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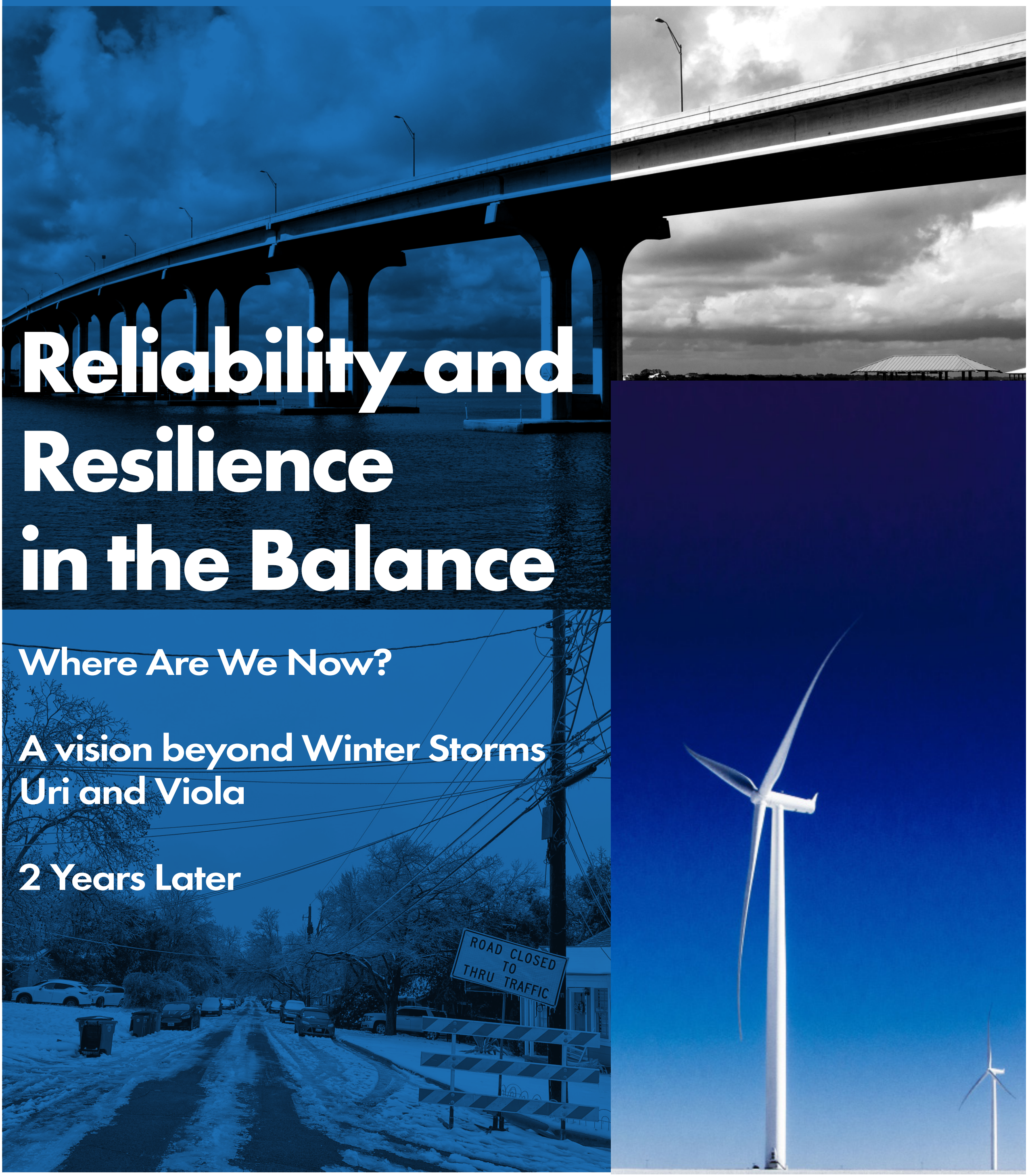
ASCE TEXAS SECTION



Reliability and Resilience in the Balance

Where Are We Now?

