Backup Plan
Part 1: The Rush for Backup Generators

Only homeowners with a backup generator such as the one pictured here would have retained electric system reliability during the extended power outages and sub-freezing temperatures caused by Winter Storm Uri. Photo: © Sphraner | Dreamstime.com

The massive Texas power outages that took place in February 2021 left many people feeling insecure about reliable utility service. This is the first in a series of articles about the rapidly increasing number of backup power systems being installed in Austin area residences.

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Roger Duncan is the retired general manager of Austin Energy and served two terms on the Austin City Council between 1981 and 1985. He was a champion of renewable energy during his career, and in most ways still is. He co-authored The Future of Buildings, Transportation and Power (2020), which discusses technologies available for a low-carbon future.

The massive power outages of Winter Storm Uri in February 2021 convinced him and his wife, Jo Clifton, that they needed a backup power source.

Duncan described the three-day outage as "tough…it was down to 8 degrees." He was lucky enough to have a wood fireplace, but had almost no wood to burn in it. People in his small neighborhood (rendered small because the hilly streets were not drivable) were sharing wood in the community.

However, the common wood supply was almost gone when the power finally came back on after three days.

He investigated backup power options after the freeze. He was interested in an electric battery, but since these had limited capacity, Duncan opted for a natural gas standby generator at the side of his house instead.

I asked him to reconcile his new generator with the environmental problems inherent in fossil fuel. He said, "We need to electrify everything that we can (with fossil-free generation) for environmental reasons. At the same time, we need to recognize

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(Image: Climate Time Machine - bubbles of ancient air in Greenland Ice)

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Image: South Padre Island dune erosion from sea level rise

that there are circumstances where renewables are not going to be able to meet the load."

"We are talking about a three-day incident in Texas, but in the Northeastern United States, with almost no sun and minimal wind in the winter, it will be extremely difficult to meet heating loads without some burning of fossil fuels.

"There may be advanced renewable technologies that will work better someday. But with today's technology, you will not be able to meet all the load with renewable energy.

"The most reliable system that we can have is not going to be the cleanest or the most affordable. The cleanest is not going to be the most reliable or affordable. You have got to determine that balance."

Tip of the Iceberg

The story of the Lone Star State's utility system crash during mid-February 2021 could best be summarized as a tale of Texas-size arrogance.

It is a state so proud and paranoid that to be free of federal regulation it refuses to be connected to electric systems in the rest of the country, even if this disconnection renders consumers helpless for lack of emergency assistance.

It is a state so fixated on free-market ideology that it refused to enforce regulations that would have kept its energy system operable during extreme weather.

It is a state so dismissive of conservationists that it does not require its utilities to do much to ensure that buildings are made more energy efficient, which could protect its citizens during crises and save them money.

When Texas ideology collided with Winter Storm Uri, it was analogous to the "unsinkable" Titanic hitting the iceberg.

However, some Austin electric customers are not waiting for the next disaster driven by Texas regulatory incompetence to occur. They are buying their own backup power systems.

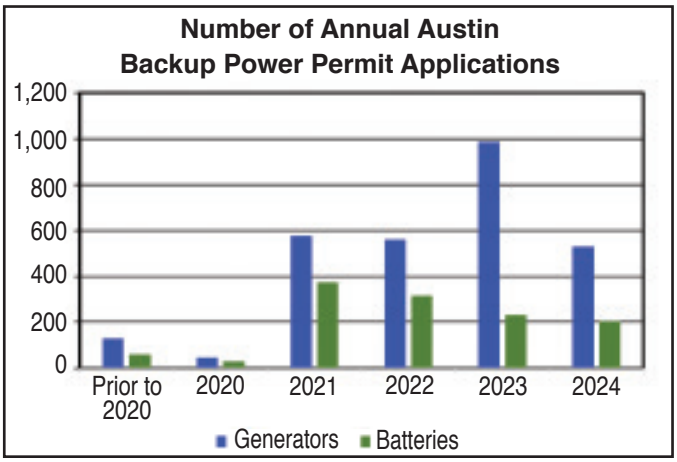
How My Interest Was Aroused

This article began when a friend told me in passing that she and her husband were buying an emergency standby natural-gas generator to prevent another crisis episode like the one they experienced with Uri. Curious, I researched the City of Austin's building permits.

According to these records, 45 homes in 2020 pulled permits for permanent onsite emergency generation systems. In 2021, the number soared to 577, a net increase of about 1,200%. During 2023, when widespread blackouts were caused again, this time by Winter Storm Mara, generator permit applications soared to 988. This is just for Travis County, which has only 4% of the state's population.

In total, there were 2,833 generator permits issued in Travis County for discrete addresses by the end of 2024; 94% of them coming after Winter Storm Uri.

Generators are not the only alternative sought by electric customers who were underwhelmed by electric system reliability. Many Austinites have also invested in lithium battery storage. There were 1,227 battery installation permits from discrete addresses by the end of 2024; 93% of them were issued after Winter Storm Uri.



This story will discuss financial, technical, environmental, and societal issues surrounding the growing trend for power security. But it is bigger than backup power. This series also details how the state lost power during the 2021 winter storm.

Electric Sentinels

Emergency standby generators are decidedly different from the portable generators that are purchased in a big-box hardware store. They sit outside a home on a concrete pad or hard surface, often next to where an electric or gas meter is located. From a distance, they might be confused with air conditioning units, and their noise levels are often similar. While portable generators usually run on gasoline or diesel, standby generators run on cleaner natural gas or propane.

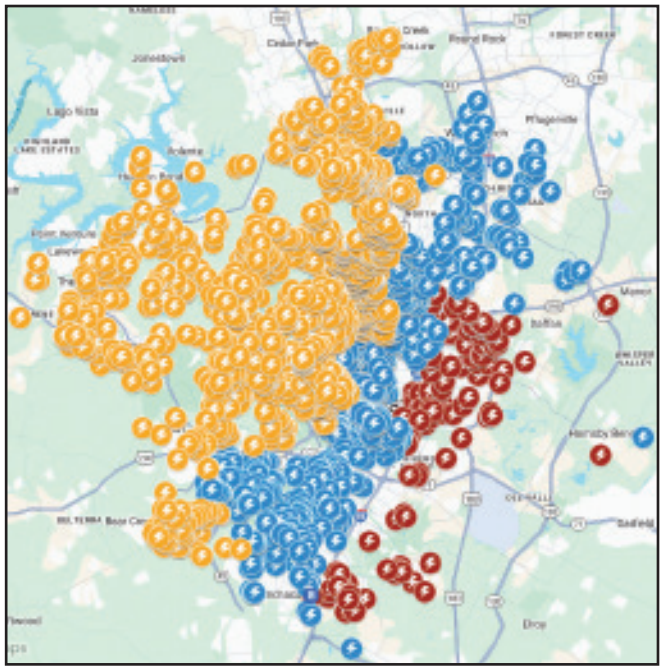
Standby generators come in various sizes but about 85% of units sold are 22 kilowatts (kW) or larger. (Contrast this to portable generators that typically range between about 1 and 12 kW.)

