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Testimony of Beth Garza

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To the House Committee on Science, Space, and Technology

Hearing on "Lessons learned from the Texas blackouts: Research needs for a secure and resilient grid"

March 18, 2021

Chairwoman Johnson, Ranking Member Lucas and members of the committee:

Thank you for the opportunity to testify before you today on the critical topic of electric resilience in light of the power outages in Texas and other southern and midwestern states. My name is Beth Garza, and I am a senior fellow in the energy program at the R Street Institute, a pragmatic free-market think tank. Although the R Street Institute is a D.C.-based organization, I live in Austin, Texas and have held various roles in and around the Texas electricity market for more than 35 years, most notably serving as the Independent Market Monitor for the Electric Reliability Council of Texas (ERCOT) wholesale markets from 2014 through 2019. In this role, I was responsible for monitoring market participant activity, evaluating wholesale market operations and recommending improvements to the wholesale market design.

After providing a brief overview of the events in Texas during the week of Feb. 14, 2021, I offer three specific suggestions for areas of research that would be to improve the security and resiliency of the electricity system. My testimony concludes with a broader discussion of the policy implications and suggestions related to the Department of Energy.

Description of the February 2021 Power Outages

During the week of Feb. 14, 2021, an exceptional arctic air mass descended upon the middle of the country, including the entire state of Texas. This cold weather was extreme in both magnitude and duration. For example, in Austin a new record was set with 144 consecutive hours with below freezing temperatures. I can speak more authoritatively regarding the effects in the ERCOT region, but

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neighboring regions—the Southwest Power Pool (SPP), and the Midcontinent Independent System Operator (MISO)—also implemented emergency operations during the week.[1]

A common description of the ERCOT is that they are the folks that "run the grid". But what does that really mean? The ERCOT, similar to the other regional independent system operators, is the organization responsible for ensuring electricity supply equals demand at all times, and achieving that balance without allowing more electricity to flow on any transmission line than that line is designed to carry. The ERCOT does not own the generators, transmission lines or the demand. Most of the time this balancing act relies on supply going up and down in response to demand.

On Sunday, February 14, electricity demand reached a new winter peak that evening around 7:00 pm. Overnight demand levels did not decrease significantly, but supply became very limited. That is, power plants were unable to operate due to the effects of increasingly severe cold weather. By 1:20 early Monday morning, the amount of supply available was not sufficient to serve all demand and to maintain balance, and demand was curtailed.[2]

[1] Office of Cybersecurity, Energy Security, and Emergency Response, *Extreme Cold & Winter Weather | Update #1*, U.S. Department of Energy, Feb. 16, 2021. https://www.energy.gov/sites/prod/files/2021/02/f82/TLP-WHITE_DOE%20Situation%20Update_Cold%20%20Winter%20Weather_%231.pdf.

[2] Bill Magness, "Review of February 2021 Extreme Cold Weather Event," Electric Reliability Council of Texas, Feb. 24, 2021. http://www.ercot.com/content/wcm/key_documents_lists/225373/2.2_REVISED_ERCOT_Presentation.pdf.

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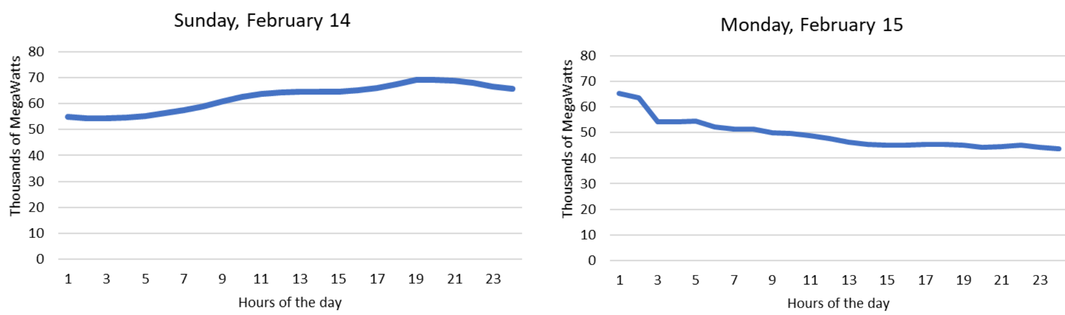
ERCOT Demand



The ERCOT issued an order to the 17 distribution utilities in the region to interrupt the flow of electricity to enough of their customers to achieve the ERCOT-specified demand reduction target. These interruptions are accomplished by opening up a device located within a substation, which prevents the flow of electricity to an entire distribution circuit, or feeder. Based on my experience, the circuits selected for interruption typically serve several hundreds to a couple of thousand customers.

