Future Directions for ERCOT

Bill Magness
President & Chief Executive Officer
ERCOT

ERCOT Market Summit
March 1, 2016
ERCOT Vision and Mission

ERCOT Vision:
Lead with independent insight on the future of electricity reliability, markets and technology in Texas in order to facilitate grid and market change for the benefit of all stakeholders.

ERCOT Mission:
We serve the public by ensuring a reliable grid, efficient electricity markets, open access and retail choice.
2016 ERCOT Strategic Goals

In support of its mission to serve the public by ensuring a reliable grid, efficient electricity markets, open access and retail choice, ERCOT’s goals are to:

1. Strategically adapt to changing resource mix:
   - Generation Resources
   - Demand Response
   - Distribution Level Resources

2. Provide thought leadership in support of continued improvements to operational reliability and markets

3. Deliver channels and tools to stakeholders for enhanced communication and increased transparency and access

4. Continually enhance our cyber and physical security posture

5. Develop ERCOT resources – people and technology
2016 ERCOT Strategic Goals

In support of its mission to serve the public by ensuring a reliable grid, efficient electricity markets, open access and retail choice, ERCOT’s goals are to:

1. **Strategically adapt to changing resource mix:**
   - *Generation Resources*
   - *Demand Response*
   - *Distribution Level Resources*

2. Provide thought leadership in support of continued improvements to operational reliability and markets

3. Deliver channels and tools to stakeholders for enhanced communication and increased transparency and access

4. Continually enhance our cyber and physical security posture

5. Develop ERCOT resources – people and technology
Changing Resource Capacity Mix

**Late 1990s**
- Gas-CT/CC: 5%
- Nuclear: 8%
- Gas-Steams: 50%
- Cogen: 11%
- Coal: 25%
- Other: 0.9%
- Renewables: 0.008%

**2015**
- Gas-CT/CC: 36.8%
- Gas-Steams: 13.8%
- Nuclear: 5.4%
- Cogen: 4.6%
- Coal: 20.9%
- Other: 1.1%
- Renewables: 17.4%
Texas is #1 in the U.S. in wind capacity.

Our capacity is more than twice the amount of #2 (Iowa).

If the ERCOT Region was a separate country, we’d be #6 in the world in wind generation capacity (as of end of 2015).
ERCOT Solar Installations by Year (as of January 2016)

- 2010: 15 MW
- 2011: 42 MW
- 2012: 82 MW
- 2013: 121 MW
- 2014: 193 MW
- 2015: 288 MW
- 2016: 288 MW, 987 MW, 572 MW, 1,847 MW
- 2017: 288 MW, 1,197 MW, 572 MW, 2,057 MW

Legend:
- Blue: Cumulative MW Installed
- Purple: IA Signed - Financial Security Posted
- Green: IA Signed - No Financial Security

Utility Scale Solar Generation – January 2016
Actual Load Duration Curves – 2011 to 2015

<table>
<thead>
<tr>
<th>Hours Over</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>65,000 MW</td>
<td>75</td>
<td>28</td>
<td>19</td>
<td>11</td>
<td>91</td>
</tr>
<tr>
<td>60,000 MW</td>
<td>382</td>
<td>198</td>
<td>207</td>
<td>183</td>
<td>333</td>
</tr>
<tr>
<td>55,000 MW</td>
<td>849</td>
<td>533</td>
<td>574</td>
<td>568</td>
<td>736</td>
</tr>
</tbody>
</table>
Examples of Distributed Energy Resources (DERs)

Capable of Providing:
- Backup (emergency) power
- Demand charge reduction (e.g., 4CP)
- Response to wholesale market prices
- ERCOT Emergency Response Service
- An offset to energy consumption
- Ancillary Services

Photos courtesy Acclaim Energy

Peak Demand Record: 69,877 megawatts (MW)
- 69,877 MW, August 10, 2015

Weekend Record
- 66,530 MW, Saturday, August 8, 2015

Winter Peak Record: 57,265 MW
- 57,265 MW, February 10, 2011

Wind Generation Records (instantaneous)
- 14,023 MW, February 18, 2016, 9:20 p.m.
  - Non-Coastal Wind Output = 9,206 MW
  - Coastal Wind Output = 1,521 MW
  - Supplying 39.5% of the load
  - Active Wind Capacity = 16,246 MW
- 45.14% Wind Penetration, February 18, 2016, 11:08 p.m.
  - Total Wind Output = 13,907 MW
  - Total Load = 30,809 MW

Summer 2015 monthly peaks
- June: 61,732 MW (June 10)
- July: 67,650 MW (July 30 – new July record)
- August: 69,877 MW (Aug. 10 – new all-time record)
2016 ERCOT Strategic Goals

In support of its mission to serve the public by ensuring a reliable grid, efficient electricity markets, open access and retail choice, ERCOT’s goals are to:

1. Strategically adapt to changing resource mix:
   - Generation Resources
   - Demand Response
   - Distribution Level Resources

2. Provide thought leadership in support of continued improvements to operational reliability and markets

3. Deliver channels and tools to stakeholders for enhanced communication and increased transparency and access

4. Continually enhance our cyber and physical security posture

5. Develop ERCOT resources – people and technology
Integrating and Managing Renewables

- Wind generators started to assist in frequency control for ERCOT after 2009, having an automatic response to frequency deviations
- Started real-time monitoring of inertia in 2014
- Enhancements to improve the performance of wind forecast
  - Added 7-day wind forecast
  - Addressed large forecast errors caused by icing by adding new capability to manually overwrite the forecast
- Started a project for utility-scale solar forecast in 2015
- New ancillary service design to meet the need of the future power grid with low inertia and high variations in “net-load”

