The Development of Competitive Renewable Energy Zones in Texas

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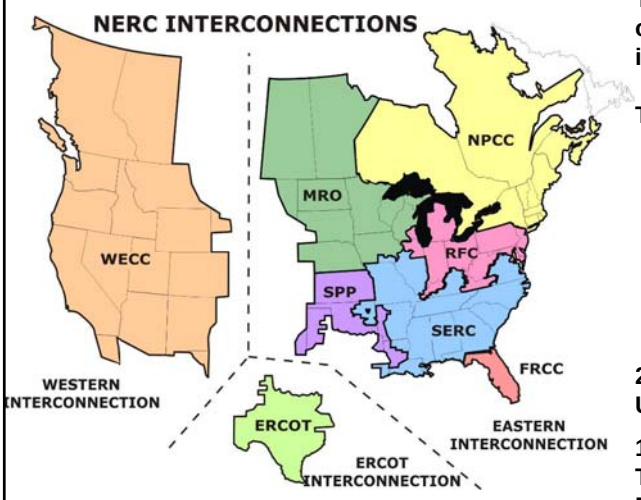
North American Electric Grids



The ERCOT Region is one of 3 NERC grid interconnections.

The ERCOT grid:

- -75% of Texas land
- -85% of Texas load
- -38,000 miles of transmission lines
- -550+ generation units
- -62,339 MW peak demand (set 8/17/06)

2,877 MW of Switchable Units

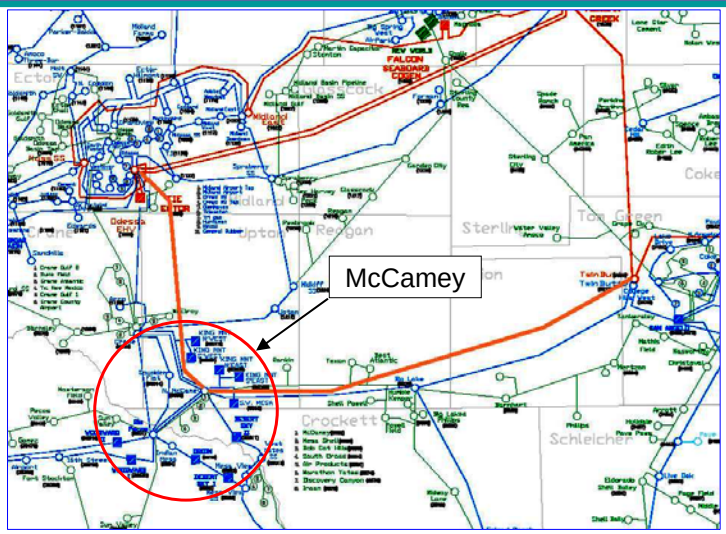
1,106 MW of Asynchronous Tie Capacity (820 MW with Eastern Interconnection)

Advantages for Wind Generation in ERCOT

- **Marginal cost of electricity is set by gas generation in most hours**
- **Generators do not pay for transmission system upgrades (ERCOT has a postage-stamp transmission rate, paid by load)**
- **Wind resources in Texas are world-class: over 30 GW of wind generation potential with greater than 40% net capacity factor and over 100 GW of wind generation potential with greater than 35% net capacity factor**
- **ERCOT contains three of the ten largest cities in the United States (Houston [4], San Antonio [7] and Dallas [9]; Austin and Fort Worth are in the top 20)**

Which Comes First?

Construction of wind units in the McCamey area stopped after export limits were imposed (due to voltage constraints).

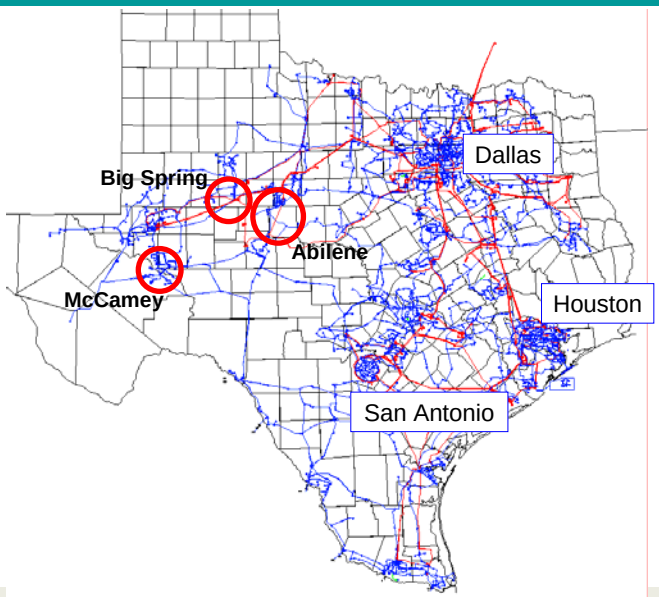


Transmission Infrastructure near McCamey, Texas
(Blue lines are 138-kV; Orange lines are proposed)

