

TESTIMONY OF PAT WOOD, III
CEO, HUNT ENERGY NETWORK
BEFORE THE UNITED STATES SENATE
COMMITTEE ON ENERGY AND NATURAL RESOURCES
MARCH 11, 2021

Chairman Manchin, Senator Barrasso, and Members of the Committee:

Sixteen years ago, as Chairman of the Federal Energy Regulatory Commission (FERC), I last testified before this Committee in support of what became the Energy Policy Act of 2005. Among other things, that law responded to the 2003 Northeastern North America Blackout by formalizing the role of the North American Electric Reliability Council (NERC) and the role of the FERC in overseeing NERC and enforcing its reliability standards across the continental United States. It also gave the FERC enforcement authority that it lacked to fully address some issues that arose in the 2000-2001 Western Markets energy crisis.

At the end of my term, my family and I went back home to Texas, where, before chairing FERC, I led the Public Utility Commission of Texas (PUCT) during our establishment of competitive wholesale and retail power markets. Motivated by my experiences in the Western Markets energy crisis of 2000-2001, the expansion of competitive wholesale power markets to two-thirds of the country, and the 2003 Blackout, I got to work on developing energy infrastructure. Since then, I've been involved with wind, solar, coal, gas and LNG projects and companies. I was a driver in the Texas Competitive Renewable Energy Zone transmission expansion, the largest U.S. grid expansion project in decades. Today, at the Hunt Energy Network, my team and I are developing a network of distribution-interconnected storage projects across the Texas ERCOT grid.

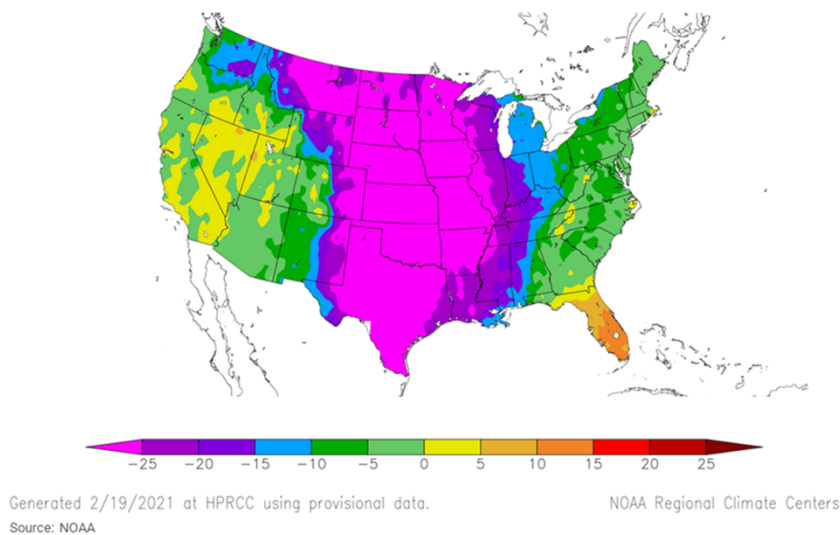
It is from those experiences that I respond to the Committee's charge, which is to examine the reliability, resiliency, and affordability of electric service in the United States amid the changing energy mix and extreme weather events.

The testimony that I would have given a month ago would have been significantly different than what I share today in some regards. The winter storm that struck the Plains and South Central states in mid-February, including all 254 counties of Texas, was the third most intense storm in 130 years of recorded Texas weather. It was historic in duration, geographic expanse and low temperature. Figure 1 shows

the geographic reach of the storm and its comparison to normal February temperatures for the week of Presidents' Day.

**Figure 1. Winter Storm Uri departure from normal temperatures.
(Week of 2/15/2021)**

Departure from normal temperature across the United States during the recent blackouts in Texas



Source: NOAA

The resulting failure of our energy system to perform as planned led to deaths, suffering and property damage. Hearings in the Texas Legislature these past two weeks have indicated that every segment of our energy and water infrastructure had significant failures, and a comprehensive root cause analysis of the energy infrastructure issues is underway.

The three pillars I have followed throughout my regulatory career are robust infrastructure, balanced market rules, and vigilant oversight. I believe those pillars provide the best way for me to discuss the Committee's charge for today: reliability, resilience, affordability and the changing resource mix.

Reliability

The beating heart of electric reliability is the real-time, short-term balance of a power system -- keeping the supply of power and demand in balance so the frequency of the real time system stays at or very near 60 Hz. Reliability also requires widespread situational awareness so the grid operator and others can see and react to deviations from NERC reliability standards, starting with the all-important 60 Hz frequency requirement. And grid reliability has long-term dimension that depends on a robust infrastructure -- a stout system of power generation, power delivery and demand assets that can integrate effectively through a wide range of potential future developments and challenges.

