The University of Texas at Austin
Energy Institute

Navigating the Unprecedented Energy Demands and Grid Reliability Challenges Driven by Industrial Growth in Texas

Findings from the 2025 Large Load Symposium at The University of Texas · **July 24, 2025**

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Executive Summary

The UT Large Load Symposium convened sixty-five representatives from the Public Utility Commission of Texas (PUCT), Electric Reliability Council of Texas (ERCOT), Texas Reliability Entity (TRE), industry stakeholders, and academic experts to address the urgent challenges posed by the rapid growth of large, power-dense loads, particularly artificial intelligence (AI) data centers and crypto mining operations. The event featured presentations from TRE and ERCOT, followed by two structured breakout sessions. Participants emphasized the need for updated interconnection processes, clear performance standards, and better coordination across load developers, utilities, and system operators.

Key takeaways included:

- Loads are coming online faster than grid processes can accommodate.
- Voltage and frequency ride-through capabilities are the most urgent technical hurdle. Load developers need certainty that their interconnection timelines will not be affected by updates to models or mitigation efforts.
- Lack of standardization in interconnection agreements, study assumptions, and modeling guidance is a core barrier.
- Stakeholders support technical conferences to inform standards and clearer guidance from regulatory bodies.
- Greater data transparency, communication and coordination, and incentives for flexibility are needed.

UT Large Load Symposium Structure

On July 24, 2025, **Goff Policy** and **McAdams Energy Group** sponsored The University of Texas at Austin (UT) Large Load Symposium to address growing concerns around ERCOT's ability to manage near- and medium-term large load growth. The event convened stakeholders from the PUCT, ERCOT, TRE, transmission service providers, load developers, technology providers, equipment manufacturers, generators, researchers, and regulatory experts.
The objectives of the symposium were to (1) define the scale and nature of the challenge including voltage stability, thermal constraints, and resource adequacy, (2) assess existing capabilities and risk mitigation technologies, and (3) identify actionable market and policy solutions.

The symposium opened with TRE and ERCOT presentations that framed the near-term reliability risks posed by large loads and set the stage for sector-specific breakout discussions. Participants were divided into breakout groups to discuss risks and solutions from their respective sectors. A second mixed-group session followed, focusing on actionable, cross-cutting solutions. A group discussion concluded the symposium, synthesizing key insights and next steps.

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This report consolidates the discussions held during the symposium.

Large Load Challenge

TRE and ERCOT presentations jointly underscored the unprecedented reliability challenges posed by the rapid growth of large loads across the ERCOT grid. TRE identified large loads as one of the most significant near-term risks to bulk power system reliability.

The North American Electric Reliability Corporation (NERC) has proposed the following definition for large load: "Any commercial or industrial individual load facility or aggregation of load capabilities at a single site behind one or more point(s) of interconnection that can pose reliability risks to the BPS [Bulk Power System] due to its demand, operational characteristics, or other factors. Examples include, but are not limited to, data centers, cryptocurrency mining facilities, hydrogen electrolyzers, manufacturing facilities, and arc furnaces." This assessment is rooted in recent events, including a 2024 incident where 1,500 MW of data center load was simultaneously disconnected due to a single transmission line fault[11] and a more recent event with a load loss of 1,800 MW in February 2025. TRE noted that these types of facilities are being built and energized faster than current system planning and interconnection processes can accommodate.

Critically, TRE emphasized the lack of directly applicable NERC reliability standards for loads, leaving a regulatory gap in how system planners and operators manage their integration. In response, TRE and NERC are developing new technical guidance, including:

- A white paper on the characteristics and risks of emerging large loads (published July 2025)[22].
- An assessment of gaps in existing standards and modeling practices (Q4 2025).
- A reliability guideline for mitigating large load risks and improving interconnection requirements (Q2 2026).

These initiatives aim to provide a foundation for future standards, modeling improvements, and operational coordination.

