



2025 ASSESSMENT OF RELIABILITY PERFORMANCE FOR THE TEXAS INTERCONNECTION

JUNE 2026



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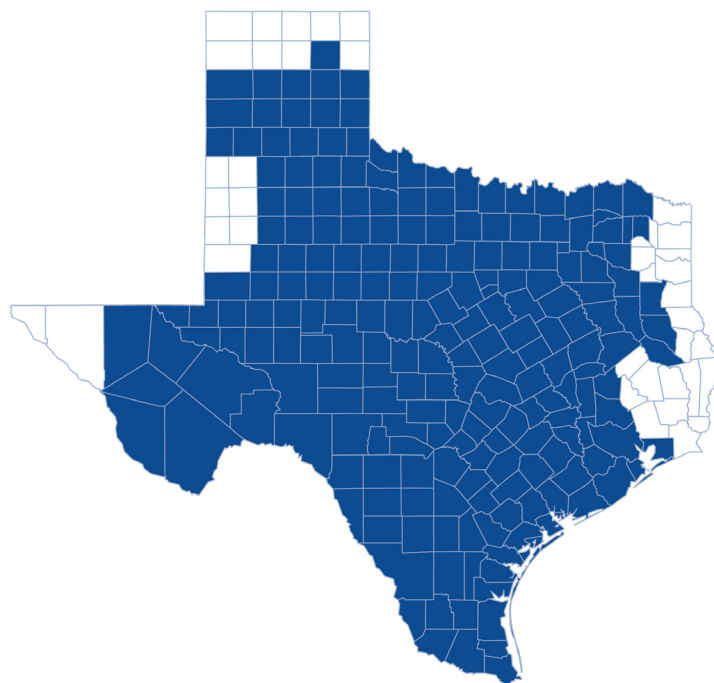
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INTRODUCTION

Electricity is essential in our daily lives for the health and safety of our communities. As part of its mission, Texas Reliability Entity, Inc. (Texas RE) periodically assesses and reports on the reliability and adequacy of the Bulk Power System (BPS) within the Texas Interconnection (also known as the Electric Reliability Council of Texas [ERCOT] Interconnection) (hereinafter, ERCOT Interconnection or the Region). This annual report focuses on BPS performance during the prior calendar year as measured by established performance metrics and other reliability indicators.

The goals of this report are to evaluate historical BPS reliability performance to establish context and baseline trends of the current reliability of the ERCOT system and support proactive and actionable results for reliability improvements.

This report provides insight into areas where reliability goals can be more effectively achieved by addressing key measurable components of BPS reliability. Additionally, it aligns data and facts reported from multiple sources with full information transparency. This report provides insight into the current state of reliability in the Texas RE Region. Its purpose is to inform policymakers and other stakeholders, elevate key issues affecting grid reliability, and prioritize focus areas for future outreach by Texas RE.



TEXAS RE'S MISSION

To assure efficient and effective reduction of risks to the reliability and security of the Bulk Power System within the ERCOT Interconnection.

DATA SOURCES

TADS

Transmission Availability
Data System

GADS

Generation Availability
Data System

DADS

Demand Response
Availability Data System

MIDAS

Misoperation Information
Data Analysis System

EVENT REPORTS

OE-417,
NERC EOP-004,
& NERC Events Analysis

Frequency Control
Performance and
Primary Frequency
Response

ERCOT ISO Data
and Reports



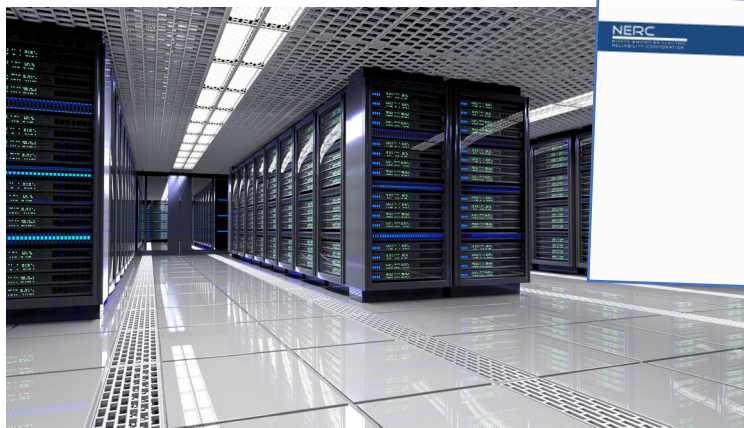
EXECUTIVE SUMMARY

Electricity is the key driver of modern life and the foundation of our digital future. Throughout 2025, the growing importance of electrical infrastructure remained at the forefront of trends powering the Texas economy. Electricity demand remained as diverse as the Texas economy itself, ranging from traditional oil and gas to modern cyber facilities, as well as from residential air conditioning to large-scale industrial processes.

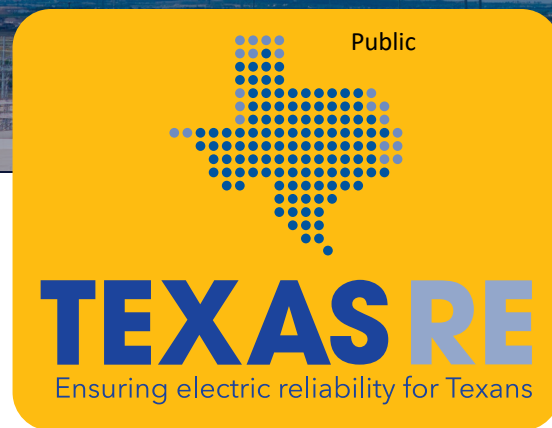
The Texas Interconnection's operational experience throughout 2025 reflected stable and positive short-term trends. The Region did not experience any Energy Emergency Alerts for the second year in a row. The Region's abundant solar resources and growing battery energy storage systems contributed to meeting peak demand throughout the summer months. Significant work on winterization efforts in recent years enabled the Region to navigate two winter storms (Enzo in January 2025 and Kingston in February 2025) without any significant issues. Although these storms were admittedly milder than Uri (2021) and Elliott (2022), the coordinated efforts at both the state and federal levels to harden the grid, increase its resiliency, and respond to winterization challenges have reduced the overall likelihood of a major impact from such winter

storms, as well as provided a template for mitigation efforts to address other emerging challenges. Simply put, the Texas Interconnection enjoyed a highly reliable and secure electric grid throughout 2025.

Just beneath this calm surface, however, significant trends in both loads and generation continued to present major reliability challenges for the Region. Much of the focus this past year centered on large load entities and particularly large computational loads. Large loads are increasingly impacting the Region in two important and interrelated ways. First, the growth of large loads poses clear



resource adequacy challenges. The Region continues to forecast unprecedented load growth primarily driven by the integration of large computational loads associated with new data centers and artificial intelligence (AI) services. For context, ERCOT's all-time peak demand is 85.5 GW,



recorded on August 10, 2023. Against this backdrop, ERCOT currently has more than 15.9 GW (19 percent of the all-time historical peak) of new load supported by approved planning studies, along with an additional 51 GW (59 percent of peak) of projects under review that could interconnect to the system by end of 2028. This mirrors trends seen across North America. The North American Electric Reliability Corporation (NERC) [2025 Long Term Reliability Assessment \(LTRA\)](#) noted that 13 of 23 assessment areas,



including the Texas Interconnection, face resource

adequacy challenges over the next 10-year horizon driven by escalating demand forecasts.

While not all large loads under ERCOT review may ultimately materialize, the magnitude of anticipated new demand presents a substantial challenge.

Addressing this growth will require a comprehensive and proactive approach to ensure the continued reliable delivery of electricity to Texans. Throughout 2025, policymakers at the state and federal levels accelerated efforts to respond to these challenges. The Texas Interconnection continued its role as one of the leaders in these important risk-mitigation efforts. In particular, the ongoing implementation of [Senate Bill 6](#) is providing additional regulatory certainty for the large load interconnection process, including requirements related to net-metering, forecasting criteria, large load demand curtailments, and transmission cost-allocation review. Associated rulemaking projects are in planning phases with implementation scheduled to occur throughout 2026. ERCOT has also begun to implement a batch study process for large loads (rather than conducting individual studies), allowing multiple large load interconnection requests to be studied simultaneously to assess aggregate system impacts, transmission needs, and reliability considerations. State policymakers are also addressing lags in transmission growth to support these new loads through innovative projects like the regional 765 kV transmission backbone. The Texas Interconnection continues to lead and innovate, and these collective efforts will remain critical to meeting

the Region's resource adequacy challenges in the coming years.

Second, the distinctive (and at times unpredictable) electrical behavior of large computational loads represents an important emerging risk to the Region and beyond. Throughout 2025, NERC, Texas RE, and the other Regional Entities released reports detailing reliability impacts from the sudden loss of voltage-sensitive data center loads. In the Texas Interconnection, these types of issues remained "faint signals" throughout 2025. Nevertheless, the growth in large computational loads in the Region highlighted the risks caused by common-mode failures, lack of performance requirements, and gaps in modeling and other data to accurately predict and respond to potential impacts. At the federal level, NERC established a [Large Loads Working Group \(LLWG\)](#) to focus on understanding the reliability impacts associated with large computational loads, identify gaps in existing processes, and recommend enhancements to planning and operational requirements. These efforts have led NERC to propose aggressive timelines in 2026 to both develop registration criteria for "Computational Load Entities" as well as simultaneously develop new Reliability

Standards. At the state level, ERCOT has also proposed large load voltage and frequency ride-through criteria to improve load performance during system disturbance conditions and to reduce adverse impacts on system stability. These efforts will need to continue to accelerate in 2026 and beyond to meet the significant reliability challenges associated with the growing number and demand from large computational loads.

At the same time, the generation necessary to meet the escalating electricity demand in the Region continued the long-term evolution towards variable generation



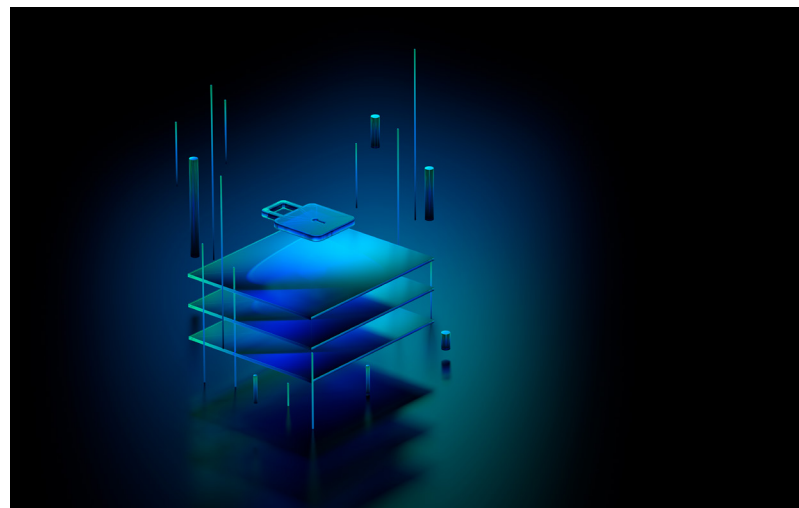


resources and energy storage. Compared with 2024, the pace of the transition to variable resources like wind and solar slowed slightly. In particular, the Texas Interconnection saw increases in installed natural gas capacity from 2024 to 2025. Further, the Texas Energy Fund (TEF) has enabled the development of new natural gas-fired resources intended to enhance system reliability and firm capacity availability. Nevertheless, over the past five years the total energy from solar generation has increased 775 percent, while energy from coal resources continues to decline. Variable energy resources served 36.9 percent of total energy in the Region in 2025 (up from 34.8 percent in 2024). 2025 also witnessed an increasing number of high-penetration hours. Throughout 2025, the Region experienced 163 hours during which renewable penetrations exceeded 70 percent, up from just one such hour in 2023. As of December 2025, ERCOT projects solar generation capacity to approach 65 GW by the end of 2028.



Similarly, storage capacity grew to over 16 GW by the end of 2025 and is forecasted to exceed 37 GW by the end of 2028. Much like large loads, the increasing dependence on variable, inverter-based resources (IBRs) has brought an array of efforts at the state and federal levels to ensure IBRs provide reliable and predictable performance. These efforts will be vital to support reliability in 2026 and beyond.

These trends of increasing demand and dispersing generation continue to occur against a backdrop of significant cyber and physical security threats. The threads of grid transformation and cybersecurity are beginning to converge around “low impact” cybersecurity controls. In particular, NERC, Texas RE, and the Regions have observed that most defense-in-depth protections—particularly those associated with medium- and high-impact CIP environments—now cover a much smaller share of assets than when the original impact criteria were developed more than a decade ago. Work is now underway to identify and mitigate potential gaps in security controls for low-impact resources, focusing particularly on remote connectivity issues.



The Texas Interconnection remained highly reliable and secure throughout 2025. However, against this backdrop of success, reliability challenges grew continuously. Throughout 2025, stakeholders from industry, state and federal regulators, and across critical infrastructure sectors continued efforts to meet these emerging challenges. The pace of change is rapid and unceasing. The Texas Interconnection’s long history as a source of innovation and solutions, coupled with sustained policy support at the state and federal levels, targeted investments, and strengthened cross-sector coordination will be required to build greater resilience into the grid as we navigate this new and rapidly evolving world.



2025 AT A GLANCE

TEXAS INTERCONNECTION

BY THE NUMBERS

	2024	2025		2024	2025
REGISTERED ENTITIES	367	403*	GENERATING UNITS	> 1,250	> 1,460
Distribution Providers	36	36	Miles of Transmission	> 54,100	> 55,000
Generator Owners	286	311	Population Served	> 27 Million	> 27 Million
Generator Operators	208	221	Percentage of Texas Load	90%	90%
Transmission Owners	28	28	MW Peak Demand	85,508	85,508
Transmission Operators	21	21	Renewable Penetration Record	75.0%	86.6%
Transmission Planners	26	26			

*Texas RE anticipates approximately 460 registered entities by the end of 2026 due to the addition of new Type II IBR generator owners and operators, as well as continued generation growth overall.

CAPACITY AND GENERATION — FIVE YEAR CHANGE

CAPACITY				GENERATION		
FUEL SOURCE	2020 (MW)	2025 (MW)	% Change	2020 (MWH)	2025 (MWH)	% Change
Coal	14,415	14,713*	2%	68,514	63,040	- 8%
Hydro	538	552*	2%	639	550	-14%
Natural Gas	52,125	70,216	35%	173,797	200,614	15%
Nuclear	4,973	5,268*	6%	41,459	41,912	1%
Total Synchronous	72,051	90,749	26%	284,409	306,116	8%
Wind	32,817	39,753	21%	87,090	114,921	32%
Solar	10,434	31,478	302%	8,749	67,814	775%
Storage	953	17,484	1,834%	-	-6,680	-
Other	169	172	2%	1,658	6,234	376%
Total IBR	44,373	88,887	100%	97,497	182,289	87%
Total Overall	116,424	179,636	54%	381,906	488,405	28%

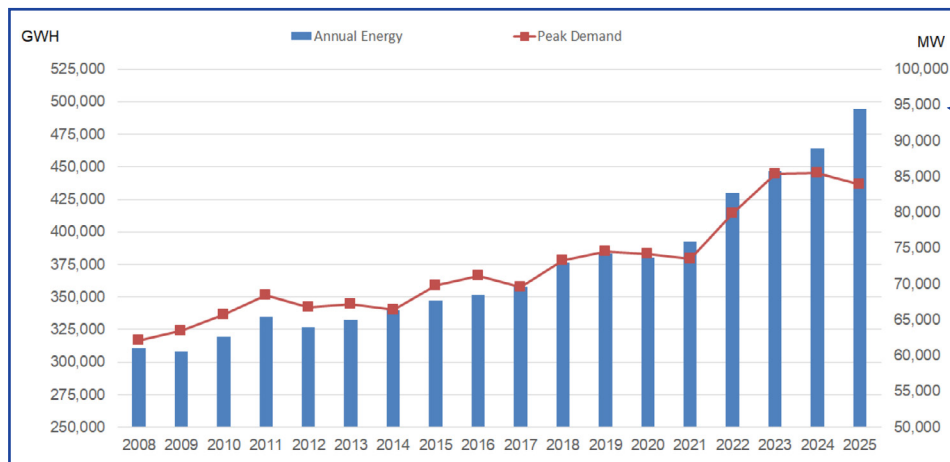
*The observed capacity increases in coal, hydro, and nuclear capacity are primarily due to improvements in resource performance and rating adjustments, rather than the addition of new generating units.

TRANSMISSION — FIVE YEAR CHANGE (BASED ON TADS DATA)

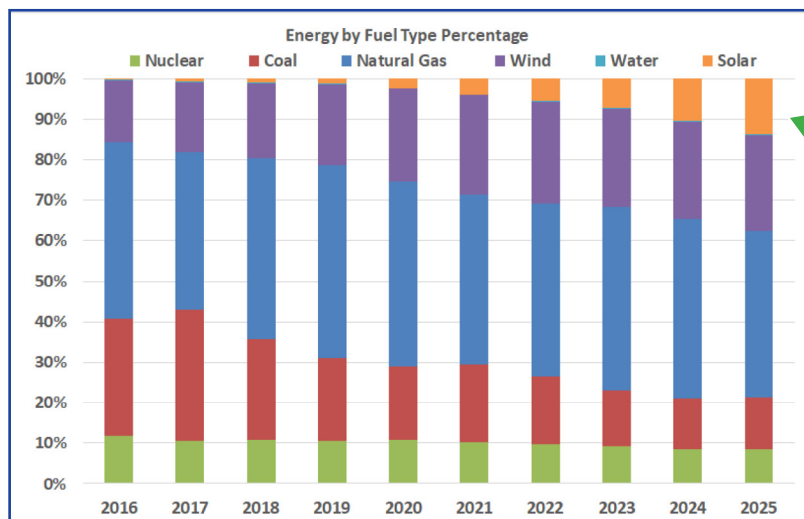
VOLTAGE	2020 (Circuit Miles)	2025 (Circuit Miles)	% Change
345 kV	18,152	21,944	+ 21%
138 kV	26,565	30,359	+ 14%

2025 AT A GLANCE

DEMAND AND ENERGY



SUMMER PEAK DEMAND:
83,876 MW
on 8/18/2025



PEAK HOURLY RENEWABLE GENERATION:

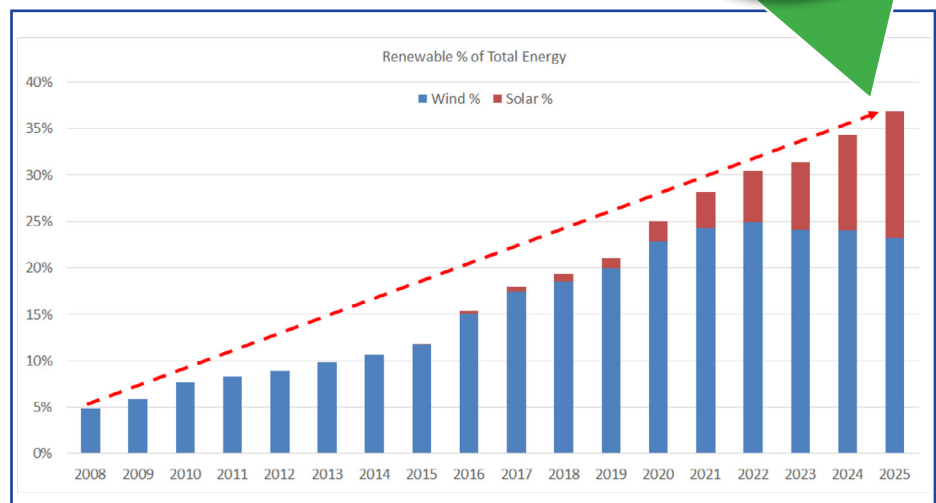
46,115 on
6/21/2025

RENEWABLE ENERGY SERVED:

36.9% of total
energy in 2025

PEAK HOURLY RENEWABLE GENERATION:

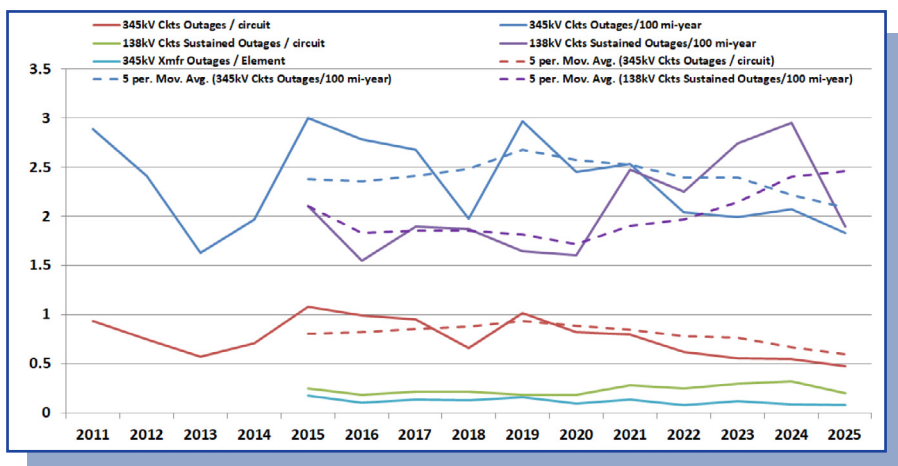
75.6% on
3/2/2025



YEAR	Count of Hours with Renewable Penetration > 70%
2023	1
2024	39
2025	163

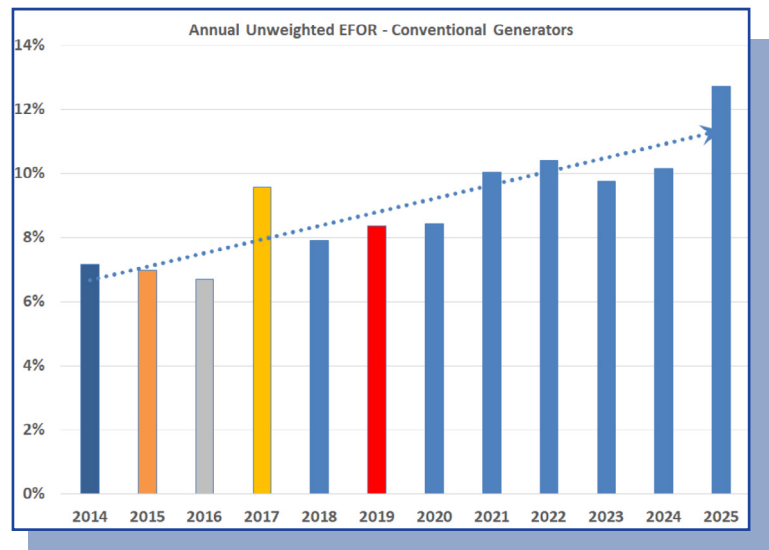
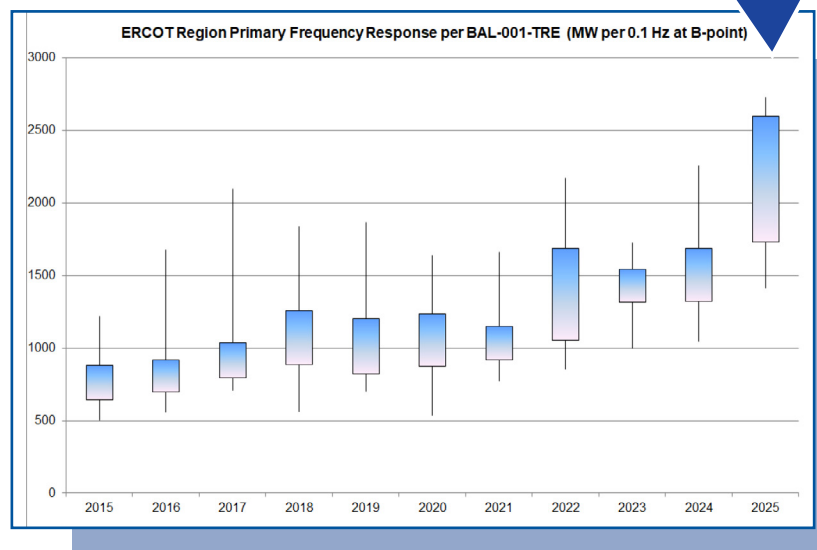
2025 AT A GLANCE

RELIABILITY



PRIMARY FREQUENCY RESPONSE:
2,127 MW/0.1Hz for for 2025 vs. NERC Obligation of 455 MW/0.1Hz

ANNUAL EQUIVALENT FORCED OUTAGE RATE for conventional generation increased in 2025 compared to prior years.



	2025	2024
CONTROL PERFORMANCE STANDARD 1 (CPS1)	177.2	175.5
TADS 345kV CIRCUIT AUTOMATIC OUTAGE RATE PER 100 MILES	1.83	2.06
PROTECTION SYSTEM MISOPERATION RATE	6.0%	4.6%
GENERATION AVAILABILITY DATA SYSTEM (GADS) EQUIVALENT FORCED OUTAGE RATE (EFOR) UNWEIGHTED	12.7%	10.8%

2025 IN REVIEW

INTRODUCTION

Texas RE continuously evaluates existing and emerging risks to the Texas Interconnection when developing its risk-based programs. In past years, Texas RE has focused on three broad risk categories in the ERCOT Interconnection: (1) grid transformation; (2) extreme events resiliency and winterization; and (3) cyber and physical security. In its 2025 Regional Risk Assessment, Texas RE highlighted the growing risks associated with the disorganized integration of large load entities. While the growth in large computational load entities falls broadly under “grid transformation,” the activities in this area were significant enough throughout 2025 to warrant their own category in this year’s assessment report.

