Wind Energy & Transmission Planning in the ERCOT Region

Background Information for House Subcommittee on Renewables
March 16, 2005

Kent Saathoff, Director of System Operations
Electric Reliability Council of Texas
• ERCOT supervises an open, non-discriminatory planning process that considers and balances the impact of transmission system additions on stakeholders
• Projects or studies can be proposed by any Market Participant, Transmission Owner or ERCOT Staff
• Stakeholders have opportunity to comment on proposals and offer alternative solutions
• ERCOT Staff performs independent review
• ERCOT Staff makes independent recommendation to the Board of Directors for major projects
• ERCOT Board endorsements are considered by the PUC for approval of Certificate of Convenience & Necessity
Facilities added and currently in service (since 1996)

- 26,500 MW of generation capacity interconnected (45% increase)
- Nearly $2 billion invested in transmission facilities
- 700 miles of new 345 kV transmission lines
- Several hundred miles of new or rebuilt 138 kV transmission lines
- Many 345/138 kV transformers
- Dynamic and static voltage control devices

Underway

- 619 miles of 345 kV transmission lines
- Numerous 138 kV lines and upgrades
- Additional $1.8 billion will be invested in the transmission system over next few years, based on current projections

ERCOT Region has seen much greater expansion of transmission infrastructure in recent years than any other North American region
Transmission Expansion Issues

• Time to build: due to permitting and right-of-way requirements, transmission projects can take years to complete

• Building ahead of need: Transmission Owners may not be willing to take the business risk for future generation interconnection projects

• Finite resources: ERCOT is experiencing record transmission expansion and new construction may be limited by available capital and resources
Operational Issues Related to Wind Power

- Wind power is not as controllable or predictable as traditional sources of electricity
- Cannot be dispatched
- Works best in conjunction with controllable generation in same area
  - Controllable resources must be used to compensate for wind variability by providing ancillary services
- In West Texas, wind tends to produce more off-peak power than on-peak
  - Although overall capacity factor for wind is in the 35-40% range, only 10% of wind farms’ total capacity is currently counted as operational for reserve margin planning
- Creates challenges in system design & operation
Wind Interconnection Efforts

- Upgrades to transmission system currently underway could accommodate SB7 renewable mandate (based on current project siting), but not a significant increase above 2,000 MW from West Texas.
- In 2003, ERCOT Board endorsed a plan to provide 345 kV lines to support a total of 1,500 to 2,000 MW of wind generation in McCamey area:
  - Subject to subscription of new generation resources
  - 755 MW online in McCamey area today
  - Contingency plan currently under new review by ERCOT Staff based on input from AEP at West Regional Planning Group meeting Jan. 2005
- In 2004, ERCOT staff prepared an “order of magnitude” study for 5,000 MW of generation in West Texas:
  - Additional studies will be required to optimize the design
  - ERCOT Region is breaking new ground in the U.S. on impact analysis for this level of wind generation
- ERCOT staff has also identified ideal locations for wind generation development along the gulf coast.
Major Transmission Completed

Major improvements to 138kV network in the McCamey area have already been completed.

New projects in service since 1999

345 kV

138 kV
Transmission Projects Endorsed

Remaining 138kV upgrades in the McCamey area will be completed by Oct. 2005.
Contingent Projects

ERCOT Board in 2003 endorsed two major 345 kV projects from McCamey area contingent upon interconnection agreements.

Currently online in McCamey: 755 MW

Contingent on 2000 MW Subscribed

Contingent on 1500 MW Subscribed
Other Projects Under Study

Areas where major transmission projects are under evaluation to reduce recurring local congestion:

- DFW
- College Station
- West Houston
- Rio Grande Valley
ERCOT West Texas
Wind in Service

Total 1,219 MW
ERCOT West Texas
Wind in Service & Under Development

Total 2127 MW

In service
Under development

In service:
- 75 MW
- 175 MW
- 20 MW
- 41 MW
- 150 MW
- 61 MW
- 160 MW
- 240 MW
- 225 MW
- 240 MW
- 114 MW
- 92 MW
- 37 MW
- 92 MW

Total 755 MW

Under development:
- 150 MW
- 61 MW
- 160 MW
- 75 MW
- 175 MW
- 92 MW
- 37 MW
- 755 MW

Total 2127 MW
ERCOT West Texas Summary of Additions, 345kV Alternative

Assumes development in clusters roughly as shown:
1. McCamey
2. Morgan
3. Abilene

These projects could support a total of 5,000 MW of West Texas wind power
### Estimated Cost to Support 5,000 MW of Wind Power from West Texas

<table>
<thead>
<tr>
<th></th>
<th>McCamey</th>
<th>Morgan</th>
<th>Abilene</th>
<th>Total</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Existing Gen</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>750 MW</td>
<td>250</td>
<td>200</td>
<td></td>
<td>1,200 MW</td>
<td>$320M</td>
</tr>
<tr>
<td><strong>New Gen</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,150 MW</td>
<td>1,250 MW</td>
<td>1,400 MW</td>
<td></td>
<td>3,800 MW</td>
<td>$1B</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1,900 MW</td>
<td>1,500 MW</td>
<td>1,600 MW</td>
<td>5,000 MW</td>
<td>$1.3B</td>
</tr>
</tbody>
</table>

Total estimated cost of new transmission upgrades is approximately $1 Billion

- Based on 345kV development option
- 765kV is also an option to be considered
- Transmission plan optimization could reduce this estimate
- Does not include any cost for additional regulation or reserve services which may be required

*Sources: LCRA, ERCOT staff, American Wind Energy Assn.*
10,000 MW and Beyond

- ERCOT staff has not developed detailed engineering analyses for wind power additions in West Texas over 5,000 MW
- Informal group is now evaluating existing studies to produce “back of the envelope” cost estimates for consideration by the Legislature
  - Broad range of stakeholders are involved
  - Results targeted for release next week
- Diversification could help meet a larger renewable goal
  - Clustered development in multiple locations (i.e., “wind zones”)
  - Other types of renewables
- Gradual phase-in schedule will be important to learn from actual operational experience and maintain system reliability
- ERCOT supports consideration of reactive (voltage) support devices to improve reliability issues associated with wind generation
The Gulf Coast Alternative

- 100 to 300 MW of wind generation could be integrated near each:
  - Galveston
  - South Corpus
  - South Padre Island
- Based upon direct connects without significant additional upgrades
- Generation levels would offset local load in the area
- Additional generation levels could be added if local high voltage transmission systems are upgraded

Between 300 MW and 900 MW could be easily integrated
The 765kV Option

- Highest-capacity transmission circuits currently in ERCOT are 345,000 volts
- 765,000 volt (765kV) lines are in use in other regions and nations
- 765kV option appears to accommodate voltage and output fluctuations (typical of wind) better than lower voltage options
  - “Shortens the distance between generation and load”
- However, more substations (injection points) = less efficiency & higher cost
- The larger the renewable target, the more attractive the 765kV option becomes
  - Cost per MW of generation is inversely proportional to the capacity needed
  - The higher the capacity required, the lower per MW cost
Questions?