Item 5: Stakeholder Engagement Topic – Transmission Planning

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Board of Directors Meeting

ERCOT Public
June 23-24, 2025

Overview

- **Purpose**
  - For ERCOT Members to provide the Board of Directors additional perspective and insight on how selected key issues in the ERCOT Region impact different types of Market Participants.

- **Voting Items / Requests**
  - No action is requested of the ERCOT Board; for discussion only.

- **Key Takeaways**
  - ERCOT worked with the Board and TAC Leadership on a framework for stakeholder policy engagement discussion launching in June.
  - A cross section of TAC segments will be invited to provide insight on high impact projects and policy matters at the Board, with transmission planning identified as the first key issue.
  - Speakers have been selected to provide perspective for their respective Segments and views expressed are their own.

Transmission Planning – Membership Segments

Industrial Consumer

- Melissa Trevino, Texas Industrial Energy Consumers
  - *TIEC Chair, Occidental Chemical*
- John Russ Hubbard, Texas Industrial Energy Consumers
  - *TIEC Counsel, O'Melveny & Myers LLP*

Investor-Owned Utility

- Wayman Smith, American Electric Power Company, Inc
  - *Managing Director, ERCOT Transmission & Distribution Planning*
- Collin Martin, Oncor Electric Delivery Company, LLC
  - *Vice President, , Transmission Grid Operations*

Independent Generator

- Chase Smith, Southern Power Company
  - *Market Compliance & Policy Manager*
- Josh Hale, Southern Power Company
  - *Commercial Services Manager*

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Transmission Planning from a Consumer Perspective

June 23, 2025

Industrial Consumer Segment

Why Do Consumers Care?

- Consumers pay for nearly all transmission in ERCOT, so we only support transmission development when it is for reliability, or when it reduces cost to consumers. Unlike other jurisdictions, ERCOT customers fund transmission interconnections and upgrades as an economic incentive for generators to site in ERCOT.
- Consumers need transmission facilities to interconnect and to facilitate wholesale competition. **Insufficient transmission can affect customers by (i) delaying interconnection requests; (ii) creating load pockets with higher LMPs; and (iii) decreasing reliability.**
- However, transmission costs are socialized to all customers under the postage-stamp transmission pricing, **and overbuilding transmission can unnecessarily increase customer costs.**

Transmission Planning Tests

In ERCOT there are three ways to determine what transmission should be built:

Economic Projects

- Intended to eliminate inefficiencies
- Expected to reduce prices ***to consumers***
- An applicant must submit an economic cost-benefit study using two different savings tests

Reliability Projects

- Need-based projects essential to serve load and support robust wholesale competition
- Considers historical load, forecasted load and additional load seeking interconnection
- Generally, non-controversial for customers. These projects are needed.

Resiliency Projects

- New category added after 2021 session
- ERCOT may recommend the PUCT approve a project if it would address a resiliency issue identified in ERCOT's Grid Reliability and Resiliency Assessment (GRRA)
- NPRR1278 is underway to address the process for ERCOT to recommend a resiliency project.

Economic Transmission Projects: Two Different Savings Tests

Assumptions can drive the results, such as the timeframe considered. Annualizing costs over many years decreases the reliability of the projections, as there is no reliable information on future generation siting or fuel costs.

Congestion Cost Savings Test

- Compares the costs against the reduction in system-wide consumer energy costs (All energy consumed multiplied by the applicable price).
- The levelized savings under this test must be equal or greater than the average of the first three years' annual revenue requirement of the proposed project.
- Industrial consumers advocated for the Legislature and PUCT to direct ERCOT to adopt the Congestion Cost Savings Test because Customers pay for all transmission, and this test ensures a line will produce savings ***for consumers***.

Production Cost Savings Test

- Compares the costs against the reductions in production (fuel) costs for generators.
- The levelized savings under this test must be equal or greater than the first-year annual revenue requirement of the proposed project for the project to pass the test.
- Historically, industrial consumers have opposed the use of this test exclusively because reductions in fuel costs generally do not translate in cost savings for consumers. **Customers do not directly pay fuel costs in ERCOT, they pay a clearing price**.
- This test primarily benefits generators who sited on the wrong side of a constraint.

Transmission Planning and Business Decisions

- Traditional industrial facilities typically have less flexibility when siting. Site locations are not fungible and are often determined based on proximity to certain resources, pipelines, or other services.
- Prior to going through the interconnection process, industrial customers invest millions in choosing the right site, negotiating land rights, designing the facility, etc.
- The timing for when a consumer submits a load request to their utility can vary greatly depending on several factors including load type, size, voltage level and other business considerations.
- For larger projects, consumers are generally working with their utilities years in advance to secure interconnection and address any system upgrades necessary to facilitate connection.

Transmission Planning and Business Decisions - Potential Hurdles

Regulatory Uncertainty

- Abrupt changes in the Protocols (or interpretations of the Protocols) can create additional requirements for interconnecting entities. This can lead to expensive retrofits and delays.
- A challenging regulatory environment or too much uncertainty can cause industries to develop projects outside of Texas.

