



Item 9.1: System Planning and Weatherization Update

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Reliability and Markets Committee Meeting

ERCOT Public

February 3, 2025

Overview

- **Purpose**

Provide an update on recent activity related to planning, modeling, generation interconnection, resource adequacy and weatherization

- **Voting Items / Requests**

No action is requested of the Reliability and Markets (R&M) Committee or Board; for discussion only

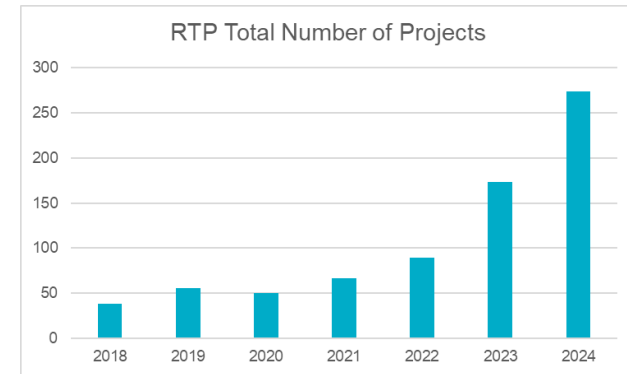
- **Key Takeaways**

- ERCOT completed four transmission planning studies to analyze various future system reliability needs. Additional analysis included a cost benefit comparison of a 345-kV and a 765-kV transmission plan to reliably and efficiently serve future demand growth.
- Solar and Energy Storage Resources (ESRs) continue to account for the vast percentage of generation requesting new interconnection. All Texas Energy Fund projects recommended for due diligence by the PUC are registered with ERCOT and in various phases of the generation interconnection process.
- The large load interconnection queue continues to increase at a record pace.
- Winter weatherization inspection work continues for the season.
- Since PUC approval of the Reliability Standard framework, ERCOT has continued to develop project plans for future assessments as well as work with Commission Staff and Transmission Operators to establish a recommended magnitude criterion.
- Probabilistic modeling results indicate a low risk of having to declare an Energy Emergency Alert under normal system conditions during the months of February and March.



2024 Regional Transmission Plan (RTP)

- Annual study to address ERCOT System transmission needs for planning horizon years two to six.
- Used to comply with NERC Reliability Standards, ERCOT Protocols and Planning Guides.
- Sufficient transmission capacity plays a key role in ensuring system reliability while meeting rapid growth in demand.
- Unprecedented forecasted load growth coupled with utilization of current transmission capacity prompted discussions of including a 765-kV infrastructure to the ERCOT transmission grid to enable power to flow more efficiently through long-distance transmission from resource-rich regions to load centers.
- To serve both current and future load growth reliably and efficiently, many miles of new transmission build as well as upgrades to existing lines will be required no matter the decision on which voltage level is to be used.
- ERCOT filed a comparison document of the costs and benefits of the 345-kV RTP and the Texas 765-kV Strategic Transmission Expansion Plan (TX 765-kV STEP) on January 24th.

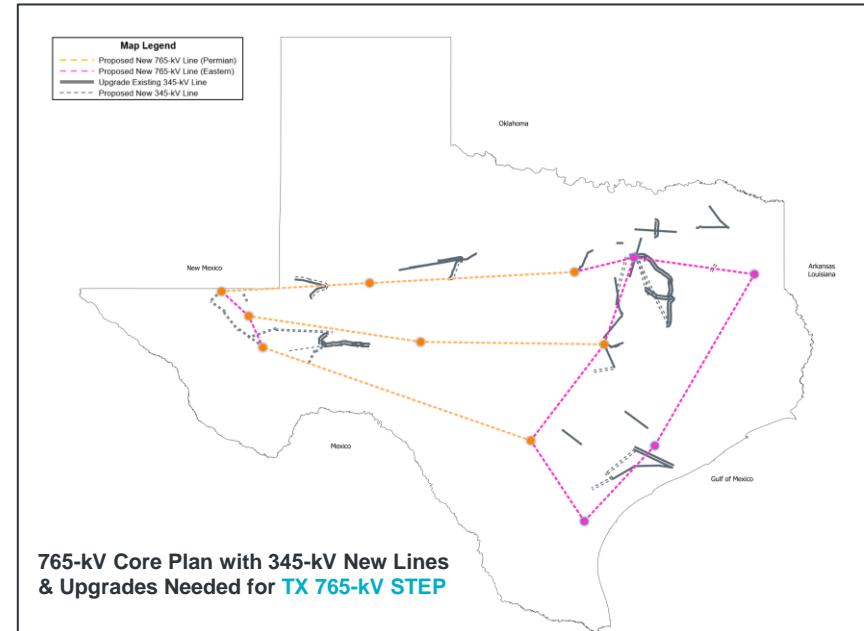
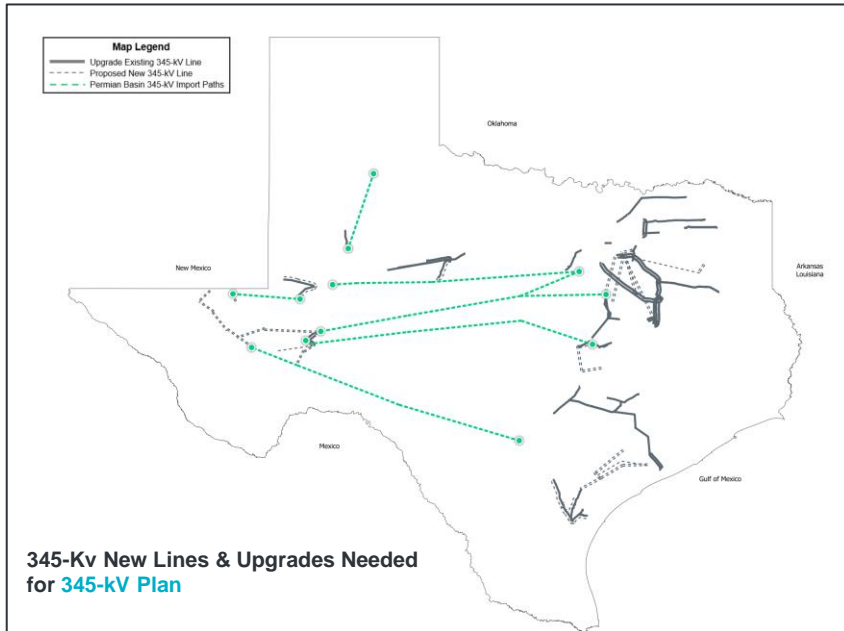


The 2024 345-kV RTP identified 274 transmission projects to reliably serve forecasted load (compared to 173 projects identified in the 2023 RTP).