Wind Generation Locations in ERCOT

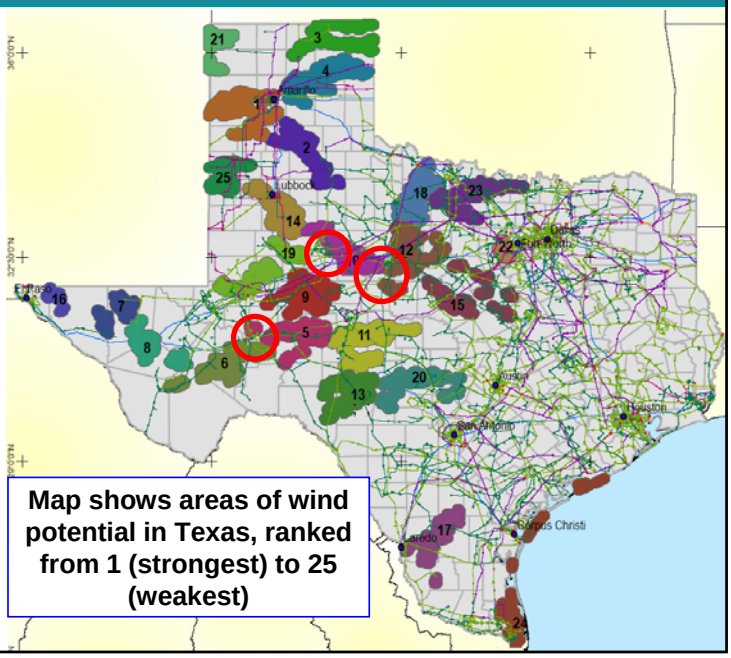
After the McCamey area became constrained, wind developers sought out locations where transmission capacity was available and wind resources were acceptable.

Most of the wind in ERCOT is currently aggregated in three areas (red circles).



Wind Resources In Texas

Current development of wind resources (red circles) is occurring in areas of lesser wind quality, and ERCOT is not gaining the advantage of wind diversity



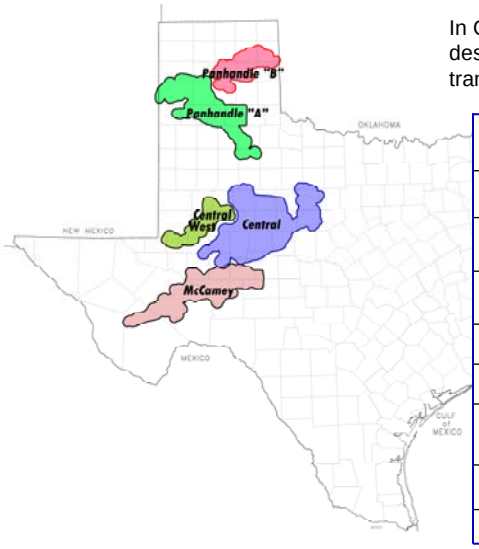
Map shows areas of wind potential in Texas, ranked from 1 (strongest) to 25 (weakest)

CREZ Background

In 2005, the Texas Legislature passed SB 20, instructing the Public Utility Commission of Texas (PUCT) to designate transmission for Competitive Renewable Energy Zones (CREZs)

- **The PUCT established contested-case docket 33672 in January, 2007**
- **Parties nominated CREZs and demonstrated financial commitment**
- **Transmission service providers proposed transmission solutions**
- **Hearings held in June 2007**
- **Interim Order was issued in October**

Designated Zones and Scenario Wind Levels

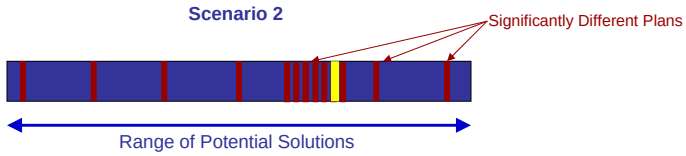


In Oct., 2007, the PUCT issued an Interim Order designating 5 areas as CREZ, and requesting transmission plans for 4 levels of wind capacity.