Insufficient or Overbuild of Transmission

- The ability to interconnect and access reliable power is crucial to industry. Insufficient transmission can lead to businesses being forced to pivot and invest in other opportunities where grid connection is available.
- Overbuilding transmission facilities results in higher prices. Power can often be one of the larger costs for industrial customers and increases can have material impacts.

Interconnection Studies

- Historically the utility modeled and studied interconnection requests in combination with ERCOT on behalf of consumers.
- Loads are now being asked to provide TDSPs with detailed design and modeling data for their projects. This request has both a learning curve and cost associated with it.
- There are potential sequencing issues associated with the study timeline which can cause delays. Engineering, procurement and construction is often done in parallel with interconnection requests. Issues identified late in the process can have costly impacts or delay projects.

Customer Engagement

- Customers work closely with their utilities to interconnect, but unless a customer is a market participant, customers do not typically engage with ERCOT during the planning process.
- Trade groups or customer representatives tend to engage when determining the framework for transmission planning (i.e., during revision requests at ERCOT or rulemakings at the PUC) or during the routing process at the PUCT.
- While reliable electricity is critical to each customer, most customers do not have the bandwidth to monitor or participate in every subcommittee or working group at ERCOT. This typically means customers are not as involved at ERCOT as TSPs, REPs, or generators.

Questions?

Discussion Agenda

I. The fundamentals of Transmission Planning from the Investor Owned Utility (IOU) perspective

II. Transmission Policy Issues of Interest to the IOU Segment

III. Key Issues for Board Awareness

I. The fundamentals of Transmission Planning from the Investor Owned Utility (IOU) perspective

Where do Transmission Projects come from?

TSP Annual Planning Assessment

- Utilizes NERC, ERCOT, & TSP criteria
- Corrective Action Plan (CAP) development for near-term and long-term planning horizon
- Steady state, short circuit, and stability analysis

Regional Transmission Plan (RTP)

- Each TSP assigned projects
- Projects are studied independently
- If the project requires new ROW or greater than $25M, a Regional Planning Group (RPG) submission is required
- Includes economic analysis

Customer Studies (Load and Gen)

- Each TSP identifies system constraints
- Transmission projects are tested and developed
- If the project is more than $25M, an RPG project submission is required
- Generation interconnection studies with minimum deliverability criteria can result in transmission upgrades

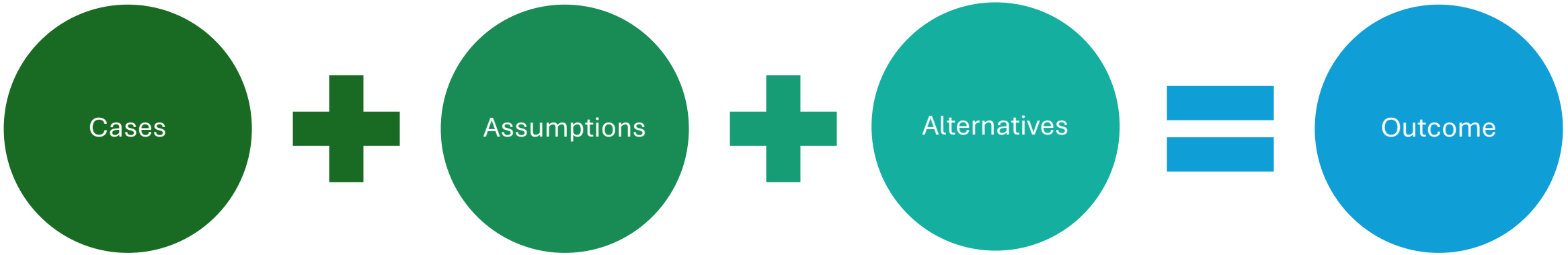
Ad-Hoc ERCOT studies

- ERCOT with the TSPs or independently will identify system constraints and recommend transmission improvements
- Examples: LRGV or Permian Basin

Rehab & Resiliency Projects

- Each TSP identifies projects based on its TSP criteria
- If the project are more than $25M, an RPG project submission is required

How TSPs Evaluate Transmission Projects



- TSPs use posted working group cases from Steady State (SSWG), System Protection (SPWG) and Dynamics (DWG)
- Cases based on the annual TSP load forecast in the Annual Load Data Request (ALDR)
- There are two case builds a year
- ERCOT will use the RTP cases for the independent review (typically)

- Cases are modified for load, topology, and generation dispatch

- Alternative solutions are tested and evaluated
- Estimates for the alternatives are developed

- The recommended solution (project) is selected based on the mitigation, feasibility, cost, implementation timeframe, and the headroom for future load growth.