<table>
<thead>
<tr>
<th>Report</th>
<th>Coastal</th>
<th>Non-Coastal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer and Fall Seasonal Assessments</td>
<td>55%</td>
<td>12%</td>
</tr>
<tr>
<td>Winter and Spring Seasonal Assessments</td>
<td>37%</td>
<td>18%</td>
</tr>
<tr>
<td>Capacity, Demand and Reserves (10-year outlook)</td>
<td>55%</td>
<td>12%</td>
</tr>
</tbody>
</table>
Environmental Regulations

- There are several proposed and recently finalized environmental regulations that could impact grid reliability in ERCOT:

<table>
<thead>
<tr>
<th>Costs to:</th>
<th>Cross-State Air Pollution Rule (CSAPR)</th>
<th>Mercury and Air Toxics Standards (MATS)</th>
<th>Ash Disposal Rule</th>
<th>Clean Water Act Section 316(b)</th>
<th>Regional Haze Federal Plan</th>
<th>Clean Power Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural gas units</td>
<td>Addresses cross-state air pollution through a cap and trade program</td>
<td>Sets limits on hazardous air pollutant emissions at power plants</td>
<td>Places requirements on disposal of coal ash</td>
<td>Requires controls to limit impacts to aquatic life at cooling water intake structures</td>
<td>Requires controls on air emissions to improve visibility in national parks</td>
<td>Sets carbon dioxide emissions limits for existing units</td>
</tr>
</tbody>
</table>

*Proposed CSAPR update rule would take effect beginning in January 2017.
**Longer timeframes for facilities required to close. Does not include the Steam Electric Effluent Limitation Guidelines (ELG) rule, which has compliance dates between 2018-2023.

Color key:  
- No costs
- Low costs
- Moderate costs
- High Costs
Planning Summary – January 2016

• ERCOT is currently tracking 241 active generation interconnection requests totaling 57,422 MW. This includes 24,472 MW of wind generation.

• ERCOT is currently reviewing proposed transmission improvements with a total cost of $1.1 Billion.

• Transmission Projects endorsed so far in 2016 total $18 Million; $477.6 Million total in 2015.

• All projects (in engineering, routing, licensing, and construction) total approximately $6.74 Billion.

• Transmission Projects energized in 2015 total about $652.9 Million.
2016 ERCOT Strategic Goals

In support of its mission to serve the public by ensuring a reliable grid, efficient electricity markets, open access and retail choice, ERCOT’s goals are to:

1. Strategically adapt to changing resource mix:
   - Generation Resources
   - Demand Response
   - Distribution Level Resources

2. Provide thought leadership in support of continued improvements to operational reliability and markets

3. Deliver channels and tools to stakeholders for enhanced communication and increased transparency and access

4. Continually enhance our cyber and physical security posture

5. Develop ERCOT resources – people and technology
ERCOT Communication Channels

**ERCOT website – www.ercot.com**
- **Today’s Outlook:** Generation and demand
- **Weather page:** Daily and seasonal
- **Other:** Reports, news releases and lots more information

**Social media – join us!**
- Twitter: @ERCOT_ISO
- Facebook: Electric Reliability Council of Texas
- LinkedIn: ERCOT

**ERCOT Energy Saver mobile app**
- System conditions – Real-Time updates
- Wholesale pricing information – Hubs and Load Zones
- Information sharing options and more
2016 ERCOT Strategic Goals

In support of its mission to serve the public by ensuring a reliable grid, efficient electricity markets, open access and retail choice, ERCOT’s goals are to:

1. Strategically adapt to changing resource mix:
   - Generation Resources
   - Demand Response
   - Distribution Level Resources

2. Provide thought leadership in support of continued improvements to operational reliability and markets

3. Deliver channels and tools to stakeholders for enhanced communication and increased transparency and access

4. **Continually enhance our cyber and physical security posture**

5. Develop ERCOT resources – people and technology
ERCOT Cyber & Physical Security Program

• ERCOT has a dedicated and integrated cyber/physical security organization and established strategy.

• ERCOT uses layered cyber and physical security architectures known as a defense-in-depth strategy along with careful monitoring.

• ERCOT is committed to external collaboration with relevant government agencies, law enforcement, industry and national labs to enhance its and the industry’s security posture.
2016 ERCOT Strategic Goals

In support of its mission to serve the public by ensuring a reliable grid, efficient electricity markets, open access and retail choice, ERCOT’s goals are to:

1. Strategically adapt to changing resource mix:
   – Generation Resources
   – Demand Response
   – Distribution Level Resources

2. Provide thought leadership in support of continued improvements to operational reliability and markets

3. Deliver channels and tools to stakeholders for enhanced communication and increased transparency and access

4. Continually enhance our cyber and physical security posture

5. *Develop ERCOT resources – people and technology*
Funding Technology Initiatives

- **Tech Hardware Refresh drives project expenditures**
  - Required to replace obsolete, aging infrastructure in order to maintain reliable systems
  - Commission has approved a funding mechanism to support ongoing technology infrastructure needs

- **Project Priority List Funding**
  - $25 Million average annual project expenditures
  - Consistent with recent years
The Best Strategy is Great People

2015 IEEE Conference
Presenters and attendees from ERCOT

Settlement System Upgrade Team
Replaced the aging system with modern tools