EAC – Power Delivery- Arlington, Va

Distributed Energy Resources; The Transmission/Distribution interface and ERCOT's Markets

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ercot
Your Power. Our Promise.

Quick Facts

What we do

The Texas Legislature restructured the Texas electric market in 1999 by unbundling the investor-owned utilities and creating retail customer choice in those areas, and assigned ERCOT four primary responsibilities:

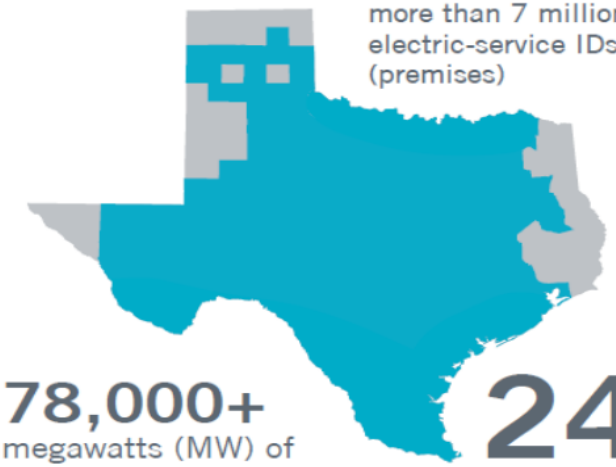
- System reliability – planning and operations
- Wholesale market settlement for electricity production and delivery
- Retail switching process for customer choice
- Open access to transmission

90 percent of Texas Load

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

66,921 MW Weekend demand record (August 7, 2016)

75% of load is competitive-choice customers — more than 7 million electric-service IDs (premises)



78,000+ megawatts (MW) of expected capacity for peak

24 million consumers in the ERCOT region

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

570+ generating units

46,500+ circuit miles of high-voltage transmission

In 2016, $2.1 billion in transmission development added to the ERCOT region.

1,266 circuit miles of transmission planned with $5.6 billion under development over the next five years.

1,448 circuit miles of transmission improvements completed by market participants in 2016.

>17,000 MW of installed wind capacity, the most of any state in the nation.

Wind Generation record:
16,022 MW (Dec. 25, 2016)

Wind Penetration record:
48.28 percent (March 23, 2016)

556 MW of utility-scale installed solar capacity as of January 2017

Solar capacity in queue:
2017: 1,211 MW
2018: 1,511 MW

Outline

- ERCOT's existing Electricity Market and Processes
- The growing potential of DER
- Potential effect on Operations, Planning and the Market
- Vision for future

ERCOT Markets – Wholesale Market

- Transmission Connected Generators over 10 MW are required to register as a Generation Resources and are paid Locational Marginal Prices (LMP) as calculated in ERCOT SCED.

