GENERAC INDUSTRIAL POWER

WHITE PAPER

The One-Million Megawatt Hour Opportunity

BY: NASH WHITNEY, DIRECTOR OF SALES, GENERAC INDUSTRIAL POWER

Background

Efficient markets don't have a lot of slack. By definition, efficient markets maximize the utilization of resources and by consequence provide the lowest cost or price. For instance, ERCOT provides some of the lowest cost electricity in the country, not just because it's cheaper to operate in Texas, which it is, but because the utilization of assets within the Texas grid is higher, ergo it's efficient. Less idle resources mean cheaper power. The challenge that relatively tight markets such as ERCOT have, is that they have difficulty responding to events that are outside of boundary conditions that define 'normal operation'. All markets, even the stock market, are designed to operate within boundary conditions. The performance and price responsiveness of those markets is a condition of how well operations produce within those boundary conditions. In other words, the further outside of 'normal operation' a market gets, the more volatile prices can become.

The largest boundary condition for electric markets is weather. There are others like fuel supply, congestion and others but by and large, weather provides the guidelines for how well electric markets can perform; and actually informs and serves as precedent for the others. When those boundary conditions are overstepped, the performance of the market becomes volatile. Case in point: Winter Storm Uri in Texas.

Inherent to the supply stack, electric markets are captive backstop mechanisms to ward against shocks such as severe weather, under-supply or over-demand conditions. These built-in backstops help provide pricing relief to the system by enabling spare capacities to participate. They can take many forms: at the highest level, reserve margins is the broader capacity target that the grid manages towards. ERCOT's reserve margin target is 13.75% (over peak demand). At lower level such as ancillary services , specific markets for spare capacities are established so that these generators can participate in, and be ready to respond to pricing events.

Looking back at previous weather-induced pricing events, the winter storm of 2011 caused power outages at over 150 generating plants and resulted in rolling outages across the state. The winter storm of 2014 resulted in an EEA Level 3 Alert (if it weren't for lessons learned from 2011) and the summer heat waves of 2019 caused the newly instituted price caps of $9,000/MWh to be met. It's widely understood that it can become exceedingly hot in the summer, and bitterly cold in the winter. For instance, it got down to two degrees below zero in Austin in the winter of 1949, zero degrees in San Antonio in the winter of 1989 and twelve degrees in Brownsville in 1899 . So certainly some precedent for experiencing cold weather, but each of these events were prior to Texas' historic growth rates in population and energy demand experienced over the past 15 years.

For comparison, the real-time average system price in February of 2020 was $18.27/MWh. That is $0.0187/kW-h. One of the lowest wholesale rates for electricity in the country. The reason is that the demand for electricity in Texas during winter months is extremely low and the frequency of weather-related shocks is also low: this is the result of 'normal conditions'. Winter storm Uri represented extraordinary conditions, well beyond normal; and the effect on price? The average real-time system price between February 14 and February 19, 2021 was $6,579.59/MWh.

Source:
http://www.ercot.com/content/wcm/key_documents_lists/225373/2.2_REVISED_ERCOT_Presentation.pdf

[1] http://www.ercot.com/mktinfo/services/
[2] https://www.statesman.com/article/20140107/BUSINESS/301079651

Regardless, there was ample awareness by ERCOT, grid operators, independent power producers, municipalities and electric cooperatives that the coming weather events would likely have extraordinary impacts on the system ; i.e. this winter storm would cause the system to be flexed outside of normal conditions and create price volatility.

Generators had witnessed it in 2011, 2014 and 2019. This means that by all accounts, both assuming that historical events from years past, the prices they observed, as well as the coming event's peak-pricing probabilities, market participants either had prepared or were preparing to ensure their equipment was ready to perform wherever possible, or economical. ERCOT does not require weatherization . Post the 2011 Winter Storm, ERCOT amended its rules to authorize generator site visits to review compliance with weatherization plans, but the standards that weatherization is held to and the compliance to those standards is solely responsible and represented by generation owners. This means that it is the decision of the generation owner of whether to or not to weatherize, and the consequences of capturing or not capturing peak pricing (i.e. generating a return for that additional investment) is a result of that decision.

There is an embedded caveat here: preparing means that within the confines of their business model, their internal return thresholds and their expected operating conditions, power producers had prepared to the point they thought was the most profitable, or most efficient for their business or stakeholders (customers). ERCOT's supply stack is structured so that the lowest cost-generators generally stand to generate the highest spark spreads when pricing events occur. The probabilities for weather-related events to outage generators and preclude them from capturing peak-pricing is a part of each and every generator's investment decisions.

