contemplated a peak demand of 67.2 GW.[3] However, prior to load shedding actions being initiated, the demand forecast for Monday, February 15, peaked at 76.8 GW,[4] (about 33% higher than the planning expectation and 14% higher than the extreme scenario).
- Supply – Electric generators have faced widespread operational challenges resulting from the cold weather, both directly and indirectly. Initial reports suggest equipment at all kinds of power plants – including wind, gas, coal, and nuclear – struggled with inadequate weatherization. Supply issues were further exacerbated by challenges related to gas pipelines, where natural gas was either unavailable or not available at sufficient pressure to run some otherwise operational gas-fired generators.

The following chart shows the ERCOT supply and demand forecasts from November 2020, the day-ahead estimated demand for Monday's peak hour (11:00 am to 12:00 pm), and the actual resources serving load at that hour. The supply resources include generation within ERCOT and imports (0.8 GW).

ERCOT Forecasted and Actual Supply and Demand, Winter 2021



In the following sections, we address several key sets of questions related to how the Texas market design has impacted supply.

[3] ERCOT's Winter 2020/21 Seasonal Assessment of Resource Adequacy, released 11/5/2020. In December 2020, ERCOT provided a load forecast (2021 ERCOT Monthly Peak Demand and Energy Forecast) that estimated peak demand of 59.4 GW in February 2021.

[4] EIA's Hourly Electric Grid Monitor, sourced from EIA Form 930.

What is the Texas approach to ensuring adequate supply through markets?

The design of electricity systems and markets is a complex process that involves myriad choices, but at its core it inevitably involves balancing customer costs (and risk), supplier cost recovery, and system performance. Across North America, utility planners and regulators, under direction from policymakers, have chosen to confront this central balancing act in different ways.

Most regions rely on a physical reliability standard, spoken about generally as “one-in-ten,” which is rooted in a choice about acceptable levels of reliability. Such standards manifest in mandatory “installed reserve margins” that define total generation development targets, even if they come at a higher cost. These installed reserve margins can be achieved through centralized planning or various types of capacity mechanisms, including capacity markets.

In Texas, the balance struck by regulators and policymakers has leaned toward relying on competitive forces and letting the market, with influence from the market design, determine levels of generator investment and resource adequacy outcomes. In taking this path, Texas is unique in the US in implementing what is called an “energy-only market.” The electricity market was designed to provide necessary price signals through its energy and ancillary services markets, with particular attention to how prices rise during times of shortage. In the short term, these prices can incentivize generator performance when it is most needed, while also providing signals for flexible loads to drop off the system to avoid purchasing high-price energy. In the long term, the intent of the designers is that investor expectations of future revenues, including large profits during high price periods, should lead to optimal levels of investments in generation resources.

What signals does a $9,000 per megawatt-hour price send?

The administrative price of $9,000 per megawatt-hour was set through a complex process. It roughly reflects the market designers’ estimate of the price at which Texans, on average, would choose to not have power for a period of time rather than pay more for electricity. To help illustrate the scale of the price, if reflected in retail rates, it would cost $30 to run a single clothes dryer cycle or over $400 to run a portable space heater for a day. It is also an extremely high price compared to average wholesale electricity prices in Texas, which generally range from $20-40 per megawatt-hour on average, though occasionally reach over $100 per megawatt-hour in the summer.

The market is designed to gradually bring higher prices as system conditions tighten in the most severe conditions, reaching the maximum allowable price of $9,000 when the system is very low on available supply, or when demand exceeds available supply, as has been the case for a large number of hours throughout this week. As mentioned before, the price has both short- and long-term goals, both subject to questions at this point:

- The short-term function is to serve as a signal to generation resources to vigorously work to provide energy as needed and to electricity consumers to decrease consumption if possible. On the supply side, outages currently appear to be mainly related to mechanical problems, and not based on short-term economics. For gas plants with frozen equipment, no price incentive can quickly unfreeze the plant. On the demand-side, those customers on retail rate structures that expose them directly to wholesale prices are expected to face incentives to reduce demand.

- The long-term function is to support expectations of future revenues sufficient to incentivize new investments that lead to dependable performance. The design theory suggests that market participants will develop expectations for long-term revenues, partially driven by high prices during shortage events, that would be expected to cover investment costs and required returns.

This week provided an extreme example of the potential investment signal of high sustained prices. This can be demonstrated through a simple, indicative calculation of the economics of a hypothetical gas generator during this week. Assuming that a 200 MW gas power plant with a heat rate of 10,000 Btu/kwh could have run every hour from Sunday through Wednesday, at actual market gas and electricity prices, we estimate that the plant could have earned almost $90 million in gross profit.[5] Extrapolated through Friday, the five-day gross profit could reach up to $140 million. To put that amount in perspective, a new plant of the same type and size could cost $140 million to build.[6]

While this is just a hypothetical example and there are many reasons these profits alone may not fully support a new plant, it clearly demonstrates that the revenue opportunity was massive for plants that were operating and exposed to the spot market, and the signal was significant.

What can be expected in coming weeks and months as a result of these events?

There is a great deal that is still unknown about the details of events over the past week. The coming weeks, months, and years will reveal some, if not all, of the varied impacts across society and the energy industry, as well as the numerous decisions and incidents that led to these outages. Some events will have been impacted by choices made years or months before February 2021, and some will be explained by individual actions over the course of this week. Investigations will ensue. The Federal Energy Regulatory Commission (FERC) and the North American Electric Reliability Corporation (NERC) have announced an investigation of the outages. There have been political calls for investigations by, and of, ERCOT, including by Governor Abbott. The Governor has also raised the possibility of reforming the power sector in the next legislative session and there may be ramifications for the Public Utility Commission of Texas.

We will likely learn which generators were offline and why, and how load shedding decisions were made. Some companies that were exposed to high prices may go bankrupt, while others may announce significant profits. There could be disputes over plant performance, applicability of force majeure provisions, and numerous other contract conditions. Customers will receive their bills for the period, and there may be efforts to provide financial support to those hit hardest. And, more than anything, there will be assessments about how to keep this from happening again.

Conclusion

Market design involves a balancing of competing considerations, including expected customer costs, risk allocation, and system performance. When a market design leans toward cost minimization, proper incentive structures and design precision are critical to creating a well-performing system. Extreme events can threaten reliability in any system, regardless of

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[5] Gas price = Katy hub daily average, Source: SNL. Electricity price = LZ Houston daily average, Source: Energy Velocity

[6] Overnight capital cost of $700-900/kw, Source: Lazard.

the approach taken to facilitate resource adequacy. Establishing a sufficiently broad range of expectations for future outcomes, whether by generators, regulators, or market operators, is made even more challenging by a changing climate and an ever-more-complex electric system. In Texas, residents and policymakers are rightly questioning the causes of this devastating week of power outages. Unfortunately, complete answers will take extensive analysis and ideal reforms are not yet clear.

About CRA's Energy Practice

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