

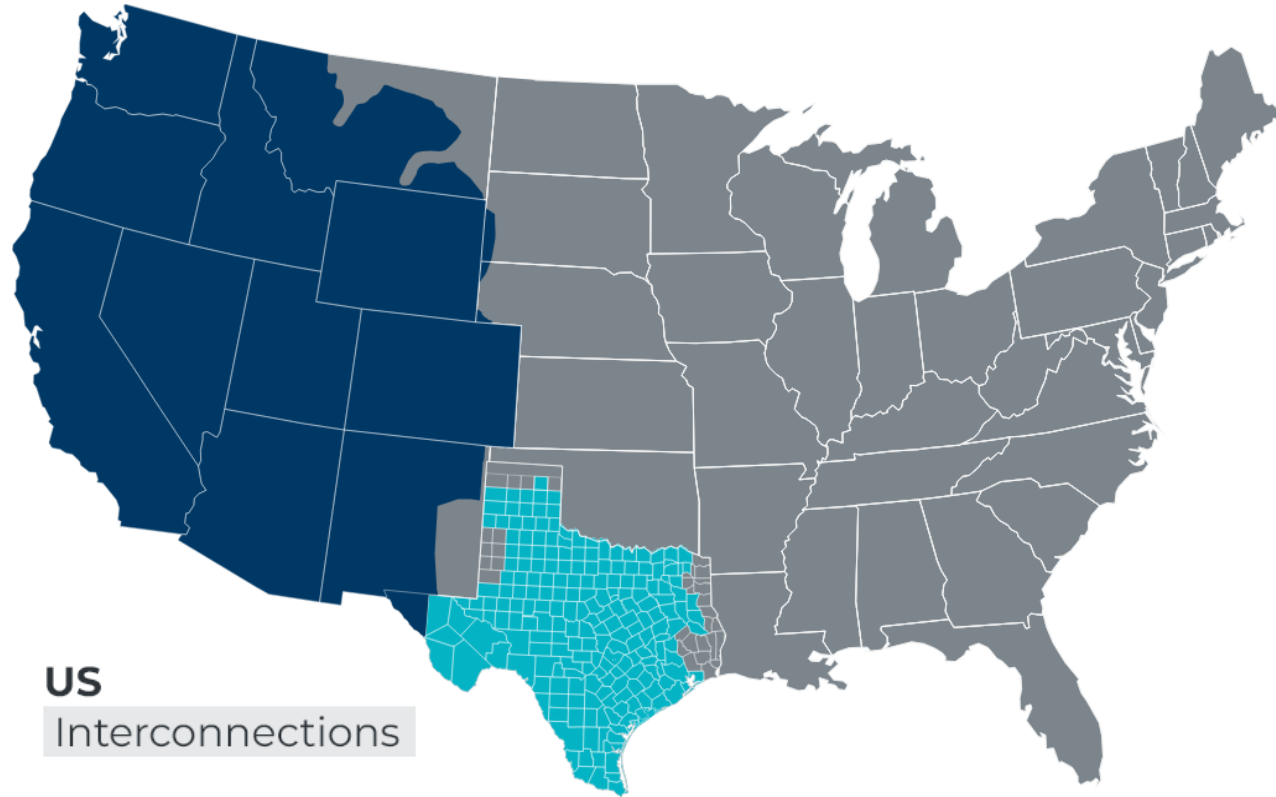


Energy Systems Integration Group (ESIG)
*Opportunities and Challenges in the Texas Power Grid –
ERCOT Perspective*

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The ERCOT Region



US

Interconnections

● Western Interconnection
Includes El Paso and Far West Texas

● ERCOT Interconnection

● Eastern Interconnection
Includes portions of East Texas and Panhandle region

The ERCOT grid is the interconnected electrical system serving most of Texas with limited external connections.

ERCOT highlights include:

- 90% of Texas electric load
- 75% of Texas land
- More than 54,100 miles of transmission lines
- 1,250+ generation units (including Private Use Networks)
- ERCOT's connections to other grids are limited to ~1,220 MW of direct current (DC) ties, which allow control over the flow of electricity

What is ERCOT?

The Texas Legislature restructured the Texas electric market in 1999 and assigned ERCOT four primary responsibilities:

- **Maintain system reliability**
- **Facilitate a competitive wholesale market**
- **Ensure open access to transmission**
- **Facilitate a competitive retail market**

ERCOT is a nonprofit organization regulated by the Public Utility Commission of Texas, with oversight by the Texas Legislature.

ERCOT is not a Market Participant and does not own or maintain generation or transmission/distribution wires.



Texas Competitive Model

The Texas Legislature restructured the Texas electric market in 1999.

ERCOT plays an integral role in all areas.



Generation

Competitive Production

- Generation resources are owned by privately owned companies, with the exception of municipal and cooperative resources. They operate and compete in the ERCOT market to serve load.



Transmission & Distribution

Regulated Open Access

- Transmission and distribution lines and related facilities are owned and operated by regulated utilities. They operate in the ERCOT market.