Pre-Event Communications

November 5	ERCOT meteorologist issues winter outlook for Market Participants and public noting the "very good" chance for an extreme cold weather evert during winter 2020/2021.
February 3	ERCOT meteorologist warns Market Participants and the public of coldest weather of the year. Weather updates continue.
February 8	Operating Condition Notice issued for extreme cold weather event, posted on public website.
February 10	Advisory issued for extreme cold weather event posted on public website. Issued grid conditions update for market media representatives.
February 11	Watch issued for cold weather event (hotline calls made, notice to Market Participants, posted on public website). News release on extreme weather expected, social media outreach.
February 12	Texas Energy Reliability Council meeting.
February 13	State Operations Center news conference: forecast Conservation Alert. Emergency notice issued for extreme cold weather event, posted on public website. Texas Energy Reliability Council meeting.
February 14	Issued conservation appeal by news release, performed social media outreach, held media briefing.

[3] https://www.weather.gov/maf/The_Coldest_Night_in_Texas#:~:text=The%20lowest%20temperature%20ever%20recorded,reports%20that%20were%20even%20colder.

[4] Slide 9: ERCOT Report: http://www.ercot.com/content/wcm/key_documents_lists/225373/2.2_REVISED_ERCOT_Presentation.pdf

[5] Slide 17: http://www.ercot.com/content/wcm/key_documents_lists/225373/2.2_REVISED_ERCOT_Presentation.pdf

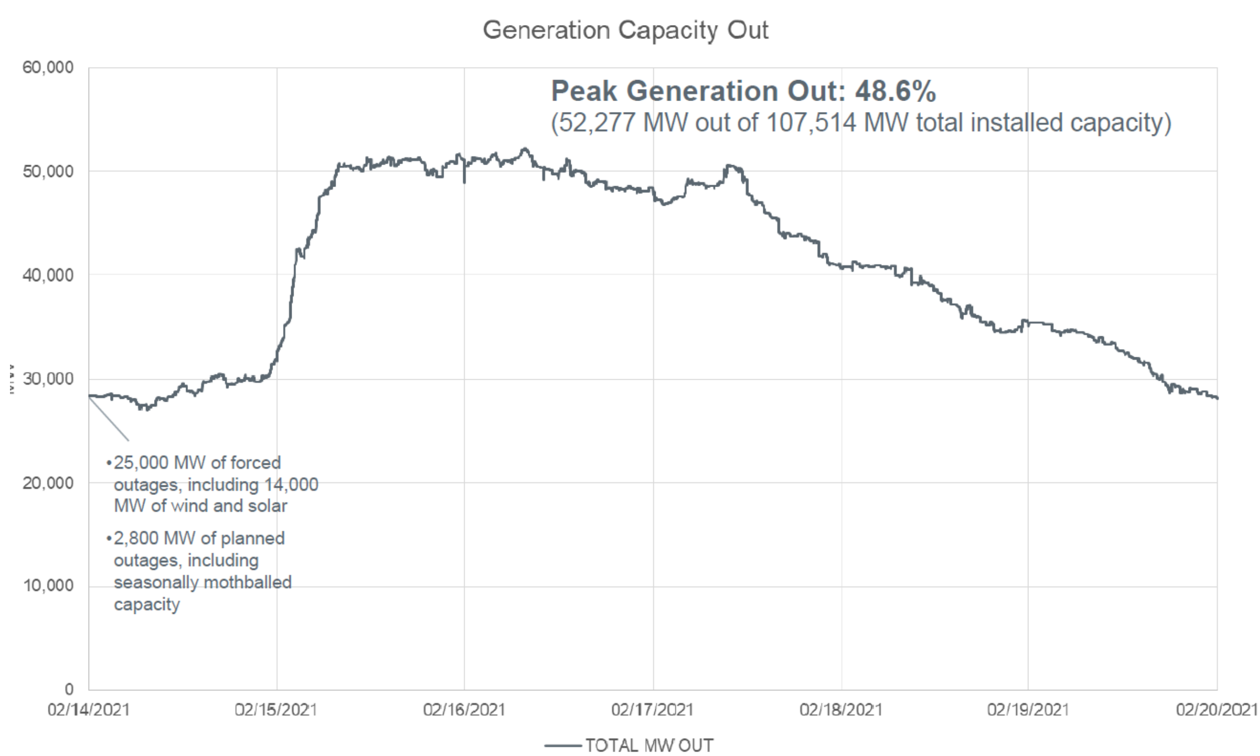
As mentioned earlier, the reality is ERCOT is a tight market. Generation responds to load requirements in a way that delivers optimal value for stakeholders under normal conditions. However, it became clear that those boundary conditions, implied or implicit in the operating models of generating plants across the state were too narrow. There simply wasn't enough capacity margin present in the supply stack or equipment's abilities to absorb the requirements found in the extraordinary conditions they were faced with.

