ercot

2017 State of the Grid

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Chief Executive Officer

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(Independent Retail
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Cooperative, Inc.
(Cooperative)

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(Investor-Owned Utility)

Karl Pfirrmann
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Carolyn Shellman
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Mohsin Hassan
VEH, LLC
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Glen Lyons
ExxonMobil Power and
Gas Services, Inc.
(Industrial Consumer)

Jennifer Richie
City of Waco
(Commercial Consumer)

Jackie Sargent
Austin Energy
(Municipal)

Mark Schwirtz
Golden Spread Electric
Cooperative, Inc.
(Cooperative)

Message from Leaders

Bill Magness
President & CEO

Craven Crowell
Chair, ERCOT Board of Directors

The Electric Reliability Council of Texas (ERCOT) works every day to meet the electricity needs of the approximately 24 million Texans who live within the ERCOT region. In 2017, ERCOT continued meeting those needs during a time of rapid growth and change for electric markets.

New Texas businesses and residents drove electricity demand records in 2017. ERCOT set a new winter peak demand record in January and also set several new monthly demand records throughout the year. While many U.S. electric markets are experiencing declines in demand, the strong Texas economy – particularly the needs of industries that require large amounts of power – is increasing the need for electricity all over the ERCOT region.

On the supply side of the power equation, ERCOT also saw significant changes. The supply of electric generation was relatively plentiful through the 2017 summer peak season, but that changed when several fossil fuel powered units announced their retirements later in the year. The loss of more than 5,100 megawatts (MW) of generation capacity is expected to tighten power reserves heading into summer 2018 and may lead to higher power prices compared to recent years.

The other ongoing theme regarding electric supply is the continued growth of wind and solar resources on the ERCOT grid. We saw a new wind penetration record in 2017, when at one point wind generation was providing 54 percent of the power in ERCOT. As wind power continues to increase in Texas, ERCOT is working collaboratively with other grid operators and utilities to reliably integrate this generation.

ERCOT continues to earn national and international recognition for its ability to adapt to changing grid conditions. Our counterparts from around the world are dealing with challenges similar to those facing ERCOT, and our employees strive to raise the bar by innovating and solving industry challenges to ensure a reliable and efficient electric system.

This past year, ERCOT worked with transmission and distribution providers to develop a process for tracking Distributed Energy Resources within the ERCOT system. Greater knowledge of these resources has become increasingly important as these resources continue to play a larger role in the region.

Also notable in 2017, ERCOT took steps to keep its regulatory oversight in Texas.

As Mexico's electric market continues to evolve, ERCOT will continue to ensure it can work productively with Mexico's grid operator without impacting the independence of ERCOT's wholesale market operations in Texas.

Finally, ERCOT is proud to have been a part of the massive effort by so many Texans to address the impacts of Hurricane Harvey. The storm did substantial damage to electric infrastructure, but the ability of service providers to recover electric service quickly was a testament to the resilience Texas has built into its grid.

While strong infrastructure and investments in technology help us prepare for catastrophic events like Harvey, there is no substitute for the dedicated, mission-driven spirit of the people in government and industry who work to keep the lights on in Texas, no matter the conditions. Their dedication to getting the job done will be critical to managing the changes and challenges ahead.

Recognized worldwide

ERCOT's role is to maintain a reliable electric system for nearly 24 million Texans. It is ERCOT's mission to serve the public by ensuring a reliable grid, efficient electricity markets, open access and retail choice.

The grid operator continually assesses its policies and procedures to ensure the electric system is able to maintain system reliability in the midst of changing grid conditions. ERCOT also makes significant investments in its tools and technologies to provide staff with the resources needed to make well-informed decisions.

Energy leaders worldwide recognize the ERCOT Independent System Operator (ISO) for its effective market design, competitive prices and system reliability. ERCOT's ability to reliably incorporate large amounts of wind power into the electric system continues to receive worldwide attention from other system operators and utilities.

Demand continues to increase in the ERCOT region due to the strong Texas economy, and energy use reached new levels in 2017. Generation developers are building new projects in the ERCOT region, and interconnection requests reached historic levels last year. Additionally, neighboring utilities in Texas requested to join ERCOT to take advantage of the competitive marketplace.

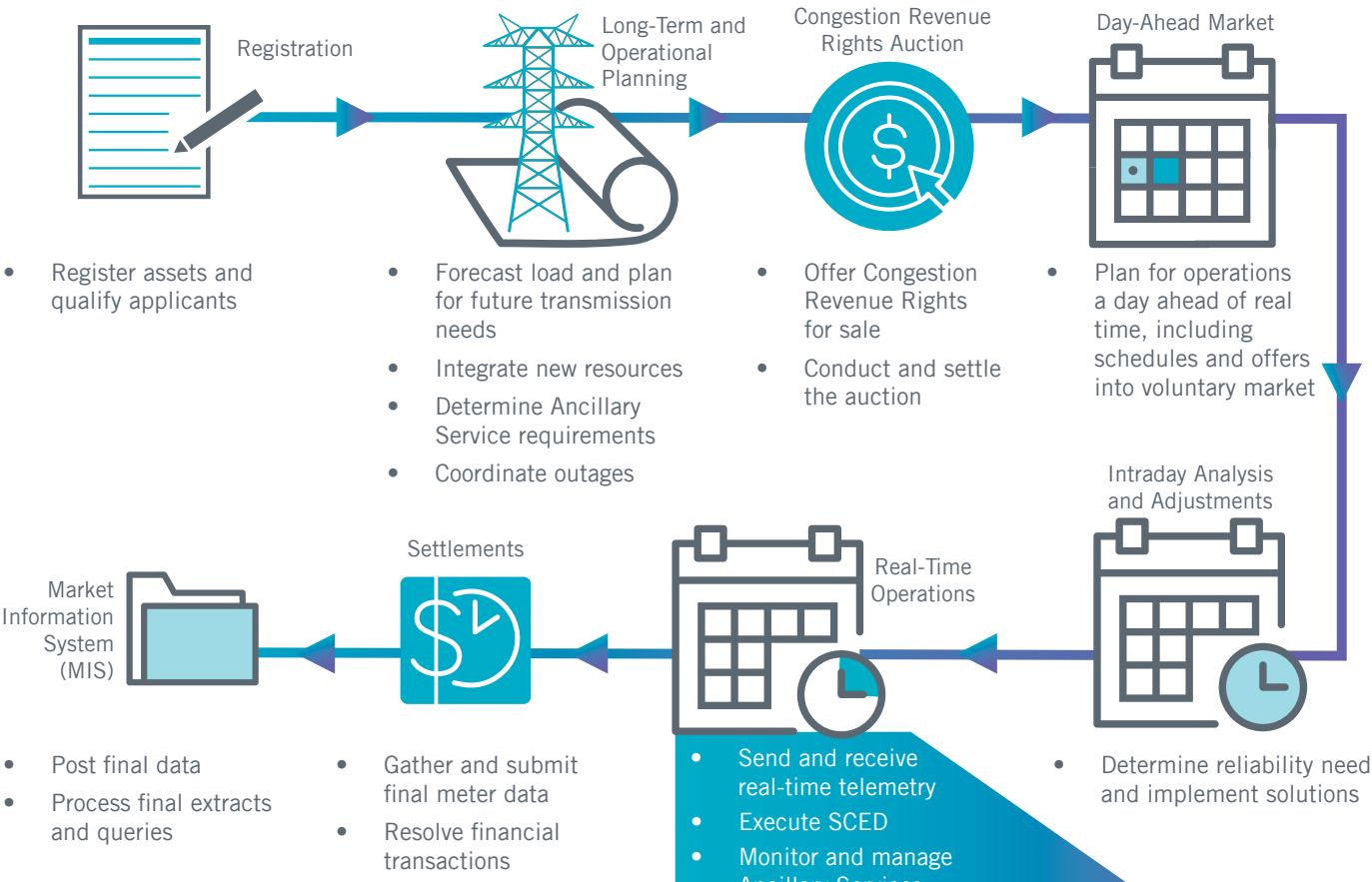
ERCOT's ability to adapt is the key to its success. With a significantly different marketplace expected in 2018 due to recent plant retirements, the grid operator is assessing how these changes may affect its grid and market operations and is working with staff, stakeholders and lawmakers to prepare for the future.

What is ERCOT?

The ERCOT ISO does not own generation or transmission infrastructure, but it does manage how those resources work together to serve about 90 percent of Texas' electric load. It also performs financial settlement for the competitive wholesale bulk-power market and administers retail switching for seven million premises in competitive choice areas.

