Report on Existing and Potential Electric System Constraints and Needs

December 2025

Key Takeaways

On April 24, 2025, the Public Utility Commission of Texas (PUCT) approved the three **765-kV** import paths recommended in the **Permian Basin Reliability Plan,** introducing the new 765-kV voltage class in the ERCOT Region. The ERCOT Board of Directors endorsed the remaining portions of the **765-kV Strategic Transmission Expansion Plan (STEP)** proposed in the 2024 Regional Transmission Plan (RTP) in December 2025.

ERCOT is tracking more than three times as many **Large Load** interconnection requests compared to 2024. The total load seeking interconnection is approximately **239 GW**. ERCOT is actively collaborating with stakeholders to improve the **Large Load** interconnection process to address current and anticipated challenges associated with the substantial volume of requests and the complexity involved in ensuring reliable interconnection of the **Large Loads**.

ERCOT and Transmission Service Providers (TSPs) that serve **West Texas** have been proactively positioning the ERCOT grid to reliably serve the rapid load growth in West Texas. Since 2014, about **$23 billion** in projects have been approved in the **Permian Basin**. So far, roughly 630 miles of 345-kV transmission lines have been built, 1,585 miles of 345-kV, 1,329 miles of 765-kV lines have been approved for new build, and various 138-kV upgrades are underway.

The ERCOT System continues to evolve with significant **load growth**, rapid expansion in transmission-connected **wind**, **solar**, and **energy storage** development, and distributed generation. ERCOT is critically evaluating planning processes and pursuing changes necessary to meet challenges associated with the **evolving grid**.

Table of Contents

About ERCOT Transmission Planning

ERCOT supervises and exercises comprehensive independent authority over the planning of transmission projects for the ERCOT System as outlined in the Public Utility Regulatory Act (PURA) and PUCT rules. PUCT rules further require ERCOT to evaluate and make a recommendation to the PUCT as to the need for any transmission facility over which ERCOT has comprehensive transmission planning authority.

ERCOT examines the need for proposed transmission projects based on ERCOT planning criteria and North American Electric Reliability Corporation (NERC) Reliability Standards. Once a project need has been identified, ERCOT evaluates project alternatives based on cost-effectiveness, long-term system needs, and other factors.

The ERCOT Protocols and Planning Guide describe the practices and procedures through which ERCOT meets its requirements related to system planning under PURA, PUCT rules, and NERC Reliability Standards.

ERCOT annually performs a planning assessment of the ERCOT Transmission Grid primarily based on two sets of studies:

- The Regional Transmission Plan (RTP) addresses region-wide reliability and economic transmission needs and includes the recommendation of specific planned improvements to meet those needs for the upcoming six years. The public version of the 2025 RTP report is posted on the ERCOT website at: https://www.ercot.com/gridinfo/planning.
- Stability studies are performed to assess the angular stability, voltage stability, and frequency response of the ERCOT System. Due to the security-related sensitive nature of the information contained in these study reports, they are not published on the ERCOT website.

ERCOT also conducts the biennial Long-Term System Assessment (LTSA) and biennial Grid Reliability and Resiliency Assessment (GRRA), which are completed in even-numbered years. The LTSA uses scenario-analysis techniques to assess the potential needs of the ERCOT System up to 15 years into the future. The role of the LTSA is to guide near-term planning decisions by providing a longer-term view of system reliability and economic needs. The GRRA assesses the system needs based on the resiliency criteria.

Recent Constraints

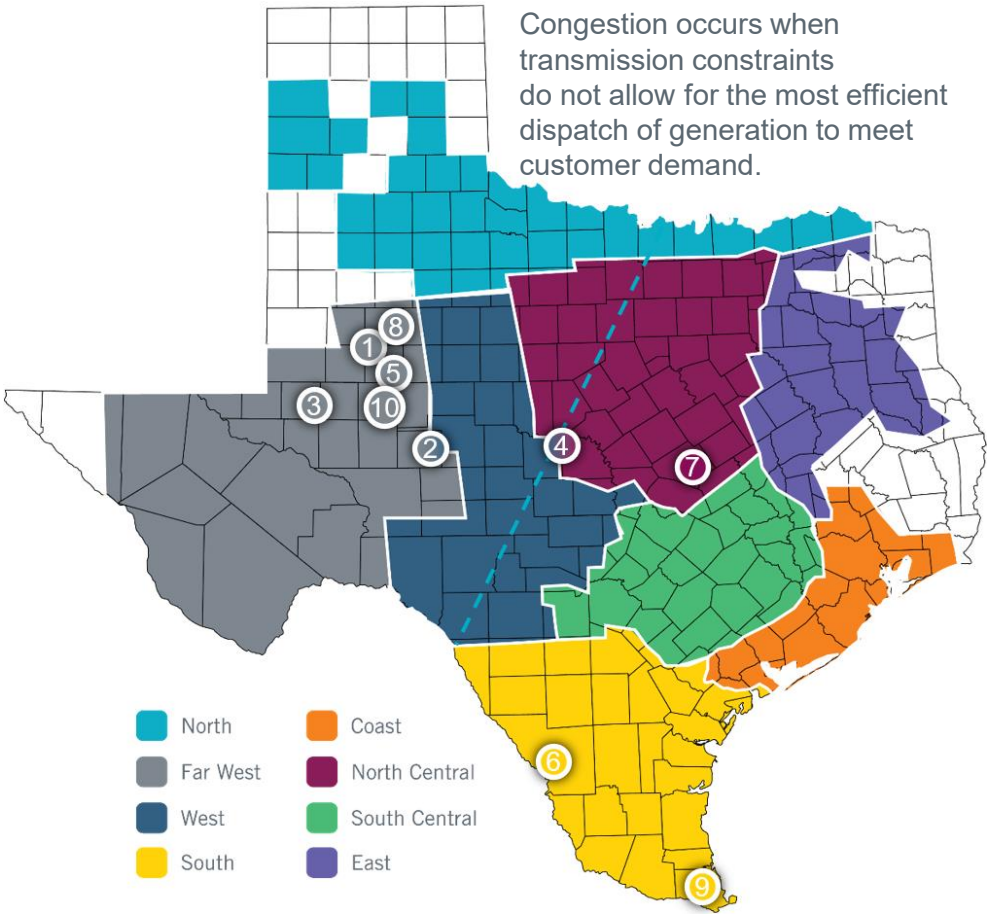
Top 10 constraints on the ERCOT System

Oct. 2024 to Sep. 2025, based on real-time data

Map	Monitored Element of Constraint	Congestion Rent*	Outage Related?
1	Koch Tap - Vealmoor 138kV	$211M	
2	Hargrove - Twin Buttes 138kV	$176M	
3	Odessa EHV Switch - Yarbrough Sub 138kV	$151M	Planned and Forced Outages
4	West Texas Export Interface	$127M	
5	Longshore Switch - Consavvy Switch 345kV	$102M	
6	Laredo VFT North - Las Cruces 138kV	$64M	
7	Bell County - Salado Switch 138kV	$64M	
8	Knapp - Scurry Chevron 138kV	$57M	
9	Haine Drive - La Palma 138kV	$54M	Planned and Forced Outages
10	Polecat Creek Switch - Wrage Ranch Pod 138kV	$52M	

*Congestion rent indicates areas of the system where economic transmission projects may be beneficial. It is not an indication of whether a project to reduce specific congestion would or would not meet the ERCOT economic planning criteria.

Congestion occurs when transmission constraints do not allow for the most efficient dispatch of generation to meet customer demand.