ERCOT considers a large load to be a single site with an aggregate peak demand of more than 75 MW. ERCOT's presentation framed the large load challenge across three critical domains:

[1] North American Electric Reliability Corporation. (2025, January 8). *Incident Review: Considering Simultaneous Voltage-Sensitive Load Reductions* (Incident review). North American Electric Reliability Corporation. https://www.nerc.com/pa/rrm/ea/Documents/Incident_Review_Large_Load_Loss.pdf

[2] North American Electric Reliability Corporation. (2025, July). Characteristics and risks of emerging large loads (White paper). Reliability & Security Technical Committee, Large Loads Task Force. https://www.nerc.com/comm/RSTCReviewItems/3_Doc_White%20Paper%20Characteristics%20and%20Risks%20of%20Emerging%20Large%20Loads.pdf

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- **System Adequacy**: Increasing need for generation and transmission resources to keep pace with load growth. While load can materialize in 6-12 months, generation takes 6-24 months, and major transmission upgrades take 3-6 years.
- **Response and Control**: Need for large loads to respond to market conditions or be interruptible during system emergencies. Improvements are underway through ERCOT protocol revisions and PUCT rulemakings.
- **Dynamic Performance**: Voltage ride-through (VRT) capability remains a key concern. ERCOT studies show that voltage dips below 0.70 per unit (p.u.) for more than 20 milliseconds could trip up to 1,500 MW of load in West Texas for a particular fault location. ERCOT emphasized that the issue could be significant in weak grid areas or in strong grid areas with high concentrations of large loads. In worst-case scenarios, the loss of over 2,600 MW of large electronic loads (LELs) could push system frequency above 60.4 Hz, threatening generator stability and triggering a cascading outage.

To help ERCOT assess the risk, ERCOT issued a Request for Information (RFI) to all Transmission Service Providers (TSPs), requesting updated dynamic models for operational and proposed LELs. This modeling effort will support more accurate risk assessments and inform the development of technically realistic VRT requirements. ERCOT suggested that resolving the system stability issues will require grid improvements, operating procedure changes, and ride through requirements at the large load facilities.

Taken together, the TRE and ERCOT presentations made clear that the integration of large loads poses both a technical and policy challenge that requires urgent action, targeted standards development, and coordinated stakeholder engagement.

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Segment-oriented Breakout Session Discussions

In the first breakout session, participants were grouped by sector to identify key risks, challenges, and opportunities related to the integration of large loads into the ERCOT system. Each group was tasked with examining the current interconnection framework, evaluating the system's ability to accommodate fast-growing and technically complex loads, and proposing near- and long-term solutions. While each sector brought distinct perspectives, several common themes emerged: concerns about modeling transparency and study assumptions, gaps in communication between stakeholders, the need for standardized interconnection processes and realistic ride-through requirements, and the urgency of regulatory guidance to keep pace with the scale and speed of load growth. The following summaries highlight the most critical insights from each group.

Group 1: Grid Operations, Planning, Regulatory Specialists

- **Top Concern:** Frequency and oscillation risks from large, inflexible loads could damage transmission and generation equipment and lead to cascading outages. Participants expressed skepticism that market incentives alone will drive the needed flexibility from large loads.
- **Transparency Gap:** ERCOT lacks direct communication with load operators, resulting in limited visibility into operational behavior. The group recommended improved transparency in the interconnection process—including queue dashboards and more structured communication among loads, transmission and distribution utilities (TDUs), and ERCOT.
- **Lessons from inverter-based resource (IBR) Integration:** Participants urged proactive standard-setting, warning against repeating the inverter-based resource experience, where grid operators had to “work around” non-compliant resources for too long.
- **Faster Interconnection for Compliant Loads:** The group supported expediting projects that meet clear, auditable flexibility or ride-through requirements. However, concerns remain about the rigidity of ERCOT’s study timeline, which may only yield marginal speed improvements.
- **Need for Firm Requirements:** To reduce the large number of speculative projects in the interconnection queue, the group called for clear standards and requirements. They noted that loads, unlike generators, are not registered market participants and thus face fewer obligations to provide data or models.

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Group 2: Large Loads

- **Modeling and Restudy Concerns:** Participants expressed significant concern that ERCOT's modeling assumptions are overly conservative and lack transparency. Loads fear that updating models, as ERCOT requests, could trigger restudies and jeopardize interconnection timelines creating a disincentive to submit additional information updates.
- **Mismatch Between System Needs and Load Capabilities:** Fast-ramping AI and machine-learning (ML) loads can swing up to 50% in seconds, posing risks to grid stability. Participants questioned whether existing frameworks can evaluate or mitigate these rapid changes, and whether ERCOT is requesting the right data to do so. Many large loads are not designed to participate in frequency response or provide grid services, and their rapid tripping during system disturbances can amplify operational risk.
- **Lack of Communication and Coordination:** Loads and ERCOT are not effectively aligned on load development ramp schedule, modeling expectations, or architecture. Participants noted that large load operators are currently unable or not set up to provide the kind of models and information ERCOT requests. Nvidia will be publishing a benchmark model for a typical data center soon which will be a helpful tool for grid operators.
- **Lack of Guidance on Curtailment Risk:** Understanding that this is a new problem without a clearly defined process, clear guidance from ERCOT about when and how often loads may be curtailed to preserve system reliability will be helpful to understand the value of mitigating the curtailment risk.
- **No Appetite for Mitigation Investment Without Certainty:** Many loads reported no current plans to install mitigation like battery energy storage systems (BESS), citing unclear standards and a lack of cost recovery mechanisms. There was also a call for a benchmarked "GW-scale campus" profile for large loads to guide mitigation planning.
- **Need for Third-Party Validation and Data Sharing Mechanism:** One solution proposed was to establish an independent entity that could collect load profiles and other data from major customers and validate ERCOT's modeling assumptions without penalizing the loads. Participants also recommended more transparency into ERCOT's modeling assumptions.
- **Process Reform Suggestions:** Participants recommended clear checklists of required models and data, a screening process during interconnection application, ability to provide feedback, and firm deadlines for study results to restore confidence in the process.