Capacity of New CREZ Wind by Scenario (MW)				
Wind Zone	**Scen. 1**	**Scen. 2**	**Scen. 3**	**Scen. 4**
Panhandle A	**1,422**	**3,191**	**4,960**	**6,660**
Panhandle B	**1,067**	**2,393**	**3,720**	**0**
McCamey	**829**	**1,859**	**2,890**	**3,190**
Central	**1,358**	**3,047**	**4,735**	**5,615**
Central West	**474**	**1,063**	**1,651**	**2,051**
Total*	**12,053**	**18,456**	**24,859**	**24,419**
* Assumes 6,903 MW of existing wind capacity				

ERCOT CREZ Study Approach

- Develop a number of significantly different core concepts and compare their performance
- Develop variations on the concepts with best performance
- Optimize the best performing plan for each scenario

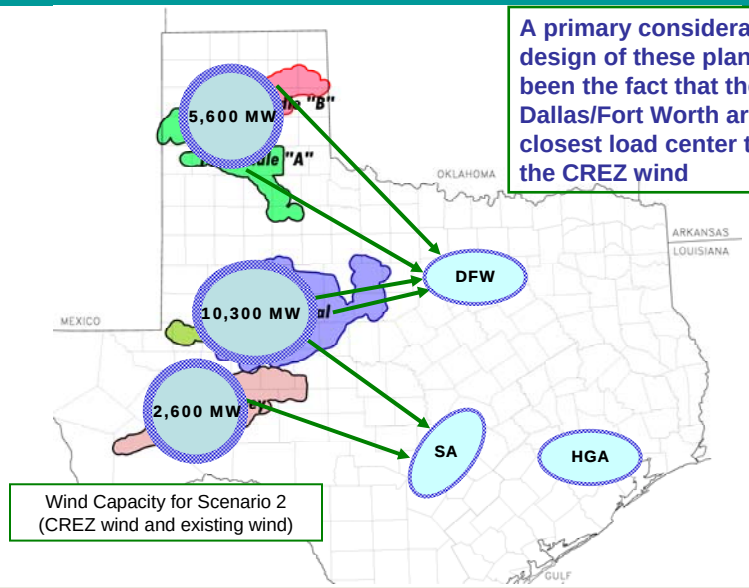


- Use steady-state models to analyze AC power flows, a security-constrained unit-commitment and economic-dispatch model to evaluate impact of generation dispatch on congestion (using real power flows as an approximation), and transient stability model for voltage, frequency and angular stability analysis.

Five Different Design Concepts

1) **Incremental 345-kV transmission system for wind in west Texas**
2) **Integrated 345-kV transmission system for wind in west Texas**
3) **Reduced number of right-of-ways using higher voltage circuits (500 kV or 765 kV)**
4) **Low impedance backbone or loop**
5) **HVDC circuit(s) to move power to load centers or between load centers, integrated with 345-kV upgrades**

System Overview



A primary consideration in the design of these plans has been the fact that the Dallas/Fort Worth area is the closest load center to much of the CREZ wind

Wind Capacity for Scenario 2
(CREZ wind and existing wind)

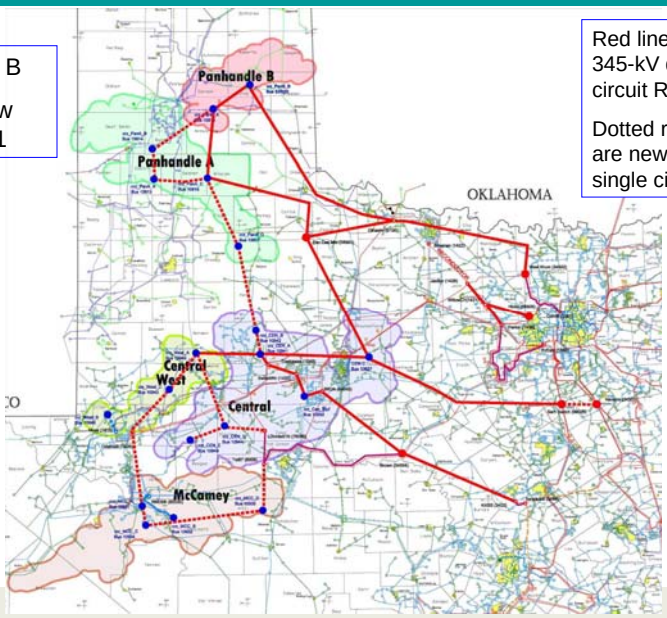
What Have We Learned?