Regional Planning Group (RPG) Review Process

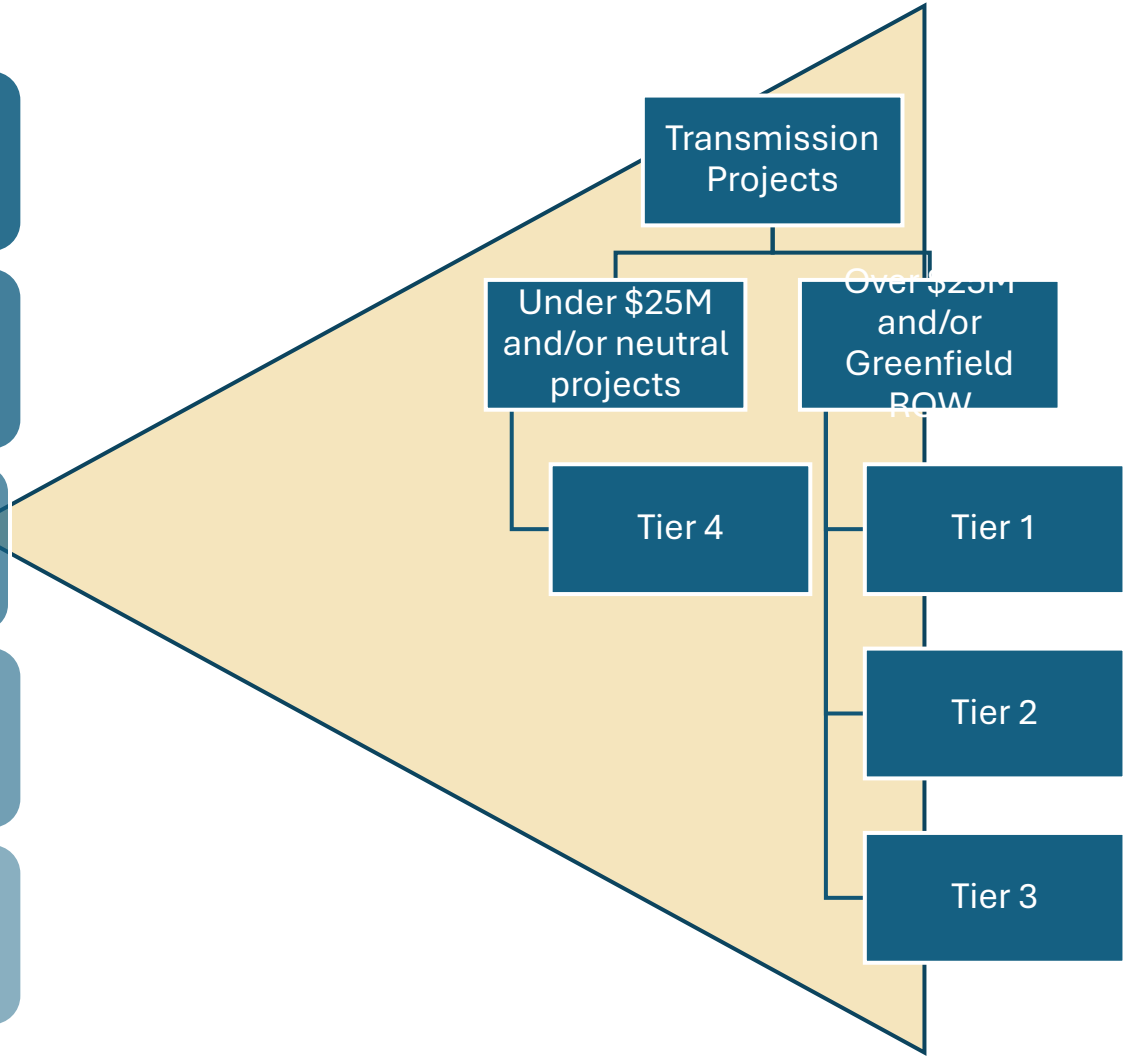
Projects Submitted to RPG

RPG Comment Period

ERCOT Evaluation Based on Project "Tier"

ERCOT Independent Review (Tier 1 & 2)

ERCOT project recommendation and Board Endorsement (if required)



Project Execution and Cost Recovery

Requires a Certificate of Convenience and Necessity (CCN) amendment

- TSP(s) submit an application to the PUCT
- A route is determined & finalized
- TSP begins ROW acquisition and project execution