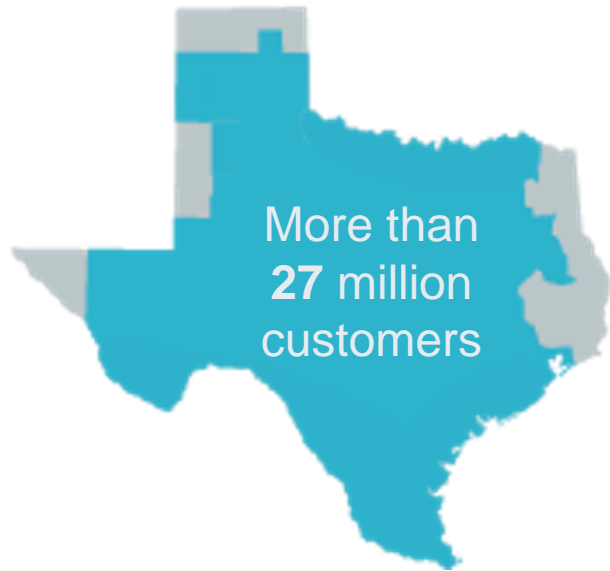


Retailers

Competitive Sales

- Retailers compete to serve consumers' electric load in ERCOT.
- Municipal and cooperative utilities sell power to one fourth of the ERCOT market.
- Nearly 100% smart meters

ERCOT Facts



85,508 MW

Record peak demand (August 10, 2023)

115,596+ MW

Expected capacity for summer 2025 peak demand (May 2024 CDR)

\$3.8 billion

Transmission projects endorsed in 2024

2024 Generating Capacity

Reflects the forecasted operational installed capacity for Summer 2025 based on December 2024 CDR report.



The sum of the percentages may not equal 100% due to rounding.
*Other includes biomass-fired units and DC tie capacity.

2024 Energy Use



* Other includes solar, hydro, petroleum coke (pet coke), biomass, landfill gas, distillate fuel oil, net DC-tie and Block Load Transfer important/exports and an adjustment for wholesale storage load.



1 MW of electricity is enough to serve about 250 residential customers during ERCOT peak hours.



39,518 MW

Wind

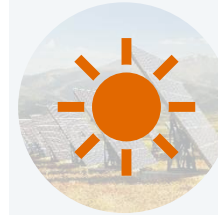
of installed wind capacity as of March 2025, the most of any state in the nation

28,550 MW

Generation Record (March 3, 2025)

69.15 %

Penetration Record (April 10, 2022)



30,305 MW

Solar

of utility-scale installed solar capacity as of March 2025

25,041 MW

Generation Record (March 10, 2025)

54.23 %

Penetration Record (March 1, 2025)

~76 % (~36,966 MW)

Preliminary Wind + Solar Penetration Record (March 1, 2025)