Reliability standards are developed by the cross-industry collaborative process at NERC and overseen by the regional reliability organizations under it. When enforcement of the NERC standards is required, FERC performs that role. Most NERC rules and FERC approvals are balanced but conservative, and they do not stretch the boundaries of possible reliability conditions, threats and solutions.

The day-to-day vigilant oversight of the grid -- the “air-traffic controller” function -- is handled every second of every day by regional grid operators such as ERCOT and PJM. Outside the organized markets, individual utilities (or “balancing areas”) such as Western Area Power Administration (WAPA) perform this role. As we saw in ERCOT last month, lacking adequate generation and storage, the system operator’s only option is to cut demand to avoid risking the collapse of frequency and voltage; failure to do so to rebalance the system could lead to a cascading blackout which could damage generators and create a widespread, lengthy electric outage.

As with other outage reports performed in recent years for events around the country, I am certain the NERC/FERC investigation of the Texas Presidents’ Day storm response will address the critical real-time decisions ERCOT made on and before February 15th. As of today, I am not aware of any evidence that ERCOT had alternatives to significant load shedding in real-time. System operators prepare for such events and hope to never have to exercise load shedding protocols -- but their responsibility is to protect the entire grid in real time, and I support ERCOT’s decision to shed load for that purpose.

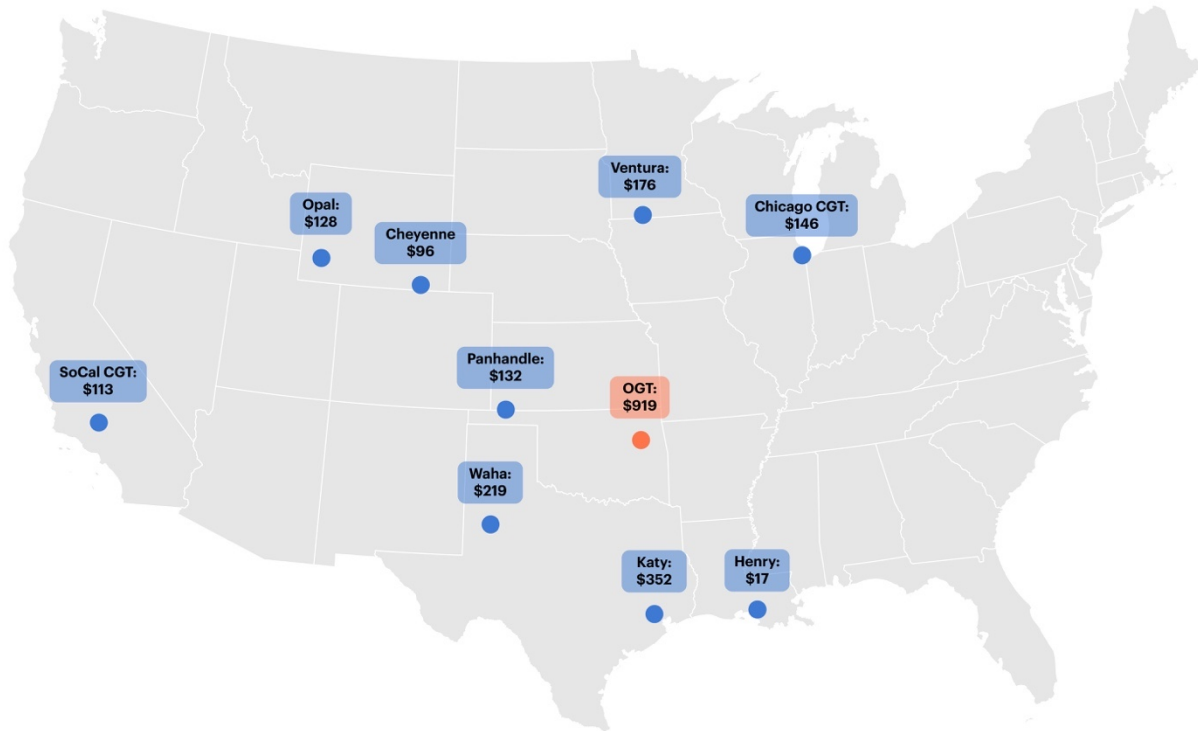
NERC and FERC are responsible for the effective operation and economics of the bulk power system (generation transmission, and competitive wholesale markets

and resources). But the distribution utilities that deliver power directly to customers play an important role in reliability. They are the regulated entities that ERCOT ordered to reduce load immediately. They did so using pre-established plans for rolling outages. Designated critical facilities such as hospitals, nursing homes, and jails were properly exempted from outages following standard practices, and the remaining customers shared the burden of the forced demand reductions.