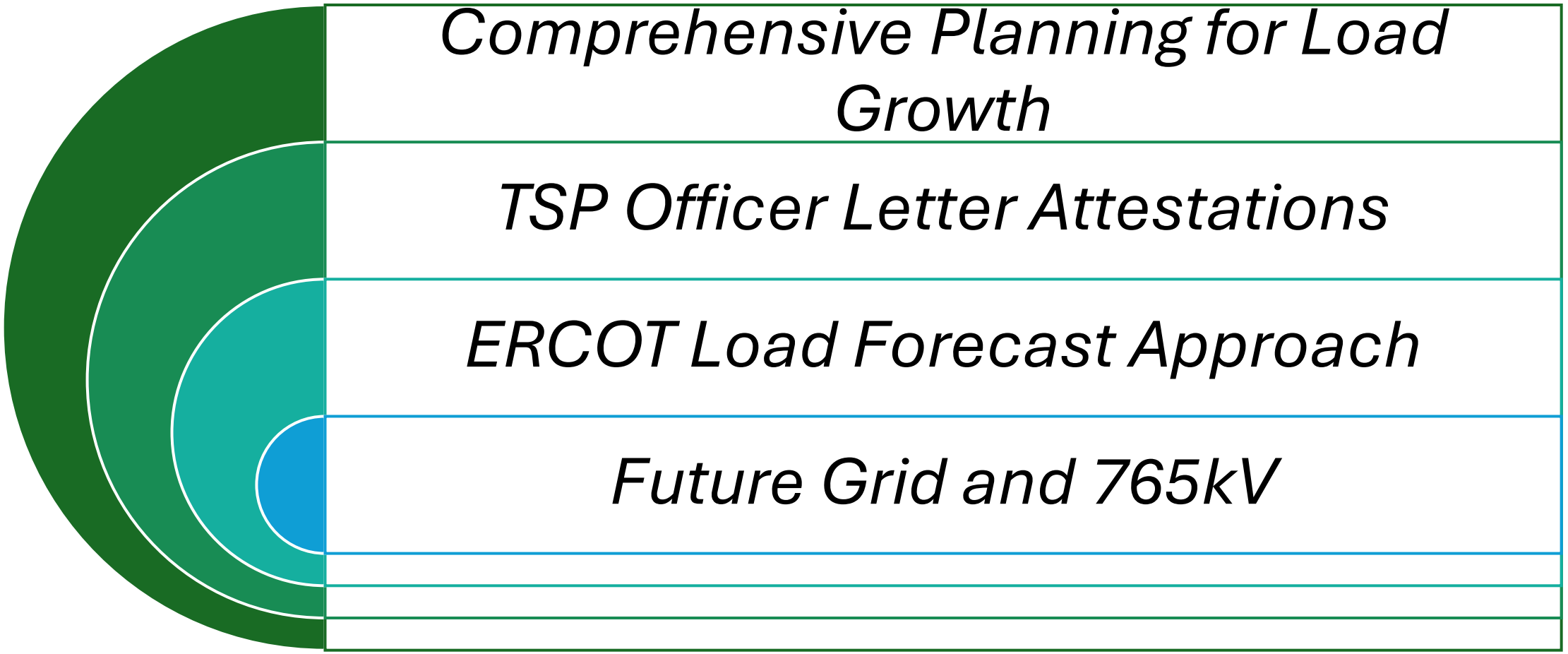
No CCN Required

- TSP executes the project as recommended/accepted by ERCOT and the Regional Planning Group.
- If the project is Tier 4, the TSP executes the project

- Project is added to the SSWG cases and to the Transmission Project Information Tracking (TPIT) report
- When construction begins, project is reported in the Monthly Construction Report (MCPR)
- When a project is completed, it is included in the TSP's Interim Transmission Cost of Service (TCOS) filing and/or Rate case filings

II. Key Transmission Policy Issues of Interest to the IOU Segment

IOU Segment Current Policy Issues of Interest



III. Key Issues for Board Awareness

I. ERCOT Regional Transmission Plan Use Cases

Issue #1: RTP Projects vs. RPG Submissions

- Regional Transmission Plan (RTP) projects do not have a consistently clear path for Regional Planning Group (RPG) processing and approval
- Due to time constraints, TSPs have limited opportunity to provide feedback and input to proposed RTP projects

Recommendation #1: Leverage the RTP

- Better leverage ERCOT's RTP results and allow adequate time for TSP preliminary feasibility review
- Allow the RTP to serve as the ERCOT Independent Review, when justifying the reliability need for an RTP-based RPG submission
- Enable RTP-based submissions to be expedited in the RPG process

II. Planning a System that can be Effectively Operated

Issue #2: Planning vs. Operations Gap

- There is a growing gap between planning and operations due to significant growth of solar resources and large loads
- Operational margin of the transmission system is rapidly declining

Recommendation #2: Realistic Planning

- Additional planning scenarios must be considered for both solar and wind generation to ensure the system is capable of supporting a wide range of real-time conditions
- Begin including nighttime and low-wind conditions in planning analyses

II. Planning a System that can be Effectively Operated, cont.

Issue #3: Energy Storage Resources (ESRs)

- ESRs represent a growing and important resource with capabilities to address supply and reliability needs
- Some ESRs participate in the ancillary service market for certain time periods while others participate in the wholesale market but are not dispatched as a reliability tool
- ERCOT can discontinue battery charging under emergency conditions, but the concept of “RUC-ing” a battery to charge and provide a set capacity in tight time periods does not currently exist
- SCED does not redispatch ESRs if they create voltage concerns when charging

Recommendation #3: Expand ESR Participation

- Expand ERCOT’s use and control of ESRs to ensure availability and performance for reliability needs
- Update SCED or use another tool to resolve voltage concerns when ESRs are charging