A vision beyond Winter Storms Uri and Viola

2 Years Later

Executive Summary

November 2023 | www.TexASCE.org/beyond-storms

Report prepared by:

American Society of Civil Engineers – Texas Section
Beyond Storms Infrastructure Network Resilience Task Committee

As a public service, the American Society of Civil Engineers regularly prepares assessment reports of critical infrastructure serving essential needs on both a state and national level. Most recently—early February 2021, the Texas Section of American Society of Civil Engineers (ASCE Texas Section) released the most current *Texas Infrastructure Report Card* (IRC).

As well, when a catastrophic event takes place and infrastructure fails, ASCE deploys skilled engineers from its membership to assess and determine what happened, why it happened, and more importantly, to develop recommendations for future change, as appropriate, to avert such an event. As such, **ASCE Texas Section convened a task committee just as Texans experienced Winter Storms Uri and Viola.**

The Committee reconvened two years later to assess progress and how the electricity grid fared during more severe winter weather and summer heat extremes. In this supplement to the original report, the Committee identified where corrective actions have been taken and critical areas where gaps remain to restore reliability and resilience in critical infrastructure in Texas.

Learn more at www.TexASCE.org/beyond-storms.

ASCE Texas Section is one of the largest and most active sections of the American Society of Civil Engineers, the oldest national civil engineering society in the United States. Established in 1913, the Texas Section represents more than 11,000 members throughout Texas. The Section is headquartered in Austin and comprises 15 Branches around the state and Student Chapters at all the state's leading universities. ***Texas civil engineers are leaders in their communities, building a better quality of life across the street and around the world.***

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Executive Summary

Since its formation as a competitive energy-only market, Electric Reliability Council of Texas (ERCOT) has needed a reliability and resilience standard. This failure to adopt a robust and enforceable reliability standard allowed the ERCOT market to ignore a series of early warning signs and indicators for over a decade. These warnings pinpointed the fundamental structural problems in ERCOT's design, creating an increasingly fragile system. The 2021 twin Winter Storms Uri and Viola uncovered many resource adequacy problems. Lacking a ***reliability compass*** to help navigate its way, ERCOT got lost. ERCOT defaulted to a myopic focus on short-term low cost while ignoring the growing reliability and resilience problems.

"Reliability and Resilience of Essential Infrastructure Impacts Everyone"

The economic consequences and tragic human loss from these failures overwhelmed any accumulated benefit gained from ignoring the warnings and recklessly pursuing the short-term cost path. The lack of a transparent, robust, and enforceable reliability standard facilitated short-term decisions. It allowed a lack of accountability to respond to warnings and created cultural complacency in solving the root cause of structural shortcomings of the energy-only market design. In the aftermath of the 2021 storms that uncovered these tragic flaws, Texas remains lost, lacking a reliability and resilience standard.

Undeniable progress has been made on many fronts, but many interim solutions have been costly and temporary Band-Aids. **The failure to adopt and embrace a robust, transparent, and enforceable reliability standard has produced the predictable result that the heart of the original problem, revenue insufficiency, has yet to be solved.** ASCE Texas Section now believes that a transparent, robust, and enforceable reliability standard must be established and implemented within ERCOT to serve as a compass for the multitude of efforts required to ensure that ERCOT has a reliable, cost-efficient, and resilient system. Supporting mechanisms must be adopted to reinforce this reliability standard with actions and enforceable changes. ASCE Texas Section developed a series of questions for the public, industry, and legislators to consider ensuring that reliability and resilience are restored in the ERCOT system.

1. **Has the PUCT and ERCOT established a transparent, robust, and enforceable reliability standard or metric to measure performance that will prioritize and ensure cost-efficient and timely reliability investments to ensure resource adequacy?**

2. **Is there a transparent, efficient, and self-correcting mechanism with performance obligations, that are neutral or agnostic to the type of resource (generation and/or demand) in place to pro-actively ensure revenue sufficiency for dispatchable resources over an applicable investment time horizon, including confirmatory evidence of incremental market-based investment in such resources?**

3. **Are the standards applied to dispatchable resources (supply and/or demand) technology and resource neutral or agnostic, and apply consistent, similar financial rewards and penalties for performance that encourage verified and efficient investments?**

4. **Are all dispatchable and non-dispatchable or intermittent resources > 100MW of equivalent installed capacity (or demand response) required to meet similar construction and structural standards (wind loads, etc.) for operating in various weather conditions, and do these resources maintain timely access to minimum critical spares, regardless of technology, to ensure reliable performance and resilient operation if the most impactful or consequential (FMEA - Failure Mode and Effect Analysis or equivalent risk analysis technique) events occur?**

In January 2022, ASCE Texas Section suggested **5 network recommendations** in a post-storm analysis report (www.TexASCE.org/beyond-storms). The Committee looked at these recommendations again based on data available since then.