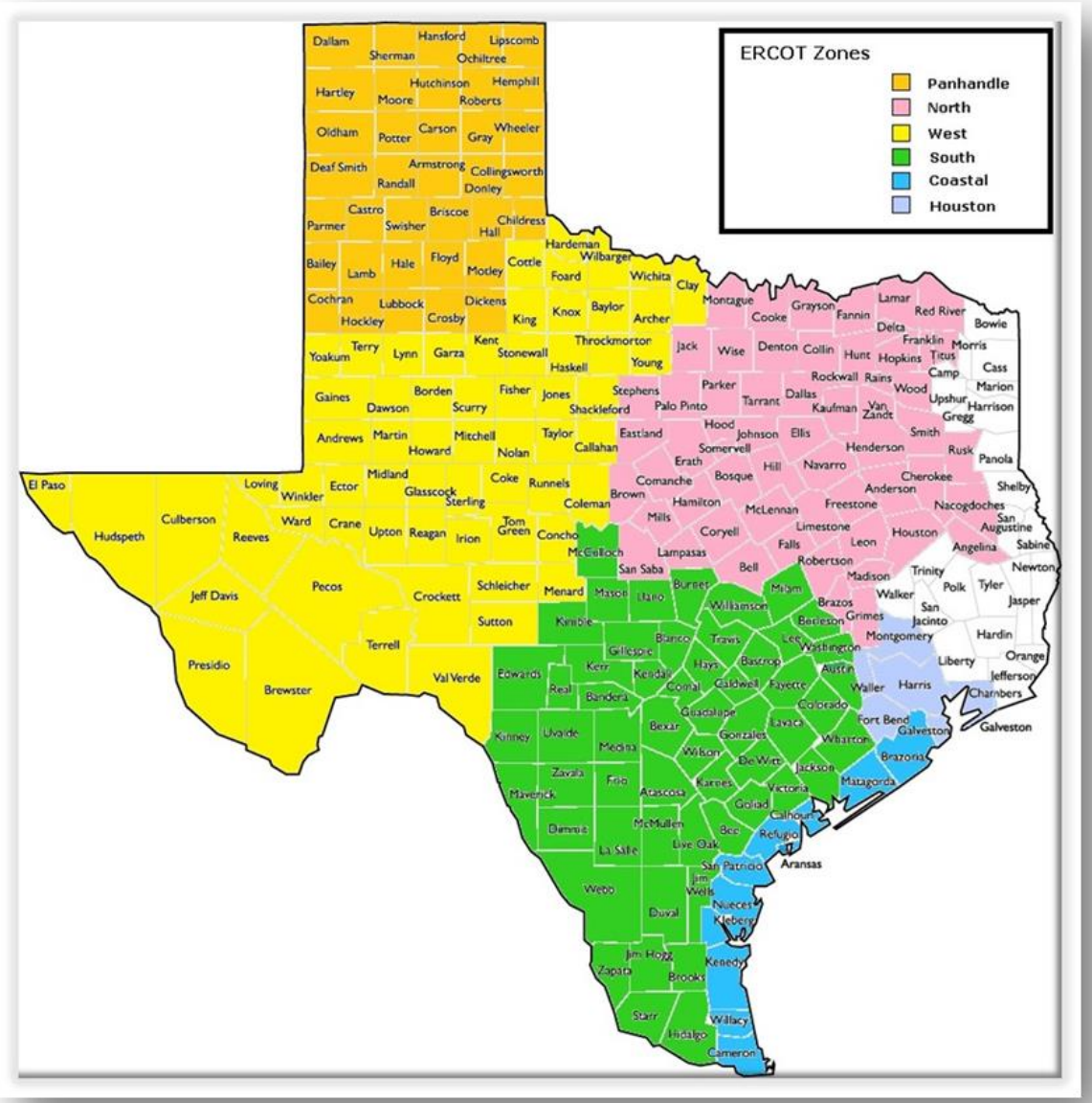
- Ancillary services are procured in the Day Ahead market and paid hourly clearing prices.

- DERs < 10 MW may choose to register as a Generation Resource to participate in SCED or Ancillary services. Otherwise, they will just be considered a passive participant.

- DERs, not registered as a Generation Resource, are paid zonal prices, not LMP. (weighted average of LMP prices in the zones)

- ERCOT Models the Transmission Grid down to the 69kV level, but does not model distribution systems.