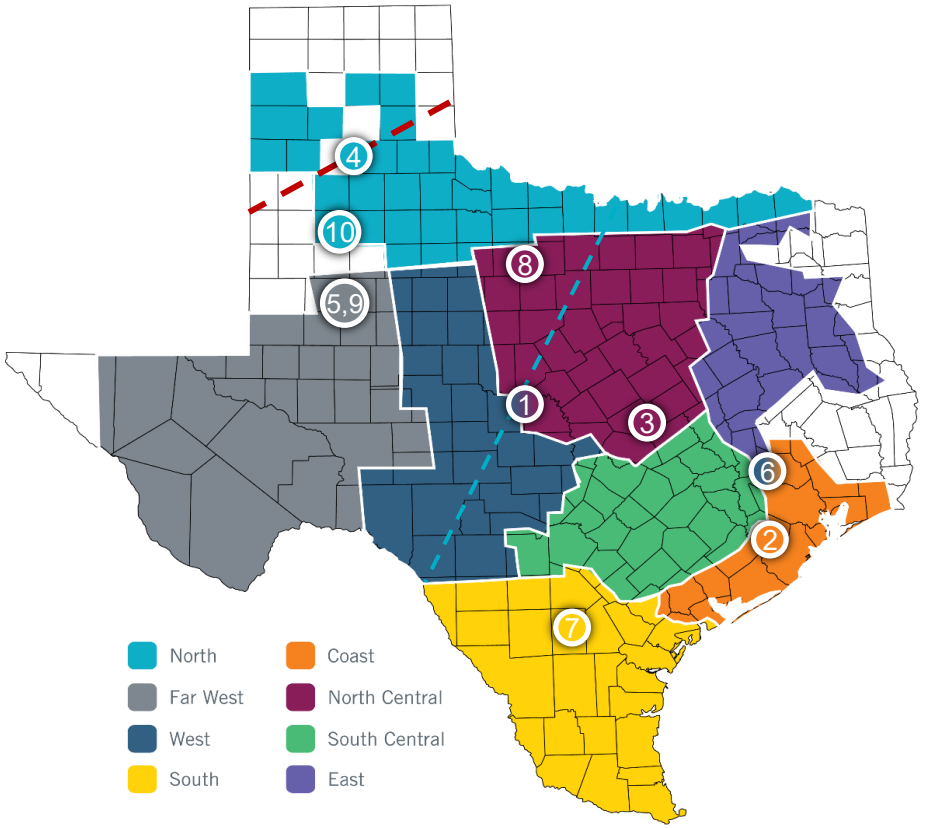
Projected Constraints

Top 10 projected constraints on the ERCOT System for 2027 and 2030 Base Cases

Based on economic analysis conducted for the 2025 RTP

Map	Constraint	Congestion Rent*	
		2027 Base*	2030 Base*
1	West Texas Export Interface	$130M	$147M
2	Houdini - W A Parish 345-kV Line	$155M	$5M
3	Bell County East Switch - Voss Lake 345-kV Line	$112M	-
4	Panhandle Interface	$19M	$72M
5	Holly POI - Wett Long Draw 345-kV Line	$18M	$69M
6	North - Houston Interface	$26M	$60M
7	Fowlerton - Tilden 138 Sub 138-kV Line	$33M	$33M
8	Murray - Paint Creek 138-kV Line	$56M	-
9	Farmland - Holly POI 345-kV Line	$47M	$9M
10	MacKenzie Substation - Northeast Substation 115-kV Line	$48M	$6M

*Congestion rent indicates areas of the system where economic transmission projects may be beneficial. It is not an indication of whether a project to reduce specific congestion would or would not meet the ERCOT economic planning criteria. Planned transmission outages were not included in the analysis.



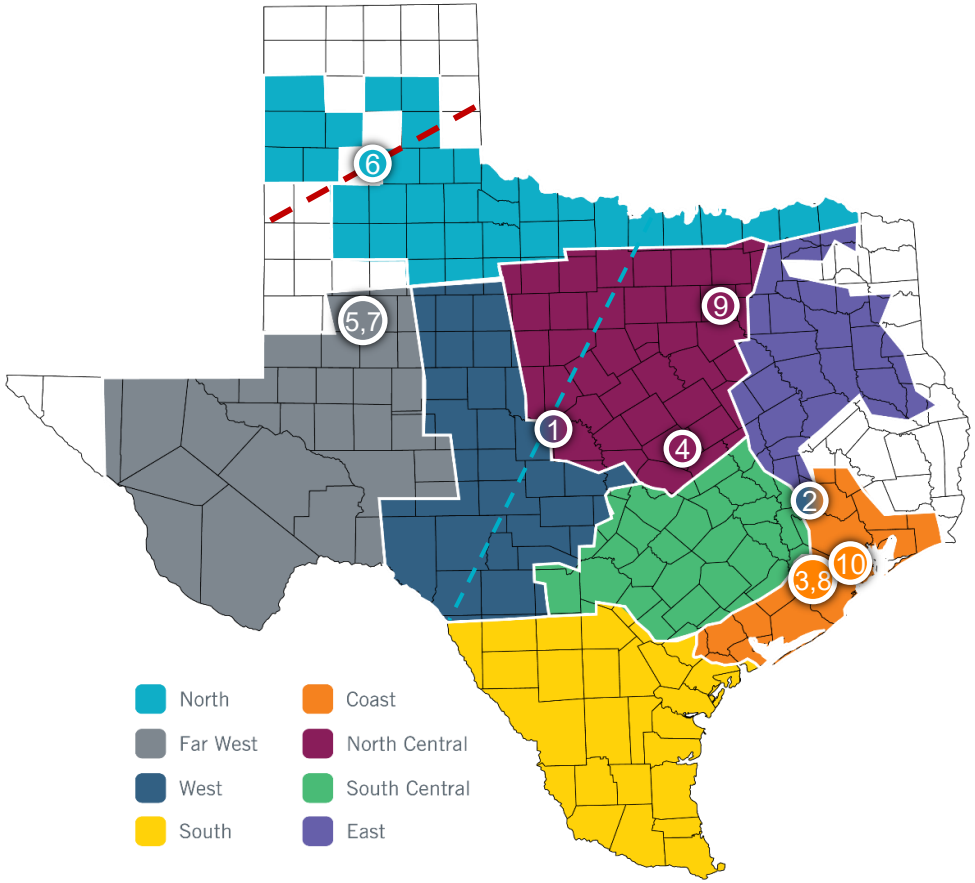
***Base Cases**: Large loads with a signed Interconnection Agreement or an Officer Letter were included and the PUCT-approved Good Cause Exception was applied.

Projected Constraints

Top 10 projected constraints on the ERCOT System for 2027 and 2030 Sensitivity Cases

Based on economic analysis conducted for the 2025 RTP

Map	Constraint	Congestion Rent* 2027 Sensitivity **	Congestion Rent* 2030 Sensitivity **
1	West Texas Export Interface	$245M	$209M
2	North - Houston Interface	$48M	$141M
3	Houdini - W A Parish 345-kV Line	$150M	$22M
4	Bell County East Switch - Voss Lake 345-kV Line	$106M	-
5	Holly POI - Wett Long Draw 345-kV Line	$9M	$48M
6	Panhandle Interface	$12M	$45M
7	Farmland - Holly POI 345-kV Line	$35M	$13M
8	Elmato POI - Houdini 345-kV Line	$33M	$14M
9	Buntin Drive - Simpson Stuart 138-kV Line	-	$37M
10	Oasis - Savana POI 345-kV line	$17M	$20M



*Congestion rent indicates areas of the system where economic transmission projects may be beneficial. It is not an indication of whether a project to reduce specific congestion would or would not meet the ERCOT economic planning criteria. Planned transmission outages were not included in the analysis.