LARGE LOAD INTEGRATION

The activities related to integration of large loads dominated industry headlines in 2025. Last year, Texas RE identified the disorganized integration of large loads as one of the highest regional risks. Consistent with this view, there were a host of key developments throughout the year as industry, as well as state and federal policymakers grappled with the resource adequacy and operational challenges associated with the growing penetration of large loads on the system.

of data center load in Virginia ([Incident Review – Considering Simultaneous Voltage-Sensitive Load Reductions](#)) following the failure of a lightning arrestor on a 230 kV transmission line. As the report noted, the electric grid has not historically experienced simultaneous load losses of this magnitude in response to system faults. Recognizing the new dynamics associated with large computational loads, the report outlined several important reliability considerations for these new types of entities, including:

- Requiring dynamic response models of large loads in their facility interconnection requirements.
- Performing studies to determine the potential magnitude of load loss for system disturbances (faults)
 - ◊ Study the impact that these large load losses would have on the system.
- Taking into consideration the potential for voltage-sensitive load loss when configuring automatic reclosing schemes.
- Actively monitoring to detect load losses coincident with system faults.

NERC INCIDENT REVIEW – CONSIDERING SIMULTANEOUS VOLTAGE-SENSITIVE LOAD REDUCTIONS

On January 8, 2025, NERC, Texas RE, and the Regional Entities published a review of an incident involving a sudden loss of approximately 1,500 MW

In addition, the report recommended that Transmission Operators ensure that operating agreements with large loads include ramp rates when connecting and/or reconnecting large loads to the system.

2025 IN REVIEW

While this incident did not cause significant operating issues, the report recognized the growing operational risks from such potential events in the future as the amount of large computational loads continues to increase. Importantly, this event served as the precursor to much of the analysis and activities undertaken by the NERC Large Load Working Group. As part of its own outreach and engagement around the operational risks from large computational loads, Texas RE staff likewise presented the report’s conclusions and recommendations to its Member Representative Committee at its February 2025 meeting, as well as during a Talk with Texas RE and at various workshops throughout 2025.

NERC INCIDENT REVIEW – VOLTAGE SENSITIVE CRYPTO LOAD REDUCTIONS

Throughout 2025, NERC, Texas RE, and the other Regional Entities developed a comprehensive incident review focusing specifically on load ride-through events within the ERCOT region. The incident review summary was released on January 9, 2026. The incident review focused primarily on bitcoin and crypto mining facilities ([Incident Review – Voltage-sensitive Crypto Load Reductions](#)). These facilities rely heavily on constant-power electronic supplies, cooling equipment, and single-phase devices that

respond to normally cleared transmission faults. Considerations from this review include:

- Neutral overcurrent protection schemes should be reviewed.
- Transformer winding configurations influence voltage sag severity.
- Constant-power device behavior must be incorporated into event modeling.
- Cooling load ride-through coordination must be strengthened.
- Restoration time variability should be studied and tracked.
- Interconnection requirements may need updates for evolving load type.

TEXAS RE MONITORING ACTIVITIES

In addition to specific reports, Texas RE personnel continued to monitor data and trends to identify potential large load performance issues. Although Texas RE did not identify any incidents meeting the reportable event thresholds in the Texas Interconnection, Texas RE did observe 12 large load ride-through incidents and one additional large load oscillation incident through its regular monitoring activities in 2025. Texas RE will continue to observe these trends throughout 2026 and provide information to industry stakeholders through reports or other outreach activities as appropriate (e.g. Assessment or Reliability Performance report, Regional Risk Assessment report, Texas RE newsletter, Talk with Texas RE, NERC Standards Review Forum (NSRF), and other meetings attended by Texas RE staff).

DEPARTMENT OF ENERGY ADVANCE NOTICE OF PROPOSED RULEMAKING (ANOPR)

On October 23, 2025, the Secretary of Energy, acting under section 403 of the Department of Energy Organization Act, directed the Federal Energy Regulatory Commission (FERC) to consider an ANOPR



2025 IN REVIEW

focused on the timely and orderly interconnection of large loads to the interstate transmission system. The ANOPR sought comment on a range of issues, including whether:

- Large loads and co-located facilities that agree to be flexible and curtail usage should be able to move through interconnection studies faster, how that process should work, and whether studies could be completed within 60 days
- Whether large loads and co-located facilities should pay the full cost of any grid upgrades needed for their interconnection, and whether those costs should be credited back over time, and if so, over what period
- How grid reliability should be evaluated when an existing power plant wants to partially shut down to serve a new large customer at the same location, including whether future load growth should be considered and whether required grid upgrades must be completed first
- How to implement these proposed changes, including how to treat large load interconnection requests that are already under review when any new requirements take effect

Importantly, the ANOPR called on NERC to review its Reliability Standards to determine if new registration categories, or new or modified Reliability Standards might be required to ensure reliability.

NERC LARGE LOAD ACTION PLAN IMPLEMENTATION ACTIVITIES

To begin understanding large loads and identifying effective pathways for their integration, NERC established the Large Loads Task Force (LLTF, now the Large Load Working Group) in August 2024. Subsequently, the NERC Member Representatives

Committee provided written input and hosted a technical panel session at the February 2025 Board meeting regarding the LLTF's proposed workplan. In February 2025, the NERC Board of Directors issued a resolution directing NERC staff to develop a comprehensive large load action plan to complement the work of the task force and provide additional structure to NERC's efforts related to large loads integration.

NERC Large Loads Working Group White Paper Series

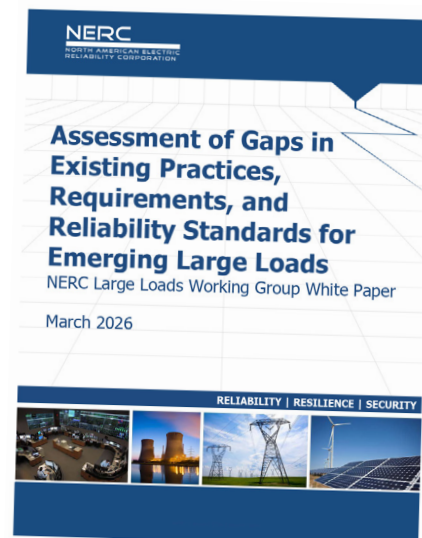
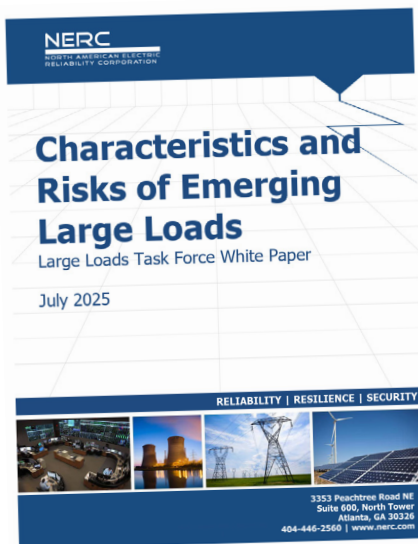
The LLWG developed a work plan focusing on several white papers. The then LLTF published its first white

paper on the [Characteristics and Risks of Emerging Large Loads](#) in July 2025. This white paper sought to identify, validate, and prioritize the characteristics and risks of emerging large loads to the BPS. This paper also established an initial definition of a large load, to be used for consistency in future discussions, and made six recommendations for future industry work.

Throughout 2025, the LLWG also worked on a second white paper on

Assessment of Gaps in Existing Practices, Requirements, and Reliability Standards for Emerging Large Loads.

The LLWG published this second white paper in March 2026. This white paper found that the existing NERC Standards, as well as industry processes and requirements, are



2025 IN REVIEW

inadequate for the reliable integration of emerging large loads onto the BPS. As a result, the LLWG recommended NERC develop registration criteria for large computation loads.

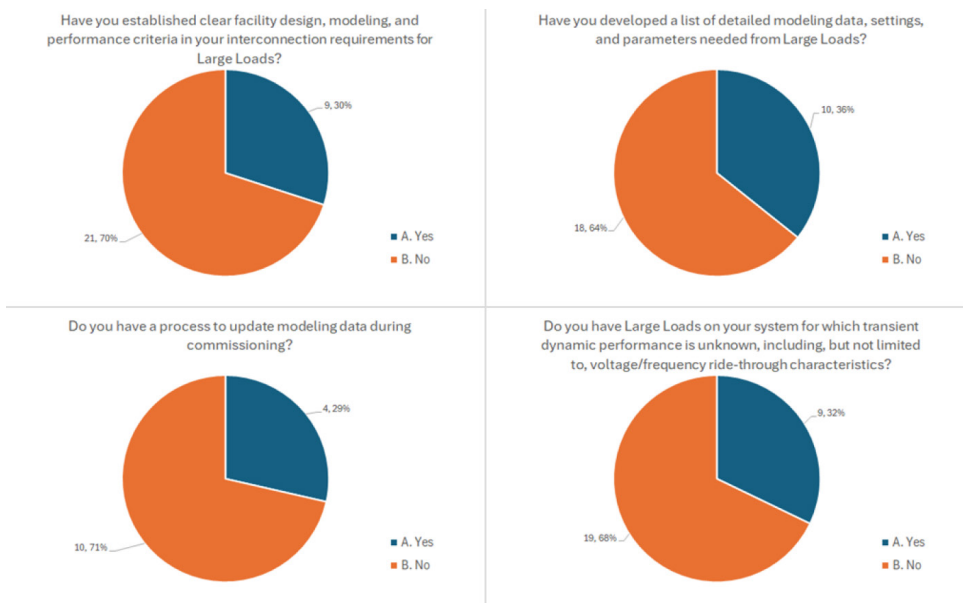
NERC Alert Level 2

On September 9, 2025, NERC issued a Level 2 Industry Recommendation Alert urging industry participants to take specific actions to mitigate risks to BPS reliability that may arise from the integration of large loads. Specifically, the alert focused on evaluating dynamic modeling and simulation practices related to large loads and their interconnection requirements. NERC also indicated that they would use response data to the study processes, commissioning procedures, and dynamic modeling for large loads to identify additional actions needed to address any observed deficiencies.

NERC received responses in January 2026 and published the [final report](#) in March. In the report, NERC identified additional steps that are needed to reliably integrate large computational loads (e.g. data centers, AI compute clusters, and cryptocurrency facilities). In the report, NERC noted a number of potential reliability gaps in connection with large load integration, including: the absence of specific procedures to handle the unique challenges associated with large loads; the lack of processes to coordinate with Transmission Owners (TOs) and Distribution Providers (DPs) to establish protection coordination and post-disturbance recovery requirements for large loads; the lack of lists of detailed modeling data, settings, and parameters needed from large loads; the absence of a standardized requirement for operational ramp limits in a post-disturbance state; the absence in modeling information and requirements; and the overall lack

of coordination (including in some cases not having contact information for large load entities).

In support of the NERC Alert, Texas RE reviewed region-specific data responses regarding these key takeaways. Overall, the data in the Texas Interconnection continues to support the need for comprehensive and coordinated actions to ensure large loads are reliably integrated into the system. The following are some of the key takeaways from the ERCOT Interconnection-specific responses:



STATE POLICY DEVELOPMENTS REGARDING LARGE LOADS

Complimenting the actions at the federal level, ERCOT and state policymakers continued a range of activities to implement Senate Bill 6's enhancements to the large load interconnection process, including requirements related to net-metering, forecasting criteria, large load demand curtailments, and transmission cost-allocation review.

Regarding the operational characteristics of large computational loads, ERCOT's Large Load Working Group (LLWG) engaged in endeavors throughout 2025 to mitigate emerging performance risks.

2025 IN REVIEW

This table summarizes some of the ongoing work related to large loads at ERCOT.

Of particular note, ERCOT submitted Nodal Operating Guide Revisions Request (NOGRR)

REGULATORY ITEM	DESCRIPTION
PGRR122	Reliability Performance Criteria for Loss of Load
PGRR136	Large Load Interconnection Study Scope Documentation
PGRR138	Large Load Interconnection Study Review and Approval Process
PGRR141	Large Load Interconnection Study Reform for Substantiated Load
PGRR144	Dynamic Model Submission and Review Requirements for Large Loads including Large Electronic Loads
PGRR145	Batch Zero Process for Large Load Interconnections
NOGRR282	Large Electronic Load Ride-Through Requirements
NPRR1308	Large Electronic Load Ride-Through Requirements
NPRR1325	Batch Zero Process for Large Load Interconnections

282 related to large electronic load ride-through requirements on November 14, 2025. ERCOT noted that as large computational loads increase in the Texas Interconnection, unanticipated load losses from typical voltage disturbances are expected to increase. This could potentially result in future operational issues, including frequency instability and other reliability problems absent frequency and voltage ride-through requirements for such resources. ERCOT and stakeholders are presently engaged in robust discussions regarding the scope and nature of these ride-through requirements and the implementation of such requirements for distinct large computational load technologies.

GRID TRANSFORMATION

The topic of grid transformation encompasses a myriad of changes and activities as the electricity sector continues to evolve from thermal resources to variable energy resources and storage systems. This section will focus on the on-going efforts to reduce risks from inverter-based resources, the initiation of real-time co-optimization in the ERCOT market, and the evolution of NERC's assessment strategy to reflect the increased complexity and variability of these new generation and storage resources.

ONGOING EFFORTS TO REDUCE OPERATIONAL RISKS FROM INVERTER-BASED RESOURCES

Activity continued in 2025 related to implementation of FERC Order 901 standards changes. Improvements were noted in primary frequency response as more battery storage capacity was commissioned. However, ride-through and oscillation events from inverter-based resources continue to be observed.



Grid-Forming Inverters (Advanced Grid Support) Status

Traditional power grids rely on synchronous generators (like those in power plants) to maintain voltage and frequency stability. The intermittent nature of wind and solar can create challenges for grid stability as their share of the resource mix grows. Grid-forming batteries equipped with advanced controls can mimic the behavior of synchronous generators, providing inertia and voltage support to the grid.

ERCOT took a large step forward with the approval of NOGRR272 and Planning Guide Revision Request (PGRR) 121 in November 2025. NOGRR272 established the requirement for Energy Storage Resources (ESRs) with an interconnection agreement data on or after April 1, 2026, to provide advanced grid support capabilities when within the inverter current limit. PGRR121 establishes the model quality test and unit model validation requirements for these advanced grid support capabilities.



FERC Order 901 Status and Category 2 IBR Registration

At the federal level, the NERC standards process mandated by FERC Order 901 has continued to progress on schedule. This order directed NERC to develop new or modified Reliability Standards that address reliability gaps related to IBRs in the following areas: data sharing; model validation; planning and operational studies; and performance requirements. In 2025, NERC filed new IBR standards for Energy Assurance with Energy Constrained Resources (BAL-007-1), Uniform Modeling Framework for IBRs (IRO-010-6, MOD-032-2, and TOP-003-8), System Model Validation with IBRs (MOD-033-3), and Verification of Generator Models (MOD-026-2). Standards development efforts will continue into 2026 for IBR

Event Reporting (Project 2023-01), Operational Studies (Project 2025-03), Planning Studies (Project 2025-04), and IBR Modeling Framework (Project 2022-02 Phase2).

The Electric Reliability Organization (ERO) Enterprise is continuing the process to register Category 2 Generator Owners (GOs) and Generator Operators (GOPs) with the target implementation date of May 2026. For Texas RE, approximately 25 new GO and 12 new GOP registrations will be added.

Texas RE IBR Ride-Through and Oscillation Monitoring Activities

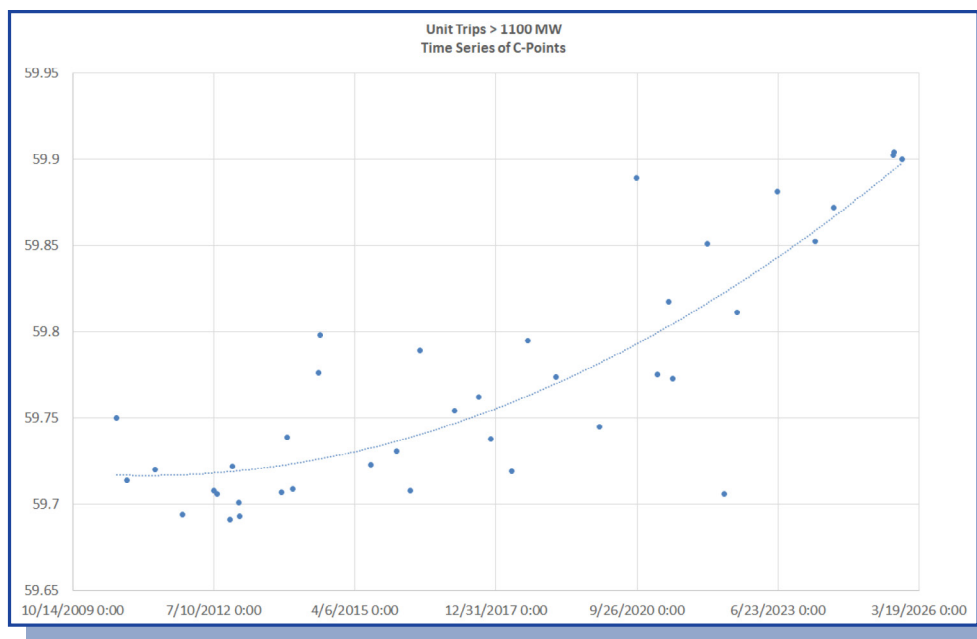
As with the data associated with large load performance described above, Texas RE continues to monitor system events related to the changing resource mix, including the transition to IBR technology. Through this process, Texas RE monitored the event types listed below in 2025. As with the large load incidents described above, these events did not meet the reportable criteria under the EOP-004 standard, DOE OE-417 reporting requirements, or under the NERC Events Analysis program. These events tended to be localized in nature, only affecting a single generation facility or substation, and did not have wide area impacts. However, these events are indicative of the complexity of integrating IBR-based technologies, with the wide range of inverter and control system settings and parameters that can impact plant-level and local area operations, and the need for comprehensive modeling, commissioning, and testing processes.

EVENT TYPE	# OF EVENTS IN 2025
IBR Ride-Through Events	12
IBR Oscillation Events	24
IBLR Large MW Change Events (no fault)	39

2025 IN REVIEW

Improvements in Primary Frequency Response from Battery Storage Integration

The continued growth in battery resources has exploded from 1,300 MW at the end of 2021 to over 17,000 MW at the end of 2025. Beginning in 2023, the inherent capability of battery resources began to manifest itself into noticeable improvements in primary frequency response. That trend continued throughout 2025. Marked improvements continue to be realized for frequency responsive headroom, nadir frequency points during generation-unit trips, and interconnection level droop response. Time trends continue to show that nadir frequencies are improving (i.e., getting higher) over time for the same size unit trips versus historical data. This means that the system frequency decay during sudden generation unit trips is being arrested faster and at a higher frequency than in previous years—primarily due to the fast response time from battery resources.



ENERGY AND TRANSMISSION ASSESSMENTS

NERC's resource adequacy assessment program continues to evolve from a deterministic approach to a probabilistic approach as more variable resources are integrated into the grid. ERCOT processes to reduce the risk continue with ongoing implementation of the 765 kV projects and Texas Energy Fund program.

NERC Energy Assessment Strategy

In 2024, NERC initiated its strategy to begin conducting interconnection-wide energy assessments by 2026. The results of this Wide Area Energy Assessment (WAEA) are intended to be incorporated into the annually published Long-Term Reliability Assessment (LTRA). Energy reliability assessments are critical for assuring the reliable operation of the BPS as the penetration of variable generation resources and/or just-in-time energy supplies increases. In turn, dispatchable and quick start units are relied upon for flexibility, where sources such as energy storage and natural gas-fired generation deliver energy to support intra-hour and inter-hour ramping to match variations in demand and energy production from the rest of the fleet. These assessments evaluate the system's ability to meet energy requirements across a wide range of circumstances, including historical weather conditions, low renewable output periods, and generation outages. Energy reliability assessments account for the finite nature of stored fuels and their replenishment characteristics. In addition, the availability of natural gas to supply electric generation can impact reliability during high natural gas demand periods throughout the year. Energy reliability assessments provide assurance to planners and operators that resources can supply both electrical energy and ancillary services needs across a span of time. 2025 was an important year for this strategy as each Regional Entity implemented the necessary processes, acquired the software tools, and completed the initial pilot study. For Texas RE, the pilot study was a great success as it showed the viability of the process and validity of the results.

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NERC Transmission Assessment Strategy

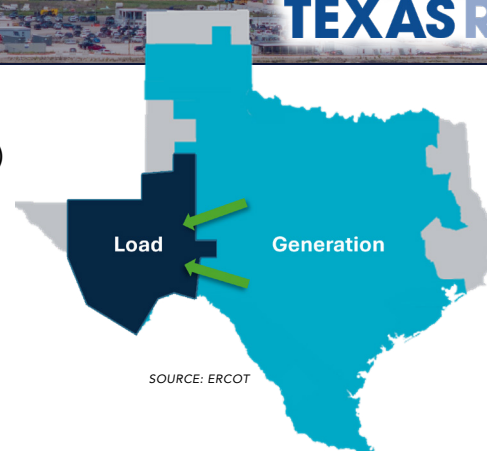
In 2025, at the direction of the Regional Entity CEOs, NERC developed a strategy to begin conducting interconnection-level transmission assessments. The objective is to analyze wide-area system risks beyond energy deficiency and resource adequacy in NERC’s Long-Term Reliability Assessments. This includes transmission assessments, weak grid conditions, undamped oscillations, voltage and dynamic stability risks, etc. The goal is to enhance the ERO’s capabilities to assess these risks in a timely manner and bring them to the forefront so that ERO and industry can take appropriate steps to address risks. Transmission assessments and studies are currently performed by Transmission Planners (TPs) and Planning Coordinators (PCs) through the existing TPL family of standards. These studies are typically focused on specific planning areas for each TP and PC. There is a potential gap in these transmission studies in that, in some cases, studies are not conducted at the interconnection level to identify possible transmission issues related to steady-state, dynamic, or stability issues. The goal of interconnection-level transmission assessments is to:

- Identify and address potential and emerging risks to BPS reliability that are currently not being analyzed at a wide-area level through existing processes or standards.
- Inform policymakers of potential and emerging risks.
- Build public confidence and awareness in the ERO’s ability to assess grid reliability.
- Maintain independence, meaning that the assessment is objective, free from bias, does not represent the interest of specific groups and is done with the support of subject matter experts.

New Far West Texas Interconnection Reliability Operating Limits (IROLs)

Load growth in Far West Texas is expected to occur faster than expected transmission upgrades. As a result, ERCOT identified two new generic

transmission constraints (GTCs) in September 2025 related to the ability to import power into the Far West area. These two new GTCs are being treated in IROLs and may require localized load shedding to avoid exceeding the GTC limits.



Texas Energy Fund Projects

The TEF was created by the Texas Legislature through [Senate Bill 2627](#) (the Powering Texas Forward Act) to provide grants and loans financing the construction, maintenance, modernization, and operation of electric facilities in Texas with a focus on incentivizing new dispatchable resources. Qualifying projects must add at least 100 MW of new dispatchable generation capacity to the ERCOT grid. Loan amounts may not exceed 60 percent of total project costs. As of November 20, 2025, six projects have been approved for loan agreements, totaling 3,564 MW. One additional project (completed in August 2025, totaling 188 MW) was approved under the Completion Bonus Grant Program. Eleven additional projects, totaling 5,420 MW, are currently under study/due diligence review.

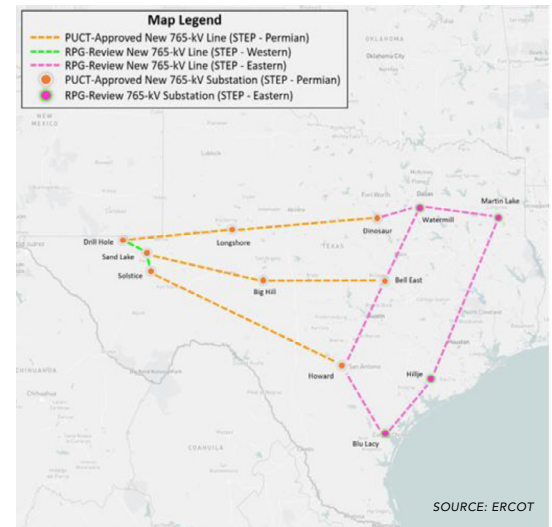
765 kV Activities

In January 2025, ERCOT submitted a comparison of the 2024 Regional Transmission Plan for the 345 kV network and the Texas 765 kV Strategic Transmission Expansion Plan (STEP) to the Public Utility Commission of Texas (PUCT). This analysis compared the reliability and economic benefits of building new 765 kV transmission lines versus only expanding the existing 345 kV infrastructure. Following the Commission’s approval in April 2025 for Phase 1 of the STEP plan, the process to build the region’s first

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765 kV transmission lines began. ERCOT's Board of Directors endorsed two additional 765 kV transmission projects in December 2025.

The proposed 765 kV transmission expansion projects provide a more robust “backbone” for the grid, improving stability and operational flexibility. The new 765 kV transmission infrastructure will have the ability to move power across the ERCOT system without causing thermal overloads or voltage collapse as confirmed through steady state analysis. This increased transfer capability provides a robust solution for meeting future load demand, reducing curtailments of generic transmission constraints (GTCs), and provides greater range of siting options for both generation resources and large loads. This new network consisting of Permian, western loop and eastern loop will interconnect major load zones—Odessa, Dallas, San Antonio, Houston, and Corpus Christi—creating a stronger grid that enables large volumes of renewable power to reliably serve demand across these load centers.



REAL-TIME CO-OPTIMIZATION

In December 2025, ERCOT completed the successful implementation of Real-Time Co-optimization in the ERCOT market. This market design change was part of ongoing improvements in the ERCOT market design and provided more flexibility in real time for ERCOT to efficiently procure energy and ancillary services. In addition, the new functionality will include improvements to modeling and consideration of batteries and the state of charge they have available for providing energy and ancillary services. Throughout calendar year 2025, Texas RE received regular updates on the progress of the implementation and supported activities regarding reducing systems risks as part of the implementation.