Key Takeaway: To reliably and efficiently serve both current and future load growth, a large number of miles of new transmission build as well as upgrades to existing lines will be required no matter the decision on which voltage plan is to be used.

345-kV Plan and TX 765-kV STEP Comparison

- The last voltage change in Texas transmission planning was in the 1960s to incorporate 345-kV.
- While 765-kV voltage level would be new to ERCOT, it has been used in other parts of the United States since the 1960s and in many foreign countries.
- SPP and MISO have proposals for building 765-kV in non-ERCOT parts of Texas.
- To serve both current and future demand reliably and efficiently, many miles of new transmission build as well as upgrades to existing transmission lines will be required no matter the voltage level decision.



Geographic locations for proposed new lines are meant to demonstrate general electrical point-to-point connections. Specific routing of any new transmission infrastructure is determined by the Public Utility Commission as part of the CCN process with Transmission Service Providers.

Cost Benefit Comparison

- Reduced impact to current grid for upgrades** - While TX 765-kV STEP includes ~400 more miles of new right-of-way (ROW), it significantly reduced the need to upgrade/ rebuild current infrastructure by ~1,400 fewer miles. Fewer existing upgrades is a benefit as today's system fully utilizes its current capability which makes existing upgrades more difficult and expensive.
- Lower line losses** - 765-kV transmission significantly reduces power losses by transmitting electricity at a higher voltage and can reduce annual systemwide transmission losses which means more energy is delivered to customers. Estimated annual line loss savings are the equivalent to a new 128 MW thermal unit operating at a 50% capacity factor.
- More transmission congestion savings** - Transmission congestion occurs when uneconomic generators are dispatched to reduce power flows over constrained lines. TX 765-kV STEP is estimated to reduce congestion and thus produce more savings for consumers in the long term compared to the 345-kV plan.

	345-kV Plan	TX 765-kV STEP
New ROW impact	434 fewer miles of ROW	
Existing System Upgrades impact		1,443 fewer miles of existing upgrades
Estimated New Construction Cost (345-kV \$30.75 billion; TX 765-kV STEP \$32.99 billion)	\$2.24 billion less construction cost	
Estimated Additional cost: Live/Hot construction to facilitate existing upgrades		\$890 million less in construction outage related cost
Estimated Consumer Energy Cost Savings (Long-term)		\$229 million more annual Consumer Energy Cost Savings
Estimated Production Cost Savings (Long-term)		\$28 million more annual Production Cost Savings
Estimated System Loss Reduction		560 GWh/year less energy loss
Incremental Transfer Capability		600 to 3,000 MW increase in power transfer capability
West Texas Stability Limit Improvement		13% more improvement
Potential Retirement of Series Capacitors		Comparable/Similar
Improvement to the Overall System Strength		Comparable/Similar

Additional Considerations

- **How does projected transmission investment compare to recent trends?**

Both the 345-kV plan and the TX 765-kV STEP are estimated to require approximately \$5 billion per year of transmission project investment over the six-year planning horizon compared to an average of over \$3 billion per year of transmission projects endorsed in the past three years. In 2024, \$3.78 billion of new transmission was endorsed by the ERCOT Board of Directors.

Transmission investment costs are typically recovered over a 30–40-year period by TSPs. As demand grows and more customers are connected to the transmission grid, costs are distributed across the increased customer base.

- **What if demand does not materialize as projected in the load forecast?**

Each year, ERCOT surveys TSPs who have a direct relationship with end use customers to compile the load forecast to be used in the RTP. ERCOT performed a sensitivity analysis with a reduced load level (~ 20 GW less overall load) to assess the impact on the need for the 345-kV plan and the TX 765-kV STEP if less than forecasted load materializes. Results showed major portions of the 345-kV plan, and the TX 765-kV STEP will still be needed to meet a reduced demand forecast.

Before a new transmission line is approved to be constructed, the PUCT will review the need for the project.

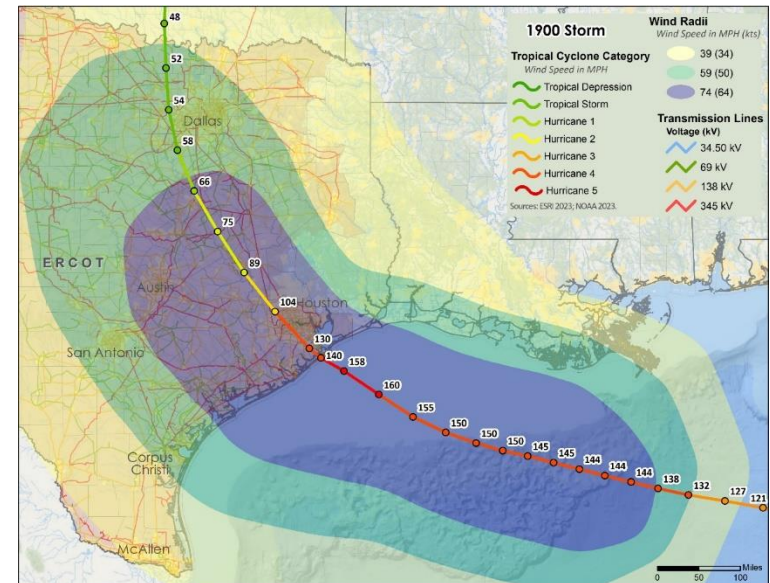
- **Are there any supply chain constraints to be noted at this time?**

Preliminary discussions with 765-kV equipment manufacturers as well as TSPs who would build the infrastructure indicate the supply chain timeline for 765-kV equipment is about the same as those for 345-kV equipment.

2024 Grid Reliability and Resiliency Assessment (GRRRA)

- Biennial study performed to meet the requirements established in 16 TAC § 25.101(b)(3)(E) to implement requirements from SB1281 of the 87th Legislature.
- The 2024 GRRRA identified projects that are necessary to prevent cascading, instability, or uncontrolled islanding and/or to reduce the impact of outages on customers under the following two extreme weather scenarios:
 - An extreme winter peak scenario that considered a weather condition similar to the 2021 Winter Storm Uri event but with the impacts of the weatherization rules effective since then factored in.
 - A hurricane scenario representing a worst-case scenario Category 5 hurricane with Houston area landfall using information provided in the Argonne National Laboratory's 2024 Hurricane Study for ERCOT.