****Sensitivity Cases**: Only large loads with a signed Interconnection Agreement were included.

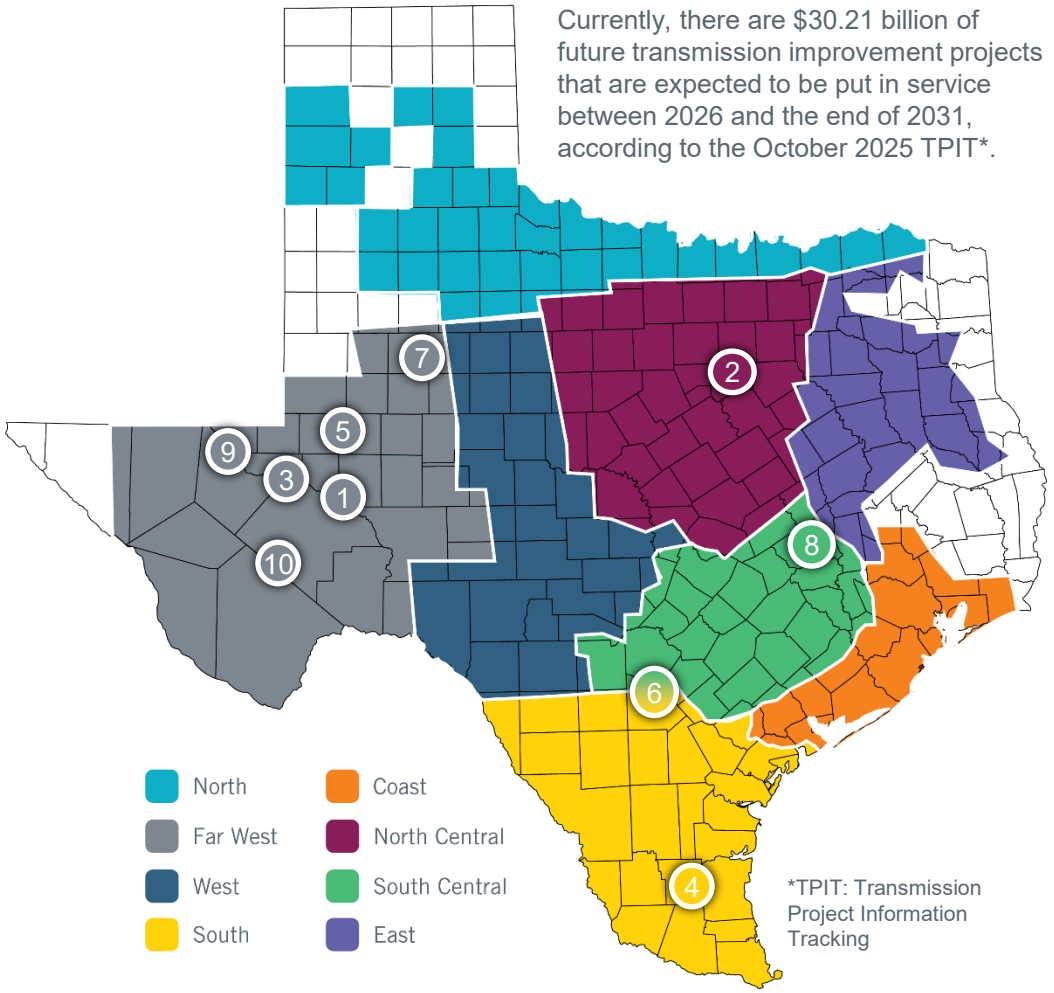
Planned Improvements

Top 10 significant improvements on the ERCOT System

Projects planned for completion within the next six years

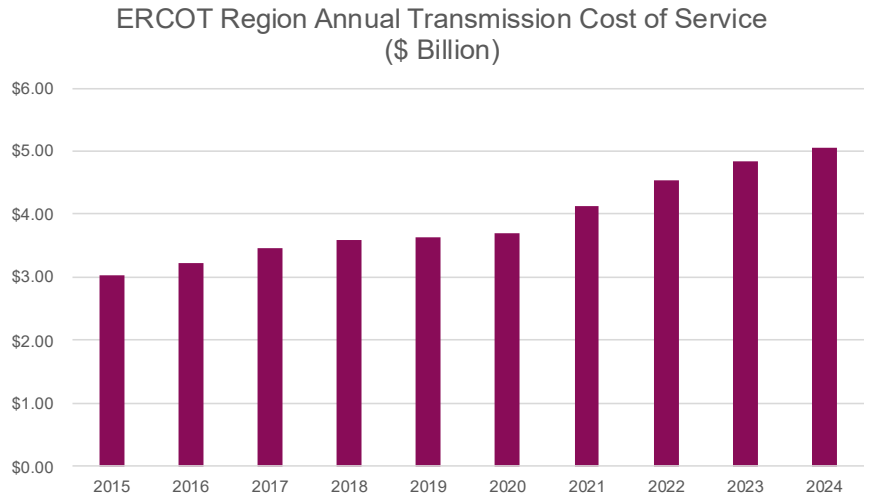
Map	Transmission Improvement	In Service
1	Bearkat - North McCamey - Sand Lake 345-kV Transmission Line Addition Project	2026
2	Roanoke Area Upgrades Project	2026
3	Pecos County Transmission Improvement Project	2026
	Silverleaf and Cowpen 345/138-kV Stations Project	2027
4	Lower Rio Grande Valley System Enhancement Project	2027
5	Synchronous Condenser Project	2027
	West Texas Synchronous Condenser Project	2027
	Bakersfield Dynamic Reactive Substation Upgrade	2027
6	San Antonio South Reliability Project	2027
7	West Texas Infrastructure Project	2028
8	Texas A&M University System RELLIS Campus Reliability Project	2029
9	Delaware Basin Stage 5 Project	2029
10	Permian Basin 765-kV Import Paths	2031

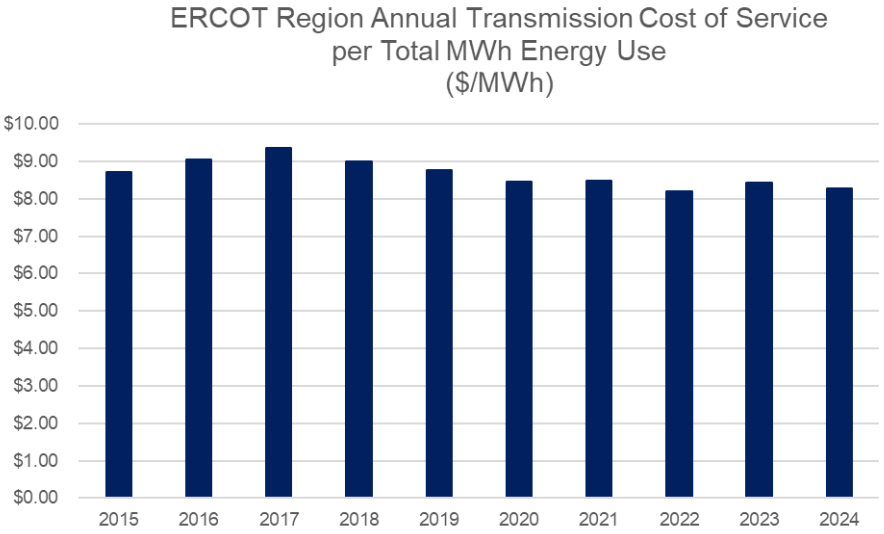
Currently, there are $30.21 billion of future transmission improvement projects that are expected to be put in service between 2026 and the end of 2031, according to the October 2025 TPIT*.