EXTREME EVENTS RESILIENCY AND WINTERIZATION



While cold weather performance has continued to improve as evidenced by the positive performance trends during Winter Storms Enzo and Kingston described below, the region cannot afford to become complacent in its weatherization efforts. Texas RE continues to focus on extreme weather and resource weatherization as an important risk element in its compliance and outreach efforts. Additionally, gas supply restrictions and overall critical infrastructure interdependencies remain an important aspect of the Texas Interconnection's overall resiliency during extreme events.

E-ISAC

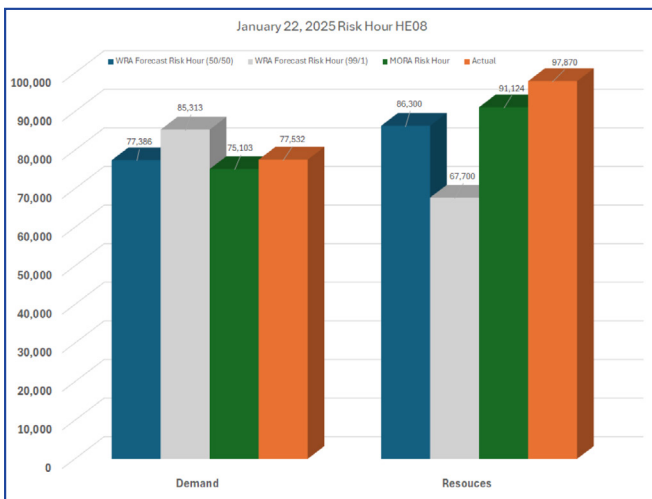
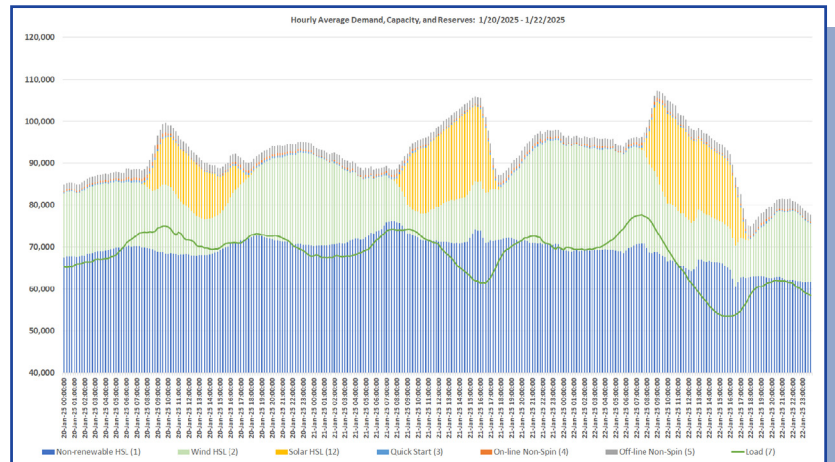
The continued focus on system resiliency has continued to drive enhanced incident response readiness testing efforts in 2025. As noted below, Texas state officials conducted the first comprehensive blackstart recovery exercise on September 11, 2025. At the federal level, the Electricity Information Sharing and Analysis Center (E-ISAC) conducted its GridEx VIII exercise on November 18-20, 2025. Both state and federal exercises focused heavily on critical infrastructure dependencies, including the importance of robust alternative communication procedures and response prioritization.

COLD WEATHER PERFORMANCE

The Texas Interconnection experienced two severe weather events in 2025. These events did not significantly affect the BPS (demonstrating improved generator performance). The thermal generation fleet performed well during both events, demonstrating the benefits of the focus on implementing weatherization mitigation measures and requirements the past several years. Key events included:

January 20-22, 2025, Winter Storm Enzo

Winter Storm Enzo brought snowfall and wintry precipitation to Texas, Louisiana, and even to Florida in areas that rarely receive it. Prior to the arrival of the winter storm, Texas state officials mobilized resources and ERCOT made preparations to ensure the power grid was fully prepared to cope with the weather. Freezing rain and snow took place in the Houston area beginning on the evening of January 20 and continued into January 21, with up to six inches of snow falling in several locations. Many major roadways in Houston had snow and ice accumulation on them by early morning on January 21, which led to dozens of road closures. An Operating Condition Notice (OCN), Advisory, and Watch were issued for extreme cold weather. A winter peak demand of 77,532 MW was recorded on January 22, 2025, at the hour ending 0800. A



Transmission Emergency was declared due to outages on approximately twenty 138 kV circuits and approximately ten 69 kV circuits due to icing (in addition to existing planned outages already in place) which caused some unsolved contingencies. The Transmission Emergency was issued until switching actions could be developed. Load outages were also observed in South Texas due to loss of transmission elements from icing.

During Winter Storm Enzo, incremental outages were lower than the projected seasonal average for the thermal fleet. Approximately 8,000 MW of incremental forced

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outages and derates occurred during Enzo, including approximately 3,000 MW of wind impacts due to icing, approximately 360 MW capacity reductions due to emissions limitations, and approximately 840 MW of capacity due to gas restrictions or curtailments.

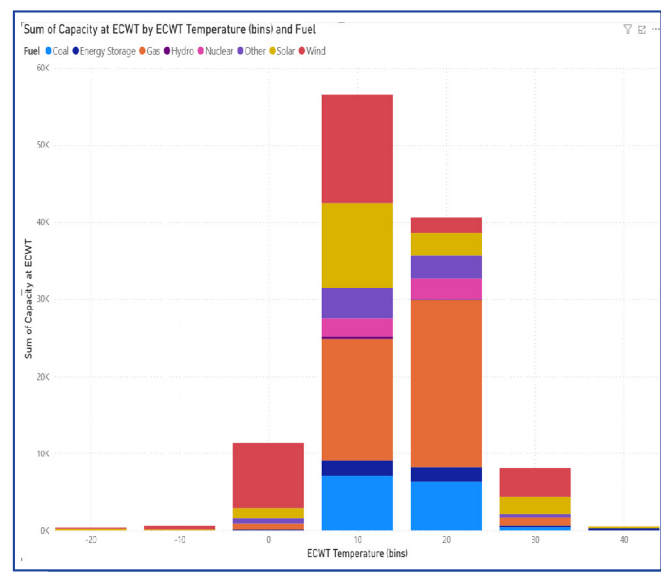
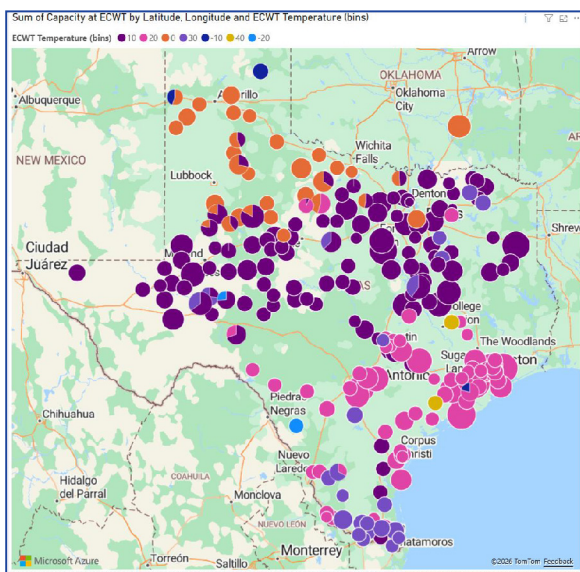
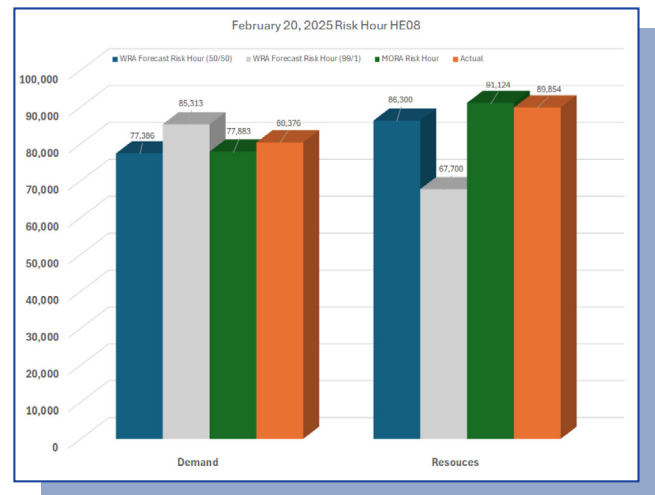
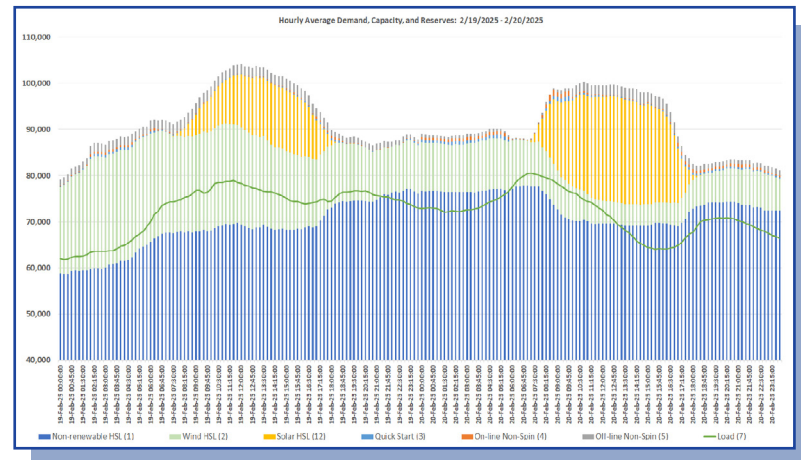
February 19-20, 2025, Winter Storm Kingston

Winter Storm Kingston also brought several cold temperatures to a large portion of the Region. An OCN, Advisory, and Watch were issued for extreme cold weather. An all-time winter peak demand record of 80,376 MW was recorded on February 20, 2025, at the hour ending 0800.

During Winter Storm Kingston, incremental outages were lower than the projected seasonal average for the thermal fleet. Approximately 7,000 MW of incremental forced outages and derates occurred during Kingston, including approximately 3,600 MW of wind impacts due to icing, approximately 1,700 MW capacity reductions due to emissions limitations, and approximately 1,100 MW of capacity due to gas restrictions or curtailments.

NERC Extreme Cold Weather Temperature (ECWT) Data Collection

NERC initiated a Section 1600 Data Request to collect and analyze the ECWT data from generation sites across North America. This data will be used to analyze and prioritize cold weather risks across each of the interconnections. Results for the ERCOT region are shown below.



Implementation of EOP-012-3 Standard, Extreme Cold Weather Preparedness and Operations

NERC Reliability Standard EOP-012-3 became effective October 1, 2025. As part of the implementation plan for the standard, the following actions were required:

- Existing generation facilities were required to calculate their Extreme Cold Weather Temperature (ECWT) by the effective date (Requirement R1).
- Facilities with a commercial operations date prior to October 1, 2027, and that have an ECWT at 32 degrees Fahrenheit or less, were required to implement freeze protection measures to protect Generator Cold Weather Critical Components to operate at the ECWT, or to develop a Corrective Action Plan to provide the capability to operate at the ECWT (Requirement R3).
- Facilities that declare a Generator Cold Weather Constraint shall submit a declaration(s) to Texas RE.
- In 2025, Texas RE approved 38 constraint declarations for 70 generating units. The general types of declarations received are known conditions that can restrict or reduce generation capacity. These can be broken down into the following general categories:
 - Wind turbine blade icing, or blade replacement needed to add de-icing
 - Wind turbine structural limitations established by the manufacturer (e.g. cold weather package)
 - Solar panel freezing precipitation accumulation
 - Combustion turbine inlet air icing
 - Other heat tracing or de-icing additions

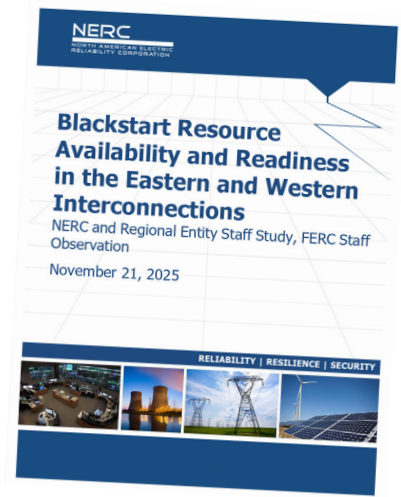
TEXAS BLACKSTART EXERCISE

In response to Governor Greg Abbott’s Executive Order No. GA-49 relating to the protection of critical infrastructure, the Public Utility Commission of Texas initiated the first ever blackstart tabletop exercise (BlackStarTx 2025) on September 11, 2025. This exercise brought together stakeholders

and emergency responders from State Emergency Operations Center, Texas Department of Emergency Management, and multiple state and federal agencies to focus on the first 72 hours of a blackout of the Texas electric grid. The exercise focused on enhancing internal communications, clarifying action prioritization, and addressing public information and warning requirements.

BLACKSTART RESOURCE AVAILABILITY STUDY

In November 2025, FERC released a review of [Blackstart Resource Availability and Readiness in the Eastern and Western Interconnections](#). The key recommendations from this report related to weatherization included the following:



1. Entities responsible for the development of system restoration plans and the selection of blackstart resources (BSRs) should consider reviewing and revising (as needed) internal processes to ensure that the selection and qualifications of BSRs include the consideration of currently effective NERC Reliability Standard EOP-012-3 operational data and capability under R2 or R3, as it pertains to blackstart service/capabilities, extreme cold weather preparedness, and operations. These entities should consider implementing more frequent (perhaps annual, preseason) assessments or validation of blackstart capabilities of BSRs to ensure operational readiness for each winter season.
2. Entities responsible for BSRs should ensure that the blackstart procedures contain specific extreme cold weather preparatory actions and

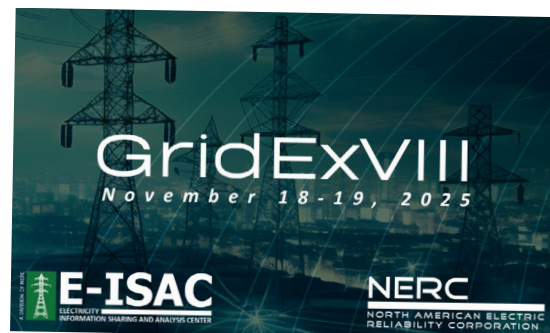
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considerations to help operators successfully perform in extreme cold weather conditions.

3. Entities responsible for, or capable of, providing blackstart service, should systematically evaluate and identify generator cold weather critical components, including those components only used during system restoration.

GRIDEX VIII EXERCISE

On November 18-20, 2025, NERC's E-ISAC conducted its eighth biennial electric grid security exercise, GridEx VIII. GridEx VIII consisted of an executive tabletop for industry executives and government leaders from the United States and Canada and distributed play for 378 organizations and approximately 28,000 participants across North America. As in past exercises, GridEx VIII consisted of a distributed play exercise designed to test organizational emergency response and recovery plans, as well as an executive tabletop exercise designed to foster strategic discussions from senior-level industry and government leaders regarding coordination and decision making during large-scale grid emergencies.



Key lessons learned from the exercise included the importance of coordination and communication across sectors and industry. The lessons learned particularly noted that Reliability Coordinators needed to improve communications processes to ensure coordination is maintained. Additionally, the lessons learned highlighted the continued need for robust, interoperable communications systems and the creation of clear, well-established communications directories and other supporting materials in advance of an event. Finally, the exercise again reinforced the need for collaboration across sectors to maintain grid reliability and support recovery during simultaneous cyber, physical, and environmental threats.

TEXAS RE ISAC FORUM

Building the themes of cross-sector coordination and communication from the GridEx VIII exercise, Texas RE held a first of its kind forum with representatives from four ISACs from the oil and gas, water, and electricity sectors on December 2, 2025. The forum emphasized the importance of cross-sector coordination as a touchstone of extreme events resiliency, as well as to protect both our electric infrastructure and other critical infrastructure operators from rapidly expanding cyber and physical security threats. Key themes from the forum included how to think about restoration priorities across critical infrastructure sectors and how to effectively confront emerging threats. Additionally, the forum highlighted the importance of coordination between federal, state, and local governments about roles and responsibilities, including the need to have real conversations about how restoration and resiliency priorities are established at each government level.



CYBER AND PHYSICAL SECURITY

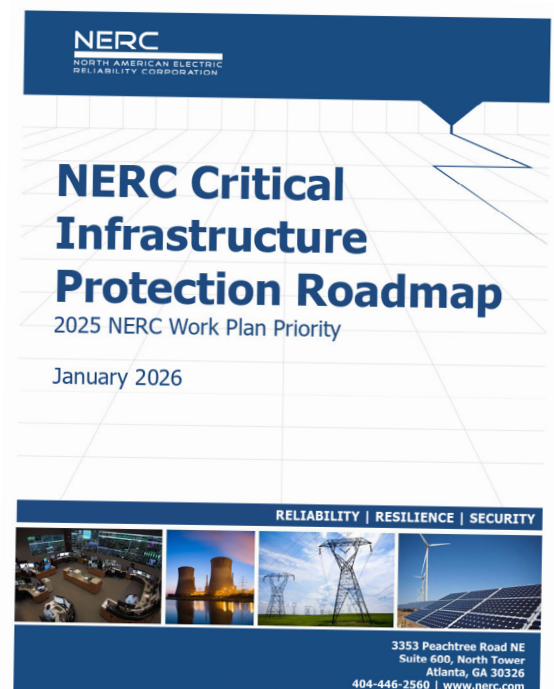
In 2025, BPS facilities in the Region experienced minimal impact from cyber and physical security events. However, the BPS faced an increasingly complex threat environment that included heightened adversary activity, expanded attack surfaces from grid transformation, and emerging risks from artificial intelligence. Sustained information sharing, foundational cyber hygiene, and strengthened cross-sector coordination are essential to preserving the reliability and security of critical infrastructure.

Grid transformation continues to shift risk in three key ways: broader, more complex supply chains increase exposure to compromised components; the proliferation of distributed devices and third-party/cloud services have created many new remote access points; and the aggregation of numerous low impact assets raises the potential for system-level effects. Together, these risks make stronger vendor vetting, tighter access controls, and expanded monitoring essential to protect critical infrastructure.

From a supply chain perspective, identifying component origins and securing increasingly complex device hardware and software continue to challenge procurement and asset-management processes, underscoring the need for stronger vendor vetting and traceability. Activities in Texas such as the implementation of the Lone Star Infrastructure Protection Act (LSIPA) aim to reduce supply chain risks to the Texas electric grid by blocking contracts that would give foreign-linked companies direct or remote access to critical systems. LSIPA requires stricter vendor vetting and targeted replacements to strengthen grid resilience, and helps protect Texans from service disruptions.

Given the continued increase of remote endpoints and third-party access, remote access remains a risk. Each remote connection and outsourced service can introduce credential theft, remote access abuse, and insider threats. This is why low impact Bulk Electric System (BES) Cyber Systems (BCS) remains a persistent focus. Many entities continue to face implementation challenges, particularly remote access controls, and a compromised asset can enable lateral movement, reconnaissance, or serve as a staging point for broader disruption. The rapid growth of dispersed generation continues to increase the number of these assets. As noted in the [NERC Critical Infrastructure Protection Roadmap](#), low impact BCS are being reframed into a core reliability priority and recommendations around practical controls such as multi-factor authentication (MFA) for interactive remote access and enhanced cyber hygiene are essential to reduce the aggregate risk these assets pose.

As noted in last year's report, cloud solutions are expanding rapidly because of the benefits of improved visibility, scalable analytics, and faster recovery response times. However, cloud solutions introduce inherent challenges around shared security responsibility



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that require clear governance, vendor assurance, and robust controls. Equally, the continued emergence of AI-enabled threats and opportunities are becoming a growing operational concern. As noted in the [2025 E-ISAC End-of-Year-Report](#), AI and automation are changing both defensive and adversary capabilities, all of which require new guidance and tooling.

2025 also proved to be an important year for testing cyber and physical security incident response. Texas and partners across the United States conducted numerous tabletop exercises that simulated cyber and physical attacks affecting critical infrastructure. These exercises brought together utilities, emergency managers, law enforcement, state and federal agencies, and private sector partners to test plans, communications, and decision-making under realistic stress. Each of these tabletop exercises played an important role in strengthening reliability and security through key outcomes including but not limited to faster and clearer communications protocols, improved incident playbooks, identification of priorities, and stronger partnerships.

As mentioned above, the PUCT conducted the first annual tabletop exercise on how the state would respond to a blackstart event tied to an Indo-Pacific conflict. Similarly, the E-ISAC conducted GridEX VIII with a focus on critical infrastructure interdependencies, communications protocols, and recovery prioritization. Lastly, in response to Governor Greg Abbott's directive to surge anti-terrorism task force resources the Texas Department of Public Safety (DPS) developed and conducted numerous exercises coordinating with private sector owners and operators of critical infrastructure that were focused on the detection of, deterrence of, and response to physical attacks against critical infrastructure.

In response to the evolving threat landscape, Texas RE continues to address these risks through our Compliance Monitoring and Enforcement Program (CMEP) by conducting strategic, risk-based outreach and targeted compliance engagements that prioritize CMEP Implementation Plan (CMEP IP) risk elements including supply chain, remote connectivity, and related risks to strengthen BPS resilience.



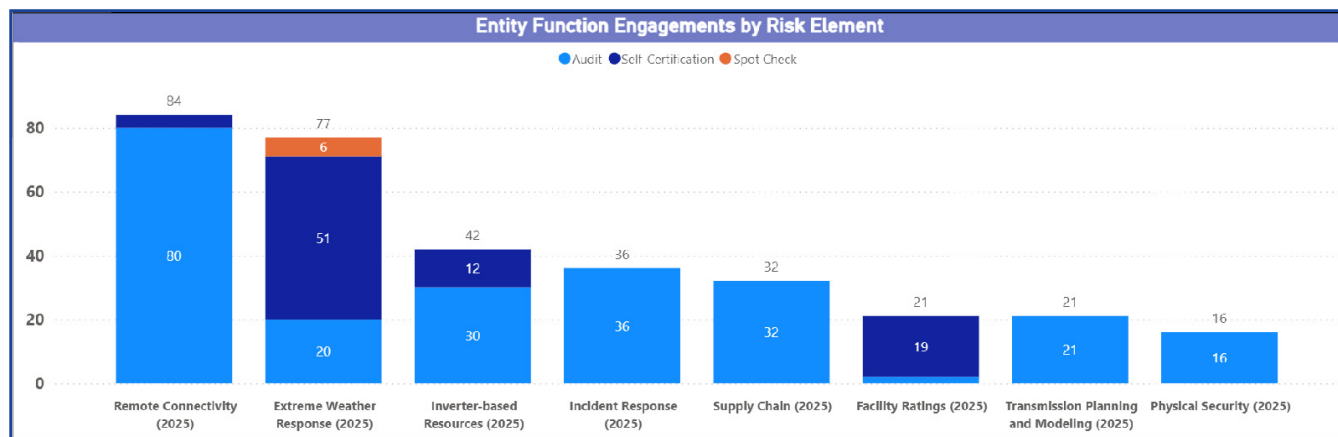
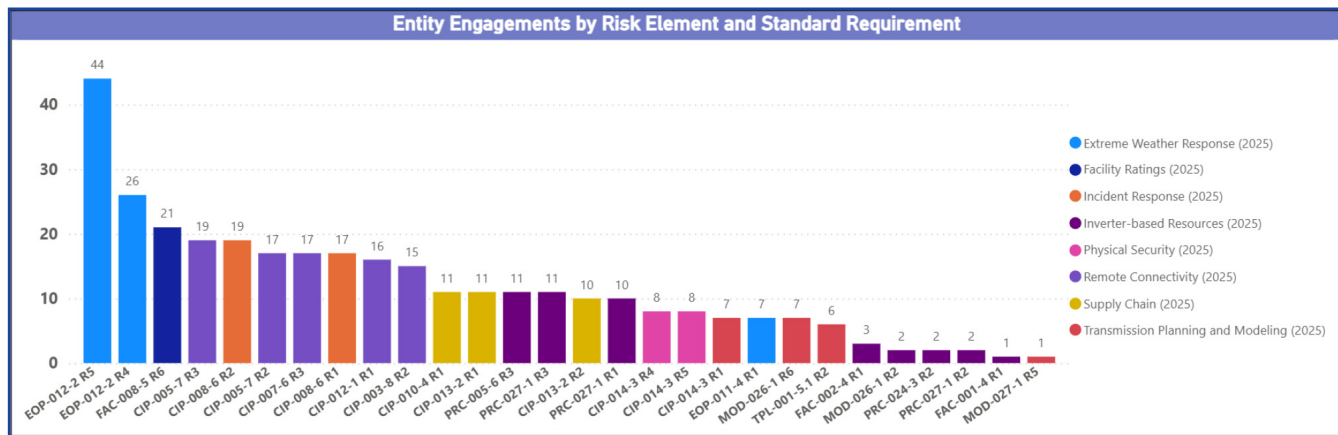
2025 RISK MITIGATION HIGHLIGHTS

Texas RE identified multiple risk focus areas to prioritize the mitigation of risks across its reliability and compliance programs. The table below summarizes some of Texas RE's key 2025 activities related to these risk focus areas.