Event

Something went wrong during this event. The next portion of this article will dive a little deeper into the facts, as well as discuss how we can improve. Let's start with some facts:

- **Events of 2011:**
  – ERCOT's available resources in 2011: 73,000 MW
  – Experienced historic high winter demand of 59,000 MW
  – 193 Generators experienced power outages
  – 4,000 MW of load shed was ordered
  – Lowest Frequency: 59.58Hz
- **Events of 2021:**
  – ERCOT's current installed generation capacity is over 107,000 MW
  – Experienced effective winter peak demand of 76,819 M
  – Over 350 generators experienced power outage
  – 25,000 MW of capacity were forced offline on February 14th, including 14,000MW of wind and solar
  – 2,500 MW of capacity were already seasonally mothballe
  – 50,000 MW of capacity were forced offline during the week (48.6% of total capacity)
  – 20,000MW of load shed was ordered
  – Lowest Frequency: 59.03Hz
  – By mitigating further frequency drop, ERCOT's management of this event avoided a catastrophic failure of uncontrolled outages that would have cost billions of dollars and weeks, if not months of blackout conditions as the system recovered and repaired.

Generation Capacity Out February 14 – 19, 2021

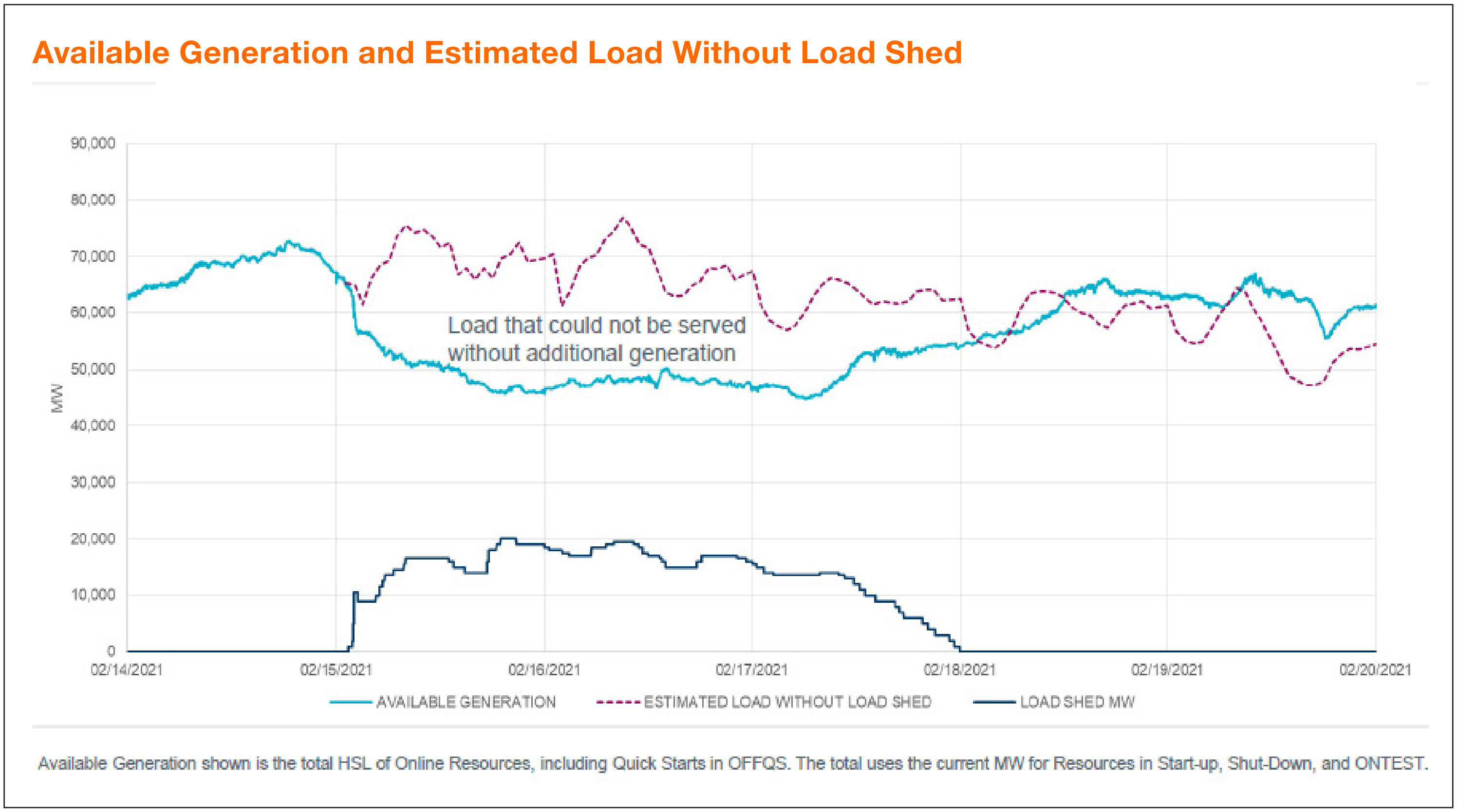


---

[6] http://www.ercot.com/content/news/presentations/2011/SARA%20-%20Winter%202011-12_V8.pdf

[7] Slide 13: http://www.ercot.com/content/wcm/key_documents_lists/225373/2.2_REVISED_ERCOT_Presentation.pdf

The effects on the system compared to the events of 2011 were considerable. Many of the root causes are still unknown and there will no doubt be a litany of analysis and reports that will be produced, but the ultimate fact remains clear: nearly half of the generation in the state was tripped offline during a peak demand event. In any market, capacity markets included, this level of shock would slice through reserve capacities and risk backstops across that system. However there are a few shining examples of how the response of the market helped avoid such a catastrophe.