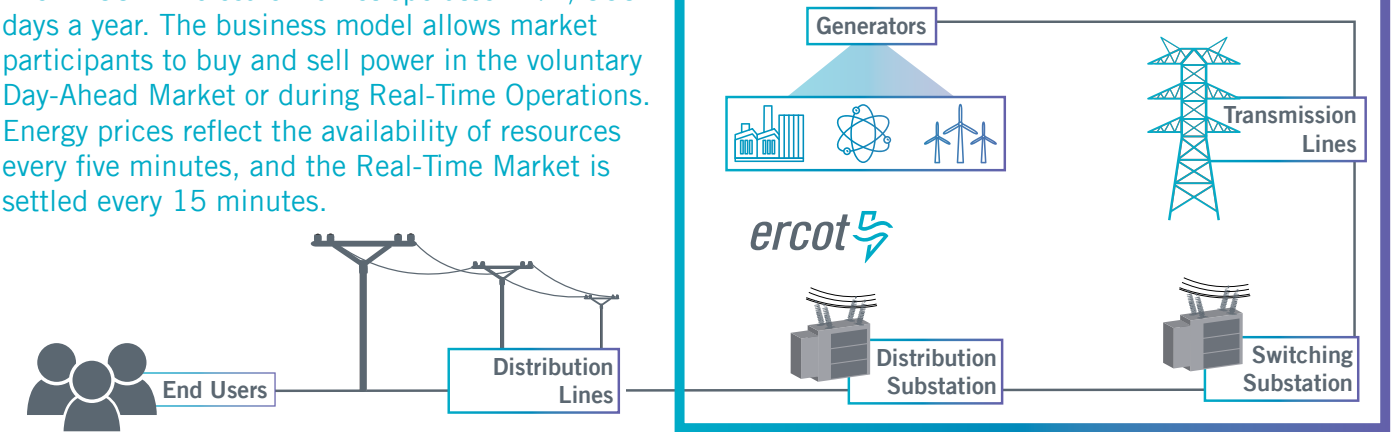
While the ERCOT control room is the nerve center for managing the electric grid, there are approximately 700 employees company-wide, primarily in the engineering and information technology sectors, who continually develop innovative tools and technologies to increase the reliability and efficiency of the ERCOT market.

ERCOT market overview



- Register assets and qualify applicants
- Forecast load and plan for future transmission needs
- Integrate new resources
- Determine Ancillary Service requirements
- Coordinate outages
- Offer Congestion Revenue Rights for sale
- Conduct and settle the auction
- Plan for operations a day ahead of real time, including schedules and offers into voluntary market
- Determine reliability needs and implement solutions
- Send and receive real-time telemetry
- Execute SCED
- Monitor and manage Ancillary Services
- Communicate results
- Gather and submit final meter data
- Resolve financial transactions
- Post final data
- Process final extracts and queries

The ERCOT wholesale market operates 24/7, 365 days a year. The business model allows market participants to buy and sell power in the voluntary Day-Ahead Market or during Real-Time Operations. Energy prices reflect the availability of resources every five minutes, and the Real-Time Market is settled every 15 minutes.



Oversight

ERCOT's 16-member Board of Directors has five unaffiliated members, including the chair and vice chair. The remaining 11 members represent the various market segments, the chairman of the Public Utility Commission of Texas (PUC) and the President and CEO of ERCOT. Changes to ERCOT Protocols must be approved by the board and filed with the PUC prior to implementation.

The PUC, which is guided by the Governor and Texas Legislature, oversees ERCOT's operations and develops the substantive rules that guide the Texas electric market. ERCOT serves as an information resource to the PUC to help its regulators make informed decisions.

ERCOT also is subject to reliability standards set forth by the North American Electric Reliability Corporation (NERC). The Texas Reliability Entity (TRE) is the regional entity delegated by NERC to monitor, assess and enforce compliance with NERC and regional reliability standards. TRE also serves as the PUC's Reliability Monitor for the ERCOT region.

State Leadership
Office of the Governor • Texas Legislature

Public Utility Commission of Texas

ERCOT Board of Directors
Finance and Audit Committee • HR and Governance Committee • Nominating Committee

Technical Advisory Committee

Stakeholder Subcommittees
Commercial Operations Subcommittee (COPS) • Protocol Revisions Subcommittee (PRS) • Retail Market Subcommittee (RMS) • Reliability and Operations Subcommittee (ROS) • Wholesale Market Subcommittee (WMS)

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

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

Building consensus

ERCOT staff works closely with elected officials, regulators and market participants to continue to improve the efficiency, transparency and flexibility of its grid and market operations.

The ERCOT stakeholder process allows representatives from all of the member segments to participate in discussions about the protocols and procedures that govern the ERCOT system and its wholesale and retail markets. Members include consumers, cooperatives, generators, power marketers, retail electric providers, investor-owned electric utilities, transmission and distribution providers and municipally owned electric utilities.

Efficient management

The PUC approved ERCOT's 2018-19 budget in 2017. The approved budget includes $222 million for 2018 and $228 million for 2019, including ERCOT operating expenses, project spending and debt service obligations for 2018 and 2019.

Despite increasing technology needs and other efforts associated with managing increased variable generation, ERCOT was able to keep the same System Administration Fee of 55.5 cents per MWh that was initially approved in the last biennial budget. The cost to operate the electric grid and market for most of Texas averages about 50-60 cents per month, or about $7 per year, for the average residential household.

In recent years, ERCOT has increased its efforts to actively manage vendor relationships, reduce costs through competitive processes and carefully examine every hiring decision. ERCOT management continues to seek opportunities to improve operational efficiency. System consolidation, automation and fast-path projects are among the initiatives to maximize productivity.

ERCOT will continue cost-management initiatives that have enabled the grid operator to postpone or minimize fee increases in spite of additional costs associated with the increasingly complex electric market.

> "ERCOT is pleased to be able to maintain a flat System Administration Fee despite rising costs associated with an increasingly complex electric market. ERCOT leadership has done an excellent job with managing costs through efficient hiring practices and other strategic decisions related to efficiency projects."
>
> – Sean Taylor
> Controller

Demand growth in ERCOT

The ERCOT system reached a new winter peak demand record in 2017 as well as six monthly peak demand records throughout the year. The new winter record was set on Jan. 6, 2017, when electricity demand reached 59,650 MW. Those monthly records occurred in January, April, May, June, July and October.

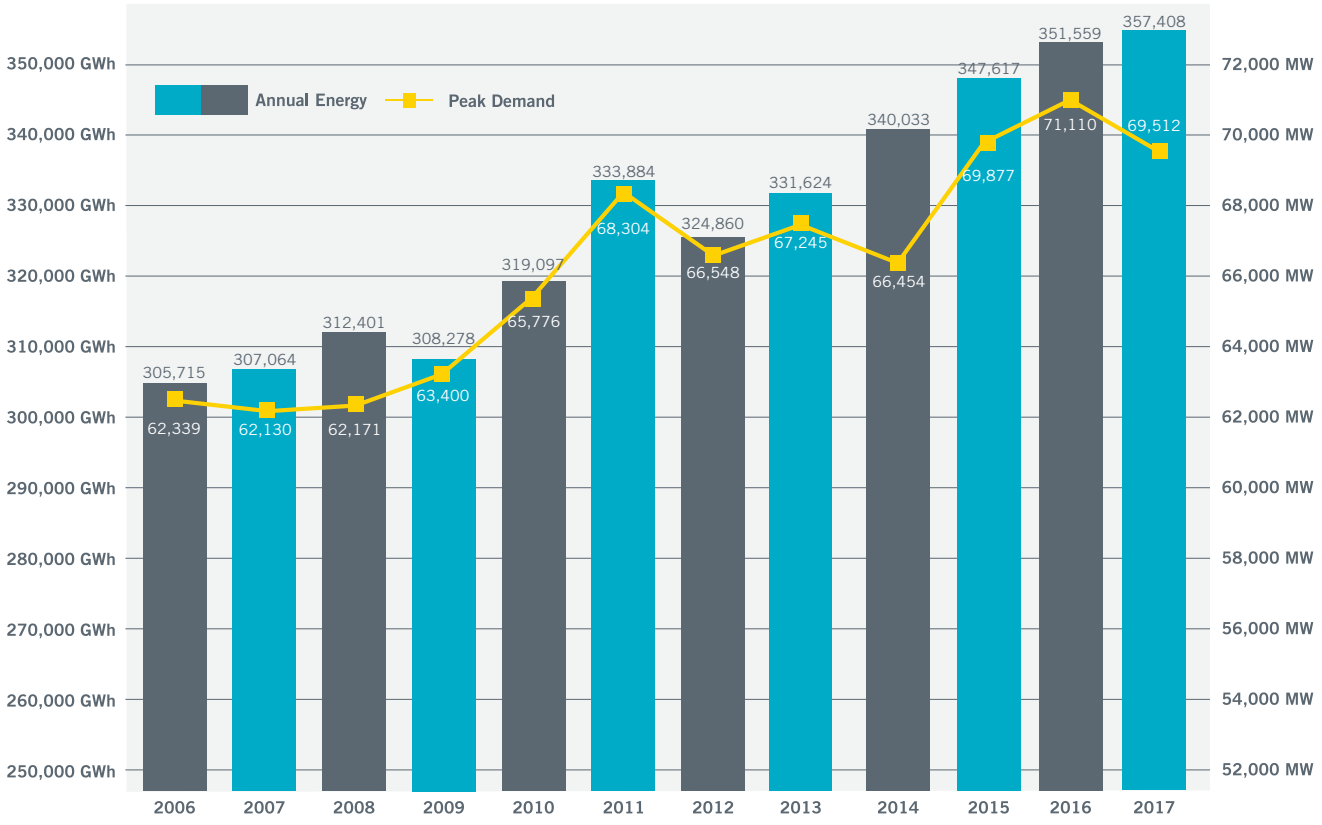
The 2017 summer peak occurred when demand reached 69,512 MW on July 28. This is more than 1,500 MW short of the all-time summer peak demand record set on Aug. 11, 2016, when demand topped out at 71,110 MW.