FOCUS AREA	OUTREACH HIGHLIGHTS	ENGAGEMENTS
Extreme Weather & Resource Weatherization	- July 2025 Talk with Texas RE on Extreme Weather Response - September 2025 presentation at NSRF on Risk of Extreme Weather - August 2025 presentation at LCRA's STORM Conference on EOP-012 - August 2025 Cold Weather Preparedness Small Group Advisory Sessions (SGAS) - October 2025 Texas RE Winter Weatherization Workshop - October 2025 presentation at NSRF on EOP-012 - November 2025 Talk with Texas RE on TPL-008	77 function engagements on the cold weather Reliability Standards, including site visits and walk downs.
IBR Ride-through	- January 2025 presentation at NSRF on PRC-029 - March 2025 Talk with Texas RE on Protection Systems and IBRs - April 2025 Talk with Texas RE on IBR Work Plans and Registration - April 2025 Spring Standards, Security, & Reliability Workshop - April 2025 presentation at NSRF on PRC-028 - October 2025 Talk with Texas RE on IBR Registration and Applicable Standards	42 function engagements that included modeling Standards and IBRs.
Physical Security, Remote Access, & Supply Chain	- February 2025 Talk with Texas RE on GridEx Planning - March 2025 Talk with Texas RE on Physical Security - April 2025 Spring Standards, Security, & Reliability Workshop - May 2025 Talk with Texas RE on GOP Functions and 3rd Party Control Centers - August 2025 Talk with Texas RE on Cybersecurity Threats - August 2025 Talk with Texas RE on CIP-003-8 - August 2025 Talk with Texas RE on Data Breach Response - October 2025 Talk with Texas RE on PUCT Cybersecurity Update - November 2025 Fall Standards, Security, & Reliability Workshop - December 2025 Talk with Texas RE on E-ISAC and Industry Collaboration - NERC Alert published on Cross-Border Remote Access to Bulk Power System Elements	84 function engagements that included requirements associated with remote connectivity. 32 function engagements that included a supply chain area of focus. 16 function engagements that included a physical security focus. 36 function engagements that included an incident response focus.
Provision of Essential Reliability Services from a Changing Resource Mix	- April 2025 Talk with Texas RE on IBR Work Plans and Registration - July 2025 Evolving Grid Workshop	42 function engagements that included modeling Standards and IBRs.
Energy Availability	- January 2025 Talk with Texas RE on NERC Reliability Assessments - January 2025 Talk with Texas RE on Inter-regional Transfer Capability Study (ITCS) - February 2025 Talk with Texas RE on Small Modular Reactors - May 2025 Talk with Texas RE on the Summer Outlook - July 2025 Evolving Grid Workshop - NERC/ERO pilot study for energy availability probabilistic analysis completed	N/A
Gas Supply Restrictions During Cold Weather	- October 2025 Texas RE workshop on winter weatherization - November 2025 Fall Standards, Security, & Reliability Workshop	N/A
Inaccurate Resource Modeling	- March 2025 presentation at NSRF on Transmission Planning and Modeling - June 2025 presentation at NSRF on MOD-026 - July 2025 Talk with Texas RE on Modeling and Model Verification - September 2025 presentation at NSRF on MOD-032 - NERC Alert published on IBR model quality issues	42 function engagements that included modeling Standards and IBRs. 21 function engagements that included transmission planning and modeling.

2025 RISK MITIGATION HIGHLIGHTS

FOCUS AREA	OUTREACH HIGHLIGHTS	ENGAGEMENTS
Facility Ratings	- May 2025 presentation at NSRF on FAC-008 Best Practices - August 2025 presentation at LCRA's STORM Conference on FAC-008 - September 2025 presentation at NSRF on facility rating walkdowns	21 function engagements that included the Facility Ratings Standard.
Integration of Large Loads	- July 2025 Evolving Grid Workshop - Monthly newsletter article on large load trends - February 2026 NERC Emerging Large Loads Technical Conference - NERC Level 2 Alert on Large Load Interconnection, Study, Commissioning, and Operations	N/A
Artificial Intelligence	- April 2025 Texas RE panelist at UT Energy Week: The Power of Intelligence: The Role of AI in Shaping the Future of Energy Panel - June 2025 Talk with Texas RE on Artificial Intelligence in the Electric Industry - July 2025 Evolving Grid Workshop - November 2025 Fall Standards, Security, & Reliability Workshop - November 2025 Texas RE panelist at Amazon Web Services Annual Utilities Security and Compliance Summit	N/A



2025 PERFORMANCE METRICS

Texas RE utilizes key performance indicators to evaluate how effectively the Region is meeting targeted electric reliability objectives. The table below describes these indicators, how they are measured, the target values, and an assessment of the state of each.

IMPROVING Improving trend compared to previous four years or improved event performance of observed conditions.	STABLE OR NO CHANGE Minimal or no change compared to previous four years.	MONITORING Declining trend compared to previous four years or specific negative event performance issues.	ACTIONABLE Declining trend for two or more consecutive years or significant negative event performance.
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Key Performance Indicator with Description	2025 Performance & Trend Results
Resource Adequacy Measures potential resource adequacy issues by analysis of planning reserve margin and energy emergency alerts.	Future reserve margins impacted by growth in large computational loads
Transmission Performance Measures transmission performance by analysis of transmission outage rates and Interconnection Reliability Operating Limits (IROL) exceedances.	Resource weatherization resulted in sustained performance during cold weather events
Resource Performance Measures generation performance by analysis of generator outage rates, primary frequency response, and balancing contingency events.	345 kV & 138 kV transmission outage rates improved in 2025 - IROL Exceedances
Grid Transformation Measures potential issues related to grid transformation by analysis of system inertia and ramping.	- Resource outages/gas restrictions during cold weather - EFOR increased in 2025, long term rate increase
Protection System Performance Measures Protection System Performance by analysis of Protection System Misoperations.	- Primary frequency response continues to improve - No balancing contingency event failures
Human Performance Measures transmission outages, generation outages, and Protection System Misoperations caused by human error.	- Solar ramp magnitudes continue to increase - Voltage ride through for IBRs and large loads
Situational Awareness Measures situational awareness by analysis of state estimator convergence rates, event analysis, and telemetry performance.	Potential reliability impacts from operational characteristics of large computational loads
	- Overall misoperations rate increased in 2025 - Misoperation count from incorrect settings stable - Misoperation rate increased in 2025, remains less than overall NERC Misoperation rate
	Reduction in transmission and generation outage rates from human error
	Human error primary causal factor in Misoperations and events
	Five loss of situational awareness events (down from eight in 2024)
	State estimator convergence rate remained stable

PATH FORWARD

As stated previously, the challenges facing the electric utility industry are unprecedented. The regulatory and reliability performance decisions that are currently being made will set the standard for the industry for years to come. Texas RE continues to be at the forefront of these decisions. For 2026, we defined four primary goals:

- Leverage Texas RE's role within the ERO Enterprise model to positively impact reliability and security.
- Foster an outstanding workplace culture.
- Promote high standards of operational excellence and accountability in our organization.
- Proactively engage and catalyze steps to mitigate the highest priority regional risks.

Each of these goals has an associated set of activities that we will undertake throughout the year to measure progress.

In 2026, Texas RE will focus on these priority items to improve the reliability of the Region, as outlined by our corporate goals:

- Leverage Texas RE's independent energy assessments and other tools to inform stakeholders regarding energy adequacy issues in the Texas Interconnection.
- Engage with industry and regulators regarding distributed energy resources and promote appropriate reliability and security coordination.
- Continue to focus attention on critical infrastructure interdependencies, including gas-electric coordination issues, to promote greater grid resiliency.
- Support efforts at the state and federal level to understand large load risks and implement sound approaches to ensure the reliable integration of such entities into the Bulk Power System.
- Engage with stakeholders and policymakers regarding the development and implementation of new inverter-based resource ride-through requirements and support efforts to better model the contribution of inverter-based resources to reliable operations.
- Identify opportunities to enhance coordination with ERCOT on energy adequacy and other key reliability topics and provide opportunities for ERCOT to share important developments.
- Share information and best practices to mitigate supply chain vulnerabilities, including continued assessment of registered entity internal controls to manage supply chain risk.



2025 KEY FINDINGS

Texas RE continually evaluates risks to grid reliability in its Region through long-term and seasonal reliability assessments, event analyses, situational awareness, tracking reliability indicators, real-time performance monitoring, and planning observations. The 2025 Assessment of Reliability Performance report provides a high-level overview of the data collected in the Region in 2025. It includes:

- Overview of 2025's numbers
- Associated historical data
- The current state of the Texas Interconnection
- Observations for the future of Texas RE's Region

To gauge reliability of the Region and turn that data into actionable information, Texas RE assessed data and historical trends in these areas:

RESOURCE ADEQUACY AND PERFORMANCE

Bulk Power System Planning

Protection and Control Systems

Situational Awareness Challenges

Human Performance

Changing Resource Mix

RESILIENCE TO EXTREME EVENTS

SECURITY RISKS

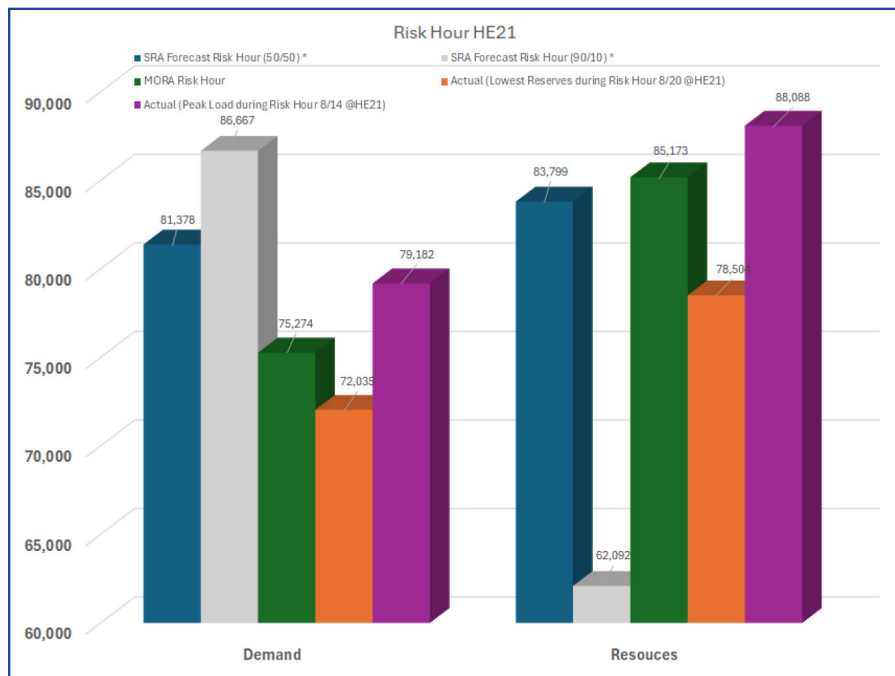
Cyber

Physical

CRITICAL INFRASTRUCTURE INTERDEPENDENCIES

2025 KEY FINDINGS: RESOURCE ADEQUACY & PERFORMANCE

Throughout 2025, ERCOT maintained sufficient operating reserves. The Region did not experience any instances in which Physical Responsive Capacity (PRC) declined below ERCOT's defined Advisory, Watch, or EEA levels. ERCOT had sufficient resources to meet the actual peak of over 83 GW in August 2025. Hour-ending (HE) 21 had the highest probability of capacity deficiencies during the summer after the evening solar down ramp. The lowest hourly reserve period during the high-risk hour occurred on August 20, 2025. ERCOT maintained sufficient resources during this period (see graph).



Texas RE continues to observe significant growth in renewable generation resources. The addition of 8,099 MW of solar resources, 1,460 MW of wind resources, and 6,661 MW of storage resources in 2025 improved margins during peak demand hours. On some days, battery resources injected over 9,000 MW during evening solar down ramp hours or prior to the morning load ramp. New battery resources contributed to maintaining the balance between load and generation during solar ramp periods and at other times with low renewable generation output. Batteries and other energy storage options will continue to play a key role, especially

2025 Resource Adequacy by the Numbers

Projected Peak*:	85,721 MW
Actual Peak:	83,876 MW
Renewable % at Peak:	38.5%
Max Hourly Wind:	28,265 MW
Max Hourly Solar:	29,503 MW
Max Hour Renewable%:	75.6%

Advisories (PRC <3000):	0
Watches (PRC <2500):	0
EEA (PRC <2300):	0

* Projected (90/10) peak from ERCOT MORA

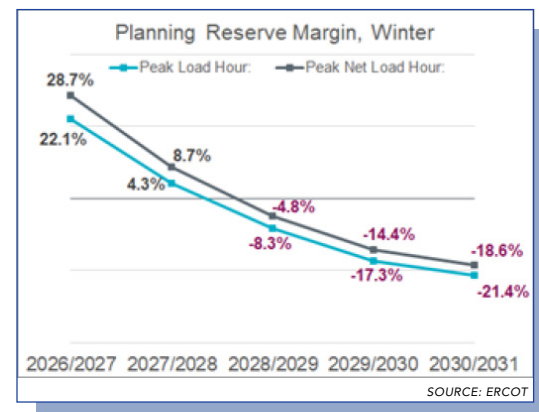
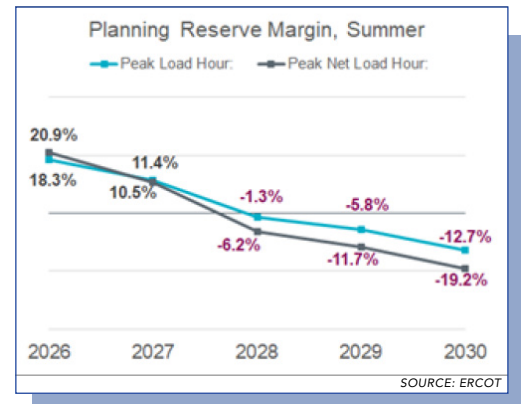
for shorter duration needs. These trends are expected to continue with approximately 59,000 MW of additional renewable and storage resources expected by the end of 2028. These additions will continue to drive changes in how ERCOT manages generation. Combined wind and solar generation curtailments exceeded 9,777 gigawatt-hours (GWh) in 2025, a large increase from 2024. Curtailments are implemented to maintain system supply and demand balance and overall grid stability. During periods when electricity supply exceeds demand, such as times of high renewable generation combined with lower system load, generation resources may be curtailed to prevent system instability. The System Operator may also curtail generation when transmission constraints limit the ability to deliver power to load centers driven by system topology or facility limitations. Increase in demand, such as large load additions and battery charging and the proposed long-term transmission improvements could potentially reduce frequency and magnitude of curtailments.

2025 KEY FINDINGS: RESOURCE ADEQUACY & PERFORMANCE

Large load interconnection requests in ERCOT continue to grow rapidly in both scale and complexity, reflecting evolving system demand patterns. Texas RE continues to have elevated concerns regarding resource adequacy in the future years due to the potential integration of a significant number of large loads. Current large load interconnection requests indicate that up to 15,900 MW of new loads with approved planning studies and an additional 51,000 MW of loads under ERCOT review could interconnect by 2028. By the end of 2030, these numbers increase to over 21,300 MW of new loads with approved planning studies and an additional 86,600 MW of load under ERCOT review. Ongoing work at the ERCOT and NERC levels include incorporating potential NERC registration of these loads as well as voltage and frequency ride-through requirements. The magnitude and pace of these requests introduce significant uncertainty and highlight the need for continued coordination among ERCOT, transmission planners, operators, and regulators to ensure adequate generation, transmission infrastructure, and operational readiness to maintain system reliability.

ERCOT’s Capacity, Demand, and Reserves (CDR) December 2025 report indicates that planning reserve margins for 2026 through 2030 decrease significantly from year to year, and cross over to negative values in 2028. Under projected normal weather conditions in ERCOT, the summer peak load hour is forecast to occur during hour ending (HE) 17, while the net peak load hour is projected to occur later in the day during HE 21. This shift reflects the increasing impact of variable and behind-the-meter resources, which reduce net load during late afternoon hours but decline into the evening, causing the net peak to occur after the normal system peak hour. The summer margins for the peak net load hours are lower than for the peak load hours due mainly to decreasing solar generation availability in the early evening when loads are still high. The decreases are mainly due to:

- The addition of new forecasted loads reported by Transmission Service Providers (TSPs), dominated by large consumers such as data centers, industrial/oil & gas production facilities, and cryptocurrency mining operations.
- The summer peak load and peak net load hour planning reserve margins enter negative territory beginning summer 2028. The lower margins for the peak net load hour relative to those for the peak Load hour mainly reflect the lower reliability contribution of solar generation during the evening hours when the peak net load occurs.
- The lower and sharply downward trajectory of the margins is due to:
 1. High load growth largely driven by new loads reported by TSPs
 2. A lower capacity contribution from wind and solar resources due to the switch to Effective Load Carrying Capability (ELCC) in the CDR
 3. Fewer planned resources that result from applying additional eligibility criteria to be included in planning reserve margins

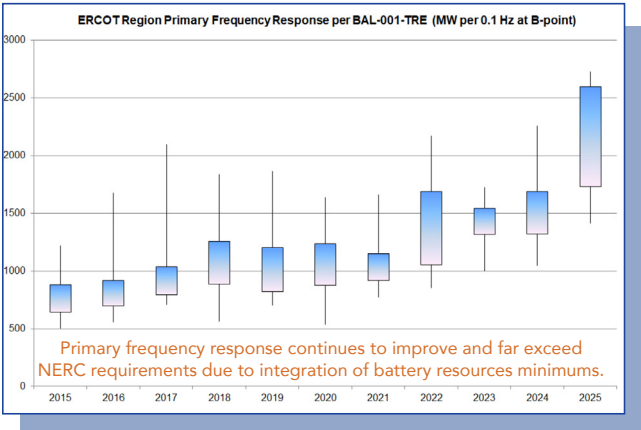


In recent years, the ERCOT system has experienced noticeable

2025 KEY FINDINGS: RESOURCE ADEQUACY & PERFORMANCE

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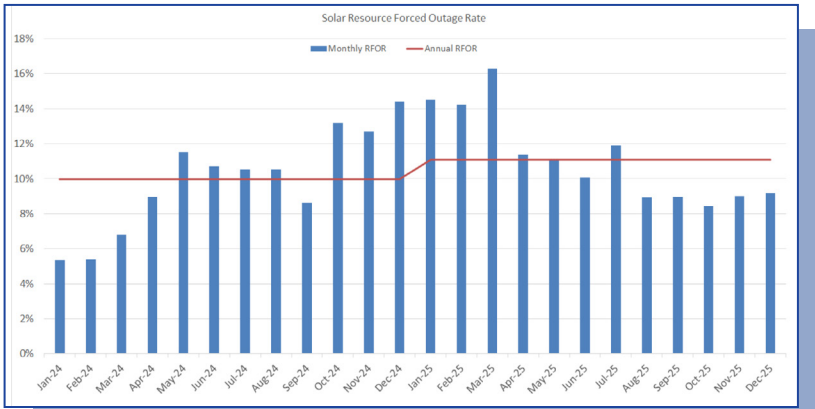
progress in primary frequency response performance during sudden changes in generation output, driven by shifts in the increasing penetration of fast-responding battery resources. Beginning in 2022, the capabilities of battery resources began to show noticeable improvements in primary frequency response. The system rate of change of frequency (RoCoF) decay during sudden generation unit trips is being arrested faster and at a higher frequency than in previous years, primarily due to the fast response time from battery resources.



Maintaining reliability in ERCOT also depends on the availability and operational performance of generation resources. Comprehensive outage and performance data are essential to understanding how different resource types contribute to system adequacy and reliability risk. ERCOT entities submit the generation outage information through the NERC Generating Availability Data System (GADS), which provides consistent, unit-level reporting of generator outage behavior across various generation technologies.

As solar generation continues to represent a growing share of the ERCOT resource mix, enhanced performance visibility and standardized outage reporting have become increasingly important for reliability assessments. To support this need, NERC expanded GADS to include solar resources, enabling improved insight into solar facility performance, availability, and outage characteristics at both the unit and fleet levels.

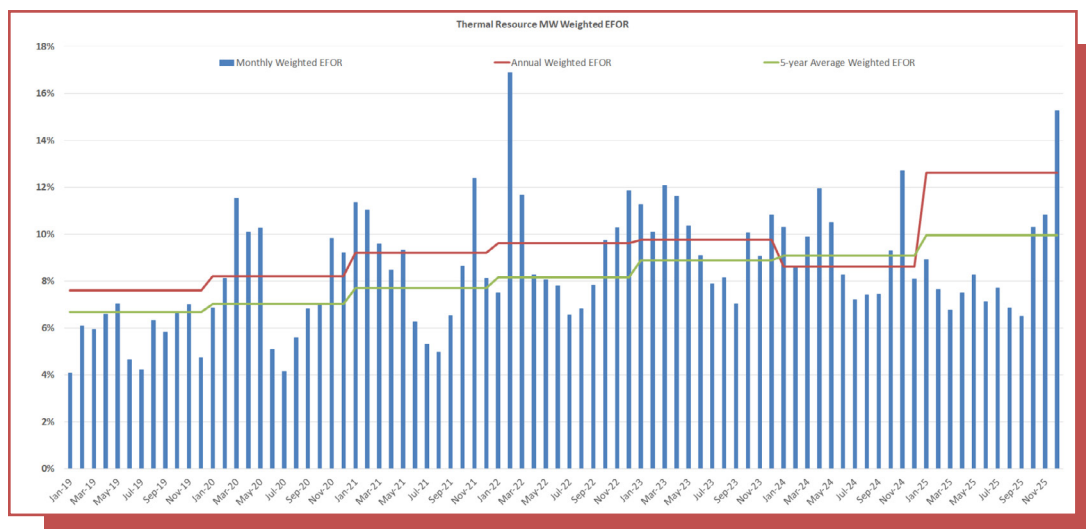
Solar facilities greater than 100 MW began mandatory reporting in GADS-Solar in 2024. Solar facilities greater than 20 MW began mandatory reporting in GADS-Solar in 2025. GADS-Solar provides similar metrics as GADS to compare unit-level and fleet-level performance. In 2025, 132 solar subgroups submitted a total of 1,355 unit-months of data in GADS-Solar. Net solar generation reported was 43,459 GWh, or 64.1 percent of the total solar generation for the year. GADS-Solar inverter outage data reporting for 2025 included 2,946 component outage reports totaling 638,274 inverter-hours of forced, planned, and maintenance outage duration, with an estimated production loss of 949.8 GWh.



A summary of key performance metrics for the ERCOT solar generators for 2025 is provided in the table to the right.

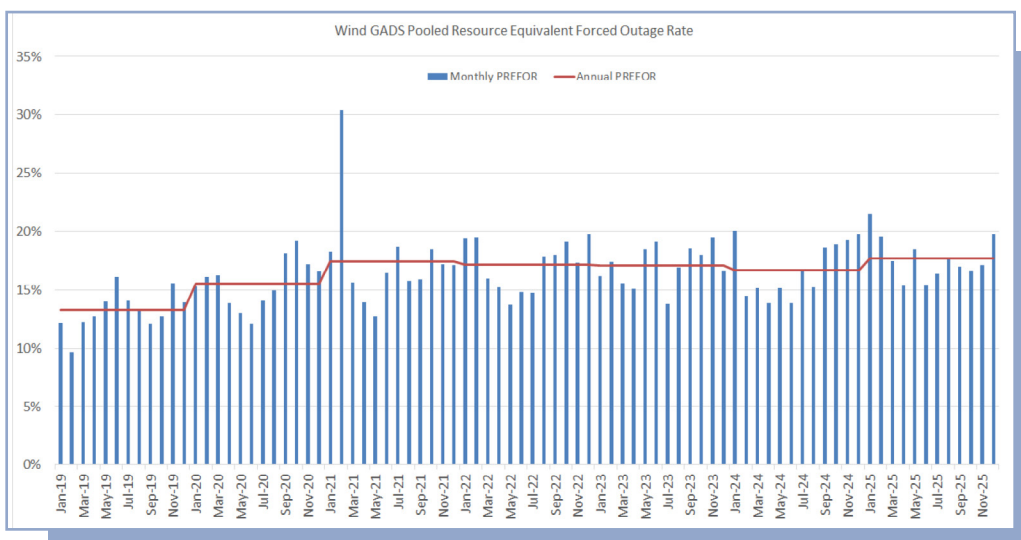
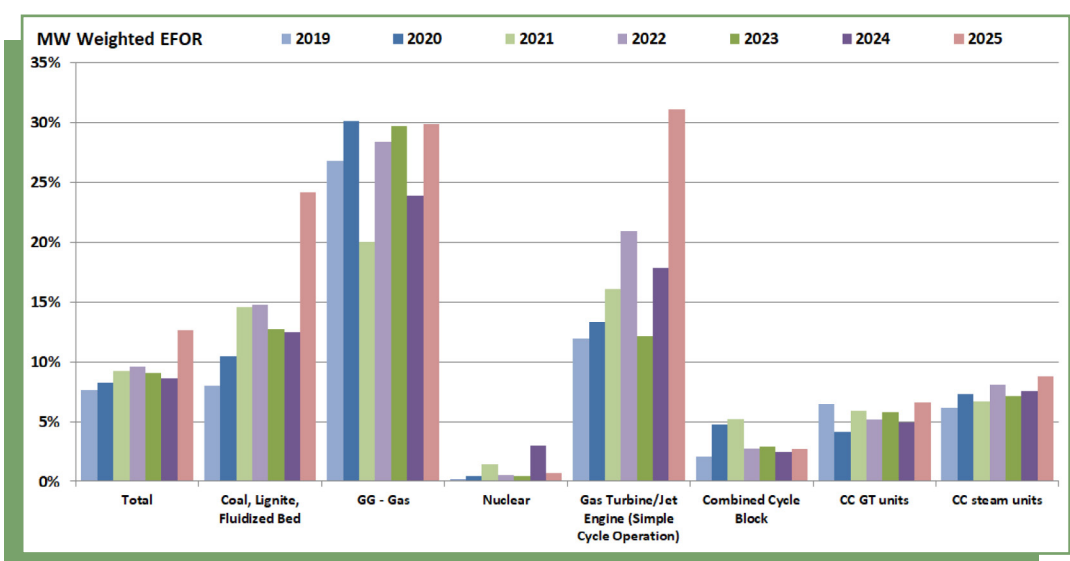
Metric: ERCOT Region GADS-Solar Data	2024	2025
Net Capacity Factor (RNCF)	25.1%	31.6%
Resource Generating Factor (RGF)	87.1%	86.3%
Resource Forced Outage Rate (RFOR)	10.0%	11.1%
Equipment Forced Outage Rate (EFOR)	4.5%	5.4%
Resource Scheduled Outage Rate (RSOR)	0.7%	0.1%
Performance Index (PI)	79.5%	85.2%
Resource Availability Factor (RAF)	89.7%	89.1%

2025 KEY FINDINGS: RESOURCE ADEQUACY & PERFORMANCE



The MW-weighted Equivalent Forced Outage Rate (EFOR) for thermal resources was 12.6 percent in 2025, which was a significant increase from 8.6 percent in 2024. This was due to several extended forced outages on multiple units. In particular, the MW-weighted EFOR for the coal fleet jumped from 12.5 percent in 2024 to 24.1 percent in 2025, in part due to extended forced outages on two units, one totaling 15 consecutive months and another ongoing outage totaling 12 consecutive months.

