



Introduction to ERCOT for the Staff of the Sunset Advisory Commission

April 18, 2022

Overview

- I. Introduction to ERCOT
- II. ERCOT Governance
- III. ERCOT Funding and Organization
- IV. ERCOT Core Functions
 - a. Planning
 - b. Grid System Operations
 - c. Commercial Operations
 - d. Information Technology
- V. Successes and Opportunities
- VI. Appendices

ERCOT Key Contacts



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ERCOT Board of Directors Leadership



Paul Foster
ERCOT Board Chair
President of Franklin
Management, LLC;
Founder and former Executive
Chairman of Western Refining
Inc.



Bill Flores
ERCOT Board Vice Chair
Entrepreneur, business
leader, and public policy
leader;
U.S. Representative, 17th
Congressional Dist. Of
Texas 2011-2021

What is ERCOT?

ERCOT is

- a 501(c)(4) nonprofit corporation;
- governed by a Board of Directors;
- subject to the oversight of the Legislature and the PUCT;
- with processes for member and other stakeholder input.



The PUCT has certified ERCOT, under PURA Section 39.151, as the **independent organization** for the ERCOT region. ERCOT acts as the independent system operator (ISO) for the region.

ERCOT's Mission and Core Functions

ERCOT performs four statutory functions, ensuring

- non-discriminatory access to the transmission and distribution systems within the region for all buyers and sellers of electricity;
- the reliability and adequacy of the regional electrical network;
- information relating to a customer's choice of Retail Electric Provider (REP) is timely conveyed; and
- electricity production and delivery are accurately accounted for among generators, wholesale sellers, and wholesale buyers.

Carried out by

Planning

Grid System Operations

Commercial Operations

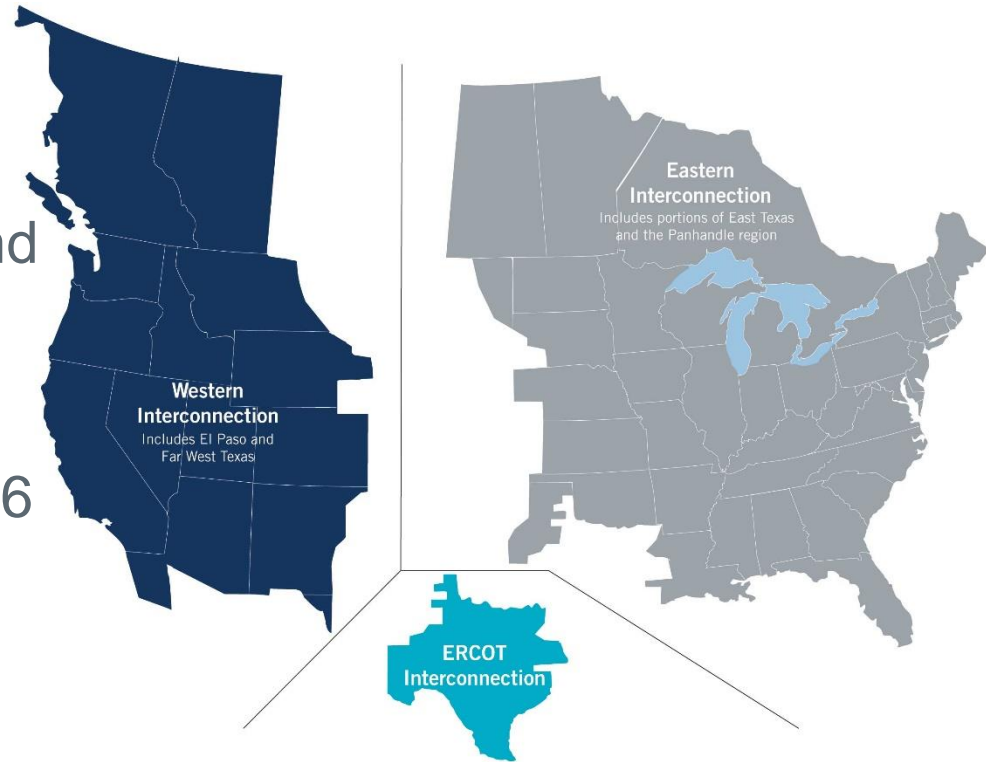
Supported by

Other Core Functions

Information Technology

ERCOT Region by the Numbers

- 1 of 3 North American interconnections
- 90% of Texas's electric demand
- 74,820 MW peak demand (Aug. 12, 2019)
- Managing flow of power to > 26 million customers
- > 1,800 active Market Participants
- 855 generation units
- 52,615 miles of transmission lines



- 4 DC ties to other grids, totaling 1,220 MW of capacity

Highlighted history and major events

- 1941 – Several Texas utilities interconnect to support war effort. Remain interconnected after WWII due to the reliability benefits.
- 1970 – ERCOT is formed to comply with North American Electric Reliability Council requirements.
- 1996 – ERCOT restructured and initiates operations as a non-profit ISO - the first ISO in the U.S. - per Legislature's restructuring of wholesale market.
- 2001 – Control areas in ERCOT region are merged into a single control area and commercial functions are centralized for efficient market operations.
- Jan. 2002 – Retail competition is launched, per Legislature's restructuring of retail market.
- Dec. 2010 – ERCOT transitions from zonal to nodal market structure.
- Feb. 2011 – Extreme cold weather event results in generator outages and derates, requiring ERCOT to declare an Energy Emergency Alert (EEA) 3 and order up to 4,000 MW of firm load shed.
- Summer 2011 – Drought, extreme heat, and wildfires result in ERCOT declaring EEAs 7 times.
- Feb. 2021 – Extreme cold weather event (Uri) results in fuel limitations and generator outages and derates, requiring ERCOT to declare an EEA 3 and order up to 20,000 MW of firm load shed.

Post-Uri Initiatives

- 2021 – Key Legislation passed by 87th Legislature included
 - SB 2
 - Changes ERCOT Board of Directors composition to 8 fully independent members who are residents of Texas.
 - The Board of Directors is chosen by the three member "Board Selection Committee" composed of one appointee each from the Governor, Lieutenant Governor, and the Speaker of the House.
 - SB 3
 - Requires weatherization of power generation and transmission facilities as well as ERCOT inspection of these facilities;
 - Directs ERCOT to procure sufficient ancillary or reliability services to ensure reliability during extreme weather events, including a winter firm fuel service;
 - Formalizes the Texas Energy Reliability Council to improve coordination between ERCOT and various state agencies; and
 - Improves upon load shedding protocols and directs ERCOT to conduct simulated load shedding exercises.

Post-Uri Initiatives (continued)

- 2021 – Present – ERCOT's post-Uri activities are guided by new legislation and direction from State leadership, including the PUCT. ERCOT is
 - **Managing the grid** more aggressively than ever before, e.g., increasing operating reserves and revising outage processes;
 - Helping **prepare the grid** for future extreme weather events, e.g., ERCOT's new Weatherization and Inspections team— more than 300 generation and 22 transmission sites inspected in Dec. 2021;
 - Implementing PUCT enhancement of ERCOT **market design**, e.g., decreasing the cap on the price of wholesale electricity during shortages and creating new reliability products; and
 - Providing **more information** in a **more accessible manner**, such as earlier publication of unplanned outage data and enhancing collaboration with State officials.
- See the status of 60 action items in ERCOT's [Roadmap to Improving Grid Reliability](#).

Post-Uri Initiatives (continued)

- 2021 – Present – ERCOT's other post-Uri activities include
 - Supporting the financing and servicing of funds under PURA Chapter 39, subchapters M and N; and
 - Extensive litigation.



ERCOT Governance

Foundations of ERCOT Governance

Legislature

Public Utility Regulatory Act (PURA)
Texas Business Organizations Code (TBOC) ch. 22, Nonprofit Corporations

PUCT Substantive Rules

MARKETS & OPERATIONS

ERCOT Protocols

Market Guides

Other Binding Documents (OBDs)

CORPORATE & MEMBERSHIP GOVERNANCE

ERCOT Bylaws

Board Policies & Procedures

TAC Procedures

Committee Charters

Subcommittee Charters/ Procedures

PURA Section 39.151 – Essential Organizations

Some provisions include

- (c) PUCT certifies the independent organization.
- (d) PUCT adoption and enforcement of rules relating to the reliability of the regional electrical network; oversight; decertification of the independent organization.
- (d-1) & (e) PUCT approval and oversight of the independent organization's budget and fees.
- (d-2) PUCT approval of debt financing or refinancing of existing debt.
- (d-3) PUCT approval of performance measures to track operations.
- (d-4) PUCT authority over reports, system of accounts, audits, inspections, administrative penalties, and dispute resolution.
- (g-6) Protocol revisions may not take effect until approval by the PUCT.
- (n) The timing for Sunset reviews of the Commission and the independent organization.
- (o) Requirement for an internal cybersecurity risk assessment and the submission of an annual cybersecurity and information security report.

The ERCOT Board of Directors

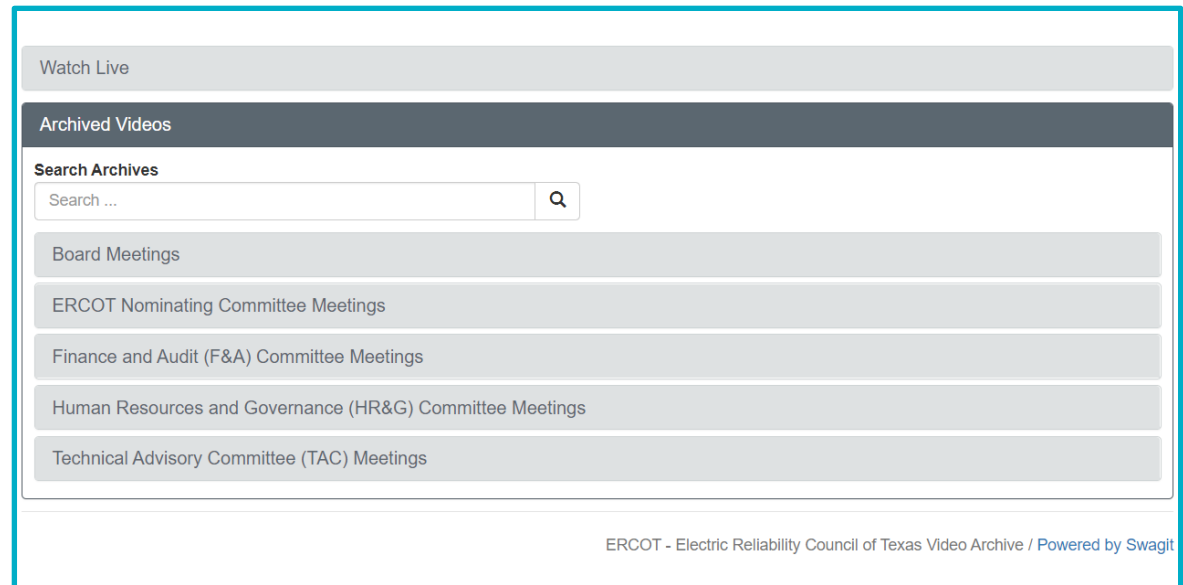
- In 2021, the Legislature changed the ERCOT Board composition as part of SB 2 (PURA Section 39.151).
- 11 Directors (9 voting, all Texas residents)
 - 1 non-voting Chair of the PUCT
 - 1 non-voting ERCOT CEO
 - 1 voting Public Utility Counsel
 - 8 voting, Independent Directors with executive-level expertise in finance, business, engineering, trading, risk management, law, or electric-market design
- Independent Directors are chosen by the ERCOT Board Selection Committee, comprised of 3 individuals. The Governor, Lieutenant Governor, and Speaker of the House each appoint 1 member of this committee. (PURA Section 39.1513)

<https://www.ercot.com/about/governance/directors>

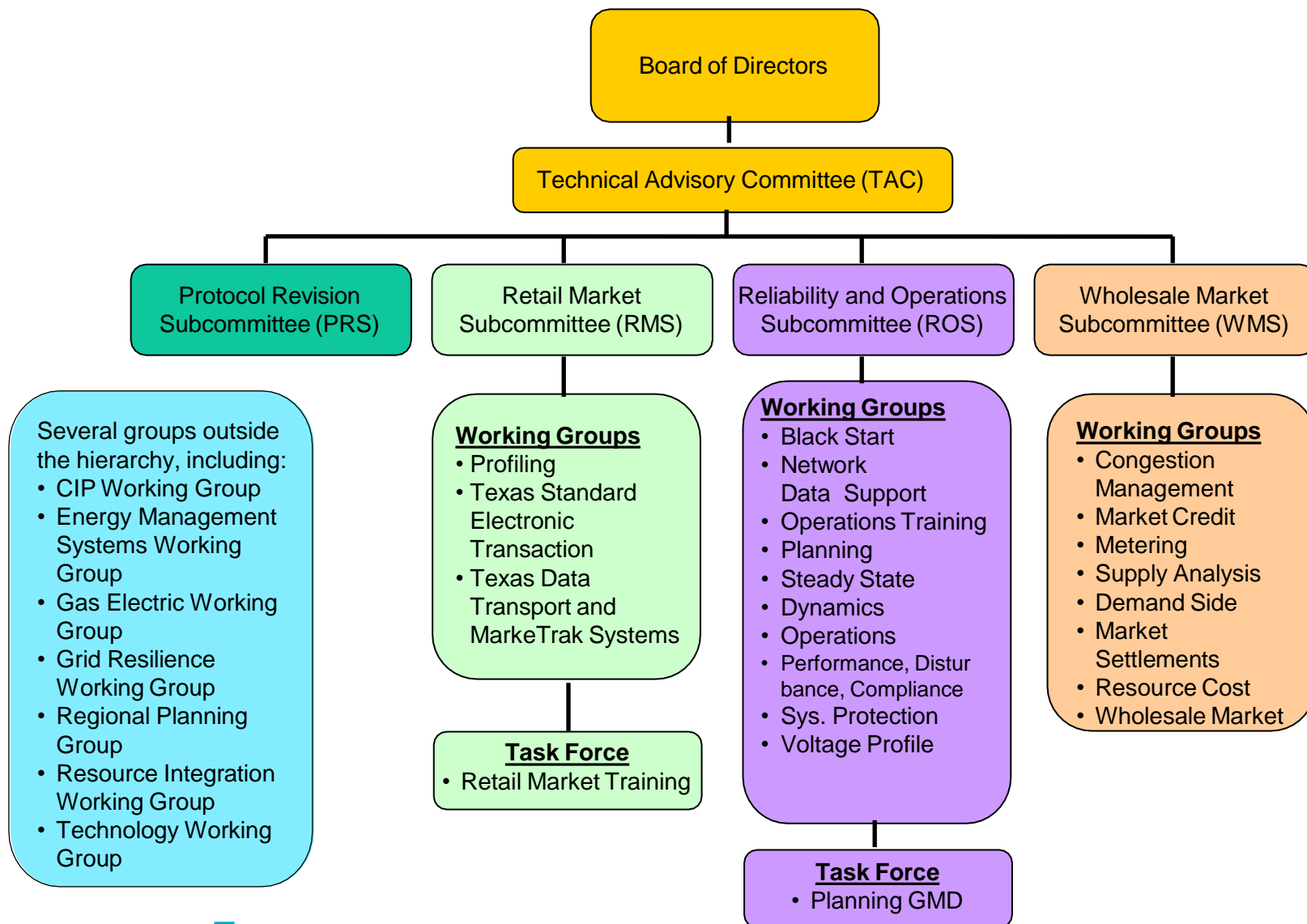


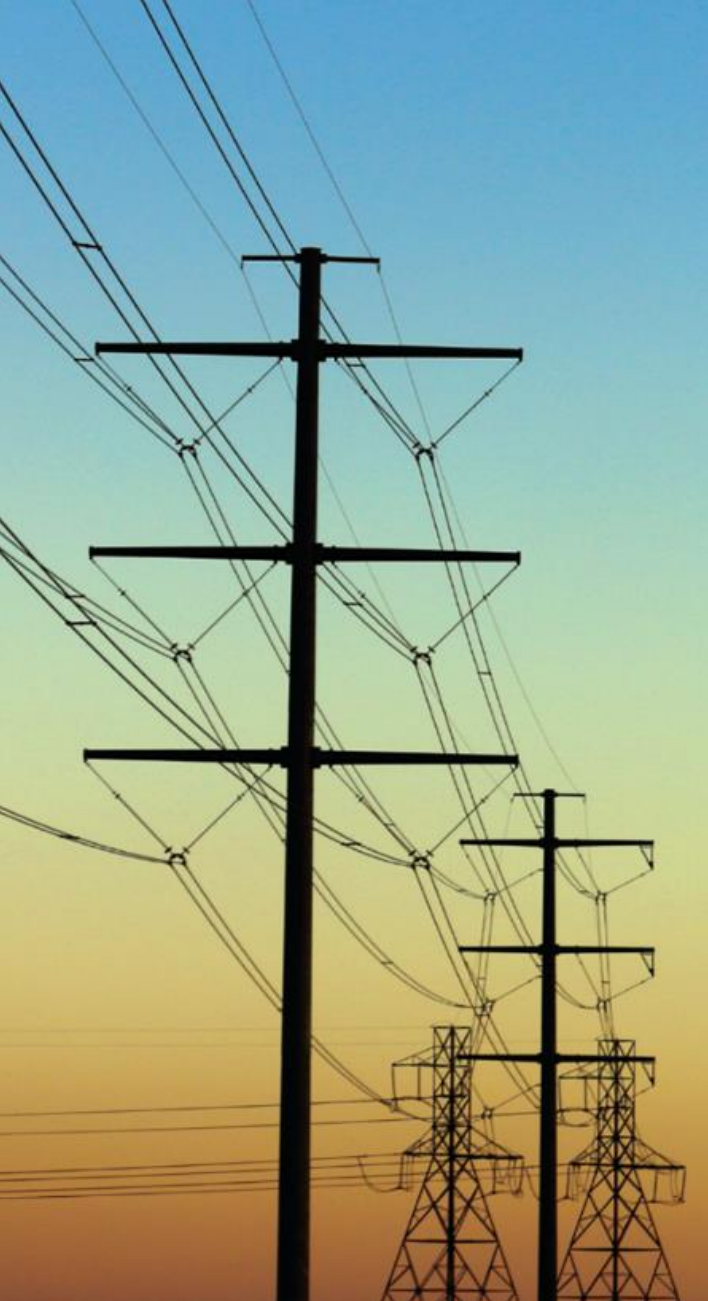
ERCOT Board Meetings

- At least quarterly (Bylaws § 4.6(a)).
 - Recent past practice: six regularly scheduled meetings per year.
- Open to the public (except certain sensitive matters in exec. session) with an opportunity for public comment.
- Live video webcast with archived videos on demand.
- At least 7 days advance notice with a published agenda.
 - May only meet either on short notice or via telephonic (remote) means to consider urgent matters.
- Also noticed as Open Meetings of PUCT; PUCT Chair and Commissioners usually attend.



ERCOT Stakeholder Committee Structure





ERCOT Funding and Organization

ERCOT Funding

- Non-profit corporation
- Not tax-payer funded
- ERCOT budget set every other year by the ERCOT Board, subject to review and approval of PUCT
- 97% of ERCOT operating revenues are collected through the System Administrative Fee*
 - \$0.555 per megawatt-hour
 - equals ~\$7 per year based on 1,000 kilowatt-hours usage per month
 - same fee maintained since 2016
- Current budget, including fees set through the end of 2023

*ERCOT operating revenues exclude the NERC Electric Reliability Organization Fee pass-through and interest income.