However, the summer of 2018 may be a record-setting year for electricity use, with the preliminary peak load forecast expected to surpass 72,000 MW.

2017 monthly records:

Jan. 6	April 28	May 26
59,650 MW 7-8 p.m.	53,486 MW 4-5 p.m.	59,264 MW 4-5 p.m.
June 23	**July 28**	**Oct. 9**
67,633 MW 4-5 p.m.	69,512 MW 4-5 p.m.	62,333 MW 4-5 p.m.

Annual energy and peak demand 2006-2017



Variable generation increases

The ERCOT market continues to see an increase in variable generation, primarily wind power. In October 2017, installed wind capacity surpassed 20,000 MW, while installed solar capacity exceeded 1,000 MW. Approximately 17.4 percent of the energy used in ERCOT came from wind in 2017.

Installed solar capacity in the ERCOT region nearly doubled between 2016 and 2017, and that figure is expected to almost double again by the end of 2018. Both solar and wind resources are expected to increase significantly by the end of 2020.

While the changing resource mix in the ERCOT region has presented new challenges for grid operators, it has not negatively impacted system reliability. New analytical and monitoring tools help ERCOT Operations manage this changing resource mix while maintaining system reliability and market efficiency. Better situational awareness with real-time analysis tools, improved outage detection and system mapping are among the tools used by ERCOT operators.

2017 wind records

Instantaneous wind penetration record for 2017:

54 percent
Oct. 27, 2017 at 4 a.m.
System load was 28,416 MW

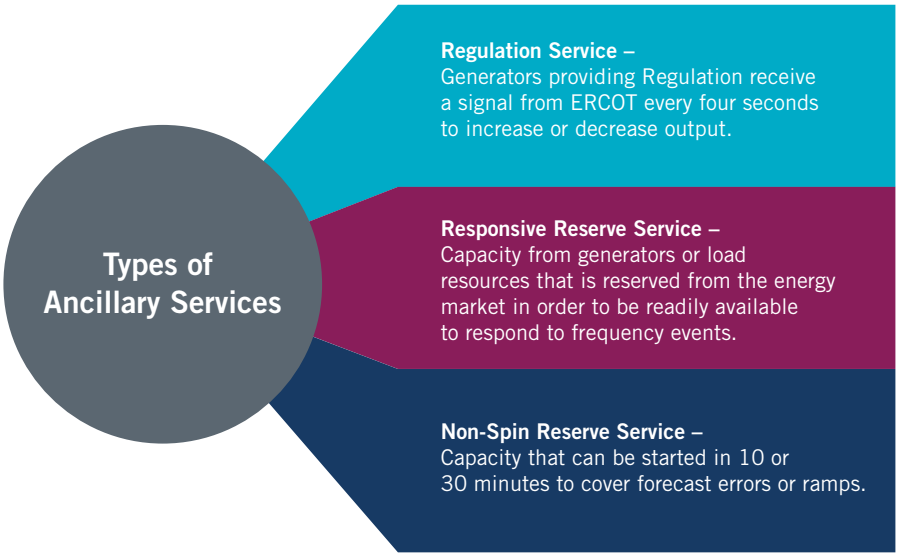
Instantaneous wind output record for 2017:

16,141 MW
March 31, 2017 at 8:56 p.m.

Managing variability

Ancillary Services are procured in the Day-Ahead Market to ensure reserve capacity is available to address variability that cannot be covered by the five-minute energy market. ERCOT and its stakeholders continue to focus on the design of these services to provide resources that can maintain system reliability by responding quickly to sudden changes in load and generation output.

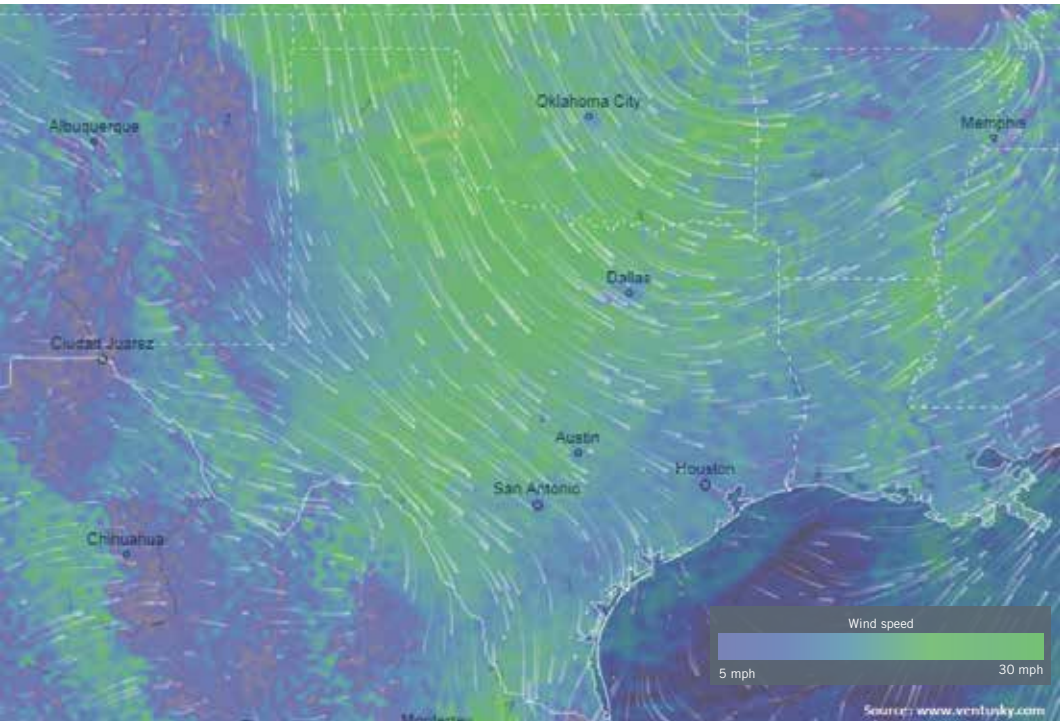
Over the last several years, ERCOT has made changes to how Ancillary Services are determined to better reflect system needs in different conditions. While ERCOT procures quantities of Ancillary Services that are decided up to a year in advance, operators have the ability to procure additional reserves based on actual system conditions.



Increasing situational awareness

With the increase in variable generation, ERCOT determined it was necessary to create a new operator desk inside the control room to help manage issues associated with the changing resource mix and variability in Ancillary Service requirements.

In January 2017, ERCOT added the Reliability Risk Desk to more closely monitor and respond to wind and solar forecast errors, net load ramps, inertia levels and Ancillary Service needs given near-term expected system conditions.



Improving wind forecasting

Wind power forecasting accuracy continues to improve with new tools and technologies, as well as increased experience. In 2017, ERCOT procured a secondary wind forecasting service to improve the resilience and flexibility of the forecast process.

ERCOT also is adding intra-hour forecasting, which will help grid operators better prepare for potential ramps in wind generation within each five-minute dispatch interval.

Improved wind forecasting reduces the amount of operational reserves needed to ensure a reliable electric system and improves the efficiency of the system dispatch.

Mapping Distributed Energy Resources

ERCOT recognizes the increasing role that Distributed Energy Resources (DERs) are expected to play in the ERCOT market. DERs may range from small solar rooftop installations to small fossil-fueled generators, which are installed at customer locations or on the distribution system.

Given ERCOT's limited amount of visibility into these resources, the grid operator in 2017 met with transmission and distribution providers to develop a process for tracking these types of resources on the ERCOT system. This was the first phase in ERCOT's efforts to identify these resources and develop a roadmap for responding to the future growth of DERs.

ERCOT system withstands Hurricane Harvey's devastation

ERCOT continually invests in emergency preparedness training for its staff, and in August 2017, those skills were put to work.