Under "typical" emergency conditions, these power interruptions are referred to as "rolling" outages because the idea is that no one set of customers should bear the entire curtailment burden, while keeping outage durations to specific customers limited in duration. As experienced in Texas this February, in many areas the amount of curtailment ordered meant all circuits not serving a critical load had to be shutoff; therefore sustained, not rolling outages ensued. I can speak to this from personal experience, as the electricity to my house was turned off for 81 consecutive hours. This was a common limitation felt by distribution utilities serving Austin and other urban areas. I assume this is due to higher concentrations of critical load in these areas.

Although there have been strong cries to find and assign the blame to someone, this event was larger and more impactful than any single person or entity could actually be responsible for. I suggest that there are many contributors and room for lots of improvement. To focus our attention today, I will discuss three key areas where research efforts would be of most value. These are 1) forecasting; 2) weatherization or winterization of power plants and their fuel supply; and 3) improved granularity of operation and control of demand within electricity distribution systems. I will conclude by offering my perspective on the policy implications for the federal government, specifically the Department of Energy.

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Weather and Demand Forecasting

Demand for electricity is very sensitive to weather conditions, primarily temperature. Electric utilities have become very good at forecasting customer demand based on foreseeable weather conditions. They are very accurate for the next day or two and based on a specific forecast of weather conditions, and are generally pretty accurate as much as seven to 10 days ahead. It would be valuable to have a better long-term view of potential weather conditions to improve electric system preparedness and assist with resiliency.

Weather expectations are also drivers for an increasing amount of supply, specifically forecasts of available wind and solar generation. Uncertainty in wind and solar generation forecasts were not a significant contributor to the recent February event. But accurately forecasting not just the expected output from these sources, but a reasonable range of outputs, becomes more important as wind and solar generation sources are an increasing portion of electricity supply.

The ERCOT prepares and publishes an assessment of demand and supply for each season. These assessments include both expected and potential extreme conditions.[3] Unfortunately, the ERCOT's forecast for extreme winter demand was based on weather experienced during February 2011. The weather conditions actually experienced during this past February were more severe, setting a new bar for what will be considered as extreme in the future. If weather events are getting more severe, I believe all electric utility systems would benefit from new forecasting tools and techniques to ensure their longer-range planning is preparing them for the conditions they may face.

Winterization of Supply

The ERCOT had what was believed to be an ample amount of installed generation capacity, but the massive reduction in available generation drove supply below firm demand, resulting in forced curtailments of customer demand. This is the final emergency action available to grid operators to maintain supply-demand balance and avoid a catastrophic systemwide blackout that could take weeks or longer to recover from. It is imperative to distinguish the causes of the supply shortfall relative to firm load, as well as how the shortfall was managed.

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[3] "Seasonal Assessment of Resource Adequacy for the ERCOT Region (SARA) - Winter 2020/2021," Electric Reliability Council of Texas, Nov. 5, 2020.
http://www.ercot.com/content/wcm/lists/197378/SARA-FinalWinter2020-2021.xlsx.