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Group 3: Transmission Providers

- **Utilities Lack Visibility and Coordination:** Utilities emphasized an absence of a systemwide view of large load interconnection activity, and neighboring utilities are often not included in kickoff meetings. They called for a centralized clearinghouse to track and coordinate load requests across service territories. They also suggested regular meetings with the loads.
- **Transmission Planning Misaligned with Load Growth:** Traditional planning cannot keep pace with the scale and speed of new large load development. Utilities stressed that planning must shift from incremental to strategic, with structured cluster studies at regular intervals (e.g., every 6 months).
- **Urgent Need for PUCT Standards:** Participants urged the Commission to establish interim standards within 3 months to avoid recurring grid stress in 2026. Without PUCT involvement, the stakeholder process at ERCOT may stall progress.
- **Voltage and Frequency Risks:** Utilities noted that voltage events are just as serious as frequency issues. They cited operational incidents where large loads were dropped but not restored, leading to price distortions and reliability concerns.
- **Resource Adequacy and Operational Readiness:** The group discussed the tension between load interconnection and available generation and the need for 765kV transmission and improved ramping capabilities for large loads.
- **Operational Risks:** Risks from fast-ramping loads, limited participation in security-constrained economic dispatch (SCED) dispatchable Controllable Load Resources (CLRs), and outdated underfrequency relays are emerging. Utilities stressed the need for more granular visibility and coordination to support real-time reliability.
- **Model accuracy:** Model accuracy and verification are unresolved, with utilities calling for trusted, testable profiles such as the graphics processing unit (GPU) load models that Nvidia is developing to support better planning, trust, and forecasting. These models could serve as a template for ERCOT load studies.

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Group 4: Technology and Research Specialists

- **Misaligned Timelines:** Developers reported that load growth is outpacing planning, with transmission studies too slow to match rapid deployment.
- **Site Preparation and Operation:** Many large load projects are located on brownfield sites that require significant modernization (e.g., uninterruptible power supply (UPS) upgrades, enhanced cooling systems). Participants noted ongoing uncertainty around whether grid capacity will be available when site construction is complete.
- **Zonal Forecasting and System View Needed:** The group called for load growth to be evaluated from a zonal or regional perspective, rather than project-by-project, to reflect aggregate impact, improve forecasting accuracy and speed the project approval process. The group suggested development of heat maps to indicate timing and location of capacity availability or reliability risks.
- **Uncertainty Around Regulatory Requirements:** Participants cited difficulty underwriting projects amid unclear requirements and curtailment risks. SB6 was viewed as a tool for initiating planning needs but requires more definition through the PUCT rulemaking and ERCOT stakeholder processes.
- **Flexibility and Incentives:** The group suggested that partial flexibility should be recognized. However, they also noted that operators may lack control over the end-use customers, limiting the facility operator's ability to participate in curtailment or demand response. Prioritizing interconnection for flexible or curtailable loads was proposed as a possible incentive since current ERCOT market mechanisms may not offer sufficient compensation to drive participation.
- **Accurate Models:** Members of this group agreed that voltage faults are a major issue that will cause cascading outages. Dynamic modeling was identified as essential for evaluating the operational impacts of large loads.