10,017 MW

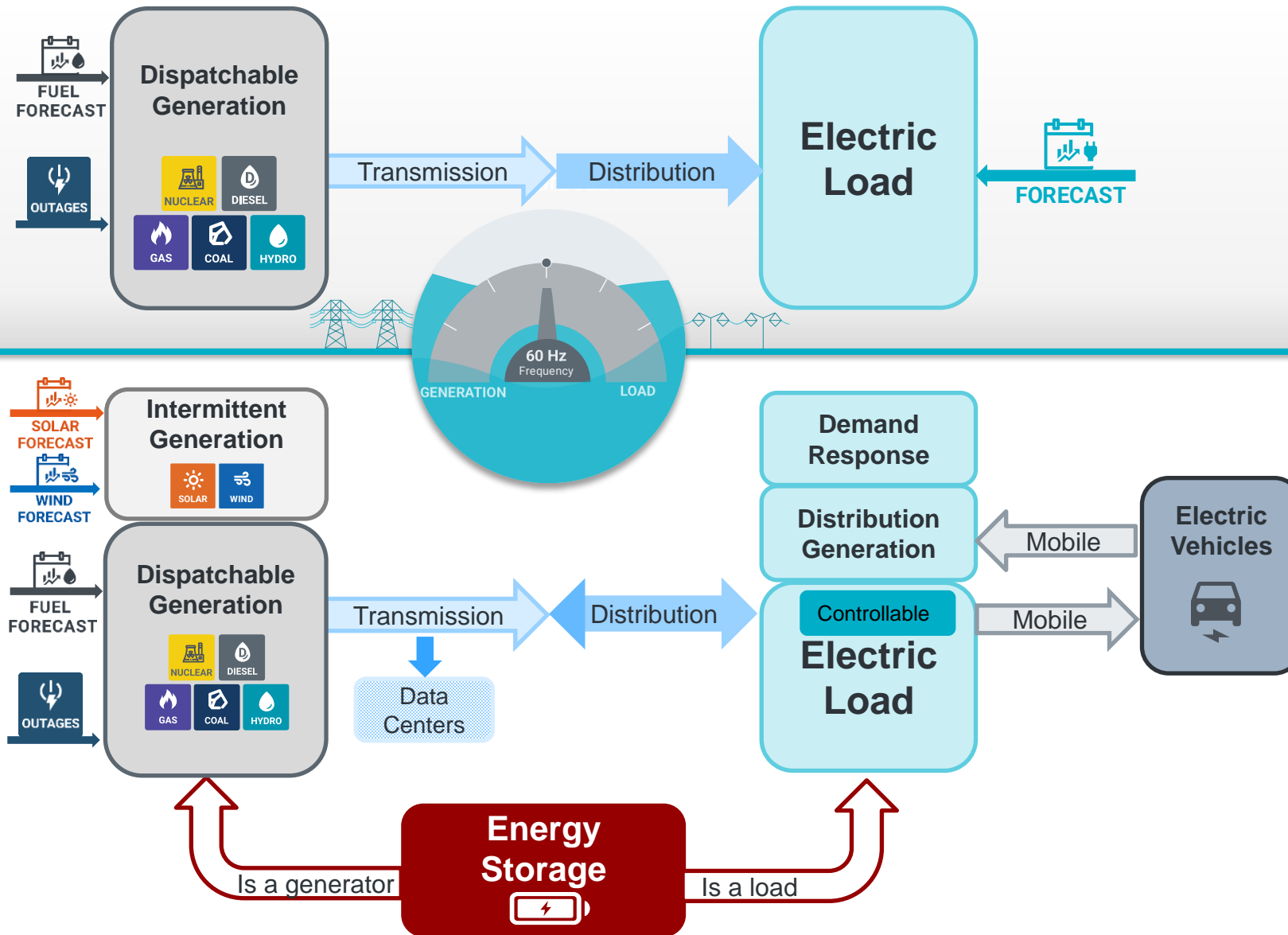
Battery Storage

of installed battery storage capacity as of January 2025

4,963 MW

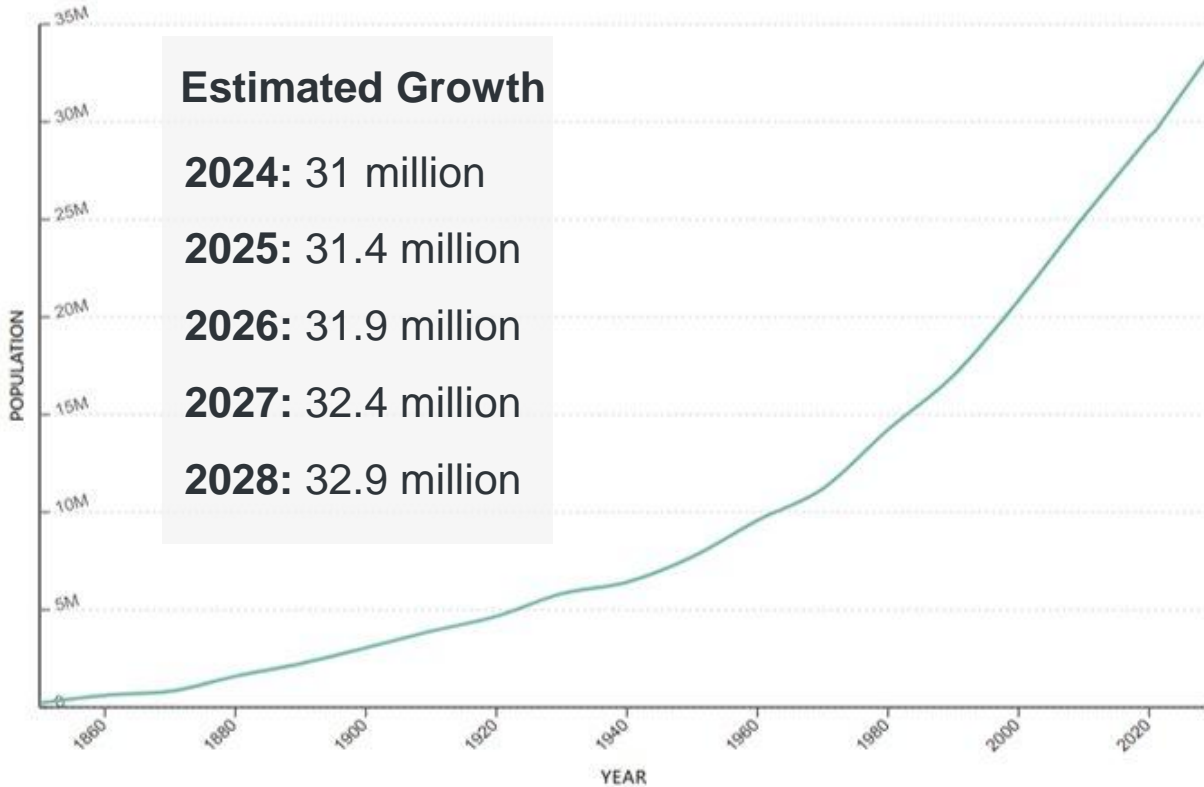
Storage Discharge Record (March 10, 2025)