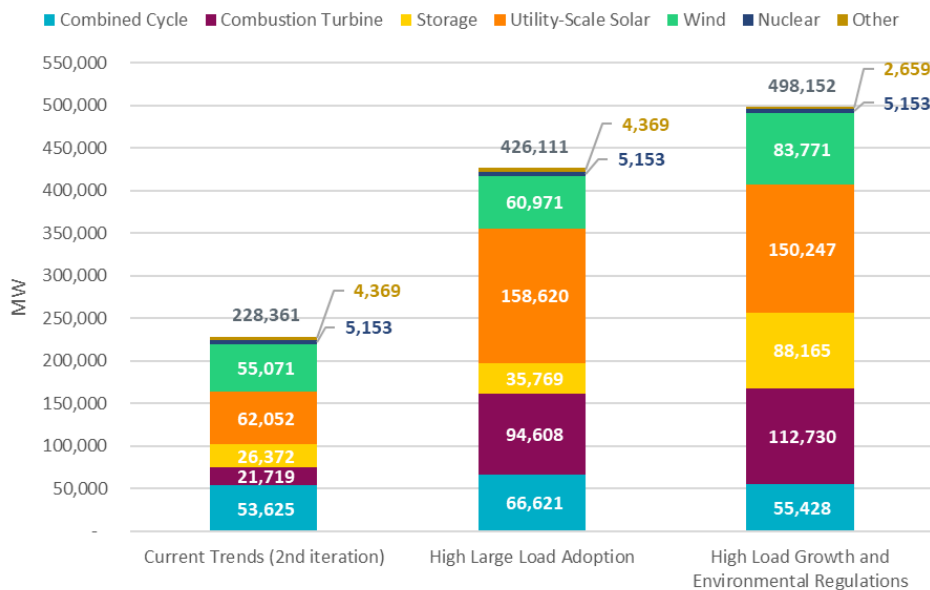
- Key assessment takeaways:
 - Additional transmission enhancements were found to be beneficial to increase the resiliency of the ERCOT Transmission Grid under both scenarios.
 - Substation hardening was found to have a critical role in increasing system resiliency under the hurricane scenario.
 - Though distribution hardening was out of the scope of this assessment, a more resilient distribution system was deemed as crucial to increase the overall system resiliency under the hurricane scenario.



2024 Long-Term System Assessment (LTSA)

- Biennial study to analyze various scenarios & potential system needs for 10-to-15-years to account for inherent uncertainty of planning the transmission system beyond six years.
- Contains both a capacity and a transmission expansion study to meet state rules to study the need for increased transmission and generation capacity.
- Utilized 2023 Long-Term Load Forecast; did not incorporate additional load driven by the unprecedented growth and new requirement from HB5066 given timing of report development & implementation of HB5066.

Total Net Nameplate Capacities in 2039



Across all scenarios, significant growth in wind, solar, natural gas, and battery energy storage was projected to replace retired coal capacity and meet rising demand.

Index	Constraint	Congestion Rent	
		2034	2039
1	West Texas Export Interface	\$556M	\$821M
2	Farmland - Wett Long Draw 345-kV Line	\$134M	\$233M
3	Meadow - PH Robinson 345-kV Line	\$162M	\$155M
4	Bell County East Switch - Sandow Switch 345-kV Line	\$121M	\$153M
5	South Texas Project - Jones Creek 345-kV Line	\$55M	\$143M
6	Panhandle Interface	\$142M	\$140M
7	Refuge - Jones Creek 345-kV Line	\$49M	\$112M
8	North - Houston Interface	\$60M	\$108M
9	Kendall - Welfare 138-kV Line	\$15M	\$81M
10	MacKenzie Substation - Northeast Substation 115-kV Line	\$55M	\$79M

Transmission challenges were identified for both the export from the renewable resource-rich regions and the import into the demand centers.



Constraints and Needs Report

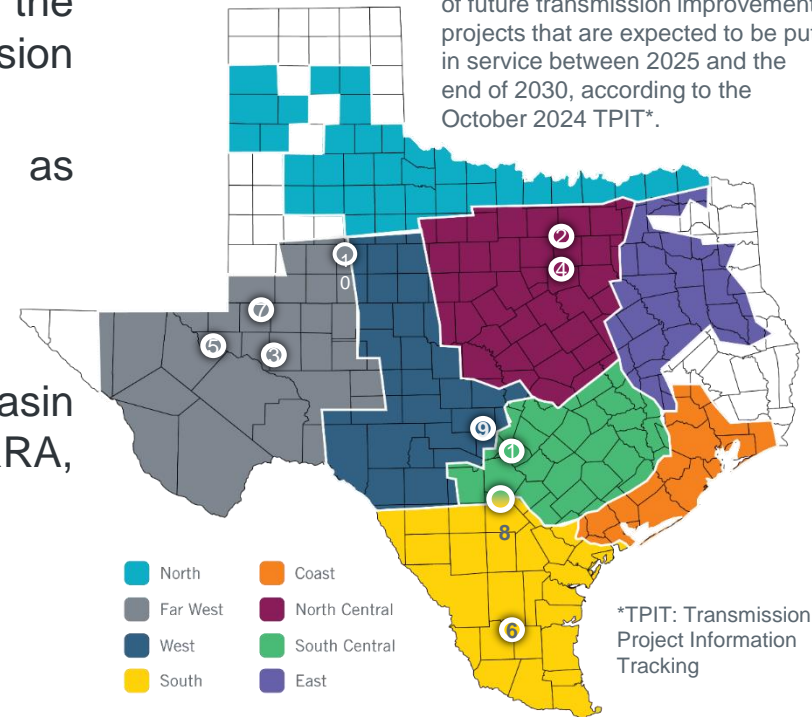
- Annual report highlights the existing and potential electric system constraints and needs.
- Includes key findings from ERCOT's transmission assessments, key challenges in the ERCOT region, and key initiatives in the ERCOT region and in the industry especially as it relates to the transmission system.
 - Recent and projected constraints as well as planned improvements to address
 - Transmission cost trends
 - Long term Load forecast summary
 - Recent study highlights (Permian Basin Reliability Plan, RTP, TX 765-kV STEP, GRRR, LTSA)
 - Latest planning criteria and rule revisions
 - Interregional studies

Planned Improvements

Top 10 significant improvements on the ERCOT System

Projects planned for completion within the next six years

Currently, there are \$14.90 billion of future transmission improvement projects that are expected to be put in service between 2025 and the end of 2030, according to the October 2024 TPIT*.