Twenty-two kW may seem oversized, given that an average Texas single-family home with central air conditioning may only use about 5 kW at the peak of a hot summer day. However, central ACs and heat pumps need a much larger initial power surge to start each cooling and heating cycle. There also may be surge requirements from other appliances, as well as resistance heating elements, justifying

The Grid Defectors: Who Are These People?

Standby Generators: The *Directory* analyzed all 2,833 generator permits at discrete addresses prior to 2025 for location and year of application, and conducted a statistically valid sample (5%, 143 permit applications) to measure property characteristics recorded on the tax roles. The results are informative, but not surprising.

• 59% of permit applications were for homes in wealthier West Austin. Just 6% came from less affluent East Austin.



This map shows the homes in Austin where permit applications for generators were requested prior to January 1, 2025.

• Appraisal district records indicate the average 2024 appraised value of these homes was almost $1.9 million, 337% higher than the average home price in Travis County; 64% of them had appraised values more than $1 million; 95% of them had appraised values over $500,000.

• Average size was 3,550 square feet; 54% were over 3,000 square feet, and 87% were over 2,000 square feet.

• Luxuries such as swimming pools, sports courts, outdoor kitchens, and large land areas were apparent in 70% of the sample.

• 17% of these owners owned more than one property.

• Over a quarter of these homes were only purchased in the last 5 years.

• 94% of these dwellings received Homestead Exemptions on their property taxes; almost half of these also received exemptions for being over 65, with some of these also receiving exemptions for disability.

As a comparison, the Median Family Income for homeowners in Travis County in 2023 was twice that of renters.

Energy Storage Batteries: People living in homes who have applied for installation permit for energy storage batteries are also living the dream, though they do not appear to be as wealthy as those with standby generators.

Photo by Paul Robbins

The largest home (really two adjacent homes) in these surveys with backup power, located on 3 acres on Lake Austin, was 27,500 square feet in size, with a pool, a boat dock, an elevator, and 3 garages totaling 2,200 square feet in size. In 2024, it was appraised at more than $24 million.

The *Directory* analyzed all 1,227 battery permits at discrete addresses for location and year of application, and conducted a statistically valid sample (32%, 396 permit applications prior to 2025) to measure property characteristics recorded on the tax roles.

• The largest difference between generator backup power and battery backup power is that 98% of battery permit applications also had permits for solar energy installations.

• 41% of permit applications were for homes in wealthier West Austin. Just 19% came from the less affluent East Austin.

• Appraisal district records indicate the average 2024 market value of these homes was over $1.1 million, more than double the average home price in Travis County; 42% of them had appraised values more than $1 million; 76% of them had appraised values over $500,000.

• Average size was 2,750 square feet; 34% were over 3,000 square feet, and 71% were over 2,000 square feet.

• Luxuries such as swimming pools, sports courts, outdoor kitchens, and large land areas were apparent in 45% of the sample.

• 16% of these owners owned more than one property.

• 44% of these homes were only purchased in the last 5 years.

• 91% of these dwellings received Homestead Exemptions on their property taxes; 22% of these also received exemptions for being over 65, with some of these also receiving exemptions for disability.

Ironically, despite the ostentatious wealth of many of these homeowners, the values of backup generators and batteries are not assessed when the Travis County Appraisal District is determining a Residential property's market value.

the extra capacity.

Generac is currently considered the market leader of Residential standby units, boasting over 80% of the standby generator market. This is probably due to its heavy marketing presence. Other manufacturers include Aurora, Briggs & Stratton, Caterpillar, Champion, Cummins, Honeywell, Kohler, and Rohiko.

According to Haley Ludwick, a Generac spokesperson, the average cost for an installed residential Generac system in the U.S. is about $14,000. (Contrast this to portable gasoline generators that cost about $300 to $4,500.) About two-thirds of the cost is for the generator and materials related to its installation, including a concrete pad (similar to those for air conditioners), wiring, transmission switch, and meter interface. The balance of the cost is for labor, warranty, and remote monitoring.

Kasey Cauble of Abacus Plumbing, Air Conditioning & Electrical (with offices in Austin) gave the turnkey range of installation costs of air-cooled units at about $17,000-20,000. Only 20% of the cost is the actual generator, with the balance being collateral equipment and materials, City installation permits, and the somewhat high cost of Austin labor. (According to Cauble, permits denote quality because some installers are scofflaws and avoid them.)

At some point in the mid-20 kW range, generator sizing requires a switch from air-cooled engines (similar to those in lawnmowers) to water-cooled engines (similar to car engines with radiators) to handle the larger loads. This can lead to an initial $11,000 to $13,000 increase in turnkey costs, about a 50% total cost increase for liquid cooled.

Liquid-cooled units will be required for full power in larger (mansion-size) homes. As example, in 2025, Cauble installed a 125 KW unit in a larger home, which is about 6 times the size of the average air-cooled unit.

Similar to an internal combustion vehicle, these generators need periodic oil changes, filters, spark plugs, battery changes, and inspections. Water-cooled generators have the additional advantages of running quieter, and running roughly 250 consecutive hours without an oil change (compared to 150 consecutive hours for the maintenance schedule of air-cooled units).

Residential units on the market today are "smart" and cell-phone connected via Wi-Fi or cell towers, so a generator owner can monitor their performance, as well as direct load to specific appliances, from a distant location. This 24/7 remote monitoring assures that the generators are always ready to provide power.

Maintenance costs are $700 for air-cooled units and $800 for liquid-cooled units with 2 visits a year (unless the machines run more than these annual consecutive hours) to assure constant readiness. Monitoring is included with these costs.

Warranties are generally for a minimum of five years or 2,000 hours of operation (which ever comes first), although extended warranties can be purchased for seven or 10 years.

It is important to emphasize that standby generators are not for everyday use. As a general rule, they are expected to run about 200 hours a year. However, with timely maintenance, minimal operating hours, and luck, these may last 20 to 30 years.

Aarin Wendt of Wendt Electrical Systems in Victoria, who sells Generac, Kohler, and Briggs & Stratton generators in Central and South Texas, provided ballpark estimates of $16,000 for a common air-cooled unit in average home sizes. However, a liquid-cooled unit for a large estate/mansion can cost $80,000. Maintenance costs are about $469 annually. Monitoring for 24/7 readiness is not extra for homes with Wi-Fi, but cellular monitoring had an extra $100 yearly cost.

Another consideration for backup generators is the cost of fuel. Based on Austin's electricity and natural gas prices in May 2025, the cost of backup generator fuel would be about $545 a year more for a 22-kW generator than the cost of electricity it replaces with 200 hours of full use. Propane is much more expensive, and would add more than $1,800 a year in additional costs. Still, for those able to purchase backup generators, fuel costs are not a major concern.