The ERCOT Electric Grid: Then and Now

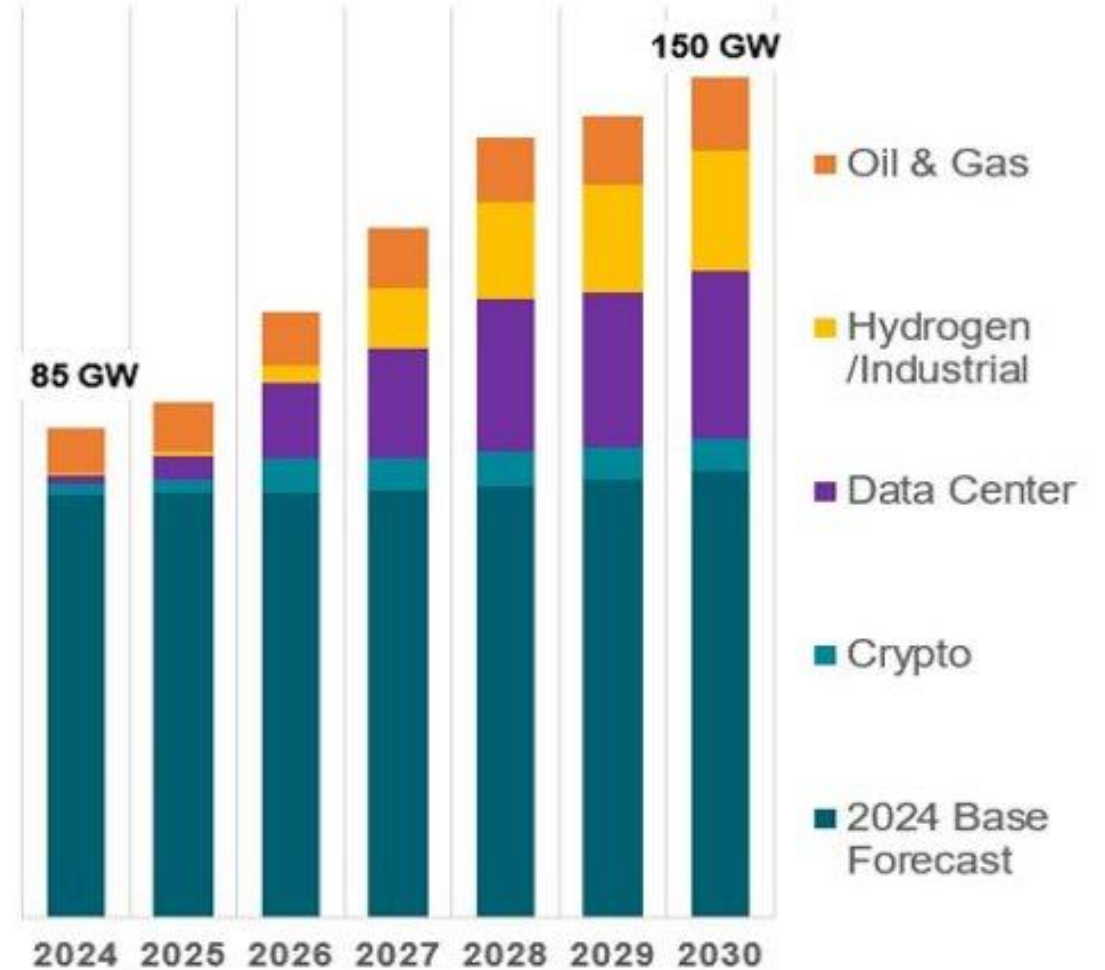


Load Side – What is Happening?

Texas Population 2023
30,500,280*



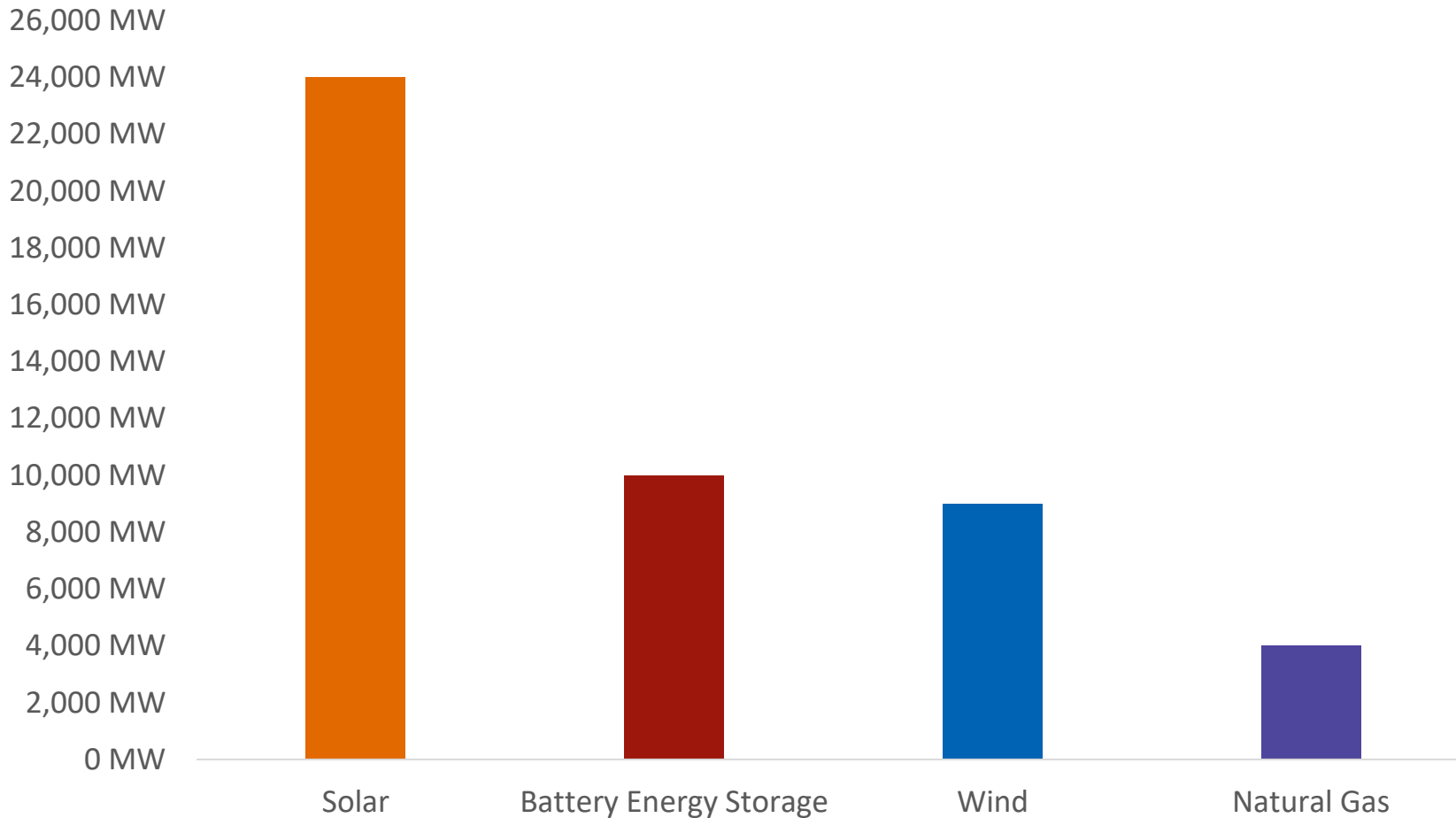
*The last US census was in 2020 so current figures are projected based on the estimates only.



