ercot

Advancing Reliability

2024

STATE OF THE GRID

About ERCOT

Founded in 1970, the Electric Reliability Council of Texas (ERCOT) is an independent, not-for-profit organization responsible for overseeing the reliable and safe transmission of electricity over the power grid serving most of Texas. As the Independent System Operator (ISO) since 1996, ERCOT has four primary responsibilities:

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

ERCOT manages the flow of electric power to more than 27 million Texas customers – representing about 90 percent of the state's electric load. As the ISO for the region, ERCOT schedules power, performs financial settlement for the competitive wholesale bulk-power market, and administers retail switching for more than eight million premises in competitive choice areas.

ERCOT is a membership-based 501(c)(4) nonprofit corporation governed by a 12-member Board of Directors and subject to oversight by the Public Utility Commission of Texas (PUCT) and the Texas Legislature. Its members include consumers, cooperatives, generators, battery owners/operators, load resources, power marketers, retail electric providers, investor-owned electric utilities, transmission and distribution providers, and municipally owned electric utilities.

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Message from the ERCOT Board of Directors

The Texas Legislature established our independent Board of Directors in 2021 to improve governance of the Electric Reliability Council of Texas (ERCOT). Our goal is to bring strong oversight and accountability to our mission of maintaining a dynamic and reliable grid, efficient electricity markets, open access, and retail choice.

The Board is made up of Texas business and policy leaders who understand the growing needs of our state. We are committed to ensuring that the hardworking families and businesses of Texas are supported by a reliable and resilient grid. This is our top priority.

In 2024, Texas added over 500,000 new residents – more than any other state. Our economy is rapidly growing, making Texas the world's eighth largest economy.

This growth means our power grid must continually adapt. It must accommodate new technologies, deal with complexities, and tackle unexpected challenges. Our role is to create and recommend durable improvements to ensure grid reliability, resilience, affordability, and a strong competitive market now and into the future.

To address these needs, we have tasked our leadership team to prioritize these challenges. In this regard, ERCOT will continue collaborating closely with hundreds of stakeholders, our Corporate Members, and the PUCT to meet these objectives. In fact, two of our Board members are PUCT Commissioners and one Board member is the chief executive and public counsel of the Office of Public Utility Counsel representing residential and small commercial consumers.

We take pride in being transparent about our governance and actions. This report outlines the progress, success, and opportunities we face to transform our grid for the challenges of 21st century Texas. By working together, we will continue to make strides for the more than 27 million Texans who depend on a reliable, resilient electric grid.

With great respect,

Bill Flores
Chair
Bryan, Texas

Peggy Heeg
Vice Chair
Houston, Texas

ERCOT Board of Directors

The Honorable Bill Flores
Chair
Bryan, Texas

Peggy Heeg
Vice Chair
Houston, Texas

Dr. Carlos Aguilar
Director
Flower Mound, Texas

Benjamin Barkley
Public Counsel,
Office of Public Utility Counsel
Austin, Texas

Dr. Linda Capuano
Director
Houston, Texas

Sigmund Cornelius
Director
Fulshear, Texas

Julie England
Director
Flower Mound, Texas

Thomas Gleeson
Chair of PUCT
Pflugerville, Texas

Alejandro Hernandez
Director
The Woodlands, Texas

Kathleen Jackson
Commissioner, PUCT
Beaumont, Texas

John Swainson
Director
Austin, Texas

Pablo Vegas
President and CEO of ERCOT
Austin, Texas

Our Guiding Principles

OUR MISSION

We serve the public by ensuring a reliable grid, efficient electricity markets, open access, and retail choice.

OUR VISION

Lead with independent insight on the future of electricity reliability, markets, and technology in Texas in order to facilitate grid and market change for the benefit of all stakeholders.

OUR VALUES

Be accountable. Take personal responsibility for doing the right things the right way.

Be a leader. Develop a vision and ensure its successful completion.

Be innovative. Engineer, operate, and implement creative solutions.

Be trustworthy. Build confidence and consistency through reliability, truth, and ability.

Be the best expert you can be. Develop and demonstrate respected skills and knowledge.

CEO Letter

As we considered the appropriate title for this annual report, *Advancing Reliability* emerged as the best choice as it represents the daily focus and priority of the men and women that work every day in ERCOT to achieve this outcome. The state of our electric grid is strong. But we also recognize the challenges and opportunities inherent in the rapid transformation occurring within the Texas and global energy economy.

Relentless Focus on Reliability
In just four years, the Texas Legislature and the Public Utility Commission of Texas (PUCT) have made significant market changes to require a renewed focus on electric reliability and resiliency. New reliability initiatives, such as weatherization inspections, firm fuel supply service, and others mentioned in this report, are now in place.

These efforts, along with major financial investments from Market Participants and innovative improvements from our employees, have helped advance reliability throughout the ERCOT electric grid.

However, the energy economy is constantly evolving and our capabilities must too. So, we are also planning for four major challenges ahead:

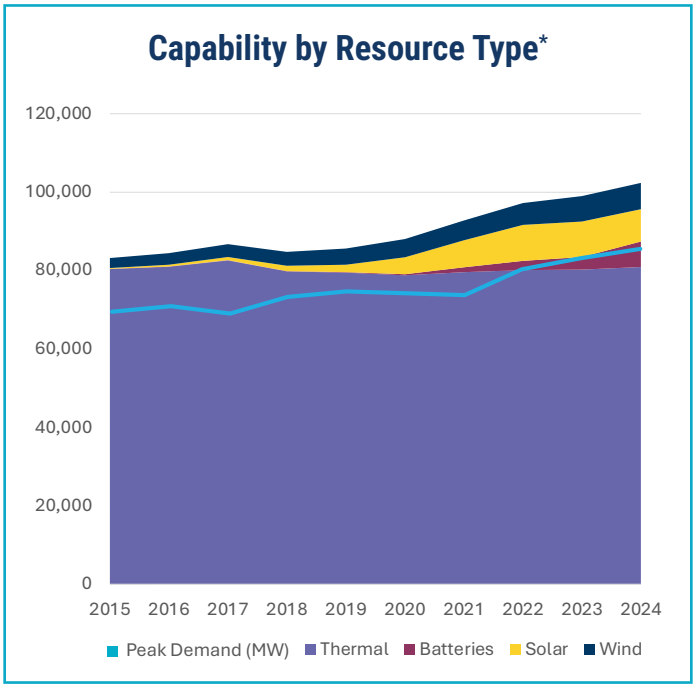
1. **Accelerating Demand**
   As Texas continues to grow its population and economy, we see accelerating demand growth over the next 10 years that will pressure existing infrastructure and spur the development of new supply and innovations to meet this challenge. We are focused on ensuring continued reliability throughout this growth period, leveraging innovations in demand and supply services.

2. **Need for More Transmission Capacity**
   With the growing demand, we clearly need more transmission capacity to deliver electricity – especially in the Permian Basin, where the electrification of oil and gas operations is important. This has led to studies and discussions about how a new 765-kV infrastructure could benefit Texans, and a decision is expected in Q2 2025.

3. **Imbalanced Generation Development**
   New generation growth has shifted to solar and battery storage, which are outpacing the growth of new thermal generation due to market economics. These resources offer significant benefit to the supply mix in ERCOT; however, to best serve Texas' growing economy, a balanced portfolio of resources that includes dispatchable and long-duration energy supply is a critical characteristic of a reliable grid.

4. **Growing Thermal Generation Risk**
   The risk to the entire market is increasing as thermal power plants age and retire. For example, today, 42 percent of the thermal generation fleet in ERCOT is more than 30 years old. We are concerned about when and how these critical, dispatchable resources will be replaced – especially if wholesale pricing remains low. In 2024, the ERCOT wholesale market had the lowest inflation-adjusted prices in 10 years.

The chart below clearly illustrates the challenge of imbalanced generation growth and thermal generation risk. The growth in firm demand requires firm supply to serve it. We are seeing an increasing number of hours each year when electric demand exceeds dispatchable capacity, and we expect this trend will continue. This increases our dependence on intermittent and duration-limited sources of electricity. Overall, it increases the risk profile of the grid, especially during periods when energy storage resources are recharging, intermittent resources are not available, and during extreme weather events.



Pathways Forward
We believe these challenges can be met with the same innovative and entrepreneurial spirit that created the nation's leading energy economy. Working in partnership with the PUCT and in support of the Texas Legislature, these meaningful changes are underway.

- Texas Energy Fund: The Texas Legislature created the Texas Energy Fund to incentivize the development of new dispatchable generation. Market interest in this program has been high.

*Capability represents the aggregate average Megawatt (MW) contribution of a resource class as measured by its Effective Load Carrying Capability (ELCC).

- Residential Demand Response: We are exploring the expansion of Residential Demand Response programs to help reduce demand at critical times.

- Firm Fuel Supply Service: Potentially expanding this important reliability service would help broaden participation.

- Technology Improvements: We are studying Grid Enhancing Technologies, such as dynamic line ratings, to maximize transmission line capacity.

- Battery Storage: Battery storage optimization efforts can enhance battery utilization for improved reliability and affordability.

- Inverter-Based Resources: We are strengthening "ride-through" requirements to ensure system reliability for inverter-based resources like wind farms, solar facilities, battery storage systems, and large loads.

Strategic Plan
To build on the progress of the past four years and address these challenges, we have implemented a strategic plan to continue enhancing electric reliability and resiliency. This plan includes a focus on improving Texas' economic competitiveness that will benefit both consumers and businesses.