Market Growth: Call Before the Storm

Generac stated in its August 2021 quarterly Investor Presentation that it experienced a 67% increase in residential sales in the previous 12 months. In a February 17, 2021 CNBC interview conducted during the Texas blackout, Generac CEO Aaron Jagdfeld said, "We can't make them fast enough." To keep pace with demand the company announced construction of a new 421,000-square-foot manufacturing plant in South Carolina. It expanded the new factory's footprint in the latter half of 2024 to keep pace with even more orders.

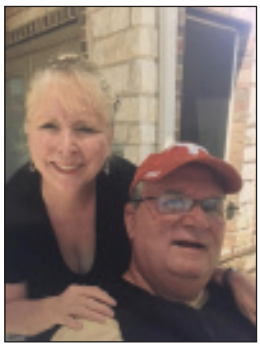
In a February 2025 presentation, Generac estimated that about 6% of single-family homes in the United States had standby generators installed. It identified growth markets in: Texas due to demand driven by the February 2021 winter power failures; and California because of grid reliability problems largely caused by intermittent shutdown of power lines to prevent wildfires. While the company saw its profits peak in 2022, 2023 and 2024 were also extremely lucrative.

Demand surges during climate catastrophes. For example, Wendt Electrical Systems typically gets 100 to 150 leads for standby units a year. But in the summer of 2021 after Winter Storm Uri, the company got 2,100. The demand has settled back down, but Aarin Wendt said there is still a spike in demand during the summer, particularly as hurricanes approach. He advised potential customers to "call before the storm" to avoid inventory backlogs that occur in the supply chain during and after emergencies.

Backup Plan
Part 2: How the Texas Electric Grid Broke

Ryan Hodnett, Courtesy WikiCommons

Weather and Isolated Texas System Created a Disaster



Terry Poulos is a retired military and business man living with his wife Cheryl Poulos in the mini-city of Sunset Valley on the edge of south Austin. Their generator was delivered in early July 2021, but installation was delayed because of a backlog in Sunset Valley's permitting process.

Both have chronic health conditions: Terry has MS (multiple sclerosis), and Cheryl is diabetic. Despite the estimated $16,000 in expenses, having chilled insulin as well as heating and air conditioning are vital health imperatives. So avoiding the survivalist drama of another extended outage like one caused by Winter Storm Uri is a priority. The February outage left them without electricity and water for almost a week.

Since they could not operate their central gas heating system without electricity, they were at the mercy of a fireplace. Cheryl had to wheel their beds in front of it to stay warm (59 degrees, which was better than the bedroom at 47 degrees). She had to carry in firewood from her acre-sized lot. She had to move perishable food outside to keep it cold. She said, "The entire thing was exhausting. All that worry and anxiety."

"I just want the reassurance (of a stand-by generator) so I can sleep at night if the power goes out," she added. "This removes ourselves from unreliability."

Terry, a free-market Republican, said that of the 54 families in the neighborhood, 15 have already said they will be seeking refuge in his house in the next outage. Several plan to buy their own generators.

Terry extolled the virtues of the machines. "It's like an insurance policy. You hope you never have to use it, but if you need it you are glad you have it."

He and his wife are strongly motivated by self-reliance. They already have 48 solar panels and collect rainwater.

After he ordered a generator, he bought stock in the company because he saw a growing trend. He urged others to, "Hurry up and get on the wait list (to buy a generator) before the wait gets longer."

Winter Storm's Death and Destruction

In late May 2021, BuzzFeed News estimated that between 426 and 978 Texans died from the winter storm in the week ending February 20.

On September 1st, 2021 the Texas Department of Insur-

ance released a report estimating at least $8.2 billion in insured losses (so far) resulted from the storm. This did not account for uninsured and unreported losses, nor did it include insurance premium increases that probably resulted from the disaster. This paled in comparison to the largest all-inclusive damage estimate for Texas for Winter Storm Uri by the Perryman Group: $195 billion to $295 billion due to property damage, lost income from business closures, and crop losses.

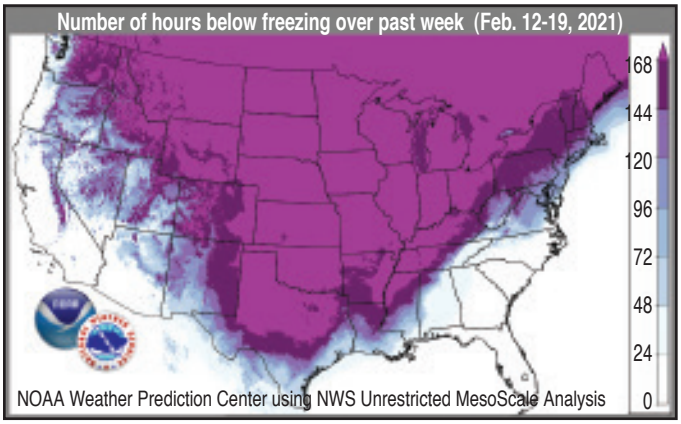
At its worst moment, about 4.5 million of the Electric Reliability Council of Texas' (ERCOT) 11.5 million customers were without electricity. However, this does not reflect the full impact because outages often rotated in the form of rolling brownouts. According to a survey of ERCOT customers conducted by the Hobby School of Public Affairs at the University of Houston in March 2021, 69% of residential ERCOT customers lost power at some point during the crisis.

Three major factors broke the ERCOT grid in February 2021: the weather (of course); the historical growth in all-electric heating; and inoperable power plants and gas wells. This story will provide a relatively concise but detailed explanation of what transpired.

The Weather

Many Texas cities, as well as weather stations throughout the Central United States, experienced new winter weather records due to Winter Storm Uri. Areas of South Texas experienced colder temperatures than some parts of Alaska during this time period.

According to the National Weather Service, many cities set new records for the number of hours at or below freezing: Austin Bergstrom (164 hours) and Austin Camp Mabry (144 hours); Houston (83 hours); Waco (205 hours); Killeen (205 hours); Abilene (252 hours); and Bryan (205 hours).



Winter Storm Uri set new records for many cities for the number of hours at or below freezing.

Between February 14th and 19th, there were 744 daily records or ties of records for the lowest minimum daily temperatures at 194 Texas weather stations. Many cities or weather stations broke records on more than one of these 10 days. The Austin Bergstrom station broke records on four of these 10 days, and Austin's Camp Mabry broke records on six of these days.

In the same period, there were 250 daily records or ties of records for snowfall recorded at 136 Texas weather stations. Del Rio, on the southern Texas border, established an all-time snowfall record of 11.18 inches in one day.

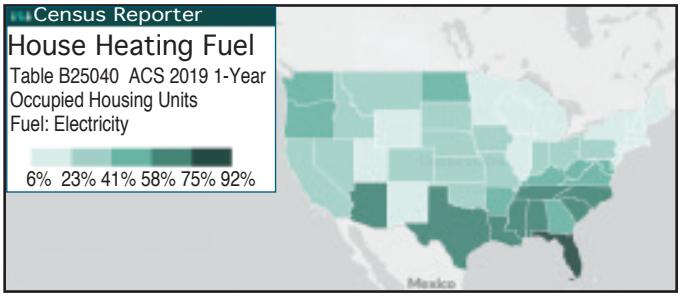
All-Electric Heat

This is the least-recognized reason for the power outage. But at the same time, it was profoundly influential. Texas homes are now predominantly heated with electricity, which places enormous demand on the ERCOT system in extreme winter temperatures.

