

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES
HEARING CHARTER

Lessons Learned from the Texas Blackouts: Research Needs for a Secure and Resilient Grid

Thursday, March 18, 2021

10:00 AM EDT

Cisco Webex

PURPOSE

The purpose of the hearing is to understand what caused the recent extended power outages in Texas and other southern and midwestern states during a severe winter storm over the second weekend of February, and to examine associated grid research and development needs. Witnesses and Members will discuss grid security research activities at the Department of Energy, including relevant grid technology, energy generation technology, and cybersecurity research. The hearing will also serve as a legislative hearing for a bill that was introduced in the 116th Congress and is expected to be reintroduced in this Congress by Rep. Ami Bera, the *Grid Security Research and Development Act* (H.R. 5760 in the 116th Congress). This bill would authorize an interagency research, development, and demonstration program on electric grid and energy system cybersecurity, physical security, resilience, and emergency response.

WITNESSES

- **Dr. Jesse Jenkins**, Assistant Professor of Mechanical and Aerospace Engineering, Andlinger Center for Energy and the Environment at Princeton University
- **Dr. Varun Rai**, Associate Dean for Research; Professor of Public Affairs, LBJ School of Public Affairs at the University of Texas at Austin
- **Mr. Juan Torres**, Associate Laboratory Director, Energy Systems Integration National Renewable Energy Laboratory
- **Ms. Beth Garza**, Senior Fellow, R Street Institute
- **Dr. Sue Tierney**, Senior Advisor, Analysis Group

BACKGROUND

Sequence of Events

In 2020, natural gas, wind, coal, nuclear, and solar energy provided 46%, 23%, 18%, 11%, and 2% of Texas's electricity, respectively.¹

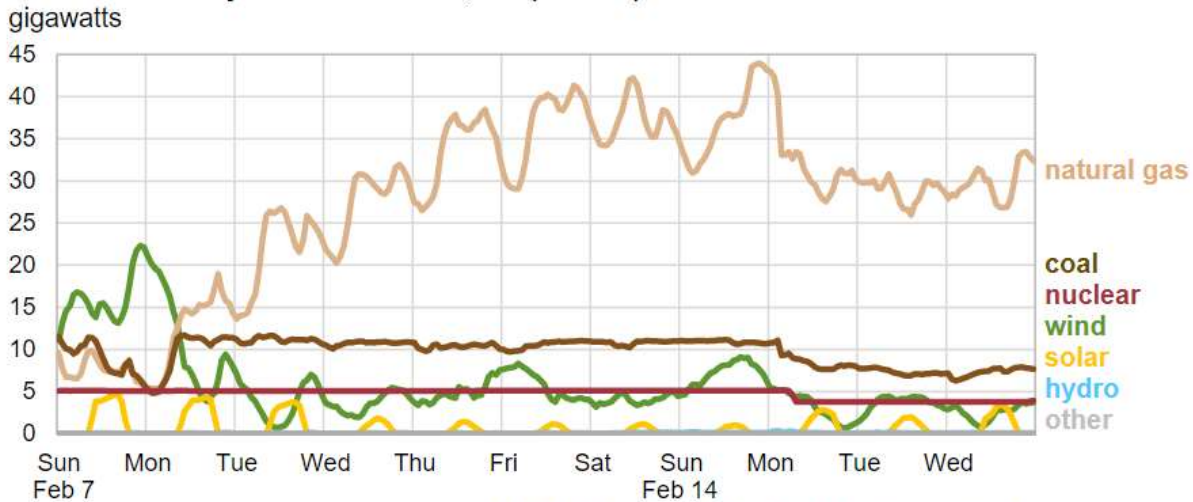
Late Sunday, February 14th, Winter Storm Uri descended on Texas and the surrounding region, leading to unprecedented low temperatures. Early in the morning on Monday, February 15th, heat and electricity demand surged. At the same time, roughly 30 gigawatts of Texas's 107,514 gigawatts installed generation capacity tripped offline due to freezing components and freezing