The overall long-term five-year trends also continue to show an increasing rate across multiple fuel types. This increase may be attributed, in part, by extended forced outage durations observed for certain units, which elevate outage metrics over time. In addition, peaking units are being dispatched more frequently and for longer durations, including during non-traditional peaking hours, to meet growing and shifting system demand. Increased operating duty on these units can contribute to higher outage exposure and forced outage rates, further influencing the observed upward trend.

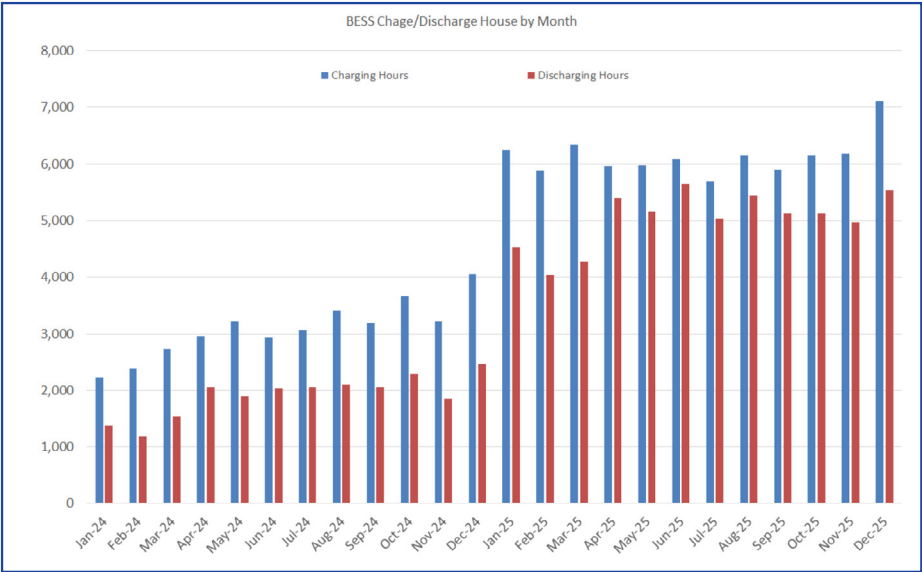
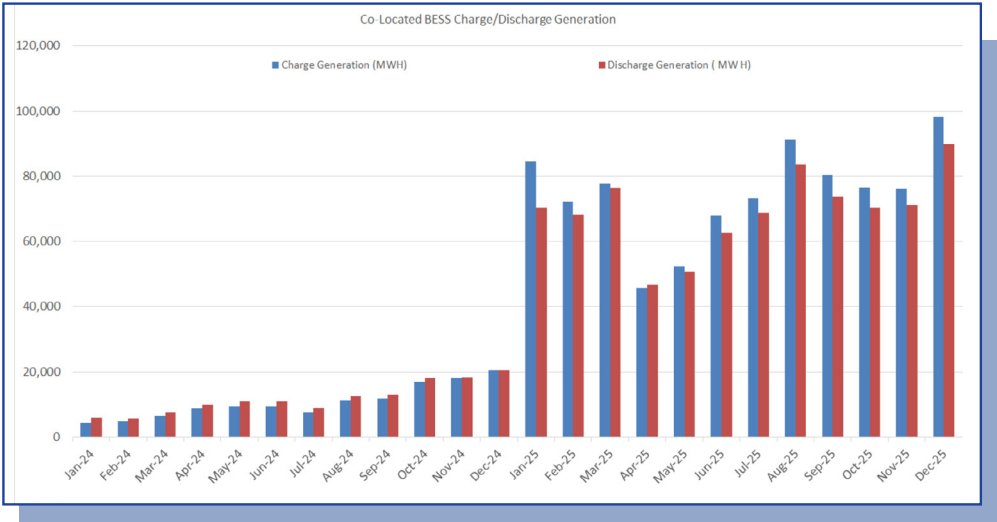


GADS Wind Resource EFOR was 17.7 percent in 2025, a slight increase from 16.2 percent in 2024.

2025 KEY FINDINGS: RESOURCE ADEQUACY & PERFORMANCE

Battery energy storage systems (BESSs) that are co-located with wind or solar facilities began mandatory reporting in GADS in 2024. GADS metrics for BESS facilities have not yet been developed. In 2025, 23 co-located BESS facilities (1,984 MW capacity) submitted a total of 248 unit-months of data in GADS. Net generation reported for 2025 was 895.6 GWh of charge generation and 832.0 GWh of discharge generation. A summary of key data for the ERCOT co-located BESS facilities for 2025 is provided in the following table.

Metric: ERCOT Region GADS Co-Located Battery Data	2024	2025
Charge Generation (GWH)	129.3	895.6
Discharge Generation (GWH)	141.9	832.0
Charging Hours	37,039	73,768
Discharging Hours	22,913	60,250
Planned Outage Hours	1,664.0	656.2
Forced Outage Hours	1,710.7	4,424.8
Maintenance Outage Hours	370.6	156.0

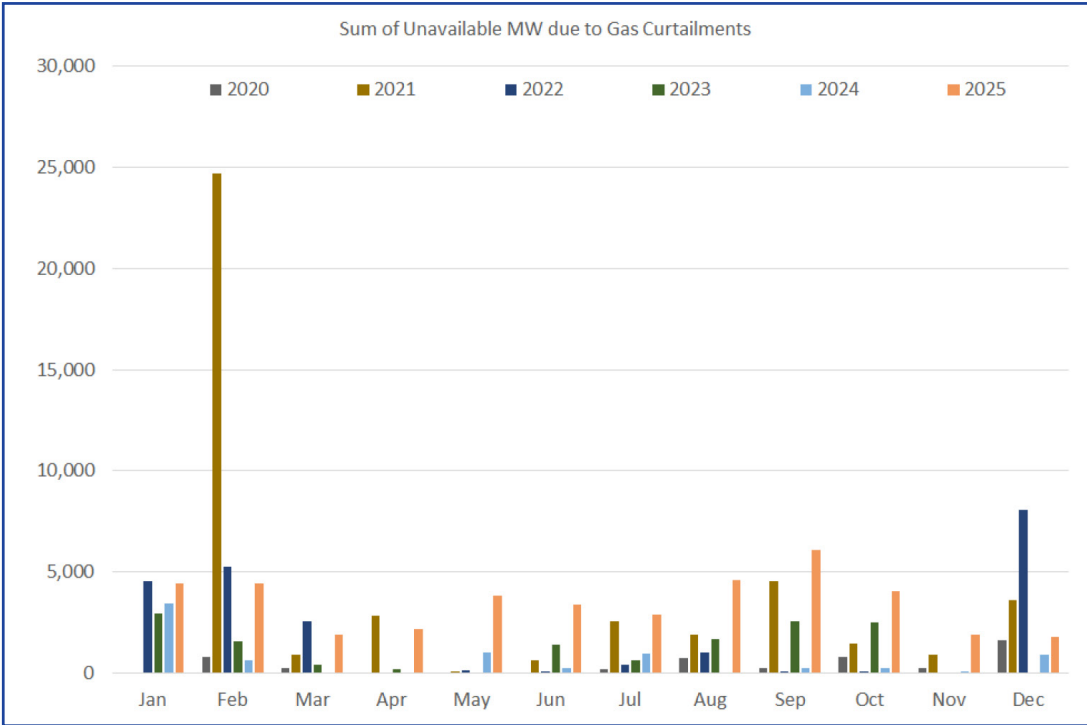
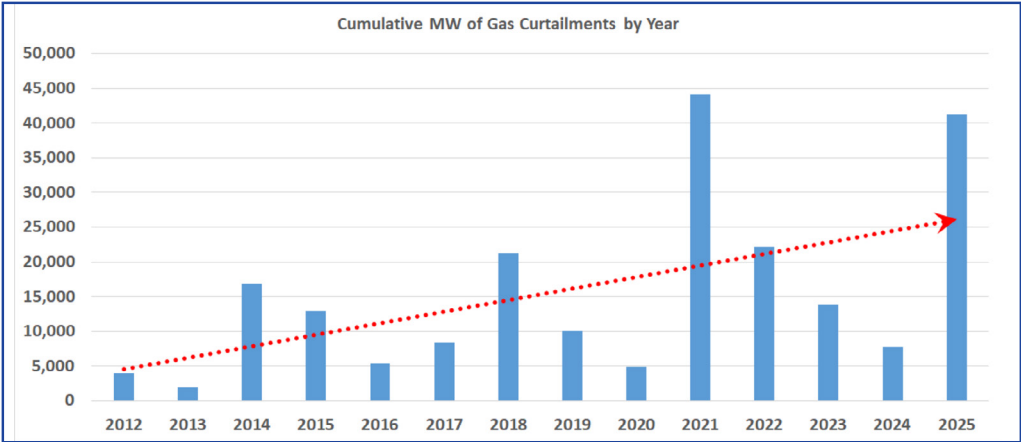


2025 KEY FINDINGS: RESOURCE ADEQUACY & PERFORMANCE

There was a significant increase in the unavailable generation capacity due to natural gas fuel curtailments in 2025 compared to 2024. Natural gas curtailment data used in this assessment was sourced from GADS-reported information. Review of the data indicates that gas curtailments during 2025 primarily occurred in the spring, summer and fall months. For transparency and reference, the report includes cumulative natural gas curtailment impacts (MW) by year, and monthly cumulative curtailment impacts for calendar year 2025.

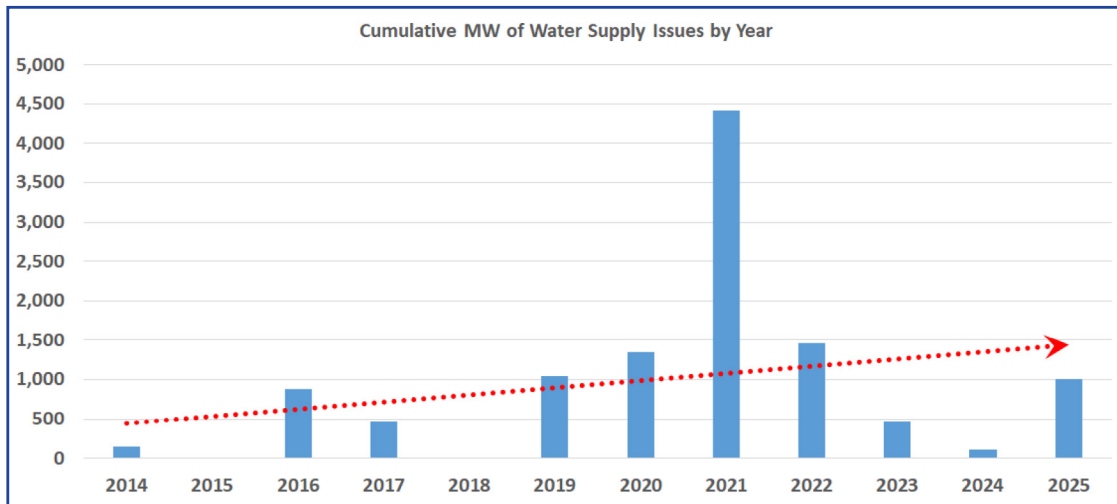
The maximum single-day natural gas curtailment impact recorded for 2025 occurred on September 22, 2025, with an associated cumulative impact of 2,644 MW.

There was a small increase in the unavailable generation capacity due to water supply issues in 2025 (ten generators at two sites) compared to 2024. The total unavailable generation capacity for 2025 was in-line with typical historical values, not including 2021 which was an outlier.



2025 KEY FINDINGS: RESOURCE ADEQUACY & PERFORMANCE

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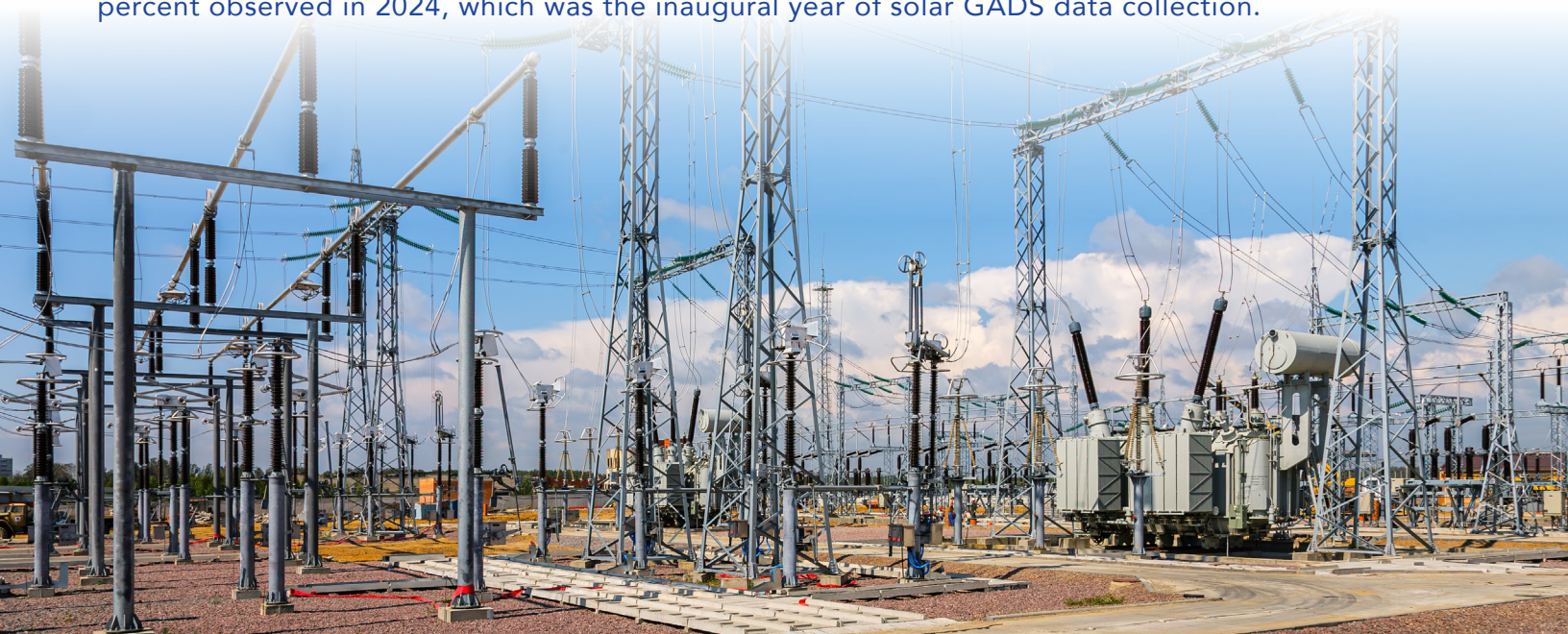


2025 HIGHLIGHTS FROM THE ANALYSIS OF RESOURCE ADEQUACY AND PERFORMANCE INCLUDE:

- Primary Frequency Response achieved a rolling average of 2,127 MW/0.1 Hz for 2025 versus NERC Obligation of 455 MW/0.1 Hz.
- No Reportable Balancing Contingency Event Recovery Period failures occurred in 2025.
- No Reportable Balancing Contingency Events greater than the Most Severe Single Contingency (MSSC) occurred in 2025.
- IROLs were exceeded five times (totaling 15 minutes) in 2025.

AREAS TO MONITOR INCLUDE:

- GADS EFOR (unweighted) for thermal resources was 12.7 percent for 2025, which was a significant increase from 10.1 percent in 2024. The GADS WEFOR (unit MW weighted) for thermal resources was 12.6 percent in 2025, which was a significant increase from 8.6 percent in 2024.
- GADS Wind Resource EFOR was 17.7 percent in 2025 and remained within the five-year long-term range of 14-18 percent.
- GADS Solar Resource Forced Outage Rate (RFOR) was 11.1 percent in 2025, a slight increase from 10.0 percent observed in 2024, which was the inaugural year of solar GADS data collection.

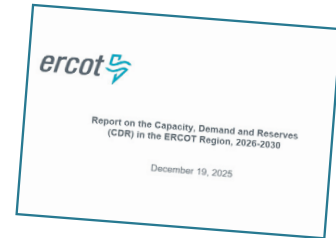


2025 KEY FINDINGS: BULK POWER SYSTEM PLANNING

BULK POWER SYSTEM PLANNING



The [2025 NERC Long-Term Reliability Assessment \(LTRA\)](#) shows a planning reserve margin above the 13.75 percent reference margin for the next five years in the Region. However, [ERCOT's December 2025 Capacity, Demand and Reserves \(CDR\)](#) report shows negative reserve margins as early as 2028 due to the inclusion of large loads dominated by data centers, oil and gas production facilities, and cryptocurrency facilities. The difference between the planning reserve margins shown in the NERC 2025 LTRA and the negative reserve margins reflected in



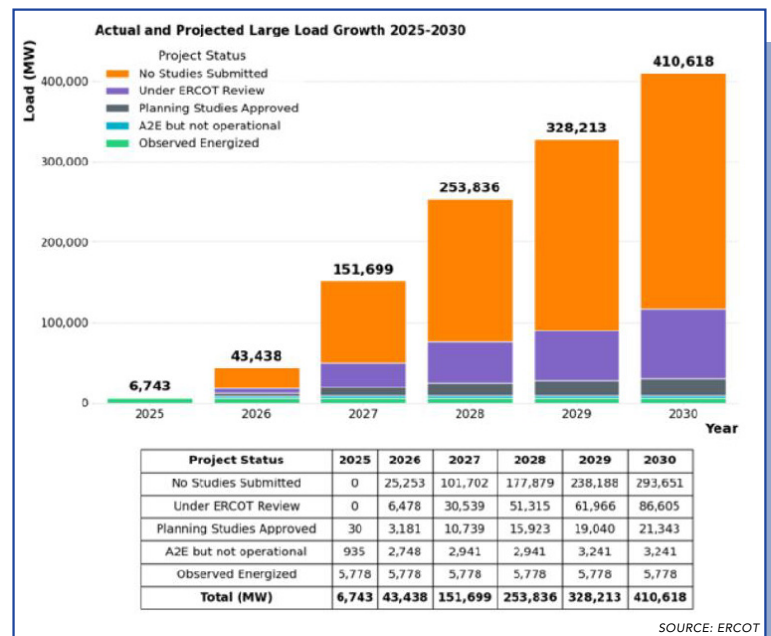
ERCOT's December 2025 CDR report is primarily driven by differences in modeling assumptions related to large load treatment in the planning reserve margin calculation. The LTRA incorporates assumptions for potential large-load curtailments associated with price responsiveness and the anticipated implementation criteria under Senate Bill 6 (SB6). This is consistent with the assumptions in the probabilistic energy assessment conducted by ERCOT in 2025 and reflect the likelihood that a portion of these loads may be curtailed voluntarily or by the operators during system stress conditions. In contrast, the ERCOT CDR reflects a more deterministic outlook, including the full contribution of large loads included in the forecast without assuming curtailment behavior. These differing assumptions result in higher effective reserve margins in the LTRA relative to the CDR, particularly in the latter years of the forecast horizon.

Large Load Integration

The Region has experienced continued rapid growth from data centers, industrial oil and gas production facilities, and other cryptocurrency mining operations. As of January 2026, approximately 8,576 MW have been energized or approved to energize. Current large load interconnection request queues indicate such load totals could reach up to 17,900 MW of new loads with approved planning studies and an additional 82,000 MW of load under ERCOT review by the end of 2030.

Integration of these loads has resulted in modifications to existing methodologies, such as load forecasts, to capture aspects of flexibility and price responsiveness more accurately. This is demonstrated by a new assumption in the long-term load

forecast methodology that credits large flexible loads for a 15 percent curtailment during on-peak hours based on this price sensitivity. In the [2025 Regional Transmission Plan \(RTP\)](#), the large loads submitted by Transmission Service Providers (TSPs) were significantly greater compared to the 2024 RTP. The forecasted summer peak demand for 2031 would have exceeded 218 GW if all TSP-submitted large loads were included.



2025 KEY FINDINGS: BULK POWER SYSTEM PLANNING

Public

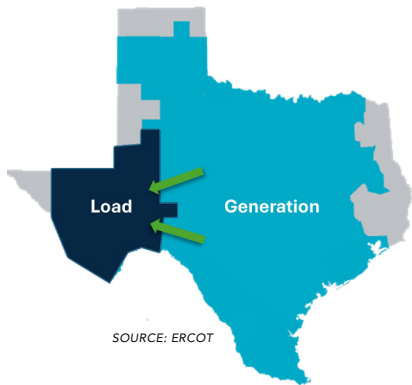
After performing a historical analysis on large load realization, ERCOT developed an ERCOT Transmission Planning Adjusted Load Forecast (ETPALF), which adjusted the 2031 forecast from 218 GW to 159 GW. The ETPALF preserved large loads substantiated with an interconnection agreement at 100 percent; large loads substantiated with officer attestations (“Officer Letters”) were reduced to 55.4 percent; and, data center officer letter loads (OLLs) were further reduced to 49.8 percent of the initial OLL reduction, resulting in a final amount that was 27.6 percent of the full data center value. In addition, Nodal Protocol Revision Request (NPRR) 1234 and PGRR 115 were both approved in 2025 to formalize the interconnection process for large loads and establish operational standards to maintain reliability.

West Texas Load Growth and 765 kV Infrastructure Proposals

In the [2025 RTP](#), the Far West weather zone load is forecasted to approach 19 GW by 2030 and exceed 20 GW by 2031 under summer peak conditions. This is attributed to the projected oil and gas load along with other large loads seeking to be connected. As shown in the table, the Far West and North weather zones are experiencing tremendous demand and energy growth compared to other areas of the Region.

Weather Zone	2025 Coincident Peak Demand (vs. 2024)	2025 Energy (vs. 2024)	Five-year Coincident Peak Demand Growth	Five-year Energy Growth
Coast	-1.2 %	4.9 %	11.6 %	17.2 %
East	3.2 %	4.5 %	25.5 %	15.8 %
Far West	18.9 %	12.6 %	100.9 %	100.6 %
North Central	1.7 %	3.5 %	9.3 %	15.2 %
North	6.4 %	16.0 %	67.7 %	117.3 %
South Central	-0.3 %	4.9 %	14.8 %	28.6 %
South	8.6 %	6.0 %	25.7 %	25.5 %
West	0.9 %	2.6 %	10.2 %	13.6 %
ERCOT Total	-1.9 %	6.4 %	13.1 %	30.0 %

Load growth in Far West Texas is expected to occur faster than expected transmission upgrades. As a result, ERCOT identified two new generic transmission constraints (GTCs) in September 2025 related to the ability to import power into the Far West area. These two new GTCs are being treated in IROLs and may require localized load shedding to avoid exceeding the GTC limits.



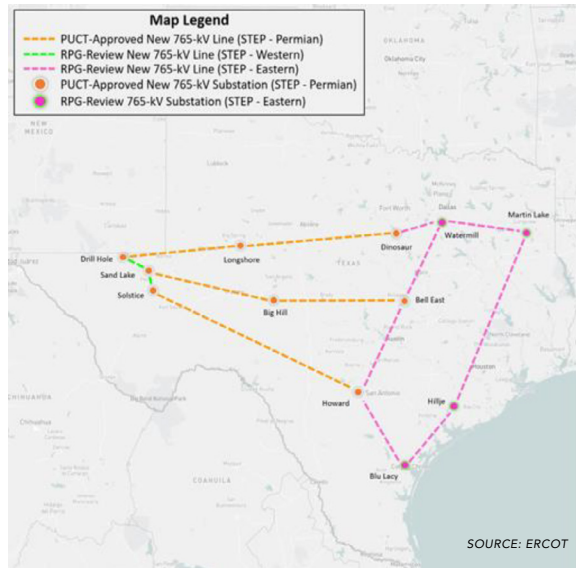
To begin to address these transmission issues, the Texas Legislature passed [House Bill 5066](#) in the 2023 legislative session, requiring, among other things, that the PUCT develop and approve an electric reliability plan for the Permian Basin region to support the on-going expansion and electrification of Texas’ oil and gas industry.

As part of the work to implement this legislative mandate, ERCOT developed a 765 kV infrastructure proposal as an alternative to the traditional 345 kV solutions to meet the unprecedented increase in forecasted load growth in Texas and particularly the Permian Basin. Working through the stakeholder process, ERCOT prepared a comprehensive comparison of the benefits and merits of a 345 kV transmission plan versus a 765 kV solution and shared this with stakeholders at a workshop in January 2025. ERCOT also

2025 KEY FINDINGS: BULK POWER SYSTEM PLANNING

developed the Permian Basin Reliability Plan study, which identified both local transmission needs and import needs with 345 kV and 765 kV options.