According to statistics from the U.S. Energy Information Administration and the Census Bureau, an estimated six million homes, or 61% of ERCOT customers, used electricity as their primary winter heating fuel in 2019. Almost all of these homes have electric water heating, cooking, and clothes drying as well. About 89% of homes that use electric heat do not have a wood-fireplace for use in emergencies.

This was not always the case. In 1970, only 8% of Texas homes used electricity for primary heating, while 90% of homes were heated with natural gas or propane.

There are options for energy-efficient all-electric homes: heat pump space heating, heat pump water heating, and induction cooking. But very few homes have hot water heat pumps and induction cooking. And few heat pump space heaters and heat pump water heaters work well at low temperatures like those that occurred during the February 2021 Texas freeze. Instead, almost all of these units revert to extremely inefficient "strip" (bare-wire) back-up heating elements, which sends ERCOT peak demand gyrating.



Market share of all-electric heat by state in 2019 (from ACS Heating Fuel survey of U.S. Census)

The growth of electric heat in Texas and the southern United States occurred for several reasons. Builders, particularly apartment builders, perceive it as less expensive to install. Another reason is that many suburban and exurban homes were, at least initially, built too far away from existing gas utility infrastructure to connect.

Still another factor is that Texas winters are much less intense than in northeastern and midwestern States. So all-electric heating bills are much less than in climates

farther north. This explains the contrast between Texas' 61% share of homes with electric heat, and New York's 12% and Maine's 8%.

The Utility System

In the early morning of February 15th at 1:23 am, severe cold weather that spiked winter demand forecasts to hit record highs also affected enough power plants to cause large generation curtailments. Even some plants that were reinforced for winter weather went offline. The worst part of the outage lasted through the end of February 17th, though generation shortages did not end until February 19th at 10:36 am. It took even longer to restore power to all customers.

During the worst hour of the three-day outage (11 am Monday, February 15), the forecasted demand was 76,783 megawatts (MW). Had there been enough available capacity, it was so frigid that this would have bested the system's all-time peak demand record of 74,820 MW set in the summer of 2019. But there was only enough supply for 48,747 MW, a 37% shortfall. Later, at 8 pm the same day, more capacity losses caused a 39% shortfall. (*See chart on this page.*)

How the grid broke can be explained several ways. This story will examine five causes of the electric utility crash, as follows:

(1) Outages by fuel type—Renewable energy critics were quick to blame clean energy as the major culprit. Indeed, intermittent wind and solar did not always produce when ERCOT required power during the crisis. That said, renewable energy sources are rarely expected to produce power at peak capacity because of intermittent weather. Still, ERCOT's wind and solar units operated at approximately 49% of their total forecasted expectation (5,793 MW out of 11,800 MW) at ERCOT's worst hour during the outages.

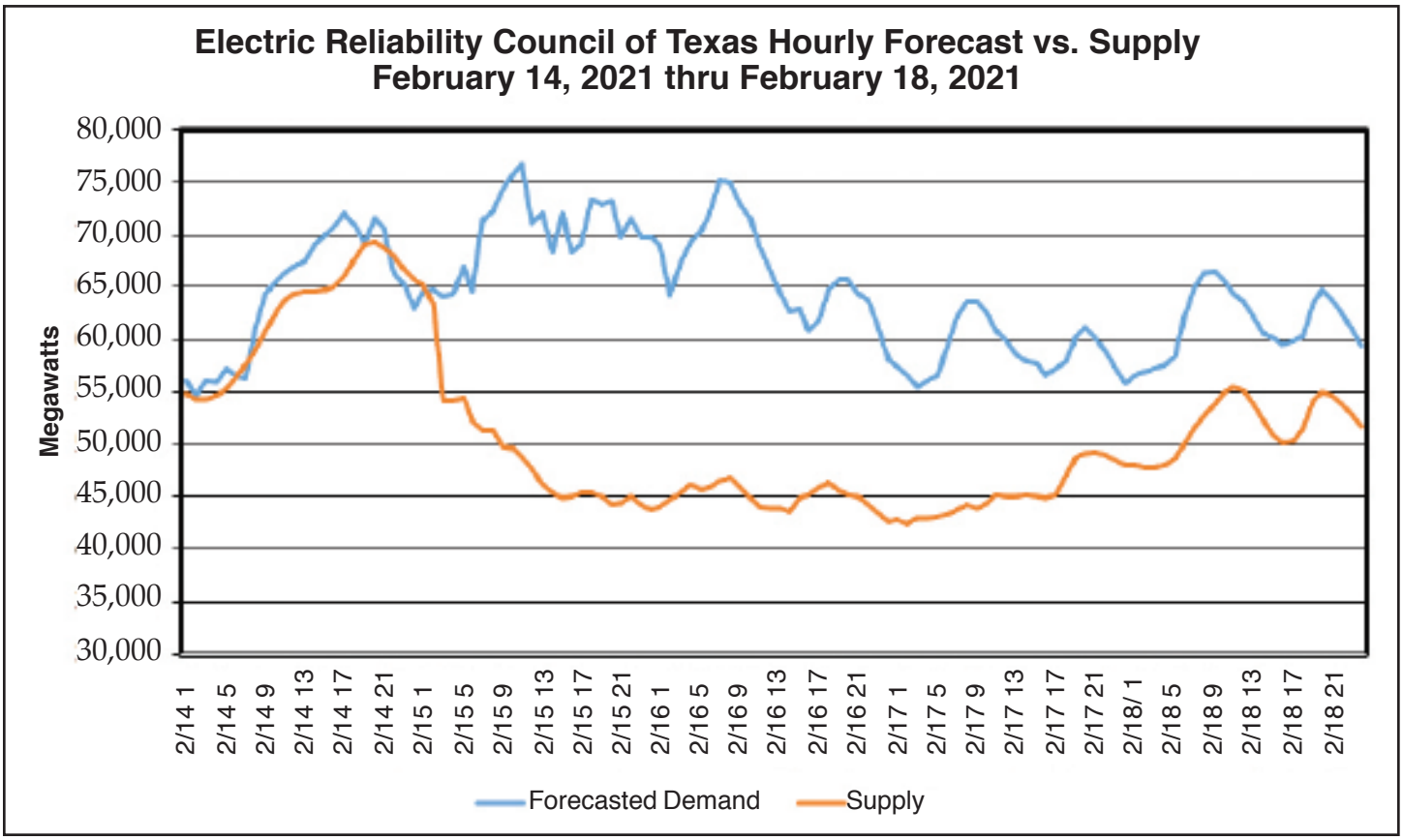
However, at ERCOT's worst hour, the underperformance of conventional power plant fleet was dangerously apparent.