ARE WE PREPARED YET?

The following section addresses the specific progress made in areas identified in the original 2022 report and the remaining gaps.

A reliable and resilient electric system in an increasingly electrified economy is critical to Texas's safety and economic health. Reliability is like a light switch; it has access to electricity you need when needed. Resilience is equivalent to a backstop to reliability. It measures the system's robustness to absorb shocks and either continue to operate, or, if it fails, quickly recover and use it again. Essential infrastructure, from water systems, transportation, and telecommunications to the broader energy industry, are all increasingly dependent on the reliability and resilience of the electric system. When ignored, this interdependence between sectors can create systemic risks and lead to cascading failures within and across multiple infrastructure sectors. We tend to blame the weather as a nefarious villain behind many problems. Winter Storms Uri and Viola (2021) were blamed for the failures in essential infrastructure. Analysis confirmed that the weather did not cause the problems. Weather catalyzed to expose the underlying issues. **Texas has a substantial and growing electric system reliability and interdependence problem.**

We must understand why the system became fragile to fundamentally fix the problems uncovered by winter storms and typical summertime peak loads. The issues identified the legacy market design shortcomings – most notably as it contributed to revenue insufficiency, growing infrastructure interdependence, economic and population growth drivers, and aging equipment as the root causes of the failures. If we fail to address these problems, the failures experienced in February 2021 ***will*** increase in frequency and duration. Complex issues can usually be resolved in various ways, provided the solutions address the fundamental problems identified. Due to this project's scope, there was a conscious effort to defer to industry, regulators, legislators, and the public to develop the balanced solutions needed to determine "how" the problems identified in the original report should be solved. The specific "how" is inherently flexible, provided that the solution(s) comprehensively addresses the "what" and "why" it happened and minimizes unintended consequences that create new problems. If we solve the wrong problem or fail to address why it happened entirely, the problem will persist, and history will repeat itself. **What were the five key network problems originally uncovered? Why did they happen? What are the solution shortfalls?**

Recommendation #1 Black Start Generators. While improving the reliability of the "black start generators" will not prevent the grid from failing, they critically serve as the fail-safe, contingent backup to restart the electric grid in case of system-wide grid failure. Electric grids are notoriously challenging to renew and can take weeks or months to return to normal. Black Start Generators are the critical resources needed to restore power and restart the grid quickly. The societal consequences of an extended, system-wide grid failure would be catastrophic and must be avoided. Seventy-five percent (75%) of the legacy black start generators experienced reliability problems during the storms, and 18 of 28 units relied on a single fuel source. Winterization of these resources and underwriting to support dual-fuel capability with 72-hour minimum reserves have been implemented. Rigorous reliability and availability tests have been established.

The solution shortfall: It remains to be seen if revenue sufficiency (see below) has been established to maintain these critical units and perform at top decile reliability levels. ASCE understands that investments have been made/proposed to improve the reliability and resilience of these resources. Still, the information is currently being kept confidential by new rules and regulations, and this Committee cannot obtain specific details

#**2 Revenue insufficiency**. The consequence of the ERCOT energy-only market structure prioritized low cost over reliability. This lower-cost approach sacrificed reliability and led to chronic under-investment (revenue insufficiency) in necessary maintenance (fix it when it breaks) and reliability of dispatchable generation and a very costly outcome. Increased cycling of dispatchable generation to support grid reliability to complement unpredictable performance from subsidized intermittent (non-dispatchable generation) wind and solar resources, further erodes reliability if supported by sufficient O&M investment. The lack of revenue sufficiency problem results in ERCOT's energy-only model being a costly "Run to Fail" model where underinvestment in the reliability of dispatchable generation, results in a system that runs until it breaks, usually under stress. The PUCT and ERCOT implemented market changes that addressed short-term transitional issues, including increased incentives for dispatchable generation during on-peak periods. Winterization and firm transportation and supply requirements for winter peak service have been established. .