III. Large Load Coordination

Issue #4: Neighboring Large Load Interconnections

- Neighboring TSPs experience impacts from other interconnecting loads in the same geographical area that are being studied in other TSP territories
- NPRR1234 and PGRR115 made some progress with TSP coordination

Recommendation #4: Load Cluster Studies

- The most efficient way to look at neighboring TSP loads is in the aggregate, via coordinated studies
- Implement a more frequent and adaptive process to study Large Load requests with a clear path to interconnection
- ERCOT should play a lead role in coordinating neighboring TSPs' Large Load study processes, through wide-area Load Cluster Studies

III. Large Load Coordination, cont.

Issue #5: Large Load Operational Impacts

- Large Loads (primarily data centers and crypto-mining facilities) can pose operational concerns such as:
  - Non-consequential load loss during system events
  - Significant ramp rates
  - Oscillations
  - Power quality issues

Recommendation #5: Enhance ERCOT Requirements

- Establish uniform requirements that define acceptable operating parameters for large loads
- Revisit ERCOT Voltage Ride-Through criteria and ramp rates for Large Loads

ERCOT Transmission Planning: an Independent Generator Perspective

Josh Hale, Commercial Services Manager
Chase Smith, Market Compliance & Policy Manager

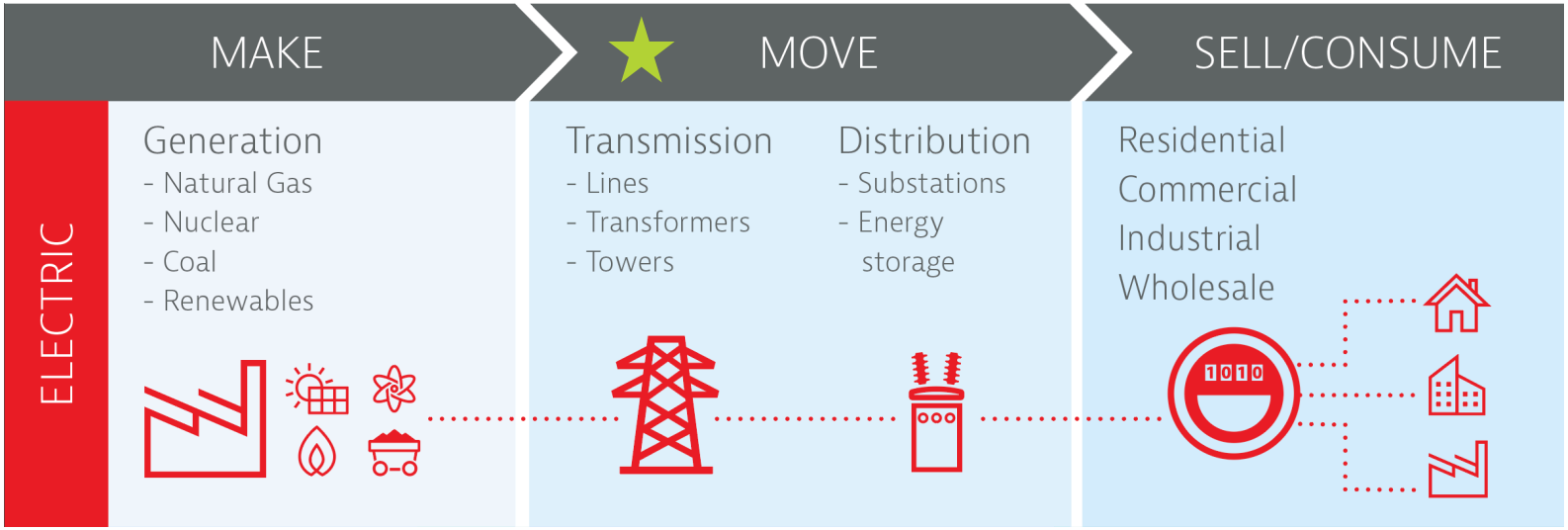
Southern Power

Agenda

- Independent Generator Segment's perspective of the ERCOT transmission planning process
- Business implications for Independent Generators
- Transmission policy engagement
- Current and future transmission planning challenges facing ERCOT

Transmission Planning: Independent Generator Perspective

Electric Value Chain



Key Insights

- Long-term, proactive transmission planning is critical to cost-effectively build transmission infrastructure and achieve reliability, economic, and public policy goals
- Transmission facilities provide (1) reliability benefits via a more robust, interconnected system and (2) economic benefits via more efficient dispatch of generation to meet customer demand, but should be balanced with market dynamics to manage costs
- Available transmission transfer capability is a key factor when selecting Resource site locations, load co-locations, and optimizing a Resource's commercial operations
- Transmission constraints may significantly impact the electricity production and financial return of a Resource, and in turn influence the ERCOT resource mix evolution