ERCOT Sources of Revenue – 2020 Actual

Source	Amount
ERCOT System Admin. Fee	\$212,184,820
NERC Electric Reliability Organization Fee Pass-Through	\$19,400,064
Interest Income	\$4,298,273
Private Wide-Area Network Fees	\$3,623,997
Generation Interconnection Study Fees	\$1,978,555
Interconnection Study Application Fees	\$791,650
Full Membership Fees	\$282,500
Black Start Training Revenue	\$112,708
Registration Fees Revenue	\$76,040
Other, misc. (each < \$5,000)	\$11,380
TOTAL	\$242,759,987

ERCOT Organization

Location	Budgeted FTEs 2022	Actual FTEs*
Taylor	787	727
Austin	45	34
Bastrop	6	6
Total	838	767

- Operations center in Taylor, about 25 miles northeast of Austin
- Backup operations center located in Bastrop
- Executive and administration center in Austin near Austin-Bergstrom International Airport

*Actuals on Dec. 31, 2021

ERCOT Executive Team

[Brad Jones](#), Interim President and Chief Executive Officer

- Penny Rychetsky, Director of Internal Audit (reports directly to the Finance & Audit Committee of the ERCOT Board)

[Jeyant Tamby](#), Senior V.P. and Chief Administrative Officer, Chief of Staff

- [Betty Day](#), V.P., Security & Compliance and Chief Compliance Officer
- [Kristi Hobbs](#), V.P., Corporate Strategy and PUC Relations
- [Mara Spak](#), V.P., Human Resources
- [Sean Taylor](#), V.P. and Chief Financial Officer

[Kenan Ögelman](#), V.P., Commercial Operations

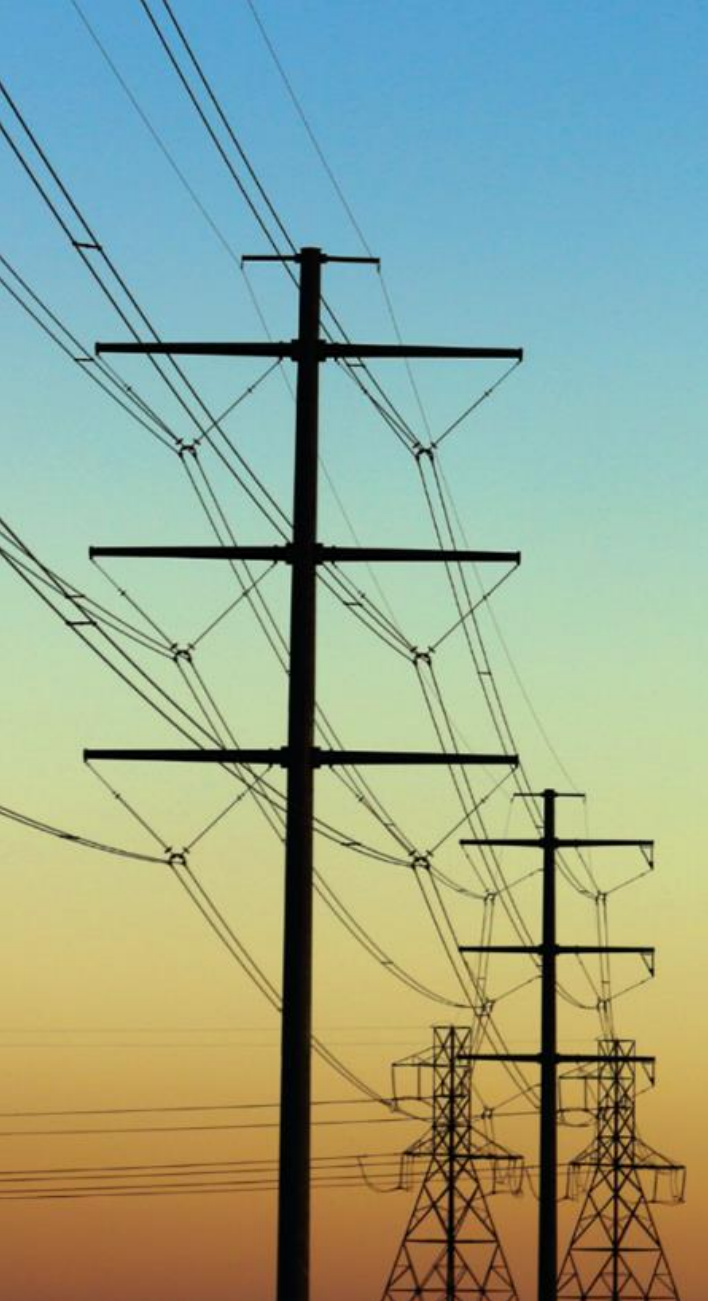
[Jayapal \(J.P.\) Parakkuth](#), V.P. and Chief Information Officer

[Woody Rickerson](#), V.P., System Planning and Weatherization

[Chad Seely](#), V.P. and General Counsel

[Dan Woodfin](#), V.P., System Operations

(Bios in links)



ERCOT Core Functions

ERCOT Core Functions

Planning

- Regional Planning
- Transmission Planning Assessment
- Resource Adequacy
- Resource Integration
- Grid Applications Support
- Weatherization & Inspection
- Engineer Development Program

Grid System Operations

- System Operations – Control Center
- System Operations – Training
- Operations Engineering & Support
- Transmission Operations Planning
- Load Forecasting & Analysis
- Operations Analysis
- Grid Coordination Support

Commercial Operations

- Renewable Energy Credit (REC) Program Administration
- Settlement Metering
- Data Loading and Aggregation
- Settlement Operations
- Settlement Services
- Retail Operations
- Market Design
- Market Validation
- Congestion Revenue Rights
- Day-Ahead Market
- Demand Integration
- Credit Risk Management

Other Core Functions

- Market Rules and Stakeholder Support
- Client Services
- Market Support Services
- Market Training
- Cybersecurity
- CIP & Corporate Compliance
- Operations & Planning Compliance

Information Technology

Planning

- Regional Planning
- Transmission Planning Assessment
- Resource Adequacy
- Resource Integration
- Grid Applications Support
- Weatherization & Inspection
- Engineer Development Program

ERCOT Core Functions: Planning

ERCOT Transmission Planning

- Transmission Planning is a core ERCOT responsibility, fundamental to maintaining system reliability and providing non-discriminatory access.
- ERCOT is the sole Planning Authority registered with North American Electric Reliability Corporation (NERC) for the Texas Interconnection.



Brazos Valley Connection image courtesy of CenterPoint Energy

Transmission Planning Studies in ERCOT

1 – 6 Years

10 – 15 Years

Regional Transmission Plan

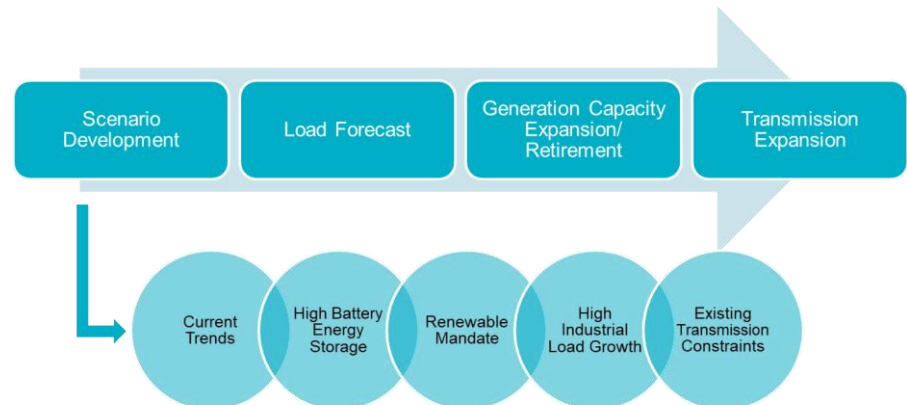
- Annual system-wide analysis
- Ongoing plan to meet reliability and economic criteria

Regional Planning Group (RPG) Project Review

- Stakeholder review of project proposals
- Projects classified into four tiers with different levels of review based on project scope

Long-Term System Assessment

- Scenario-based study of future system-wide needs
- Provides guidance for near-term planning



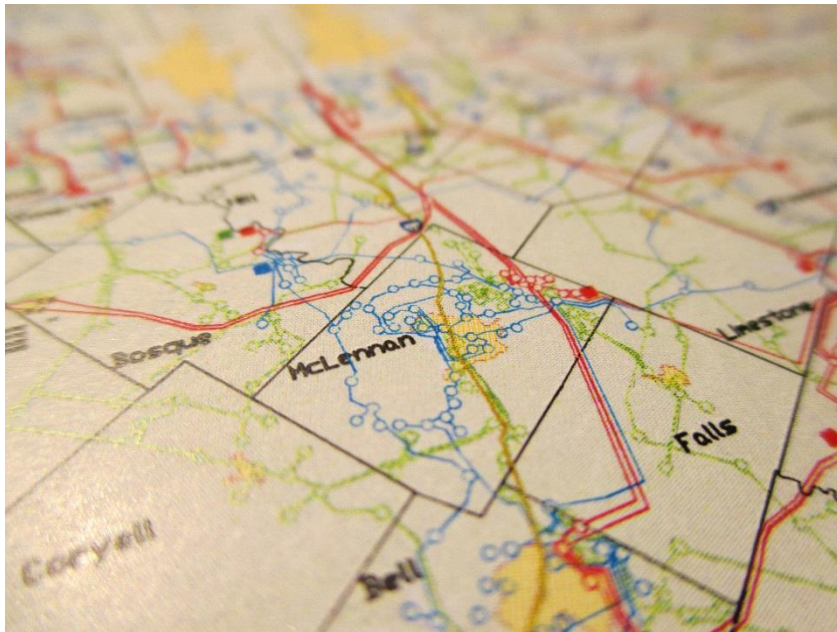
Transmission Planning Criteria

- **Reliability Projects** – Transmission projects that are needed to meet reliability criteria that could not otherwise be met in planning studies by the simultaneously-feasible dispatch of available generation.
- **Economic Projects** – Transmission projects that allow reliability criteria to be met at a lower total cost than the continued dispatch of higher cost generation, subject to the established economic criteria.
 - *(new) PUCT rulemaking in 2022 to implement Consumer Benefit test (SB 1281)*
- **(new) Resiliency Criteria** – *SB1281 introduced a new biennial grid reliability assessment to improve the grid reliability and resiliency. PUCT rulemaking will be held in 2022.*
- **(new) Deliverability Requirement** -- *PGRR095 establishes a minimum deliverability for Generation Resources that are dispatchable.*

ERCOT Stakeholder Planning Teams

Regional Planning Group (RPG)

- Non-voting forum
- Review and comment on projects and studies



Planning Working Group (PLWG)

- Working group
- Responsible for writing the “rules”



Resource Adequacy Reports

- **Capacity, Demand and Reserves (CDR) Report**
 - Provides long-term forecasted capacity reserves available to support the summer and winter peak demand hour, after accounting for voluntary load reduction programs.
- **Seasonal Assessment of Resource Adequacy (SARA)**
 - For the upcoming seasonal forecasted peak demand hour — and for multiple risk scenarios — provides a forecast of “Capacity Available for Operating Reserves,” a planning indicator of the risk that emergency operating procedures may be needed.
- Both reports provide an inventory snapshot of individual operational and planned resources, and their expected generating capabilities during future peak demand periods.
- **CDR/SARA Improvement Initiatives**
 - Upcoming Commission project to consider CDR improvements
 - Ideas being discussed: (1) capture reliability impacts of wind, solar and battery storage, (2) forecast capacity reserve margins for multiple “high risk” hours, (3) more strict criteria for recognizing planned project availability, (4) design overhaul to make it more user-friendly and focused on reserve margin risks.
 - ERCOT developed a new probabilistic SARA model that accounts for uncertainties in the variables determining operating reserves; provides likelihoods of various forecasted reserve outcomes for multiple hours.

Weatherization and Inspection in 2021

- The Weatherization and Inspection group was formed in 4Q'21 in response to responsibilities assigned to ERCOT in SB 3.
- 2021 Work Accomplished
 - Delivered a weather study in consultation with the Office of the State Climatologist;
 - Developed and distributed forms for Winter Weather Readiness Reports (WWRRs);
 - Held workshops to present WWRRs and answer questions;
 - Received and reviewed 904 WWRRs;
 - Inspected 302 Generation Resources and 22 Transmission Facilities;
 - Established a mechanism to evaluate and track 532 generation and 16 transmission assertions of good cause for noncompliance from generation; 418 from generation and 14 from transmission were satisfactorily resolved and closed by December 31, 2021; and
 - Delivered 60 generation resource and 2 Transmission Service Provider (TSP) assertions of good cause for noncompliance to PUCT for evaluation and potential enforcement.

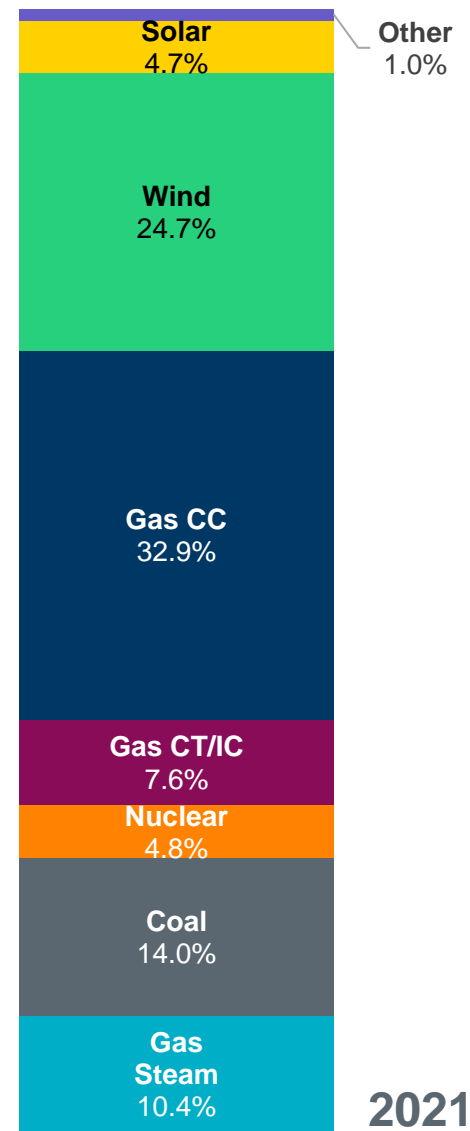
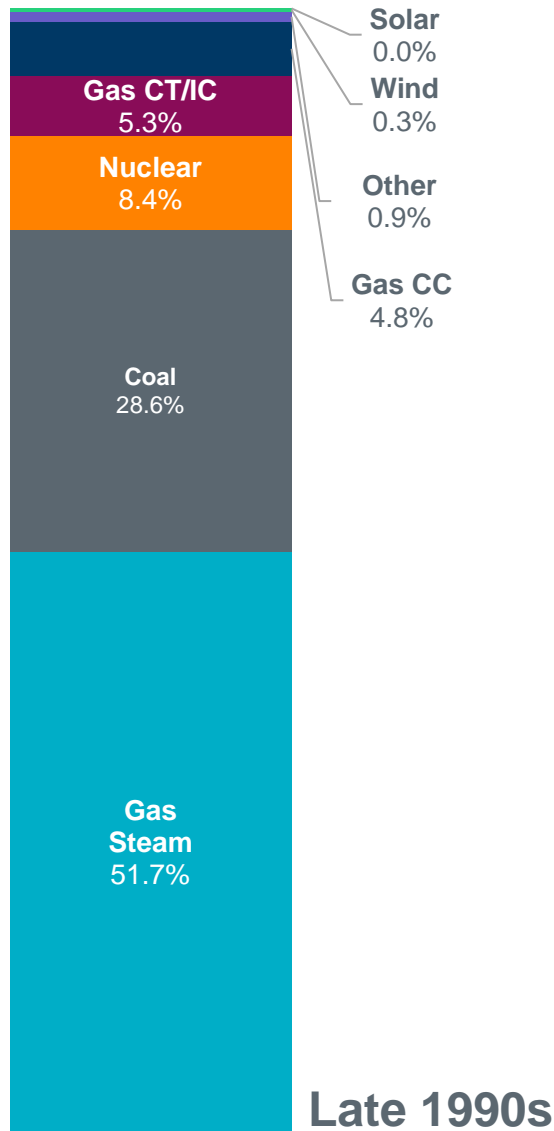
Network Modeling

- Primary purpose is to build and deliver the **Network Operations Model** and the **Annual Planning Models**. This includes:
 - All associated CIM deliverables used to populate downstream systems such as one-line diagrams and contingency files;
 - Planning cases for the Steady State Working Group for use by Market Participants and ERCOT System Planning for controlling and planning the physical ERCOT transmission grid; and
 - System Protection cases for the System Protection Working Group's analysis.

Resource Integration

- Primary purpose is to follow a generation interconnection request through the entire process and act as primary contact to Interconnecting Entities (IE) and Resource Entities (RE) from the Generation Interconnection application to the Commercial Operations stage including:
 - Screening Studies;
 - Review of Full Interconnection Studies;
 - Quarterly Stability Analysis;
 - Modeling; and
 - Commissioning.

Changing Resource Capacity Mix



Capacity totals are based on Real Power Ratings (RTG_MW) for generating units. "Other" is comprised of Biomass, Hydro and Storage.

Totals include Distribution Generation Resources (DGRs) but do not include Settlement Only Distribution Generators (SODGs), Private-Use Networks (PUNs) or Synchronized planned projects.

The percentages do not include capacity from synchronized planned projects.

Data as of September 10, 2021



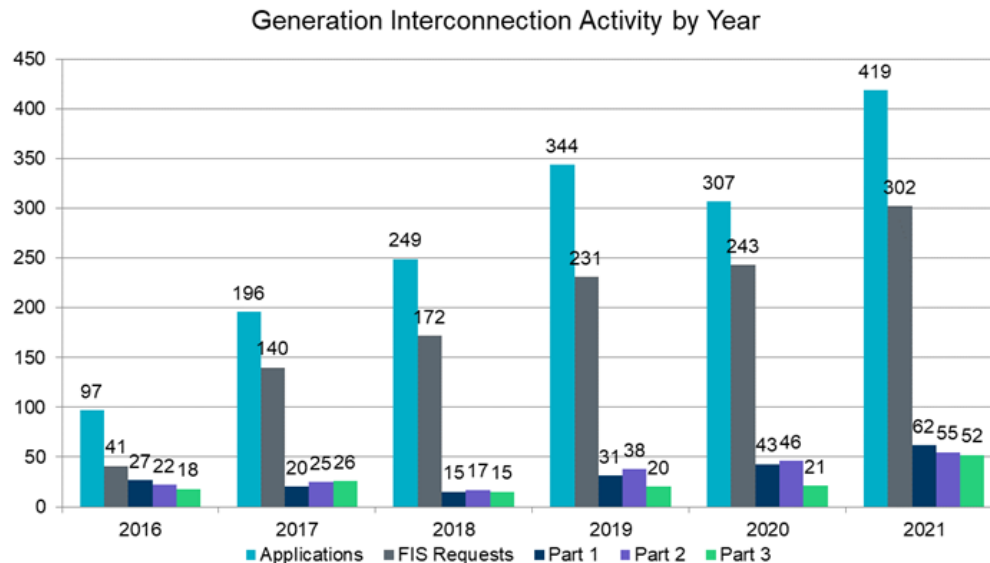
Planning updates since SER submission

Planning updates since SER submission

- Grid Applications Development and Support has increased # FTEs to support SB 3 Electrical Supply Chain Mapping.
 - Supporting new Mapping data for use in the state Emergency Operations Center in response to legislation after the 2021 winter weather event.
- Grid Applications Support has been reorganized and is described as a separate program.
- Resource Adequacy new initiatives:
 - Expand CDR/SARA report scope: (1) extend resource adequacy analysis to multiple higher-risk hours, (2) capture system reliability impacts of wind, solar and battery storage, (3) create a public report dashboard with data visualization tools and dynamic data updating.
 - Upcoming Commission project to consider CDR-specific improvements.
 - ERCOT expects to move forward with a Protocol change that requires a Cost of New Entry (CONE) study to be conducted on a periodic basis.