Gas-fired plants: ERCOT's gas units operated at 54% of total rated capacity (29,857 MW out of 55,663 MW). Later during the outage, gas units reached a low point of 47% of their total rated capacity.

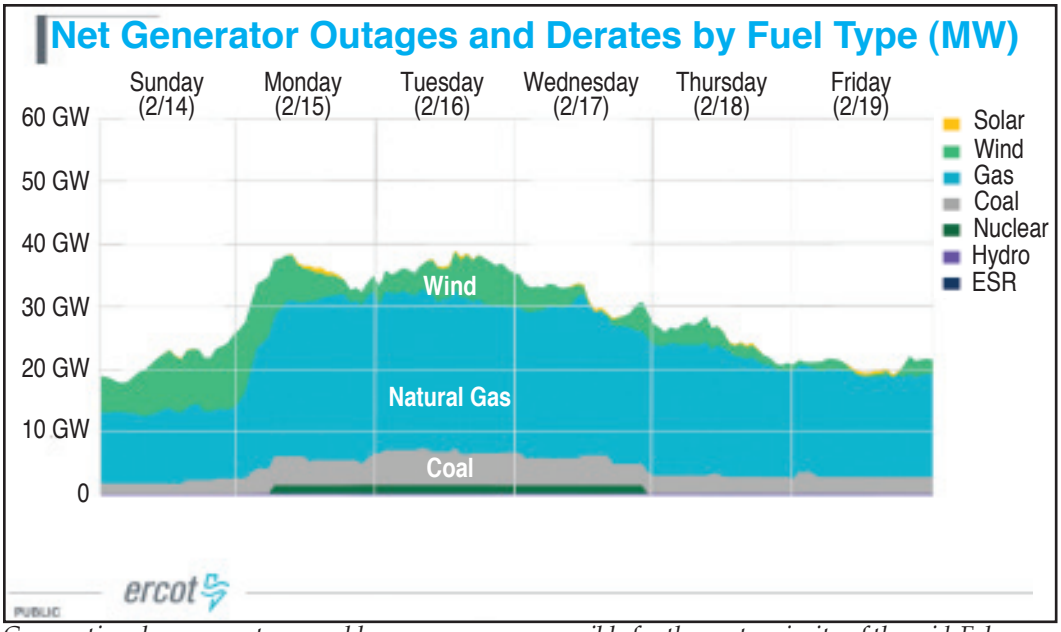
Coal-fired plants: ERCOT's coal units operated at 57% of their total rated capacity (8,311 MW out of 14,480 MW). Later during the outage, coal units fell to a low of 43% of total rated capacity.

Nuclear plants: ERCOT lost one of its four nuclear units, so the atomic fleet operated at 73% of total rated capacity (3,780 MW out of 5,153 MW).

(2) Outages by failure category—There were 585 separate generation units affected at some point during the Texas outage. ERCOT partially analyzed the reasons for these failures in an April 27, 2021 presentation available to the general public. While its analysis is not wholly transpar-



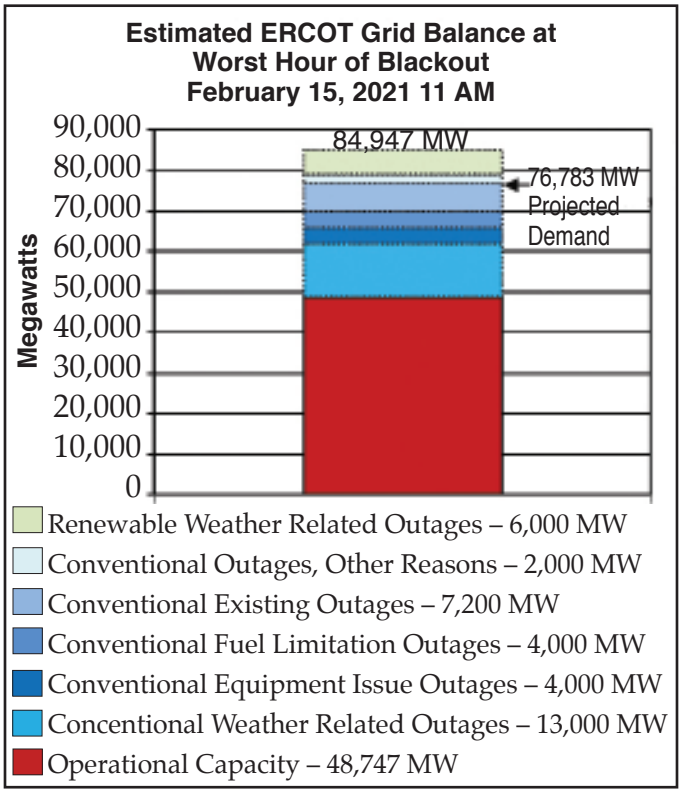
The electricity outages that began early on the morning of February 15 created a gap of as much as 39% between supply and demand.



Conventional power, not renewable energy, was responsible for the vast majority of the mid-February electric outages. (From April 27, 2021 ERCOT presentation.)

ent (ERCOT will not release source numbers for its visual charts) some estimates can be derived.

Weather-related outages and reduced power ratings of dispatchable gas, coal, and nuclear capacity—most of which could have resulted from lack of weatherization—reached about 13,000 MW at 11 am February 15th, the worst hour of the outage. These outages had fallen to about 7,000 MW by the end of February 17th.



At the worst hour of the blackout, February 15 at 11 AM, ERCOT's demand would have been 76,783 MW, the highest in history. ERCOT should have had about 85,000 MW of capacity. However, there were only 48,747 MW of operable capacity because of various types of outages. This chart details them.

Equipment issues were responsible for about 4,000 MW of outages and capacity reductions at 11 am February 15th (the worst hour), and fluctuated between 3,000 and 6,000 MW through the end of February 17th.

Fuel limitations, most of which could have resulted from lack of winter preparedness by gas producers, were responsible for loss of about 4,000 MW at 11 am February 15th and fluctuated to as high as 8,000 MW through the end of February 17th.

The Texas Oil and Gas Association has defended its members' role in the outage, stating that a survey of its producers indicated that almost two-thirds of them were plagued by electricity cutoffs during the freeze. The implication is that the wells would have otherwise been productive. However, a July 2021 report by the Energy Institute at the University of Texas at Austin analyzed the blackout. The report stated that gas production in the Permian Basin in West Texas declined by about half between February 8th, a day with moderate weather, and February 14th, the much colder day just before the ERCOT power outage. It seems unlikely that much of this decline was due to electricity shortages.

The other major reason for conventional power capacity losses during the blackout was planned outages for maintenance and unexpected events. This was about 7,200 MW at 11 am February 15, with about 6,000 MW of this being gas plants. It was not possible to quickly restart most of these plants and weather forecasts did not give much advanced notice of the storm's severity.

If there had been more notice, restarting some of these plants for this critical period might have occurred. However, it is unknown how much of this existing outage capacity would have been affected by weather-related outages and reduced power ratings, equipment issues, or fuel limitations, had they been operational.