From public testimony it appears, however, that many critical loads within Texas such as natural gas and water infrastructure may not have been recognized as critical facilities, so those were turned off pursuant to the outage orders. Much of Texas' natural gas production and processing plants now use electricity in their processes; without electricity, wellheads froze (produced gas often contains water) and gas processing also froze up. It has been reported that the production of Texas natural gas was cut in half by Friday, February 19th. With Texas supplying 40 percent of the nation's natural gas, this had significant availability and price impacts across the country.

As Figure 2 demonstrates, natural gas prices across the country escalated significantly above the typical winter prices (\$7-\$10 per MMBtu) during the event. This price run-up actually began several days before as gas customers increased purchases in anticipation of the cold weather ahead, while gas production facilities (and windmills) in western Texas began to freeze up under unusually damp conditions.

Figure 2. Spot Prices at U.S. Regional Gas Hubs (2/16/2021)



Source: IEA based on ICE NGX

The interface of the gas and electric systems was an issue in the 1989 and 2011 Texas power outages. Though it remains terribly important, true integration remains unresolved and thus should remain in keen focus. Unlike in the summer, when natural gas is flowing largely to fuel power plant demand, in the winter, natural gas is also supplying heating to homes and businesses, which understandably enjoy a statutory priority for service in Texas. However, because most of Texas has historically experienced relatively mild winters, now over two-thirds of Texas homes are heated by less efficient electric heat rather than by natural gas. (That number was less than 8% in 1970). This means that the multi-day power outages experienced by 4½ million Texans caused even greater human misery as their all-electric homes became progressively colder.

Back to the outage management process. As was widely reported in the local Texas media, many facilities such as commercial buildings (downtown office buildings) were preserved from outages despite not being occupied. These may have had backup generators or been on the same circuits as critical facilities. It is clear that state regulators and distribution utilities need to reassess, redefine and update the identification and designation of “critical” in utility outage plans and

implementation processes. And that list would be different in summer peaks than in winter peaks. Revisions of this nature have already occurred in California as they have refined wildfire-driven outage management. Texas utilities have made large regulated investments in smart metering and distribution IT capability, but those cannot be used for granular outage management. It will be necessary for distribution utilities to reengineer their circuits and feeders system-wide to divide their grids into a large number of smaller, sectionalized feeders that can be individually shut off, with less load on feeders containing critical facilities. That way, future outages can be managed in a more granular fashion that rotates the pain across a larger part of the customer base. During the Texas outages, if the distribution utilities had been able to phase interruptions among more customers on a granular basis, we might have avoided leaving 4.5 million customers continuously out of service for up to four days and lessened the disastrous overall impact on the public. Unfortunately, unlike the telecom network where data speeds can be slowed at times of network congestion, currently there are no dimmer switches on many parts of the distribution network. It's either on or off.

In most other weather scenarios, like flood or hurricanes, windstorms or thunderstorms, electric distribution systems bear the brunt of the impact. As with gas and water utility operations, oversight for system reliability falls upon local or state regulators. Those regulators often set infrastructure performance standards for such items as frequency and duration of outages, response times, and in the case of gas and water, product quality standards. In my experience, these sorts of clear minimum performance standards make it clear to the regulated companies what the goal is and allow them to manage the most effective plan to address the reliability issue.

Resiliency

Resiliency has short-term and long-term dimensions. Long-term, power system resiliency relates to the foundational ability of a system to perform over many seasons and years. It has a planning and economic dimension different from shorter-term reliability and is a central focus of the robust infrastructure pillar of effective market structure. In the context of the power system, resiliency encompasses power generation plants, fuel resources, transmission and distribution, security from physical and cyber attacks, redundancy and the customer interface. The key focus of resiliency planning is “what can the customer depend on if a stress event lasts for a day, a week or even longer?”

Over the short term, power system resilience incorporates operational considerations such as assuring that the system has effective situational awareness, emergency operation plans and skills, backup equipment and spare parts. All these elements, and others, reduce the impact of a disaster and restore electric and other services as quickly as possible for customers and communities.

Most power system damage and resiliency events in my lifetime have been transmission- or distribution-related outages. Our mostly above-ground, highly visible infrastructure has always been susceptible to weather threats such as hurricanes, ice, floods, tornadoes, etc. And customers have become used to the rapid manual repairs to the damaged facilities. The Texas Presidents' Day event had a comparatively modest negative impact on the wires, but a dramatic impact on the availability of generation.

Every NERC region, including ERCOT, performs Summer and Winter Reliability Assessments each year for the upcoming season. The ERCOT Winter Assessment released in October modeled an "extreme/contingency case" with a forecast demand at 67.2 GW and generation at 68.6 GW. This would have required some emergency measures, but not rolling outages. But on Presidents' Day the projected 8am demand was much higher than this extreme case -- 74.5 GW, equal to the ERCOT all-time summer peak in August 2019. And the average available generation supply that day ended up being at 49.0 GW, a dramatic shortfall that led to the outages called by ERCOT at 1:23am that morning. Without question, the planning process needs to be changed, and significantly. As a Houstonian who has lived through three major hurricanes, a drought and two monster winter storms since 2005, I can assure you that the weather isn't what it used to be, and we must model, and prepare for, more extreme cases in our infrastructure planning.