As Harvey ravaged the Texas Gulf Coast on Aug. 25 and heavy rain followed for the next several days, the grid operator ramped up operations to ensure the electric system remained reliable, and supported restoration efforts by the transmission operators.

While the system experienced a significant number of transmission outages, including three major 345-kV lines between Corpus Christi and Houston, the grid remained stable and ERCOT competitive electricity markets continued to operate normally.

More than 7,000 MW of generation resource capacity was unavailable or operating at reduced capacity in the days following Harvey's landfall. However, this did not impact ERCOT's ability to meet system-wide demand since electricity use was well below what is typical for August. The reduced demand was due to a combination of structural damage along the coast and cooler temperatures in much of the region.

The hardest hit areas included Rockport, Port Aransas and Victoria, and heavy storms caused significant flooding in the Houston area. Due to the extreme flooding and damage, transmission and distribution companies had to come up with unique ways to restore service to their customers. From mobile substations to amphibious bucket trucks, these restoration efforts were unlike anything many of the utility workers had experienced before.

> "The scope of the storm's impact required a remarkable effort by ERCOT and the many other entities affected. It illustrated the importance of preparedness and the need for flexibility to take innovative actions during and after these events."
>
> – Dan Woodfin
> Senior Director of System Operations

Impacts of solar eclipse

A partial eclipse occurred in the ERCOT region on Aug. 21. It was the first total eclipse visible in the United States since 1979, but only covered a portion of Texas.

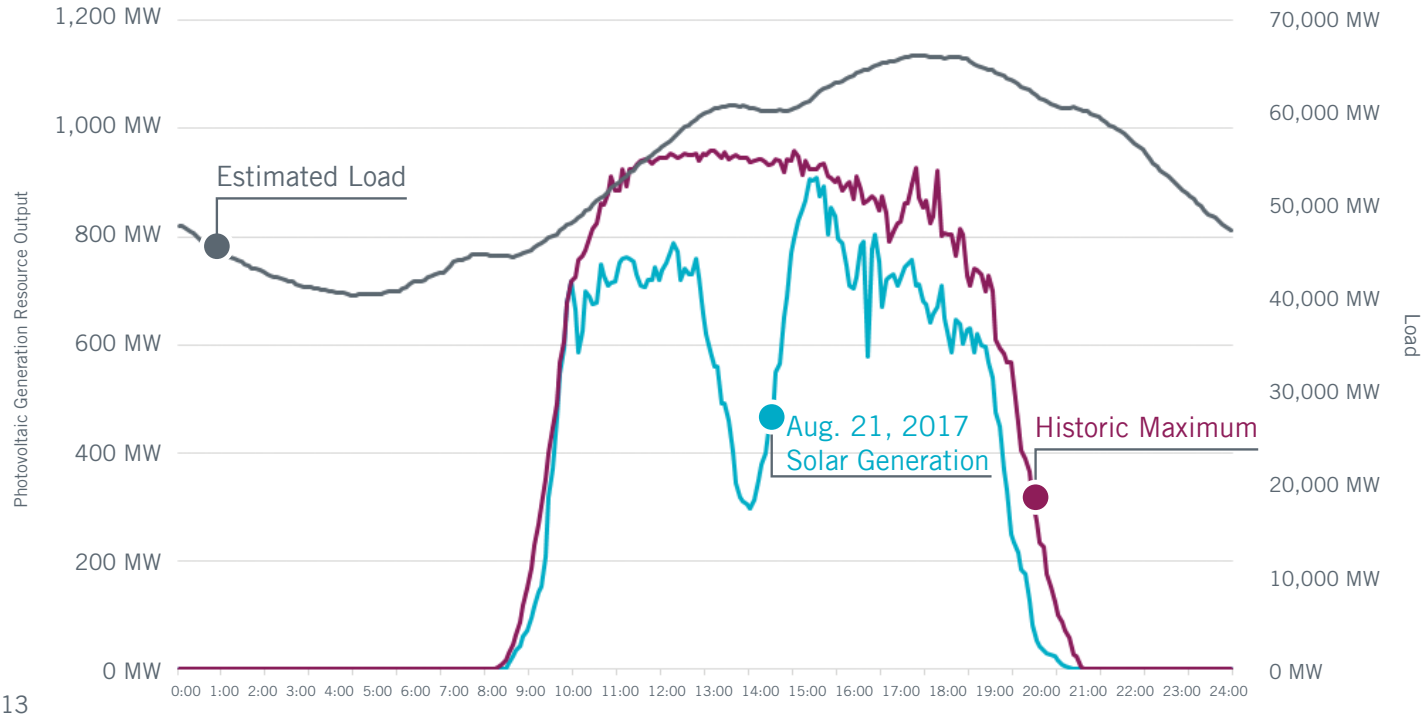
The eclipse lasted about two and a half hours in the ERCOT region, from 11:30 a.m. to 2 p.m. During this time, roughly 65 to 75 percent of the sun's disk was covered when the eclipse passed over the solar farms.

Solar generation decreased by 461 MW over the course of an hour, and ERCOT system load decreased by 661 MW over a 30-minute duration. This event did not cause any system reliability issues since the eclipse was factored into ERCOT's solar forecast.

The next total solar eclipse in the U.S. will be April 8, 2024, and is expected to travel over Texas. As solar generation continues to increase in the ERCOT region, the impact is expected to be much greater.

Aug. 21, 2017 solar output

compared to the historical maximum in the ERCOT region



Managing tighter reserve margins

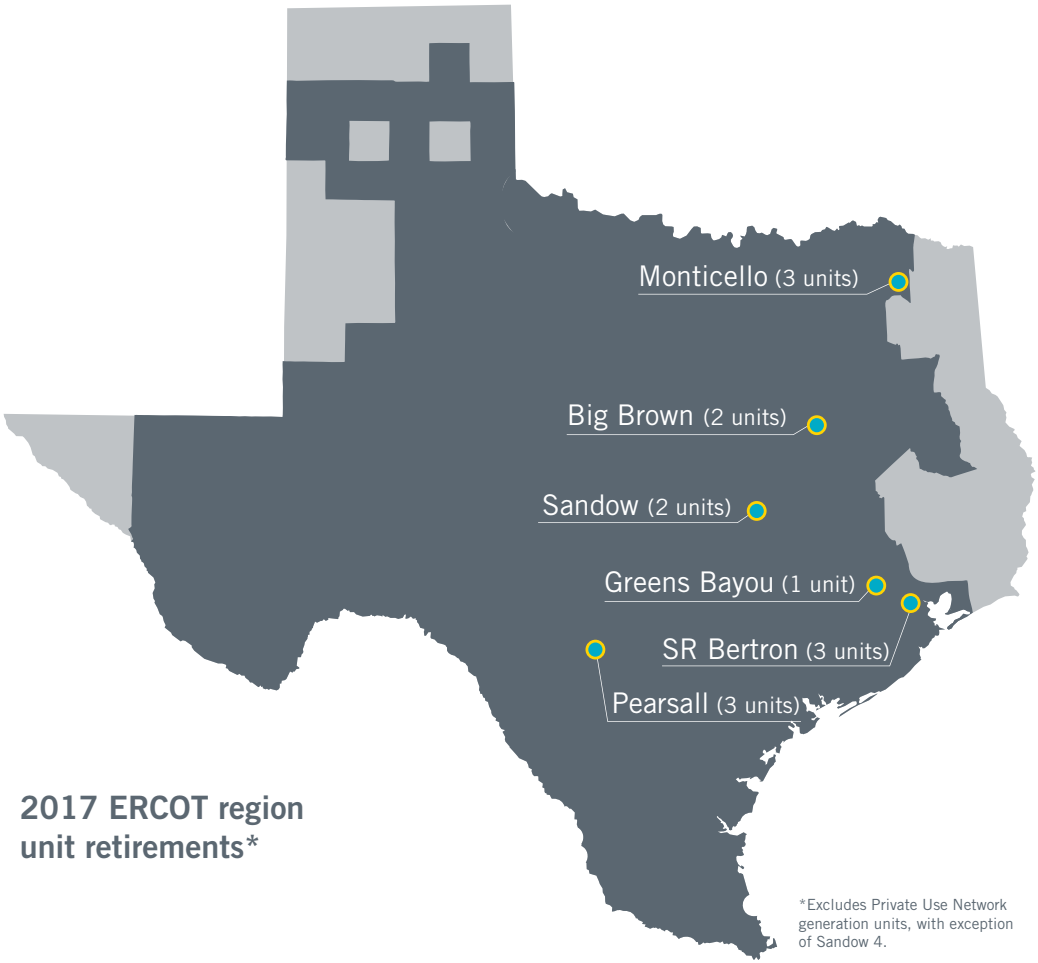
As the electric grid operator for most of Texas, ERCOT has the tools necessary to maintain grid reliability in a broad range of situations.