Planning updates since SER submission

- Resource Integration increased the number of FTEs within the program.
 - The increase is associated with new protocols implementing small generator Interconnection and increasing interconnection applications year over year.



Planning updates since SER submission

- Addition of the Weatherization and Inspection group.
 - Work Accomplished to Date includes:
 - Delivered a weather study in consultation with the Office of the State Climatologist;
 - Developed and distributed forms for Winter Weather Readiness Reports (WWRRs);
 - Held workshops to present WWRRs and answer questions;
 - Received and reviewed 904 WWRRs;
 - Inspected 302 Generation Resources consisting of 174 Dispatchable and 128 Intermittent Renewable Resources (IRR) as well as 22 Transmission Facilities in December 2021;
 - Established a mechanism to evaluate and track 532 generation and 16 transmission assertions of good cause for noncompliance; 418 from generation and 14 from transmission were satisfactorily resolved and closed by December 31, 2021;
 - Delivered 60 generation and 2 TSP assertions of good cause for noncompliance to PUCT for evaluation and potential enforcement; and
 - Delivered a Final Report on Winter Weather Readiness Inspections to PUCT in January 2021.

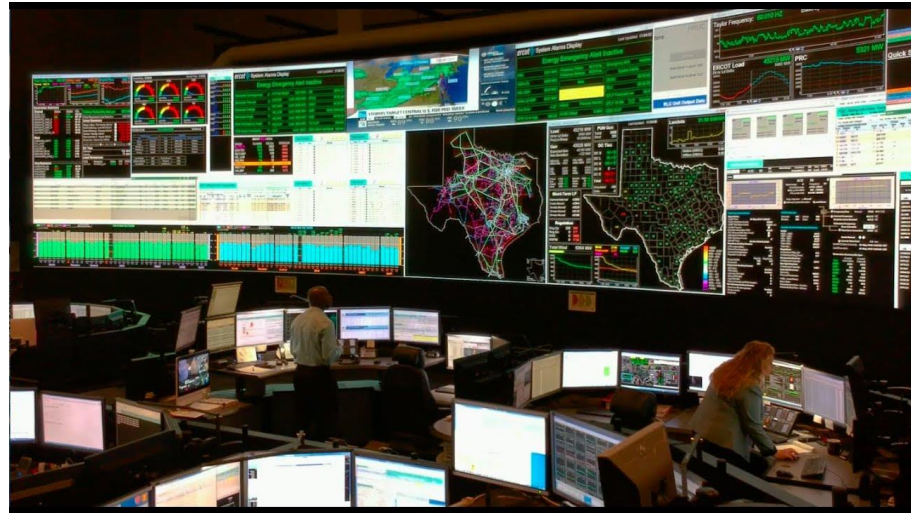
Grid System Operations

- System Operations – Control Center
- System Operations – Training
- Operations Engineering & Support
- Transmission Operations Planning
- Load Forecasting & Analysis
- Operations Analysis
- Grid Coordination Support

ERCOT Core Functions: Grid System Operations

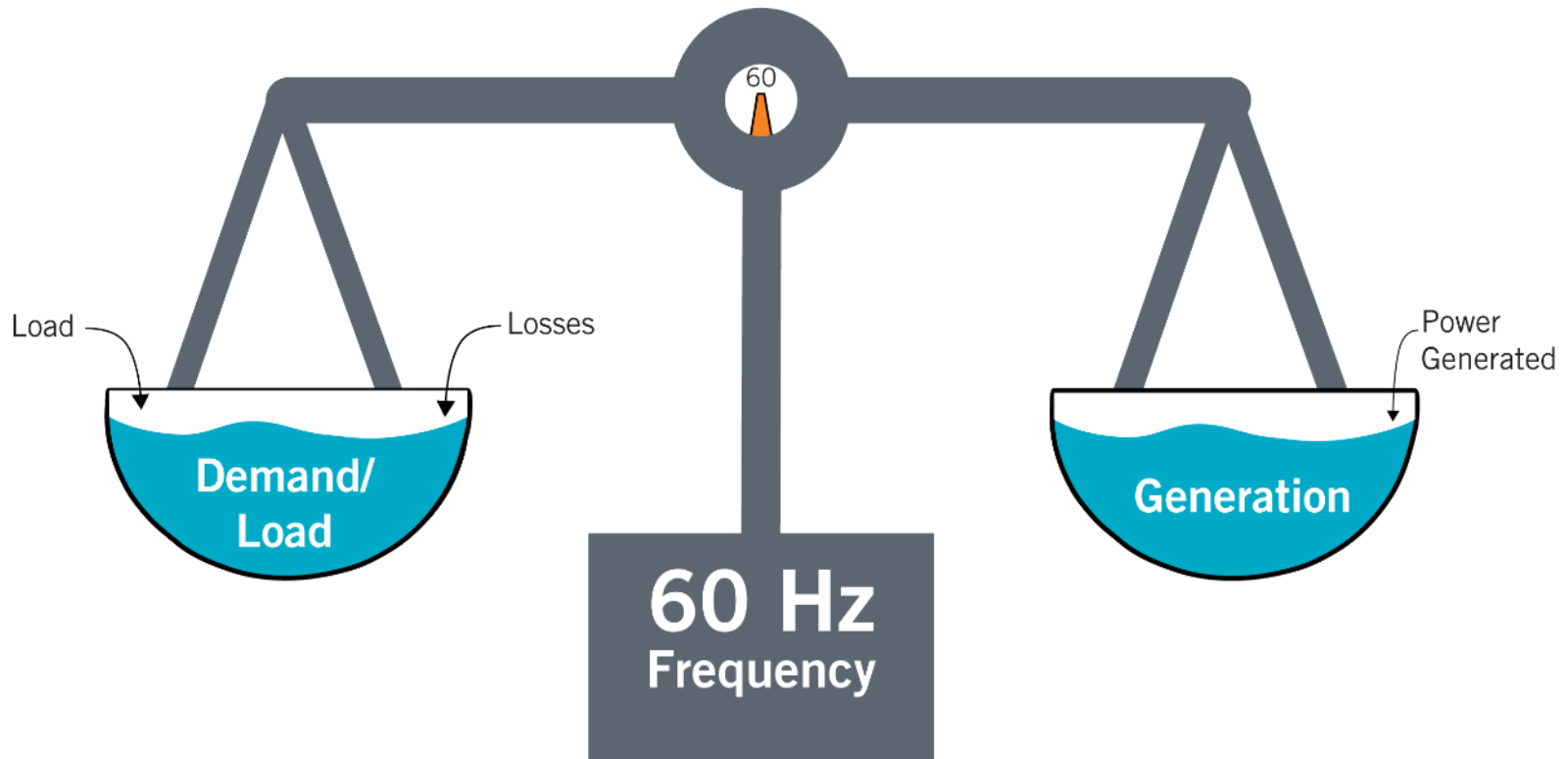
ERCOT System Operations

- The ERCOT Control Center operators have the responsibility and authority to direct the real-time actions of all generating plant and transmission line operators in the ERCOT region for the stable and reliable operation of the Bulk Electric System (BES) during normal and emergency conditions.
- ERCOT operates two Control Centers 24 hours a day, seven days a week to continuously monitor the 52,615 miles of transmission lines and approximately 855 generation units in the ERCOT Interconnection to maintain security and reliability of the ERCOT system.



Power Supply (Generation) Must Match Load (Demand)

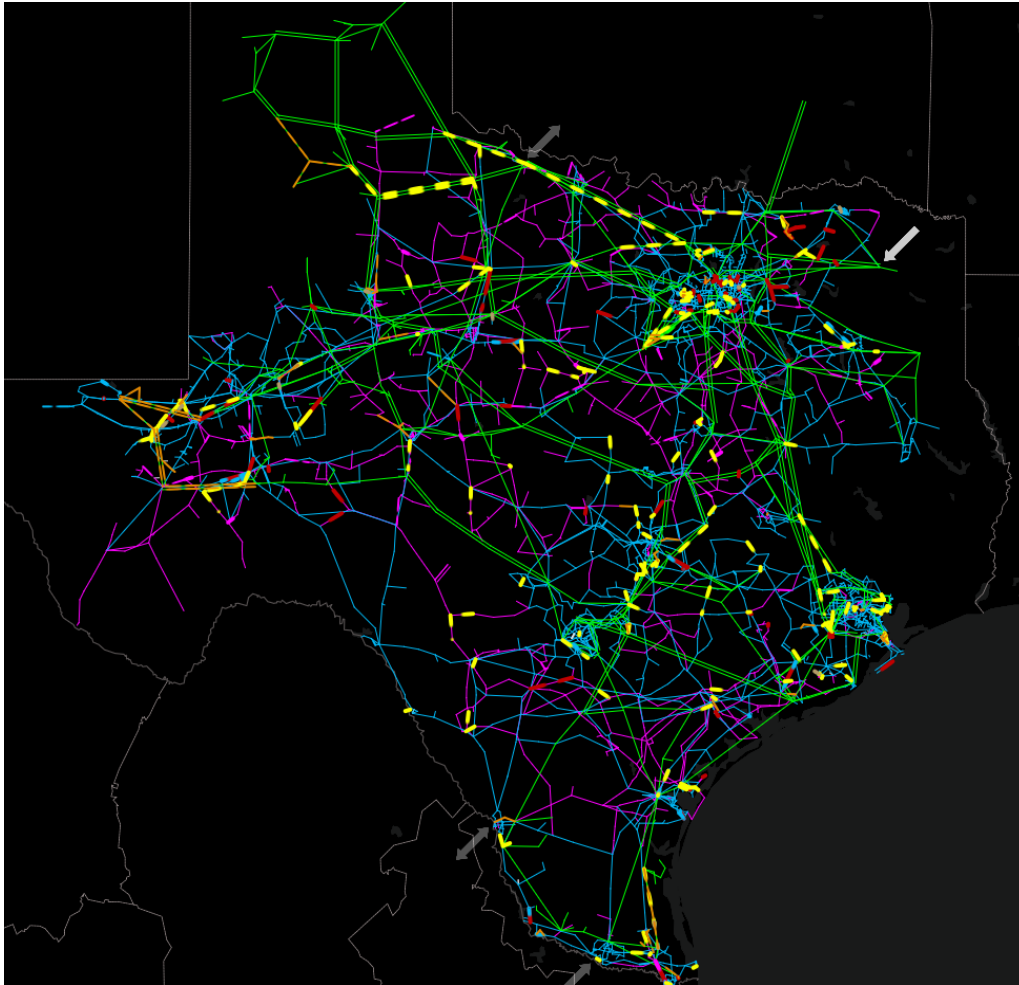
- The fundamental concept behind ERCOT operations is that generation must match load at all times and must operate within limits.



Training and Qualifications

- System Operations Training (SOT) provides task and knowledge-based training for System operators to ensure they are prepared to reliably operate the ERCOT Bulk Power System during normal, abnormal, and emergency conditions.
 - Continuing Education provides a minimum of 30 hours of training on NERC Standards, a minimum of 30 hours of simulations, and 200 hours of operating topics over a three-year period.
 - SOT designs and develops training materials and evaluates the training program each year.
 - Training includes Operator Development Program, Severe Weather Drills, Emergency Operations Training, and Black Start Training for System Operators and Market Participants.

Engineering Support and Transmission Analysis



- Coordinating Planned Outages
- Day-Ahead Studies and Limits
- Mitigation Plans – seasonal through real-time
- Event Analyses
- Operations Improvement Process

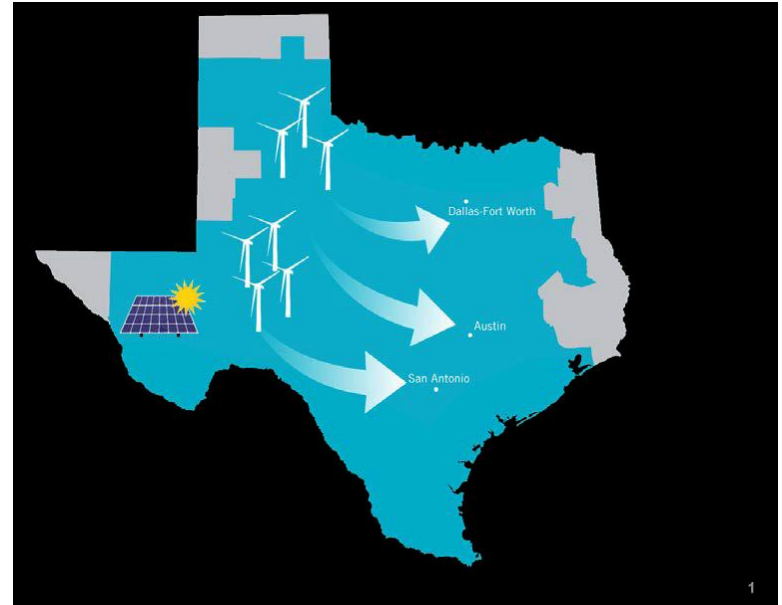
System Transmission Limits

There are limits on moving power between points/areas on the grid.

Thermal limits can be calculated in real-time in a simple powerflow and can be modeled directly in the market dispatch software.

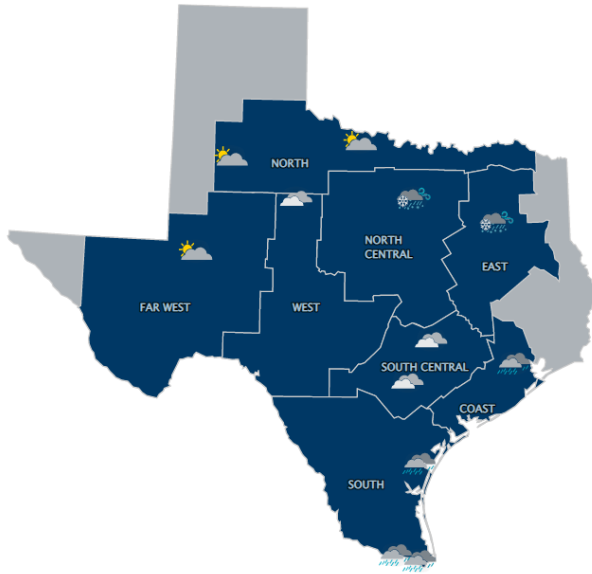
Dynamic stability limits are much more complex to determine and are calculated in offline simulations.

- This requires detailed models of power plant characteristics and controls.



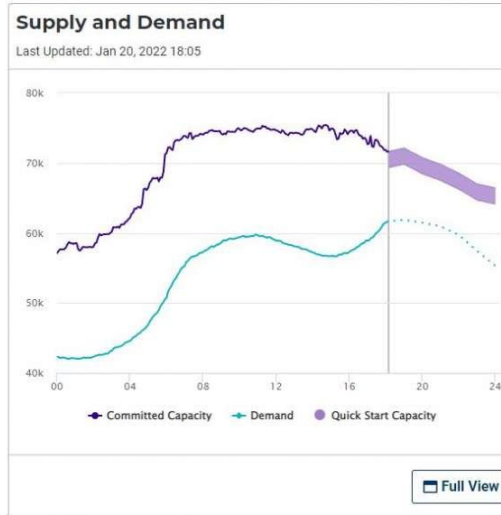
Load Forecast and Analysis

- Load Forecast and Analysis supports System Operations with the following primary activities:
 - Creates long-term demand forecasts for system planners;
 - Creates near-term demand forecasts for system operators; and
 - Provides weather forecast support to system operators via an on-staff meteorologist.



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.



System Operations updates since SER submission

System Operations updates since SER submission

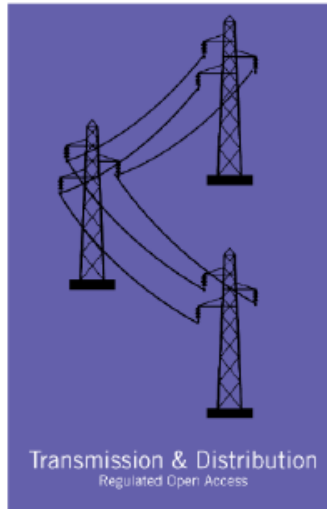
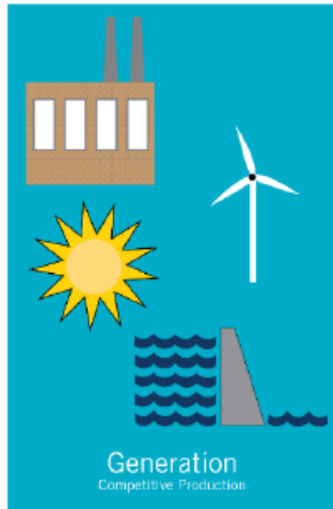
- SB 3 requires summer and winter load shedding exercises and simulations.
- There is increased workload for Operations Engineering & Support to support PUCT requests for additional reporting and improvements.
- Transmission Operations Planning added five new positions in 2022 to improve stability analysis, event analysis, and process improvement efforts.
- SB 3 moved weatherization checks from Operations Analysis to a new Weatherization and Inspection department.

Commercial Operations

- Renewable Energy Credit (REC) Program Administration
- Settlement Metering
- Data Loading and Aggregation
- Settlement Operations
- Settlement Services
- Retail Operations
- Market Design
- Market Validation
- Congestion Revenue Rights
- Day-Ahead Market
- Demand Integration
- Credit Risk Management

ERCOT Core Functions: Commercial Operations

Competition in Generation and Retail



- Fully competitive generation market.
- 5-minute security-constrained economic dispatch in Real Time with voluntary Day Ahead and Ancillary Services markets.
- Generators paid 15-minute average prices at node.
- Load-serving entities pay avg. load-zone prices.
- Monopolies.
- Transmission and distribution service providers' (TDSP) rates set by PUCT; MOUs' and Coops' rates set by own governing bodies.
- All transmission costs rolled into a single "postage-stamp" rate set by PUCT and paid by load.
- Competitive retail market in customer-choice areas (everywhere but Non Opt-In Entity (NOIE) service areas).
- ERCOT conveys customer choices of competitive retail electric providers (REPs).

ERCOT Market Design Objectives

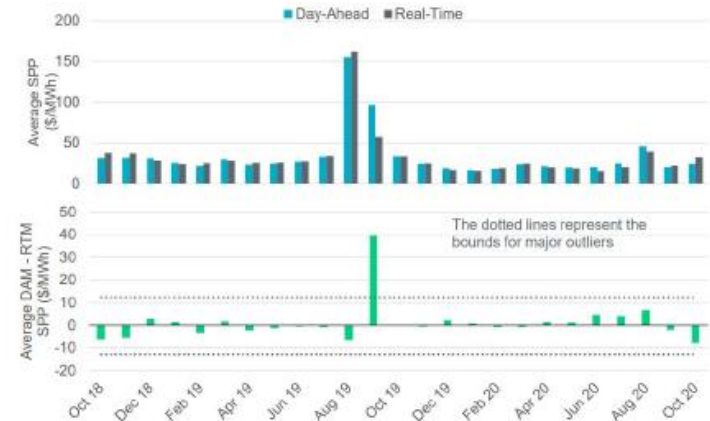
- Reliability needs and market incentives must converge.
 - Scarcity pricing is key in an energy-only market. Balance between administratively set high prices when scarcity exists and competitive pricing to promote best outcomes for the Texas economy.
 - Accommodate the capabilities and limits of new resource types and concepts.
- Settlements must be accurate and timely (more than \$10 Billion in transactions each year).
- Software tools define what is possible.
- Vendor relationships and managing change control is very important.
- Facilitating a competitive retail market accommodating new products and services is also very important.

Market Design

- The goals of market design are to:
 - Incent Market Participants to meet reliability needs; and
 - Limit need for any out-of-market interventions.
- Components of the design have had to change over time to better meet those goals within ERCOT's market design. The department works to implement those changes.
- Key issues for design discussion in the near-term:
 - Funding and revenue neutrality concerns created by market inconsistencies;
 - Pricing mechanisms when out-of-market actions have been taken; and
 - Integration of new resource technologies and business models.