*TPIT: Transmission Project Information Tracking

Transmission Investment Trend for ERCOT Region



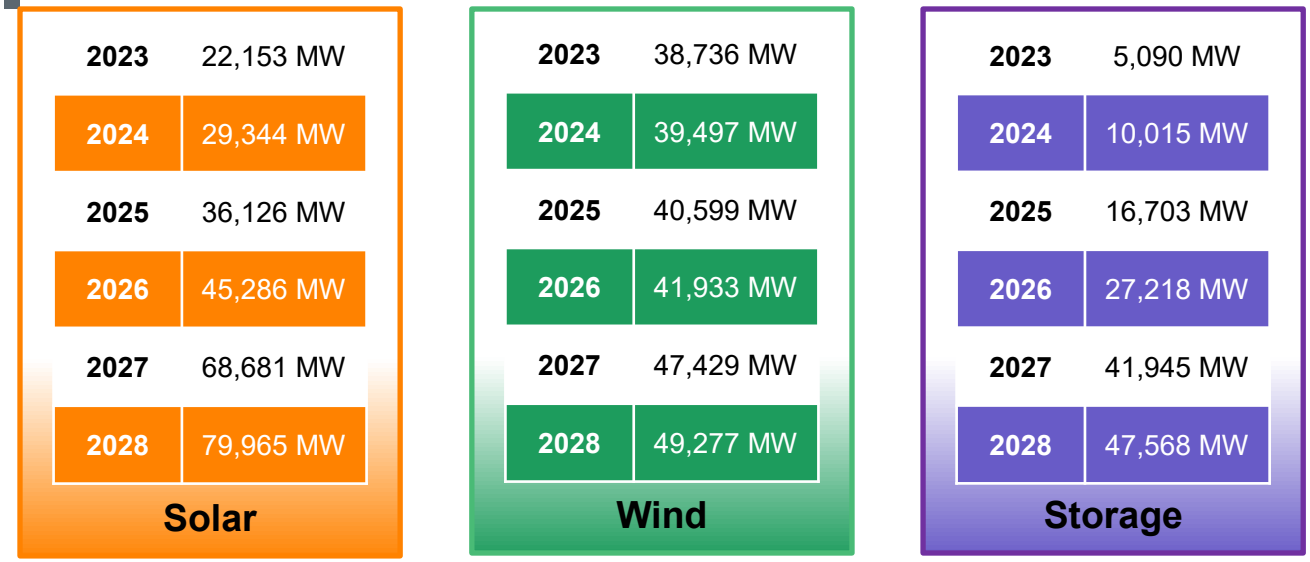


The total Transmission Cost of Service[1] (TCOS), which is driven by investments in new infrastructure and system upgrades, has risen in recent years as Texas experiences strong economic growth and increasing electricity demand.

The same economic growth also results in an increase in MWh of energy usage[2]. The TCOS per MWh, when adjusted for inflation[3], has declined slightly for the last 10 years as shown in the bottom graph.

1. TCOS values are based on ERCOT's Yearly Wholesale Transmission Service Charges filed with PUCT
2. Total MWh Energy Use values are based on ERCOT's Demand and Energy Report published on the ERCOT website
3. Adjusted using the Consumer Price Index

The Changing Grid – Generation



> 7,300 MW

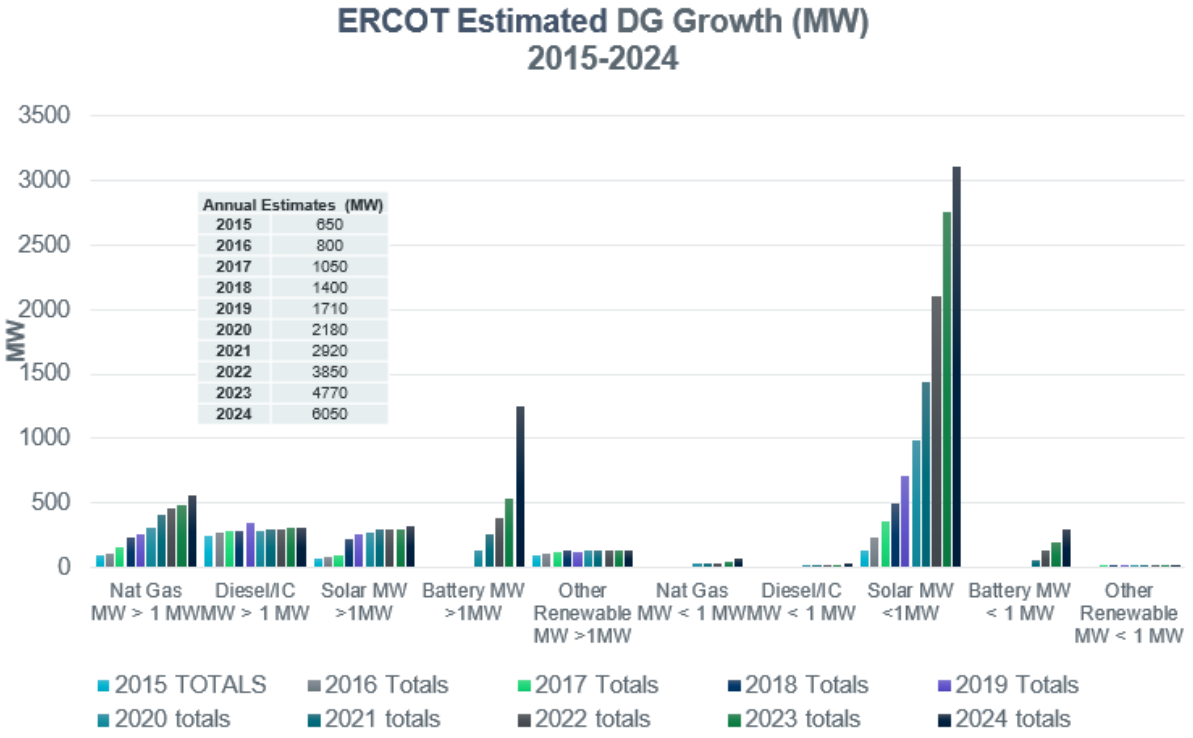
Thermal Generation Retirements (2018-2025)

- ERCOT continues to experience a rapid shift in the type and location of generation available to serve demand.
- Robust growth of inverter-based resources (IBRs) has continued. IBRs are power generation or storage systems that connect to the power grid through power electronic inverters, such as solar PV, wind turbines, and battery energy storage systems. By the end of 2026, it is projected that over 114 GW of transmission-connected wind, solar, and battery energy storage capacity will be installed. Total IBR capacity has the potential to exceed 176 GW in 2028. However, additional growth is expected to be impacted by reduced federal tax incentives and other financial challenges.
- Over 7,300 MW of coal and natural gas generation has retired since 2018. ERCOT anticipates 8.8 GW of new gas-fired generation by the end of 2029, driven by incentives from the Texas Energy Fund. Supply chain issues and increasing costs for generation equipment may limit resource additions beyond that.
- The change in generation mix has also resulted in increased distance between generation sites and demand centers. Retired coal and gas generation were closer to large cities, whereas the most abundant wind and solar resources tend to be more distant from demand centers.

The Changing Grid – Distributed Generation (DG)

- ERCOT continues to improve DG integration processes under increasing DG penetration.
  - HB3390 introduced a requirement for Transmission Distribution Service Providers (TDSPs) to provide unregistered DG information to ERCOT via their TSPs. As part of this, NPRR1265 for Unregistered Distributed Generators (≤1 MW) was approved by the PUCT.
  - ERCOT recently posted NPRR1317 and PGRR140. These Revision Requests aim to establish a process for collecting data from Non-Settled Generators with a capacity greater than 1 MW.