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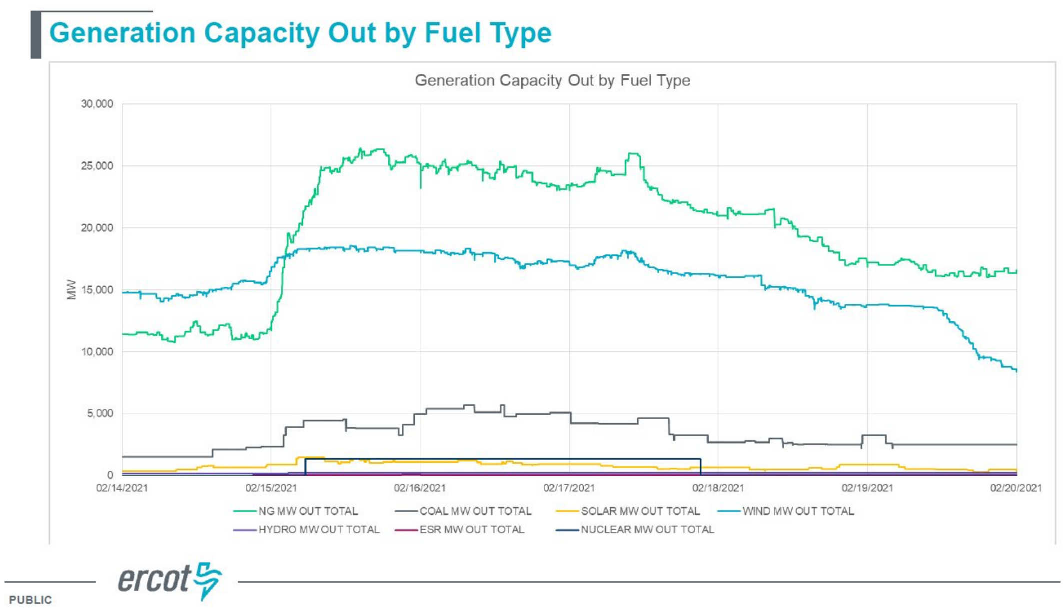
I caution that it is too early to draw firm, detailed conclusions about the causes of generator outages. Data about which power plants were not operating is just now becoming public.[4] Based on this data, testimony and public statements by generation owners, it is clear that every type of generation—nuclear, coal, gas, wind and solar—were limited in some manner during the extreme cold in ERCOT. Details about specific outage causes will take longer to develop and analyze. Still, we can provide a preliminary assessment based on currently available information, which indicates that the primary causes of generation outage were due to insufficient weatherization and fuel supply disruptions, especially for natural gas-fired facilities.



Non-verified statements have been made that maybe half of the outages at natural gas power plants were due to the lack of natural gas fuel delivered at sufficient volumes and pressures. It is too early to draw specific conclusions other than the co-dependence of the electricity and natural gas systems, especially in Texas, was once again centerstage.

Much has been made of the lack of mandatory winterization standards for power plants in Texas. I suggest that it is easy to say that winterization should be mandatory, but effective regulations require a

[4] "Unit Outage Data," Electric Reliability Council of Texas, March 4, 2021. http://www.ercot.com/content/wcm/lists/226521/Unit_Outage_Data_20210304___Public_.xlsx.

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specific standard to be met. Should all Texas powerplants be required to be able to operate in subfreezing weather? For what duration? What about sub-zero temperatures?

Any such standards should also have benefits that exceed costs. One of the challenges power plant and natural gas system owners in Texas face in this regard is the relative infrequency of very cold weather, which limits and complicates the determination of winterization benefits. Power plant and natural gas fuel system winterization comes in various forms with different costs and performance implications. Understanding these cost and performance tradeoffs will be very valuable input to the standard-setting process.

Another value of improved forecasting of weather extremes would be its contribution toward establishing appropriate weatherization standards and requirements. Although we are focused today on the recent winter event in Texas, preparation for other types of extreme weather—heat, wind, rain—would be of value to all utilities across the country.

Distribution System Improvements

An overlooked takeaway from these events is that better deployment and utilization of advanced technologies could have reduced the magnitude of the supply shortfall and led to a less severe outcome. New "smart grid" technologies, when combined with market mechanisms, could have enabled a much deeper degree of voluntary demand reduction by end users that would have reduced the shortfall. To address any remaining shortfall, such technologies should enable the bulk system and distribution system operators an enhanced ability to stabilize power flows and enact more surgical involuntary curtailments based on the value of the end use activity. They can also enable the ability to restore power expeditiously to customers, ideally basing this priority according to the sensitivity of the end user to sustained power outages. Instead, some customers in the same municipal area never lost power while others lost it for days. Further, some critical uses like natural gas transport infrastructure were curtailed but some low value uses were not. What if there was the ability to ensure that non-critical uses of electricity (washing machines, dishwashers, etc.) were automatically limited, allowing scarce supply to be available for more important uses?

Texas, for example, has expansive advanced metering infrastructure (AMI) deployment but preliminary results indicate the Texas "smart grid" was not managed in a smart manner. For example, the general manager of Austin Energy, my local public power utility, described our "advanced" meters as capable of being disconnected remotely, but requiring a person in the field to reconnect. I heard this as I was sitting in my cold, dark house and thought, "here's an area for improvement." This same topic came up during hearings at the Texas Legislature, where an executive from CenterPoint Energy (serving the greater Houston area) described different limitations preventing them from using their advanced meters to

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manage the curtailments.[5] The limitations as I have heard them described, seem to be a lack of supplemental technologies combined with institutional and policy deficiencies.