Market Design Analysis

- Types of work:
 - Validating day-to-day pricing outcomes;
 - Analyzing market outcomes more broadly;
 - Reporting to stakeholder bodies;
 - Supporting questions from individual stakeholders; and
 - Supporting changes to the design.
- Key issues include:
 - Price corrections (both avoiding the need and determining when they should be performed);
 - Convergence between markets;
 - Resource response to market signals; and
 - ERCOT out-of-market actions.



This analysis then feeds back into market design. How are things working today vs. how do we, as a market, think it ought to work tomorrow?

Congestion Revenue Rights (CRRs)

- A CRR is a financial instrument that entitles the owner to be paid or charged when there is transmission grid congestion in the Day-Ahead Market (DAM).
 - A CRR can exist between any two financial settlement points in the grid (with the exception of electrically similar points).
 - CRRs are NOT contracts for physical energy production or consumption
- CRRs can be used to hedge the cost of congestion at the CRR purchase price; they can also be used as a financial arbitrage tool when the Buyer expects that the cost of DAM congestion will be greater than the cost to purchase the CRR.
- If congestion occurs in DAM, the owner of a CRR on the congested path can recover the cost of congestion.
- DAM settlement point prices are used to determine the value of each CRR (sink settlement point price – source settlement point price).

CRR Auctions

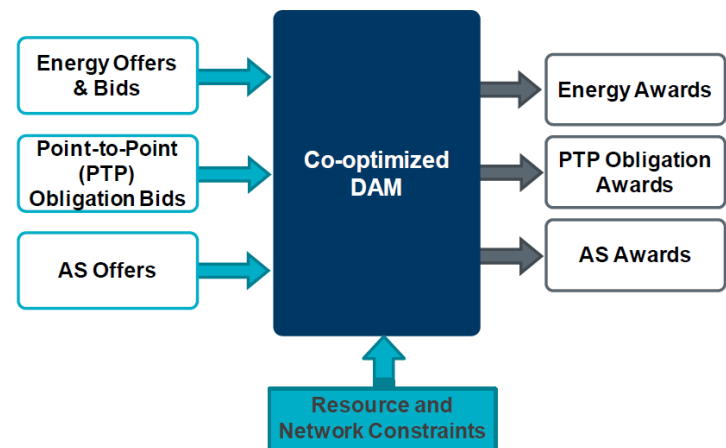
CRR Auctions are optimized using a network model that is modified from the current production network model.

- Monthly auctions - Every month, ERCOT auctions up to 90% of the available grid capacity for the following month.
- Long-term auctions - ERCOT holds a series of rolling 6-month auctions that span the next 3 years.
 - The available grid capacity to be sold increases gradually from 10% to 70% the closer the 6-month period is to the monthly auction.
- Every calendar month throughout the year, ERCOT holds 1 monthly auction and 1 long-term auction.

ERCOT's Day-Ahead Market (DAM)

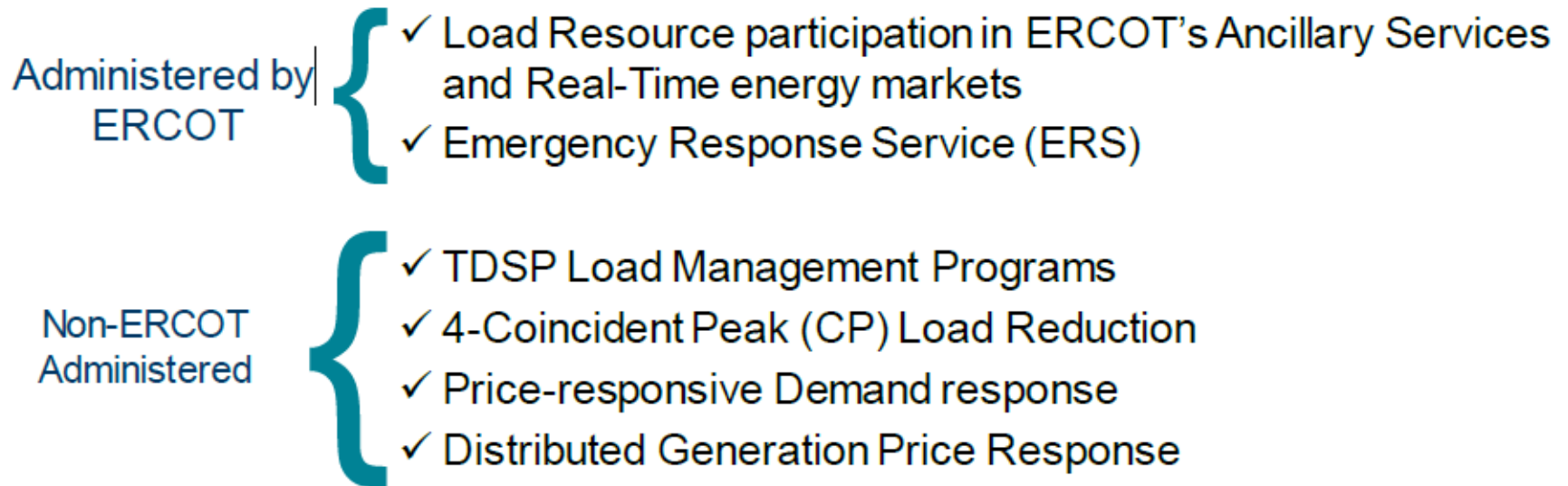
The Day-Ahead Market provides:

- A voluntary market for energy and Ancillary Services;
- A platform to hedge congestion costs in the day ahead of the Operating Day; and
- Financial instruments to mitigate the risk of price volatility in real time.
- Features of ERCOT's DAM:
 - Co-optimization of energy, certain CRRs, and Ancillary Services; and
 - Financially binding.
- DAM co-optimizes energy, Ancillary Services, and CRR over a constrained network by maximizing bid-based revenues minus offer-based costs.

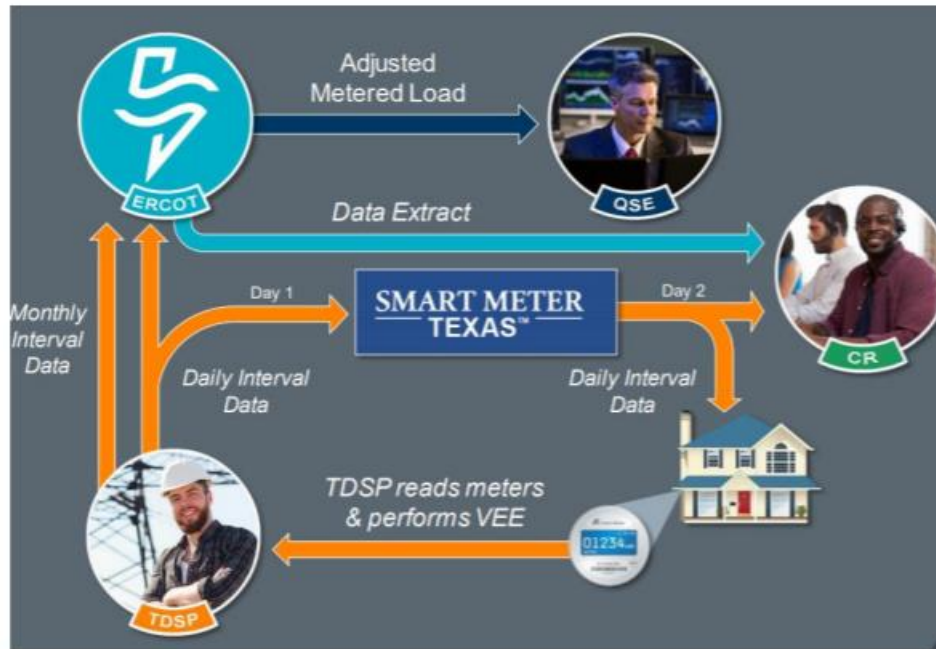


Demand Integration

- Demand response helps preserve system reliability, enhance competition, mitigate price spikes, and encourage the demand side of the market to respond better to wholesale price signals.
- Various categories of demand response are



Settlement Metering & Data Loading and Aggregation



CR: Competitive Retailer
VEE: Data Validation, Estimation and Editing
QSE: Qualified Scheduling Entity

Responsibilities of Settlement Metering include

- Approving ERCOT Polled Settlement (EPS) metering design proposals;
- Performing audits of EPS facilities and documents;
- Retrieving EPS Meter data and process for Data Loading;
- Working with Market Participants on metering issues; and
- Managing the Texas Renewable Energy Credit (REC) program.

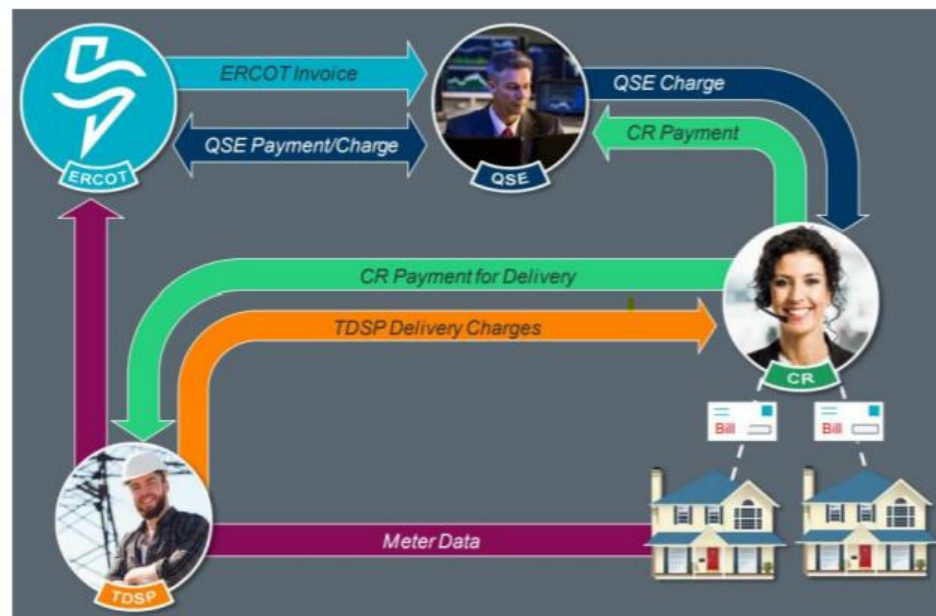
Responsibilities of Data Loading and Aggregation include

- Collecting EPS data to prepare for settlement;
- Collecting usage data metered by TDSPs to prepare for settlement,
 - Applying usage profiles for missing data;
- Aggregating data to use for settlements; and
- Working with Market Participants on data issues.

Settlement Operations & Settlement Services

Responsibilities of Settlement Operations include

- Validation of settlement system results;
- Daily invoicing of Qualified Scheduling Entities (QSEs);
- In the event of unpaid invoices, short-paying QSEs; and
- As necessary, financial resettlements.



Responsibilities of Settlement Services include

- Determining financial impacts of Revision Requests and ensuring they are properly captured in the ERCOT Protocols;
- Ensuring accurate system implementation of Revision Requests impacting settlements; and
- Managing the Verifiable Cost process wherein certain generators can seek compensation for specific costs.

Retail Operations & Credit Risk Management

Retail Operations responsibilities include

- Processing of all competitive market retail transactions (switches, move-ins, move-outs);
- Managing the Mass Transition process by which a defaulting REP's customers are switched to Providers of Last Resort (POLRs); and
- Ensure system compatibility of new retail market entrants ("flight testing").

ERCOT Credit Risk Management maintains financial security against the risks of a default by an ERCOT Market Participant.

Category	Risk Factors
Net Generators	Short positions from unplanned outages, weather events
Net Load	Un-hedged exposure to high prices and/or load, bilateral contract exposure, no Real-Time credit constraint, customer credit exposure
Day-Ahead / Real-Time Traders	Day-Ahead – Real-Time price spreads, no Real-Time credit constraint
CRR Account Holders	Spread on PTP obligations
All Counter-Parties	Counter-Party creditworthiness and reputation, insufficient capitalization, cash flow, credit exposure to other entities, fraud



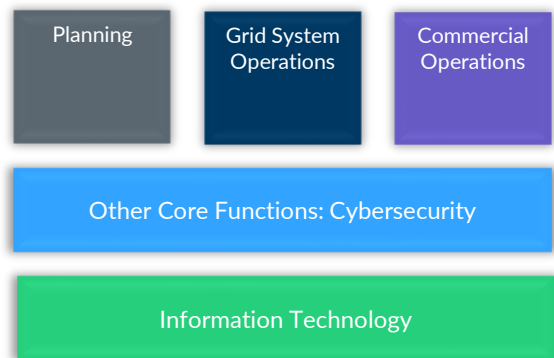
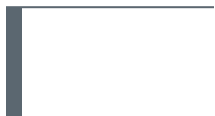
Commercial Operations updates since SER submission

Commercial Operations updated since SER submission

- HB 4492 requires in part:
 - Data Loading and Aggregation to perform the daily calculation of Load Ratio Shares for eligible entities used in the calculation of Uplift Balance Invoices;
 - Settlement Operations to issue monthly Securitization Default Uplift invoices;
 - Settlement Operations to issue daily Securitization Uplift Charges invoices; and
 - Credit Risk Management is responsible for Securitization Default Uplift and Securitization Uplift Charges escrow deposit management and support.
- Market Design has a significant increase in supporting activities for PUCT market design proposals:
 - Providing analysis to the PUCT in vetting design concepts and providing frameworks needed to support new programs; and
 - Reviewing public comments filed in PUCT dockets related to market design changes.

Commercial Operations updated since SER submission

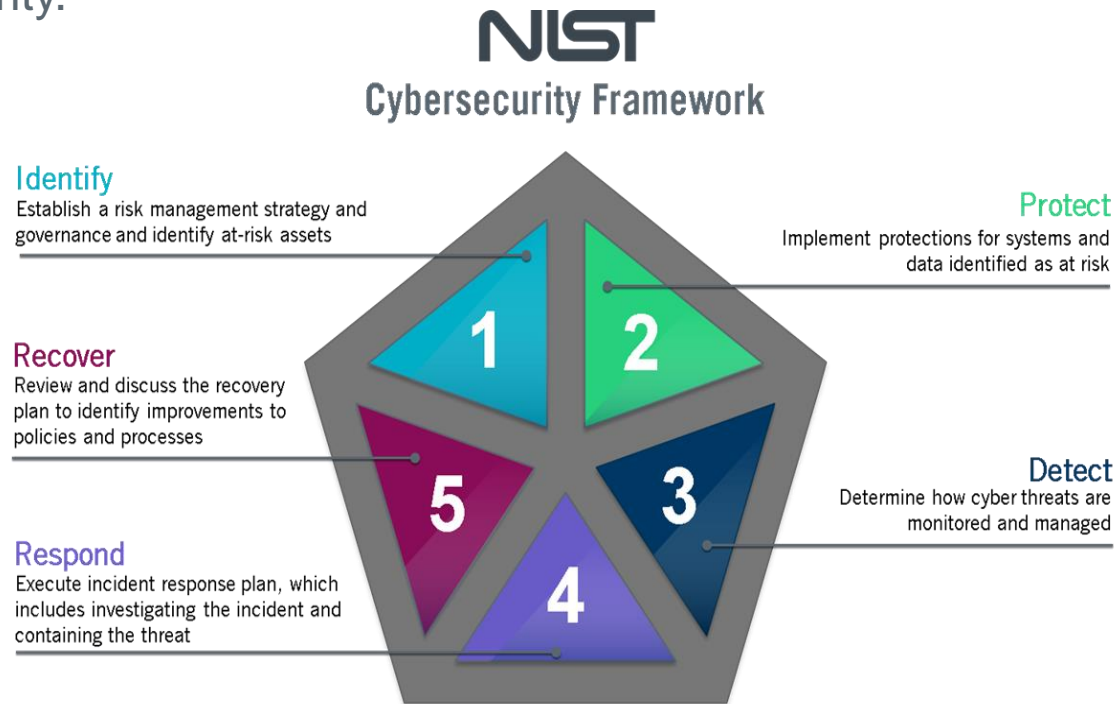
- In mid-2021, ERCOT began to procure more Ancillary Services in the Day-Ahead Market to manage the grid more aggressively by having more reserves.
 - The largest increase was in Non-Spinning Reserve Ancillary Service requirements.
- Credit Risk Management will become responsible for escrow deposit management and support for Securitization Uplift Charges.
- Implementation work initiated for ERCOT Contingency Reserve Service (ECRS).
- Work to implement Nodal Protocol Revision Request (NPRR)1093 which modified the Day-Ahead Market to allow non-controllable Load Resources to also provide Non-Spinning reserve services is planned to complete before Summer 2022.
- Demand Integration administers new processes for Critical Load Attestation.
- Project work and RFP design is underway to complete implementation of NPRR1120 Create Firm Fuel Supply Service.



ERCOT Core Functions: Cybersecurity

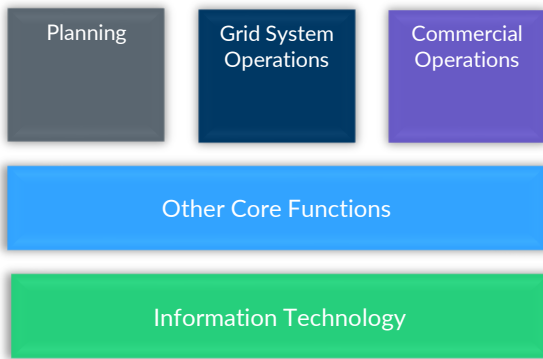
ERCOT Cyber & Physical Security Program

- ERCOT has strong executive management support for security.
- ERCOT has a dedicated and integrated cyber/physical security organization and established strategy.
- ERCOT uses layered cyber and physical security architectures known as a defense-in-depth strategy, along with careful monitoring.
- ERCOT is committed to external collaboration with government agencies, law enforcement, industry and national labs to enhance its and the industry's security posture.



National Institute of Standards and Technology

ERCOT Core Functions: Information Technology



ERCOT IT Division - Overview

Manage, Plan, Operate and support critical system infrastructure to

- Manage the reliability of the Texas electric grid;
- Facilitate Day-Ahead and Real-Time Wholesale Electric Market;
- Support Settlement and billings for the market;
- Enable retail customer choice; and
- Provide Open Market Information for all participants.

ERCOT IT Key Functions

Manage, plan, operate and support corporate systems necessary for

- Accounting;
- Legal;
- Human resources;
- Procurement;
- Intranet systems and internet systems;
- Email;
- Desktop support;
- Voice and virtual meeting systems; etc.