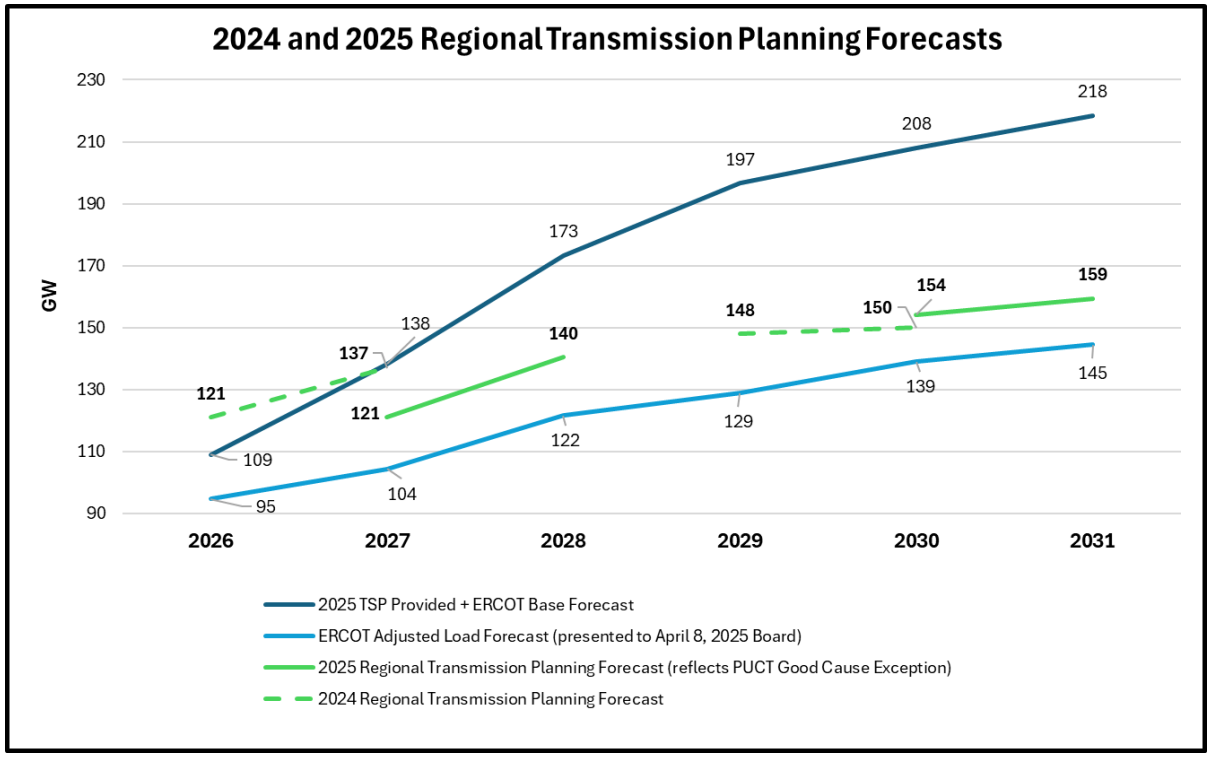
- These efforts align with the proposed Distributed Energy Resource (DER) modeling requirements in NERC Reliability Standard MOD-032 in accordance with FERC Order 901.
- ERCOT participates in the NERC System Planning Impacts from Distributed Energy Resources Working Group (SPIDERWG), which develops guidance documents to aid transmission planning, modeling, and analysis as DER penetration increases.



The Changing Grid – Demand

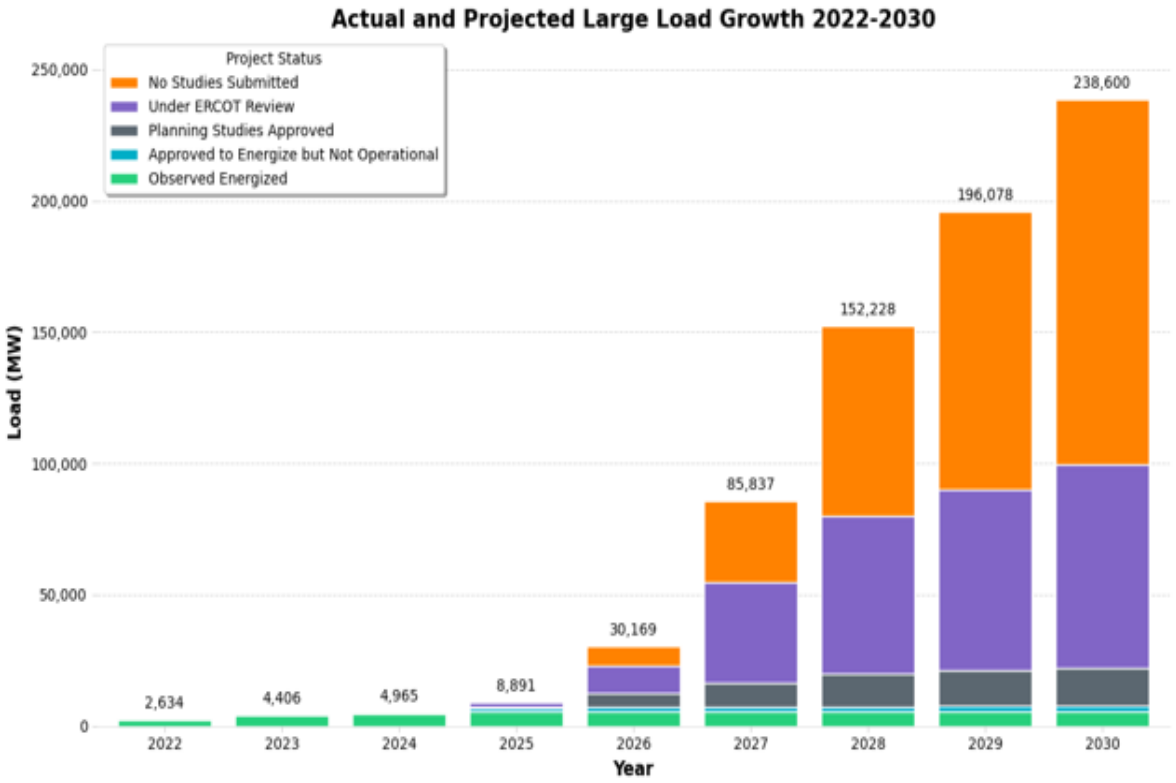
- The 2025 TSP-Provided Load Forecast projects a demand of 218 GW for year 2031, which is significantly higher than the forecast submitted in 2024, which was 150 GW. This increase is attributed to future data center load growth attested to by TSP Officers ("Officer Letter Loads" – OLLs).
- ERCOT Protocols and Planning Guide have incorporated HB5066 policy into the transmission planning process. ERCOT must include TSP officer-attested load information in its transmission planning analysis.
- ERCOT filed a Good Cause Exception with the PUCT to allow the use of the ERCOT Transmission Planning Adjusted Load Forecast (ETPALF) in the 2025 RTP.
- Based on historical trends, the ETPALF reduced OLLs to 55.4% of their maximum demand. Data center OLLs were reduced an additional 49.8% from the initial reduction.
- For example, a 100 MW data center OLL was reduced to:

  *100 MW * 55.4% * 49.8% = 27.6 MW*
- Peak load studied for year 2031 was 159 GW.