** HB5066 - ERCOT has limited ability to verify Transmission Service Provider (TSP) officer attested load

Key Takeaway: Forecasted load growth is significant

Supply Side – What is Happening?



Dispatchable Thermal Generation

(2009-2024) only 1,700 MW of net new dispatchable thermal generation added.

- 23,083 MW added
- 21,354 MW retired

61,027 MW of net new solar and wind added (2009-2024)

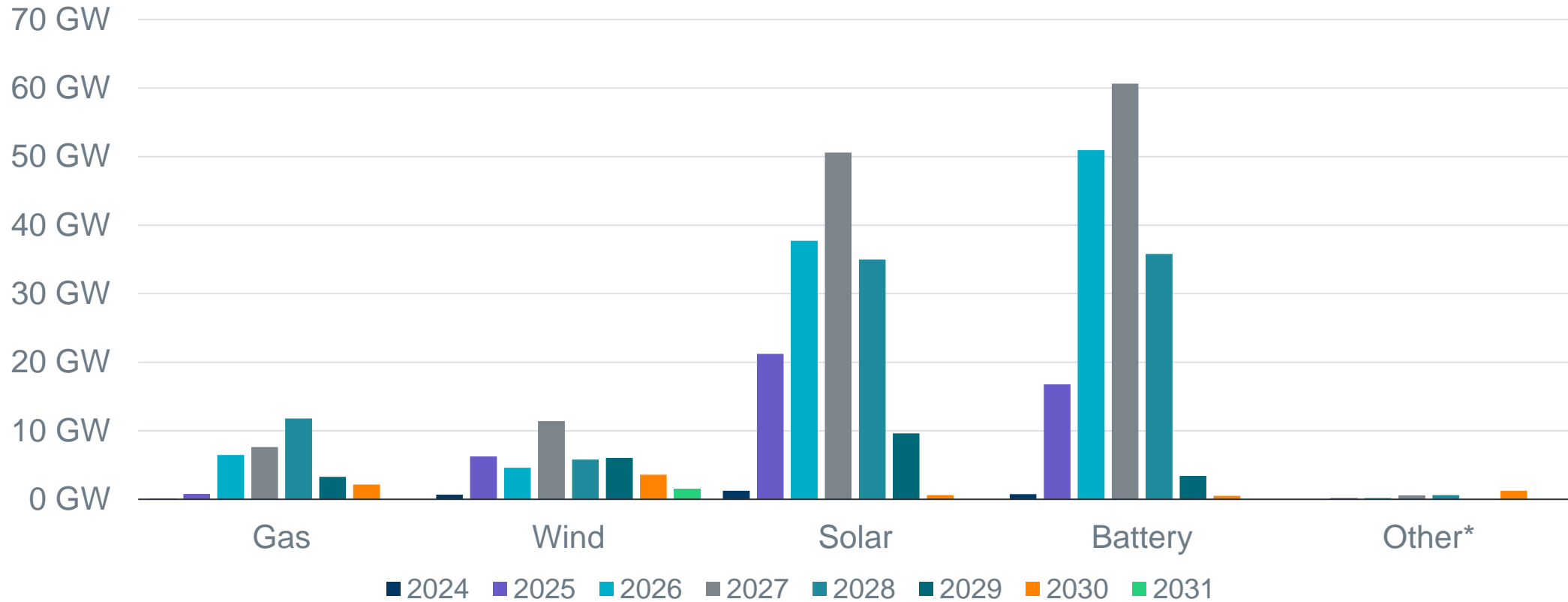
Total Thermal Fleet is 88,779 MW*

- 42% is older than 30 years (36,951 MW) (1995)
- 27% is older than 40 years (24,129 MW) (1985)
- 13% is older than 50 years (11,773 MW) (1975)
- 3% is older than 60 years (2,628 MW) (1965)

Key Takeaway: From January 2021- March 2025, ERCOT synchronized approximately 45,000 MW of new generation.

Supply Side – What is happening?

1,987 active generation interconnection requests totaling 400 GW as of February 28, 2025
 (Solar 156 GW (39%), Wind 40 GW (10%), Gas 32 GW (8%), Battery 169 GW (42.3%), Other 3 GW (.7%))



Key Takeaway: Solar and Battery Energy Storage account for >81% of the amount of generation seeking interconnection.

*includes petroleum coke, hydroelectric, fuel oil, geothermal energy, other miscellaneous fuels reported by developers, and fuel cells that use fuels other than natural gas.
 (excludes capacity associated with projects designated as Inactive per Planning Guide Section 5.2.5)

Transmission System Challenges & Complexities

- Demand is escalating as new large loads are added to the ERCOT system faster and in greater sizes than historical interconnections.
- The current generation mix is more diverse than previous portfolios, can be built faster, and is more geographically disbursed from load centers.
- While we're seeing changes in the speed of load growth and generation coming onto the Texas power grid, transmission still requires 3-6 years to be energized.