The same improvements that could have eased the burden of lengthy outages on a subset of customers, could also form the foundation for demand (customers) to express their willingness to pay and receive higher reliability. The ability to use scarce supply to serve the demand which values it the most is the foundation of economic efficiency.

I have laid out three areas where technological improvements could improve grid resilience. But their success in doing so depends on evolving market conditions and regulatory architectures. Technology development institutions, like the Department of Energy (DOE), should be synchronized with the evolving energy regulatory contexts that vary across the state, regional and federal levels. For example, optimizing the DOE's assessments, coordination efforts and research and development (R&D) functions with the evolving functions and policy agendas of state public utility commissions and the Federal Energy Regulatory Commission (FERC) is crucial.

DOE Policy Implications

The translation of recent events into the proper role of government must identify tools suited to address legitimate market failures. Policy instrument choice must also account for the risk of government failure, whereby an intervention creates inefficiencies that can outweigh the harm caused by the market failure. In the case of the DOE's research agenda, market failure is most pronounced in knowledge spillovers, where the creation of knowledge by one entity can benefit others. Since an individual firm cannot capture these spillover benefits, this sometimes results in the private sector having insufficient incentive to develop and deploy new technologies.[6]

To maximize taxpayers' return on grid resilience R&D efforts, it is imperative that the DOE's innovation programs are routinely scrutinized and adjusted for changing conditions in the marketplace and regulatory environment. Last month's events serve as a case in point when there is a disconnect between technology development—such as the highly touted benefits of the "smart grid" in the 2000s—and the regulatory institutions that establish the rules of the road for technology deployment

[5] Texas House Joint Hearing of the State Affairs and Energy Resources Committees – Part 1, Feb. 25, 2021. https://tlchouse.granicus.com/MediaPlayer.php?view_id=46&clip_id=19369.
[6] Adam B. Jaffe, et al., "A tale of two market failures: Technology and environmental policy," *Ecological Economics*, Vol. 54 (2-3), August 2005. http://www.sciencedirect.com/science/article/pii/S0921800905000303.

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and management. This should not come as a surprise, as a report last year from the DOE's Advanced Grid Research division found that AMI deployment was costly nationwide with speculative but "wide-ranging benefits that are highly dependent on how the technology is implemented and the value streams pursued." [7] Value streams for grid resilience are exceptionally dependent on the regulatory architecture. With this backdrop, last month provides another reminder of a critical lesson for the DOE and regulatory bodies: coordinate agendas to maximize the net benefits of emergent grid resilience technologies.

In recent years, the DOE has increased its interagency coordination with the FERC and the North American Electric Reliability Corporation (NERC) on matters of grid resilience and security.[8] Synchronizing FERC rules and NERC reliability guidance and standards alongside DOE activities should guide technological development. But it also highlights the value of the DOE's other functions, namely in developing and disseminating information and coordinating government and private sector activities.

Last month's events should inform an adjustment to the DOE, the FERC and the NERC's joint agenda. Previous evidence on grid resilience heavily emphasized transmission and distribution as the most vulnerable components, while fuel limitations were a minor factor in generation susceptibility. Last month's events, however, indicated the vulnerability of power generation to a single type of event, and likely will put added emphasis on addressing power plant fuel assurance, especially as it relates to the interdependency with natural gas infrastructure. Deploying the DOE's enhanced natural gas-electric system modeling could greatly inform next steps for the FERC and the NERC in their response. However, the most important lesson is that regardless of the cause of the supply shortfall, massive improvement in regulatory and technology development spheres is needed to improve demand-side responsiveness.

Specific DOE policy recommendations include:

1. *Orient DOE strategies to enable programmatic flexibility and robustness in the face of uncertainty*. Market conditions, regulatory environments and technologies are dynamic. The DOE's strategic orientation should preserve option value in programmatic adjustments to avoid inefficient "lock-ins" but also recognize the downsides of constant tinkering in R&D programs,

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[7] Advanced Grid Research, *AMI in Review: Informing the* Conversation, U.S. Department of Energy, last accessed March 15, 2021, p. 48. https://www.smartgrid.gov/documents/voe_series/voe-ami-in-review-informing-the-conversation.