Information Technology Organization

IT Architecture & Strategy

- IT Strategy
- IT Architecture
- IT Governance
- Technical Design
- IT Asset Lifecycle Management

Application Services

- Commercial Applications
- Common Platforms
- Enterprise Information
- Tools Development
- Web Design
- IT Automation

Grid & Market Solutions

- Grid & Market Application Engineering - Grid
- Grid & Market Application Engineering - Market
- Grid & Market Technology Development
- Grid & Market Systems Support

Infrastructure Services

- Workplace Services
- Network Services
- Data Center Services
- Database Services

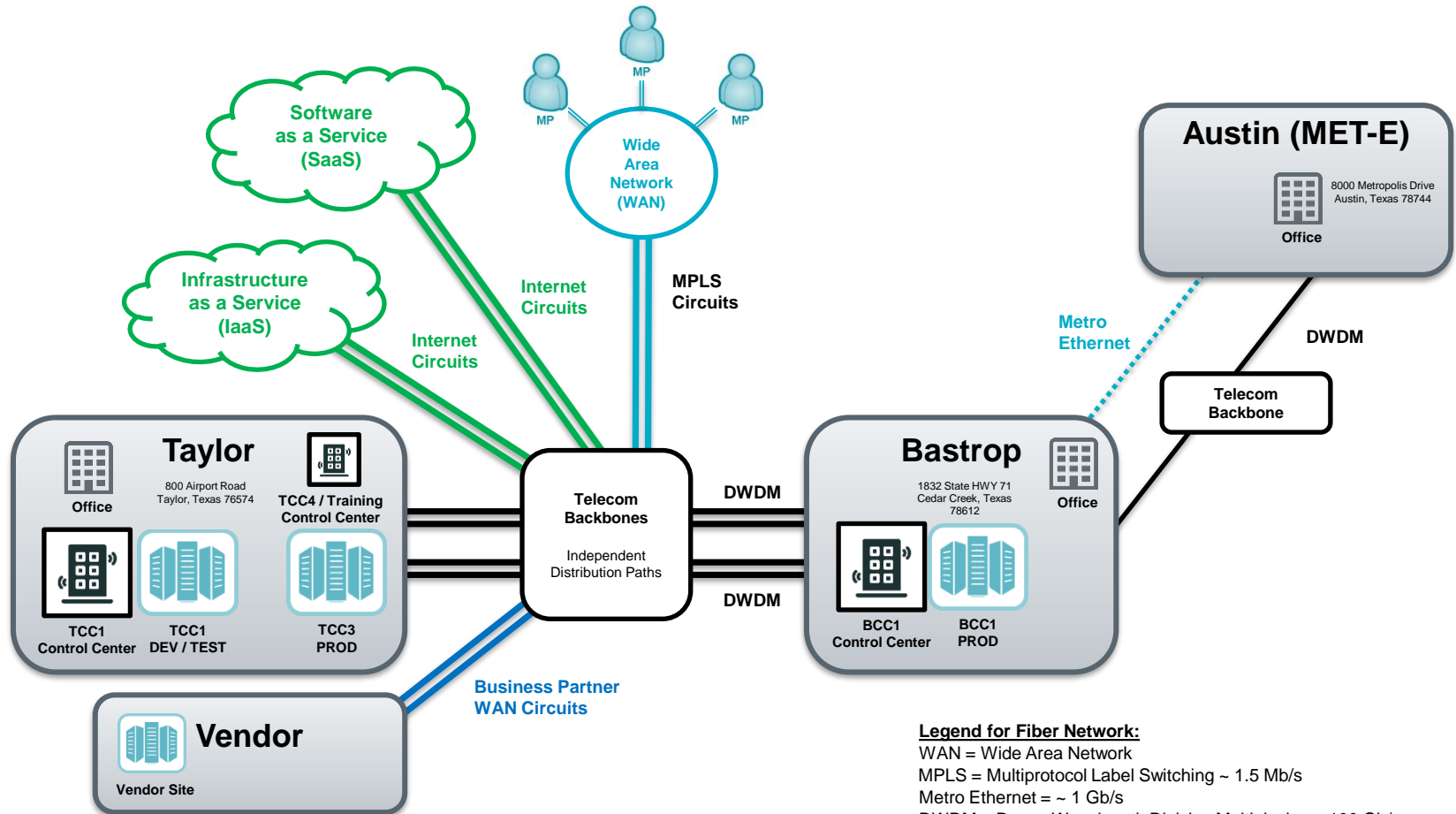
Test Management Services

- Test Management & Coordination
- Test Delivery & Execution
- Testing Tools & Automation
- Test Data Management

IT Operations

- IT Operations
- Integration Support Services
- IT Operations Systems & Tools
- System Reliability Administration
- Identity & Access Management
- Service Management

Data Centers Managed by IT



Legend for Fiber Network:

WAN = Wide Area Network

MPLS = Multiprotocol Label Switching ~ 1.5 Mb/s

Metro Ethernet = ~ 1 Gb/s

DWDM = Dense Wavelength Division Multiplexing ~ 100 Gb/s

IT Investment and Maintenance Expenses

Services	FTE	IT Infrastructure	Hardware and Software Maintenance (2021 actuals)
Grid Management Services	15 %	19 %	15 %
Wholesale Market Management Services	12 %	22 %	20 %
Retail Market Management Services	7 %	8 %	6 %
Market Data Transparency	14 %	25 %	15 %
ERCOT Corporate Applications	12 %	2 %	12 %
IT Infrastructure Management	24 %	11 %	21 %
Security	0 %*	3 %	3 %
IT Governance	9 %	7 %	6 %
IT Remote access and Help Services	7 %	3 %	2 %

* Security FTEs are outside of IT

Other Core Programs updates since SER submission

Other Core Programs updates since SER submission

- SB 2 requires the PUCT to approve all Revision Requests submitted through the ERCOT governance process.
- SB 2 requires that an ERCOT Market Impact Statement to accompany all Revision Requests.
- ERCOT Cybersecurity recently entered into a service contract for the Cybersecurity Risk Information Sharing Program (CRISP) and is managed by the Electricity Information Sharing and Analysis Center (E-ISAC).
- ERCOT completed an audit by the Texas Reliability Entity (Texas RE) in the fall of 2021. The results of the audit were zero findings, one area of concern, and two recommendations.

Other Core Programs updates since SER submission

- In the aftermath of the 2021 winter weather event, the Texas Legislature and PUCT established significant changes, including among other things:
 - House Bill 4492 Securitization- New processes to distribute almost \$3B to ERCOT market and re-collect funds over next 30 years (NPRR1103/1114).
 - Market design blueprint developed under PUCT Project 52373-
 - Confirmed priority of continuing Fast-Frequency Response and ECRS (NPRR863);
 - Changed Ancillary Services to include Load Responses in Non-Spin (NPRR1093);
 - New concept for Firm Fuel Product (NPRR1120);
 - New concept for Backstop Reserve Service; and
 - Phase 2 potential changes- Dispatchable Energy Credit (DEC) Program and Load Serving Entity (LSE) Obligation Program.

Other Core Programs updates since SER submission

- With this clear direction on priorities and the urgency to deliver:
 - ERCOT has deconstructed all Passport scope back into individual items for current and future project planning purposes based on PUCT and ERCOT Board priority.
 - Staff previously working on Passport Program have pivoted to engage the other high-priority projects described on the prior slide as part of the normal delivery processes in the Project Management Office.



ERCOT Successes, Opportunities and Recommendations

Successes

Biggest successes include

- A more reliable and resilient bulk electric system than ever before;
- A bulk electric system that meets the demand of a rapidly growing population and economy;
- A wholesale market that is recognized as one of the best in the country and that contributes to the continued economic prosperity of Texas;
- The most successful and competitive retail market in the United States.
- An ERCOT-led industry process that has enabled the construction of thousands of miles of transmission over the past 20 years;
- The successful integration of the most megawatts of renewable energy in the country; and
- Expeditionary enactment of lessons-learned and directives from Legislature and State leadership

Opportunities

Biggest areas with opportunities for improvement include

- Increasing resiliency during extreme weather;
- Marrying the reliability needs of a grid that continues to grow with market incentives;
- Increasing visibility in the delivery of natural gas to generation;
- Reliably integrating increasing amounts and varieties of intermittent Resources;
- Incorporating increasing amounts of battery storage, distributed generation, and large, flexible loads;
- Forecasting future conditions on a rapidly evolving grid; and
- Addressing the impacts to the markets of defaults by market participants.

Initial Legislative Recommendation

- The ERCOT Bylaws must require that actions taken on short notice or at teleconference meetings be ratified at the ERCOT Board of Director's next regular meeting.
 - This requirement is inconsistent with the legal meaning of “ratify,” which applies to actions the company takes without required Board approval that the Board authorizes retrospectively, or to defective Board actions; in this case, the Board is required to ratify actions that were lawfully taken, many of which have already been implemented.
 - PURA § 39.1511(b).
 - Elimination of ratification requirement.

Thank you

ERCOT Glossary

<https://www.ercot.com/glossary>

Links to Videos about ERCOT

What is ERCOT?

<https://youtu.be/9yKRz08buaA>

How does ERCOT work?

<https://youtu.be/8aldmvik3aU>

ERCOT Control Room video

https://youtu.be/-KatQ9Q_IQk

Transmission Planning in ERCOT

<https://youtu.be/Sfs2II7GZSI>

Distributed Generation and Demand Response
in ERCOT

<https://youtu.be/xL2HeYTBIT0>

Financial Transactions in ERCOT

<https://youtu.be/9VOx630WqTA>

Appendices

- I. Appendix: Statutory Authority and Recent Legislation
- II. Appendix: ERCOT Programs



Appendix I: Statutory Authority and Recent Legislative Changes

Statutory Authority and Recent Legislation - Overview

Statutes that significantly impact ERCOT – Federal

- Federal Power Act (16 U.S.C. §§ 824k, 824o, 824q, 824t)
- Energy Policy Act of 2005 (42 U.S.C. § 15801 et seq.)
 - FERC orders requiring provision of transmission service in ERCOT region must provide that utility is entitled to receive compensation per PUCT ratemaking methodology
 - Calls for FERC to certify an Electric Reliability Organization (NERC) to develop and enforce reliability standards applicable to ERCOT

Statutory Authority and Recent Legislation – Overview

Statutes that significantly impact ERCOT – State (including amendments enacted during the 79th Texas Legislative Session)

- Public Utility Regulatory Act (PURA) (§ 39.151 et seq.) – ERCOT enabling statute – provides for the following:
 - Definition and functions of an independent organization (ERCOT)
 - PUCT must certify an independent organization for the region
 - PUCT may adopt and enforce rules relating to the reliability of the regional electrical network, and has full oversight over the independent organization, including right to decertify
 - Requires PUCT approval of independent organization's budget, debt financing or refinancing of existing debt
 - Fee cases no longer categorized as contested cases
 - Composition, qualifications and selection of the ERCOT board of directors by ERCOT Board Selection Committee
 - Market rules (Protocols) require PUCT approval to become effective
 - Timing for Sunset review of PUCT and ERCOT
 - Requirement for cybersecurity risk assessments and reports

Statutory Authority and Recent Legislation – Overview

Statutes that significantly impact ERCOT – State (cont.)

- Other key provisions of PURA applicable to ERCOT:
 - § 39.1511: Board/committee open meeting and webcasting requirements
 - § 39.1512: Disclosure of ERCOT Board member conflicts of interest
 - § 39.1513: Establishment of and qualifications for the ERCOT Board Selection Committee
 - § 39.1515: Requires ERCOT to contract with an independent entity selected by the PUCT to monitor the wholesale market (i.e., the Independent Market Monitor)
 - § 39.1516: Requires ERCOT to contract with an entity selected by the PUCT to monitor cybersecurity concerns in the ERCOT market
 - § 39.159: Requires ERCOT to (1) establish requirements to meet the reliability needs of the ERCOT region; (2) determine annually the quantity and type of ancillary services needed to ensure grid reliability and procure those services; and (3) develop performance requirements for providing ancillary services
 - § 39.601-.609 & 39.651-.64: Securitization enabling legislation related to the 2021 winter weather event
 - §§ 35.0021 & 38.075: Sets forth ERCOT obligations to inspect generation, transmission and distribution facilities for weather emergency preparedness

Statutory Authority and Recent Legislation – Overview

Statutes that significantly impact ERCOT – State (cont.)

- Other state statutes applicable to ERCOT (outside of PURA):
 - Tex. Util. Code § 35.0021: Requires ERCOT to inspect generation providers for compliance with weatherization standards
 - Tex. Util. Code § 38.075: Requires ERCOT to inspect transmission service providers for compliance with weatherization standards

Attorney General Opinions that significantly impact ERCOT

- Opinion No. KP-0363: Construes PURA Section 39.151(d) as likely “to allow the Public Utility Commission to order ERCOT to correct prices for wholesale electricity and ancillary services”
- Opinion No. OR2021-13431: Outlines categories of ERCOT information that may be disclosed by the PUCT under the Public Information Act

Statutory Authority and Recent Legislation – Overview

Recent Legislation – 87th Legislative Session (2021)

- SB 2
 - Changes ERCOT Board of Directors composition to 8 fully independent members who are residents of Texas
 - The Board of Directors is chosen by the three member "Board Selection Committee" composed of one appointee each from the Governor, Lieutenant Governor, and the Speaker of the House
- SB 3
 - Requires weatherization of power generation and transmission facilities as well as ERCOT inspection of these facilities
 - Directs ERCOT to procure sufficient ancillary services to ensure reliability during extreme weather events
 - Formalizes the Texas Energy Reliability Council to improve coordination between ERCOT and various state agencies
 - Improves upon load shedding protocols and directs ERCOT to conduct simulated load shedding exercises

Statutory Authority and Recent Legislation – Overview

Recent Legislation – 87th Legislative Session (2021) cont.

- SB 713
 - Moved Sunset Review of ERCOT, PUCT, and OPUC to the 2022-2023 biennium
- SB 1281
 - Requires ERCOT to conduct a biennial assessment of the grid's reliability in extreme weather scenarios
- HB 3648
 - Requires the PUCT to conduct an external audit of ERCOT's financial condition and ERCOT's compliance with all applicable PUCT standards
- SB 1580 & HB 4492
 - Authorize the securitization financing of default payments resulting from extreme winter weather events
 - Require ERCOT to report to the PUCT if a Market Participant fails to pay amounts owed to ERCOT



Appendix II: ERCOT Programs

Updated Program Information

Program	2021 Actual Expenditures	2021 Employees as of 12/31/21	2022 Budgeted Expenditures	2022 Budgeted Employees	Contact
System Operations – Control Center	\$ 8,965,897	49	\$ 8,980,546	53	Dan Woodfin
System Operations – Training	\$ 1,576,191	8	\$ 2,096,065	9	Dan Woodfin
Operations Engineering & Support	\$ 4,504,934	29	\$ 4,576,068	30	Fred Huang
Transmission Operations Planning	\$ 1,728,276	10	\$ 2,727,904	16	Jeff Billo
Regional Planning	\$ 2,621,325	13	\$ 3,070,456	17	Prabhu Gnanam
Transmission Planning Assessment	\$ 1,707,764	11	\$ 2,047,917	12	Prabhu Gnanam
Resource Adequacy	\$ 1,200,527	5	\$ 1,840,570	6	Pete Warnken
Load Forecasting & Analysis	\$ 1,261,710	6	\$ 1,223,909	6	Jeff Billo
Operations Analysis	\$ 1,687,048	6	\$ 2,129,506	12	Jeff Billo
Resource Integration	\$ 2,220,121	12	\$ 2,213,493	13	Bill Blevins
Engineer Development Program	\$ 1,006,904	8	\$ 872,229	7	Bill Blevins
Grid Coordination Support & Development	\$ 4,178,141	27	\$ 4,386,400	30	Bill Blevins
Weatherization & Inspection	\$ 2,330,551	2	\$10,000,000 *	6 *	David Kezell

* The 2022 Budget for Weatherization & Inspection program is an estimate. The program is being defined.

Updated Program Information

Program	2021 Actual Expenditures	2021 Employees as of 12/31/21	2022 Budgeted Expenditures	2022 Budgeted Employees	Contact
Market Rules and Stakeholder Support	\$ 758,479	6	\$ 789,049	6	Ann Boren
Renewable Energy Credit (REC) Program Administration	Included with Settlements Metering		Included with Settlements Metering		Mark Ruane
Settlements Metering	\$ 1,819,292	12	\$ 2,048,447	12	Mark Ruane
Data Loading and Aggregation	\$ 944,603	5	\$ 975,675	5	Mark Ruane
Settlements Operations	\$ 772,785	6	\$ 793,365	6	Mark Ruane
Settlements Services	\$ 1,105,198	9	\$ 1,140,339	9	Mark Ruane
Retail Operations	\$ 1,698,278	9	\$ 1,440,820	9	Mark Ruane
Credit Risk Management	\$ 868,467	6	\$ 1,058,154	6	Mark Ruane
Market Design	\$ 1,143,962	8	\$ 1,435,210	10	David Maggio
Market Validation	\$ 607,640	3	\$ 951,660	6	David Maggio
Congestion Revenue Rights	\$ 915,852	6	\$ 945,552	6	Sandip Sharma
DAM (Day Ahead Market)	\$ 1,127,045	9	\$ 1,336,958	9	Sandip Sharma
Demand Integration	\$ 921,469	5	\$ 1,017,374	6	Sandip Sharma

Updated Program Information

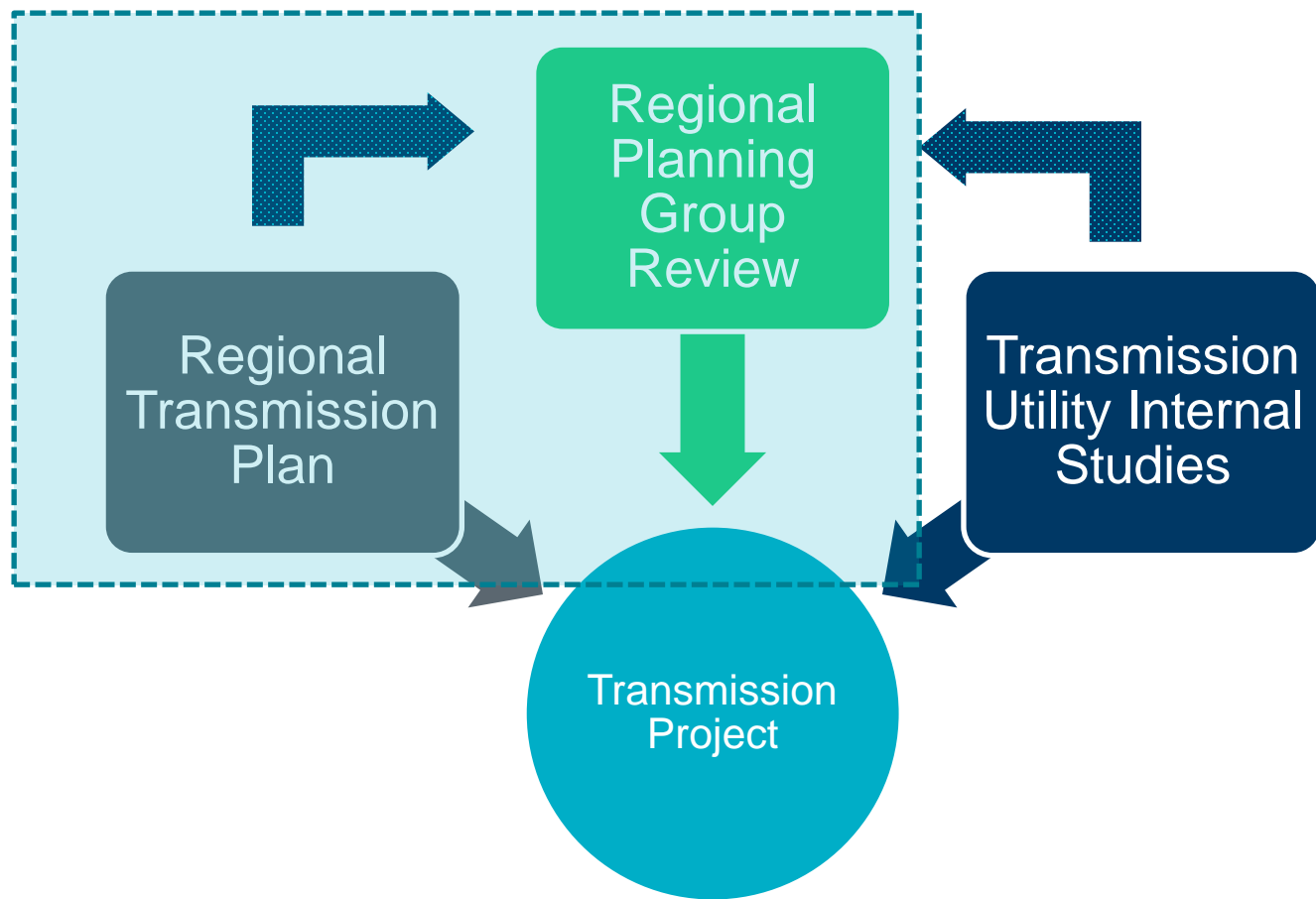
Program	2021 Actual Expenditures	2021 Employees as of 12/31/21	2022 Budgeted Expenditures	2022 Budgeted Employees	Contact
Passport Program Implementation	\$ 189,958	1	\$ 307,643	1	Matt Mereness
Client Services	\$ 2,171,156	13	\$ 2,480,430	15	Ted Hailu
Market Support Services	\$ 879,243	6	\$ 892,000	6	Ted Hailu
Market Training	\$ 906,002	5	\$ 973,013	5	Ted Hailu
Cyber Security	\$ 3,320,222	14	\$ 4,118,842	16	Mike Allgeier
CIP & Corporate Compliance	\$ 1,226,744	7	\$ 1,411,575	8	Chad Thompson
Operations & Planning Compliance	\$ 1,309,257	8	\$ 1,427,227	8	Chad Thompson