¹ <https://www.statista.com/chart/24202/texas-energy-mix-by-fuel-type/>

fuel supplies. Natural gas, coal, nuclear, wind, and solar plants were all affected. Natural gas outages had the biggest impact, because the state generates almost half of its electricity using natural gas. The impact from the loss of natural gas is two-fold, since gas is also used to heat homes directly as a heating fuel. These power plants primarily faulted because they were not designed to operate in such severe cold weather conditions. During this time, the peak electricity demand and power plant outages were both at all time highs, greater than any scenario ever planned for.

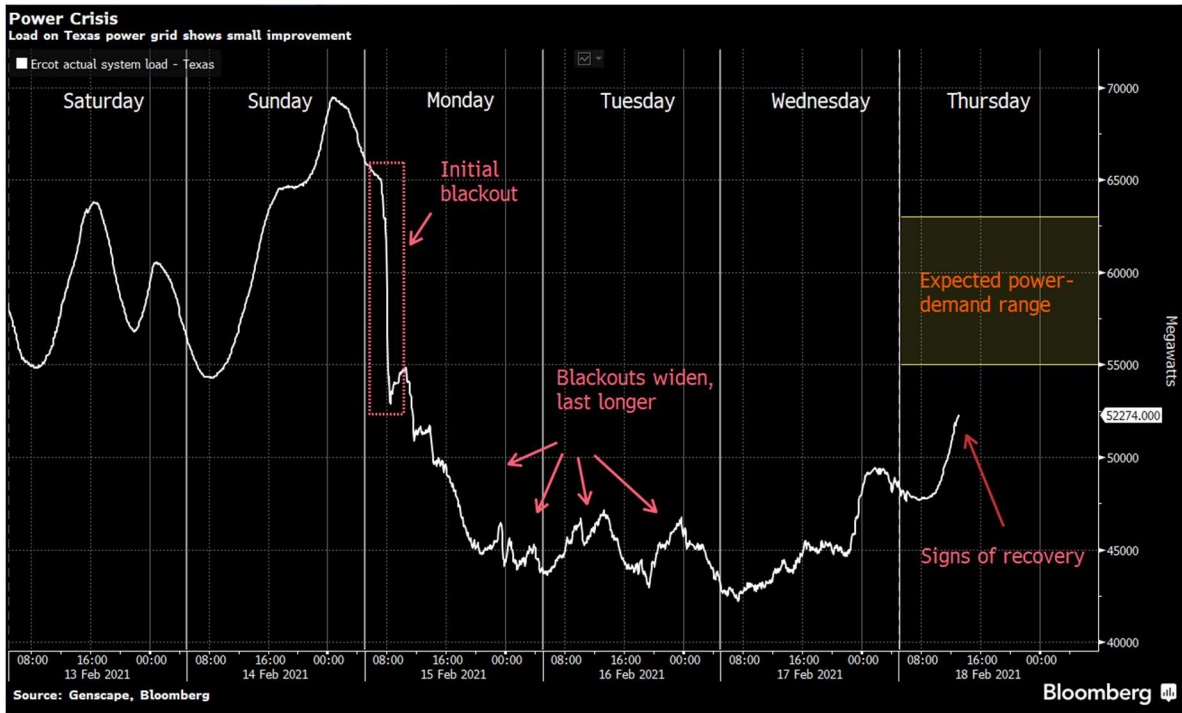
By the evening of February 15, two million Texas households had no electricity. More generation resources failed as the freeze persisted and at the peak of the crisis, 48.6% of the generation assets under the Electric Reliability Council of Texas (ERCOT), Texas’s grid operator, were offline. By February 16, over 4 million households had no electricity.² On Thursday the 18th, ERCOT grid load began to climb substantially and exceeded 50 gigawatts for the first time in over three days. However, the sustained power outages had spawned a secondary crisis as bursting water pipes, households dripping their pipes to avoid bursts, and lack of electricity for water management resulted in mass water outages across the state. As of February 25, over one million Texans were still without safe drinking water access.