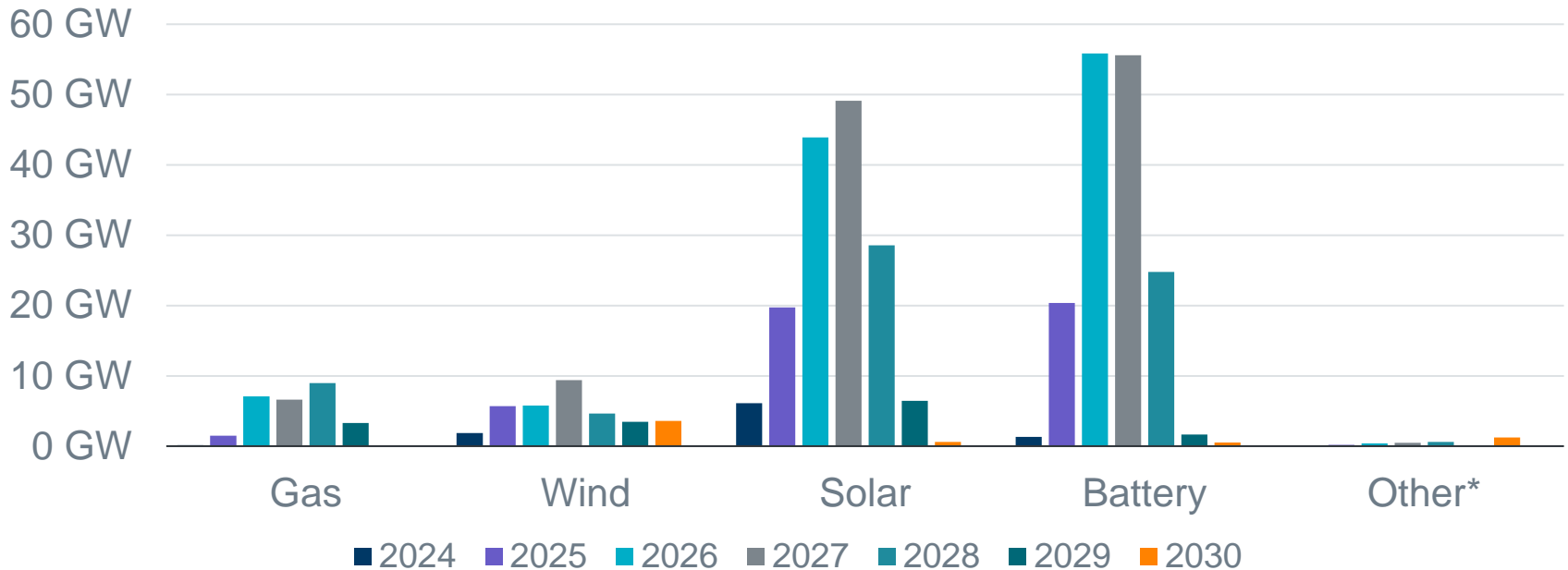
Key Takeaway: The Constraints and Needs report provides an annual summary of the major Planning work in the region.



Generation Interconnection Requests

1,917 active generation interconnection requests totaling 379 GW as of December 31, 2024
 (Solar 154 GW, Wind 34 GW, Gas 28 GW, and Battery 160 GW)

(Excludes capacity associated with projects designated as Inactive per Planning Guide Section 5.2.5)



A break-out by zone can be found in the monthly Generator Interconnection Status (GIS) reports available on the ERCOT Resource Adequacy Page: <http://www.ercot.com/gridinfo/resource>

* Other includes petroleum coke (pet coke), hydroelectric, fuel oil, geothermal energy, other miscellaneous fuels reported by developers, and fuel cells that use fuels other than natural gas.

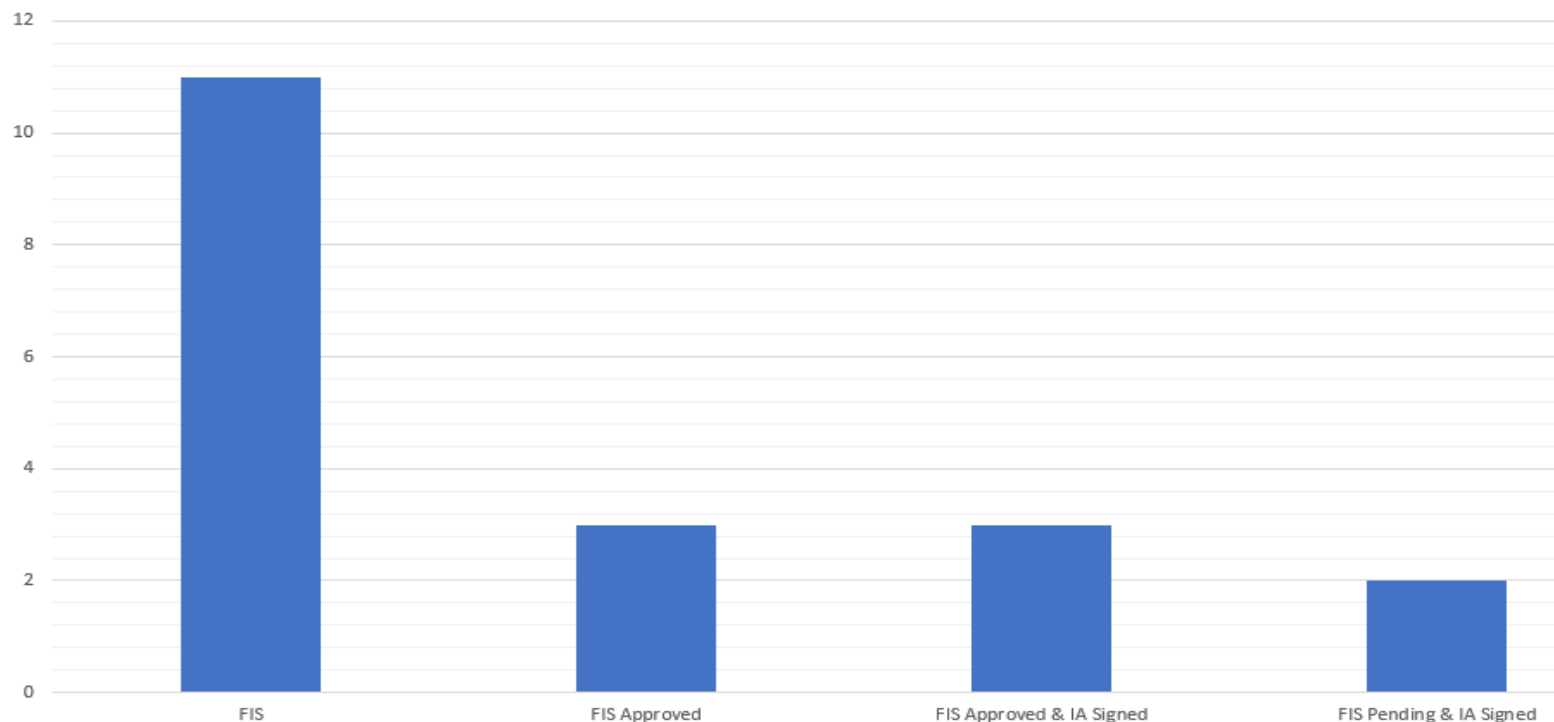
Key Takeaway: Solar and Battery Energy Storage continue to account for approximately 83% of the amount of generation seeking interconnection.