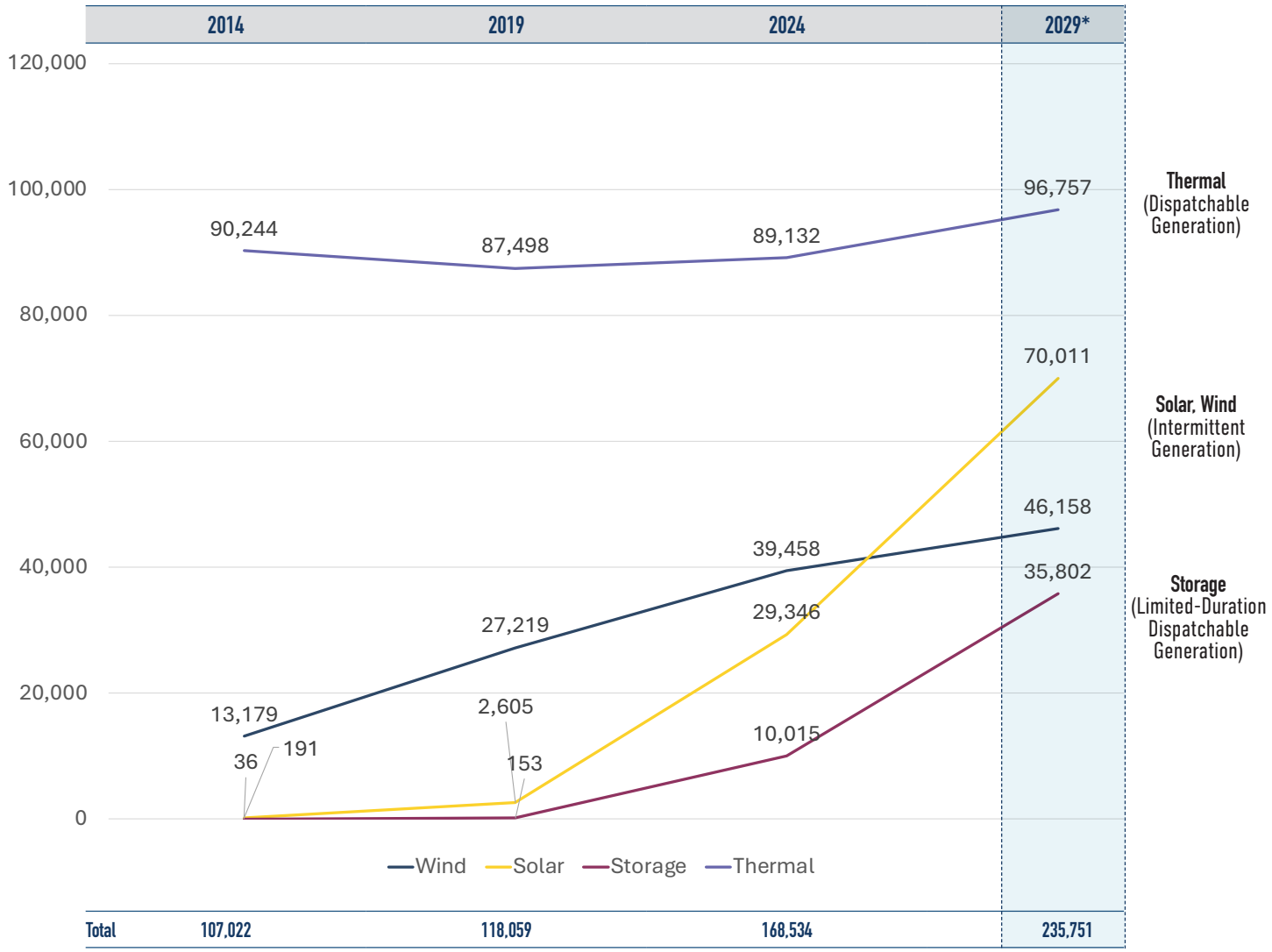
Looking Forward
This report reviews the progress we've made in the past four years and outlines many important initiatives focused on advancing grid resiliency and reliability. I'm confident that, together, we will continue to lead the energy expansion ahead while meeting the challenges and opportunities outlined here.

Sincerely,

Pablo Vegas
President and Chief Executive Officer

By the Numbers

SUPPLY: Fuel Mix Snapshot (MW Capacity)



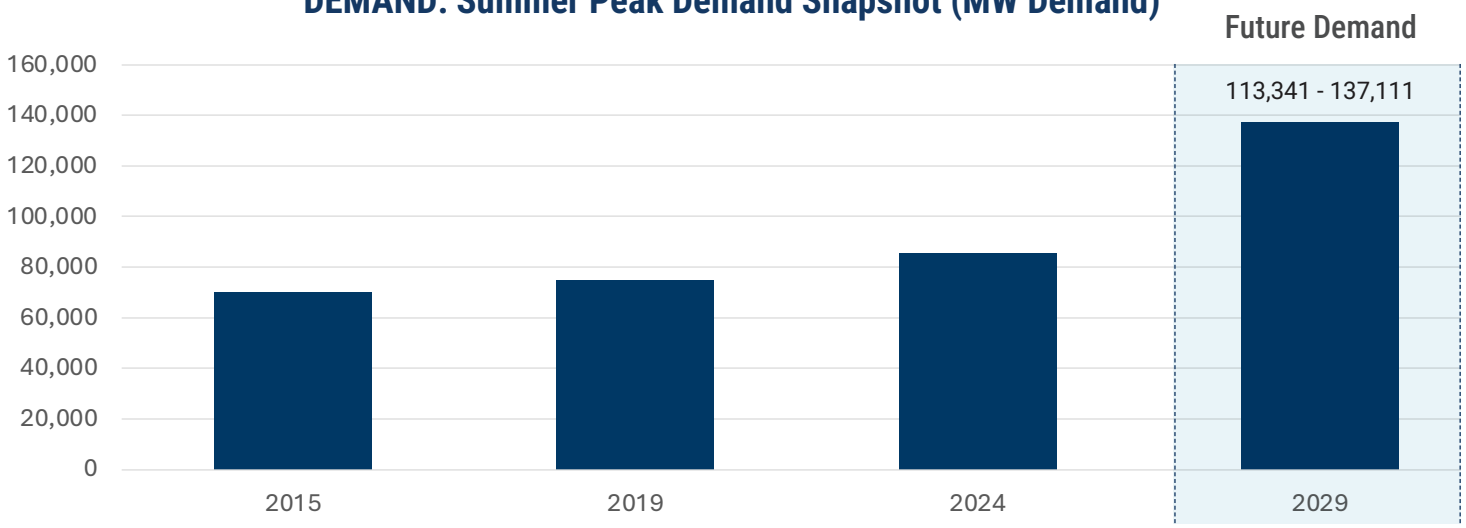
DISPATCHABLE THERMAL GENERATION (Numbers are rounded)

2015–2024			
-11,980 MW of dispatchable thermal generation retired	**10,867 MW** of new dispatchable thermal generation added	**-1,112 MW** of net new dispatchable thermal generation added	**~9,700 MW** Texas Energy Fund Projects in Due Diligence process

- Capacity totals are based on Installed Capacity Ratings for generating units. "Thermal" is made up of Natural Gas, Nuclear, Coal, Biomass, and Diesel.
- Planned projects are added to installed capacity after approval for synchronization to ERCOT Grid.
- Totals include Private-Use Networks (PUNs), Distribution Generation Resources (DGRs), Settlement Only Distribution Generator (SODGs), Unavailable Switchable Capacity, Extended Outage Units, and Mothballed Units.