Hourly net generation by energy source (Feb 7–Feb 17, 2021)
Electric Reliability Council of Texas, Inc (ERCOT)



Source: U.S. Energy Information Administration, *Hourly Electric Grid Monitor* (ERCOT net generation by energy source)

² http://www.ercot.com/content/wcm/key_documents_lists/225373/Urgent_Board_of_Directors_Meeting_2-24-2021.pdf



Texas Electricity Load, February 13-18. Times are in GMT, six hours ahead of Houston. Source: Javier Blas, Bloomberg

The Texas grid was also at risk of a longer-term catastrophic failure. Power plants are designed to operate within a certain frequency range, and their equipment will be damaged or destroyed if they operate outside of those ranges for more than a brief period of time. The ratio of electricity demand to supply needs to remain fairly matched to maintain the frequency of the grid. In a preliminary report on February 24, ERCOT acknowledged that due to the mismatch in supply and demand, the Texas grid was operating below 59.4 Hz for 4 minutes and 23 seconds in the wee hours of February 15. Had grid managers not forced more controlled outages and operations continued below 60 Hz for even five more minutes, more generation units would have tripped offline automatically, creating a cascading failure that would have resulted in “total collapse” of the Texas power grid and no electricity in Texas for several weeks.³

Although the generation failures were the largest factor by far in the Texas blackouts, transmission, distribution, and overall network failures (such as downed power lines and overloaded transformers) also contributed.

Fallout

More than seventy Texans lost their lives as a result of Winter Storm Uri. More than a dozen of those seventy were inside homes that lost their heat with the utility outages.

³ http://www.ercot.com/content/wcm/key_documents_lists/225373/Urgent_Board_of_Directors_Meeting_2-24-2021.pdf

A Texas-based economic research firm projected that Winter Storm Uri could cost \$195 billion-\$295 billion in damages and economic harm, making it potentially more financially impactful than Hurricane Harvey.⁴

On February 23, five of ERCOT's sixteen-member board announced they would resign, and a sixth withdrew his application to the board.⁵ On February 26, ERCOT barred Griddy, an electricity retailer that served 29,000 customers in Texas, from participating in the state's public power market because its billing plans had resulted in residential customers being billed \$5,000 or more for five days of service.⁶ On March 1, the Chairman of the Texas Public Utility Commission (PUC), DeAnn Walker, submitted her resignation to the Governor of Texas.⁷ That same day, the oldest electric power cooperative in Texas, Brazos Electric Power Cooperative, filed for bankruptcy. Brazos and its subsidiaries serve 1.5 million consumers in Texas.⁸

On March 3, ERCOT removed its CEO Bill Magness, offering an \$800,000 severance which Magness did not accept. On March 4, ERCOT's independent market monitor, Potomac Economics, determined that ERCOT had overcharged Texas consumers by \$16 billion by keeping prices at the wholesale market cap of \$9,000/MWh for 32 hours longer than necessary. The ERCOT wholesale market incurred \$55 billion in charges over just a week. Potomac Economics recommended that the Texas PUC should retroactively reduce the price of power for the week of February 14-19 and eliminate some of the \$16 billion overcharges, but the PUC declined to take that action.⁹ On March 8, 2021, a second PUC commissioner, Shelly Botkin, resigned.¹⁰ On March 9, Just Energy group, an electricity retailer headquartered in Canada with major operations in Texas, filed for bankruptcy in the U.S.¹¹

Research, Development, Demonstration, and Commercial Application Solutions

Extreme weather events such as Winter Storm Uri and other risks such as cybersecurity events are now significant and growing threats to the security of our nation's electric grid. Additionally, we are constantly transforming our grid to adapt to a rapidly changing electricity generation mix in efforts to meet climate goals and lower costs for consumers. The Department of Energy plays an important role in improving our electric grid and hardening it against these physical and cyber security events, as well as against the effects of climate change.