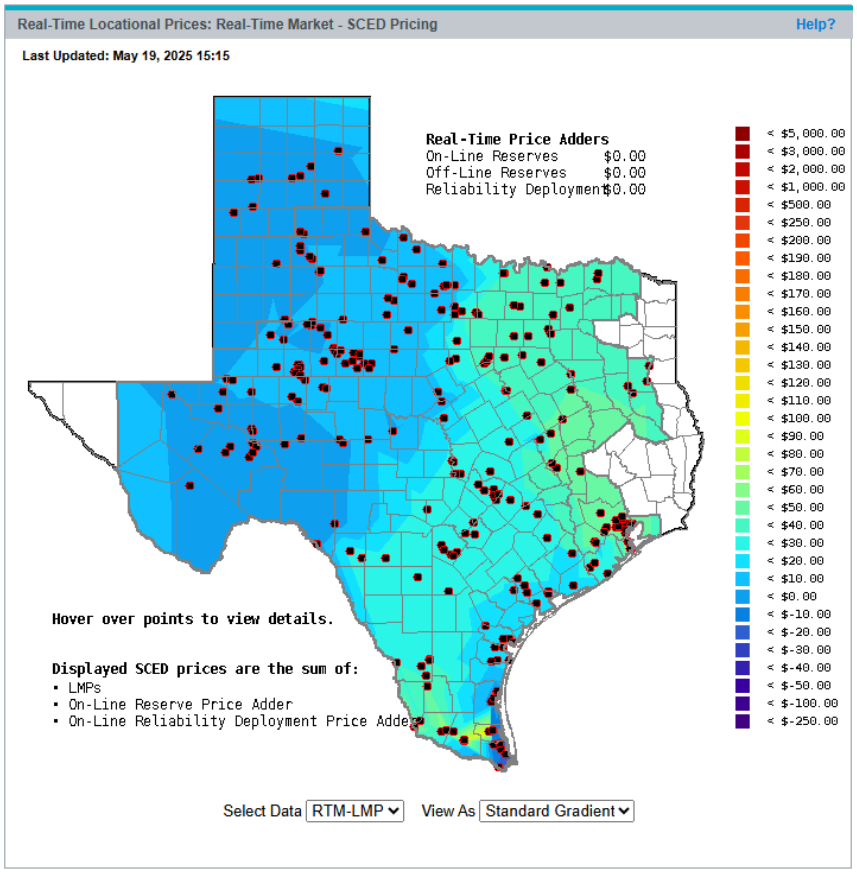
Transmission Planning: Business Implications

Resource Siting

- Transmission transfer capability is a key factor when selecting Resource site locations
- Nodal prices (including transmission constraints) are key to the ERCOT market and guide economic decisions
- Nodes price higher where supply is more valued and can incentivize Resource retention and development

Commercial Operations

- Independent Generators sell wholesale electricity and/or Ancillary Services
- Transmission constraints raise congestion costs and increase curtailed energy, harming the financial performance of some Resources
- Market Participants hedge congestion and curtailment risks via bilateral contracts, co-location with loads, and market products



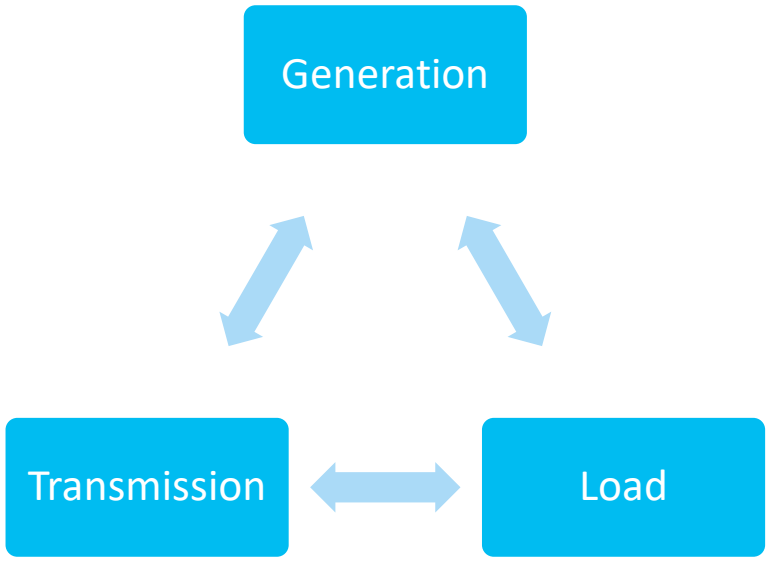
Key Terms

- **Transmission congestion** occurs when transmission constraints prevent the most efficient dispatch of generation to meet customer demand, leading to differences in electricity price points
- ERCOT may **curtail the energy production of certain Resources** to relieve transmission constraints and maintain transmission elements within rated operating limits

Market vs. Regulatory Congestion Management

Three options for congestion

- New generation capacity can relieve "high side" of a constraint
  - More supply near load pushes against power flow over constrained element
- New load (including co-located load) on "low side" of constraint
  - Efficiently utilize congestion-curtailed generation capacity
- Transmission operation and/or build to increase transfer capacity
  - If economic geography/development patterns preclude market solutions, then transmission operation/ development may be warranted
  - The current congestion cost savings test does not consider refunds to loads of congestion hedging



