Conclusions

- The average reserve margin will be higher under the $9,000 price cap
  - 14.1% for $9,000 and 13% for $3,000
- Considering retirements, net capacity additions will be 12% higher during the 2013-2016 period but only 1% higher in the long-run under the $9,000 scenario
- Increase in price cap does not lead to an increase in wholesale price

Conclusions (Preliminary)

- Energy efficiency reduces the need for new generation in the short run
  - -33% in the short term (through 2016)
  - -16% in the long run (through 2022)
- Forcing wind into the grid results in reduced average reserve margins; however, prices were not affected

Resource Adequacy in Texas

- ERCOT is an energy-only market
- There is a reserve margin target of 13.75% (was 12.5%)
  - ERCOT’s interpretation of “1 load-shed event in 10 years” is more stringent than “1 day of outage in 10 years”
- After the summer of 2011, concern is that generation capacity expansion would not keep up with demand growth in the future
- System-wide offer cap (price cap) is being gradually increased to $9,000 by 2015 from $3,000 in 2011.
- We tested impacts of these price caps on reserve margins, prices, curtailment
Demand Growth

- Since 2000, the population in Texas grew by >20%
- Texas economy continued to grow despite the 2008 crisis
  - increased oil & gas activity is a key driver
- Demand for electricity grew accordingly
  - ~1.5% per year for overall demand
  - >2% per year for peak demand

Last Summer vs. Current Analysis

- Last year, we studied the impact of the increased caps under ‘extreme’ summer of 2011 conditions, growing at 2% a year.
- Now, we use ERCOT’s growth scenarios described in the CDR report
  - Low demand growth from December 2012 CDR
  - High demand growth from May 2012 CDR (still not ‘extreme’)

<table>
<thead>
<tr>
<th>$9,000 cap baseline case (2013-22 values)</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 2012 study</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>Average RM</td>
</tr>
<tr>
<td>Extreme Price Hours</td>
</tr>
<tr>
<td>Average Price</td>
</tr>
</tbody>
</table>

ERCOT Demand Growth Scenarios

- Average growth in December 2012 CDR is 1.7%, revised downwards from the May 2012 CDR of 2.5%

Natural Gas Price Scenarios

Source: Annual Energy Outlook 2012, Energy Information Administration and Dr. Foss
Net Capacity Additions - Baseline

- Through 2016, 12% more builds in the $9,000 case than the $3,000
- Overall, increased cap leads to 1% increase in builds through 2022

Wholesale Electricity Prices - Baseline

- Prices do not differ significantly: 10-year average is about $49/MWh for both

Reserve Margins

- Higher reserve margins in later years due to slower demand growth
- CDR always predicts a declining reserve margin; can only count 'confirmed' capacity

Alternative Scenarios

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Natural Gas Price</th>
<th>Demand Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEO</td>
<td>AEO Forecast</td>
<td>ERCOT Low Demand</td>
</tr>
<tr>
<td>AEOHD</td>
<td>AEO Forecast</td>
<td>ERCOT High Demand</td>
</tr>
<tr>
<td>CEE</td>
<td>CEE Forecast</td>
<td>ERCOT Low Demand</td>
</tr>
<tr>
<td>CEEHD</td>
<td>CEE Forecast</td>
<td>ERCOT High Demand</td>
</tr>
<tr>
<td>Energy Efficiency Scenario</td>
<td>AEO Forecast</td>
<td>ERCOT Low Demand</td>
</tr>
<tr>
<td>Wind Integration Scenario</td>
<td>AEO Forecast</td>
<td>ERCOT Low Demand</td>
</tr>
</tbody>
</table>

- Energy Efficiency and Wind Integration scenarios are preliminary results
- Each scenario was run with a $3,000 and $9,000 price cap
Alternative Scenarios

• Our energy efficiency scenario integrates higher levels of energy efficiency into ERCOT
  – Twice the amount predicted in CDR
• The wind integration scenario forces 1,000 MW per year of new wind capacity
  – 500 MW in West Zone and 500 MW in Houston Zone (Coastal) with different availability profiles

Net Capacity Additions ($9,000 Cap)

• Energy Efficiency scenario sees 16% less builds in comparison to AEO case
• Wind integration scenario experiences 31% more builds compared to AEO case

Wholesale Price ($9,000 Cap)

• Wholesale prices are nearly identical under both price caps
• No significant difference between low demand and high demand scenarios
• Unlike wind integration, increased energy efficiency, cause higher prices in some years

Reserve Margin ($9,000 Cap)

• $3,000 cap very similar to $9,000 over the long-term
• Lower reserve margins under high demand growth scenarios
**Net Capacity Additions**

- With EE, there is less capacity early on; investment picks up in later years
- With wind, there are a lot more new builds early, and less builds later on

<table>
<thead>
<tr>
<th>Year</th>
<th>AEO</th>
<th>EE</th>
<th>Wind</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>1,500</td>
<td>14,979</td>
<td>19,568*</td>
</tr>
<tr>
<td>2014</td>
<td>2,000</td>
<td>12,580</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>2,500</td>
<td></td>
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</tr>
<tr>
<td>2016</td>
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</tr>
<tr>
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<tr>
<td>2018</td>
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</tr>
<tr>
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<td>2020</td>
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<td>2021</td>
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<td></td>
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</tr>
<tr>
<td>2022</td>
<td>6,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* For reliability purposes, ERCOT would only count ~$1 GW of 9 GW of wind we forced into the system; so, 11,568 MW could better reflect the ERCOT criterion

**Further Research**

- Demand response—flattening the demand curve by providing incentives for consumers to switch off their power during periods of high demand
- Implementing EPA regulations such as MATS and water for cooling
- Different Natural Gas Scenarios
- What is the ‘optimal’ reserve margin?