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Group 5: Generators

- **Study Assumptions Penalize Co-Located Loads:** ERCOT's interconnection studies treat all loads as fully grid-dependent, ignoring co-located generation. Tools like batteries, capacitor banks, and synchronous condensers are also often excluded from analysis. This inflates grid impact and undermines hybrid site economics. SB6 implementation creates urgency around deployment of co-located projects.
- **No Standard Load Interconnection Framework:** There is no standardized interconnection process or agreement for loads. Participants called for formal guidance and consistent treatment across TDUs and ERCOT. While participants see SB6 as a chance to standardize expectations, they stressed that clear rulemaking from the PUCT is urgently needed.
- **Voltage Ride-Through (VRT) Testing Misaligned:** ERCOT requires VRT compliance at the Point of Interconnection (POI) which requires tight coordination for co-located facilities. Additionally, UPS systems can disconnect loads during grid disturbances, undermining ride-through compliance and exacerbating voltage recovery issues. Accurate modeling and shared testing protocols between co-located resources are essential for meeting VRT expectations.
- **Parallel Operation Not Properly Encouraged:** Backup generation does not require interconnection when islanded, but grid-parallel operation introduces regulatory complexity. However, batteries and other generation equipment could be used as a tool for ERCOT such as for fast frequency response (FFR).
- **Ancillary Services and BESS Underutilized:** Batteries could help meet VRT and frequency needs, but current market design and study assumptions do not credit these mitigations.
- **Regulatory and Protocol Gaps:** Participants pointed to gaps in metering, telemetry, and netting rules that inhibit innovation and delay financing for load projects.

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Topics Identified through Cross-Segment Discussions

In the second breakout session, participants from different sectors regrouped to identify the most severe technical and procedural risks associated with large load interconnection and to propose actionable elements for a future regulatory or planning framework. Key themes emerged across all five groups, highlighting areas of convergence and urgent next steps.

Topic 1: Improve Coordination and System Visibility

Across all groups, participants stressed the need for improved coordination between ERCOT, TSPs, and load developers. Today's fragmented approach, where ERCOT and utilities study loads in isolation, with limited insight into load development ramp schedules, model assumptions, or future load behavior, was identified as a primary contributor to system uncertainty.

- Many called for a centralized database or dashboard that tracks study milestones and interconnection status similar to the Resource Integration and Ongoing Operations Interconnection Services (RIOO IS).
- Participants urged early coordination with the load developer, TSP, and ERCOT to align assumptions between site configurations and study requirements.
- Participants suggested heat maps of reliability risk to show when and where curtailment might be needed based on probabilistic modeling.
- Participants expressed the need to clearly understand the frequency and magnitude of possible curtailment risk.
- Others suggested structured cluster studies similar to Midcontinent Independent System Operator (MISO).

Topic 2: Standardize the Interconnection Process

Groups consistently recommended the creation of a Large Load Interconnection Agreement (LLIA) to formalize the expectations currently missing from the process.

- TSPs use non-uniform forms, study methods, and data requirements, creating uncertainty and inefficiency.
- There is no clear pass/fail standard for reliability studies, especially for VRT compliance.
- Large loads are not required to provide models or validation like generators, yet their impacts are increasingly significant.
- ERCOT's current approach to restudy discourages proactive investment—when loads install mitigation like BESS or firmware controls, they are still subject to re-study delays.

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Topic 3: Realistic and Tiered Ride-through Standards

The mismatch between ERCOT's draft VRT standards and real-world capabilities of loads, especially those using GPUs or AI servers, was a central concern.

- AI-driven facilities produce fast, high-magnitude oscillations and sub-millisecond power swings not captured in traditional modeling.
- Loads often trip offline or transfer to backup before the POI sees the voltage dip, creating grid visibility and control gaps.
- Many participants advocated for two distinct solutions:
    - A local voltage ride-through mechanism (e.g., battery or control system at the load)
    - A system-level frequency response strategy, potentially expanding fast frequency response (FFR) eligibility to include loads with onboard BESS
    - These options could be integrated into existing ancillary services or contracted for, with the understanding that the constraint to developing these options may be ERCOT systems.
    - A tiered approach could be considered so that loads with higher performance ability can be prioritized in the interconnection process.

Topic 4: Forecasting, Screening, and Project Validation

Participants emphasized the need to distinguish between speculative load requests and viable projects to improve system planning and reduce unnecessary modeling burden.