[8] See e.g., "Statement of James B. Robb," Docket No. AD19-12-000, North American Electric Reliability Corporation, March 28, 2019. https://www.nerc.com/news/testimony/Testimony%20and%20Speeches/FERC%20Security%20Incentives%20Technical%20Conference%203-28-19%20FINAL.dotx.pdf.

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whose productivity is very sensitive to long-term programmatic stability. R&D programs designed to deploy resources in a manner to maximize net benefits across a broad set of future scenarios will age well and put taxpayer dollars to better use.

2. *Target DOE assessments, technology development pathways and interagency collaboration toward identifying and rectifying common mode failure*. Such efforts should reflect and build upon existing research, especially that which identifies correlated outages of extended durations. Currently, many industry-planning methods presume generation outages are independent, or uncorrelated, with one another. This can result in planning methods that understate the probability of supply disruptions, including those tied to common mode events like severe weather, cyber and physical attacks, and natural gas supply constraints.[9] The increasing share of natural gas and renewables generation, which exhibit extensive correlated derates and outages, underscores this value.
3. *Bolster demand responsiveness to any cause of supply disruption*. Although the specific causes of February's outages could be rectified, I caution against presuming that avoiding this type of event altogether is achievable. A risk of mass disruptions to bulk electric supply will always exist, be they from extreme weather, natural disasters or intentional attacks. Thus, we must focus on the ability to manage scarce resources and the ability to "bounce back" from grid emergencies. Technologies enabling us to do so include advanced sensors, monitors and flow controls, all which enable more voluntary demand reduction and, when necessary, more surgical involuntary load curtailments. This customer-centric approach requires advanced technology to expand the ability of consumers to receive a level of service reliability that they are willing to pay for in the competitive marketplace.
4. *Focus on the resilience of the natural gas system, especially at its nexus with the electricity system*. Enhanced DOE assessments of natural gas-electric system interdependencies could greatly inform state and federal rulemakings, prudency reviews and standards development, in addition to informing market participants and legislators. Market forces should dictate the role natural gas plays in our energy future, whereas policies to advance technologies can help private sector-led investment mitigate the risks of gas supply chain disruptions and bolster its ability to bounce back.
5. *Align energy R&D spending with spillover benefits across federal and state regulatory contexts*. The most prudent R&D spending is upstream in the innovation cycle, where spillover benefits are greatest. These should be accompanied by DOE program performance metrics, regular program reevaluation to determine when to phase-out public investment, and stronger linkages

[9] *Exploring the Impacts of Extreme Events, Natural Gas Fuel and Other Contingencies on Resource Adequacy*, Electric Power Research Institute, Jan. 28, 2021. https://www.epri.com/research/products/000000003002019300.

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to private sector needs across differing electric regulatory model.[10] DOE advisory processes and technology assessments should reflect the commercial usefulness of such technologies in all relevant regulatory contexts, such as soliciting input from power generators and state regulators under both the regulated monopoly utility model and competitive independent power producer model. All expenditures should be scrutinized in context of a highly constrained fiscal environment.[11]

Although I cannot comment on all aspects of the Grid Security Research and Development Act (H.R. 5760), I am encouraged by the role of the DOE to 1) administer *competitive* grants tied to enhancing energy sector resilience and emergency response; 2) collaborate strategically with other federal and state agencies and the private sector and; 3) implement an R&D program to help address tomorrow's energy sector resilience and security concerns.

I look forward to your questions.

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[10] See e.g., "Testimony of Devin C. Hartman before the U.S. House Committee on Energy and Commerce Subcommittee on Energy Hearing on 'Federal Energy Related Tax Policy and its Effects on Markets, Prices and Consumers'," March 29, 2017, p. 15. https://docs.house.gov/meetings/IF/IF03/20170329/105798/HHRG-115-IF03-Wstate-HartmanD-20170329.pdf.

[11] *Ibid*.

Beth Garza is a senior fellow with R Street's Energy & Environmental Policy Team.

Prior to joining R Street, Beth served as the director of the Electric Reliability Council of Texas Independent Market Monitor from 2014 through 2019 after serving as the deputy director since 2008. In this role, she was responsible for monitoring market participant activity, evaluating wholesale market operations and recommending improvements to the wholesale market design.

Over the course of her 35-year career in the electric utility industry, Beth has held a variety of leadership roles in generation and transmission planning, system operations, regulatory affairs and market design for both regulated and competitive entities. Her previous employers include Nextera and Austin Energy.

Beth is a graduate of the University of Missouri and is a registered professional engineer in the State of Texas.