On September 26, 2024, the PUCT issued an order approving the Permian Basin Reliability Plan. Subsequently, the PUCT approved construction of the initial three 765 kV import paths into the Permian Basin on April 24, 2025, as part of initial approval of ERCOT's STEP. Following this action, ERCOT's Board of Directors endorsed two



additional 765 kV transmission projects in December 2025. Overall, the STEP includes 192 reliability projects to address all reliability violations in the 2025 RTP, including the 765 kV STEP projects. In total, the STEP plan contemplates construction of 2,468 miles of new 765 kV lines, 649 miles of new 345 kV lines, and over one thousand miles of upgrades to existing 345 kV lines among other enhancements. Such system upgrades include new substations, transmission line additions, upgrades and rebuilds, new 345/138 kV transformers, existing 345/138 kV transformer upgrades, and the addition of capacitor banks and reactors.

Initial work is currently underway on the 765 kV backbone projects with targeted in-service dates of 2029 to 2030.

2025 HIGHLIGHTS FROM THE ANALYSIS OF BULK POWER SYSTEM PLANNING INCLUDE:

- Summer Peak: Actual 83,876 MW versus projected 85,721 MW
- Winter Peak: Actual 80,376 MW versus projected 80,850 MW
- Renewable Percentage of Total Load at Summer Peak: 38.5 percent
- Peak hourly wind generation: 28,265 MW on March 3, 2025
- Peak hourly solar generation: 29,503 MW on September 9, 2025
- Peak hourly renewable penetration: 75.6 percent on March 2, 2025

AREAS TO MONITOR INCLUDE:

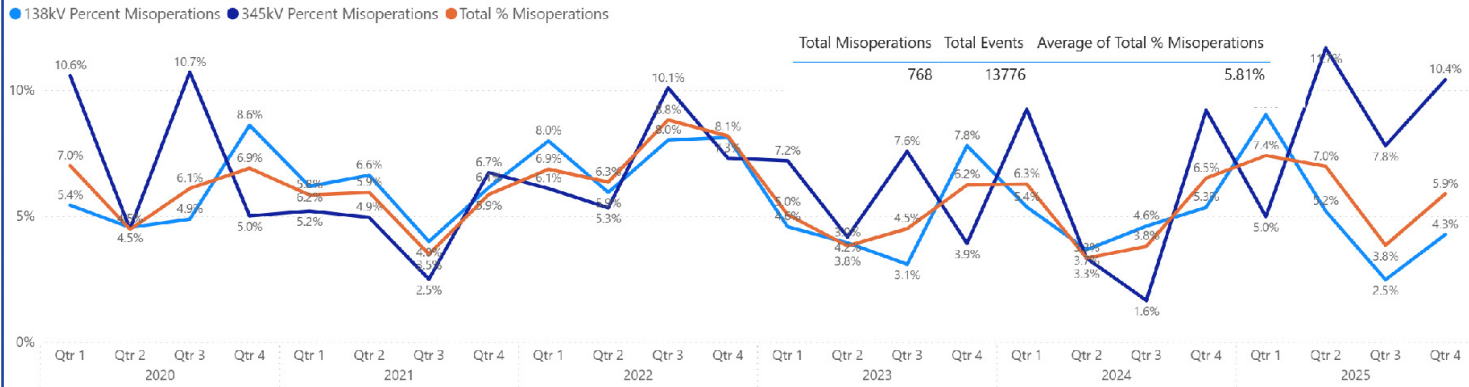
- Energy growth rates in the North and Far West Weather zones continue to drive the overall Region demand, increasing by 16.0 percent and 12.6 percent respectively over last year. Overall, the Region's energy growth increased by 6.4 percent year-over-year.
- Transmission solutions for load growth will be monitored and reviewed. Inclusion of these transmission projects into NERC's future transmission assessment strategy is critical.
- As of December 2025, ERCOT projections indicate utility-scale solar generation will increase almost 175 percent to almost 65,000 MW, wind generation will increase 16 percent to more than 47,500 MW, and storage resources will increase 225 percent to over 37,400 MW during the next two years (based on current signed generation interconnect agreements with financial security).

2025 KEY FINDINGS: PROTECTION & CONTROL SYSTEMS

Public

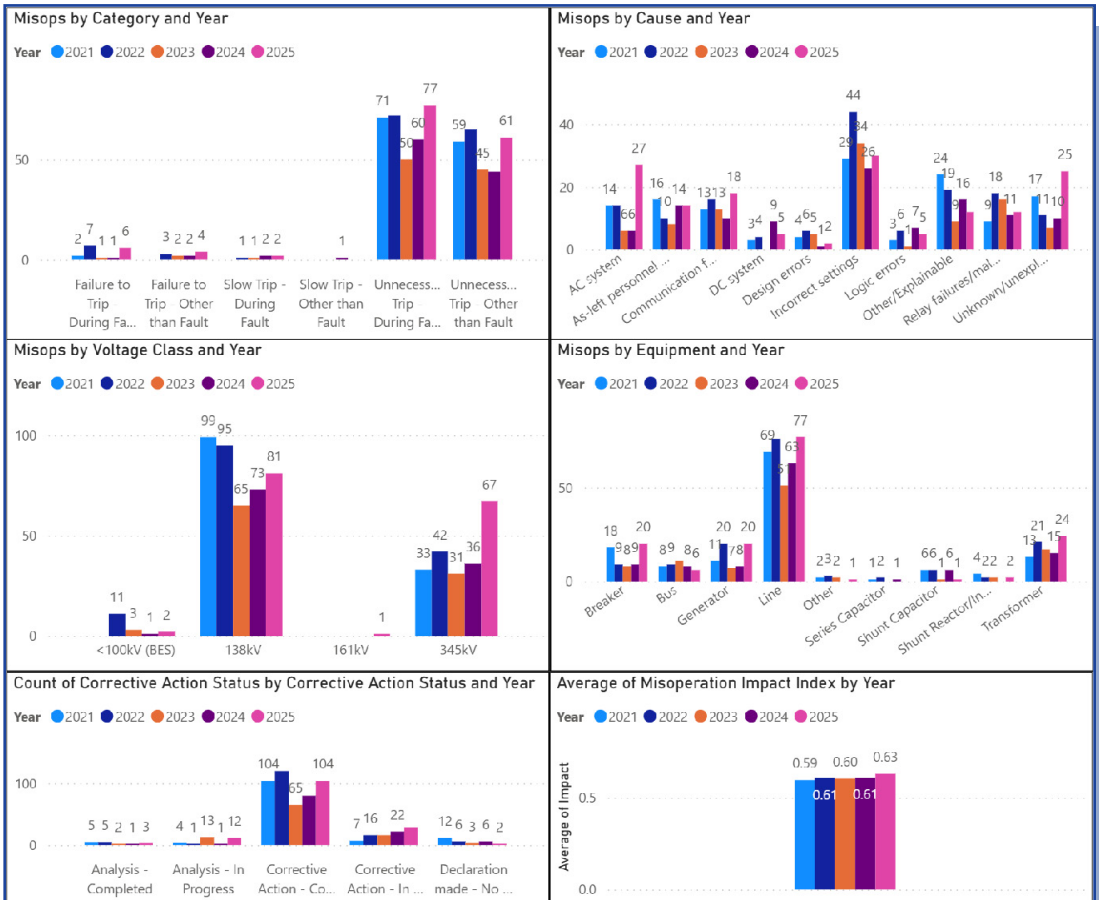
PROTECTION & CONTROL SYSTEMS

138kV Percent Misoperations and 345kV Percent Misoperations by Quarter



2025 HIGHLIGHTS FROM THE ANALYSIS OF PROTECTION SYSTEM MISOPERATIONS INCLUDE:

- Since January 2021, the overall transmission system Protection System Misoperation rate has increased slightly, from 5.2 percent in 2021 to 6.0 percent in 2025. The five-year average Misoperation rate from 2021-2025 was 5.5 percent.
- In 2025, three main categories account for 60 percent of the total Misoperations: incorrect settings/logic/design (25 percent), AC systems (18 percent), and unknown (17 percent). Incorrect settings continue to be the largest category of Misoperations over the past five years.
- Misoperations due to incorrect settings, as-left personnel errors, and relay failures remained flat or stable in 2025 compared to 2024.
- Misoperations due to AC systems, communications systems, and unknown showed significant increases in 2025 compared to 2024.
- Corrective actions were completed or are in-progress for approximately 70 percent of Misoperations that occurred in 2025.

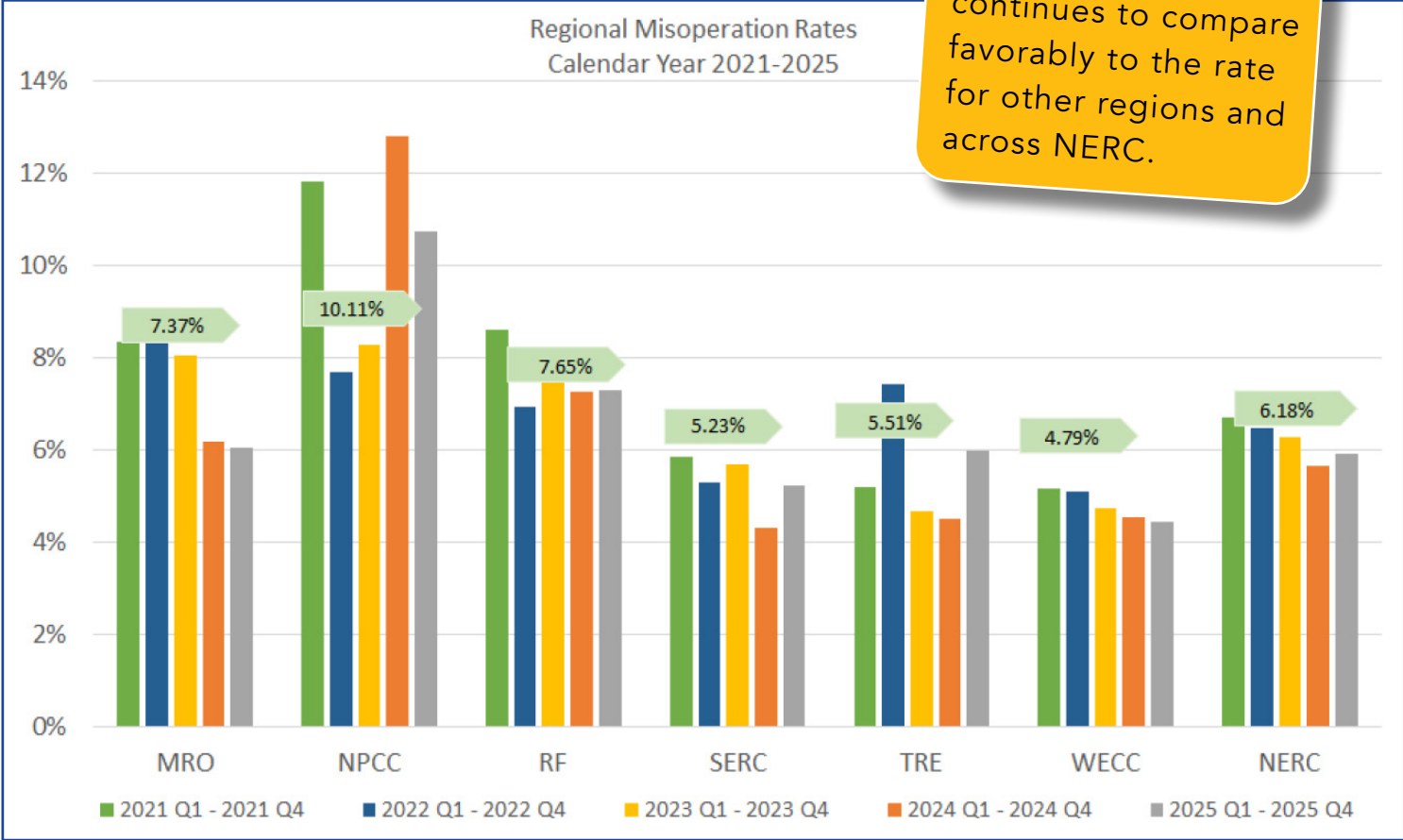


2025 KEY FINDINGS: PROTECTION & CONTROL SYSTEMS

AREAS TO MONITOR INCLUDE:

- Incorrect settings, logic, and design errors remained the largest cause of Misoperations, accounting for 26 percent of Misoperations in 2025.
- Misoperations with an unknown cause continued to increase in 2025, which warrants additional monitoring.

The Texas RE Region Protection System Misoperation rate continues to compare favorably to the rate for other regions and across NERC.



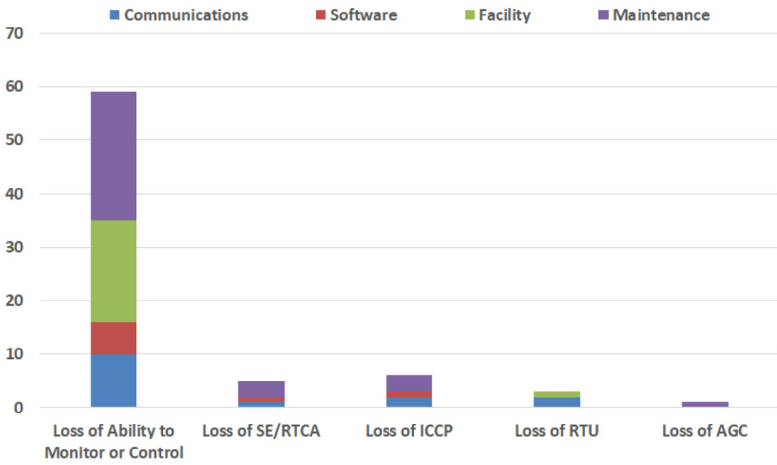
Protection System Misoperations were a contributing factor in only one system event in 2025 categorized under the NERC events analysis process.

2025 KEY FINDINGS: SITUATIONAL AWARENESS CHALLENGES

Public

SITUATIONAL AWARENESS CHALLENGES

Loss of Situational Awareness Events by Type and Attributes

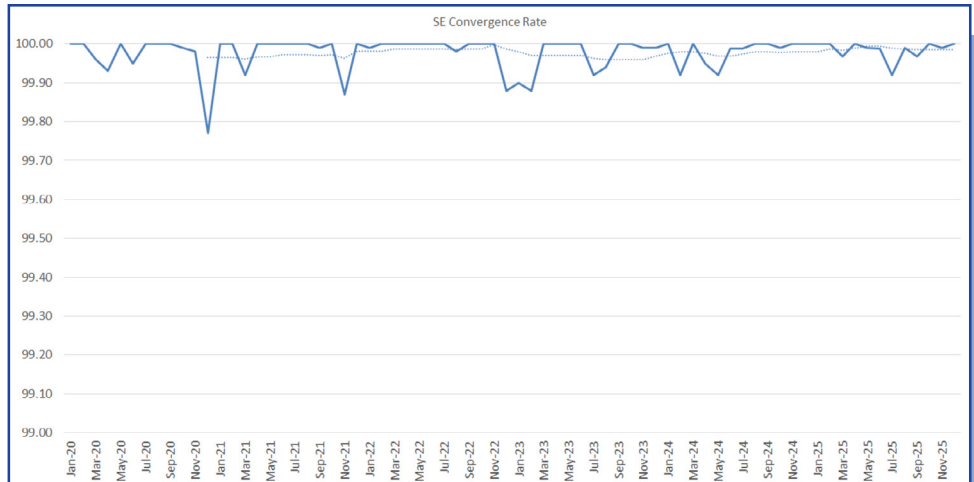


LOSS OF SITUATIONAL AWARENESS EVENTS ARE BROKEN DOWN INTO SEVERAL CATEGORIES BY THE CAUSE OF THE EVENT. THESE ARE:

- Loss of ability to monitor or control
- Loss of State Estimator (SE) or Real-time Contingency Analysis (RTCA)
- Loss of Inter-Control Center Communication Protocol (ICCP) links
- Loss of remote terminal units (RTUs)
- Loss of Automatic Generation Control (AGC)

2025 HIGHLIGHTS FROM THE ANALYSIS OF LOSS OF SITUATIONAL AWARENESS INCLUDE:

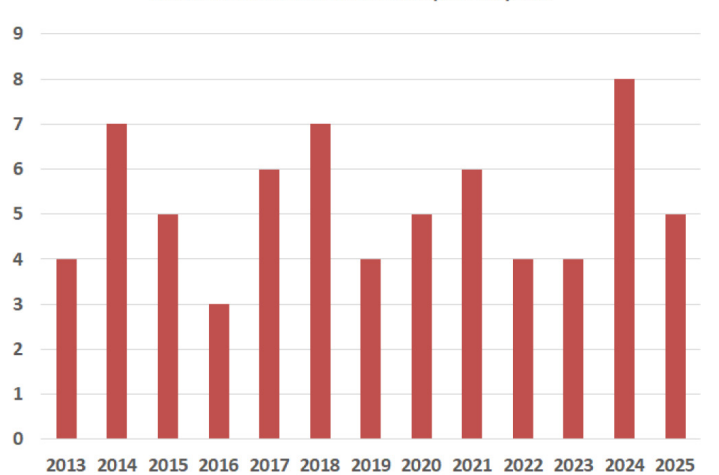
- Convergence rates for ERCOT's state estimator continue to surpass the goal of 97 percent, exceeding 99.98 percent in 2025.
- Overall telemetry availability rates remain stable at approximately 96 percent overall. Telemetry availability for points critical for state estimator was 92.4 percent.



AREAS TO MONITOR INCLUDE:

- A total of five Category 1 loss of System Control and Data Acquisition (SCADA) or Energy Management System (EMS) events were reviewed in 2025 at Transmission Operators' control facilities. Average duration was approximately 79 minutes.

Loss of EMS and SCADA Events Reported by Year



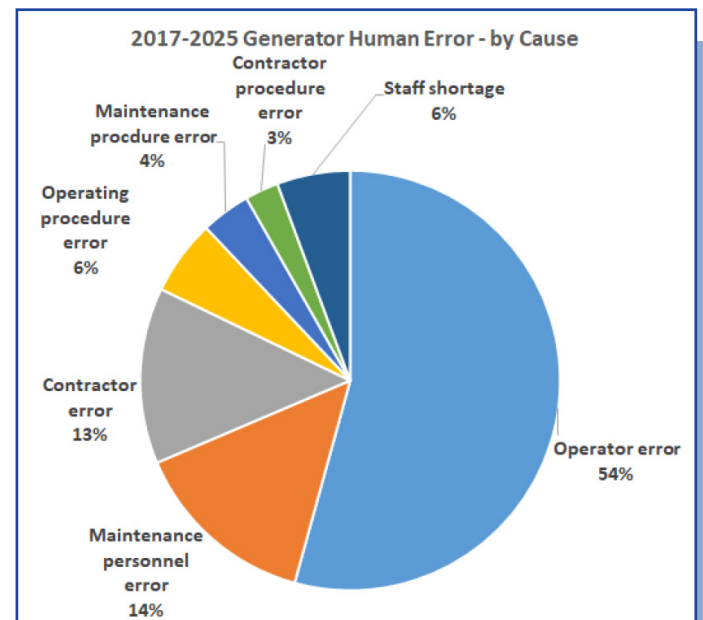
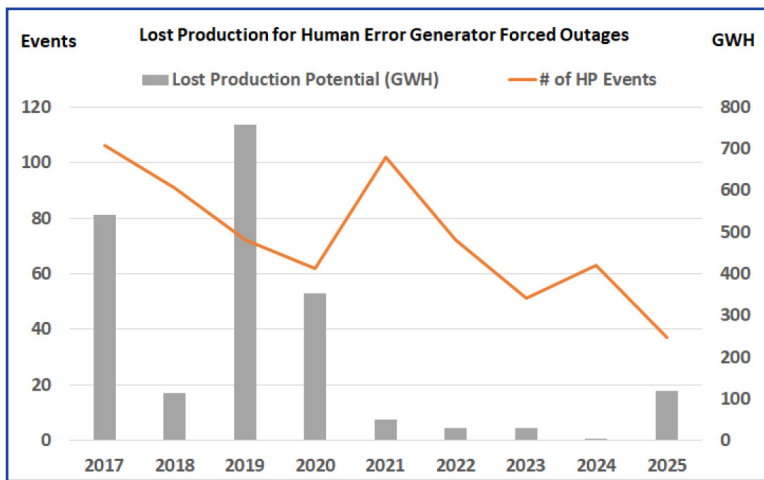
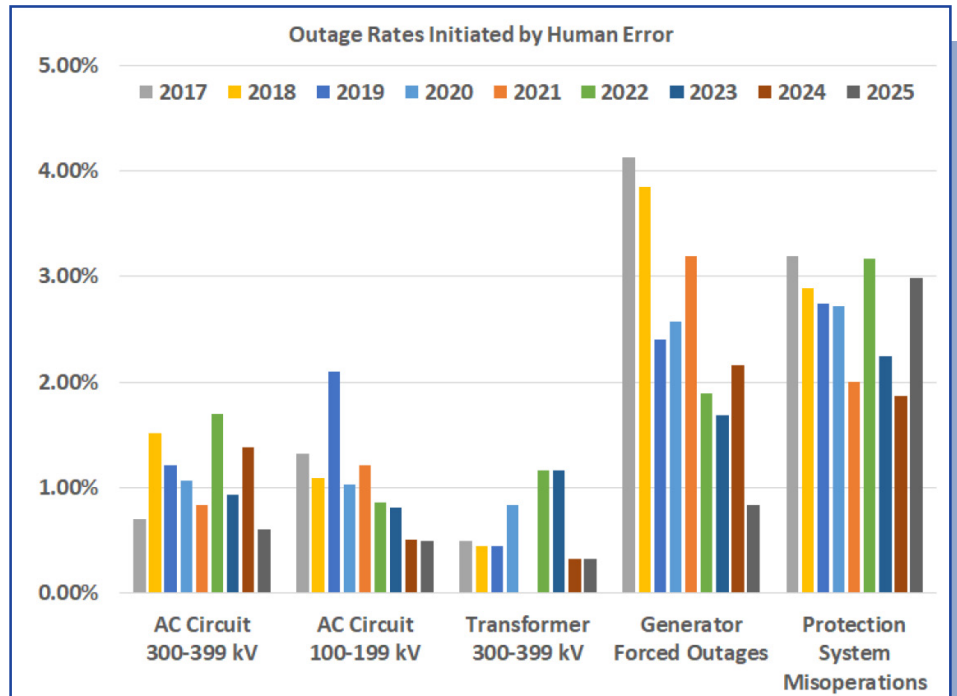
HUMAN PERFORMANCE

2025 HIGHLIGHTS FROM THE ANALYSIS OF HUMAN PERFORMANCE INCLUDE:

- Outage rates in GADS data caused by human error decreased in 2025.
- Human error outage rates for 138 kV circuits remained stable in 2025.
- TADS human error outage rates for 345 kV circuits decreased in 2025 compared to 2024.
- Protection System Misoperations from incorrect settings and personnel errors increased in 2025.

AREAS TO MONITOR INCLUDE:

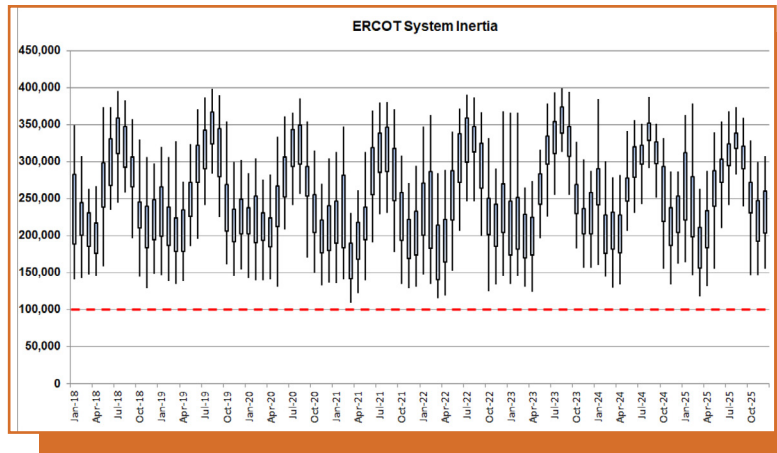
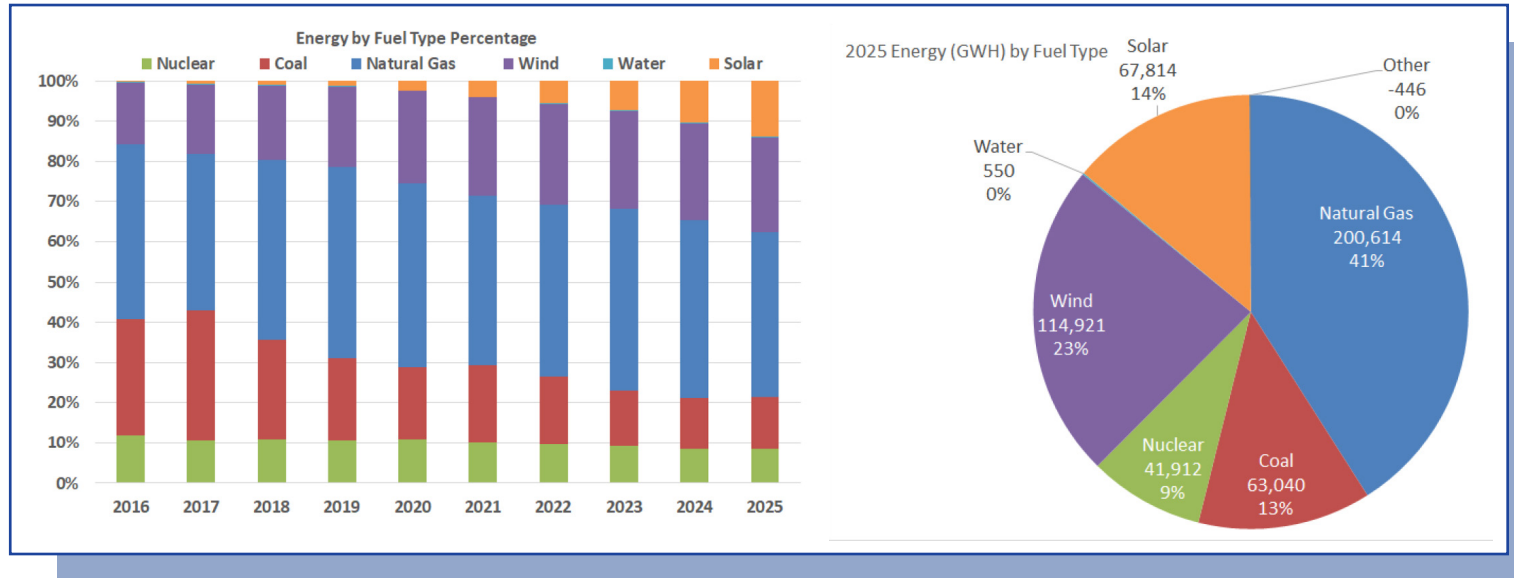
- Causal analysis of human errors in events and Protection System Misoperations continue to show repeated issues due to lack of adequate error checking processes and procedures.
- Overall transmission and generation outage rates due to human error are showing slight improvement in long-term trends.