Figure 3 compares the performance of the various generation resources connected to the ERCOT grid with their actual performance on Presidents' Day. A comparison of the Dependable Capacity in ERCOT's seasonally-adjusted resource adequacy study (column 3) with the actual Average Generation (column 4) shows a large drop-off of generation across the board. Another view of the hourly sources of generation over February 5-18, 2021 against the temperature is shown as the final page of the Appendix.

Figure 3: Analysis of ERCOT Presidents’ Day Generation Resources

	Winter Nameplate Rating (MW)	Winter Dependable Capacity (MW)	2/15 Average Generation (MW)
Gas	51,523	51,523	32,108
Wind	28,755	7,070	3,153
Coal	13,630	13,630	8,616
Nuclear	5,153	5,153	4,141
Solar	4,898	304	805
Hydro & Biomass	619	499	189
TOTAL	104,578	78,179	49,102

Source: ERCOT, EIA

Regulators use a mixture of rules and incentives are used to achieve resiliency in power markets. State governments have passed regulations in many of these areas, and NERC has adopted standards applicable in most areas. These come with penalties for non-compliance. Regulators use carrot-and-stick incentive/penalty structures, which can drive technological innovation and creative solutions to resiliency challenges. PJM and ISO New England’s capacity performance markets are one example of this; Texas’ energy-only market with price caps set up to the “value of lost load” is another.

In 2016, Texas regulators introduced an administrative price adder to increase market clearing prices as excess capacity dwindled, sending an earlier and more pronounced price signal to both supply and demand resources. As the numbers in Figure 3 above show, last month Texas had plenty of steel in the ground, but not enough of that steel capacity worked to produce energy when Texans needed it most.

We don’t yet know the reasons why each of those generators failed to be available when we needed them last month, so I’m not jumping to conclusions and solutions yet. If the data show there were inadequate steps taken to preserve power infrastructure, then we need a weatherization solution, possibly a mandate, much like airline safety standards. If the data indicate shortcomings in the natural gas production and delivery systems that support about half of the power in ERCOT,

that has different solutions. Those may include gas wellhead, processing plant and pipeline weatherization and a requirement for gas-fired power plants to have dual-fuel backups or on-site LNG storage, as we have in New England. If commercial issues are a major cause of failure to perform, that leads to possible solutions including changes in power plant gas contract requirements or when “force majeure” can be invoked.

Transmission is an important resilience measure because severe weather and other disruptions are not as geographically broad as the entire grid. In many previous events, transmission delivered available supplies from neighboring states and regions to the region hardest hit. We do not have a good way to pay for lines between regions. Improved planning processes and tax credit for inter-regional transmission might improve the economics of lines around the country that have been proposed but do not have any clear customer or market to reward their impact or reliability and resilience.

Issues relating to physical and cyber attacks on the power system are serious resilience threats that also deserve attention. One discrete issue that did arise when I chaired FERC related to the lack of availability of key transmission and distribution equipment from domestic sources. If transformers are damaged, their replacements from overseas can take months to be delivered and installed. To my knowledge, we still do not have enough spare transformers to mitigate this risk. The recent SolarWinds cyber attack indicates potential areas of vulnerability as well. Electromagnetic Pulse is another relevant threat being addressed by the Department of Homeland Security.

Resilience is broader than just the power system – as this Texas event, Hurricane Harvey and other past disasters have shown, resilience also encompasses the question of, how prepared are our communities and fellow Americans to cope when unexpected events happen? And what can we do at the local level to mitigate the negative social impacts? Do we have backup generation, water, temporary housing, medical equipment, and telecommunications to address the gap when our interdependent critical infrastructures fail under extreme weather and other attacks? Over the longer term, issues like building codes come into focus as well.

The core lesson from recent experience is that we have not been aggressive or creative enough to imagine and model the breadth of “black swan” events that could occur. Although we hope these events will not happen, it is our collective responsibility to assume that they might, and to plan for them accordingly.

Affordability

The bottom line is, how much risk are we willing to prepare for and insure against, and how do we pay for those preparations? As a utility regulator, my fundamental job was to look at how the energy (and telecom) industries could best support economic development in Texas and the nation. Having straddled the divide between traditional cost-of-service regulation and modern market-based competition, I can assure you the competitive model is the better way to bring price, service and technological innovation benefits to customers. Texas was once the nation's 21st most expensive state in terms of power rates; now it is the 43rd. This has enabled significant business growth and improved customer welfare. (In the appendix, find my rebuttal of a recent inaccurate news story on this issue). Even in parts of the nation where electric competition is not as robust, the presence of market prices is a helpful reference point for regulators, investors and elected officials. Importantly, "competition" does not mean "deregulation," as reliability, economic and customer protection regulations still apply in competitive energy sectors.