In 2017, generation owners in the ERCOT region announced plans to retire or indefinitely suspend operations of more than 5,100 MW of generation resource capacity. These announcements, combined with continued load growth and delays in planned generation projects, have resulted in a significantly lower reserve margin over the next few years. ERCOT is assessing these changes and will provide a final seasonal assessment prior to the 2018 summer operating season.

As summer 2018 approaches, ERCOT's focus will be on system performance. The ERCOT market has seen cycles of retirements and new investments in the past, so these types of shifts are not without precedent. Planning reserve margins fluctuate over time and likely will continue to do so as the market responds to changing conditions.

The PUC has directed ERCOT to study and consider the appropriate level of reserves needed to maintain reliability while minimizing costs in ERCOT's energy-only market. ERCOT will present the findings of its study of the Economically Optimal Reserve Margin in late 2018.

Effective Jan. 1, 2018, a new PUC rule requires generation owners to notify ERCOT of their plans to retire units at least 150 days in advance of the closure dates. Formerly, the rule required a 90-day notice.



2017 ERCOT region unit retirements*

*Excludes Private Use Network generation units, with exception of Sandow 4.

Building generation in ERCOT

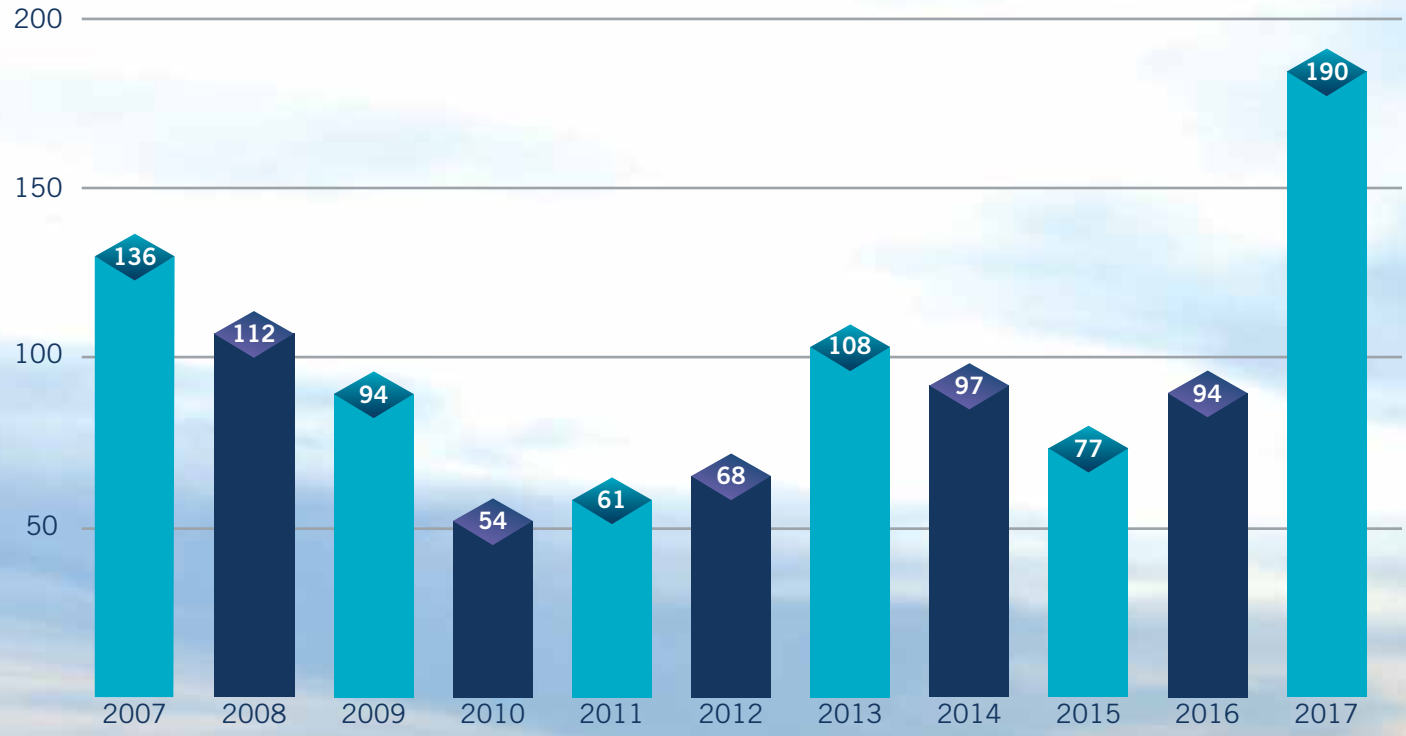
Generation developers continue to add new resources to the ERCOT system. Interconnection requests reached historic levels in 2017 with nearly 200 requests. Utility-scale solar projects accounted for 56 percent of those requests.

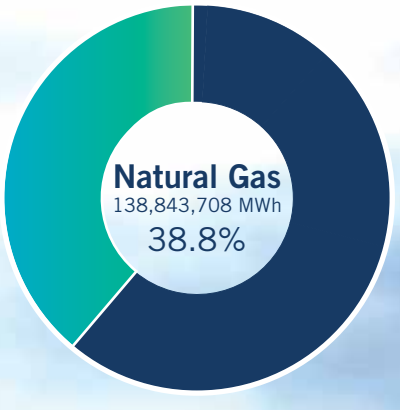
Anyone can choose to build new generation in the ERCOT region. Generation developers must submit an interconnection request to ERCOT for any projects 10 MW or larger. As part of the interconnection process, ERCOT, the developer and the interconnecting Transmission Service Provider conduct studies to determine the impact of a project to the ERCOT system and identify any potential transmission issues that need to be addressed.

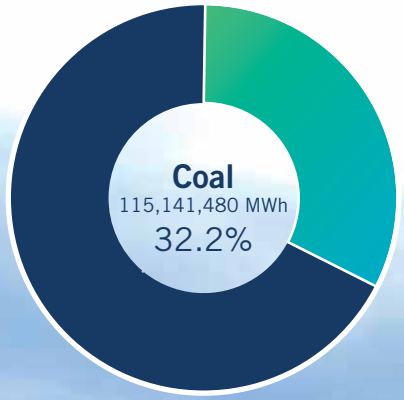
The interconnection process is designed to ensure that grid reliability is maintained and projects are in compliance with NERC reliability standards and other requirements set forth by ERCOT and the PUC.

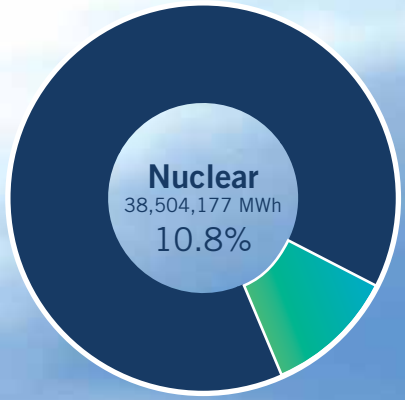
Generation interconnection requests by calendar year

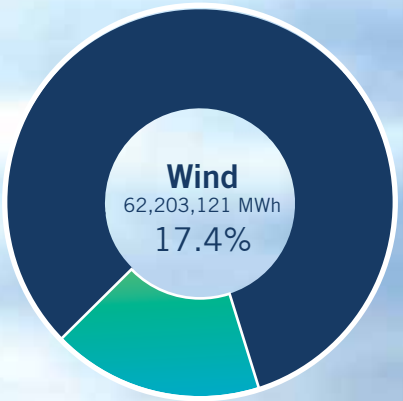
2007-2017

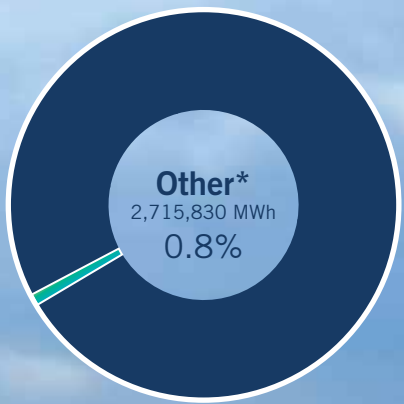












2017 energy use

Consumers used more than 357 billion kilowatt-hours of energy in 2017, a 1.6 percent increase compared to 2016.

*Includes solar, hydro, petroleum coke, biomass, landfill gas, distillate fuel oil, net DC-tie and Block Load Transfer imports/exports and an adjustment for wholesale storage load.