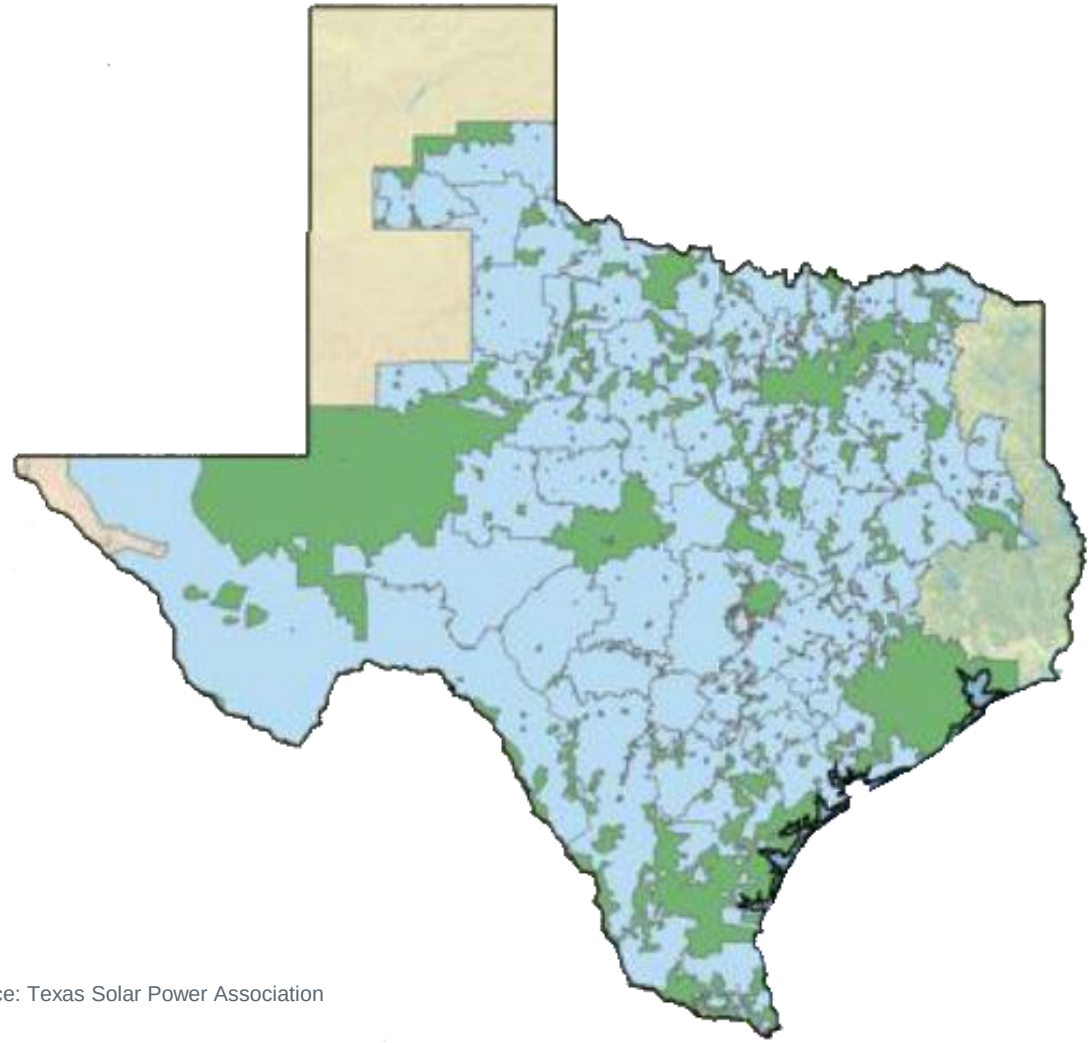
ERCOT Load Zones



ERCOT Markets – Retail Market

- Retail Electric Providers (REP's) provide service to 75% of ERCOT's loads (i.e. competitive choice)
- Non-Opt in Entity (NOIE's) are Municipally Owned Utilities or Electric Cooperatives which have chosen not to offer competitive choice. They provide service to the remaining ~25%.
- REP's may offer service to any load operating in a completive area.
- The Public Utility Commission provides the "Power to Choose" website for REP comparisons.
- A Distribution Service Provider may provide distribution services to consumers served by many different REP's.

ERCOT includes Competitive, Municipal and Cooperative Service Areas



Competitive Retail Area

Municipally Owned Utilities and Electric Co-Ops

Source: Texas Solar Power Association

Growing Distributed Energy Resources

- ~900 MW of DERs in Competitive areas + ~200 MW in NOIE areas

- Two basic groups

  - Self Dispatched Generation – often providing backup power to critical infrastructure & may be responding to prices. There are less than 200 units in operation and approximately 70 inject onto the grid.

  - Intermittent generation, primarily rooftop solar, typically offsetting native load and exporting excess generation during light load conditions. There are an estimated 23,000 locations representing ~1/5 of Distributed generation sites.

Potential effect on Grid Operations and Planning

- Current DER penetration represents about 1.4% of total generating capacity. DER dispatch already affects congestion.
- Increased error in load forecasting, load adaptation, and State Estimation results
- Incorrectly modeled response to faults and system disturbances
- Lack of coordination during System Restoration
- Over-operation of voltage control equipment not coordinated with active sources.
- Planning is studying the future system, today. Knowledge of future DER capacities could make a difference in Planning studies.

Potential effect on Markets

- Existing market does not include DERs in price formation.
- Failure to apply LMP pricing to distribution injections could lead to conflicting price incentives.
- Current market has price spikes from ramping requirements exceeding modeled resources. Increases in non-responsive resources could aggravate this situation.

A Vision for ERCOT's future

- ERCOT's plan for integrating DERs do not involve modeling of distribution circuits. ERCOT in coordination with the TSP would assume a Registered DER or Unregistered cluster of DER would be "normally" located on a specific CIM Load.
  - On dense distribution systems, this assumption may be violated. What risks does this introduce?
  - Should there be a mechanism for the Transmission ISO to exercise some level of control over groups of distributed resources? How should this be accomplished in a market environment?
  - How should reactive and transient contributions of distribution resources be included in Grid reliability and market studies?
  - How should the transmission planning include DERs?

A Vision for ERCOT's future

- One step at a time, with concurrence of Market Participants

  - **Step 1** – Model in ERCOT's Common Information Model (CIM) Load all the Registered DERs (~87 units and ~ 550 MW).
    - The CIM Load would serve as the Transmission/Distribution Interface.
    - The ERCOT CIM currently has over 5500 CIM Loads
    - Incorporate lessons learned from higher penetration RTO/ISOs

  - **Step 2** – Develop a standardized method for collecting appropriate data for future unregistered DER unit accumulations.

  - **Step 3** – Establish thresholds for adding accumulations of DER that exceed agreed upon thresholds into the CIM Loads.