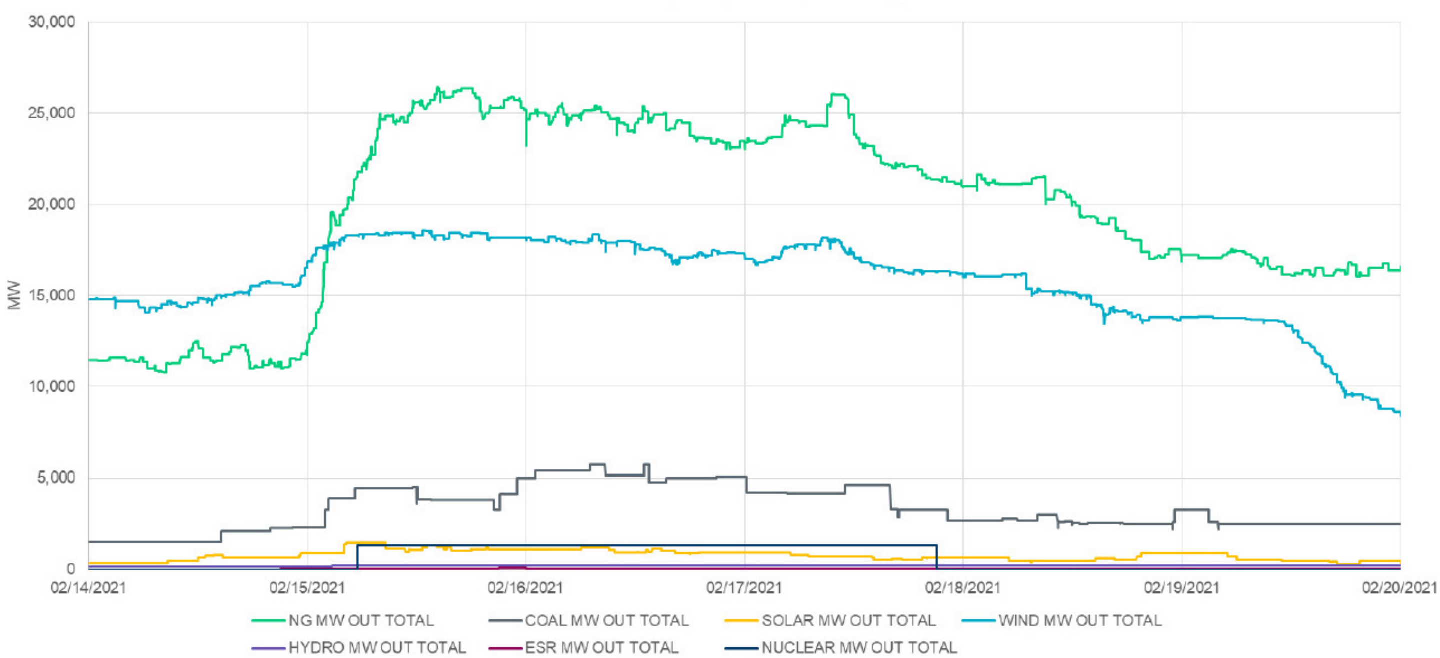


Base-load natural gas suffered a disproportionate share of power outages. However, the response of non-base-loaded natural gas such as simple cycle gas turbines and distributed generation helped mitigate against deeper power cuts to consumers across the state. If you examine the below graph inverted, natural gas was able to recover about 10,000 MW of capacity across the week, a larger recovery than any other generation fuel-type. Understanding that many in the state suffered days on end with no power, this response from natural gas supply likely saved thousands of additional consumers from prolonged outages. This speaks both to the resiliency of intermediate and peak power capacities ability to respond, and also to the supply stream of natural gas fuel that helped deliver this capacity when it was needed the most. Most distributed generation is fueled through distribution pipelines, rather than transmission scale pipelines, where residual pressures across the system enabled continual flow in the face of upstream chokes, such as compressor station outages and wellhead freeze-offs. Frankly, this event should be seen as a win for natural gas.