The Changing Grid – Interconnection of Large Loads*

- ERCOT continues to track nearly **238.6 GW** of large load interconnection requests.
- 7,502 MW have been approved to energize since January 2022.
- The interim Large Load interconnection process, created in 2022 to integrate load additions reliably and quickly, has been replaced by the formalized Large Load interconnection process created in NPRR1234 and PGRR115. Submitted by ERCOT and approved in May 2025, these Revision Requests formalize the Large Load interconnection process and establish operational standards for maintaining reliability.
- ERCOT continues to work with stakeholders to address the challenges associated with the unprecedented volume and unique characteristics of the current large load interconnection request process.

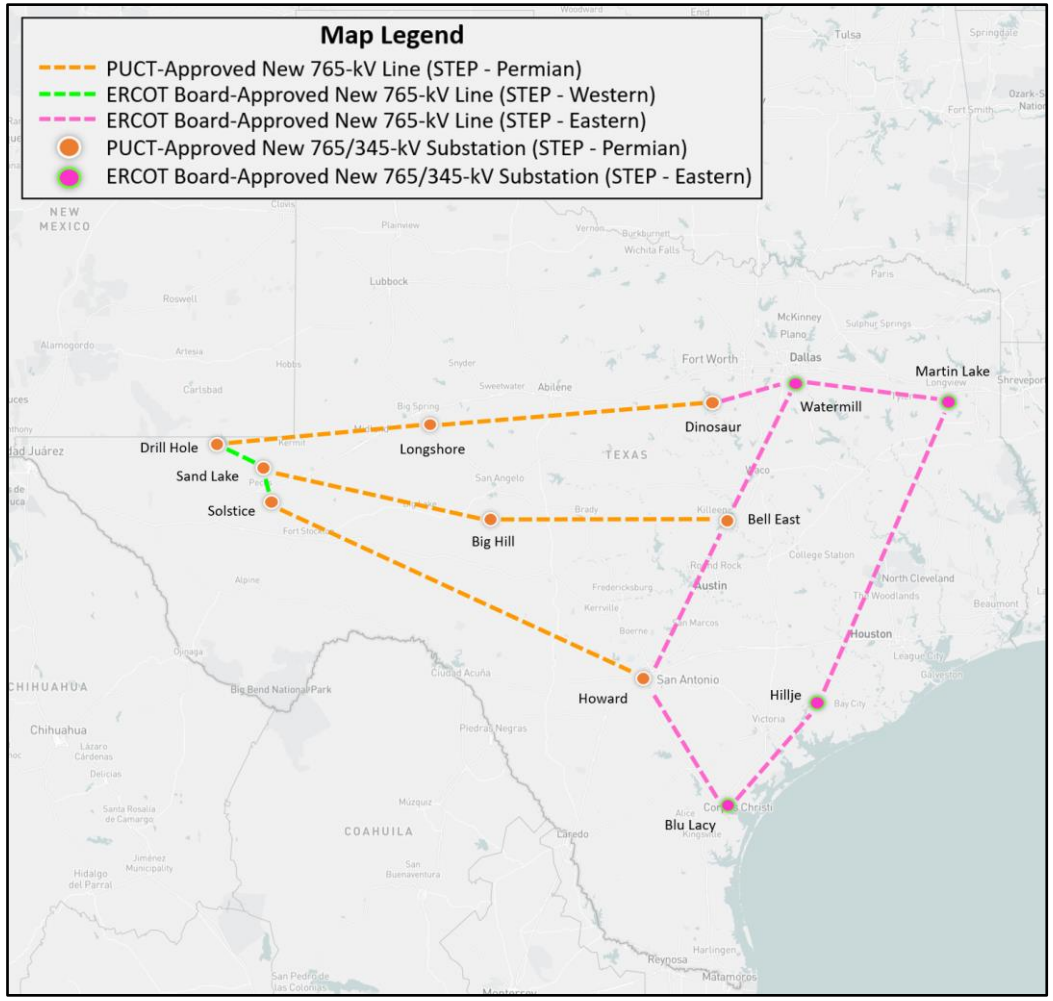


- **Approved to Energize –** Projects that have received Approval to Energize from ERCOT Operations. NOTE: Not all MWs in this category have been observed to be operational.
- **Planning Studies Approved –** Projects that have received ERCOT approval of required interconnection studies. Any MWs that were not approved are reclassified as No Studies Submitted.
- **Under ERCOT Review –** Projects that have studies under review by ERCOT.
- **No Studies Submitted –** Projects that are tracked by ERCOT but that have not yet provided sufficient information for ERCOT to begin review. Additionally, MWs that were not approved by ERCOT after review of planning studies are included in this category until a path to interconnect these MWs is identified, or the customer cancels the interconnection request.

*All information is as of December 17, 2025.

The Introduction of 765-kV to the ERCOT Region

- On April 24, 2025, the PUCT approved the three 765-kV import paths recommended in the Permian Basin Reliability Plan. This introduced the 765-kV voltage class to the ERCOT Region, the first new voltage class since the 345-kV was introduced in Texas over 60 years ago.
- In December 2025, the ERCOT Board of Directors endorsed the eastern and western portions of the 765-kV STEP proposed by the 2024 RTP, which completed the STEP backbone to meet the future growth, reliability, and need for large power transfer between major generation locations and load centers.
- With the unprecedented load growth in Texas, ERCOT continues to evaluate potential additional 765-kV needs.