Continued growth

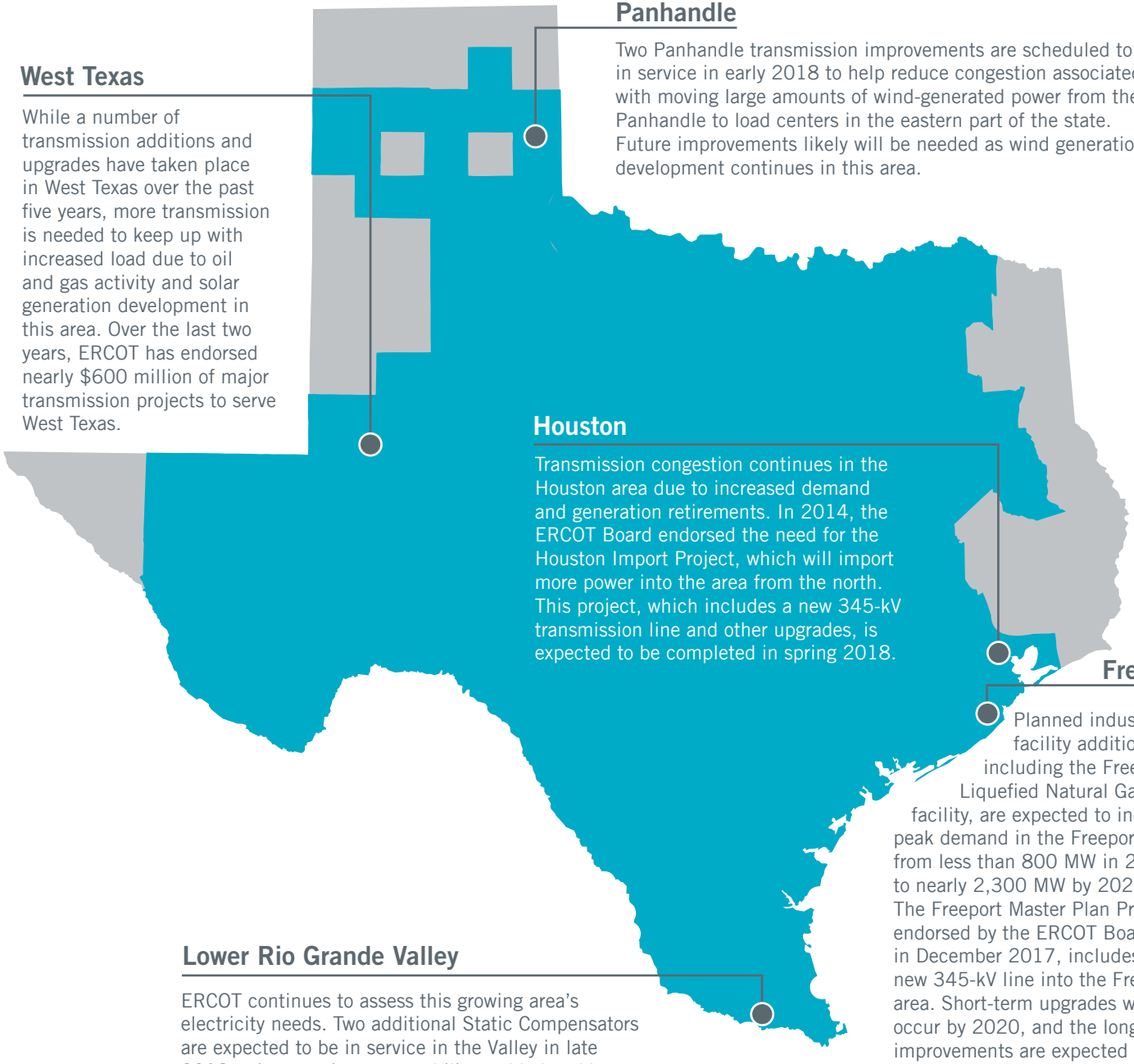
As electricity demand continues to increase in the ERCOT region, the grid operator analyzes trends statewide to determine where new infrastructure is needed.

The 2017 Report on Existing and Potential Electric System Constraints and Needs provided an assessment of the need for increased transmission and generation capacity for the next six years (2018-2023) in the ERCOT region. The annual report summarizes data included in other transmission planning studies and ERCOT's Regional Transmission Plan, which is submitted annually to the PUC and NERC.

Transmission planning process

1.	**Proposal**	ERCOT staff, Transmission Owner or Market Participant
2.	**Study**	ERCOT
3.	**Engineering and Routing**	Transmission Owner
4.	**Certificate of Convenience and Necessity Approval**	Public Utility Commission of Texas
5.	**Construction**	Transmission Owner

Planning by region



Panhandle

Two Panhandle transmission improvements are scheduled to be in service in early 2018 to help reduce congestion associated with moving large amounts of wind-generated power from the Panhandle to load centers in the eastern part of the state. Future improvements likely will be needed as wind generation development continues in this area.

West Texas

While a number of transmission additions and upgrades have taken place in West Texas over the past five years, more transmission is needed to keep up with increased load due to oil and gas activity and solar generation development in this area. Over the last two years, ERCOT has endorsed nearly $600 million of major transmission projects to serve West Texas.

Houston

Transmission congestion continues in the Houston area due to increased demand and generation retirements. In 2014, the ERCOT Board endorsed the need for the Houston Import Project, which will import more power into the area from the north. This project, which includes a new 345-kV transmission line and other upgrades, is expected to be completed in spring 2018.

Freeport

Planned industrial facility additions, including the Freeport Liquefied Natural Gas facility, are expected to increase peak demand in the Freeport area from less than 800 MW in 2014 to nearly 2,300 MW by 2022. The Freeport Master Plan Project, endorsed by the ERCOT Board in December 2017, includes a new 345-kV line into the Freeport area. Short-term upgrades will occur by 2020, and the long-term improvements are expected to be in place by 2022.

Lower Rio Grande Valley

ERCOT continues to assess this growing area's electricity needs. Two additional Static Compensators are expected to be in service in the Valley in late 2018 to improve import capability and help address load growth in this region.

Proposed market design changes

ERCOT, the PUC and stakeholders routinely study ways to improve the market and ensure pricing mechanisms are in place to represent the increased value of electricity when supplies are limited. The grid operator is responsible for assessing possible changes and ensuring the chosen policies can be successfully implemented.

In 2017, the PUC instructed ERCOT to assess the cost and time to implement Real-Time Co-optimization (RTC) and marginal line losses. RTC is the process of procuring energy and Ancillary Services simultaneously in the Real-Time Market. With marginal losses, ERCOT would account for transmission line losses in its pricing mechanisms.

ERCOT estimated it would cost around $40 million and take four to five years to implement RTC. In a similar progress report, the grid operator determined it would cost around $10 million and take 18 to 24 months to move forward with marginal losses. At the direction of the PUC, ERCOT will report back on these proposed market changes in mid-2018.

In early 2018, the PUC approved the removal of Reliability Unit Commitment resources, including Reliability Must-Run units, from the online capacity considered when calculating Operating Reserve Demand Curve price adders.

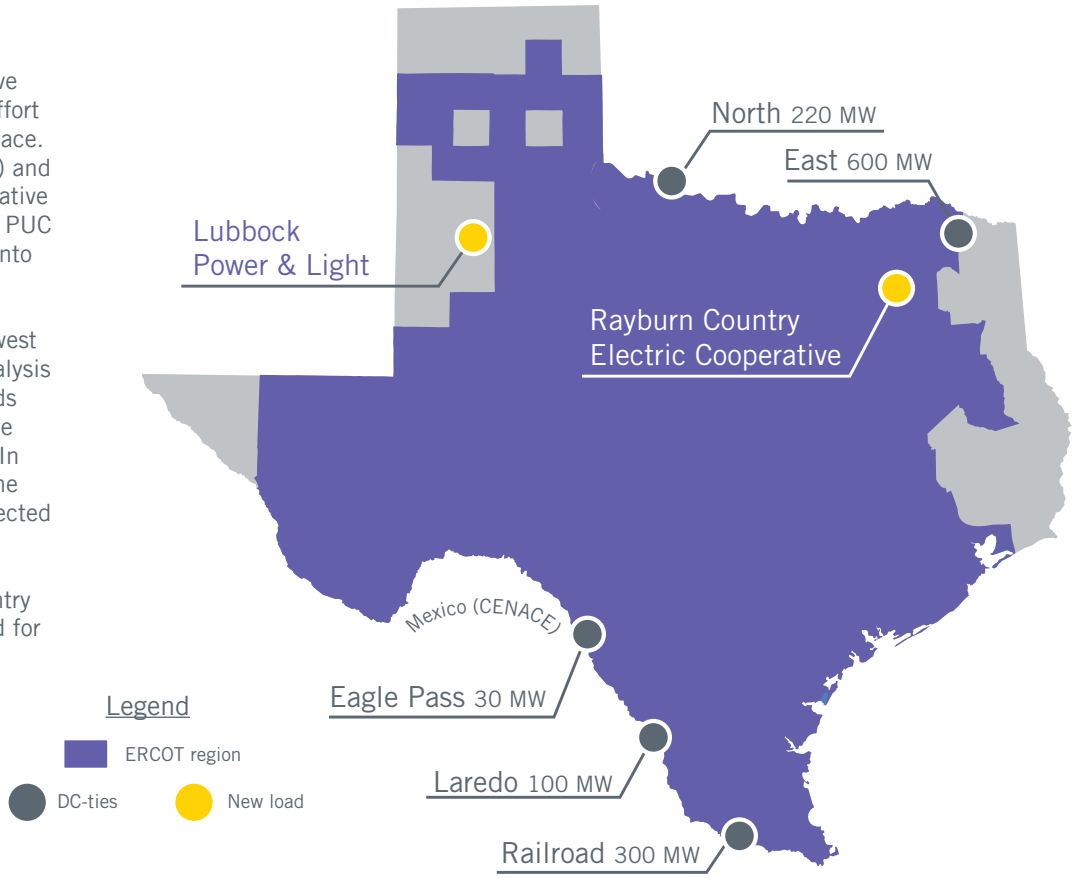
> "We serve as an information resource to the PUC and stakeholders to help them make well-informed decisions regarding market changes. Once a policy decision is made, our job is to build the systems and platforms that are necessary to implement those market changes."
>
> – Kenan Ögelman
> Vice President of Commercial Operations