Various other causes resulted in outages and reduced power ratings for dispatchable power plants of an estimated 2,000 MW lost at 11 am February 15th.

Regarding weather-related outages and reduced power ratings for renewable energy, considerable wind capacity was kept offline because units were not winterized to prevent turbine blade icing. Solar output was minimally affected by inclement weather and equipment problems. But as stated earlier, unlike conventional power plants, failure in renewable energy production is not based on

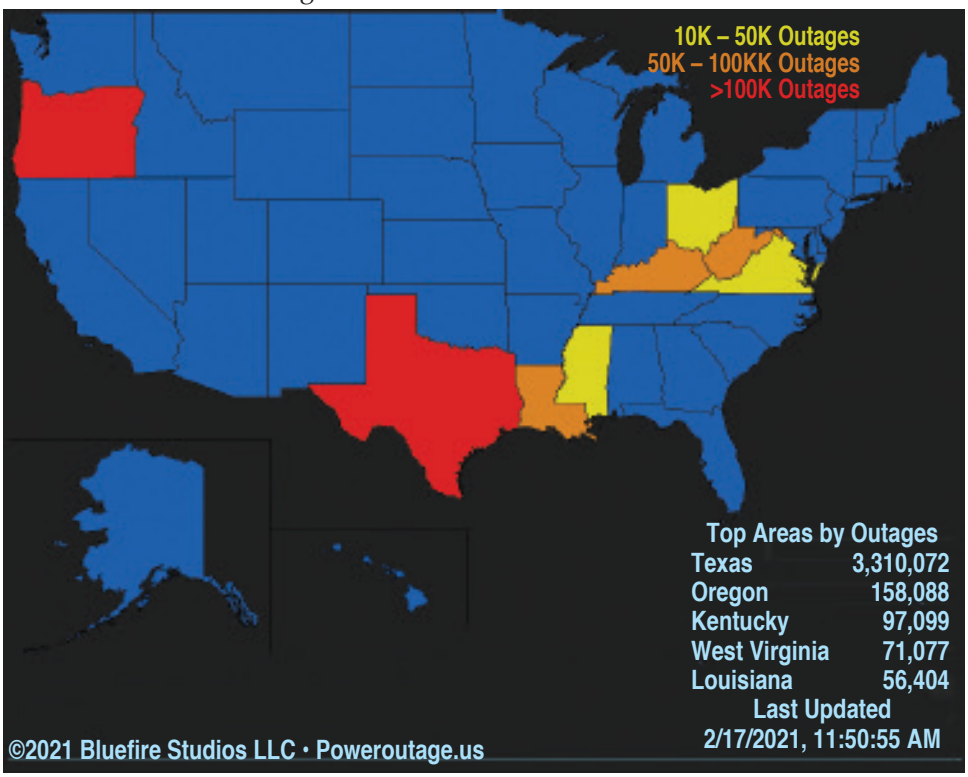
peak rating of capacity. We do not expect a 100-MW solar plant to work at midnight.

At the worst hour, about 6,000 MW of expected renewable capacity was lost. If Texas renewable energy plants had been operating optimally, they would have lessened the blackout's severity. However, the failures were largely in conventional power plants.

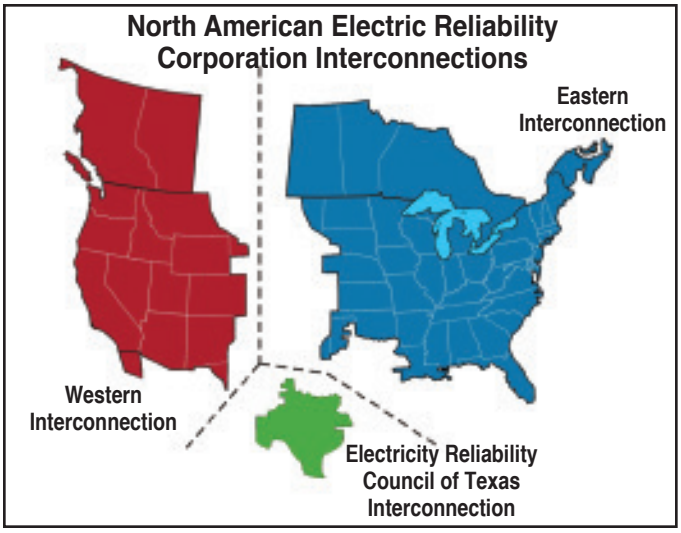
(3) Outages by lack of emergency backup power—ERCOT is an "island grid." It can import just a tiny amount of energy from areas outside its system, about 1,220 MW. By design this constraint is self-imposed so that most of Texas avoids federal electricity regulation. But then ERCOT lacks emergency backup power in extreme weather events. There were, theoretically, more than 90,000 MW of unused dispatchable capacity, plus considerable production of intermittent wind and solar power, in the western United States that Texas could have drawn on, but there were literally no transmission lines to convey it. *(See image this page.)*

(4) Outages compared to other states—Even though extreme winter temperatures blasted all or part of 22 states during this time period, no other state in the country came anywhere close to the Texas outage rate, either in terms of total number or percentage of customers. Below is a screenshot taken from the Web site of Poweroutage.us, a company that monitors power failures around the country in almost real time. This screenshot depicts outages on February 17th, the third day of the massive power outage.

At the time, 3.3 million customers in Texas (almost all of them in ERCOT) were without power, down from its peak of about 4.5 million outages earlier in the crisis. Notice



Screenshot from Poweroutage.us on February 17, 2021 comparing power outages in all U.S. states. (Courtesy of Poweroutage.us)



that, as shown in the chart, every state on the Canadian border, and Alaska, experienced almost no disconnections.

The next highest state was Oregon. At its peak, 330,000 customers, about 18% of the total, were in the dark in the same relative time period as Texas. Oregon's grid was ravaged when thousands of power lines were brought down by an ice storm, causing the largest power outage in its history. Texas' problems, on the other hand, were largely caused by incompetent power plant and fuel supply management.

(5) A pricing system that incentivizes negligence—The previous discussion about power plants in northern states highlights that it is routine to operate them in frigid weather. In fact, many Texas plants did operate during the February blackout. However, many did not because there was no strict legal requirement to weatherize them for cold weather.

Historically, power plant operators have been allowed to bid into the ERCOT market with no required standard for winter operation. Some plant owners skimped on winter weatherization costs to underbid their competitors who made such investments.

This race to the bottom not only adversely affected minimum quality of service during extreme winter events. It also discouraged investment in reliability.