Planning



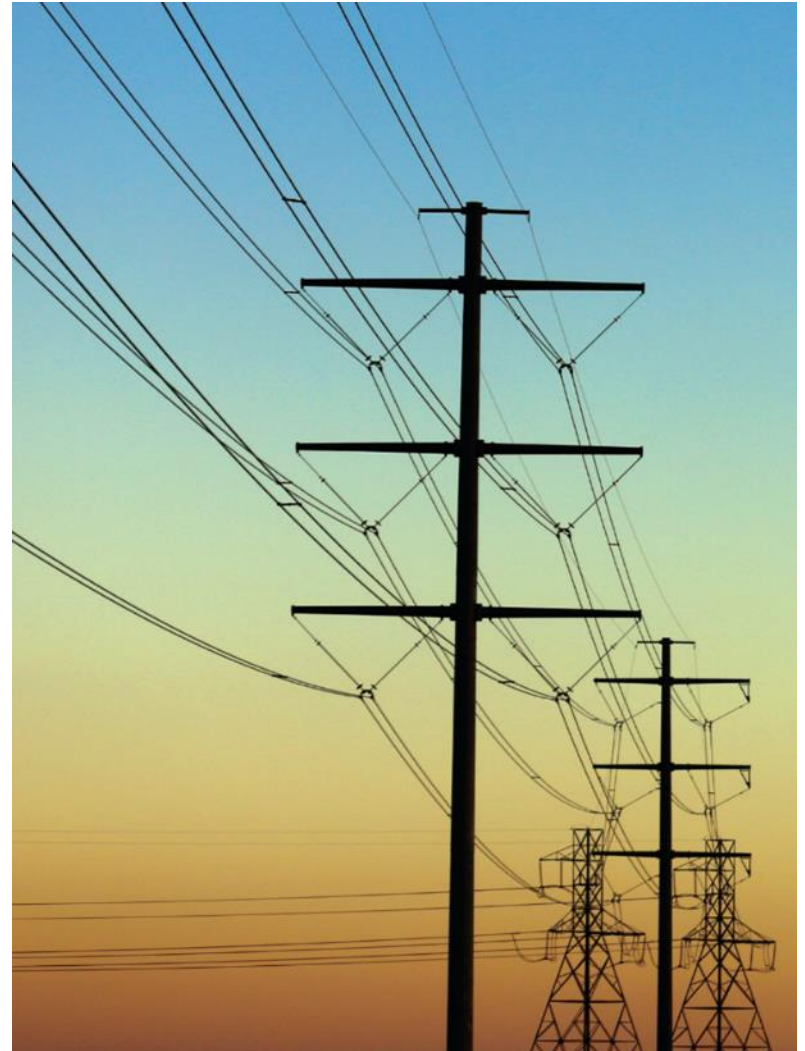
Grid Planning

ERCOT Planning



Transmission Planning Rules & Requirements

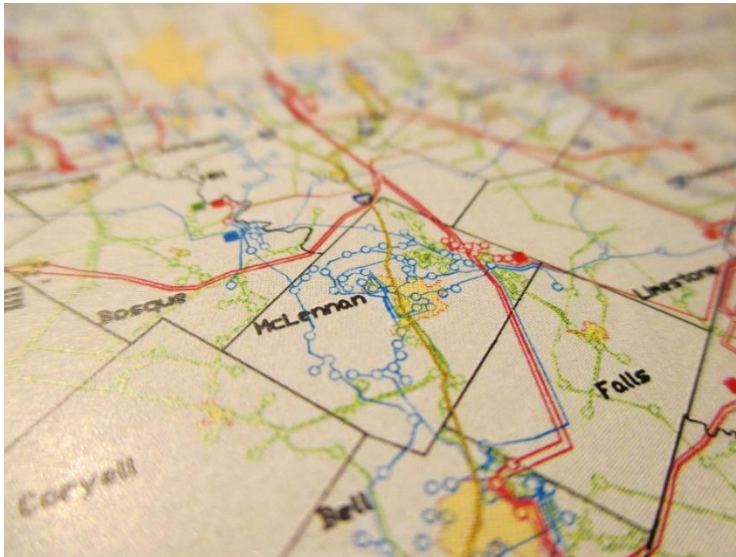
- ERCOT supervises and exercises comprehensive independent authority over the planning of transmission projects for the ERCOT system as outlined in PURA and Public Utility Commission of Texas (PUCT) Substantive Rules.
- Reliability
 - ERCOT Planning Guide Section 4
 - North American Electric Reliability Corporation (NERC) TPL-001-5
- Economic
 - ERCOT Protocols Section 3.11.2
 - PUCT Substantive Rule 25.101



ERCOT Stakeholder Planning

Regional Planning Group (RPG)

- Non-voting public stakeholder forum
- Review and comment on transmission projects and studies

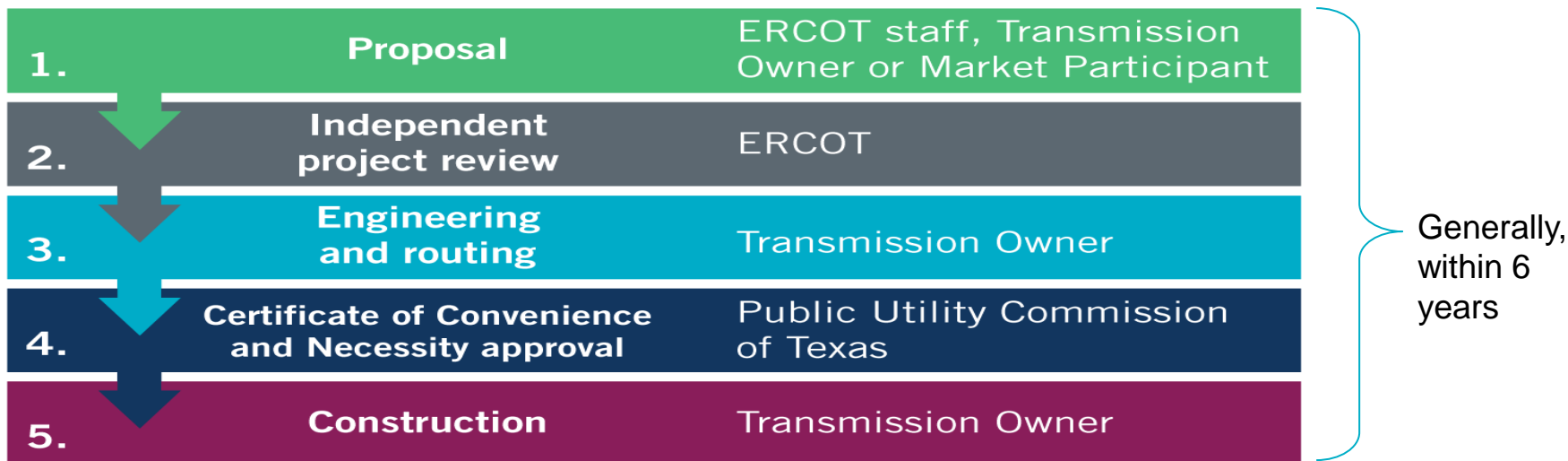


Planning Working Group (PLWG)

- Working group
- Responsible for writing the “rules” for transmission planning



Transmission Project Timeline



- Regional Planning reviews proposed transmission projects that are subject to Certificate of Convenience and Necessity review at the PUCT, and projects that exceed \$100 million in expected capital cost.
- Annual planning studies are conducted to determine system needs within a 6-year planning horizon.
- Longer term studies are conducted every other year to ensure that near-term planning decisions are informed by long-term system trends.



Regional Planning

Regional Planning- Overview

- ***Objective*** - The Regional Planning program performs detailed transmission planning studies designed to identify cost-effective transmission projects that meet identified system needs in a timely manner and promote the future reliability of the ERCOT grid
- ***Location/Division*** – Taylor/ Grid Planning & Weatherization
- ***Number of FTEs as of FY 2021*** – 14
- ***Budgeted expenditures for Fiscal Year 2021*** - \$3,036,980

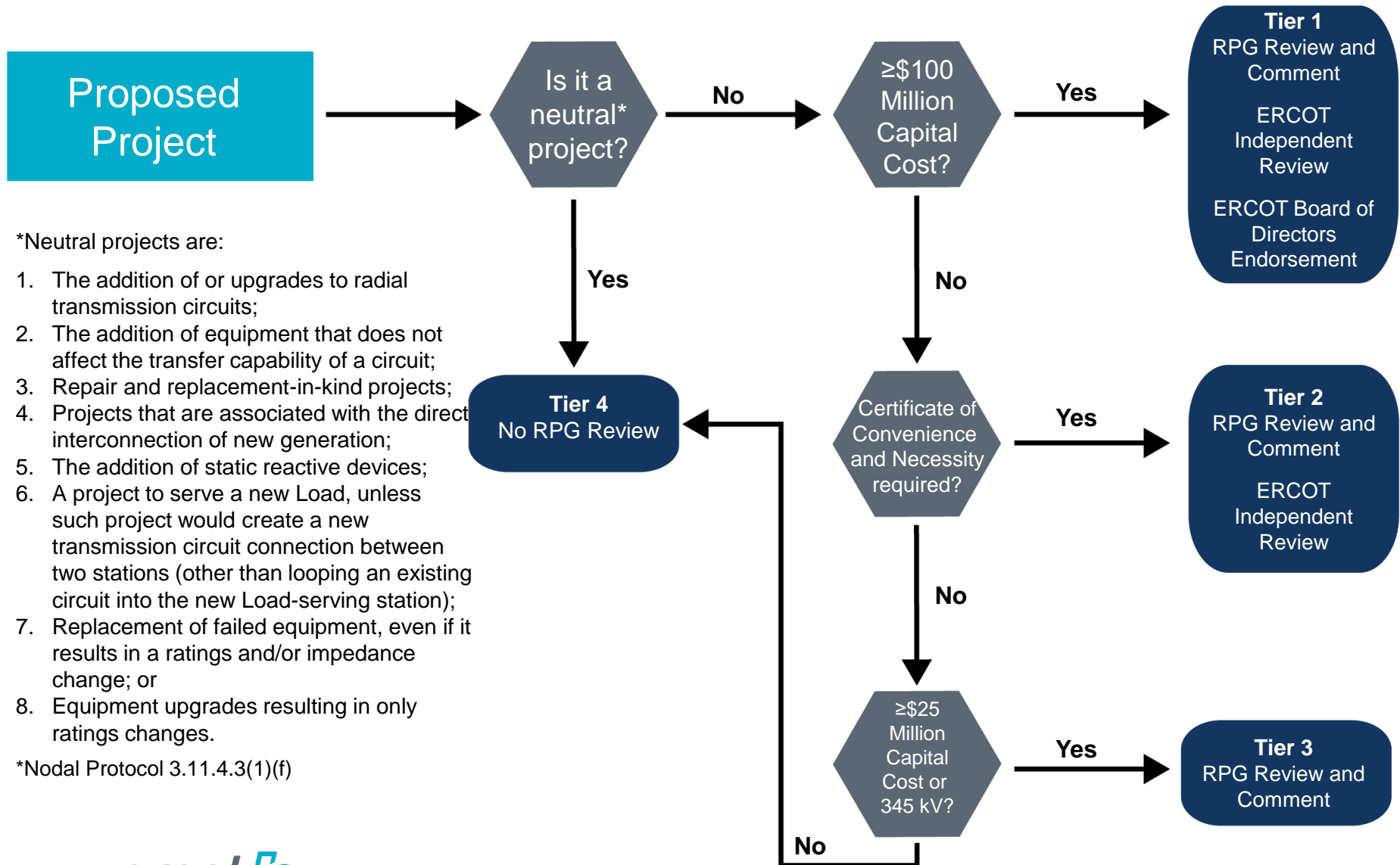
Regional Planning- Functions

- ***Coordinate & Conduct of the Regional Planning Group (RPG) process***
 - Stakeholder group that provides advice and comments on proposed transmission projects and transmission planning studies.
 - ERCOT Independent Review establishes the need for the proposed transmission project
 - Determines if project is needed to maintain future grid reliability or expected to reduce overall future grid operating costs
- ***Study of grid stability limitations***
 - Ensure system remains reliable, with stable operations immediately following a significant system disturbance
 - Stability limitations are increasingly relevant as generation sources are developed further from major centers of customer demand, and as the number of inverter-based resources (such as wind generation, solar photovoltaic generation and battery resources) increases.

Regional Planning- Functions (cont.)

- ***Assessment of reliability impacts of proposed generation retirements***
 - Complete required grid reliability studies whenever ERCOT is notified by a generation resource owner that the resource owner intends to retire or mothball an operating generation unit.
- ***Special Studies***
 - Transmission constraints that have a significant impact on grid reliability or the cost effectiveness of grid operations sometimes warrant special ad hoc transmission planning studies. Example,
 - An assessment of the cost-effectiveness of transmission solutions to alleviate the West Texas Export stability constraint;
 - An assessment of the need for new transmission to reliably serve growing oil and gas customer demand in the Delaware Basin region
 - An assessment of the grid reliability need for additional import capacity into the Lower Rio Grande Valley.
 - Special studies are also conducted at the request of the PUCT. Example,
 - Study to determine the preferred transmission solution to allow Lubbock Power & Light to transfer 70% of its customers into the ERCOT region

Regional Planning Group Planning Process



*Neutral projects are:

1. The addition of or upgrades to radial transmission circuits;
2. The addition of equipment that does not affect the transfer capability of a circuit;
3. Repair and replacement-in-kind projects;
4. Projects that are associated with the direct interconnection of new generation;
5. The addition of static reactive devices;
6. A project to serve a new Load, unless such project would create a new transmission circuit connection between two stations (other than looping an existing circuit into the new Load-serving station);
7. Replacement of failed equipment, even if it results in a ratings and/or impedance change; or
8. Equipment upgrades resulting in only ratings changes.

*Nodal Protocol 3.11.4.3(1)(f)



Transmission Planning Assessment

Transmission Planning Assessment - Overview

- ***Objective*** - ERCOT Transmission Planning Assessment conducts annual and biennial transmission studies designed to meet the requirements set forth under the NERC, Reliability Standards, ERCOT Protocols and Planning Guides, PUCT Substantive Rules, and state law.
- ***Location/Division*** – Taylor/ Grid Planning & Weatherization
- ***Number of FTEs as of FY 2021*** – 11
- ***Budgeted expenditures for Fiscal Year 2021*** - \$1,751,007

Transmission Planning Assessment - Functions

- ***Complete the annual Regional Transmission Plan (RTP)***
 - evaluate the need for additional transmission capacity throughout the ERCOT interconnection within a six-year planning horizon
 - propose transmission projects to meet these identified system needs
 - coordinate and communicate with transmission owners to identify system needs and the feasibility of potential solutions
 - evaluate economic projects that reduce overall grid operating costs sufficiently to cover the expected cost of the transmission project for customers
 - perform analyses in compliance with the transmission planning requirements and other applicable requirements of NERC and the ERCOT Protocols and Planning Guides
 - update stakeholders on the status and findings of the RTP at monthly Regional Planning Group meetings

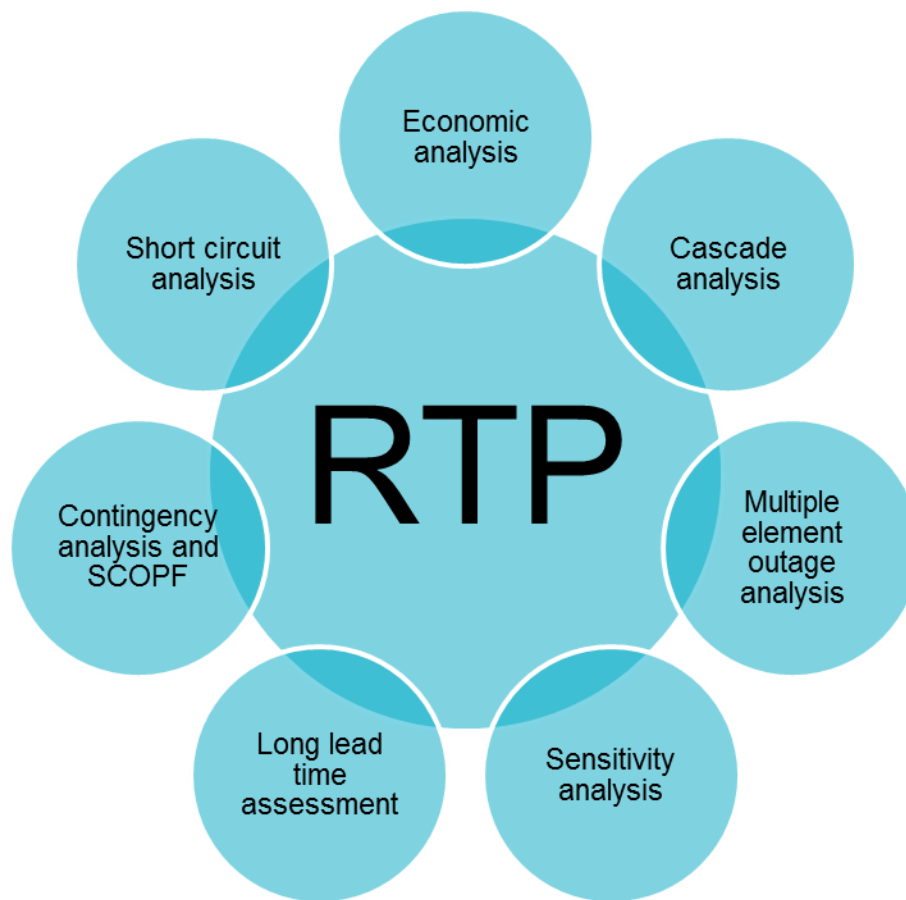
Transmission Planning Assessment – Functions (cont.)

- ***Complete the biennial Long-Term System Assessment (LTSA)***
 - evaluate long-term system needs (over 10-to 15-year planning horizons) using a set of potential future scenarios
 - develop likely generation expansion for each scenario alongside the ERCOT Resource Adequacy program; and
 - for each future scenario, evaluate regional transmission needs
- ***Geomagnetic Disturbance evaluation***
 - analyzes and publishes the potential impacts of Geomagnetic Disturbances on the ERCOT grid in compliance with NERC requirements.