Texas Energy Fund Status (as of January 17, 2025)

All eighteen projects recommended for Due Diligence by the PUC are in various phases of the generation interconnection process.

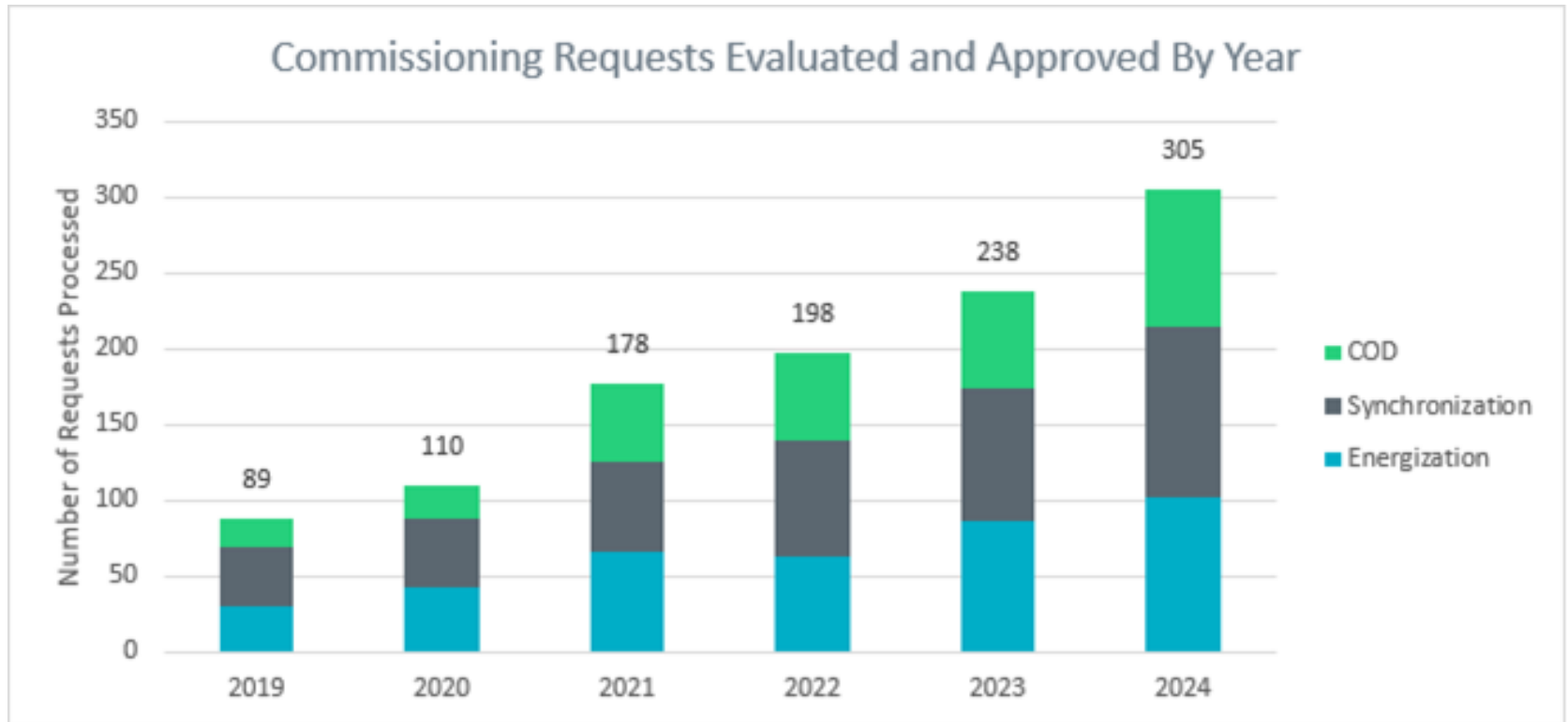
Status of TEF Projects approved for Due Diligence



Key Takeaway: All eighteen have submitted a Generator Interconnection or Modification (GIM) application with ERCOT and are advancing through the interconnection process. Six projects have completed all Full Interconnection Studies (FIS), and five projects have Signed Generation Interconnection Agreements (SGIAs).