*2029 accounts for forecasted planned projects expected to be in-service between 2025 to 2029 that have reached the signed interconnection agreement (SGIA) interconnection milestone from the February 2025 file of the Resource Capacity Trend Charts. Unconfirmed Retirements listed in the December 2024 CDR are also reflected in this snapshot, which is comprised of 2,137 MW of Coal retirements and 880 MW of Natural Gas Steam retirements. Includes mid-Feb 2025 snapshot of Texas Energy Fund Projects in Due Diligence process.

DEMAND: Summer Peak Demand Snapshot (MW Demand)

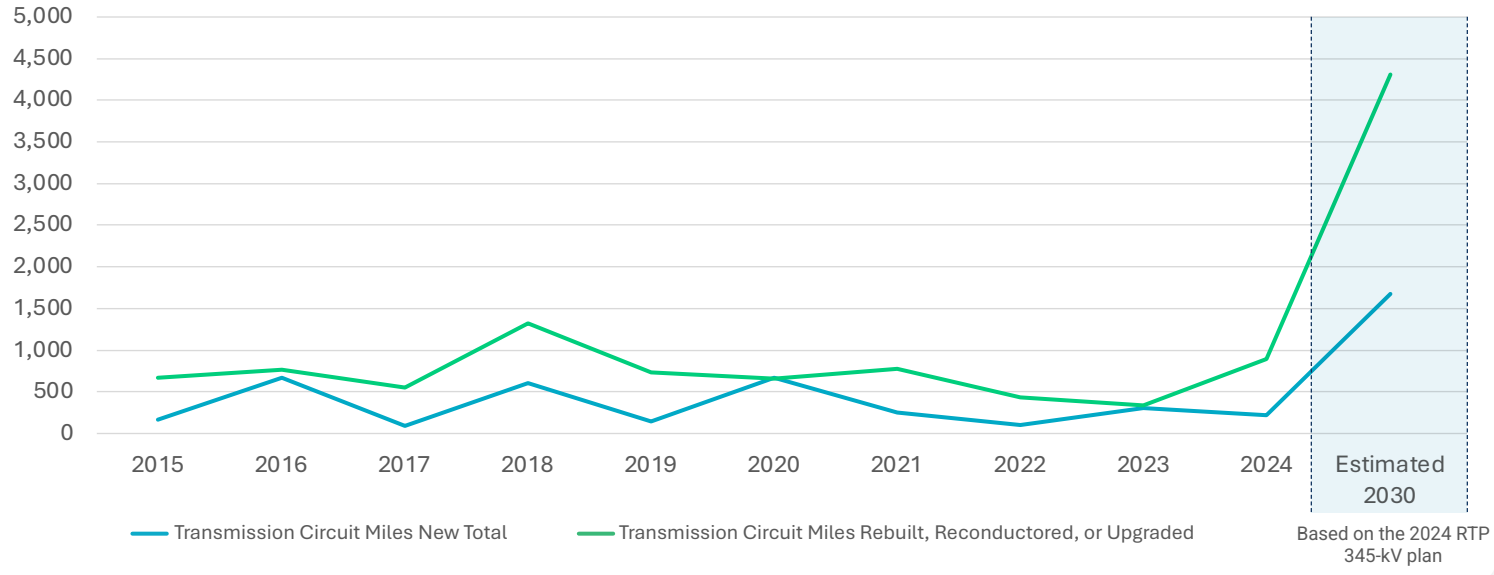


FUTURE DEMAND (MW)

Summer Load and Resource Scenarios	2025	2026	2027	2028	2029
Original Firm Peak Load	86,717	102,624	117,359	133,558	137,111
Firm Peak Load, including 50% of TSP* Officer Letter Loads	85,917	97,281	107,492	118,248	121,264
Firm Peak Load, including 25% of TSP Officer Letter Loads	85,117	94,610	102,558	110,593	113,341

* Transmission Service Provider
Note: Supply and Demand projections are routinely updated. Please see ERCOT.com for the latest information.

NEW AND REBUILT TRANSMISSION CIRCUIT MILES



Key Project Overview: Electric Reliability and Resiliency Initiatives Since 2021

Following Winter Storm Uri in 2021, the Texas Legislature and the PUCT directed ERCOT to improve electric reliability and resiliency for Texans through several key initiatives.

Weatherization and Inspections
We ensure that generation and transmission assets owned by Market Participants meet strict weatherization standards set by the PUCT through on-site inspections. Our team of inspectors, with support from contracted personnel, visit hundreds of sites each year, verify corporate officer declarations of weather-preparedness, and provide weatherization workshops twice a year for Market Participants.

Since inception in December 2021, the Weatherization Inspection Program successfully met and exceeded the PUCT rule requirements for inspection frequency. At the end of February 2025, we had completed 3,362 weatherization inspections of generation and transmission facilities.

Generation Facilities	Transmission Facilities	Total Weatherization Inspections
2,222	1,140	3,362

Grid Reliability and Resiliency Assessment
In 2024, at the direction of the Texas Legislature and the PUCT, we created this first-of-its-kind study on the impact of extreme weather conditions on the ERCOT Transmission Grid. This assessment considers the impact of generation availability and potential customer outages caused by extreme weather conditions (e.g., winter storms and hurricanes), identifies areas of Texas that face significant grid reliability and resiliency issues based on the scenarios studied, and proposes transmission projects to increase the grid's reliability or resiliency.

Firm Fuel Supply Service
Ensures that generators in the program have access to additional on-site fuel during times of natural gas shortages or other fuel supply disruptions. It aligns with directives from the Texas Legislature and the PUCT to enhance grid reliability and resiliency, particularly during extreme cold weather.

Improved Forecasting
We have significantly improved our weather forecasting capabilities to better serve our region. This includes enhanced forecasting for exceptional weather events. We have also procured multiple additional weather forecast streams for use in demand forecasting models, which provide more options for ERCOT's forecasters to select the most appropriate weather scenario for reliability.

