The Competitive Renewable Energy Zones Process

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The ERCOT Region is one of 3 interconnections in North America. The ERCOT grid:
- 75% of Texas land
- 85% of Texas load
- 38,000 miles of transmission lines
- 550+ generation units
- 68,305 MW peak demand (set 8/3/2011)

Regional Import Capacity: 1,256 MW of Asynchronous Tie Capacity (820 MW with Eastern Interconnection)
Competitive Renewable Energy Zones

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
- First Hearing held in June 2007
Designated Zones and Scenario Wind Levels

In Oct. 2007, the PUCT issued an Interim Order which designated 5 areas as CREZ and requested that ERCOT and stakeholders develop transmission plans for 4 levels of wind capacity.

<table>
<thead>
<tr>
<th>Wind Zone</th>
<th>Scen. 1</th>
<th>Scen. 2</th>
<th>Scen. 3</th>
<th>Scen. 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panhandle A</td>
<td>1,422</td>
<td>3,191</td>
<td>4,960</td>
<td>6,660</td>
</tr>
<tr>
<td>Panhandle B</td>
<td>1,067</td>
<td>2,393</td>
<td>3,720</td>
<td>0</td>
</tr>
<tr>
<td>McCamey</td>
<td>829</td>
<td>1,859</td>
<td>2,890</td>
<td>3,190</td>
</tr>
<tr>
<td>Central</td>
<td>1,358</td>
<td>3,047</td>
<td>4,735</td>
<td>5,615</td>
</tr>
<tr>
<td>Central West</td>
<td>474</td>
<td>1,063</td>
<td>1,651</td>
<td>2,051</td>
</tr>
<tr>
<td><strong>Total</strong>*</td>
<td>12,053</td>
<td>18,456</td>
<td>24,859</td>
<td>24,419</td>
</tr>
</tbody>
</table>

* Assumes 6,903 MW of existing wind capacity
CREZ Ruling – 2,376 Miles of New ROW

Red lines are new 345-kV double circuit ROW
Dotted red lines are new 345-kV single circuit ROW
Planning cost estimate: $4.9 B (based on straight-line routing)

<table>
<thead>
<tr>
<th>Zone</th>
<th>New Wind Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panhandle A</td>
<td>3,200</td>
</tr>
<tr>
<td>Panhandle B</td>
<td>2,400</td>
</tr>
<tr>
<td>Central</td>
<td>3,000</td>
</tr>
<tr>
<td>Central West</td>
<td>1,100</td>
</tr>
<tr>
<td>McCamey</td>
<td>1,900</td>
</tr>
</tbody>
</table>
Next Step - Selecting Transmission Providers

The PUCT assigned the proposed CREZ circuits to a set of incumbent and new entrant transmission service providers.
PUCT staff developed a schedule to consider the routing (CCN) applications for the 72 new circuits.

Transmission Service Providers studied potential routes, developed testimony, and worked with property owners.

This graph depicts the number of projects by TSP that were in permitting and construction by month.

Projects were modified by TSP and ERCOT if obstacles were noted during route development.
As of January 30, 2014, the CREZ transmission projects were complete. The transmission plan is designed to serve approximately 18.5 GW:
- ~3600 right-of-way miles of 345 kV
- $6.9 billion project cost
Lines are open-access; use not limited to wind

The Impact of CREZ on Wind Generation Development in ERCOT

Current ERCOT Wind Generation Records

10,296 MW, on March 26, 2014, at 8:48 p.m.
- Non-Coastal Wind Output = 8,863 MW
- Coastal Wind Output = 1,433 MW
- Wind gen. supplied 28.78% of the 35,768 MW Load

39.40% Wind Penetration, on March 31, 2014, at 2:12 a.m.
- Total Wind Output = 9,699 MW
- Total Load = 24,618 MW
Why Has CREZ Been a Success

- The ERCOT region has both world-class wind resources and large population (load) centers
- There are few barriers to land development in west Texas
- The CREZ project combined economic development, development of in-state energy resources, and development of green energy
- Cost allocation formulas are settled
- The overall risk of the project was controlled by taking small steps, and by maintaining the ability to change course if needed
- The regulatory processes and technical planning analyses moved forward in tandem
- Wind integration is facilitated in ERCOT by a large fleet of flexible natural gas, combined-cycle generation, and by system-wide dispatch at 5-minute intervals
- The geographic scope of the ERCOT system lends itself well to regional planning
Takeaway Thoughts

• Infrastructure development can have unforeseen benefits
  – Some CREZ circuits are also being used to connect new shale-gas load to the ERCOT system.

• The challenge of integrating new technologies continues
  – CREZ planning and development has required several industry-leading technical studies
    • Reactive device plan optimization
    • Sub-synchronous interactions
    • Stability impacts of regions with high wind penetration and reduced system strength
  – Continued development and validation of models that accurately represent the behavior of power-electronics-based generation resources is essential
  – The changing nature of the resource fleet is affecting other areas of planning
Questions?