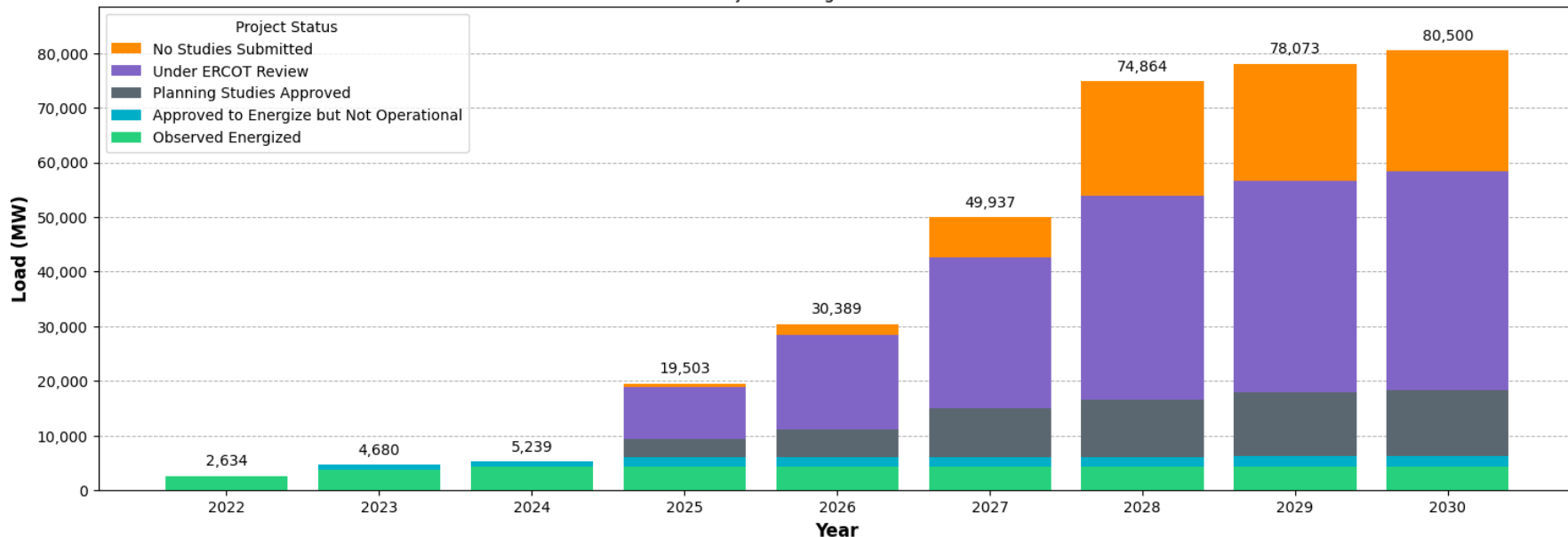
2024 Commissioning Results



Key Takeaway: ERCOT processed a record number Generation Resource applications in 2024, which connected over 12 GW of new generation to the system compared with approximately 7 GW in 2023.

Current Large Load Interconnection Queue (as of January 17, 2025)

Actual and Projected Large Load Growth 2022-2030



Project Status	2022	2023	2024	2025	2026	2027	2028	2029	2030
No Studies Submitted	0	0	0	705	1,965	7,406	20,965	21,474	22,202
Under ERCOT Review	0	0	0	9,469	17,312	27,432	37,324	38,594	40,074
Planning Studies Approved	0	0	0	3,323	5,106	9,093	10,569	11,699	11,918
Approved to Energize but Not Operational	88	918	983	1,750	1,750	1,750	1,750	2,050	2,050
Observed Energized	2,546	3,762	4,256	4,256	4,256	4,256	4,256	4,256	4,256
Total (MW)	2,634	4,680	5,239	19,503	30,389	49,937	74,864	78,073	80,500

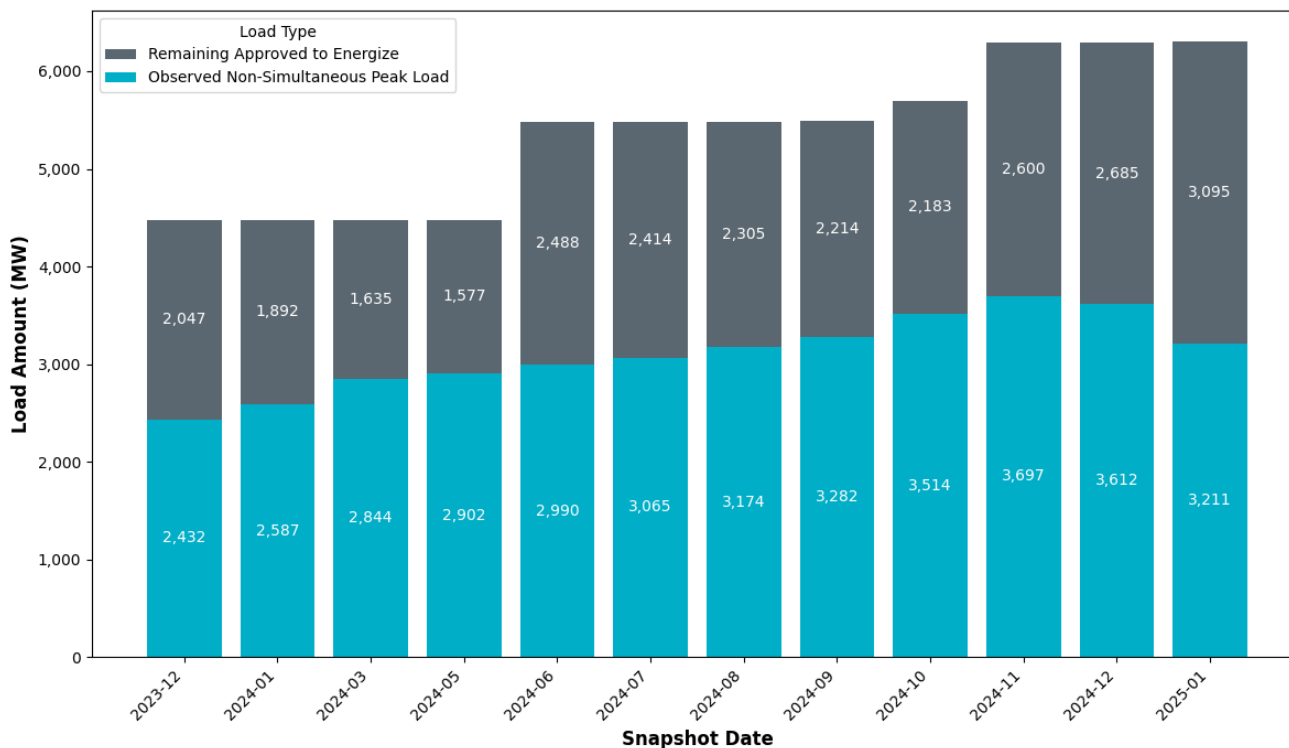
Key Takeaway: ERCOT is tracking approximately 80k MW of Large Loads seeking interconnection compared to 63k MW in December.



Loads Approved to Energize – Observations

Of the 6,306 MW that have received Approval to Energize, ERCOT has observed a **non-simultaneous** peak consumption of 3,211 MW in January 2025 with an all time peak of 3,697 MW that occurred in November 2024.

- Non-simultaneous peak Load is the sum of the maximum value for each individual load regardless of when that maximum occurred and represents how much approved load ERCOT believes is now operational
- Remaining 2,600 MW may energize at any time without additional approval



Key Takeaway: ERCOT has reviewed and approved studies for the interconnection of over 18,000 MW of Large Loads in the past two years of which approximately 1/3 have received Approval to Energize.