[6] http://www.ercot.com/content/news/presentations/2011/SARA%20-%20Winter%202011-12_V8.pdf

[7] Slide 13: http://www.ercot.com/content/wcm/key_documents_lists/225373/2.2_REVISED_ERCOT_Presentation.pdf

Generation Capacity Out by Fuel Type



Opportunity

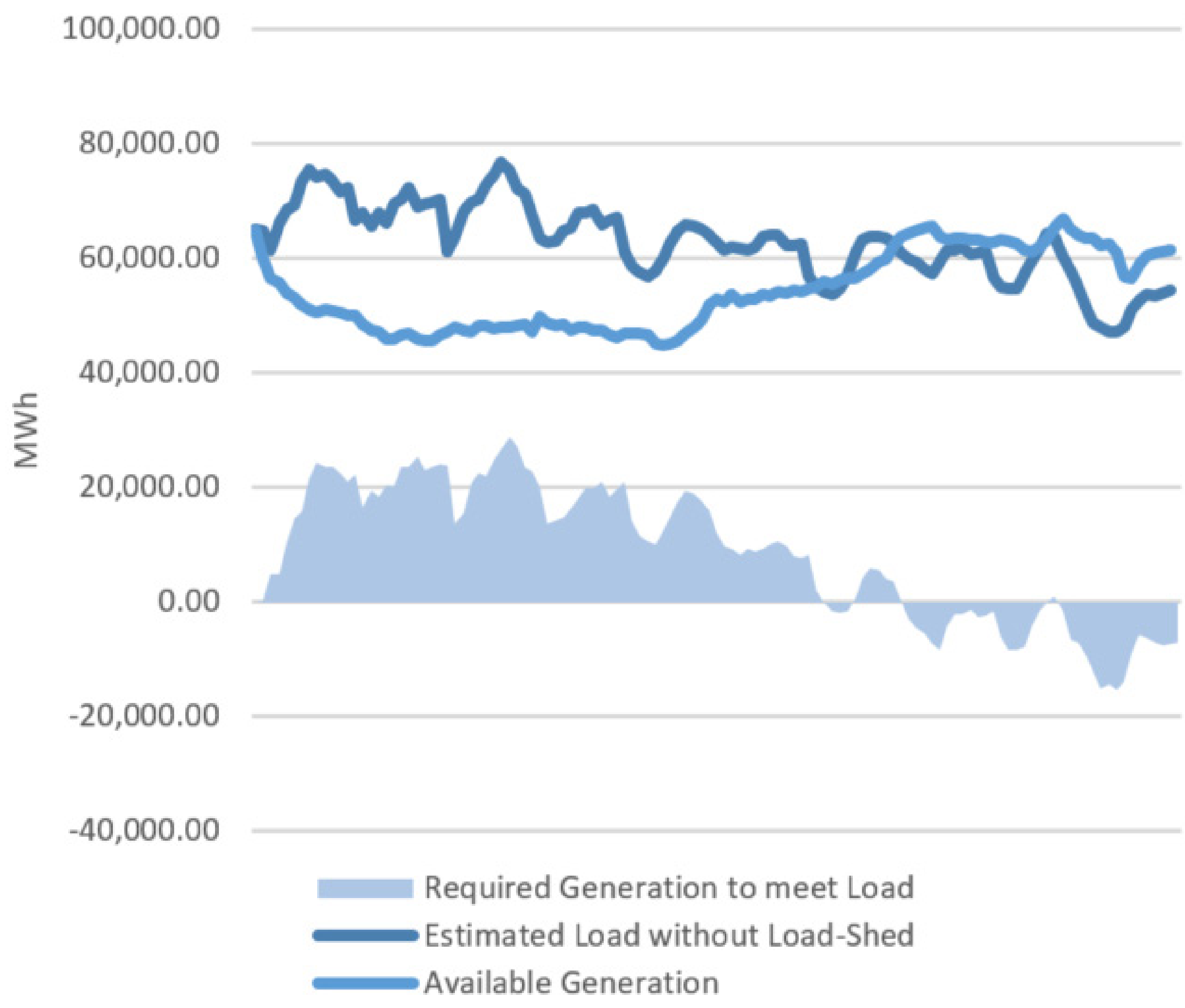
Aside from the obvious weatherization plans that will likely be supported through a menagerie of different consultants, aftermarket instrumentation and upfit organizations, the real opportunity lies adjacent to making base-load power more robust and reliable. These base-load plants operate very well within the boundary conditions, referenced earlier, and sometimes the marginal cost of increasing their ability to respond outside of those boundary conditions exceeds the marginal benefit of that response. This is not always the case, and in the wake of an event that resulted in over 72 hours of ~$9,000/MW hour prices, upgrades are easily justifiable. However, there are PPA and contractual obligations that are part of that equation whereas baseload plants are often not able to realize peak pricing.