Fast Frequency Response Service
This tool autonomously and quickly stabilizes the electric grid frequency by either injecting or absorbing power within one minute of dispatch. Since it's always available, it gives our grid operators a critical tool for maintaining reliability.

ERCOT Contingency Reserve Service
This Ancillary Service offers incentives for market resources that can provide power or demand response within 10 minutes of dispatch to meet sudden changes in supply or demand.

Modified Non-Spinning Reserves
As a result of 2024 changes, customer loads can now participate in this service by agreeing to decrease demand quickly when needed. This adds liquidity to the market and potentially allows generation resources to provide different system services.

Reliability Standard Assessments
We supported the PUCT in developing ERCOT's first empirical Reliability Standard. Moving forward, we will conduct probability-based assessments every three years to evaluate the grid's compliance with this standard and use the data to inform market or operational changes needed to remain in compliance.

ADDING NEW GENERATION

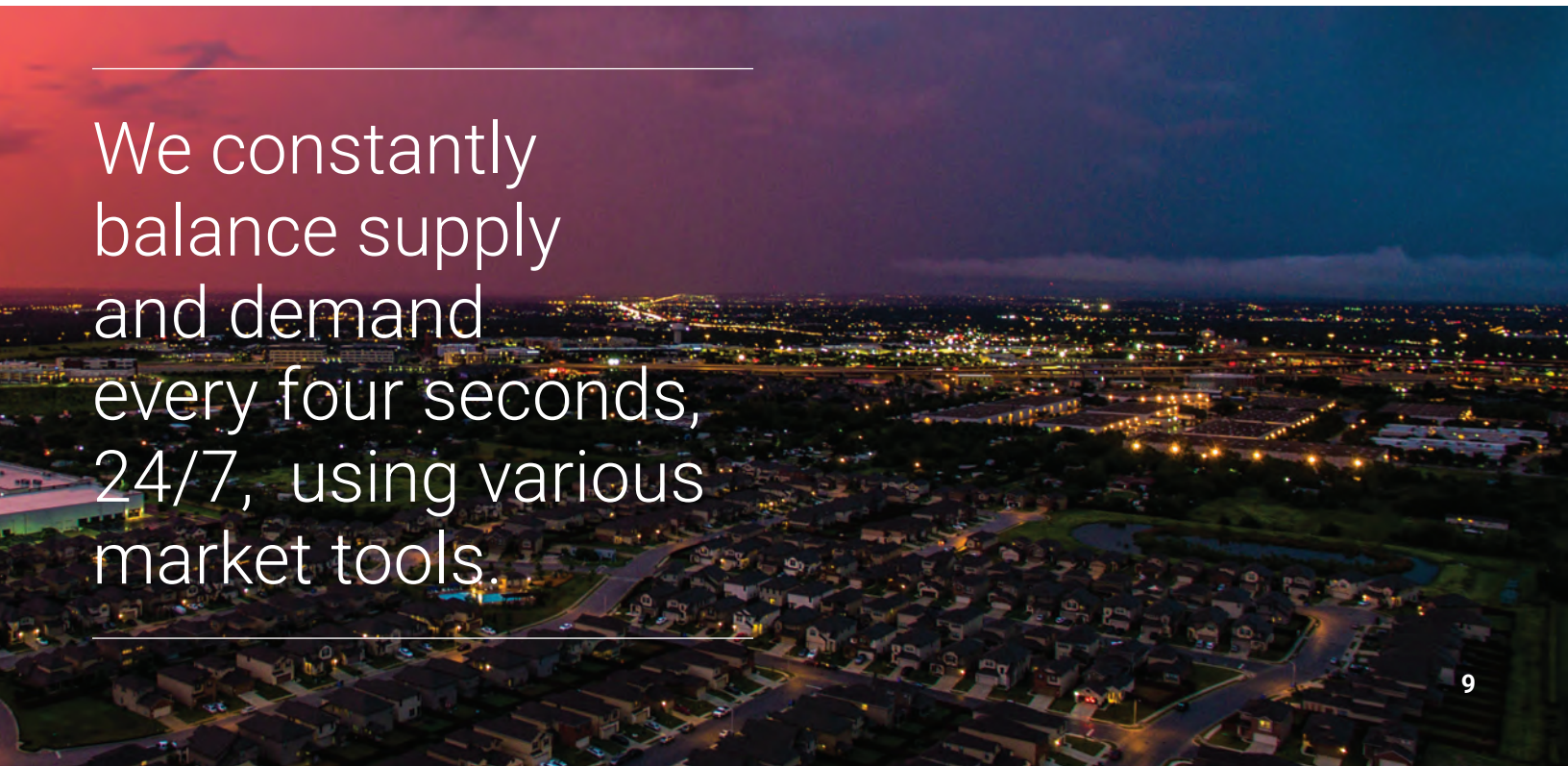
From 2021-2024, we synchronized approximately 45,000 MW of new generation projects to the electric grid.

Solar
~23,000 MW

Battery Energy Storage
~10,000 MW

Wind
~9,000 MW

Thermal (Gas, Diesel)
~ 4,000 MW



Grid Research, Innovation, and Transformation

The evolution of the electric grid is accelerating due to changing generation resources, large increases in demand, distributed generation, and advances in technology. To address these challenges, we are ramping up efforts in research, innovation, and grid transformation.

Research Partnerships
ERCOT is involved in multiple research activities with academic and industry organizations that will support innovations across operations, planning, and other critical support functions for ERCOT. Some of our research partners include the Power Systems Engineering Research Center, Electric Power Research Institute, Energy Systems Integration Group, and the Centre for Energy Advancement through Technological Innovation. Additionally, we collaborate with universities that specialize in areas relevant to our needs, such as Texas A&M University and Rensselaer Polytechnic Institute.