Regional Transmission Plan

- Annual planning assessment that addresses the ERCOT system's reliability and economic transmission needs for the six-year planning horizon.
- Fulfills part of ERCOT's obligation toward compliance with the NERC Reliability Standards (TPL-001 and FAC-002) as the NERC-registered Planning Coordinator for the ERCOT region.
- Projects identified in the RTP are subject to ERCOT Protocols Section 3.11.4, Regional Planning Group Project Review Process

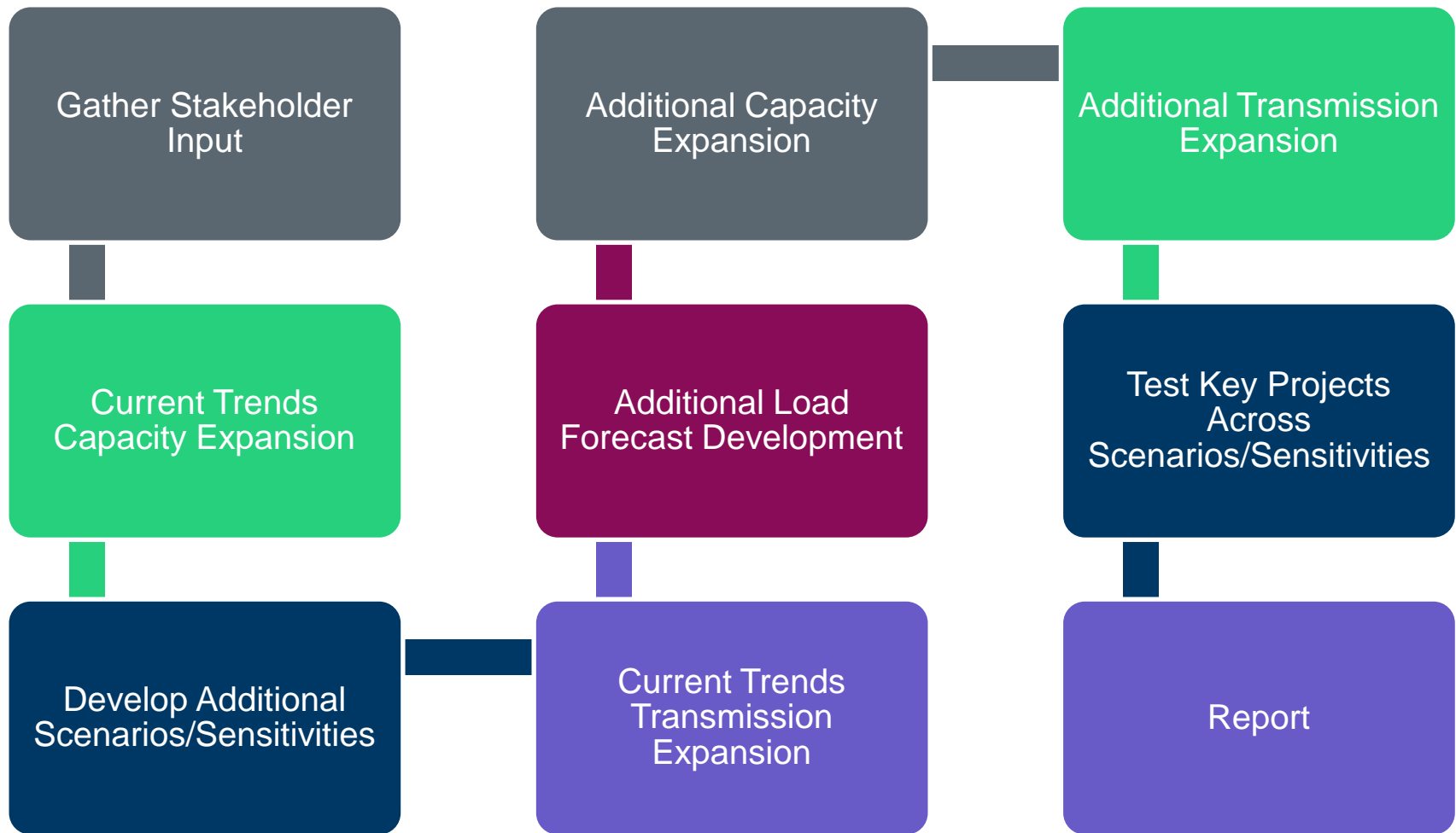
The RTP annual assessment is comprised of multiple studies



Long-term System Assessment (LTSA)

- An evaluation of the potential needs of ERCOT's extra-high voltage (345-kV) system in the 10- to 15-year planning horizon
- Guides the six-year planning process by providing a longer-term view of system reliability and economic needs
 - ERCOT studies different scenarios in its long-term planning process to account for the inherent uncertainty of planning the system beyond six-years

LTSA Process



Grid Planning - Effectiveness and Efficiency

- The ERCOT Regional Planning and the Transmission Planning Assessments are recognized throughout the electric utility industry for
 - its ability to thoughtfully assess future transmission needs and to identify cost -effective projects to meet these needs,
 - to innovate new analytical tools and procedures designed to decrease the time and cost associated with transmission planning studies.
- Transmission Planning Assessment is frequently audited by NERC staff and by the Texas Reliability Entity (the NERC Regional Entity) and is consistently found to be compliant with the applicable NERC planning standards.
- In the last 10 years, Regional Planning Group (RPG) independent review has saved in excess of \$150 million in identifying cost-effective transmission solutions



Resource Adequacy

Resource Adequacy - Overview

- Prepares assessments of the sufficiency of forecasted resources to meet customer electricity demand in the ERCOT region, along with associated supply risks
 - Publishes long-term and seasonal resource adequacy reports
 - Supports North American Electric Reliability Corporation (NERC) in conducting annual/seasonal reliability assessments and investigations of emerging reliability issues
 - Represents ERCOT on NERC technical advisory groups
- Conducts studies to determine target capacity reserve margin levels that meet three alternative criteria
 - a given reliability standard,
 - what is optimal from a societal cost perspective,
 - what will support investment in new generation assets

Resource Adequacy - Overview

- Publishes other high-profile public reports, including:
 - The monthly *Demand & Energy* report, which provides data on historical customer demand and generation for the ERCOT region and by zone
 - The monthly *Generator Interconnection Status* (GIS) report, which provides information on generation projects for which interconnection requests have been submitted to ERCOT
 - Monthly *Resource Capacity Trend Charts* that show the growth in annual generation capacity by generator type as well as expected growth in planned resources based on project developer information
- Produces long-term (15-year) generation capacity expansion scenarios to support the development of the biennial Long-Term System Assessment
- Prepares data submissions for the Federal Energy Regulatory Commission's *Annual Electric Balancing Authority Area and Planning Area Report*

Resource Adequacy - Overview

- Prepares the quarterly and annual *Unregistered Distributed Generation* reports, which provide the aggregate installed capacity of generation and storage facilities connected to local distribution systems that are typically less than one megawatt in size
- Completes periodic assessments of drought risks for cooling water supplies needed by generation units looking out 18 months
- Develops simulated annual hourly generation profiles for operational and planned wind and solar sites based on meteorological data going back to 1980



Resource Integration

Resource Integration- Overview

- Resource Integration consists of 10 employees.
- Primary Activities of Resource Integration:
 - approves Generation Interconnection Request (GINR) applications;
 - Conducts Security Screening Studies;
 - Processes Full Interconnection Studies
 - Reviews Transmission Service Provider (TSP) conducted FIS studies;
 - conducts Quarterly Stability Analysis (QSA) assessments;
 - approves resource asset registrations; and
 - approves of energization, synchronization and commissioning checklists
 - Manage registration of small Generation into the ERCOT Market

Resource Integration- Overview

- Primary Activities of Market Design (continued):
 - Working with internal project teams to support and test changes to ERCOT market software;
 - Generating reports for tracking Resource Interconnection; and
 - Resolving questions from TSPs and Interconnecting Entities.

Grid Coordination Support & Development



Grid Coordination Support & Development-Overview

- Grid Applications Support consists of two groups:
 - Network Modeling;
 - Grid Applications Development
- Primary Activities of Network Modeling:
 - develops, refines, and implements tools and processes to produce an accurate model of the ERCOT electric grid that is used in planning and operating a reliable electric system and facilitating the market
- Primary Activities of Grid Applications Development:
 - develops, maintains tools and display for all departments in Grid Planning and Operations
 - investigates new third-party software and provides support for grid projects



Weatherization and Inspection (new)

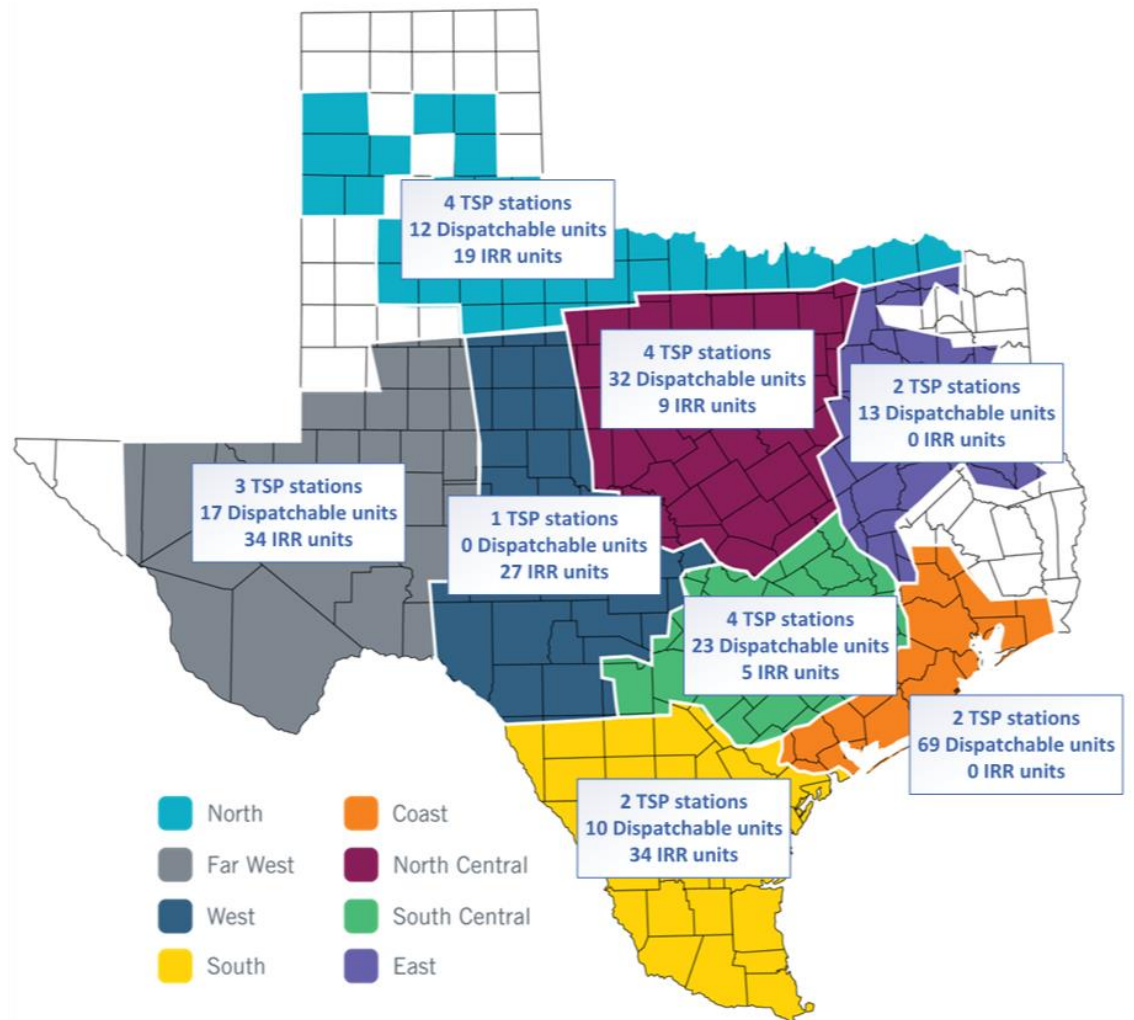
Weatherization Services – History

- ERCOT has conducted site inspections annually since 2011.
 - General authority to conduct these site inspections exists from PURA § 39.151(a)(2)
 - In June 2014 PUCT adopted amendments to 16 TAC § 25.53 requiring the filing of Emergency Operations Plans (EOP) which included a subordinate plan that addresses severely cold weather and severely hot weather, and to 16 TAC § 25.362 specifically authorizing ERCOT to conduct generator site visits to review compliance with weatherization plans.
 - Approximately 80 of these weatherization plan checking site visits occurred annually since 2011.
 - Information sharing on best practices and lessons learned was central to these efforts with recommendations being offered by the ERCOT inspector.
 - These site visits did not require reporting nor was enforcement necessarily contemplated.
- ERCOT has also provided services to witness on site testing of black start generators.
- These services were historically provided by ERCOT Operations personnel.

Weatherization and Inspection – A New Group

- Senate Bill 3 signed by Governor Abbott on June 8, 2021, required weatherization of generation, transmission, and natural gas facilities.
- PUCT Rule 25.55 (16 TAC § 25.55), finalized on October 19, 2021, established a first phase of weather emergency preparedness standards for generation and transmission facilities and assigned specific responsibilities to ERCOT. A second phase of rulemaking in 2022 is anticipated to result in additional assignment of responsibilities to ERCOT.
- NERC has seated a standard development team to revise their Reliability Standards to include requirements for “Extreme Cold Weather Grid Operations, Preparedness, and Coordination”.
- ERCOT established a new Weatherization and Inspection Department in 4Q21 to support PUCT and NERC requirements, as necessary.
- It is anticipated that this new organization will eventually support many of ERCOTs field services needs including black start generator testing.

Weatherization and Inspection – Map of December 2021 On-Site Inspections



On-site Inspections

22 Transmission
174 Dispatchable
128 IRR
324 Total

Completed between
December 2, 2021 and
December 22, 2021



Engineer Development Program

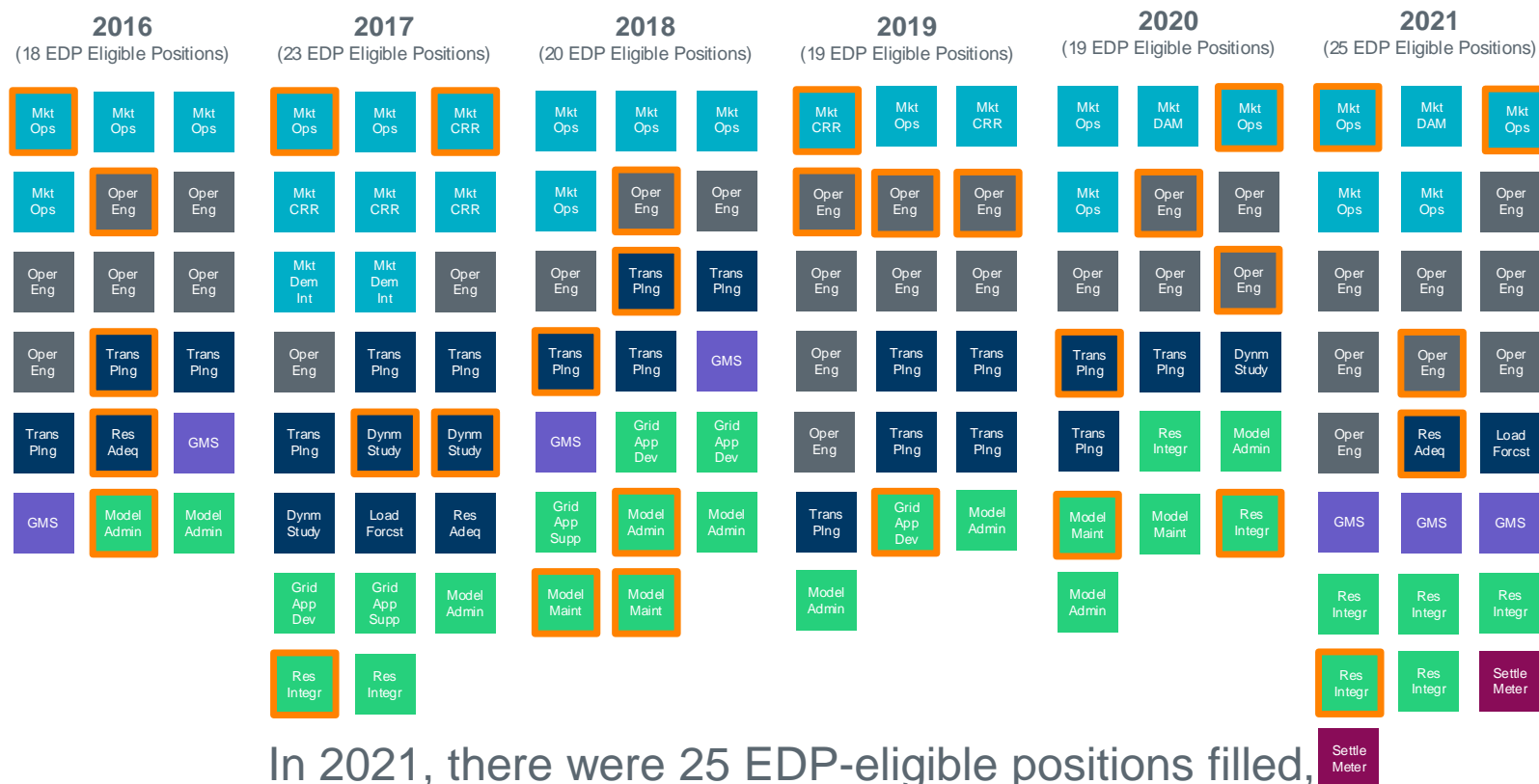
Engineer Development Program-Overview

- Engineer Development Program consists of 9 employees.
- Primary Activities of Resource Integration:
 - Daily engineering work;
 - Various department specific modules;
 - Longer term technical project

Engineer Development Program– Updates since SER submission

EDP Annual Demand 2016 – 2021

- Open Position in Market Operations
- Open Position in System Operations
- Open Position in System Planning
- Open Position in Grid & Market Solutions
- Open Position in Grid Coordination
- Open Position in Settlements Metering
- Position filled with EDP Graduate



In 2021, there were 25 EDP-eligible positions filled,
5 of which were filled by EDP graduates.

Grid System Operations

System Operations – Control Center



System Operations – Control Center - Overview

- The ERCOT Control Center operators have the responsibility and authority to direct the real-time actions of all generating plant and transmission line operators in the ERCOT region for the stable and reliable operation of the Bulk Electric System (BES) during normal and emergency conditions.
- ERCOT operates two Control Centers 24 hours a day, seven days a week, utilizing advanced network analysis applications—including State Estimator, Real Time Contingency Analysis, Real-Time and Study Mode Operations Power Flow, Voltage Stability Analysis and Dynamic Stability Analysis—to continuously monitor the 52,615 miles of transmission lines and approximately 855 generation units in the ERCOT Interconnection to maintain security and reliability of the ERCOT system.

System Operations – Control Center - Overview

- Real-Time Contingency Analysis (RTCA) is executed to evaluate the reliability of the ERCOT system, and to determine real-time and predicted post-contingency exceedances with System Operating Limits (SOL). RTCA has approximately 8,825 contingency scenarios being processed, executes every five minutes, and can be executed manually as required.
- Load Frequency Control (LFC) is executed every four seconds to maintain grid frequency near 60 Hz.
- Performs critical inertia analyses on expected grid conditions and identifies hours when levels may not be sufficient as well as monitors the critical inertia levels in real-time based on actual conditions.
- Manages the DC-Tie scheduling and inadvertent energy accounting for the DC Ties which ERCOT shares with the Southwest Power Pool and Centro Nacional de Control de Energia.

System Operations - Training



System Operations Training-Overview

- System Operations Training consists of 7 employees.
- Primary Activities of System Operations Training:
 - analyzing, identifying, and creating a list of Bulk Electric System (BES) company-specific Real-time reliability-related tasks based on a defined and documented methodology;
 - designing and developing training materials based on this task list;
 - implementing delivery of training to System Operators; and
 - evaluating the training program each calendar year
 - Providing severe weather and Black Start Restoration Training for ERCOT and the Market participants yearly

Operations Engineering and Support



Operations Engineering & Support - Overview

- Responsible for all real-time and near-real-time engineering support to the System Operations Control Center.
- Primary Activities of Operations Engineering & Support:
 - Triaging real-time and near-real-time system events; calculating System Operating Limits; facilitating changes to the network operations model; reporting on system events; developing mitigation plans associated with grid congestion; and providing front-line troubleshooting on software applications and databases used in the Control Center;

Operations Engineering & Support - Overview

- Primary Activities of Operations Engineering & Support (continued):
 - Providing 24/7 on-site and on-call engineering supports to the Control Center;
 - Facilitating the interconnection of all new transmission equipment and generation resources into the ERCOT grid; and
 - Receiving and processing transmission and resource outage requests.