The real opportunity is for distributed generation and microgrids. This opportunity is quantified in the adjacent chart and below as the difference between the load that couldn't be served and the available generation at the time: 1.2 million megawatt-hours of generation . This is a substantial opportunity, particularly assuming this generation could very well have achieved peak wholesale pricing at $9,000/MWh, equating to 11.2 billion dollars in missed revenue opportunity.

There are multiple ways that this opportunity can manifest itself through microgrids and distributed generators. Grid-connected generation provides incremental capacities directly into the broader system, and enables wholesale price capture with those capacities. These systems require interconnect processes and permits to be completed, but represent a substantial opportunity for those willing to participate. Alternatively, 'behind the meter' generation or 'island mode' microgrids and generation can provide both an opportunity to participate in demand response programs such as ERS, but can also be used to provide backstop pricing to businesses that utilize indexed (to wholesale) rates.

One thing to consider when exploring this potential further, is that the laws of supply and demand will still hold true. There was an extraordinary event that shocked the capability of our electric grid. It produced glaring gaps in capability (supply) against a peak-demand condition, resulting in incredibly high and historic pricing. Changes in these conditions, either through an increase in capacity (supply), or more flexible use of curtailing loads (demand), the consequent prices will undoubtedly be affected. However, the opportunity should be clear that there is a substantial shortage in flexible capacities and loads across our system that can yield positive returns on investment, or at the very least, substantially reduce the overall cost of resiliency.

Load vs. Available Capacity 2/15 to 2/20



The key message is that distributed generation and microgrids can provide the flexibility that the grid needs to operate effectively outside of boundary conditions that are established predominantly by base-load and intermediate load generation. This 'flex' is imperative for the future reliability of the ERCOT grid, but what's more is it provides the necessary mechanisms for the sustainability of low electric prices we enjoy in the state while enabling appropriate returns to be made on investments. As our electric grid continues to grow, so will be the definitions of how electrons are reliably delivered to end customers across a growing spectrum of operating environments; and a broad influx of surgically placed smaller, distributed generation capacities offers the most economical way to satisfy those dynamic and growing definitions.

[8] http://www.ercot.com/content/wcm/lists/226521/Available_Generation_and_Estimated_Load_without_Load_Shed_Data.xlsx

GENERAC INDUSTRIAL POWER

Generac Power Systems, Inc.
S45 W29290 Hwy. 59
Waukesha, WI 53189

ASKGNRC@generac.com
1-888-GENERAC
(1-888-436-3722)

GeneracIP.com

201903876 07/2021