Innovation
We encourage our employees to innovate by exploring new technologies, partnering with peers around the globe, and developing solutions to meet today's and tomorrow's challenges. For instance, one team developed a tool to analyze price spikes and price separation in the electricity market. This tool helps us better understand the causes of price fluctuations and is essential for detecting grid anomalies, market trading outcomes, and improving both grid reliability and market efficiency.

Innovation Summit
In 2024, ERCOT hosted its first annual Innovation Summit to share best practices and exchange ideas. Stakeholders from across Texas and the U.S. came together to discuss the rapid changes in the electric grid and explore innovative solutions. The next summit will take place in May 2025.

Grid Transformation
Our electric grid transformation efforts focus on addressing the future challenges of the grid. We identify potential initiatives through a comprehensive process that includes conducting surveys, researching industry reports, and facilitating collaborative sessions. This approach allows us to gather valuable insights, understand the needs of the future grid, and prioritize initiatives.

Some topics of our grid transformation initiatives include:

- Energy storage resources commitment and dispatch
- Awareness of distributed generation operational information
- Demand flexibility
- Load dynamic performance
- Security constrained optimizations
- Artificial intelligence advancements

Our ongoing grid transformation initiatives will lead to potential new tools and processes to enhance grid reliability, changes to existing systems and applications, the creation of new market products, and potential changes to ERCOT protocols.

Initiatives will be periodically reviewed to assess their effectiveness and relevance. Based on these evaluations, modifications will be made as needed to ensure continuous improvement and alignment with evolving industry needs and technological advancements.

Monthly Outlook for Resource Adequacy
ERCOT has developed a probability-based modeling system for our monthly report that assesses the risk of emergency conditions and the adequacy of operating reserves. The report is publicly available and includes scenarios showing expected demand and resource availability for specific hours, based on possible grid conditions.

Distributed Energy Resources Program

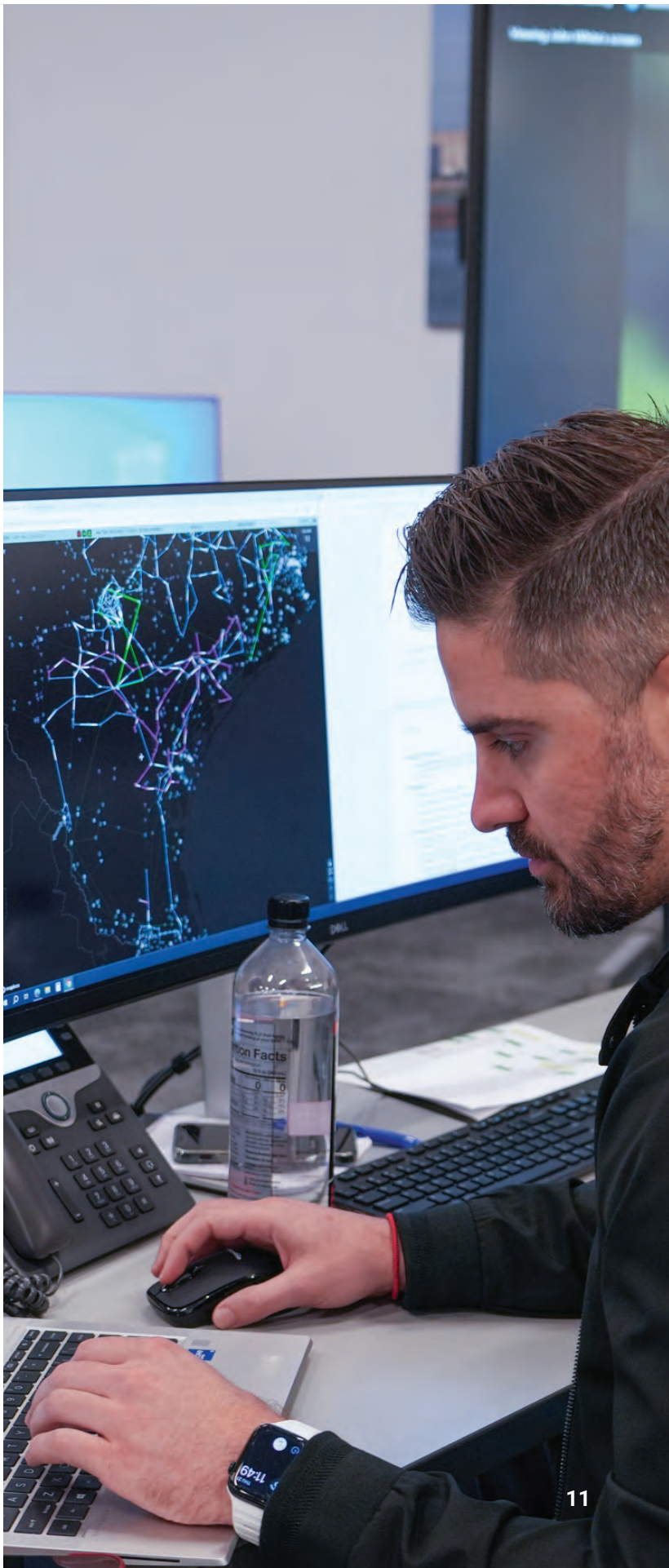
Following the completion of a recent pilot project, we are exploring how Aggregate Distributed Energy Resources can participate in the ERCOT wholesale market. The program will enable homes or businesses to combine their resources, such as battery storage and rooftop solar, to respond to ERCOT's dispatch instructions. For example, participants might discharge their batteries to meet grid needs or reduce their energy use during peak times. This effort will help us understand how these resources can support grid reliability, improve the wholesale market, attract investments, reduce the need for additional transmission and distribution infrastructure, and improve load management during emergencies.

Entering 2025, resources participating in this program fall within these capabilities:

31.9 MW
CAPABILITY FOR ENERGY

11 MW
CAPABILITY FOR NON-SPINNING RESERVE SERVICE

8.8 MW
CAPABILITY FOR ERCOT CONTINGENCY RESERVE SERVICE



Operational Excellence

ERCOT manages both real-time operations and performs system planning to support the electric grid of today and tomorrow. We're focused on a number of high-profile issues.