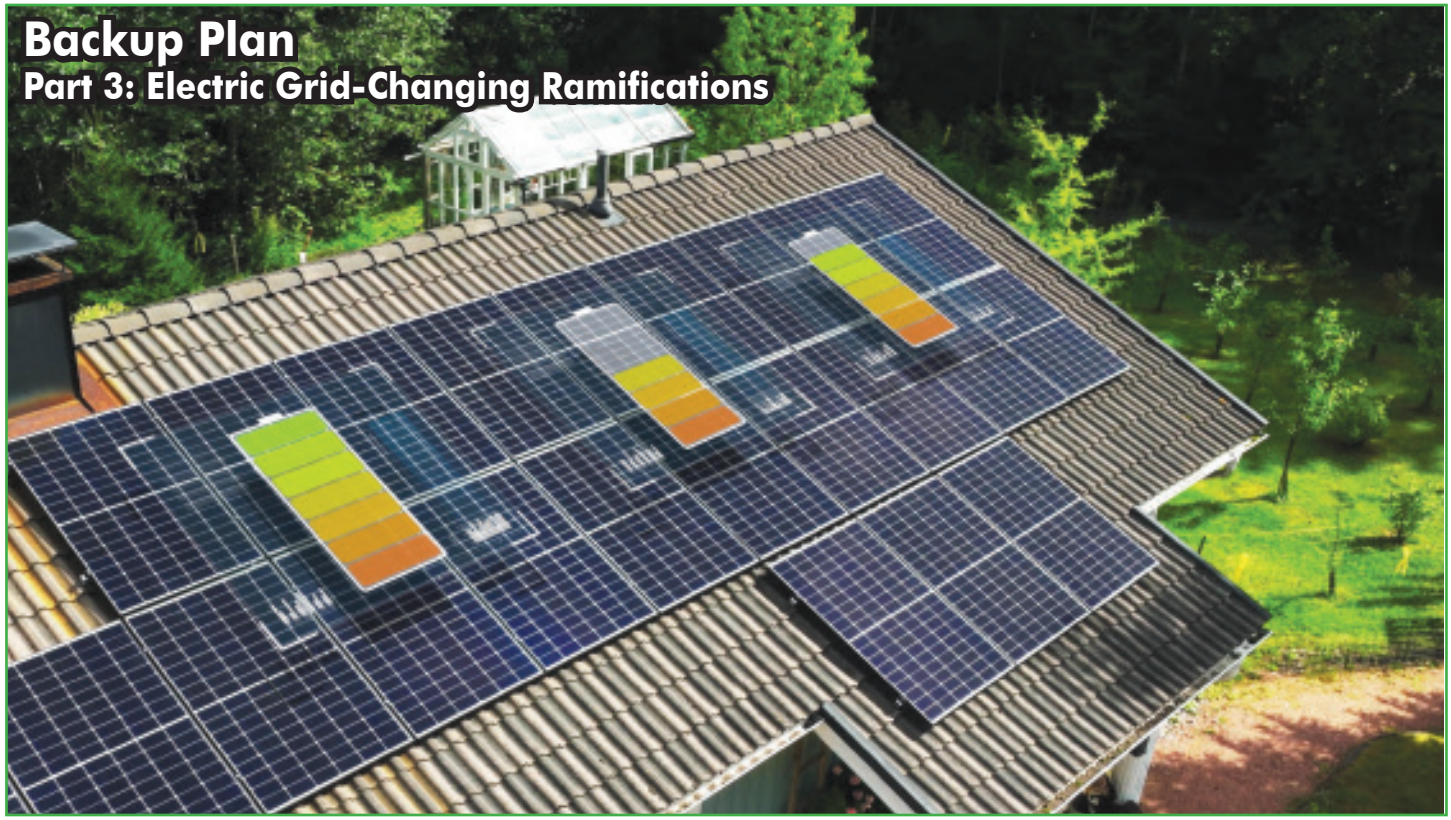
Prior to passage of legislation to deregulate Texas' electric market in 2002, it was standard for utilities to create a reserve margin of power plant capacity. These included power plants that were brought online when other plants were down for maintenance or encountered unexpected mechanical failures. And they included peak power plants that were cranked up in the very hottest and coldest hours of the year.

Since reserve power and peak power plants that do not operate frequently were no longer allowed as part of overhead in the deregulated market, an artificial and extreme price cap of $9 per kilowatt hour (kWh) was eventually established. Regulators thought the expectation of reaping windfall profits for plants that rarely operate would incentivize the private sector to build more reserve and peak-demand capacity. By comparison, energy costs in the last few years often ran 2 to 3 cents per kWh.

But no decoupling of this $9 per kWh market cap occurs during emergencies. Excessive electric and gas costs during the February ERCOT outage have been estimated as high as $50 billion.

A free marketeer might wonder why the tantalizing $9 per kWh market cap did not incentivize power plant weatherization. After all, owners of a weatherized power plant operating during extreme winter temperatures like those occurring in the February storm could have made a killing. It is because such weather is extremely rare. Why spend extra money on an unexpected event when you have to compete day-to-day at tight margins?

Backup Plan
Part 3: Electric Grid-Changing Ramifications



TechAnimationStock/Shutterstock.com

Solar Roofs and electric storage batteries can also get people through a blackout, but again, only if the homeowner can afford them.

Bill Carter and his family live in the Austin suburb of Buda. Since he lived near a hospital, the electric circuit he was a part of rarely lost power during the February outage. "The biggest problems were mobility and frozen gasoline pumps. All of the grocery stores did not function for a week or so."

But as a lifelong environmentalist and retired Texas Commission on Environmental Quality employee, he had been considering solar energy and more (electric-battery) self-reliance for some time. His wife has chronic health problems, and the family did not want to take a chance on power going out for any great length of time. The freeze became a motivational event but, in addition, electric outages in the Pedernales Electric Cooperative service area where he lives have sometimes lasted for 12 hours.

In July 2021, Carter installed more than 5 kilowatts (kW) of solar panels and a 21-kWh Enphase solar battery backup. While the new solar system will probably provide his home with more than 60% of its electricity over the course of the year, the expensive batteries will probably not yield a payback over their expected life. He made the investment for self-sufficiency.

His home will have about half of an average day's consumption stored, and more like two days if he's careful after an outage. And that's not taking into account the continued energy the photovoltaic array would be providing.

Looking back on the February outage, Carter said, "I think that the ERCOT (Electric Reliability Council of Texas) system is a travesty and definitely not protective of the electricity customers in Texas." Conversely, he does not see his kind of grid independence as a long-term solution.

"ERCOT should not be a stand-alone grid" and should be interconnected to the rest of the country, he said. "I don't think

it's a solution to ERCOT's unreliability that people should go out and get generators." He also said that public utilities (like Austin Energy) should have been allowed to keep all the power they generated during the outage to help their customers instead of being forced to feed it back to the larger dysfunctional ERCOT grid.

As the installation of standby generators proliferate, they will affect not only the electric system, but society as well. These effects will not be wholly negative or positive. This final part of this series on backup home generators will provide a nuanced view of a few of the major implications of this trend.

Demand Side Management

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If the trend holds, and inceasing numbers of backup generators and batteries are installed in Austin, it would be possible for Austin Energy to coordinate or aggregate them to offset peak demand. The utility, or contractor for the utility, could dispatch them in unison through WiFi to defer peak demand during a few critical hours of the year. The generator and battery owners and aggregator contractors would, under this scenario, be compensated.