Transmission Operations Planning



Transmission Operations Planning - Overview

- Performs transmission analyses required to support ERCOT system operations, including the Quarterly Stability Assessment, Interconnection Reliability Operating Limit studies, outage coordination stability analyses, maintaining Generic Transmission Constraints to manage stability limits, Black Start planning, seasonal transmission analysis, and reviewing Constraint Management Plans, Geomagnetic Disturbance Plans, Remedial Action Schemes, and Voltage Profile studies
- Conduct operations planning studies for event analysis
- Implements real-time stability analysis tools

Load Forecasting & Analysis



Load Forecast and Analysis - Overview

- Creates long-term demand forecasts for system planners
- Creates near-term demand forecasts for system operators
- Provides weather forecast support to system operators via an on-staff meteorologist

Operations Analysis



Operations Analysis - Overview

- Evaluate the grid's response to frequency deviations
- Determine Ancillary Services needed to maintain grid reliability, qualify resources for providing those Ancillary Services, and serve as subject matter experts for Energy Management System tools used to monitor frequency and deploy Ancillary Services
- Administer ERCOT's wind and solar integration program with a focus on forecasting for system operators
- Conduct resource studies for event analysis



Grid Applications Support

(previously part of Grid
Coordination Support &
Development)

Grid Applications Support-Overview

- Primary Activities of Grid Application Support:
 - maintenance, reliability, accuracy, and operational development of ERCOT's advanced network applications, including State Estimator, Real Time Contingency Analysis, Contingency Analysis, Real -Time and Study Mode Operations Power Flow, Voltage Stability Analysis, and Dynamic Stability Analysis

Commercial Operations



Renewable Energy Credit (REC) Program Administration



REC Program Administration - Overview

- The Renewable Energy Credit (REC) Program Administration is responsible for fulfilling the obligations of Texas Senate Bills 7 and 20 via administration of PUCT Sub Rule 25.173, “Goal for Renewable Energy”. The program provides incentives to generating companies that locate in Texas and build renewable resource generation facilities.
- Tasks include:
 - Maintaining compliance with REC Administration requirements in accordance with PUCT Substantive Rule 25.173(g)
 - Providing reporting to enable regulators to assess the effectiveness of the program
 - Maintaining the systems necessary to support the program

Settlement Metering



Settlement Metering - Overview

The Settlement Metering program supports the Texas wholesale electric market by ensuring the accuracy and timeliness of ERCOT Polled Settlement (EPS) meter usage data and distribution loss factor methodologies and provides EPS meter point modeling and mapping in the Network Model. Responsibilities include:

- Collection, validation, edit and estimate generation metering data in support of settlement processing
- Review and approval of meter engineering designs
- Review and approval of Transmission and/or Distribution Service Provider (TDSP) site specific documents for each EPS metering point, demonstrating compliance with Protocol and Guide Requirements
- Review and approval of TDSP documentation of issues with EPS metering points and processing Temporary Exemption Applications
- On-site compliance audits of EPS metering facilities
- Review and approval of annual distribution loss factors

Data Loading and Aggregation



Data Loading & Aggregation - Overview

The Data Loading and Aggregation program is responsible for ensuring the accuracy and timeliness of billing determinants used in settlements.

Tasks include:

- Management of meter data loading processes
- Management of energy data aggregation processes to support settlements
- Calculation of transmission and distribution loss factors
- Annual 4-Coincident Peak (4CP) reporting to PUCT
- Ongoing analytical and data support

Settlement Operations



Settlement Operations - Overview

Settlement Operations ensures that electricity production and delivery and market activities are accurately accounted for.

Tasks include:

- Financial settlement for Market Participants
- Generation of initial, final and true-up settlement invoices
- Validation of key settlement data
- Invoicing for securitization programs
- Ongoing analytical and data support for Legal, external stakeholders, regulators, etc.

Settlement Services



Settlement Services - Overview

Settlement Services ensures settlement systems and calculations are compliant with ERCOT Protocols and PUCT Rules.

Tasks include:

- Ensuring settlement systems are built to specifications and perform accurate settlements
- Review and validation of cost and operational parameters for Generation Resources used in price formation and settlements
- Assisting in the development of policy and decision making by contributing to Protocol revisions
- Providing ongoing reporting of settlement and other data
- Ongoing analytical and data support for Legal, external stakeholders, regulators, etc.

Retail Operations



Retail Operations - Overview

Retail Operations is responsible for ensuring that information pertaining to competitive retail switching is processed accurately and in a timely manner.

Tasks include:

- Identifying and resolving any discrepancies that arise in relation to customer switching and move-ins/outs.
- Certification of systems and business process compliance for prospective retail market participants.
- Supporting a variety of data transmission activities with Market Participants that utilize North American Energy Standards Board (NAESB) standards for data transport
- In the event of a Mass Transition of retail customers, coordinating the process and providing end-user communications.
- Providing ongoing support and reporting to stakeholders and PUCT.



Market Design

Market Design- Overview

- Market Design team provides detailed analysis of wholesale market outcomes and proposed market design changes;
- Supports stakeholder discussions of proposed market design changes;
- Develops rules and requirements necessary to implement market design changes in the software that runs the ERCOT market.

Market Design- Overview

- Primary Activities supporting Market Design
 - Performing quantitative and qualitative analyses of wholesale market outcomes and market design changes;
 - Supporting discussions of market design changes in the ERCOT stakeholder process;
 - Developing and reviewing proposed changes to the ERCOT rules governing the wholesale electricity market;
 - Working with vendors and internal project teams to support and test changes to ERCOT market software;
 - Generating market-facing analysis reports for market stakeholder forums upon request; and
 - Resolving questions from Market Participants and other stakeholders concerning the analysis and design changes.

Market Validation



Market Validation- Overview

- Market Validation team maintains and monitors the key applications in the ERCOT Market Management System (MMS);
- Validates the correctness of day-to-day market results; and
- Identifies inconsistencies across the components of the wholesale electricity market in order to support ERCOT's overall goal of providing electric grid reliability and market efficiency.

Market Validation- Overview

- Primary Activities supporting Market Validation
 - Monitoring the overall performance of the software used to administer the wholesale electricity market within ERCOT;
 - Validating the day-to-day results of the wholesale electricity market using software to review pricing outcomes and performing prices corrections, when necessary;
 - Working with vendors and internal IT teams to maintain and update ERCOT MMS applications;
 - Generating and maintaining market reports per requests and protocols;
 - Performing analysis for and otherwise supporting other ERCOT Commercial Operations programs to ensure consistency across the components of the wholesale electricity market; and
 - Supporting ERCOT stakeholder meetings by providing subject matter expertise.

Congestion Revenue Rights



Congestion Revenue Rights- Overview

- The Congestion Revenue Rights team oversees and manages the Congestion Revenue Rights (CRR) market, which includes conducting monthly and long-term CRR auctions, and facilitating bilateral trading.
 - At ERCOT, a Congestion Revenue Right (CRR) is a financial instrument that results in a charge or a payment to the CRR holder when the transmission grid is congested in the Day-Ahead Market.
 - CRRs may be used either as a financial hedge or as a financial investment based on congestion costs. As a hedge, a CRR locks in the congestion price at the CRR's purchase price. As an investment, a CRR may be used to speculate whether the congestion rent will be greater than the purchase price.

Congestion Revenue Rights- Overview

- Primary Activities supporting the CRR Market
 - Create and post CRR Network Models: The CRR team creates a CRR Network Model for the annual Pre-Assigned CRR (PCRR) allocation and for each auction. For each calendar year, 25 CRR Network Models are created (12 monthly auctions, 12 long-term auctions, and 1 annual PCRR allocation).
 - Annual and monthly PCRR allocations: The CRR team facilitates the allocation of PCRRs to eligible municipals and co-operatives who chose not to opt in to retail competition when the Texas electric market was de-regulated (Non-Opt-In Entities, or NOIEs)

(continued)

Congestion Revenue Rights- Overview

- Primary Activities supporting the CRR Market (continued)
 - Execute CRR Auctions:
 - Long-Term Auctions: Facilitates a series of six-month rolling auctions that gives CRR Account Holders the opportunity to obtain CRRs for up to three years into the future. CRRs effective for the auction months that were obtained in a previous auction, allocation, or bilateral trade can also be offered for sale in the auction.
 - Monthly Auctions: Facilitates a monthly auction that gives CRR Account Holders the opportunity to obtain CRRs for the upcoming month.
 - Bilateral trades: CRRs can be traded bilaterally to another qualified CRR Account Holder. The CRR program monitors bilateral trades and helps ensure that they are validated (credit-check) and completed successfully.

Day-Ahead Market



Day-Ahead Market- Overview

- The Day-Ahead Market team supports and executes the Day-Ahead Market with two operators each day, 365 days per year (modified shift-work).
- The Day-Ahead Market is a voluntary, financially binding daily market that occurs the day before the Operating Day for buyers and sellers to transact energy, Ancillary Services, and congestion.

Day-Ahead Market- Overview

- Primary Activities supporting the Day-Ahead Market
 - Preparing for the Day-Ahead Market: Operators verify required postings on the Market Information System (MIS) for the next Operating Day and review external system data interfaces to ensure upstream source data has been transferred into the Market Management System (MMS).
 - Executing the Day-Ahead Market: Operators then confirm parameters and initiate the application. During the market execution process, the optimization engine will iterate through solutions, and operators will monitor the validity of the iterative solutions while monitoring the workflow messages to determine if any errors have been flagged.

Day-Ahead Market- Overview

- Primary Activities supporting the Day-Ahead Market (continued)
 - Verify the Market results: Once the Day-Ahead Market has converged, it is analyzed using the Price Validation code. Operators will then verify the validity of the final solution and confirm it is ready for publishing.
 - Publish Results: After operators validate the results, these results are communicated to Market Participants via the MIS and Market Manager. Lastly, the final market solution input/output data is transferred to the Settlements system for processing.
 - Support inquiries: Operators and support engineers also manage inquiries from Market Participants concerning Day-Ahead Market modeling, submissions, awards, and potential downstream impacts.

Demand Integration



Demand Integration- Overview

- The Demand Integration team administers the ERCOT Emergency Response Service (ERS) program and manages Load Resource participation into the ERCOT market.
 - ERS: PUCT Substantive Rule 25.507 requires that ERCOT administer ERS, a special emergency response service deployed in an Energy Emergency Alert (EEA) event to assist in preventing or reducing the impact of firm load shed.
 - Load Resource participation: Load Resources are loads that register with ERCOT and meet the requirements to provide Ancillary Services or participate in ERCOTs energy market. They can participate as either Controllable or Non-Controllable Load Resources, with each having a different set of requirements.

Demand Integration- Overview

- Primary Activities supporting ERS
 - Supports Qualified Services Entities representing ERS Resources with processes to understand the demand response potential of their resources prior to making offers into the next ERS Standard Contract Term;
 - Executes the procurement process for each ERS Standard Contract Term;
 - Periodically tests and evaluates the performance of each ERS Resource and, if an ERS deployment event occurs, evaluate Resource performance;
 - Evaluates each ERS Resource's term availability at the end of each ERS Standard Contract Term;
 - Combines test/event deployment performance and term availability to calculate payment information provided to ERCOT Settlement and Billing.

Demand Integration- Overview

- Primary Activities supporting Load Resource Participation
 - Assists Resource Entities with the registration of new Load Resources;
 - Performs tasks to add new Load Resources into the Network Model;
 - Performs qualification tests and evaluation performances;
 - Performs test deployments and performance evaluations for each qualified Load Resource as required to maintain qualification status; and
 - Perform performances evaluation for each Load Resource following any deployment events.

Credit Risk Management

Credit Risk Management - Overview

Credit Risk Management is responsible for the management and administration of ERCOT Protocols addressing financial and credit requirements for ERCOT market participants

Tasks include:

- Reviewing and approving credit applications for entities applying to become ERCOT counterparties
- Maintaining credit limits for CRR Account Holders for CRR auctions
- Monitoring credit exposure on an ongoing basis and determining the amount of collateral needed from counterparties
- Issuing collateral requests and managing counterparty collateral and escrow deposits
- Reporting of credit exposure and other data to stakeholders
- Ongoing analytical and data support for Legal, external stakeholders, regulators, etc.

Other Core Support Functions

Market Rules and Stakeholder Support



Market Rules & Stakeholder Support - Overview

- Department consists of 6 employees.
- Provides coordination for & transparency into ERCOT governance process by:
 - Ensuring that all matters proceed through stakeholder governance process in accordance with governing documents (ex. Protocols & Market Guides).
 - Facilitating activities of the Technical Advisory Committee (TAC) and its subcommittees, including:
 - agenda development;
 - communication of issues with subcommittee/TAC leadership & ERCOT;
 - coordination & development of meeting materials including ERCOT positions on Revision Requests being discussed;
 - facilitation of meetings including meeting minute development for voting bodies, capturing committee actions & action items.
 - Developing and/or compiling TAC materials for ERCOT Board meetings.
 - Supporting meeting scheduling for the Board, TAC, Subcommittees, working groups, task forces and necessary workshops.
 - Facilitating annual election of ERCOT membership to seat TAC & Subcommittees.

Client Services, Market Support Services and Market Training



Client Services - Overview

- Management of relationship between Market Participants and ERCOT
- Single Point of Contact for 1800+ Market Participants
- 15 FTEs: 2 managers and 13 Account Managers
- Wide scope of subject matter expertise
 - Grid Operations
 - Market Operations
 - Commercial Operations
- Registration / qualification
- Communication, facilitation and education
- Market Participant Satisfaction Survey

Market Support Services - Overview

- Market Participant Registration, Resource Registration
- Communication – Market Notices
- Market Participant Identity Management - Digital Certificates
- Electric facts Labeling
- 2020 statistics (4000+ documents, 500+ Market Notices, 350+ Digital Certificates)
- 6 FTEs: One manager – 5 analysts
- Increasing need for services due to increase in:
 - Types of Market Participants, Resources
 - Need for more Market Notices

Market Training - Overview

- Development and delivery of training to Market Participants / Public
- Training on a wide array of ERCOT functions
 - Grid Operations
 - Market Operations
 - Commercial Operations
- Instructor Led Training (ILT) and Web Based Training (WBT)
- Current curriculum – 16 ILT and 24 WBT courses
- 5 FTEs: One manager and 2 instructors / 2 support staff
- Increasing opportunities and challenges:
 - Complexity of market / Remote work environment



Cybersecurity

Cybersecurity - Overview

The Cybersecurity program consists of the following functional areas: Threat Operations and Intelligence, Security Architecture, and Cybersecurity Administration.

- Threat Operations and Intelligence:
 - Operates and tunes the security toolsets, including security information and event management (SIEM), intrusion Detection/Protection system (IPS), application whitelisting solution, endpoint detection and response toolset (EDR), and endpoint protection solution (AV)
 - Provides security monitoring and response
 - Escalates and coordinates responses to emerging threats
 - Leads cyber incident response
 - Develops and leads cyber security investigations, forensics, and threat hunting
 - Develops and implements security awareness and training
 - Provides security metrics and trend reports

Cybersecurity - Overview

- Security Architecture

- Provides non-functional security requirements for all capital projects and operations and maintenance initiatives
- Ensures that security is built in up-front for ERCOT projects, which results in lower costs and a greater return on investment
- Performs security risk assessments on all new vendors and new categories of ERCOT purchases
- Evaluates and approves all firewall changes within the ERCOT enterprise to ensure secure configurations
- Evaluates and approves all software installed on ERCOT workstations
- Establishes Secure Configurations for new cyber asset types
- Maintains and improves ERCOT's cyber governance policy documents
- Serves as a core member of the Patch Review Board to review and ensure timely patching of security patches

Cybersecurity - Overview

- Security Administration

- Implements and maintains all ERCOT security toolsets
 - ERCOT Cybersecurity has an overlapping defense in depth approach to our cybersecurity leveraging many defensive toolsets, technologies and policies/procedures
- Manages ERCOT's vulnerability management program
- Performs vulnerability assessment and secure configuration scans on all new ERCOT system builds so that they are fully secure prior to going into production
- Performs system-hardening checks on all IT baseline changes so that changes do not negatively impact system security
- Engages as part of ERCOT's Change Advisory Board (CAB) to ensure all changes are secure

Critical Infrastructure Protection (CIP) and Corporate Compliance



Critical Infrastructure Protection (CIP) & Corporate Compliance - Overview

- Monitors how well ERCOT business operations meet compliance obligations, including NERC Critical Infrastructure Protection, System and Organization Controls (SOC) audits of financial settlements and billing, and Committee of Sponsoring Organizations of the Treadway Commission (COSO) controls for risk management, governance, and fraud deterrence
- Maintains a program for analyzing and reporting on compliance issues, including recommendations for corrective actions found in prior issues and industry trends
- Perform regular assessments for controls, processes, and procedures, using evidence provided to identify gaps and risks in meeting regulatory obligations
- Stay ahead of developing rules and regulations on the local and national level, coordinating with ERCOT Legal to post comments and balloting of proposed rules and rule changes.
- Consult with the Project Management Office on projects and company initiatives to ensure deliverables are compliant with associated regulations

Operations and Planning Compliance



Operations & Planning Compliance - Overview

- Perform analyses and prepare a quarterly report for the PUCT regarding market participant compliance with ERCOT Protocols, and monitor the implementation of corrective actions for market participants found to be non-compliant
- Maintains a program for analyzing and reporting on compliance issues, including recommendations for corrective actions found in prior issues and industry trends
- Perform regular assessments for controls, processes, and procedures, using evidence provided to identify gaps and risks in meeting regulatory obligations
- Stay ahead of developing rules and regulations on the local and national level, coordinating with ERCOT Legal to post comments and balloting of proposed rules and rule changes.
- Consult with the Project Management Office on projects and company initiatives to ensure deliverables are compliant with associated regulations

Passport Program Implementation



Passport Program Implementation- Overview

- In late 2020, ERCOT created a Passport Program to align and deliver multiple market designs and upgrades under a single umbrella:
 - Real-Time Co-optimization: a significant market re-design to co-optimize energy and ancillary services in real-time (3.5-4.5 year project)
 - Energy Management System (EMS) Upgrade: a major software and technology upgrade of EMS (primary control room software), converting software from Fortran to C++ (3-5 year project)
 - Other Market Design Changes: work to address the reliability needs of the emerging technologies of Energy Storage Resources (ESRs), Distribution Generation Resources (DGRs), and introduce a new 10-minute Ancillary Service defined as ERCOT Contingency Reserves Service (ECRS).

Passport Program Implementation - Overview

- Primary Activities of the Passport Program
 - Strategically plan and execute the implementation of new protocol scope and software systems under a single program structure.
 - Passport Program established and managed:
 - Master program schedule,
 - ERCOT staffing efforts,
 - Vendor development and support,
 - Program risks and mitigation, and
 - Budget to deliver the protocols and systems by July 2024.

Passport Program Implementation- Overview

- As discussed in SER filing, in 1Q2021 a risk-based decision was made to de-couple the protocol market design changes from the EMS upgrade due to ERCOT staffing resource constraints and risk to the EMS upgrade.
- In 4Q2021, after the SER was filed, the PUCT established the Market Design blueprint which did not include RTC, therefore:
 - ERCOT deconstructed all Passport scope back into individual items for current and future project planning purposes based on PUCT and ERCOT Board priority.
 - Staff previously working on Passport Program have pivoted to engage the other high-priority PUCT projects as part of the normal delivery processes in the Project Management Office.

End of document