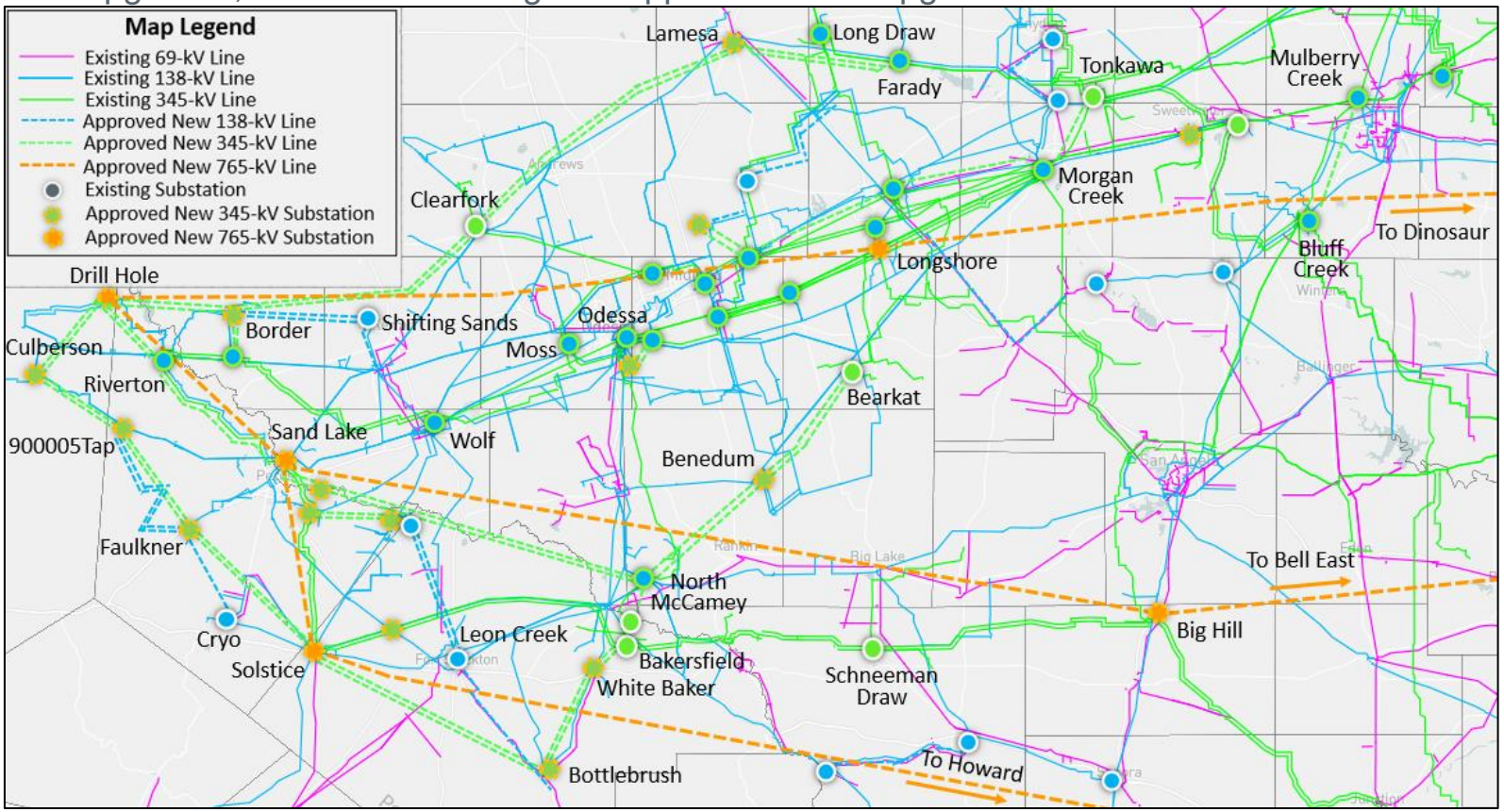


Permian Basin Development

- ERCOT and TSPs that serve West Texas have been proactively positioning the ERCOT grid for potential long lead time transmission enhancements needed to reliably serve the fast-growing loads. These efforts include the completion of four special studies for the region in the past six years.
  - 2019: ERCOT completed the **Delaware Basin Load Integration Study** with extensive input from TSPs, identifying a **five-stage transmission upgrade road map** to reliably serve different levels of Delaware Basin load.
    - All five-stage transmission upgrades, including two new 345-kV import paths to Delaware Basin anticipated to significantly increase the load serving capability in Delaware Basin, have since been accepted or endorsed by ERCOT.
  - 2021: ERCOT completed the **Permian Basin Load Interconnection Study**, informed by the TSP-sponsored IHS Markit study report for Permian Basin load forecast.
    - More than 500 miles of 345-kV transmission line addition and upgrades were identified.
    - Approximately 900 miles of 138-kV transmission line addition, upgrades, and conversion were identified.
  - 2023: ERCOT identified reliability risks in West Texas due to unexpected loss of generation and or load during the disturbance and proposed **six synchronous condensers** to improve transmission grid strength to support the overall system reliability and resiliency in West Texas.
    - All recommended synchronous condensers were endorsed by the ERCOT Board in January 2024.
  - 2024: As directed by the PUCT, ERCOT developed the **Permian Basin Reliability Plan**, which incorporated the S&P Global Commodity Insights Permian Basin load forecast and TSP-provided Large Load information.
    - This plan contains both **local upgrades** and new **765-kV import paths** to address reliability issues in the Permian Basin area.
- As the grid quickly evolves, ERCOT continues to collaborate with stakeholders to reliably serve the rapid load growth in West Texas. This includes not only the oil and gas loads but also Large Loads.

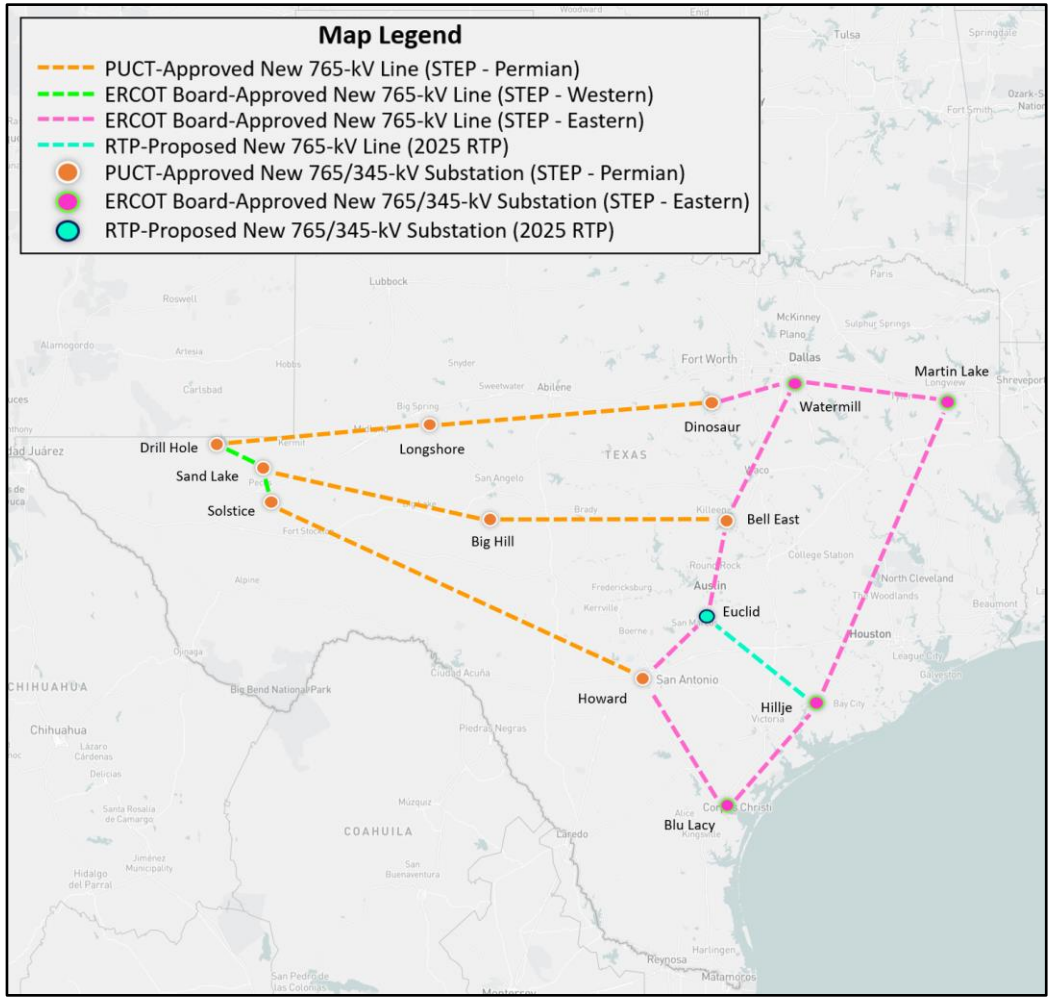
Permian Basin Transmission Buildout

- Since 2014, there have been ~$23 billion of approved projects in the Permian Basin area.
  - ~630 circuit miles of 345-kV transmission lines have been built.
  - ~1,585 circuit miles of 345-kV transmission lines have been approved for new build.
  - ~1,329 miles of 765-kV transmission lines have been approved for new build.
  - Numerous 138-kV upgrades are either already built, approved for new build or upgrade, upgraded, or converted along with approved future upgrades.