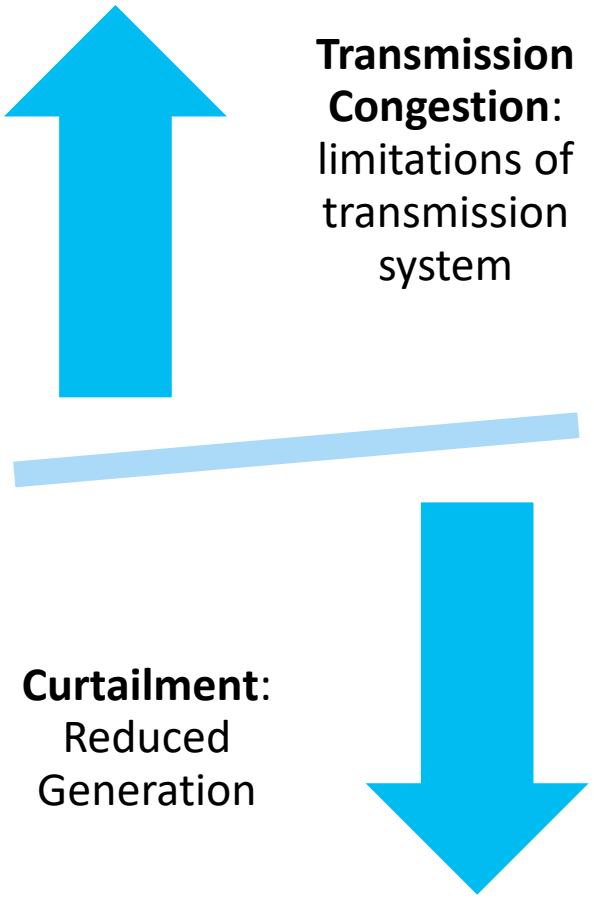
Balance in Transmission Policy

With congestion hedging costs returned to loads, congestion is an economic signal that influences market development – neither "good" nor "bad"

- Transmission is a permanent addition to customer bills vs. competitive dynamics
- Congestion can influence dispatchable vs. non-dispatchable investment/retirement signals for generators

Transmission Risks – Invest in New Generation?

Decision to invest in new generation in ERCOT requires complex transmission analysis



Transmission Congestion: limitations of transmission system

Curtailment: Reduced Generation

LOW RISK OPPORTUNITY

Predicting key transmission information is important to identifying low risk opportunities:

- Transmission investment approved to alleviate local transmission congestion
- Low curtailment risk: Maximize generation revenues
- Low basis risk: Maximize contract revenues
- Contract price that appropriately covers risk and meets financial hurdles

Invest in new Generation

Transmission Risks – Commercial Operations

Upon commercial operations, complex transmission analysis is required to manage volatility to maximize energy output, hedge congestion exposure and meet financial expectations.

VOLATILITY DRIVERS

Key drivers impacting operations:

- Extreme weather
- Generic transmission constraints
- New/retired generation
- Gas price
- Policy changes
- Transmission/generation outages
- Load/generation forecast error

VOLATILITY MANAGEMENT

A suite of transmission analysis tools is crucial to managing volatility:

- Multiple software vendors providing transmission tools
- Large datasets – historical & forecast
- Trading/hedging products to manage financial risk
- Generation bidding strategy
- Basis/curtailment mitigation: monitor transmission constraints

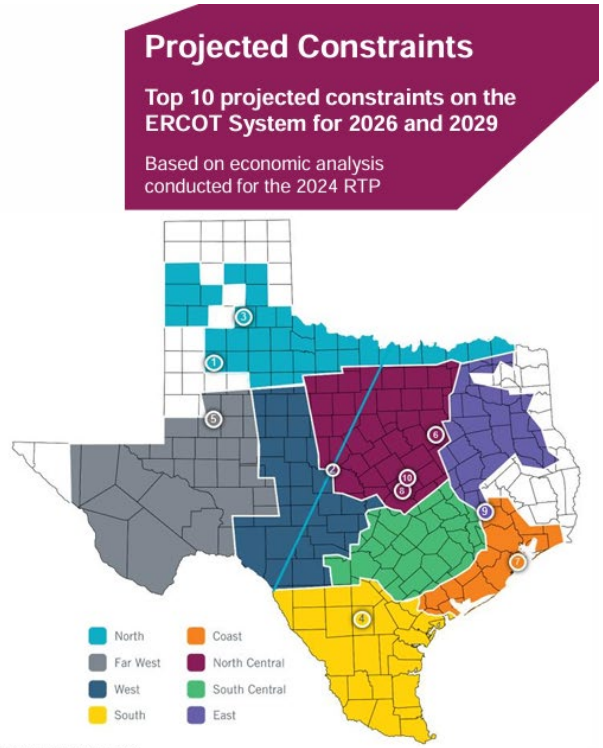
Generic Transmission Constraints

- Generic Transmission Constraints are operating limits used to constrain power flow between regions for purpose of managing stability and non-thermal reliability limits ★ ★
- GTCs may significantly increase congestion costs and the curtailment of certain Resources
- The West Texas and Panhandle GTCs are forecasted to be two of the most impactful constraints through 2029
- ERCOT publishes GTC exit strategies
  - Most exit strategies require significant transmission upgrades
  - ERCOT uses economic and reliability criteria to decide if a transmission upgrade to exit a GTC is warranted