Weatherization and Inspection Update

- Report of Receipt of Declarations of Winter Weather Preparedness were submitted to PUC on December 20, 2024.
 - 519 of 528 generation entities submitted timely; while 9 were late, none are outstanding.
 - 54 of 57 Transmission Service Providers (TSPs) submitted timely; while 3 were late, none are outstanding.
- Winter weatherization inspections are underway :

	Generation Resources	TSP Facilities	Inspection Totals
December 2024 (completed)	141	8	149
January 2025 (planned)	103	66	169
February 2025 (planned)	57	80	137
Total Inspections	301	154	455

- Winter Storms Blair (Jan 5-6) and Clara (Jan 8-11) had limited impact in the ERCOT territory with adequate reserve margins maintained throughout.

Key Takeaway: Winter weatherization inspection activity is tracking as planned.



Reliability Standard Implementation Update

Current implementation activities for the Reliability Standard:

- ERCOT is preparing its “maximum load shed” report, which must provide the “maximum number of megawatts of load shed that can be safely rotated during a loss of load event and a summary of the methodology used to calculate this value.” This report is due February 6th per a filing date extension granted by the Commission.
- Reliability Assessment project plan developed in December 2024; main preparatory 2025 activities to support the first Assessment, which starts in 2026, include:
 - Developing a multi-zone version of the probabilistic model to account for resource adequacy impacts due to generation deliverability constraints across the ERCOT grid.
 - Prototyping the Reliability Assessment process and model preparation to conduct trial simulations for forecast year 2026.
 - Beginning development of required modeling assumptions report in summer 2025.

Key Takeaway: Significant preparatory work is needed throughout 2025 to ensure that an effective and well-vetted Reliability Assessment development process is in place for the 2026 Reliability Assessment cycle.

Monthly Outlook on Resource Adequacy (MORA)

Probabilistic modeling results indicate a low risk of having to declare an Energy Emergency Alert (EEA) for February and March. Highest risk hours transition from the morning in February to the early evening hours in March (Hour Ending 7 p.m. and 8 p.m.).

Feb

Hour Ending (CST)	EMERGENCY LEVEL		
	Chance of Normal System Conditions	Chance of an Energy Emergency Alert	Chance of Ordering Controlled Outages
	Probability of CAFOR being above 3,000 MW	Probability of CAFOR being less than 2,500 MW	Probability of CAFOR being less than 1,500 MW
1 a.m.	99.62%	0.25%	0.17%
2 a.m.	99.77%	0.07%	0.04%
3 a.m.	99.55%	0.21%	0.12%
4 a.m.	99.57%	0.24%	0.13%
5 a.m.	99.53%	0.23%	0.13%
6 a.m.	99.65%	0.21%	0.15%
7 a.m.	97.85%	1.03%	0.76%
8 a.m.	94.56%	2.14%	1.58%
9 a.m.	98.07%	0.69%	0.47%
10 a.m.	99.35%	0.32%	0.23%
11 a.m.	99.86%	0.05%	0.03%
12 p.m.	99.98%	0.01%	0.01%
1 p.m.	99.99%	0.00%	0.00%
2 p.m.	100.00%	0.00%	0.00%
3 p.m.	100.00%	0.00%	0.00%
4 p.m.	99.98%	0.01%	0.00%
5 p.m.	99.99%	0.00%	0.00%
6 p.m.	99.99%	0.00%	0.00%
7 p.m.	99.94%	0.02%	0.02%
8 p.m.	99.81%	0.05%	0.04%
9 p.m.	99.66%	0.15%	0.10%
10 p.m.	99.90%	0.04%	0.03%
11 p.m.	99.96%	0.00%	0.00%
12 a.m.	99.99%	0.00%	0.00%

Note: Probabilities are not additive.

Mar

Hour Ending (CST)	EMERGENCY LEVEL		
	Chance of Normal System Conditions	Chance of an Energy Emergency Alert	Chance of Ordering Controlled Outages
	Probability of CAFOR being above 3,000 MW	Probability of CAFOR being less than 2,500 MW	Probability of CAFOR being less than 1,500 MW
1 a.m.	99.33%	0.26%	0.19%
2 a.m.	99.16%	0.31%	0.15%
3 a.m.	99.18%	0.31%	0.19%
4 a.m.	99.38%	0.21%	0.13%
5 a.m.	98.79%	0.54%	0.40%
6 a.m.	98.23%	0.73%	0.57%
7 a.m.	95.97%	2.25%	1.75%
8 a.m.	95.56%	2.61%	1.97%
9 a.m.	98.49%	0.83%	0.57%
10 a.m.	99.57%	0.19%	0.15%
11 a.m.	99.95%	0.03%	0.00%
12 p.m.	99.92%	0.03%	0.02%
1 p.m.	99.89%	0.04%	0.03%
2 p.m.	99.88%	0.04%	0.04%
3 p.m.	99.77%	0.11%	0.07%
4 p.m.	99.47%	0.27%	0.23%
5 p.m.	99.35%	0.30%	0.20%
6 p.m.	98.31%	0.82%	0.59%
7 p.m.	90.18%	6.31%	5.42%
8 p.m.	90.73%	6.21%	5.30%
9 p.m.	94.62%	3.34%	2.73%
10 p.m.	97.47%	1.44%	1.12%
11 p.m.	99.59%	0.11%	0.08%
12 a.m.	99.75%	0.04%	0.00%

Note: Probabilities are not additive.



Capacity, Demand and Reserves (CDR) Report

Significant Methodology Changes affecting the CDR (per NPRR1219)

- Shift to Effective Load Carrying Capabilities (ELCCs)
- Peak Net Load Information: Planning Reserve Margin and associated loads and resource information for the forecasted peak Net Load hour are being officially reported.
- Updated Criteria for Planned Resources: The criteria for including planned resources in the CDR has been expanded to include the following:
 - ERCOT notification that a project developer has provided the required financial security for interconnection facility construction to the transmission provider.
 - The transmission provider has received a notice to proceed with interconnection construction.
- Inclusion of Publicly Announced Planned Retirements: A new category for planned retirements has been added to account for generation resources associated with publicly announced retirement plans, but their resource owners haven't yet submitted a formal Notification of Suspension of Operations (NSO) to ERCOT.