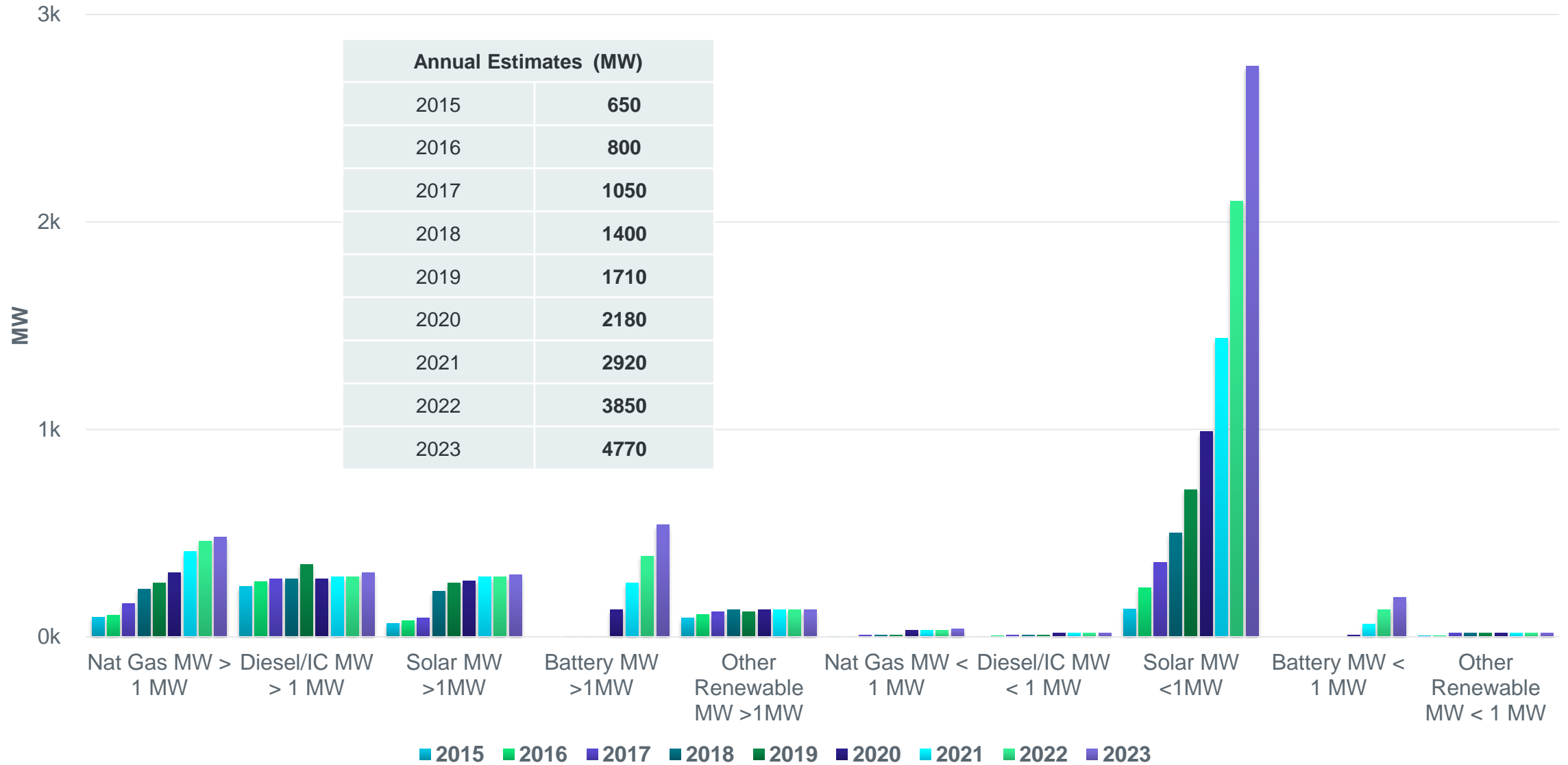
Load
(6-12 months)

Generation
(6-24 months)

Transmission
(3-6 years)

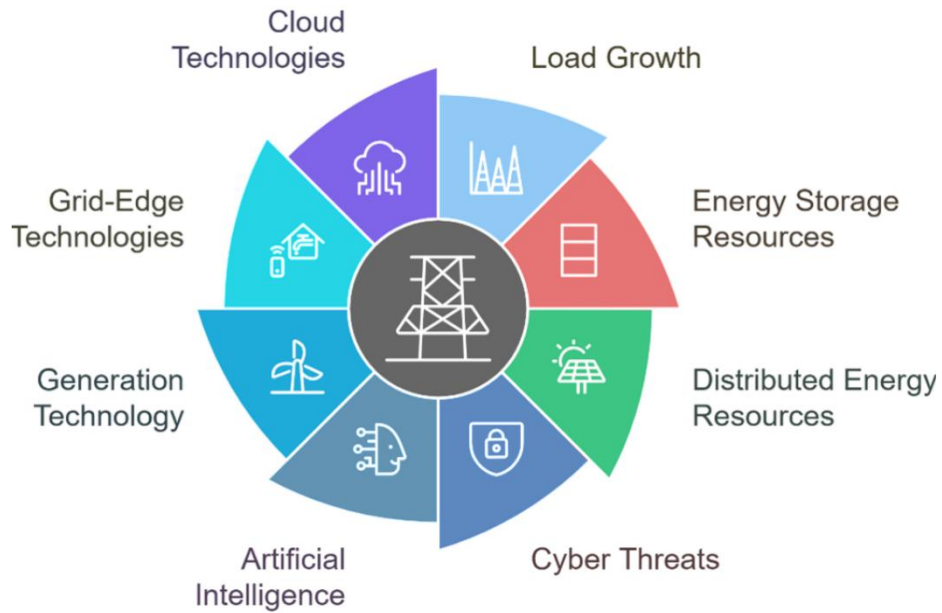
Key Takeaway: The forecasted pace of load growth could exceed the pace at which transmission capacity can be built to support it.