In my career, I have had first-hand experience with a number of reliability events: the 1989 Texas winter outage, the 2000-2001 Western Markets energy crisis, the 2003 Northeastern North America Blackout, the 2011 Groundhog Day Texas outages, the 2014 Midwest polar vortex, the 2018 New Years' Northeast winter and the 2021 Texas Presidents' Day outages. All of these show that achieving a reliable, resilient energy system has a cost.

While we have occasional transmission outages, the redundancy and oversight of the transmission system generally has kept those outages from harming customers directly. Distribution outages, often weather driven, tend to be more frequent and more localized, and they do affect customers directly. Customers have expectations about how long their power may be out – those expectations generally relate to where you live and what caused the outage. But generation supply outages are rare. Texas has experienced a supply event roughly every ten years. Customers expect that the redundancy and diversity of power supply will always be sufficient. Last month in Texas, it was not.

Prices in wholesale energy markets, like those of many other commodities, have always been volatile. For that reason, retailers, utilities, and marketers perform the valuable function managing the volatility risks in power procurement through

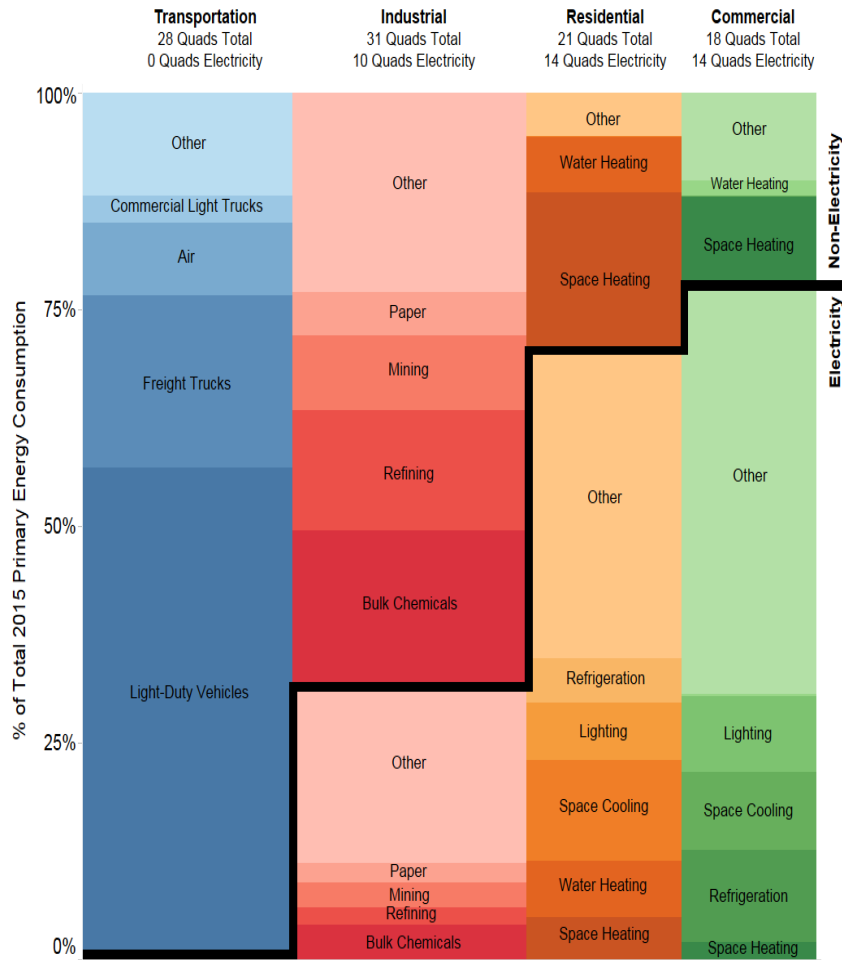
contracts and financial instruments, and engaging with end-use customers in mitigating the price impacts. The party that bears these risks varies depending on the regulatory regime. Under the traditionally regulated, vertically integrated utility model, all costs are reviewed by regulators and, if approved, passed through on customer bills. In a more competitive environment, customers can select among different rate plans, including a fixed-price, fixed-term supply contract from one of many suppliers. Such contracts, selected by over 90 percent of Texas retail electric customers, push the risk (and reward) of managing the price volatility onto the energy supplier. Suppliers who are less successful in managing those risks are pushed out of the market.

After the financial costs from expensive Texas Presidents' Day event period are finalized, I expect we will see all of these outcomes. Regulated utilities inside ERCOT will recover many costs from their ratepayers, and some retailers will exit the market moving their customers to a PUCT-approved provider. But most customers, who mostly have fixed-price power contracts, were not exposed to the high real time prices and will pay their regular rate for their monthly consumption.