Department of Energy, Office of Electricity (OE)

⁴ [perryman-preliminary-estimates-of-economic-costs-of-the-february-2021-texas-winter-storm-02-25-21.pdf](#) (perrymangroup.com)

⁵ <https://www.texastribune.org/2021/02/23/ercot-members-resign-texas/>

⁶ <https://www.bloomberg.com/news/articles/2021-02-27/griddy-barred-from-texas-power-market-for-payment-breach?sref=veMZyIzD>

⁷ [EvbcLO4XUAIB4Ki \(640x841\) \(twimg.com\)](#)

⁸ https://www.reuters.com/article/idUSKCN2AT1FE?il=0&utm_source=reddit.com

⁹ <https://www.texastribune.org/2021/03/05/texas-ercot-electric-bills/>

¹⁰ <https://www.houstonchronicle.com/business/energy/article/PUC-Commissioner-Shelly-Botkin-resigns-winter-stor-16010194.php>

¹¹ https://www.eenews.net/energywire/2021/03/10/stories/1063727033?utm_campaign=edition&utm_medium=email&utm_source=eenews%3Aenergywire

The DOE Office of Electricity’s main mission is to support grid modernization and resilience through programs that improve the planning and operational capabilities of the electrical sector at both the transmission and distribution level. This includes research on a variety of technologies related to the smart grid, demand response, microgrids, energy storage, renewable energy integration, transformer resilience, grid planning, sensor development, and power flow controllers. OE also provides technical assistance to States, regional entities, and tribes on a variety of topics to assist with the development and implementation of their electricity-related policies and handles permitting of cross-border transmission lines and coordinating Federal transmission permitting on Federal lands. OE was funded at \$211.7 million in Fiscal Year 2021.

Department of Energy, Office of Cybersecurity, Energy Security, and Emergency Response (CESER)

The DOE’s Office of Cybersecurity, Energy Security, and Emergency Response (CESER) was created in early 2018. Prior to 2018, the Department of Energy research programs on grid modernization and grid security were housed under a single office called the Office of Electricity and Energy Reliability. The mission of CESER is to lead “the Department of Energy’s emergency preparedness and coordinated response to disruptions to the energy sector, including physical and cyber-attacks, natural disasters, and man-made events”.¹² CESER programs support improving cybersecurity preparedness in the energy sector; coordinating responses and recovery from cyber incidents; detecting and mitigating cyber risks for energy sector owners and operators; and sharing of threat information among energy sector partners, in addition to a variety of other activities. CESER partners with other federal agencies, including DHS, DOD, and NIST, and industry partners in carrying out its mission. CESER received \$156 million in funding for FY21.

LEGISLATION

Draft Grid Security Research and Development Act

In the 116th Congress, Congressman Bera and Energy Subcommittee Ranking Member Weber introduced the *Grid Security Research and Development Act* (H.R. 5760). This bill would authorize a cross-agency research, development, and demonstration program to advance electric grid and energy system cybersecurity, physical security, resilience, and emergency response. The bill included a focus on concurrent and co-located disasters and a technical assistance program to help communities develop plans for preventing and recovering from various power outage scenarios. It also included authorization of test bed facilities to test and improve cybersecurity devices, components, and processes; interagency coordination to advance security capabilities for the electricity sector; authorization of an education and workforce training program led by DOE to identify core skills used by electric grid security professionals and to develop methods to retrain electricity sector personnel; and authorization of a research program to ensure the resilience and security of critical integrated grid infrastructure. The bill passed the House on suspension by voice vote, and as part of the *Clean Economy Jobs and Innovation Act* (H.R. 4447), but was not enacted.

¹² <https://www.energy.gov/ceser/ceser-mission>