2025 RTP Highlights

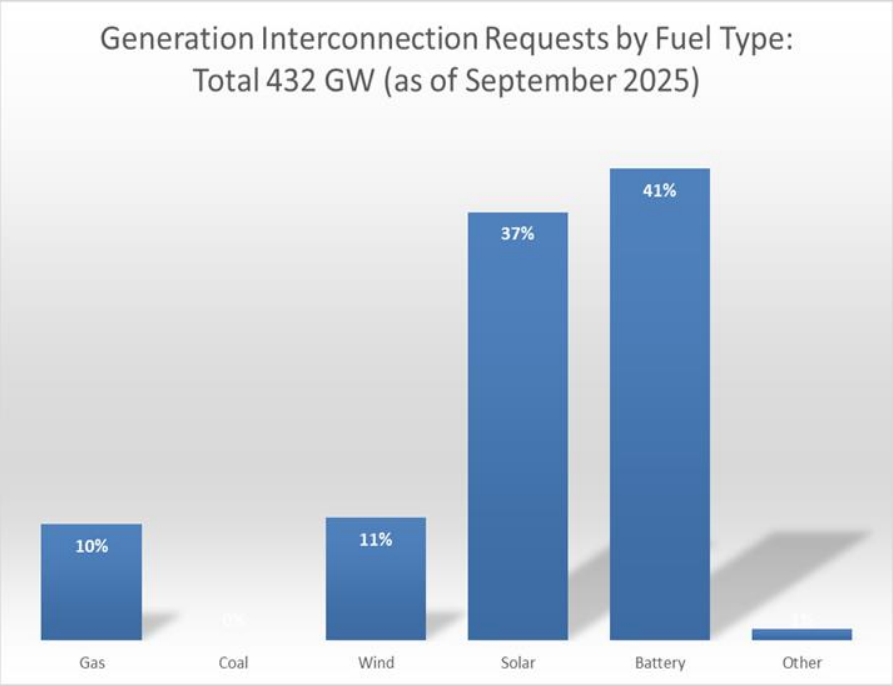
- The 2025 RTP evaluated potential 765-kV equipment additions to address additional load growth.
- Additional 765-kV equipment was added to address a growing import need in Central Texas.
- The 2023 and 2024 RTPs identified strained import capability into the Central Texas region. Additional regional load growth incorporated into the 2025 RTP further strained import capability.
- The Euclid 765-kV substation plus ~130-mile Euclid – Hillje 765-kV line bring approximately 2,500 additional MW into Central Texas, reduce the 345-kV upgrade needs, and provide operational outage flexibility for remaining 345-kV upgrades needed along the existing critical paths.



Recent Planning Criteria and Rule Revisions

- Large Load interconnection requirements and modeling standards
  - NPRR1234 and PGRR115, which established the interconnection and modeling requirements for Large Loads, were approved in May 2025 and implemented in December 2025.
- Resiliency
  - The resiliency criteria proposed by ERCOT in PGRR117, Addition of Resiliency Assessment and Criteria to Reflect PUCT Rule Changes, became effective on April 1, 2025.
  - ERCOT submitted NPRR1286, Establish Multi-Value Criteria for Resiliency-Related Transmission Project Evaluation, in May 2025, to address the process for determining whether an upgrade that meets the resiliency criteria provides sufficient benefit balanced with economic savings and/or reliability benefits, in accordance with 16 TAC § 25.101(b)(3)(A)(iii). This NPRR is currently in the stakeholder process.
- Generation addition in planning models
  - Additional steps outside of the current planning practices were needed to create planning models capable of accommodating the unprecedented load growth in the 2024 and 2025 RTPs.
  - ERCOT submitted PGRR127, Addition of Proposed Generation to the Planning Models, in May 2025, to adjust the criteria for adding Generation Resources to the planning models. This PGRR is currently in the stakeholder process.
- Regional Planning Group (RPG) estimated capital cost update for the tier classification
  - The estimated capital cost thresholds used by ERCOT to categorize transmission projects were last changed in June of 2018 and have since become outdated with the rise of transmission project costs over the years.
  - ERCOT submitted NPRR1274 in 2025 to update the estimated capital cost thresholds to reflect the transmission costs increase over the years. The NPRR was recommended for approval by the ERCOT Board in December 2025.

Effort to Integrate Inverter-Based Resources



Source: ERCOT GIS Report posted on 10/2/2025 for September 2025

- Unlike synchronous machines, IBRs (i.e., wind, solar, and battery) rely on grid strength and inverter controls for stable operation; as IBR penetration increases and synchronous machines decline, ensuring system stability becomes increasingly critical.
- Approximately **89% of new interconnection requests are IBRs**, with nearly **41% specifically for inverter-based ESRs (i.e., batteries)**.
- With minimal impact to the hardware, Advanced Grid Support (AGS) ESR can enhance grid stability, reduce generation curtailment due to stability constraints, and lessen the severity of grid disturbance.

- The AGS-ESR test requirement has been approved and incorporated into ERCOT DWG Procedure Manual posted on the DWG website, and the Frequently Asked Questions (FAQ) document has been posted on the Inverter-Based Resource Working Group (IBRWG) website.
- The Planning and Operating Guides revision requests (NOGRR272 and PGRR121, Advanced Grid Support Requirements for ESRs) were approved in November and became effective in December 2025.

Ongoing Efforts for Large Load Interconnection

- Over 200 GW of Large Loads are currently in the interconnection process. ERCOT and stakeholders are improving the Large Load interconnection process to address anticipated challenges. Key efforts include:
  - Published the ERCOT DWG Large Load Survey and the Large Load Stability Whitepaper to help TSPs and Large Load Customers with data collection and stability assessments during the interconnection process.
  - Completed assessment of transmission upgrade effectiveness in reducing loss of load, considering the rapid growth of Large Electronic Loads (LELs) and uncertainties in their voltage ride-through (VRT) capabilities. The results were presented at the October LLWG meeting.
  - Submitted Nodal Operating Guide Revision Request (NOGRR) 282 to establish LEL ride-through performance requirements
  - Assessing the proposed VRT requirements in the planning horizon and the potential impact on system response by varying LEL trip and reconnection behavior based on the scope presented at the September LLWG meeting.
  - Engaged with consultants for potential subsynchronous resonance (SSR) risks on synchronous generators due to LEL exhibiting AI-driven active power variations, with findings shared at the October LLWG meeting.
  - Engaged with Texas A&M University and EPRI for phase domain and electromagnetic transient models of LELs.
  - Contracted with McKinsey and Company to assist with improvement of the Large Load Interconnection process. ERCOT and McKinsey will work with Large Load customers, including data centers, utilities, and other stakeholders to develop a framework expected to identify short- and mid-term solutions to interconnection queue issues in early 2026 — with a goal of providing a streamlined, transparent, and consistent interconnection process for reliably connecting Large Loads later in the year.

ERCOT Interregional Transfer Study

- ERCOT is currently working with PowerGEM to perform a study of the costs and benefits of increasing synchronous and/or asynchronous connections between ERCOT and other regions.
- Summary of the study objectives and scope:
  - Full assessment of costs and benefits of increasing connections to other regions from the perspective of Texas consumers
  - Advantages/disadvantages of synchronous vs. asynchronous connections
  - Alternatives to synchronous and asynchronous connections, such as switchable generation
- Target study and report completion in Q2 2026.

Contacts and Links

Contacts and Information

For general communications and queries, please submit an information request to: https://www.ercot.com/about/contact/inforequest

Media

Media@ercot.com

Regulatory and Government Relations

GovernmentRelations@ercot.com

Links

ERCOT website: ercot.com

Market Participants can access additional planning information on the Market Information System (MIS), which can be accessed through the "MIS LOG IN" link located at the top of the ERCOT website. A digital certificate is required to access to this area. Information available on the MIS includes a variety of data, procedures, reports, and maps for both operations and planning purposes, including the following planning-related information:

- Generation project interconnection information
- RPG information
- Steady-state base cases