



# Intelligent Efficiency in Texas

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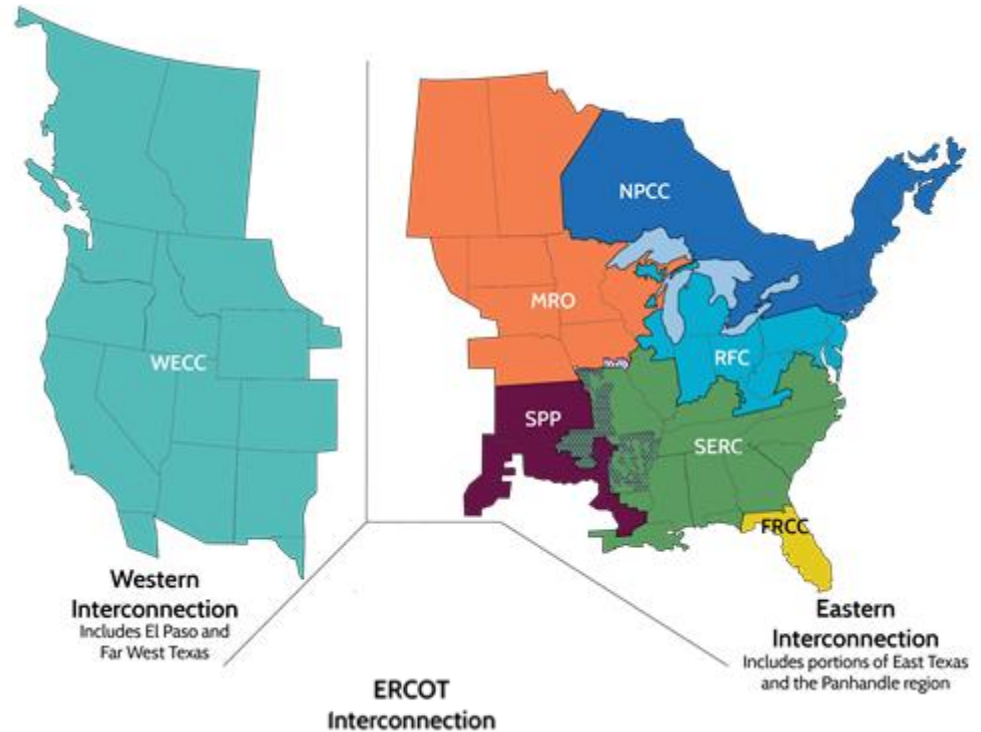
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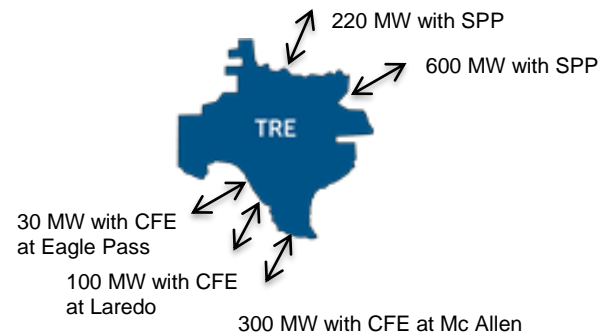
# The ERCOT Region

The interconnected electrical system serving most of Texas, with limited external connections