Affordability requires tradeoffs. Do we design hospital intensive care capacity to account for a once-a-century pandemic? Should southern state highway departments invest in salt trucks and snow plows that sit idle until the next ten-year major winter storm? The more modular and cheaper a fix is, the easier it is to just use more redundancy to improve resilience. Many types of lower-cost technologies are starting to come into the power industry. Many are options like energy efficiency, photovoltaics and storage, that customers can adopt directly, reducing their dependence on the power system.

As Figure 4 shows, there are large segments of our economy that could be electrified. This will be a large growth driver – and challenge -- for the power industry. The flat load growth we have experienced over the past 15 years, due to efficiency gains, is only temporary. The coming growth in electric demand will trigger the need for more (likely low-carbon) resources, but these greater volumes will provide a larger base over which to spread the expected greater costs.

Figure 4: Potential Electrification of the U.S. Economy



Source: NREL

Changing resource mix

Our nation has diverse resource capabilities and no single national power portfolio. The Pacific Northwest is rich in hydropower; the Midwest, coal; the Plains states, wind; the Southwest, solar; and many regions, natural gas.

Texas is blessed with as many energy resources from above the ground as we have below ground. That affects how we can think about the future for the country. Renewables have become the dominant additions to the power system because their costs have fallen so dramatically over the last 15 years. Driven by customer demand, an open market and the elimination of many barriers to entry, large numbers of wind farms, solar plants, and storage facilities are being built across

Texas to develop this rich resource base. In just two decades, Texas has added enough wind to become the nation's leader in wind production, and added enough solar to become second in solar production. Although Texas adopted our renewable portfolio standards (RPS) in 1999, mostly private investment has shot through all of our renewable resource mandates and goals. Today, in a post-RPS market, customer demand and low resource costs have yielded over 30,000 MW of in-state renewable investment, with an additional 60,000 MW of proposed projects in various stages of regulatory review.

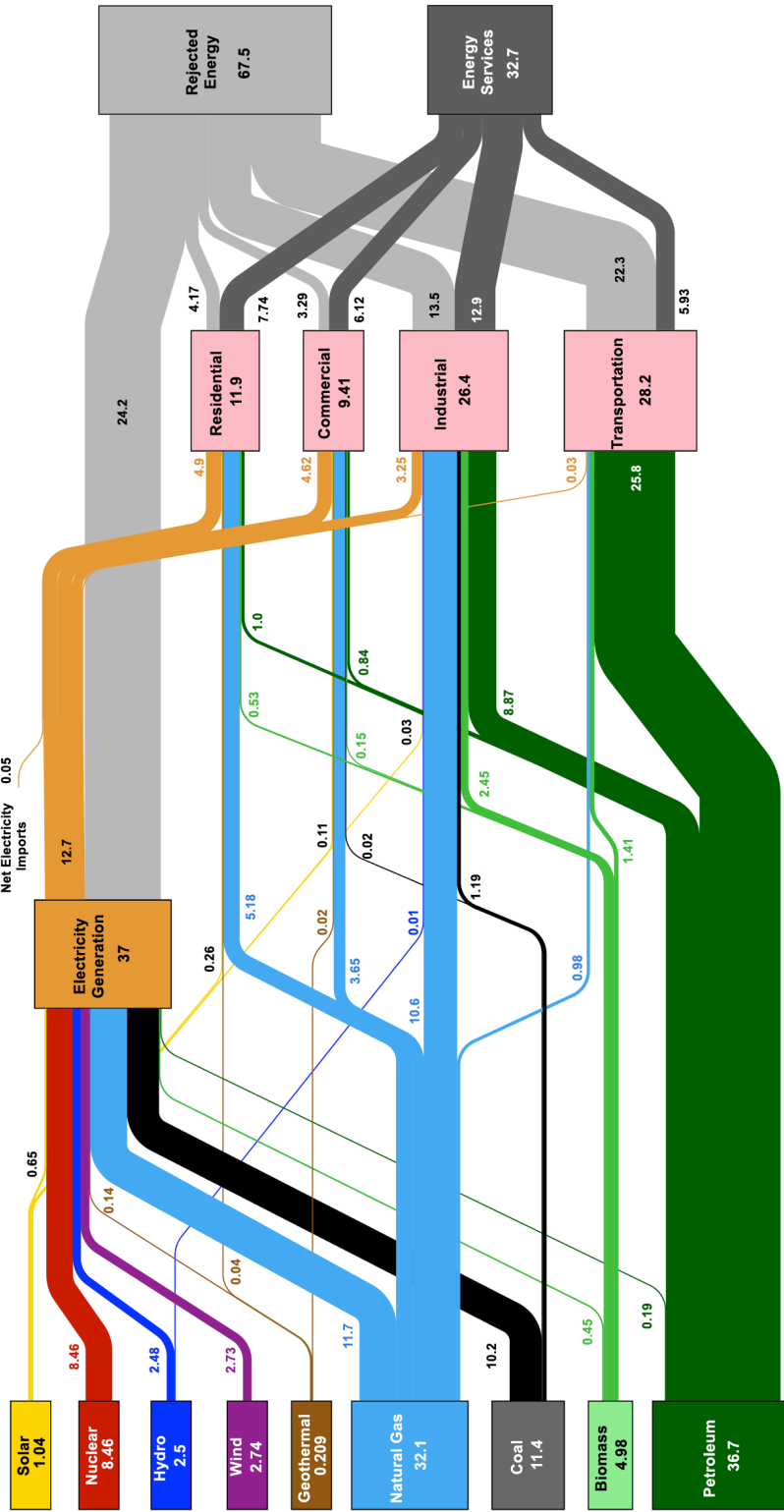
This means that the Texas power grid is where the low carbon future is already being realized. We continue to learn how to better hit the balance between affordability, reliability and the environment. If something doesn't work right, we will fix it – and, using the innovation and creativity that our open system has welcomed for a generation now, we will build it back better than before. We have no alternative.