Market Participant Communications
While we do not own, operate, or maintain generation resources, transmission assets, or distribution lines, our operators act like air-traffic controllers. We remain in constant communication with Market Participants and direct their activities through real-time scheduling systems, market notices, and phone calls. Every year, we send more than 30 million dispatch instructions to Market Participant resources. Our rules also require backup systems in case normal communications are interrupted for any reason.

Operator Training
ERCOT helps ensure the reliable operation of the bulk power system by employing trained grid operators. These professionals undergo a variety of training programs and events to meet state and federal requirements for the 24x7x365 operation of the electric grid.

New Operator Training

We offer an extensive program for entry-level system operators that provides specialized training, one-on-one mentorship, and shadowing with seasoned operators on the control room floor.

Continuing Education

System operators and shift engineers are required to take a minimum of 85 continuing education hours each year.

North American Electric Reliability Corporation (NERC) Training

ERCOT provides a minimum of 30 hours of training, a minimum of 30 hours of simulations, and 200 hours of operating topics over a three-year period to meet NERC standards.

More than 1,000 Market Participant system operators participate with ERCOT in emergency training, drills, and simulations for severe weather or grid events each year.

Drills and Simulations

In addition to individual training, operators undergo regular drills and simulations on a variety of topics, including emergency procedures, severe weather, cyber and physical security, and event recovery planning.

Security and Cybersecurity
ERCOT constantly prepares for threats to the electric system. Whether the threat is cyber or physical, ERCOT consistently invests in trained staff and resources to help keep the electric grid safe. From system redundancies to controlled access, ERCOT has multiple layers of protective measures to safeguard its critical infrastructure. This layered cyber and physical security approach is known as a defense-in-depth strategy.

We comply with – and strive to exceed – federal cybersecurity and critical infrastructure protection standards enforced by NERC. These standards

require bulk power system users, owners, and operators in the United States to address cyber risks and vulnerabilities by establishing controls to secure critical assets from physical and cyber sabotage, reporting security incidents, and establishing plans for recovery in the event of an emergency. The ERCOT Critical Infrastructure Security Department uses industry best practices, including the National Institute of Standards and Technology Cybersecurity Framework, to help shape our own security policies and programs.

Critical Infrastructure
We support 2023 Texas Legislation to ensure ERCOT Market Participants do not procure critical electric grid equipment or services that would allow access to or control of critical electric grid equipment by citizens of or businesses associated with the countries of China, Iran, Russia, North Korea, or any other country designated by the Governor as a threat to critical infrastructure.

Texas Cybersecurity Monitor Program
We have established and maintain a cybersecurity monitor. This position is responsible for managing a cybersecurity outreach program, communicating emerging threats and business best practices, reviewing cybersecurity self-assessments, researching and developing business best practices for cybersecurity, and reporting to the PUCT on cybersecurity preparedness for monitored utilities.

Communication

Effective communication with Texans, stakeholders, and Market Participants is a key responsibility, especially when it comes to grid reliability.

Redesigned Mobile App
ERCOT provides real-time information through our mobile app, offering round-the-clock access to grid data and planning information. In 2024, we redesigned this platform to make it easier to navigate, added new dashboard features, and made it simpler for users to provide feedback. These improvements help educate and inform by offering real-time, transparent information.

Increased Social Media Presence to Reach More Texans
With the goal of informing and educating more Texans, ERCOT implemented a comprehensive social media strategy that includes posting more frequently, improving content, and better utilizing platforms to communicate more effectively with the public. With the recent addition of Instagram, ERCOT is now posting consistent content on more major social media channels.

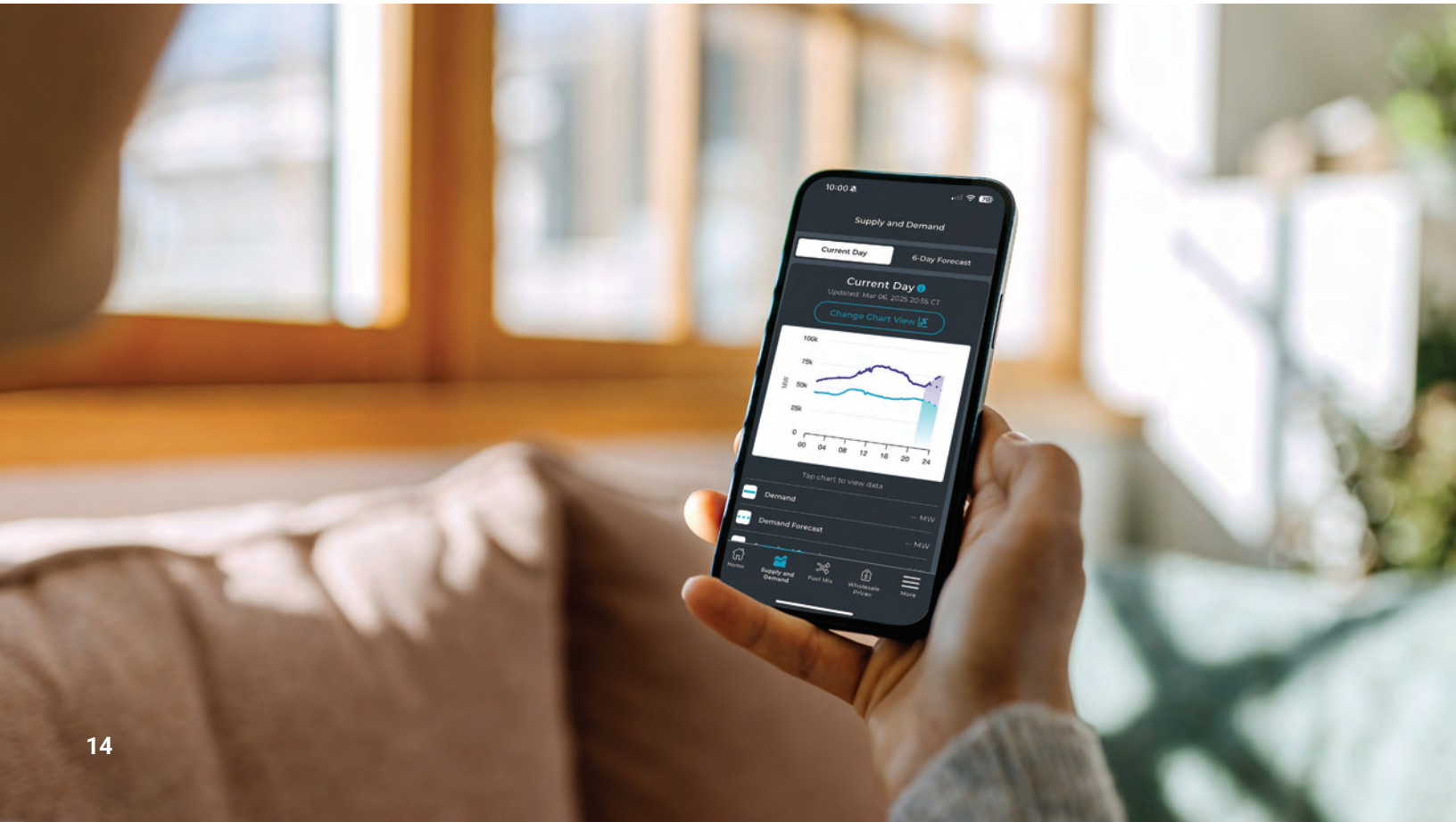
Since 2021:
ERCOT has grown its social media audiences by more than 400%.