- There was broad support for requiring financial obligations, site control, or other "confidence criteria" before loads can secure interconnections. These steps would help ERCOT and TSPs prioritize real, ready-to-build projects. The commission could help to address this concern by prioritizing creation of the confidence criteria established by SB6.
- Multiple groups proposed a screening mechanism during the interconnection application that assesses ramp schedules, architectural configuration, and performance capability—ideally coupled with standardized forms and timelines.
- The current ERCOT load forecasting process may not capture the rapid rise or operational characteristics of AI and hybrid campuses. Participants recommended more dynamic, regional forecasting tools to reflect geographic clustering and operational diversity.
- Nvidia's modeling work was repeatedly cited as a valuable resource. Their development of standardized GPU load profiles offers a critical reference point for ERCOT, TSPs, and developers. These profiles can improve the accuracy of load interconnection studies, reduce reliance on conservative assumptions, and serve as a template for other

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high-performance computing loads. Several participants suggested these efforts could underpin a generic “GW-scale campus” model or be included in a central modeling library accessible to ERCOT and utilities.

Topic 5: Integrate and Incentivize Mitigation Solutions

Stakeholders expressed concern that mitigation investments are not recognized by ERCOT in its current process.

- Loads are reluctant to install mitigation if it leads to costly restudies or delays.
- Groups urged ERCOT to accept co-located and load-side solutions (e.g., BESS, power shelves, microgrid controls) as valid elements of VRT or reliability compliance, ideally with a staged verification framework.
- Participants requested that mitigation solutions be eligible for compensation if they support grid reliability (e.g., as FFR assets or demand response participants).

Topic 6: Technical Working Groups

Multiple groups endorsed the formation of a technical working group or task force, involving ERCOT, TSPs, load developers, and equipment vendors.

- The group would work toward defining realistic compliance standards, standardizing study formats, and aligning timelines.
- There is a need for a technical summit to surface viable solutions, discuss vendor capabilities, and align expectations before rules are finalized.

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Actionable Solutions

- **Develop a standardized Large Load Interconnection Agreement (LLIA):** ERCOT, PUC, and TSPs should jointly define modeling expectations, timelines, data requirements, and pass/fail criteria.
- **Create a system-wide study milestone dashboard or reporting platform:** Enable TSPs, ERCOT, and loads to track study progress and avoid duplicated efforts. If ERCOT cannot develop this in a timely fashion, it could be outsourced.
- **Define interconnection protection rules for data/model updates:** ERCOT should clarify that providing updated models will not automatically trigger a restudy or jeopardize energization scales or timelines.
- **Launch a technical working group (ERCOT, TSPs, loads, OEMs):** Form a standing body to co-develop standards, validate models, and resolve technology feasibility questions. Iterate to move quickly.
- **Standardize load modeling inputs and formats:** ERCOT should release templates for dynamic profiles, BESS configurations, ramp rates, and mitigation options.
- **Create a third-party modeling data center or repository:** Allow loads to submit data to a neutral entity for model review and validation outside the ERCOT formal process, i.e. "third party review."
- **Require telemetry for large loads ≥75 MW:** Loads should provide real-time or near-real-time load profile data to ERCOT and TSPs.
- **Define coordinated communication protocols for load development schedules:** Loads must communicate expected load development schedule and operating profiles in advance; ERCOT to provide standardized formats and timelines.
- **Enable BESS and microgrids as part of VRT compliance pathways:** ERCOT should recognize co-located solutions like BESS and grid-forming microgrids in lieu of full system upgrades.
- **Create dual-track ancillary service paths: one for frequency, one for VRT** Allow loads with onboard BESS to participate in Fast Frequency Response (FFR) and localized voltage ride-through mitigation. ERCOT's information technology (IT) system change constraints could limit options, so there could be a need to creatively manage this.
- **Pilot voluntary "readiness reviews" prior to formal interconnection:** ERCOT and TSPs could review load models informally before formal submission to flag gaps.
- **Host a technical conference before implementing VRT standards:** Gather load developers, inverter vendors, battery suppliers, ERCOT, and engineers to align on what's feasible.

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Conclusion

The UT Large Load Symposium underscored the unprecedented scale and urgency of the challenges facing ERCOT as it navigates a wave of large (≥75 MW) load interconnections. While stakeholders brought diverse perspectives, the message was clear: Texas cannot afford to rely on legacy processes and informal coordination to manage this transition.

Stakeholders broadly agreed that without immediate action the grid will remain vulnerable to both operational and investment risks. The momentum generated at the symposium offers a critical opportunity: to align regulatory, planning, and technical strategies before reliability is compromised.

The path forward requires urgent but deliberate attention, disciplined coordination, shared responsibility, and a willingness to modernize foundational practices. The rapid growth of large loads presents unique technical challenges, while also offering new opportunities for increased grid resilience. If implemented with urgency and accountability, the solutions discussed at this symposium can position Texas to lead in integrating the next generation of large loads.

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