2025 KEY FINDINGS: CHANGING RESOURCE MIX

Public

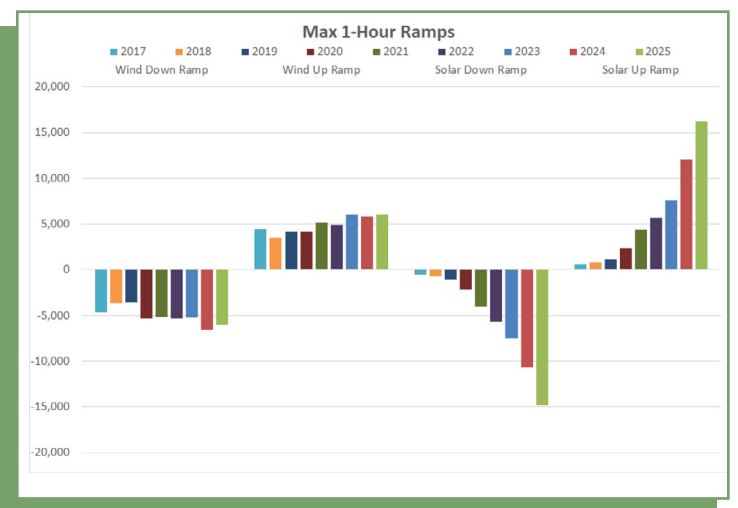
CHANGING RESOURCE MIX



Since 2017, renewable generation has increased from 18% to 37% of energy while coal has decreased from 32% to 14%.

In 2025, approximately 13,750 MW of renewable and storage generation were approved for commercial operation. The margin between minimum inertia conditions and critical inertia levels remains well within adequate safety margins.

Evening solar down ramps continue to increase (especially during the summer months) as shown in the chart below. In 2025, the maximum solar down ramps exceeded 15,000 MW per hour. Flexible quick start and battery resources were most often used to ensure resource adequacy, control system frequency, and meet ramping needs.

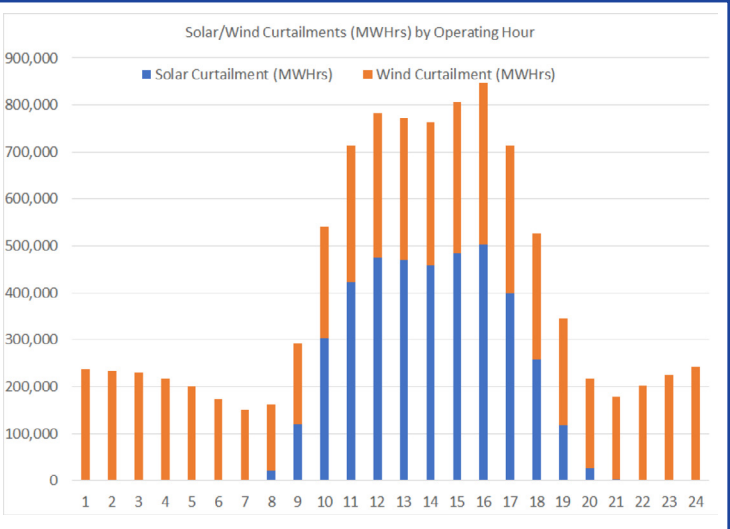
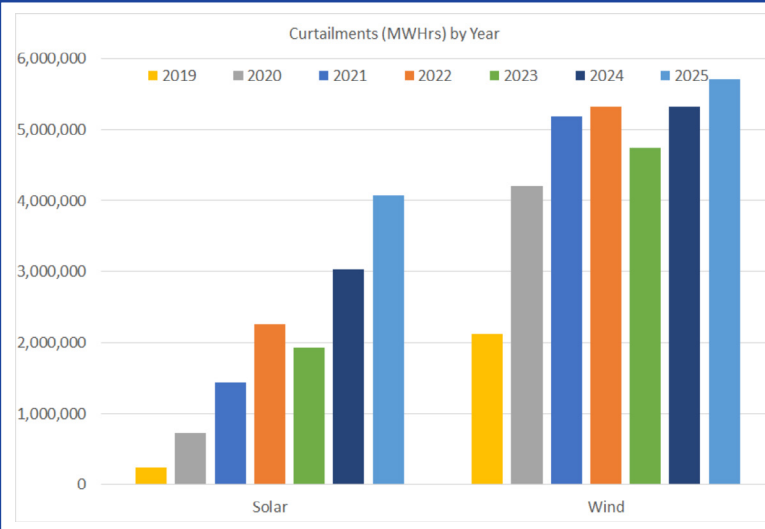
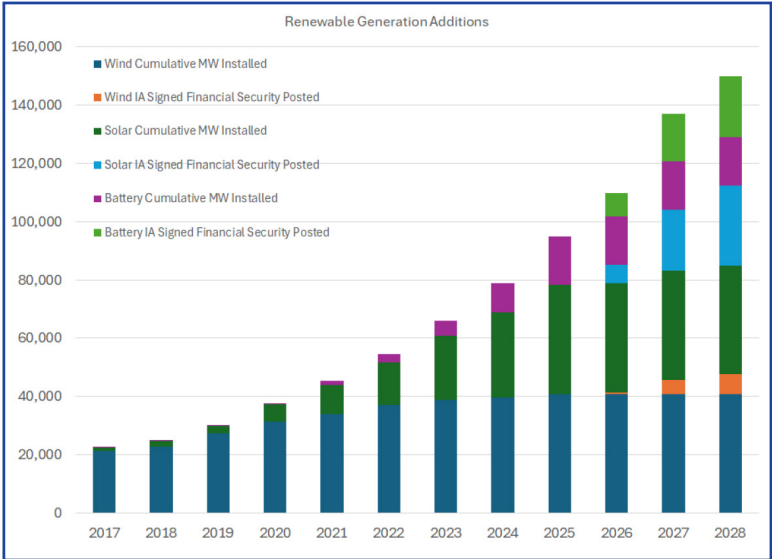


2025 KEY FINDINGS: CHANGING RESOURCE MIX

Today’s resource mix continues to evolve with the addition of inverter-based generation resources and energy storage. Exponential increases in both solar and storage resources are projected though wind resource growth has slowed. Stability challenges and large solar ramp periods will continue to be significant issues. Voltage and dynamic stability constraints associated with large-scale power transfers from West Texas to the east and from South Texas to the north are expected to continue. Management of stability constraints through GTCs in West and South Texas will continue to result in curtailments of wind and solar energy in order to manage power transfers within stability limits. Load growth in Far West Texas is expected to occur faster than expected transmission upgrades.

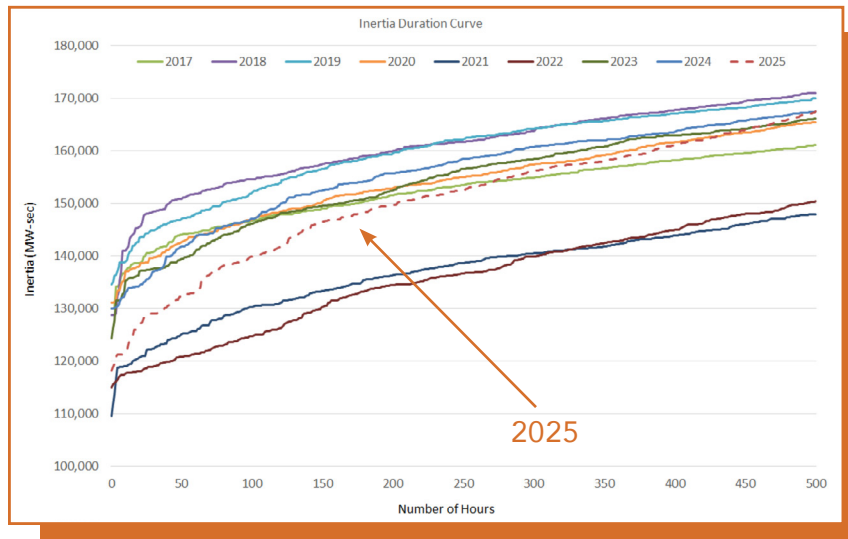
As a result, ERCOT identified two new IROLs in September 2025 related to the ability to import power into the Far West area under low solar/wind conditions.

Combined wind and solar generation curtailments increased by 17 percent in 2025, from 8,362 GWh in 2024 to 9,777 GWh in 2025.



2025 KEY FINDINGS: CHANGING RESOURCE MIX

Public

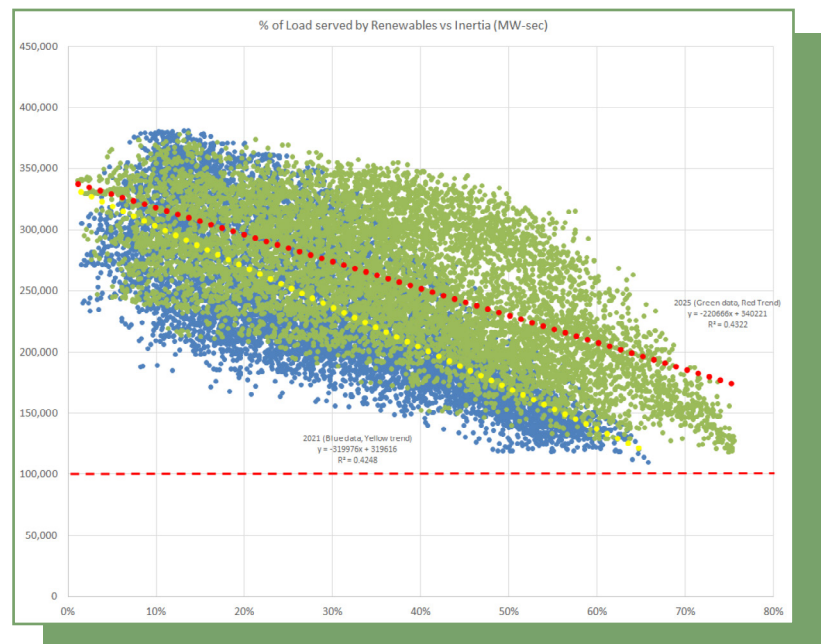


This chart shows a comparison of inertia levels during the lowest inertia hours. Overall system inertia in 2025 (dashed line) remained near historic norms, at or below the levels from 2024. The minimum hourly inertia level in 2025 was 118.3 GWs on March 18, 2025, at HE12 when the intermittent renewable resource (IRR—i.e., solar and wind generation) penetration level was 74.9 percent and system load was 48,973 MW (net load of 12,290 MW).

This chart shows the relationship between the percentage of load served by renewables and system inertia levels. The chart compares 2021 versus 2025. It shows how the 2025 slope of the regression trend line has shifted and flattened as renewable penetration levels increased.

2025 HIGHLIGHTS FROM THE ANALYSIS OF CHANGING RESOURCE MIX INCLUDE:

- Overall inertia levels in 2025 showed minor change and remained comparable with historical norms.
- Wind and solar curtailments increased in 2025 with long-term curtailment trends continuing to show an increasing rate, particularly for solar generation.



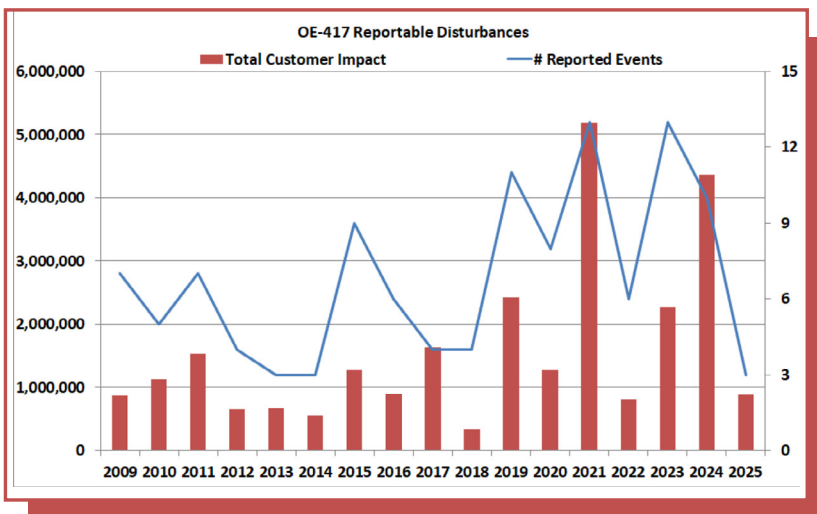
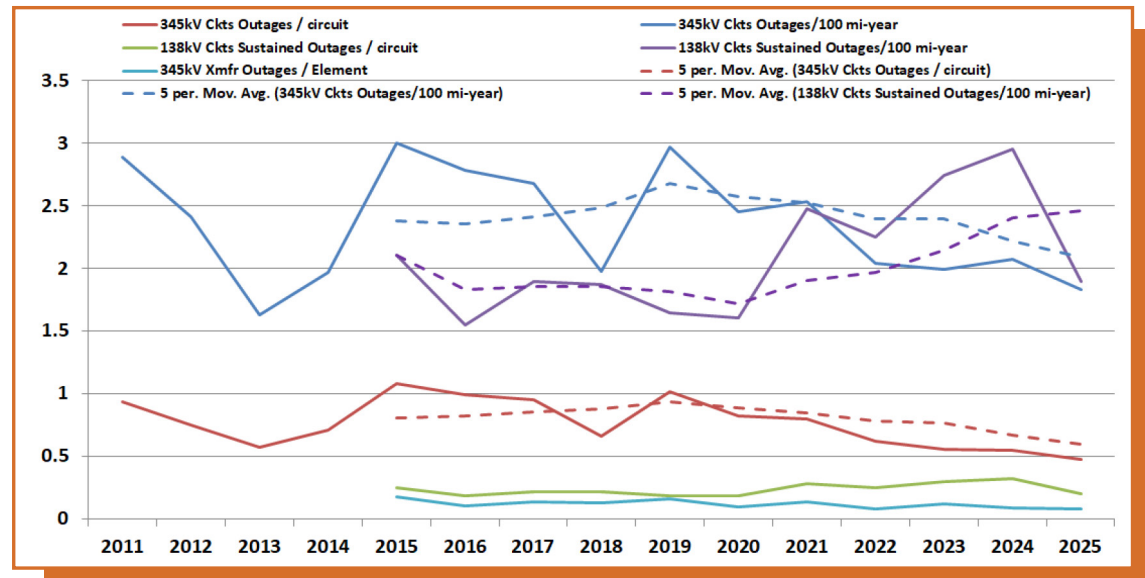
AREAS TO MONITOR INCLUDE:

- The ratio of dispatchable generation to renewable generation continues to evolve. In 2025, almost 7,500 MW of renewable generation and 6,290 MW storage resources were approved for commercial operation.
- Maximum one-hour ramp magnitudes for solar generation are increasing, exceeding 15,000 MW per hour. Increased solar penetration will continue to stress the system during solar down-ramp periods putting additional stress on storage resources and non-spin ancillary services to reduce the risk.
- Low voltage ride-through issues for wind and solar inverters continue to occur, although the number and magnitude of the reductions is improving. Ongoing implementation of the NERC PRC-028, PRC-029, and PRC-030 Standards is expected to reduce the magnitude and impact from these events.

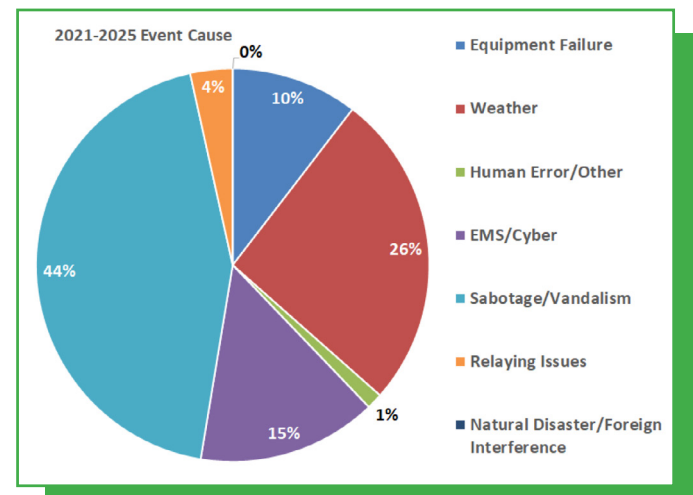
2025 KEY FINDINGS: RESILIENCE TO EXTREME EVENTS

RESILIENCE TO EXTREME EVENTS

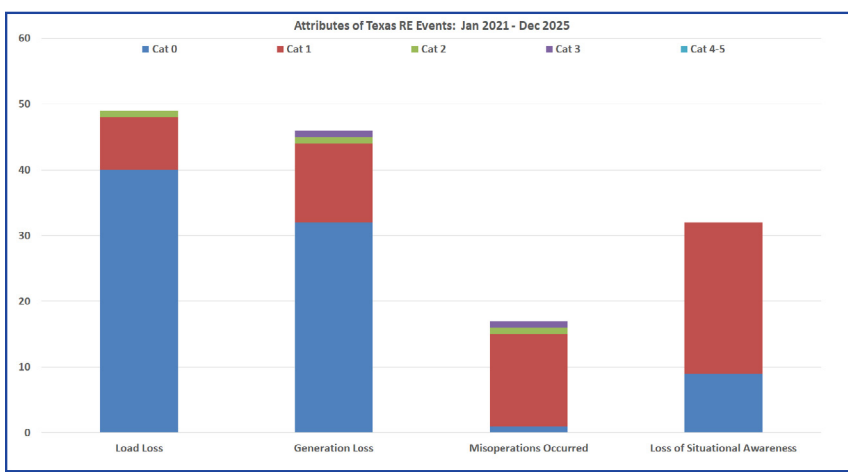
345 kV and 138 kV circuit automatic outage rates in 2025 were at their lowest level in the last five years. As in prior years, duration of sustained outages was primarily due to failed substation or circuit equipment. A single fire-related outage accounted for 85 percent of the 345 kV outage duration.



Significant drop in customer outages in 2025 due to fewer severe weather events.



Equipment failure and weather continue to drive major events.



2025 KEY FINDINGS: RESILIENCE TO EXTREME EVENTS

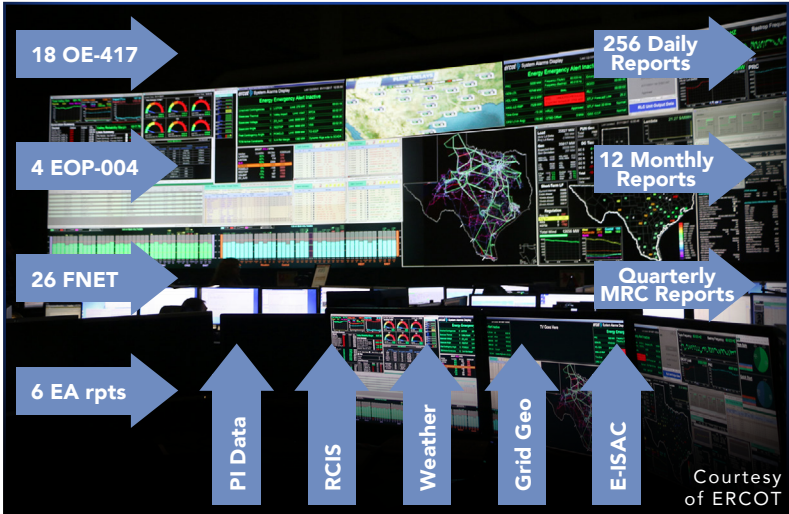
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Multiple extreme events in recent years have tested the transmission grid’s ability to maintain the reliability levels expected by Texans. These include Hurricane Harvey in August 2017, the cold weather event of January 2018, the Panhandle ice storm of October 2020, Winter Storm Uri in February 2021, Winter Storm Elliott in December 2022, Winter Storm Heather in January 2024, and Winter Storms Enzo and Kingston in 2025. Generation system outage performance on extreme days continues to be driven by weather and/or fuel issues.

Date	Number of Generation Outage Events on Extreme Day	Leading Causes for Extreme Day	Cumulative Outage Duration on Extreme Day	Cumulative MW Impact on Extreme Day	Cumulative GWh Impact on Extreme Day
8/27/2017	41	Weather	22,798 hours	10,107 MW	2,917.5 GWh
1/16/2018	84	Balance of Plant/Fuel	2,891 hours	11,893 MW	517.8 GWh
5/11/2019	36	Turbine Generator	1,626 hours	6,449 MW	282.5 GWh
7/1/2020	44	Auxiliary systems	3,352 hours	8,251 MW	247.9 GWh
2/15/2021	187	Weather	6,937 hours	35,241 MW	1,204.1 GWh
12/23/2022	164	Weather	2,180 hours	23,163 MW	321.8 GWh
1/30/2023	65	Turbine Generator/Fuel	2,745 hours	9,327 MW	332.4 GWh
1/15/2024	92	Fuel, Weather	916 hours	10,200 MW	89.6 GWh
1/6/2025	74	Fuel, Weather	4,687 hours	9,884 MW	283.2 GWh

Review of transmission outage data over time shows that rates trend in a consistent range and the relative order of causes has not changed significantly for both 345 kV and 138 kV systems. Failed transmission circuit and substation equipment continued to be the dominant causes of sustained outages’ durations.

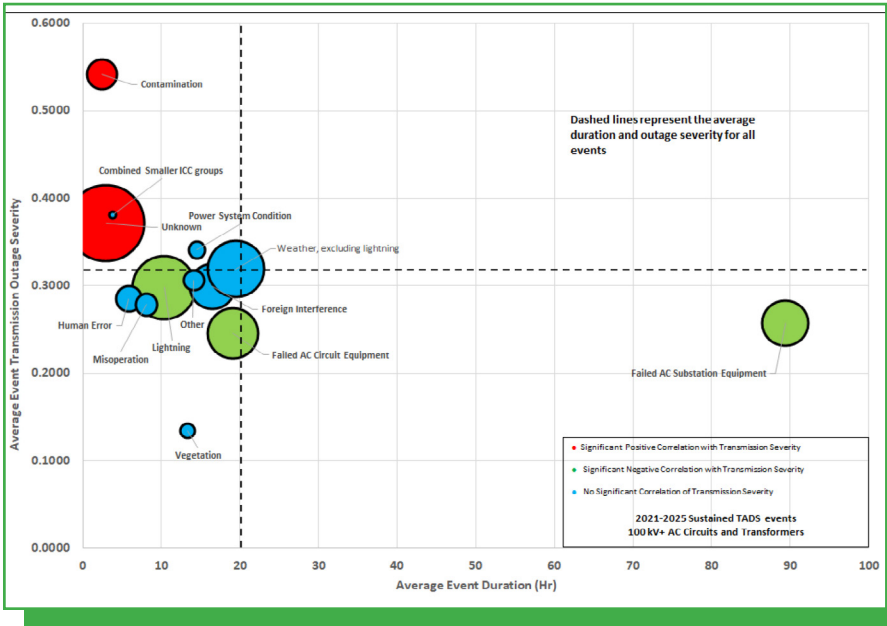
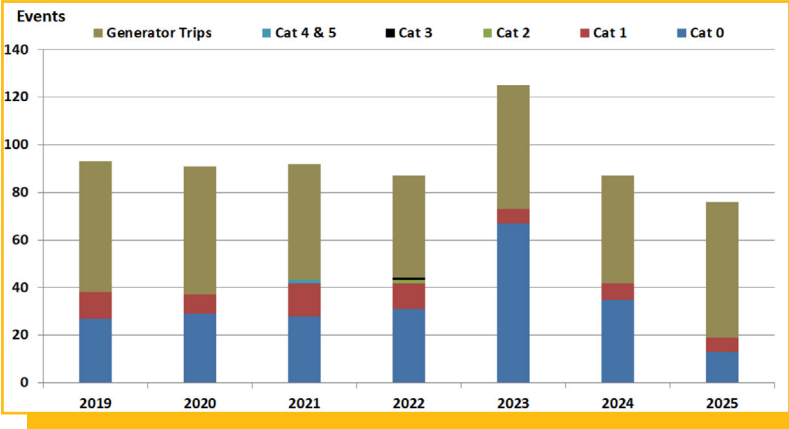
In 2025, Texas RE analyzed 76 BPS events which was on par with historical values. In total, 558 events were reviewed between 2020 and 2025. Of the 403 root and contributing causes identified, the “Equipment/Material” category occurred most frequently with 42 percent of all identified causes. “Design/Engineering” was second with 14 percent, followed closely by “Management/ Organization” with 11 percent. The number of Category 1 events has been stable over the last five years.