POSTING FREQUENCY INCREASED
885%

IMPRESSIONS GREW
500%

ENGAGEMENTS GREW
218%

VIDEO VIEWS GREW
6,604%



Texas Advisory and Notification System (TXANS)
Launched in 2023, this opt-in public notification program helps raise awareness earlier about possible periods of high demand or tight grid conditions. Available in both English and Spanish, it increases transparent communication with Texans about grid operations.

Texas Energy Reliability Council
The Texas Legislature created this council to ensure that the state's energy and electric industries meet high-priority human needs and address critical infrastructure issues. The council, led by the Chief of the Texas Division of Emergency Management, includes leaders from ERCOT, PUCT, the Railroad Commission of Texas, the Office of Public Utility Counsel, the Texas Commission on Environmental Quality, and the Texas Transportation Commission, along with appointees from the electric and gas industries.

Gas-Electric Coordination
Natural gas facilities are crucial to the resilience of the ERCOT grid. We have partnered with the gas industry to establish ongoing, collaborative relationships to ensure the reliable operation of the power system.

Our coordination efforts include: monitoring for potential disruptions from operational flow orders or other pipeline issues and communicating with pipeline representatives to identify reliability concerns that could impact generation.

Through the Gas-Electric Working Group, we bring ERCOT, stakeholders, and gas pipeline operators together to improve communication on issues like those above, current events, maintenance, critical infrastructure designations, and other topics of shared interest.

Critical Supply Chain and Infrastructure Map
We help maintain a map that shows the locations and connections of critical Texas power infrastructure. This confidential map is shared with state agencies and transmission and distribution providers that focus on protecting key assets during weather events.

Future Focus

Market Enhancements

Real-Time Co-optimization plus Batteries

The Real-Time Co-optimization process is a new method that automatically selects the most efficient and effective resources for both dispatching energy and meeting Ancillary Service needs.

Currently, ERCOT purchases Ancillary Services in the Day-Ahead Market, but these services are not typically reallocated between resources in the Real-Time Market. This new process will enhance the operational efficiency and reliability of the ERCOT system and is expected to save the wholesale market over a billion dollars annually.

The project is anticipated to go-live in December 2025, six months earlier than initially planned.

Dispatchable Reserve Reliability Service

This is a legislatively required new Ancillary Service designed to compensate dispatchable generators for being available to produce power during low-supply intervals. While still in development, this service will require resources to be capable to run at their highest sustainable limit for four hours, after being given two hours of notice.

Demand Response

We are working with the PUCT and stakeholders to develop new opportunities to attract residential demand response to further improve reliability and flexibility.

> "The implementation of Real-Time Co-optimization is the most significant market enhancement to the Real-Time Nodal market design since its beginning in 2010."
>
> ERCOT President and CEO Pablo Vegas

Reliability Enhancements

Improving Contributions from Inverter-Based Resources and Large Loads

During certain grid events, like a lightning strike, we require generation resources and large loads to "ride-through" certain events without tripping off-line, to support the grid frequency and voltage needs of the bulk power system.

In 2024, we revised these "ride-through" requirements – consistent with national standards – to ensure that all resources are contributing to the grid when needed.

Permian Basin Reliability Plan

Electric demand forecasts show that electricity demand in the Permian Basin will reach approximately 26 GW by 2038, which is about the size of current demand in the Dallas-Fort Worth Metroplex.

As a result of this anticipated electric demand, the Texas Legislature and the PUCT instructed ERCOT to create a transmission reliability plan for the Permian Basin region. This plan focuses on extending transmission service to additional mineral resource areas, increasing capacity to meet future demand, and reducing interconnection times for areas without transmission access.

We submitted this plan to the PUCT for review in July 2024, and it was approved in September 2024. The PUCT is now determining which Transmission Service Providers will be responsible for building the infrastructure outlined in the plan.

After their decisions, these providers will apply for necessary approval and can begin the construction process.

ERCOT.com