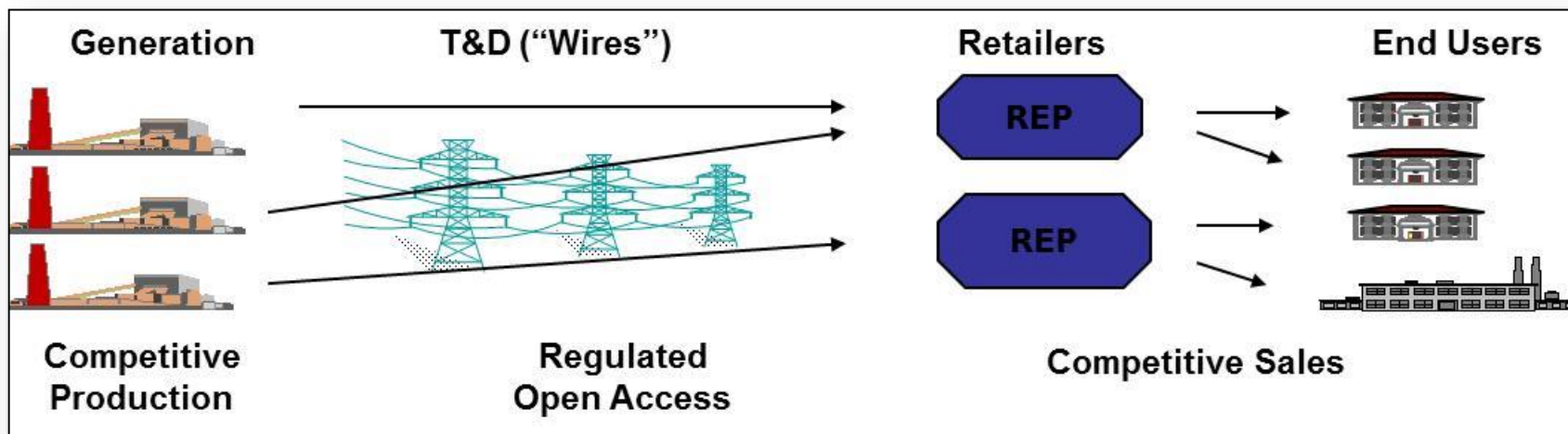
- 90% of Texas electric load; 75% of Texas land
- 71,093 MW peak, August 11, 2016
- More than 46,500 miles of transmission lines
- 550+ generation units



*ERCOT connections to other grids are limited to ~1,250 MW of direct current (DC) ties, which allow control over flow of electricity.*



# Texas Competitive Model



## Wholesale

- Fully unbundled Wholesale market
- ERCOT operates a single Balancing Area
- 5-Minute security constrained economic dispatch with Day-Ahead and Ancillary Services markets
- Generators are paid Locational Marginal Prices (LMPs) at node.
- Load-serving entities pay averaged load-zone prices.
- Voluntary Day-Ahead Market