Load deferral through aggregation is hardly new. Austin Energy has paid financial incentives to reduce aggregated summer peak demand for decades. The utility already temporarily cycles off air conditioners during a few peak hours each year. In 2020, Austin Energy saved 102 MW of summer peak demand by deferring appliance loads from 102,000 customers. Another 70 MW of summer peak demand was saved by cycling industrial load.

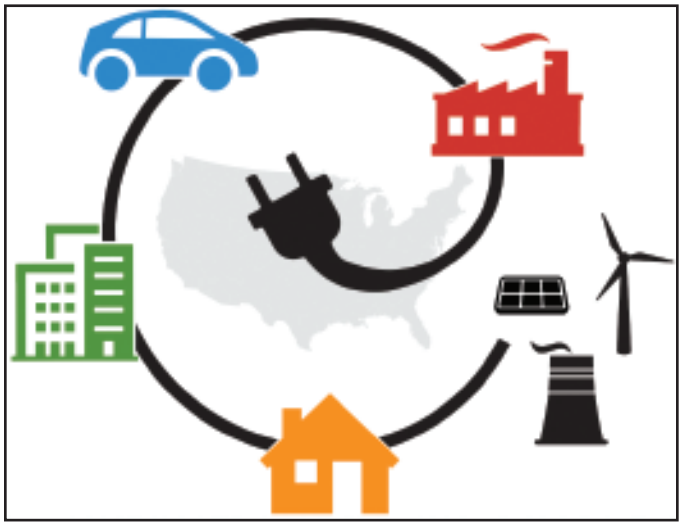
If a thousand 22-kW standby generators had been operated by Austin homes served by natural gas (which have small winter electric loads) during Winter Storm Uri, they could have provided vital relief to as many as 17,000 Austin homes. Further, this power would not have been subject to ERCOT's mandatory load-shed requirements that caused the blackouts.

I asked Roger Duncan, the former general manager of Austin Energy quoted at the beginning of the series, if he saw a potential in aggregating the load of several hundred residential generators that will be installed in the Austin area in the next year to defer the utility's peak demand.

"Absolutely," he said. "I support all versions of demand response strategies: virtual generators…microgrids…aggregation of generators." When he worked for the City of Austin, he actually investigated aggregating emergency generators in large downtown buildings in the 1990s as an option to control peak demand, but at that time all the generators were diesel-fueled (with their inherent air pollution). "But today, if you have cleaner generators, demand response with them is quite valid."

Generac backup generators come with aggregation ability preinstalled. Other units may require adapters, though adaptation costs are probably minimal.

Electrification



Ardent clean energy advocates envision an energy system free from all fossil fuels, even inherently cleaner natural gas and propane. With greenhouse-associated weather catastrophes (including Winter Storm Uri) pointing toward a literally savage future, carbon hawks seek to replace carbon fuels with solar cells and wind. Among other strategies, they urge conversion of natural gas- and propane-heating for homes and businesses, as well as gasoline vehicles, to electrically powered alternatives.

With relatively scarce and still expensive energy storage to bolster intermittency, and other dispatchable renewable technologies (hydro and geothermal) absent or insufficient in various regions of the world (including Texas), this electrification strategy is not yet seamless. Further bedeviling the concept is a lack of public support.

Given the sheer number of people in Texas who survived Winter Storm Uri because of fireplaces and fossil fuel heating (or who fervently wished these had been available to them while shivering), it is going to be many years or even decades before many Texans are ready to consider universal electrification. For now, most consumers who can afford it are preparing for the next climate change-related weather catastrophe by installing standby generators fueled by natural gas or propane.

The Rich Can Avoid Unreliability

Courtesy of Canter Power Systems

Electric customers in the Residential rate class wealthy enough to purchase standby generators are now creating a kind of rate classism, where reliability of service is linked to income.

Residential electric customers wealthy enough to purchase standby generators are more likely to have reliable power in the event of another weather emergency. Those without the money may be in for more suffering. Just as there exists a digital divide between those who have access to broadband internet service, there will be an electric reliability divide between those with standby generators and those without.

There has always been a link between wealth and utility consumption, where people with more money consume more simply because they can afford more. As a rule, people with higher incomes have a higher level of consumption because they prefer and can afford the additional service for more comfortable homes, more space in these comfortable homes, and more water for greener lawns. Many utilities also levy regressive rates that reward high consumers with volume discounts: the more you use, the less you pay per unit. (Both Austin Energy and Austin Water have steeply progressive rates that reward customers who use less.)

However, reliability has seldom been in question. What we are seeing now is that people with means are paying for increased security of utility service, in many cases because they no longer trust grid reliability. And there are even tiers within this trend.

Those who can afford it and have the space can install larger, safer, standby generators that run on cleaner natural gas or propane to supply their whole home. Those with less money can buy portable generators. They are less convenient, noisier, and more polluting because they run on gasoline or diesel. Care must be taken to operate them safely. Portable generators also generally provide less electricity than standby generators. Cell phones, computers, lighting, and refrigerators may be powered with portable generators. Larger end uses such as central HVAC and resistance (bare-wire) space heating will need more capacity.

Then there are people too poor to buy backup power, too frail to operate it, or do not own enough land to site it (usually in apartments). People in expensive downtown condos are an exception to this new model for attaining reliability. But if the condo residents chose, and the building has enough space, backup generators might be retrofitted. New condos can (and increasingly, probably will) have backup power installed during construction.

Courtesy Alex Wilson

A relatively new appliance, the portable storage battery, will also be available to people who cannot afford standby generators. These relatively lightweight lithium battery packs (often weighing only between 8 to 40 pounds) can be placed indoors to power modest electric loads such as computers and table lamps. Larger units can also power refrigerators. They are charged from a wall-plug, though DC solar chargers are also often available.

While much cleaner than either standby or portable generators at the point of use, they have their limitations. Though smaller capacity units can be had for as little as $100 to $300, they are expensive considering the sometimes small amounts of power that they store. Larger units with solar assist can cost thousands of dollars. Even then, portable batteries will not allow enough electricity to provide heat or water heat to your home or the capacity to start and run a central air conditioner or heat pump.

Instead of freezing in the dark with these smaller units, you will still freeze while working on your computer in a dimly-lit home.

Conflicting Motivation

I am an environmental activist, consumer advocate, and environmental writer. Since the late 1970s, I have been trying to advance solutions to eventually create an energy system that runs completely on clean energy, free of fossil and fissile fuels, in the real world (not some wishful fantasy). I have repeatedly come into conflict with some of my more idealistic colleagues when I have pointed out inconsistencies in their theories. You cannot legislate physics.

Some readers of this series of articles will no doubt conclude that I am extolling the virtues of natural gas and propane. Such judgment would be shallow.

Rather, I am reporting on a trend in energy use and in our society. One cannot change the future without acknowledging the present and learning from the past.

I may offer my regrets, but not apologies.

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