The solution shortfall: The fundamental problem of revenue insufficiency for dispatchable generation remains unresolved. Central to the ongoing debate is the inability to balance the desire to continue the legacy energy-only market structure (a structure that created the revenue insufficiency problem) and a capacity market. This has fundamental negative consequences in various areas, including a) reliability investments, b) firm fuel transportation and supply, and c) Ongoing O&M maintenance. The legislature has directed the PUCT to establish a reliability standard in ERCOT, but the resolution is uncertain at the time of this document. Dispatchable demand solutions are needed to complement dispatchable supply with similar revenue-sufficiency needs.

#**3 Interdependency**. Interdependency risk occurs when one infrastructure sector's reliability depends on another infrastructure sector's reliability (e.g., the natural gas industry relies on the electric network and vice versa). Issues arising from interdependence were material contributing factors to cascading uncontrollable failures across infrastructure sectors. Supply chain review and identification of critical infrastructure have been implemented. Winterization of upstream natural gas infrastructure has been made. Changes to support dual fuel capability have been implemented, and firm fuel and transport requirements have been established. There is extensive evidence of individual and company-level actions across infrastructure sectors (backup generators, etc.).

The interdependency solution shortfall: There needed to be more action on addressing the growing interdependency driven by increased electrification or any explicit analysis effort around this issue. No clear systemic focus is observable outside individual sectors. Focus on weatherization and demand efficiency has been the central focus to date.

#**4 and #5 Regulations, processes, and model biases.** Regulations and market designs can negatively or positively impact reliability. There are regulatory structures that burden the grid and reduce reliability during periods of extreme demand. Subsidizing activities that result in negative impacts on reliability must be eliminated. Models help to anticipate potential challenges, but models that chronically fail to correlate to the market, fail to provide actionable insight. ERCOT management now understands the priority of reliability. The PUCT is working to establish a reliability standard for ERCOT.

The Regulation, process, and model solution shortfall: The core problem of revenue insufficiency has yet to be fully addressed through regulatory change. Left unresolved, this is a large enough challenge to be considered an existential threat risk to a reliable and resilient grid. The problem of revenue insufficiency extends to all essential infrastructure, and there are few solutions implemented in the aftermath that address a robust solution to ensure essential infrastructure can satisfy revenue-sufficiency requirements and avoid operating in the run-to-fail mode. Models continue to under forecast seasonal load scenarios—the risk of reliance on trying to inspect reliability in the system instead of building reliability into the foundation. Robust solutions for dispatchable demand response to complement dispatchable supply are needed.

Conclusion

Complex problems are seldom solved overnight and often require multiple solution iterations to solve the problem in stages. This is especially evident in high-consequence political situations. Avoiding complex issues, like failing to invest in black start generation by hiding behind a claim that “we’re focused on fixing things, so we never get to that stage,” is akin to not fixing the sprinkler system and fire alarms because we’re going to prevent fires from happening the next time. ASCE understands that investments have been made/proposed to improve the reliability and resilience of these resources. Still, the information is currently being kept confidential by new rules and regulations, and this Report Committee cannot obtain specific details. Reliability and resilience of essential infrastructure impact everyone. **The forecast of the potential for brownouts during the summer of 2023 and a lack of dispatchable investment in ERCOT are indicators that the problems have not been solved.**

“Texas Is Not Out of the Woods”

Texas is not yet out of the woods concerning a reliable and resilient electric network. Changes have been made, but Texas still needs a guiding compass pointing to Reliability and Resilience. The path forward begins with establishing a transparent, robust, enforceable Reliability Standard for ERCOT. Reliability and resilience in Texas will become a reality when this standard is adopted and consistently supported with solutions that answer the questions on the first page and address the gaps identified above. Solving the remaining issues will take courage and a renewed sense of purpose. The clock is ticking.

Find more about the authors of this report and the ASCE Texas Section at www.TexASCE.org/beyond-storms.

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