## Transmission

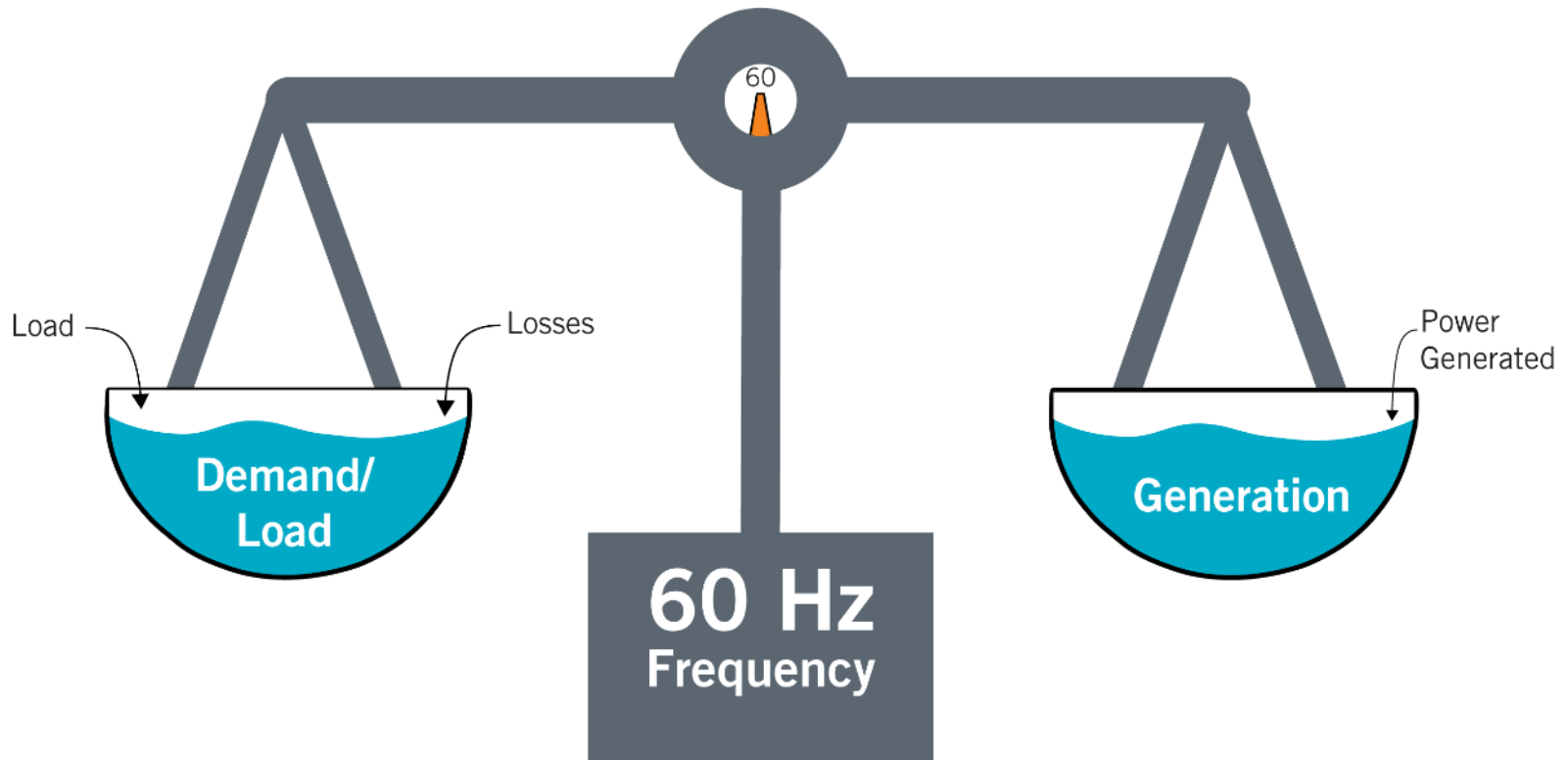
- All transmission costs are rolled in to single postage-stamp rate paid by load.
- Any transmission owner that transmits power for another entity is a regulated utility under state law.
- No transmission service market

## Retail

- Full Retail competition for all customer types
  - Except in municipal and cooperative utility areas
  - Customers choose retail provider and terms of contract
- Smart meters (which measure time of consumption) installed on all customer types – about 7 million meters

# Power Supply (Generation) Must Match Load (Demand)

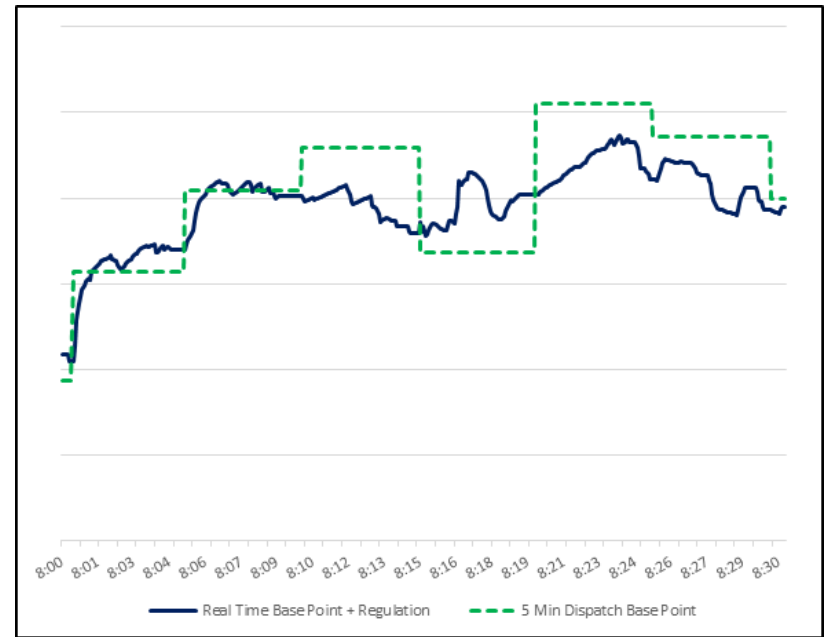
- The fundamental concept behind ERCOT operations is that generation has to match load at all times.