- **A fundamental question in this study:**
  - What transmission plan is best suited to collect wind generation from scattered locations across much of west Texas, move it hundreds of miles to east Texas, and then redistribute the power-flows to load centers, utilizing any available transmission capacity but without increasing congestion on the existing transmission system?
- **Answer: It depends**
  - On the distribution of wind resources
  - On the strength of the underlying system in West Texas
  - On the availability of strong connections on the existing system near load centers

Scenario 1

Cost: ~$3.8 B

Miles of New ROW: 1,831



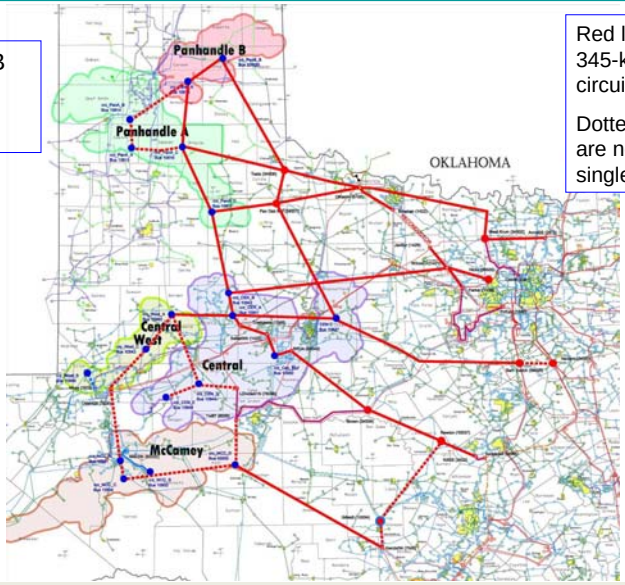
Red lines are new 345-kV double circuit ROW

Dotted red lines are new 345-kV single circuit ROW

Scenario 2

Cost: ~$4.9 B

Miles of New ROW: 2,376



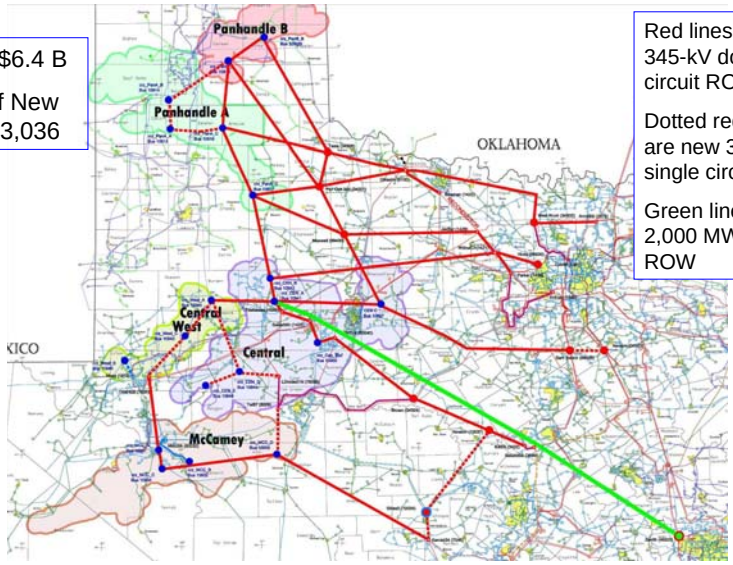
Red lines are new 345-kV double circuit ROW

Dotted red lines are new 345-kV single circuit ROW

Scenario 3

Cost: ~$6.4 B

Miles of New ROW: 3,036



Red lines are new 345-kV double circuit ROW

Dotted red lines are new 345-kV single circuit ROW

Green line is new 2,000 MW HVDC ROW

Next Steps

- **A Technical Conference will be held at the PUCT on April 24, 2008**
- **A second Hearing on the Merits will be held on May 15, 2008**
- **A final order may be issued as early as June 2008**
  - Order should include the amount of wind generation in each CREZ
  - Order should be followed by the selection of transmission companies to build the new transmission
  - Legal action may follow
- **Selected transmission companies will have 1 year to submit routing applications (CCNs)**
- **PUCT will have 6 months to review applications**
- **The first transmission pathways from CREZ to loads may be in service in late 2012**

Summary

- **CREZ process was designed to build transmission for wind generation in a timely manner, to take advantage of best wind resources, and to increase wind diversity**
- **CREZ Rulemaking began in October, 2005; the final ruling is possible in summer 2008**
- **New transmission capacity is not expected to be available for at least three years**
- **Recommended plans represent significant changes to the existing transmission infrastructure**
  - Incorporating generation from new areas into ERCOT
  - Fifty percent increase in the number of miles of 345-kV ROW
- **Local and regional upgrades are on hold waiting for final CREZ ruling**

ERCOT

Questions?