ERCOT Estimated Total Distributed Generation (DG) Growth 2015-2023 (MW)

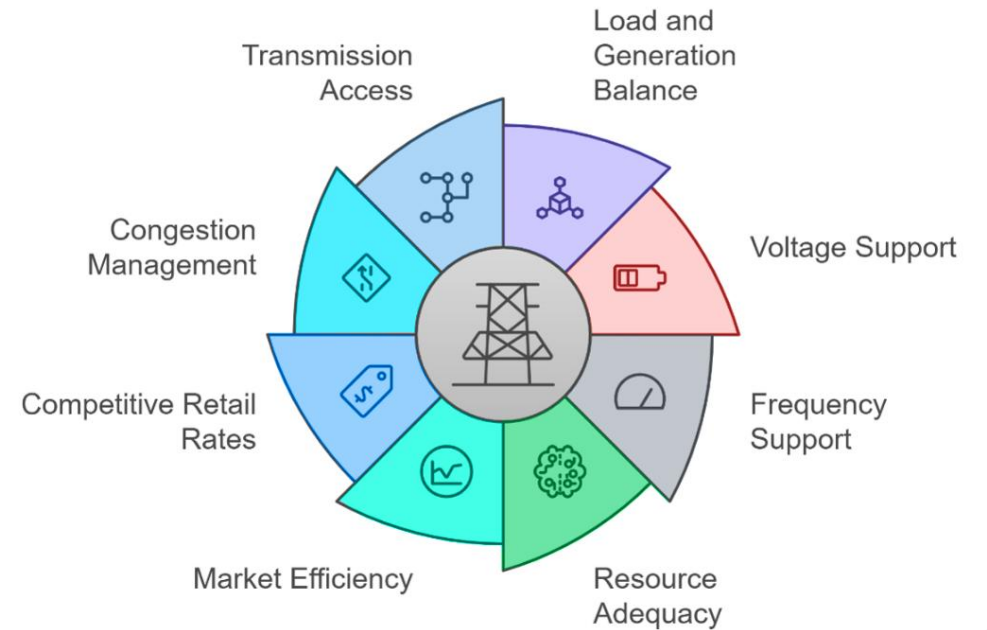


Opportunities and Challenges

Dynamics of the Texas Power Grid



ERCOT Business Needs



Innovation & Transformation (I & T)

Opportunities - Load

Interconnecting

Expediting the interconnection of loads

3

Forecasting

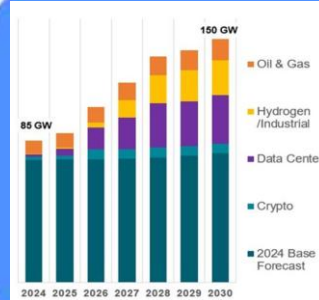
Improving the prediction of future trends

2

Modeling

Improving dynamic models to better simulate system behavior

1



4

Situational Awareness

Improving the understanding and response to real-time conditions

5

Flexibility

Leveraging the ability to respond to benefit reliability and market efficiency

6

Tooling

Improving the traditional tools to run studies

Opportunities - Supply



Opportunities - Transmission & Distribution



Opportunities - Markets

Energy Storage Resources

Optimizing participation

Ancillary Services

Providing additional support to ensure system reliability

Real Time Co-optimization

Enhancing efficiency through simultaneous energy & ancillary optimization



Flexibility Products

Offering adaptable solutions to meet changing demands

Reliability Services

Exploring market mechanisms for reliability services

Tooling

Improving necessary tools for analysis

Opportunities – Emerging Technologies



ERCOT Grid Transformation – Technology Roadmaps – What are we up to?

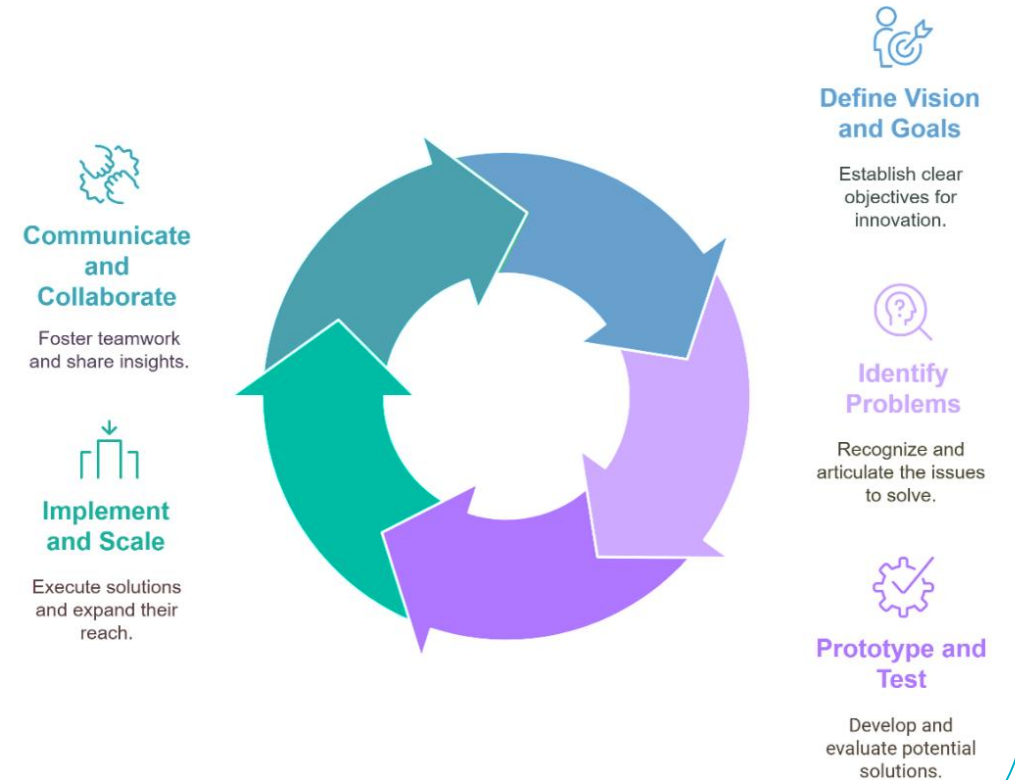
- I. Managing the grid with large penetration of energy storage resources
- II. Developing demand response products
- III. Managing the grid with large penetration of distributed energy resources
- IV. Improving the awareness of power system dynamic security
- V. Improving power system steady state security assessment
- VI. Improving power systems dynamic security assessment
- VII. Evaluating control capabilities to maintain system security and reliability
- VIII. Evaluating emerging AI/ML technologies
- IX. Assessing the power system short circuit protection
- X. Assessing the power quality