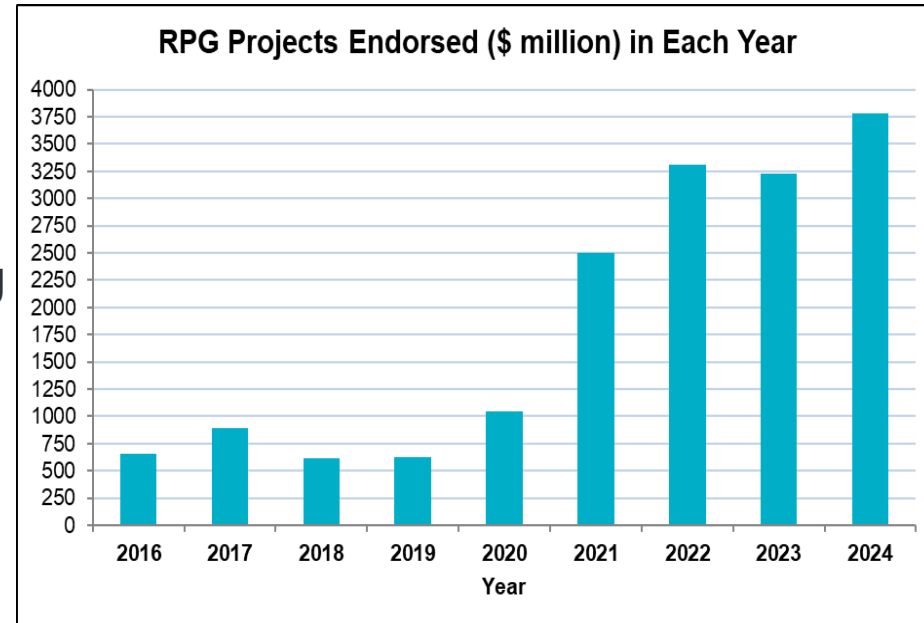
Key Takeaway: With the significant changes to the report, ERCOT delayed the release of the CDR from December to provide sufficient time to evaluate Resource and Load accounting methodology changes.



Appendix

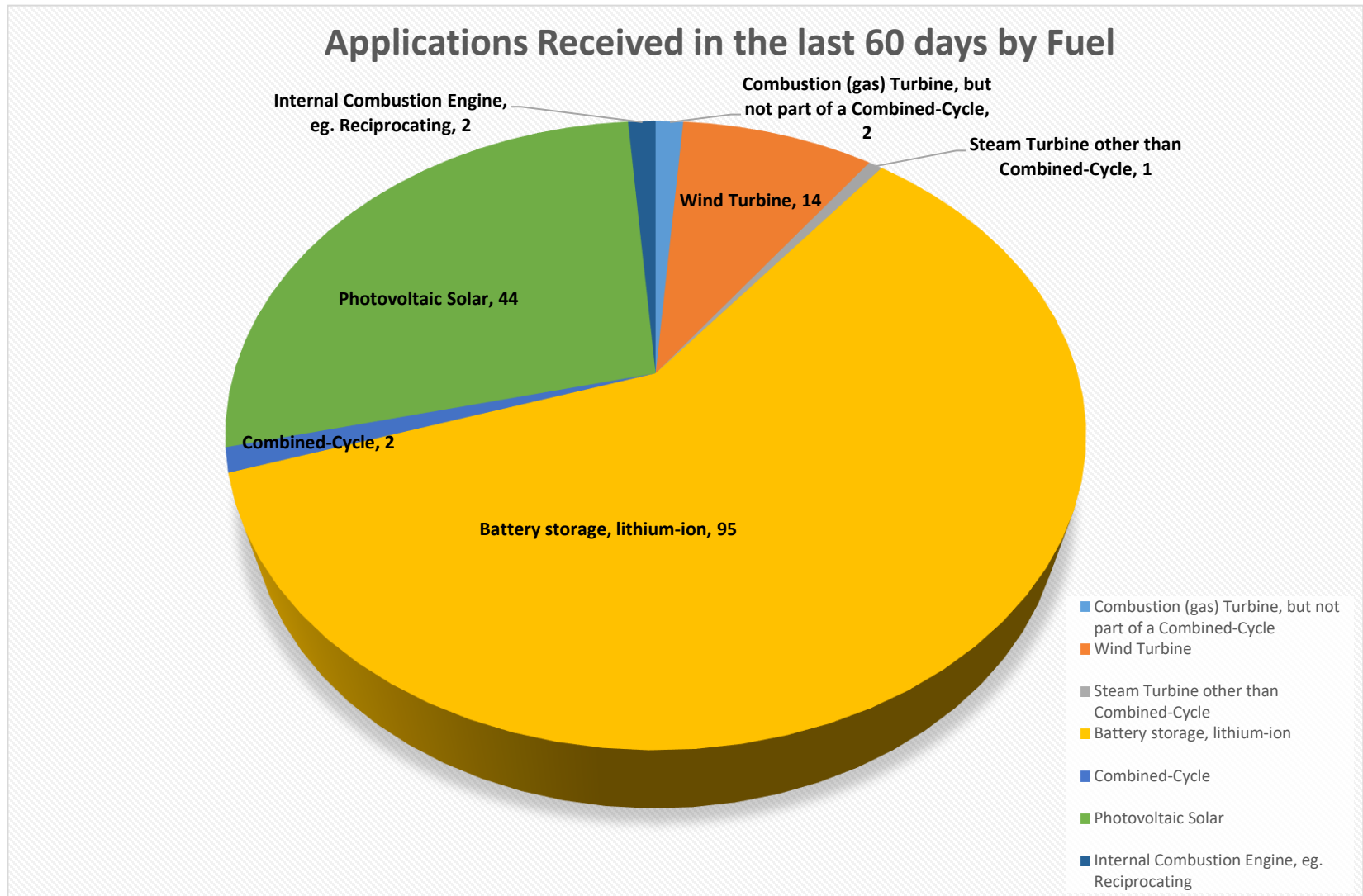
Transmission Planning Summary

- As of October 1, 2024, projects energized in 2024 total about \$2.435 billion.
 - \$1.553 billion energized in all of 2023
- As of December 31, 2024, ERCOT has endorsed transmission projects totaling \$3.785 billion in 2024.
 - Total endorsed transmission projects in 2023 equaled \$3.231 billion
- As of October 31, 2024, projects in engineering, routing, licensing, and construction total about \$16.504 billion.



Key Takeaway: Transmission buildout as well as project endorsement continues at a record pace with more projects energized by October than were energized in all of 2023.

Generation Interconnection Activity (as of January 13, 2025)



Key Takeaway: Battery Energy Storage continues to be the most active generation type requesting interconnection studies.

Generation Resource Project MWs by Fuel Type and Interconnection Stage (as of January 13, 2025)