The variable nature of wind and solar resources mean we will continue to need a diverse set of firm, low-carbon generation and storage resources at the bulk system and customer levels, plus transmission and energy efficiency. What I lived through with the Presidents' Day outages, though, makes it clear to me that we will need a diverse resource mix for many years to come. Four-hour batteries, cloudy skies and still winds cannot keep the lights on for a week or longer. Over the past three weeks, I have read more about carbon capture use and sequestration (CCUS) technology than ever before. I thank you for using the proven two-pronged approach of federal tax incentives and public R&D dollars to stimulate innovation in CCUS, and I ask you do more. The same goes for small modular reactor nuclear technology, which could become a cost-effective and durable addition to power grids across the nation in the future.

We are swiftly moving to the day when we get a much larger percentage of energy in a given year from low variable cost, low/zero carbon resources. But during critical stress periods, I want to know that firm and dispatchable resources will also be there – although not working as many hours of the year as they do today, and not emitting as much, if any, CO₂. We will have to figure out new, market-based ways to pay for that dispatchable resource availability. We figured out how to perfectly land that dune-buggy on Mars last month; we'll figure out how to clean up (or offset) fossil fuel supply and emissions impacts. I don't ever want to have to look at the Daily Outlook graph on my ERCOT app again and worry about how keep the lights on.

The easiest solution to both reliability and pollution is the energy you never need to consume -- efficiency. My politics run conservative, and the operative root word there is "conserve." The most impactful chart in my career is the annual Lawrence Livermore National Lab's Energy Flow Chart (next page). I am struck by the level of "rejected" (wasted) energy in our overall system (upper right light gray box) and know we have a long way to go to shrink that box. Reducing that wastage should be task number one on our national to-do list because efficiency will save us money, protect our neighbors, create good jobs, enhance our global economic competitiveness, and take some pressure off of the supply side of our energy infrastructure. Good bipartisan energy policies already point in that direction, and I have faith that market-driven innovation will get us there.

Estimated U.S. Energy Consumption in 2019: 100.2 Quads



Source: LLNL March, 2020. Data is based on DOE/EIA MER (2019). If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports consumption of renewable resources (i.e., hydro, wind, geothermal, and solar) for electricity in hydrogen-equivalent values by assuming a typical fossil fuel plant heat rate. The efficiency of electricity production in hydrogen production is assumed to be 45%. The commercial sector's electricity is assumed to be 21% for the residential sector and 48% for the industrial sector. The efficiency of electricity is estimated as 45% for the residential sector, 45% for the commercial sector, and 48% for the industrial sector. The efficiency of electricity is assumed to be 45% for the residential sector, 45% for the commercial sector, and 48% for the industrial sector. Totals may not equal sum of components due to independent rounding. LLNL-MI-410527

LETTER TO THE EDITOR, WALL STREET JOURNAL

Dear Editor,

Your February 24th story on Texas power rates is incorrect and misleading. Opponents of competition reheat this tired idea every couple of years, but I was disappointed to see it in the likes of the Journal.

As a part of their flawed and impossible to replicate analysis, your reporters assert that the most recent average Texas competitive rate was 13 cents per kilowatt-hour. But, just a short week after a severe test of our energy markets, every single one of the 88 residential plans on the state-sponsored clearinghouse website (powertochoose.org) prices the average kwh charge at less than 13 cents, and three-fourths of the rates offered average less than 11 cents. (2000 kwh usage, Houston, 3 to 48 month fixed-rate plans).