Innovation and Transformation – Foundational Elements

Pillars of Innovation Success



Innovation and Transformation Cycle



Quick Recap of the Presentation

- The Texas power grid is rapidly evolving
- Plenty of opportunities on the load, supply, and grid side
- Innovation and transformation are vital to deal with the challenges
- Collaboration amongst various stakeholders is crucial
- ERCOT research, innovation, and transformation activities are underway, always open for partnerships
- Success needs an “all-of-the-above” comprehensive approach

**There has never been
a more exciting time
to shape the future of
the power industry.**

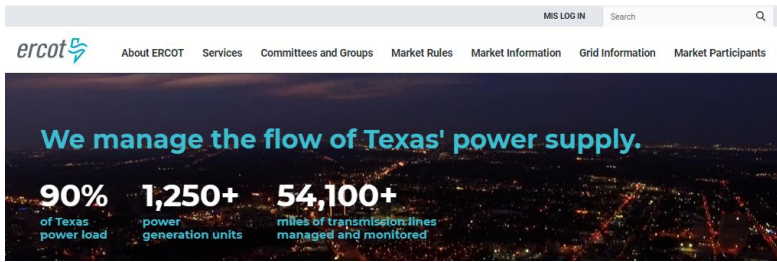


- **Embrace the challenges.**
- **Seize the opportunities.**
- **Be the force that drives the transformation!!!**



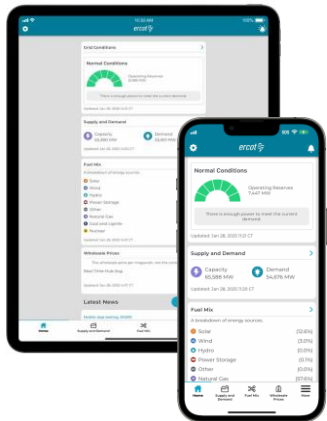
Thank you!
Have a fantastic spring technical workshop

ERCOT Communication Channels



ERCOT website – www.ercot.com

- Today’s outlook and grid conditions
- Daily and seasonal weather
- Market information, prices and more



New ERCOT mobile app

- Real-time updates
- Wholesale pricing
- News and alerts

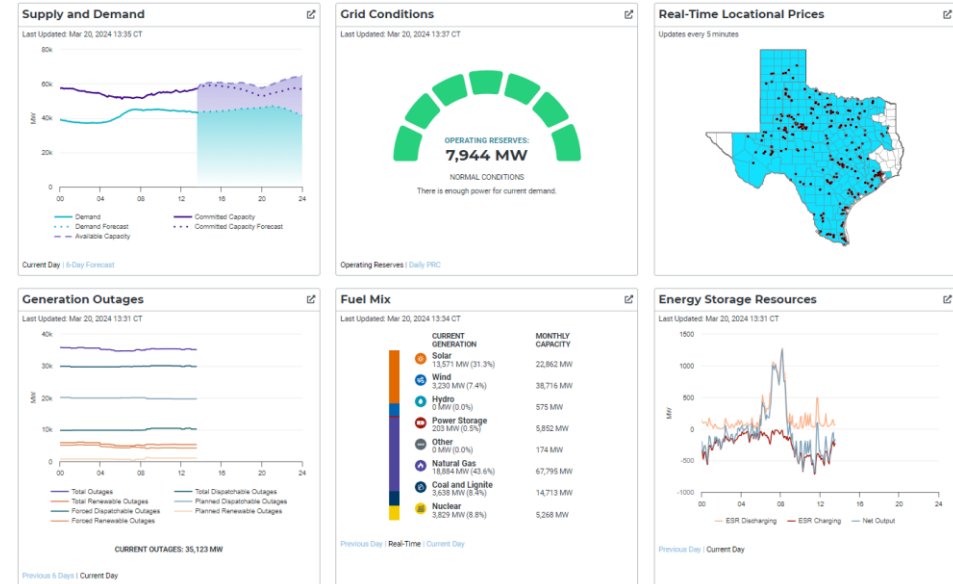


Grid and Market Conditions

These dashboards offer a snapshot of current conditions in the ERCOT system. The timestamp on each indicates when the information was last updated. Click the Full View link on a dashboard for an expanded display.

*Note: The 6-Day Forecast graph should only be used as a relative indication of future system conditions. Due to uncertainties associated with the longer-term nature of the forecasts used, both the Available Seasonal Capacity and Demand Forecast may adjust significantly as the Operating Day approaches.

*Note: Capacity available from demand response programs is not reflected in the Current Day and the 6-Day Forecast graphs unless these programs have been deployed.



- Early notifications ahead of periods of higher demand
- Provides greater transparency on grid operations
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