- In other words, a 1 MW reduction in load has exactly the same effect on the grid as a 1 MW increase in generation.*

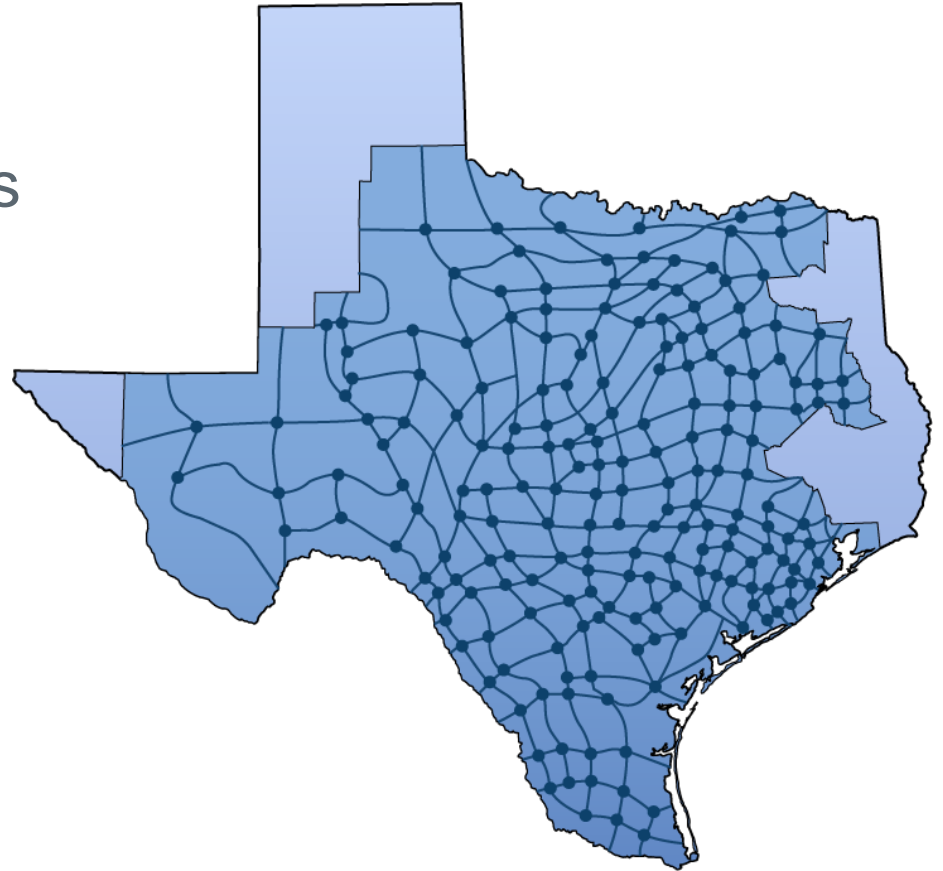
# Ancillary Services

- Load and generation are constantly changing, requiring continual rebalancing, due to:
  - Daily load patterns
  - Instantaneous load variation
  - Changes in intermittent generation output
  - Generators tripping offline
- Ancillary Services are procured to ensure sufficient resources are on-line, or able to be brought on-line in a timely manner, to balance the variability that cannot be covered by the 5-minute energy market.
- ERCOT is in process of redefining the Ancillary Services framework to make these services more efficient and technology neutral.