Commercial and industrial customers have similarly benefitted from our competitive wholesale and retail markets. Furthermore, [the EIA*](#) itself ranks Texas at the bottom (#43 out of 50) of the list of states on retail electricity rates.

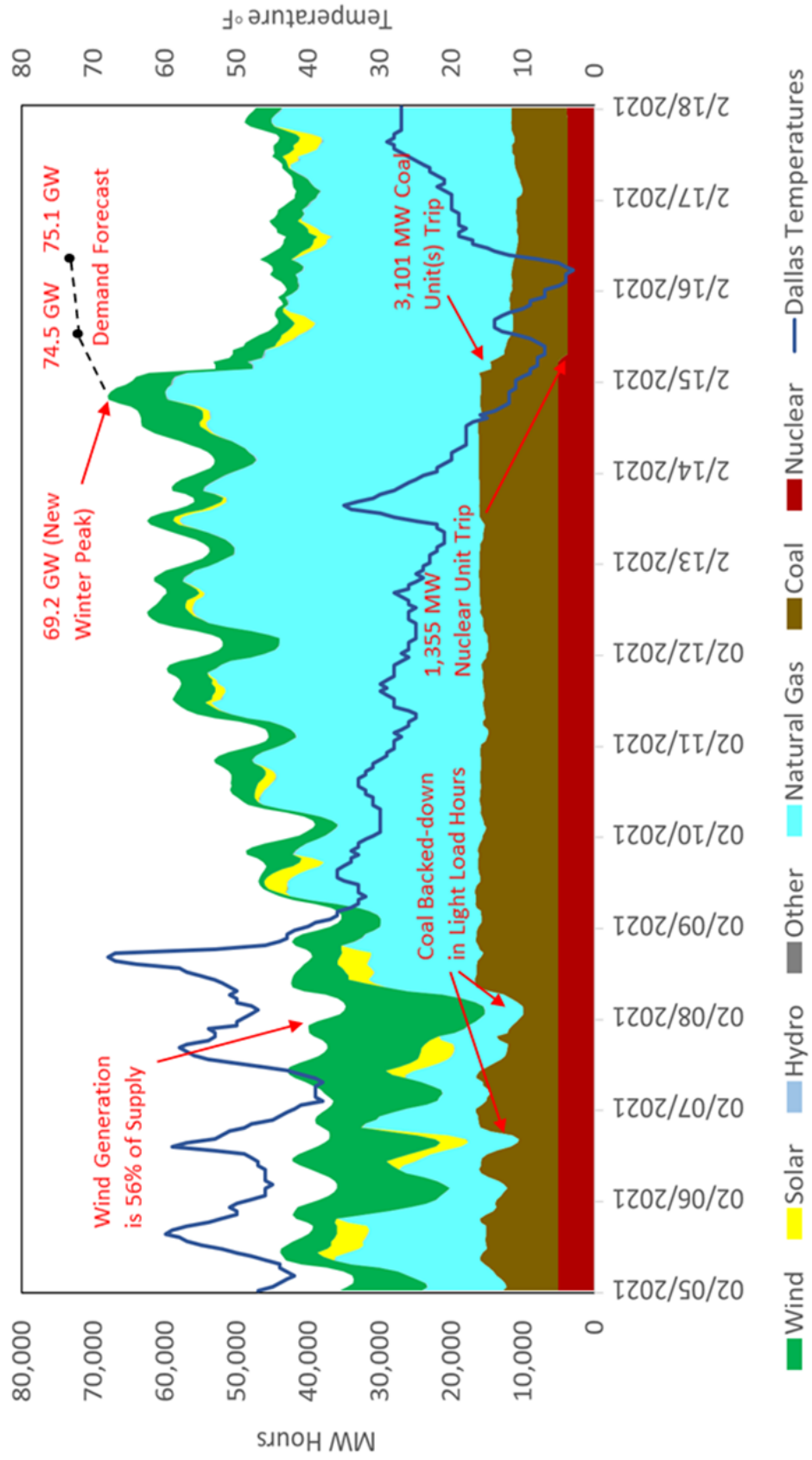
Regulated utilities that had to purchase additional gas and electricity at high prices last week have already announced their plans to charge those excess costs from their captive customers. In the competitive retail market, practically all have fixed contracts and are free to choose a more attractive offer if their supplier tries to bill them for past losses. Businesses that bet wrong own that risk, not captive “ratepayers.”

Mother Nature took a swing at Texas last week, and we have problems to fix – which we will – but the Texas competitive electricity system will continue to support our strong economy.

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Wood is past chairman of the Public Utility Commission of Texas and of the Federal Energy Regulatory Commission

Electric Reliability Council of Texas, Inc. (ERCOT) electricity generation by energy source 2/5/2021 - 2/18/2021, Central Time



Source: www.eia.gov