Top 10 projected constraints on ERCOT System[1]

Map	Constraint	Congestion Rent* 2026	Congestion Rent* 2029
1	MacKenzie Substation - Northeast Substation 115-kV Line	$15M	$181M
2	West Texas Export Interface	$178M	$49M
3	Panhandle Interface	$139M	$100M
4	Fowlerton - Tilden 138 Sub 138-kV Line	$108M	$19M
5	Farmland - Wett Long Draw 345-kV Line	$19M	$64M
6	Navarro - Richland 69-kV Line**	$62M	-
7	Meadow - PH Robinson 345-kV Line	$54M	$42M
8	Stagecoach - Killeen Elm 138-kV Line	$49M	$24M
9	North - Houston Interface	$46M	$34M
10	Temple North - Pepper Creek Switch 138-kV Line	-	$40M

*Congestion rent indicates areas of the system where economic transmission projects may be beneficial. It is not an indication of whether a project to reduce specific congestion would or would not meet the ERCOT economic planning criteria. Planned transmission outages were not included in the analysis.
**A placeholder RTP proposed project (2023-NC39) was recommended in 2023 RTP to resolve the reliability issue on Navarro - Richland 69-kV Line in 2028.



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[1] ERCOT 2024 Report on Existing and Potential Electric System Constraints and Needs

Transmission Policy Engagement

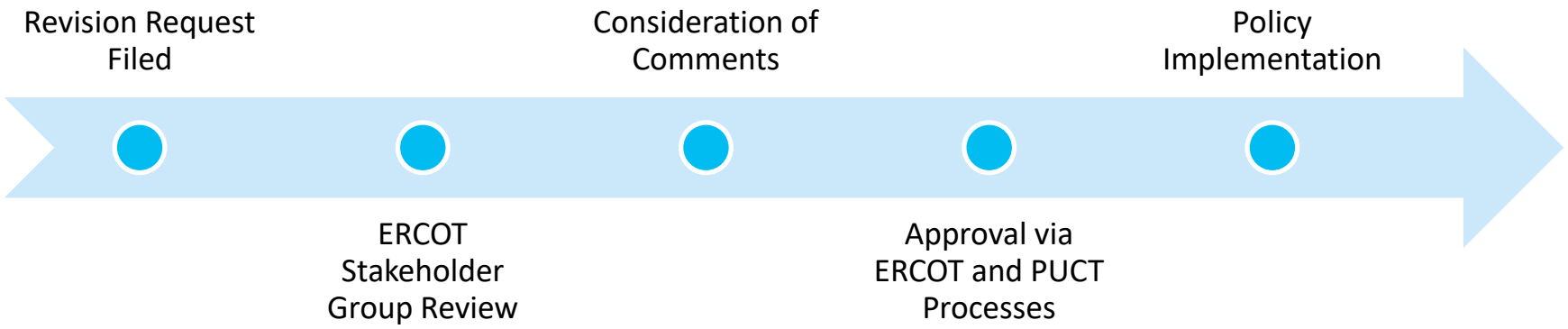
Independent Generator segment engages on transmission planning issues in ERCOT stakeholder groups:

Regional Planning Group

Monitors and provides feedback on ERCOT planning activities and studies, reviews and assesses impact of proposed transmission projects

Reliability and Operations Subcommittee and Planning Working Group

Evaluates and offers feedback on interconnection and transmission planning policies used by ERCOT to assess interconnection requests and plan for ERCOT System needs



Current and Future Challenges facing ERCOT

Planning for the Future Grid

- ERCOT's transmission planning process must plan for forecasted load growth, a changing resource mix, and System reliability and economic needs
- Facilitate economic development opportunities for Texas
- Address System resiliency needs and mitigate the impact of extreme weather events
- Mitigate instability and subsynchronous oscillation risks by improving system strength and bypassing unnecessary series capacitors, respectively

Mitigating Impact of Transmission Constraints

- Prudently manage congestion costs and curtailment associated with transmission constraints, particularly Generic Transmission Constraints
- Identify meaningful GTC exit strategies
- Deploy reliable and effective transmission reconfigurations
- Retain signals for generation to optimally site to resolve constraints

Accurate Long-Term Load Forecasting

- Growing interest in large load development and TSP-Officer attested letters are leading to unprecedented and rapid forecasted load growth
- Assess and potentially adjust load forecast to produce meaningful results: better match transmission investments to load growth