Courtesy of ERCOT

2025 KEY FINDINGS: RESILIENCE TO EXTREME EVENTS

Transmission outage severity, as measured by the cumulative ratings of the circuit(s) unavailable due to outage (expressed in megavolt-amperes (MVA)) and duration of the outage, is one measure of transmission system resilience. Outage severity can be further broken down by the causes of the sustained outages.

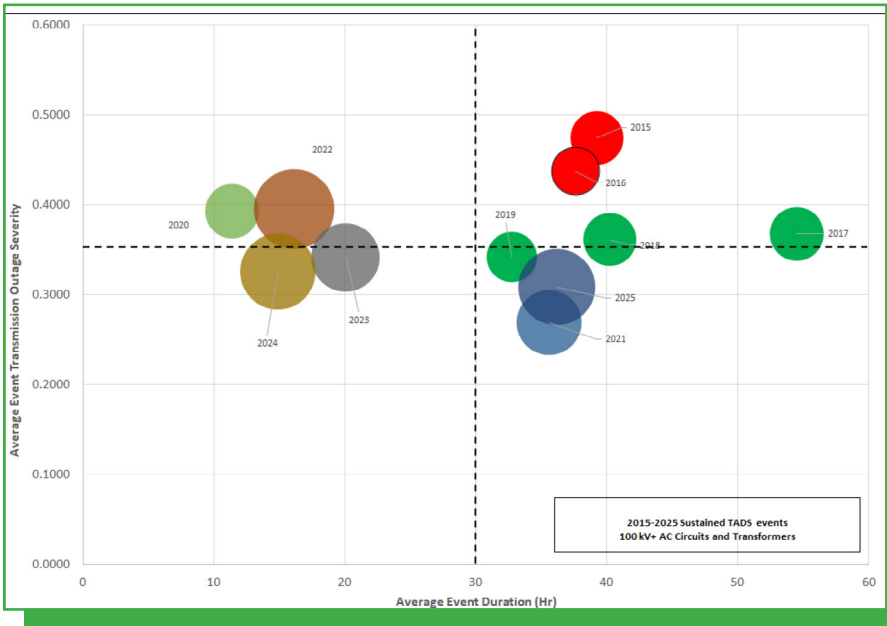


558 events analyzed

403 root and contributing causes identified

Qualified event attributes dominated by:

- Load loss
- Generation loss
- Physical security events



Comparison of overall transmission outage severity from 2015-2025 shows that 2025 was an above average year in terms of outage severity. However, a single fire-related outage in 2025, accounting for 85 percent of the outage duration, severely affected the analysis of the results.

2025 KEY FINDINGS: RESILIENCE TO EXTREME EVENTS

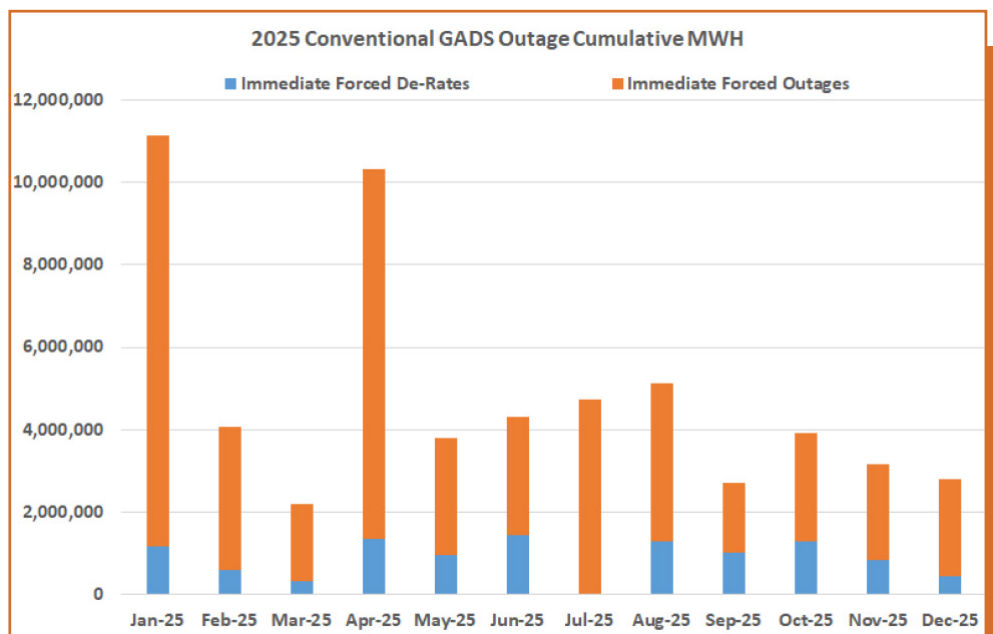
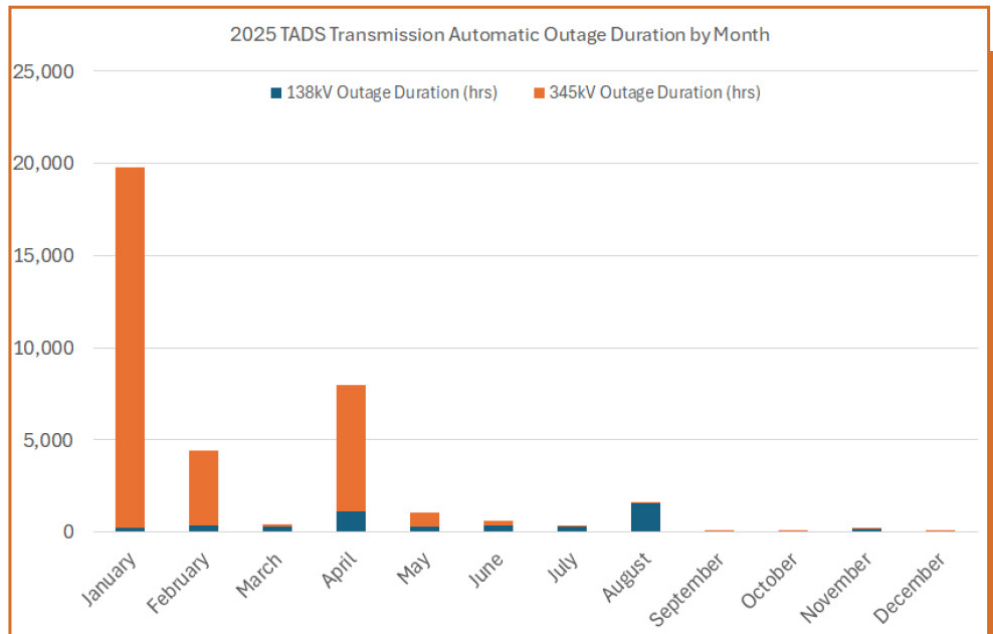
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2025 HIGHLIGHTS FROM THE ANALYSIS OF RESILIENCE INCLUDE:

- Long-term trends are indicating stable trends in outage rates per circuit and per 100 miles of line for the 345 kV and 138 kV systems. The outage rates in 2025 were at their lowest level in the last five years.
- For 345 kV transmission circuits, predominant causes for sustained outages in 2025 were unknown, failed AC substation equipment, and failed AC circuit equipment, representing 54 percent of the total sustained outages. A single fire-related outage accounted for 85 percent of the outage duration.
- For 138 kV transmission circuits, predominant causes for sustained outages in 2025 were failed AC circuit equipment, failed AC substation equipment, and unknown, representing 59 percent of the total sustained outages. Failed transmission circuit equipment, failed substation equipment, and foreign interference accounted for 84 percent of the outage duration.

AREAS TO MONITOR:

- Weatherization of generation resources will continue to be a primary focus for the foreseeable future with the ongoing implementation of the EOP-012 standard.
- Generation system outage performance on extreme days continues to be driven by weather and/or fuel issues.



SECURITY RISKS

Critical infrastructure protection requires sustained vigilance to preserve BPS reliability and security. In 2025, BPS facilities in the Region experienced minimal impact from cyber and physical security events. However, external risks outside the electric industry and the Region persisted including ransomware, social engineering, remote access vulnerabilities, and AI enabled threats, along with continued activity from foreign state-sponsored advanced persistent threats.

2025 CYBER AND PHYSICAL SECURITY INITIATIVES AND RISKS INCLUDED

- November 2024 - Governor Greg Abbott issued Executive Order GA-49 related to the protection of critical infrastructure and to carry out specific tasks. In 2025, implementation of these tasks (e.g. Texas Blackstart Exercise) began.
- January 2025 - Governor Greg Abbott issued a ban prohibiting the use of artificial intelligence and social media apps affiliated with the People's Republic of China (PRC) and the Chinese Communist Party's (CCP) on government-issued devices.
- January 2025 - Governor Greg Abbott directed the Texas Department of Public Safety to surge Texas Anti-Terrorism Task Force resources to aggressively combat radical jihadist terrorism focusing on prevention and protection of our local communities.
- March 2025 - The Office of the Director of National Intelligence National Counterintelligence and Security Center released the 2025 Annual Threat Assessment of the U.S. Intelligence Community.
- April 2025 - President Trump issued an Executive Order on Strengthening the Reliability and Security of the United States Electric Grid.
- June 2025 - NERC issued a Level 2 Industry Recommendation Alert regarding Cross-Border Remote Access to Bulk Power System Elements to all registered GOs or GOPs.
- June 2025 - President Trump issued an Executive Order on Sustaining Select Efforts to Strengthen the Nation's Cybersecurity, Amending Executive Order 13694 and Executive Order 14144.
- December 2025 - President Trump issued an Executive Order on Ensuring a National Policy Framework for Artificial Intelligence.
- The 89th Texas Legislative Session (2025) passed key legislation prioritizing critical infrastructure and security:
 - « Texas Cyber Command (HB 150): Establishes a new entity within The University of Texas System to assume cybersecurity responsibilities from the Department of Information Resources (DIR), including threat monitoring, incident response, and protection for critical infrastructure.
 - « Texas Grid Security Commission (SB 75): Creates a dedicated commission to strengthen the electric grid against physical and cyber threats.
 - « Lone Star Infrastructure Protection Act updates including:
 - Expansion of Foreign Entity restrictions, increased penalties and compliance (SB 2368), and investigation of CCP-aligned tech.
- The Department of Energy (DOE), along with The Cybersecurity and Infrastructure Security Agency (CISA), the National Security Agency (NSA), and the Federal Bureau of Investigation (FBI), issued joint cybersecurity advisories including:
 - « Cybersecurity Advisory - AA25-0022A: Threat Actors Chained Vulnerabilities in Ivanti Cloud Service Applications.
 - « Cybersecurity Advisory - AA25-050A: #StopRansomware: Ghost (Cring) Ransomware.
 - « Cybersecurity Advisory - AA25-071A: #StopRansomware: Medusa Ransomware.
 - « Cybersecurity Advisory - AA25-093A: Fast Flux: A National Security Threat.

2025 KEY FINDINGS: SECURITY RISKS

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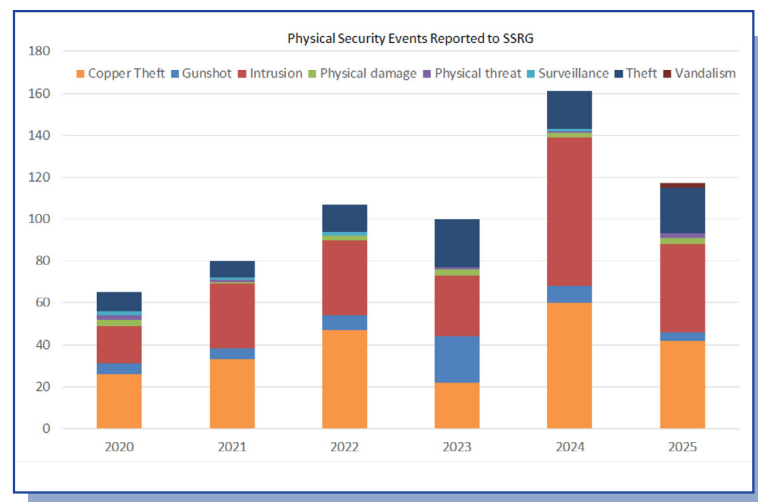
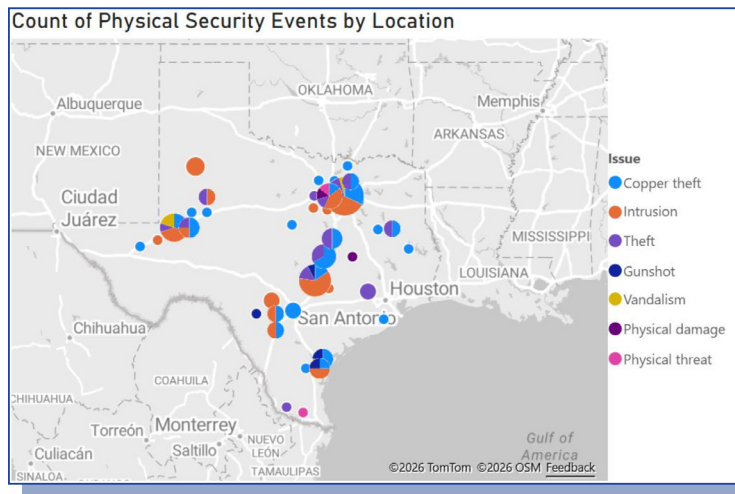
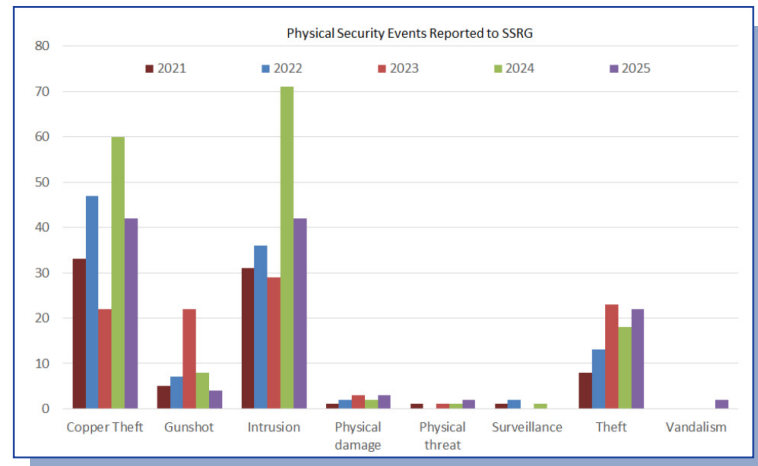
- « Cybersecurity Advisory - AA25-141A: Russian GRU Targeting Western Logistics Entities and Technology Companies.
- « Cybersecurity Advisory - AA25-141B: Threat Actors Deploy LummaC2 Malware to Exfiltrate Sensitive Data from Organizations.
- « Cybersecurity Advisory - AA25-163A: Ransomware Actors Exploit Unpatched. SimpleHelp Remote Monitoring and Management to Compromise Utility Billing Software Provider.
- « Cybersecurity Advisory - AA25-203A: #StopRansomware: Interlock.
- « Cybersecurity Advisory - CISA and USCG Identify Areas for Cyber Hygiene. Improvement After Conducting Proactive Threat Hunt at US Critical Infrastructure Organization.
- « Cybersecurity Advisory - AA25-239A: Countering Chinese State-Sponsored Actors Compromise of Networks Worldwide to Feed Global Espionage System.
- « Cybersecurity Advisory - AA25-266A: CISA Shares Lessons Learned from an Incident Response Engagement.
- « Cybersecurity Advisory - AA25-343A: Pro-Russia Hacktivists Conduct Opportunistic Attacks Against US and Global Critical Infrastructure.

2025 PHYSICAL SECURITY EVENTS AFFECTING BPS FACILITIES

There was a decrease in the number of physical security events reported in 2025 compared to 2024. The majority of the reported events were substation intrusions and copper theft.

Below are a few other notable events:

- Gunshot damage to wind plant pad-mount transformer.
- Multiple individuals showed up at a solar site for employment, apparent victims of an employment scam.
- Individuals attempted to enter wind plant facility with instructions to work on a bitcoin mining unit, which the site did not possess.



2025 KEY FINDINGS: SECURITY RISKS



AREAS TO MONITOR INCLUDE:

Although the overall number of physical security events reported in 2025 declined compared to 2024, the most frequent event types continued to be substation intrusions and copper theft. These recurring incidents underscore an ongoing need to deter unauthorized entry and protect high-value materials that are attractive targets for theft. In addition, 2025 highlighted an emerging physical access risk from employment-related scams, where individuals arrived at generation sites claiming to have been hired or directed to perform work and attempted to gain entry to BPS facilities. This trend—illustrated by reports of multiple individuals appearing at a solar site for employment and attempted entry at a wind plant under instructions to service a non-existent bitcoin mining unit—reinforces the importance of consistent site access controls, identity verification, and clear coordination between operations, security, and contractors.



2025 KEY FINDINGS: CRITICAL INFRASTRUCTURE INTERDEPENDENCIES

CRITICAL INFRASTRUCTURE INTERDEPENDENCIES

In April 2025, FERC released a system performance review of the arctic storms that occurred in January 2025, known as Winter Storms Blair, Cora, Demi, and Enzo ([System Performance Review of the January 2025 Arctic Events](#)). Major takeaways from the review included positive steps taken by natural gas entities to improve preparation for extreme cold weather, highlighting improved communication and coordination, as well as improved gas generator stability. Other items noted in the review included:

- During the January 2025 arctic events, the natural gas system was aided by significant storage withdrawals, on par with week-level peaks seen during Winter Storms Elliott, Gerri, and Heather.
- During the January 2025 arctic events the natural gas system performed well. While some of this improved performance may be a result of the weather being less severe compared to prior winter storms, natural gas entities appear to be showing continuous improvement from prior winter storm experiences on its cold weather performance, preparations, and communications. Natural gas entities should continue to find ways to improve their cold weather preparations and real-time communications with stakeholders during extreme cold weather events.
- Natural gas and electric industry coordination continues to be necessary to address the challenges of preparing for and responding to extreme cold weather. While the participants reported some improvements in natural gas and electric coordination, gaps remain.
- Several natural gas pipelines have increased their issuances of critical notices pertaining to upstream receipt point impacts. Similarly, many electric entities improved their coordination with natural gas suppliers. Nonetheless, transparency issues persist, particularly concerning real-time fuel availability. Multiple electric entities continue to face challenges in obtaining operational impact data from natural gas producers and suppliers, limiting visibility into supply constraints.

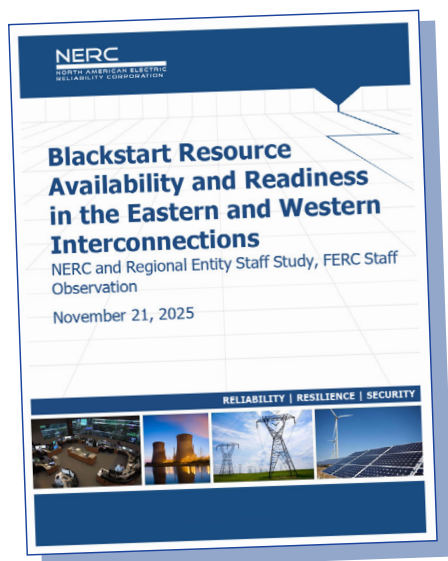
Follow-up continues on two blackstart study reports from FERC that were issued in 2023 and 2025 and highlighted the critical interdependency between the natural gas and electric industries. These were the [FERC,](#)

[NERC, and Regional Entity Staff Study on Blackstart and Next-Start Resource Availability in the Texas Interconnection](#), released in December 2023, and the [Blackstart Resource Availability and Readiness in the Eastern and Western Interconnections](#), released in November 2025.

The key recommendations from the

2025 report related to electric-gas coordination included the following:

1. Dual-fuel Blackstart Resources (BSRs) should identify, mitigate, and communicate the residual risk related to their primary and alternate fuel supply availability and deliverability during a blackout scenario to the



2025 KEY FINDINGS:

CRITICAL INFRASTRUCTURE INTERDEPENDENCIES

entities responsible for the applicable system restoration plans. BSR owners should evaluate primary and backup communication methods with fuel suppliers and delivery entities (e.g., trucking or barge delivery of alternate fuels). This communication should include the identification of critical communication infrastructure that supports both the natural gas system and alternate fuel delivery necessary for BSR participation in restoration in the event of a blackout.

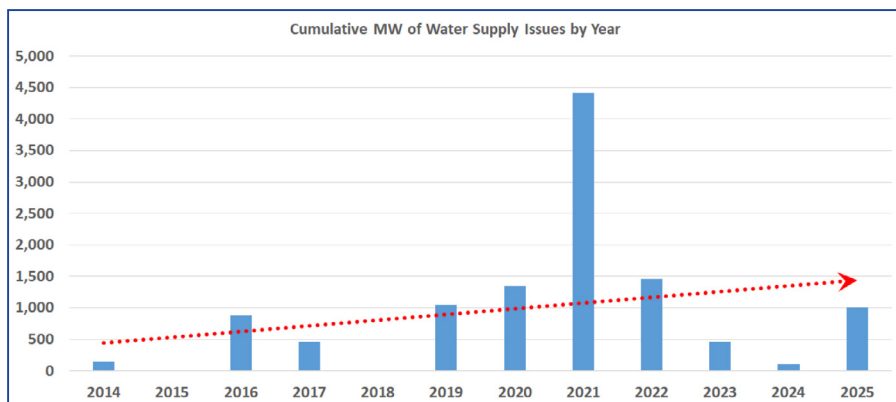
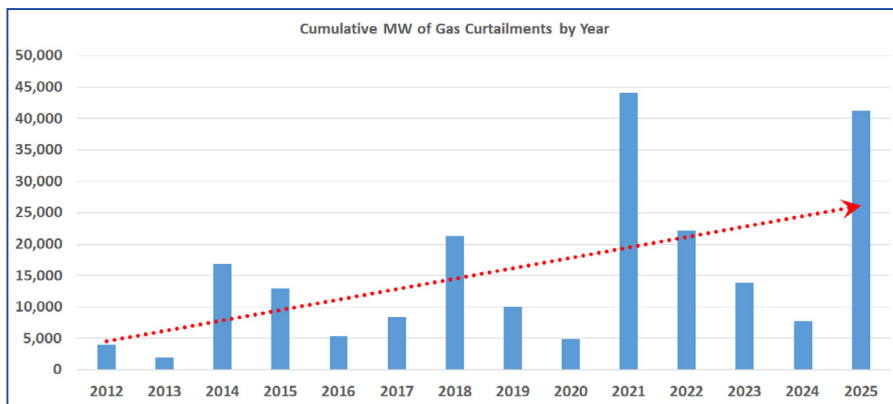
2. Entities responsible for development of system restoration plans should evaluate their restoration plans and the BSR capabilities and procedures to ensure that restoration plans consider and manage fuel availability risk under extreme cold weather conditions for blackstart service of designated BSRs. Entities responsible for the implementation of system restoration plans with identified dual-fuel-capable BSRs should evaluate and establish/strengthen their documented requirements for a minimum amount of onsite or readily available backup fuel to successfully implement the plan.
3. The joint study team reaffirms Recommendation 2 from the FERC, NERC, and Regional Entity Staff Study, Blackstart and Next-Start Resource Availability in the Texas Interconnection, emphasizing its continued relevance. Given the multijurisdictional nature of the Eastern and Western Interconnections encompassing multiple states and energy regulatory authorities, the joint study team recommends that each individual entity with system restoration plan requirements proactively collaborate, based on its regional electric system restoration assessments. These entities should also develop joint blackstart system restoration plans to address electric and natural gas system identified interdependency risks. The joint study team recommends that subject matter experts (SMEs) from the electric and natural gas industries evaluate the potential impact of a wide-area electric blackout on natural gas system functionality, consequent impacts on electric system restoration, and potential single points of failure, as pertains to individual Transmission Operator area system restoration plans. These SMEs should also help develop system restoration plans that include solutions to resolve identified issues. It is recommended that such restoration plans include the following:
 - Distinguishing between critical customer loads and system restoration critical loads, which includes natural gas supply, processing, storage, and delivery facilities; and
 - Requiring Transmission Owners/Operators with natural gas-fueled BSRs in their system restoration plans to jointly work with natural gas transmission and delivery facility owners to identify necessary natural gas supply route(s) supporting BSRs. It is recommended that these Transmission Owners/Operators also identify the source of the natural gas supply (including storage).



2025 KEY FINDINGS: CRITICAL INFRASTRUCTURE INTERDEPENDENCIES

2025 HIGHLIGHTS FROM THE ANALYSIS OF CRITICAL INFRASTRUCTURE INTERDEPENDENCIES INCLUDE:

- There was a significant increase in the unavailable generation capacity due to natural gas fuel curtailments in 2025 compared to 2024, primarily in the spring, summer, and fall months.
- There were no loss of SCADA, loss of control, or visibility events in 2025 due to a loss of external communications.
- There was a small increase in the unavailable generation capacity due to water supply issues in 2025 compared to 2024 (ten generators at two sites). Total unavailable generation capacity due to water supply issues in 2025 was in-line with typical historical values, not including 2021 which was an outlier.



CONCLUSION

The Texas RE/ERCOT Region demonstrated strong reliability performance in 2025 while navigating unprecedented system transformation, rapid load growth, and an evolving resource mix. Proactive regulatory actions, enhanced planning and assessment capabilities, and continued investment in grid resilience have positioned the Region to address current challenges, though the scale and pace of anticipated load growth and increased reliance on inverter-based resources will require sustained collaboration among industry, regulators, and policymakers. Texas RE will continue to advance reliability and security through leadership within the ERO Enterprise, operational excellence, and proactive risk mitigation, with a focus on strengthening energy adequacy assessments, improving coordination with ERCOT and stakeholders, addressing large load and infrastructure interdependencies, and sharing best practices to support the long-term reliability of the BPS and continued reliable service to Texans.



TEXASRE
Ensuring electric reliability for Texans

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