What happened in Texas? Understanding the February 2021 blackouts and learning lessons to prepare the grid for extreme weather events: An introduction

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1. BACKGROUND

In February 2021, Texas experienced a 1-in-30-year cold weather event that resulted in sub-freezing temperatures well below average for over six days. The extreme cold weather led to record-high winter electricity demand and a decrease in electricity supply due to limitations in gas availability and inadequate weatherization against the adverse conditions. As demand exceeded supply in the evening of February 14-15, a drop in frequency threatened a total blackout across ERCOT, which was forced to initiate customer load-shedding. Over 200 people died during the event, with most of the deaths attributed to power outages. Widespread power interruptions also impacted critical infrastructures that depend on electricity to function, like natural gas, communication and water systems. About 29,000 residential customers who opted for electricity purchases at variable rates were exposed to extreme bill volatility caused by wholesale market price spikes. Financial consequences were devastating for these customers, and several companies that inadequately hedged price risk declared bankruptcy after the crisis subsided.

The event was followed by extensive finger-pointing, and some immediate reactions blamed competition, ERCOT's electricity market structure and grid management, wind's underperformance and limited interconnections with neighboring regions. As of this writing, the response in Texas has largely been to harden individual points of failure, such as power plants and critical natural gas facilities. The most significant energy-related bills passed by the Texas Legislature to date will result in a $18-billion out-of-market directive to build up to 10 gigawatts of new natural gas-fired power plants sitting in reserve; substantial changes to the governance of ERCOT and certain aspects of the ERCOT market (e.g., emergency pricing); a mandate for electricity suppliers in the state to purchase dispatchable power services as insurance; and the ban of wholesale-indexed products that include a direct pass-through of real-time prices for residential customers. These steps may address pieces of what was a highly complex

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failure across multiple infrastructure and regulatory systems. However, enhancing grid reliability against the threat of extreme weather will require more systems-level reforms.

This EEEP symposium examines the various factors that contributed to the 2021 Texas electricity crisis, reflects on lessons learned from the event and provides recommendations to better prepare for extreme weather events and reduce the risk of widespread, long-duration power interruptions. The symposium brings together different perspectives and balanced discussions on these topics, in line with EEEP's aim to provide in-depth, non-technical overviews of policy analyses and conceptual questions that motivate further academic research.

2. STRUCTURE OF THE SYMPOSIUM

The symposium contains four papers focusing on the 2021 Texas electricity crisis. The papers share the view that many factors (wind's underperformance, inadequate winterization despite multiple prior recommendations by the Federal Energy Regulatory Commission (FERC) and the North American Electric Reliability Corporation (NERC), Texas opposition to interconnections, ERCOT's management of the grid and market structure) contributed to the crisis, but none was solely responsible for it.

In the first paper, Peter Hartley, Kenneth B. Medlock III and Elsie Hung provide context on load and resources in the ERCOT market, and recount the evolution of Winter Storm Uri and its consequences over February 10-21. Next, the authors discuss the role of interdependencies between natural gas and electricity systems, wind generation failures and limited interconnections with neighboring regions during the crisis. They argue that, while avoiding the extent of the load shed and customer outages experienced would have been possible with a more resilient natural gas supply chain, all capacity types must be operable to cope with high stress events: during Uri, inadequate operational capacity (not insufficient nameplate capacity) was the issue. The authors also emphasize the need to fully evaluate availability of dispatchable resources in planning scenarios, noting that the social benefit of reliability provided by these back-up resources may be undervalued in current market designs. The paper makes several recommendations, including the enhancement of market structures to ensure adequate reserve capacity and more actively integrate the social value of reliability and the value of lost load in market rules.

As noted above, the Texas response to the crisis to date has not addressed fundamental systems-level practices to enhance the reliability of bulk, i.e., transmission-scale, power systems against the threats of extreme weather. In the second paper of the symposium, Chiara Lo Prete and Seth Blumsack discuss three systems-level strategies through policy recommendations around power generation planning, the demand side of the electricity market, and interdependence of critical infrastructures. For each strategy, the discussion reviews relevant failures in the ERCOT system and the policy response to the crisis in Texas, draws comparisons with other electric power systems, and weaves insights from past studies into the analysis. The authors argue that, while market design was not a major cause of the crisis, markets are not well suited for managing risks associated with catastrophic events, and private incentives often do not provide socially acceptable solutions in these circumstances. As a result, enhancing resilience to extreme weather events will involve actions that fall outside of wholesale electricity markets, such as weatherizaton standards for extreme cold conditions. The authors also note that reforms in the natural gas market that improve fuel allocation between local distribution

companies and power plants during periods of scarcity would help support electric system reliability – this understudied topic deserves closer scrutiny in future research.

The third paper, authored by Marie Petitet, Burçin Ünel and Frank A. Felder, focuses on capacity market reforms to enhance resiliency to extreme weather events. Unlike other organized electricity markets in the U.S., Texas relies on an "energy-only" market in which prices for both energy and ancillary services rise above the offer prices of generation units when reserve margins are low. Prices in times of scarcity are based on an operating reserve demand curve (ORDC) that reflects the system operator's demand for reserves. This mechanism supports new generation investment and provides incentives for performance of generation capacity under a wide variety of weather conditions. However, critics contend that ERCOT's "energy-only" market design complicated the task of maintaining grid reliability under grid emergency conditions, while a market structure relying on capacity markets may have prevented a crisis of this scale. The paper reviews initiatives to address extreme weather events in Europe and the U.S., with an emphasis on ERCOT, and identifies best practices and avenues for improvements. The authors also propose three criteria for evaluating whether and how to use capacity requirements and associated market to address extreme weather events, when capacity markets are implemented.

Finally, the opinion piece authored by Charles Mason raises an interesting and important question, both in the context of Winter Storm Uri and more generally: How should we think about pricing electricity in situations that could trigger a life-threatening emergency? The piece discusses potential policy interventions that might shield individuals (particularly vulnerable customers) from the risk of having to defect from using electricity during life-threatening weather events, when prices and needs are high. One of the proposed interventions is the establishment of wholesale price caps below the values that are currently in use.

3. CONCLUSION

The Texas electricity crisis in February 2021 remains the object of important study and further investigation. Two and a half years after the event, this EEEP symposium presents a comprehensive retrospective on the factors that contributed to the exceptional emergency, and provides policy recommendations to reduce the risk of widespread, long-duration power interruptions. Lessons learned from the event have broader relevance for bulk power systems around the world, which are likely to experience tight supply conditions as a result of the increasing frequency and intensity of extreme weather events, coupled with variability due to the evolving resource mix. The task is challenging and made more salient by the increasing reliance on electricity to reach net zero by 2050. In this EEEP symposium, readers will be able to deepen their understanding of core issues in the current debate on this important subject.

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