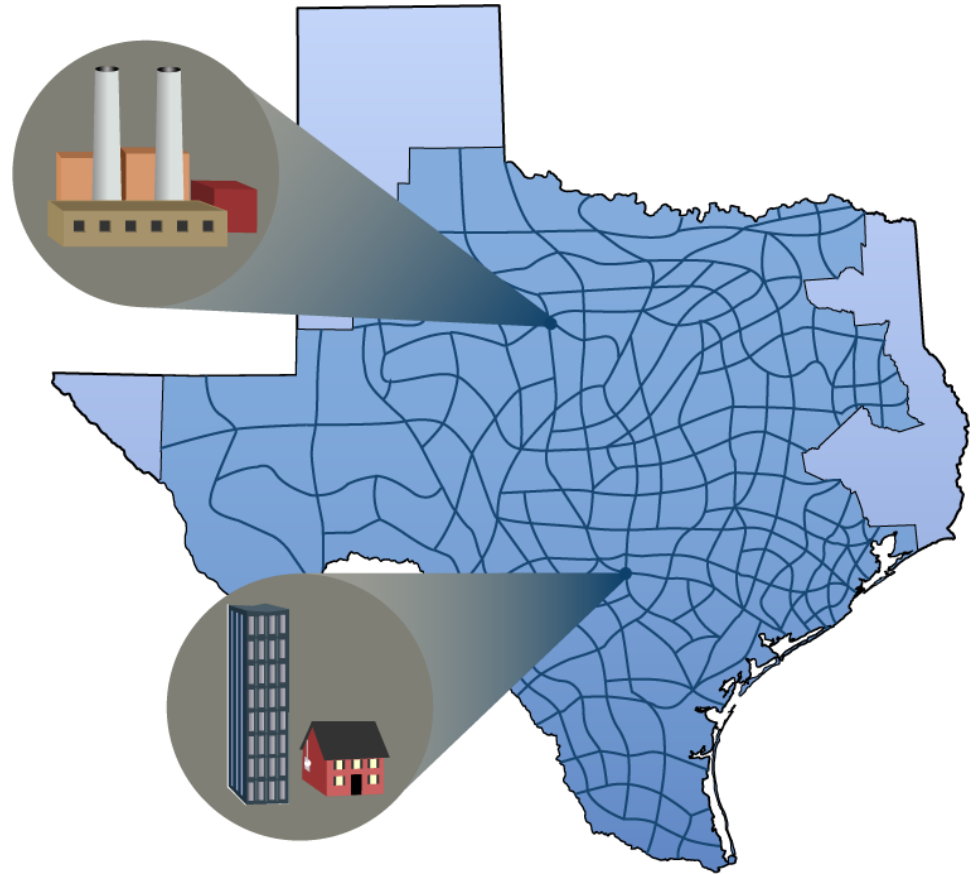
# Commercial Markets

- Bilateral Market
- ERCOT Facilitated Markets
  - Day-Ahead Ancillary Services Market
  - Day-Ahead Energy Market
  - Real-Time Energy Market



# Congestion Costs

- All costs are directly assigned
- Congestion Revenue Rights available for hedging



# Energy-Only Market: What does that mean?

It's all about the recovery of costs to build (and operate) generation.

*In ERCOT, these costs must be recovered with revenues from energy production and operating reserves.*





# Energy-Only Market: What does that mean?

Energy Pricing must support investment in new generation. A much higher clearing price \$9,000/MW or MWh in ERCOT.

**Scarcity pricing** – higher energy prices during periods where energy reserves are scarce

**Operating Reserve Demand Curve** – reflecting the cost of deploying reserves (Ancillary Services) in the energy price.



# Looking into the future

- More intermittent renewables
- More distribution level resources
- Less conventional, thermal generation
  - Coal and Nuclear under market pressure from:
    - Low natural gas prices
    - Renewable resources
    - Added regulation
    - Renewable portfolio standards
- Storage?
- Distribution level thermal resources?
- Changes to the Retail Market

## ERCOT seeks...

- Better visibility and accounting of distribution level resources for operational reliability and planning
- Improvements in ancillary services to accommodate the changing resource mix.
- Optimal pricing of energy to create the correct incentives.