Joining ERCOT

Neighboring utilities in Texas have requested to join ERCOT in an effort to enjoy its competitive marketplace. Lubbock Power and Light (LP&L) and Rayburn Country Electric Cooperative are working with ERCOT and the PUC to move a portion of their loads into ERCOT.

In 2017, ERCOT and the Southwest Power Pool performed a joint analysis to report the impacts to both grids resulting from LP&L moving some of its load to the ERCOT region. In early 2018, the PUC approved the integration, and the move is expected to occur by 2021.

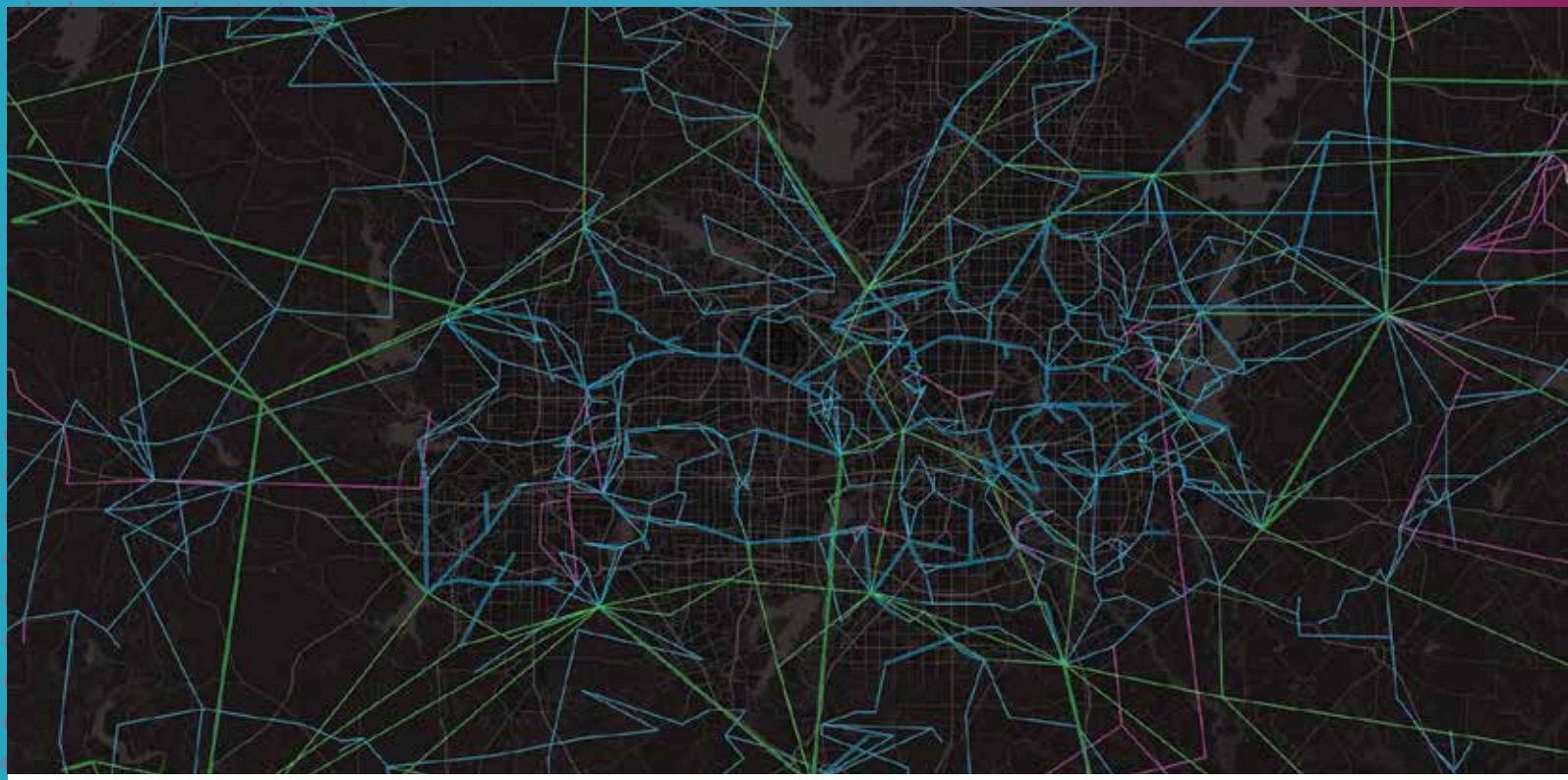
A similar study for Rayburn Country Electric Cooperative is scheduled for release in early 2018.



Working with Mexico

As the Mexican power market evolves, it has become increasingly important for ERCOT and the relatively new Mexican power grid operator, El Centro Nacional de Control de Energía (CENACE), to work together to ensure both grid operators are able to fulfill their missions and reliably serve their customers. ERCOT currently has three DC-ties with Mexico that allow the transfer of power between the two regions. ERCOT, CENACE and the DC-tie operators work together to manage the flow of energy across those ties during normal and emergency operations.

In 2017, ERCOT took some steps to keep its regulatory oversight in Texas. This is due to two proposed interconnection projects that would allow power flow between ERCOT and another state via Mexico. The PUC instructed ERCOT to file a Nodal Protocol Revision Request (NPRR) to outline the steps that could be taken to protect its jurisdictional status. NPRR 861 was approved by the ERCOT Board in early 2018.



Improving access to information

As the electric system becomes more complex, grid operators need access to as much data as possible in a strategically-organized format that helps them make well-informed decisions inside the control room. In 2018, ERCOT will begin using an improved visualization tool known as GridGeo. The tool is designed to help operations teams maintain overall awareness of the grid.

GridGeo, which has been in formal development for the past 18 months, will allow operators and supporting engineers to view large areas of the grid and then drill down for detailed system views. This tool is expected to provide more geographically accurate information and allow operators to visualize weather overlays on the grid and view multiple substation one lines in a single view.

Updating IT infrastructure

An abundance of highly sophisticated technologies are used to operate the ERCOT system in a reliable and efficient manner. The grid operator's information technology infrastructure consists of more than 400 business applications, thousands of servers, more than four petabytes of storage, redundant high speed fiber networks, a Wide Area Network and three data centers.

In 2016, ERCOT began a major data center technology refresh to replace aging equipment with new architecture that is faster, more resilient, flexible and capable of improving system reliability. These added efficiencies also are expected to lower ERCOT's operating and maintenance costs.

By the end of 2017, 90 percent of the hardware had been deployed and 85 percent of the applications, databases and file systems were migrated to new hardware. Approximately 74 percent of the approved $48 million budget for this entire project was spent through 2017.

The technology upgrade is tracking on budget and on schedule. It is expected to be completed in 2018.

Modeling system receives major upgrade

Grid operators rely on a series of network models to view and analyze the hardware that makes up the electric system. This includes transmission lines, generators, substations and other critical infrastructure. Accuracy and ongoing updates are essential to ensure the operators have an accurate depiction of what is occurring on the grid at all times.

In May 2017, ERCOT completed a significant upgrade of the Network Model Management System (NMMS) to improve ERCOT's modeling capabilities. The NMMS is an umbrella of applications used to build the Network Operations Model and Annual Planning Models.

This complex system accepts direct user input from Transmission Service Providers and indirect input from Resource Entities and sends data to other downstream systems, such as the Energy Management System and Market Management System.

The NMMS upgrade included building and testing more than 40 production and future models, the activation and archiving of more than 20 of those models and modifying over 300 validation rules and functions. Since going live in 2017, the new NMMS system has produced more than 70 production and future models.

For model coordinators, there is an improved user interface that makes it easier to navigate through applications, and existing processes have been streamlined for increased efficiency. Additionally, moving the NMMS from Citrix to a web-based application has improved data security.

Retail market participants benefit from upgraded tool

Also in 2017, ERCOT upgraded its MarkeTrak tool used by retail market participants to resolve any retail issues such as missing transactions, inadvertent gains and usage disputes. This online workflow application is the preferred method for addressing these types of issues and communicating between the Transmission and Distribution Service Providers, Load Scheduling Entities and ERCOT. Approximately 150,000 issues are resolved via MarkeTrak annually.

Protecting ERCOT's critical networks and systems

ERCOT's critical role in providing reliable electric service to Texans 24/7 means the grid operator must heavily guard against any physical and cyber threats that may arise.

ERCOT follows industry best practices to provide a secure environment, including the use of a defense-in-depth strategy that allows staff to identify potential threats and take immediate action to protect the electric grid. The grid operator also coordinates with local, state and federal agencies to enhance its security presence and ensure national reliability standards are being met.

In 2017, ERCOT participated in the biennial GridEx IV exercise hosted by NERC to test its ability to respond to a simulated cyber and physical attack on the electric system and other critical infrastructure.

This exercise included more than 80 ERCOT employees from various departments and more than 20 external participants representing the regulatory, law enforcement, emergency management and gas industries. Eight market participants, represented by more than 240 individuals, also participated in the exercise.

GridEx highlighted the importance of effective communication between internal and external entities during a grid event.

ERCOT is home to thought leaders

One of the best things about working for ERCOT is the people. From executives to individual contributors, ERCOT's highly experienced staff are the key ingredient behind the grid operator's reliable and efficient wholesale market.

ERCOT's diverse organization includes staff from all over the world, from entry-level college graduates to seasoned experts. ERCOT employees understand the critical role of the business and work daily to develop creative solutions to complex challenges affecting the industry.

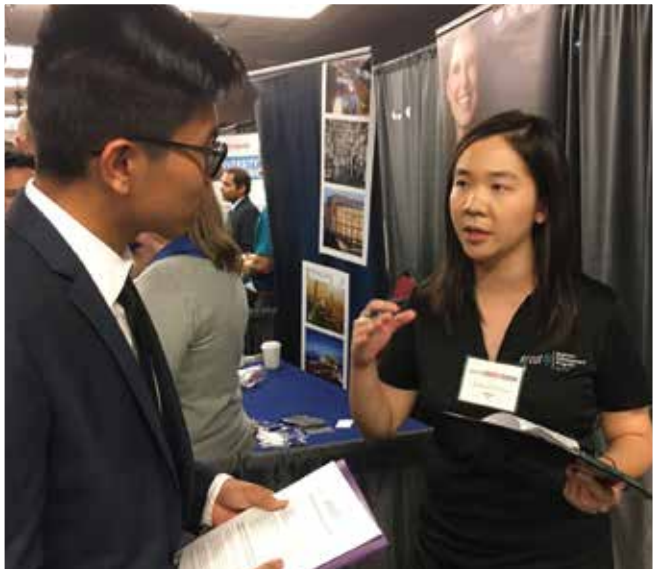
Dozens of national and international groups request meetings with ERCOT annually to discuss ERCOT's energy-only market and its success with integrating renewable power, among other topics. ERCOT staff also are invited to travel worldwide to share their expertise and meet with other energy experts about industry trends and best practices.

Additionally, ERCOT staff participate in a multitude of energy-related conferences and other speaking engagements throughout the year. Participating in these types of events helps elevate ERCOT's presence and creates an opportunity to discuss issues impacting the industry beyond ERCOT.

Developing careers at ERCOT

ERCOT offers attractive programs for college graduates with engineering and IT degrees. The ERCOT Engineer Development Program is a year-long program that exposes entry-level engineers to 15 areas of the business, with the goal of developing them to become skilled power engineers. The Building Information Technology Staff program introduces participants to multiple IT tracks, including development, infrastructure and operations.

ERCOT also has a robust internship program, which gives students a wide range of opportunities to learn about the electric industry and apply their skills to meaningful projects. Many of the interns transition into the EDP and BITS programs to continue their careers with ERCOT.



In 2017, guests from these countries and others visited ERCOT facilities and staff.

Poland

Germany

Mexico

Morocco

Argentina

Chile

Collaborating, sharing grid and market expertise

ERCOT hosts visitors from all over the world — and sometimes sends delegates to other countries — to share expertise related to its grid, market operations and related topics.

Ukraine

China

Japan

South Korea

Taiwan

India

Australia

New Zealand

Training paves the way for success

ERCOT provides ongoing training for employees and market participants year-round. Keeping up with developing technologies in the midst of changing grid conditions is critical to the successful operation of the electric system.

Control room operators attend a week's worth of training every six weeks, and ERCOT hosts Black Start and Operator Training Seminars each year for staff and market participants. ERCOT also offers management training and coaching clinics for staff, as well as monthly training sessions for all employees.

Given the numerous trainings offered, ERCOT is adding a new training center on the Taylor campus. Construction began in late 2017, and the building is expected to be completed in late 2018. This facility will become the new home for annual black start and operator training.

The 22,000 square-foot training center will feature a mock control room for simulations and tours, as well as an observation room for viewing the control room while in training.

Giving back to the community

ERCOT employees support a number of local charities through volunteering and fundraising opportunities organized by ERCOT's Community Involvement Committee. While the ERCOT organization is unable to make charitable donations due to its 501(c)(4) status, employees have voluntarily donated nearly $160,000 to a number of organizations over the past five years.

They include United Way, Central Texas SPCA, Ghisallo Cycling Initiative, Beginners Learning Alternative Designs for Energy (BLADE), Taylor Independent School District, Shepherd's Heart Food Pantry, military and veterans services, Court Appointed Special Advocates (CASA) and the Red Cross. Employees also volunteer their time for Meals on Wheels and donate blood to a local blood bank.

Quick facts

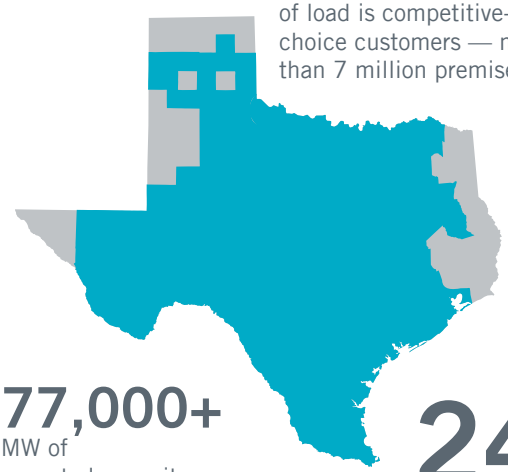
90 percent of Texas load

71,110 MW
Record peak demand (Aug. 11, 2016)

68,368 MW
Weekend demand record (July 29, 2017)

>20,800 MW of installed wind capacity, the most of any state in the nation

75% of load is competitive-choice customers — more than 7 million premises

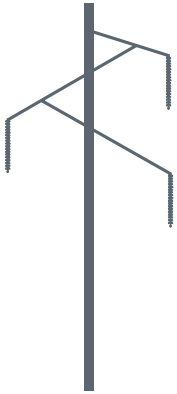


77,000+ MW of expected capacity for peak demand as of February 2018

24 million consumers in the ERCOT region

1,102 MW of utility-scale installed solar capacity as of February 2018

1 MW of electricity can power about 200 Texas homes during periods of peak demand



46,500+ circuit miles of high-voltage transmission

610+ generating units as of February 2018, excluding PUNs and battery storage

Projects energized in 2017 total about $805.4 million

As of February 2018, tracking 334 active generation interconnection requests totaling 67,398 MW

Generation capacity as of February 2018
*Includes hydro and biomass

The Electric Reliability Council of Texas (ERCOT) manages the flow of electric power to 24 million Texas customers — representing about 90 percent of the state's electric load. As the Independent System Operator for the region, ERCOT schedules power on an electric grid that connects more than 46,500 miles of transmission lines and 600+ generation units. It also performs financial settlement for the competitive wholesale bulk-power market and administers retail switching for seven million premises in competitive choice areas. ERCOT is a membership-based 501(c)(4) nonprofit corporation, governed by a board of directors and subject to oversight by the Public Utility Commission of Texas and the Texas Legislature. Its members include consumers, cooperatives, generators, power marketers, retail electric providers, investor-owned electric utilities, transmission and distribution providers and municipally owned electric utilities.

The 2017 State of the Grid report is dedicated to everyone who was impacted by Hurricane Harvey and to those who aided in the recovery.

Image credits:

P. 13 eclipse photo courtesy of NASA/Aubrey Gemignani • P. 26 photo of Wind Integration Workshop courtesy of Energynautics GmbH • P. 29 training center rendering courtesy of STG Design • P. 30 photo of Hurricane Harvey relief event courtesy of LeAnn Powers

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April 2018

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