Global Opportunities in the Power Industry

Jason Bohrer
Lignite Energy Council
Opportunities?

Are you serious?
The retirement of 200 coal plants as of July 2015 nationwide represents the phase out of nearly 40 percent of the 523 U.S. coal plants that were in operation just five years ago.
CO2 Rules

- Rules for New Plants
  - 1400 lbs/mwh

- Rules for Existing Plants
  - Efficiency Improvements
  - Natural Gas Reliance
  - Renewable Offsets
CO2 Rules

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Global Carbon Emissions and World GDP / capita

- World Carbon Emissions
- GDP per Capita (Current US$)

Electric demand is growing

- 3 Gigawatts in North Dakota (~10 years)
Electric demand is growing

- 47 Gigawatts in Japan (~10 years)
Electric demand is growing

- 30 Gigawatts in China
Electric demand is growing

- 30 Gigawatts in China
  - PER YEAR
  - For 16 years
Electric demand is growing

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  - PER YEAR
  - For 16 years
Coal meets that need
Electric demand is growing, but so is the realization that CO2 must be addressed

- A lower carbon intensity is now the norm, but that means different things to different people.
In America, that is with the Clean Power Plan
The Chinese Approach

- Reduce coal usage to 60% of power supply by 2035.
Where are the US Opportunities

- North Dakota, with CO2 for EOR
Lignite: Domestic Energy

- North Dakota produced 27.7 million tons of lignite in 2013...the equivalent of 70 million barrels of oil

- The average car in the United States consumes 280 gallons of gasoline. So on a BTU basis, the 27.7 million tons of lignite would produce enough energy to run 10 million cars for a year.
Average Electricity Costs
2012 Megawatt-Hour

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Dakota Lignite Plants</td>
<td>$25.30</td>
</tr>
<tr>
<td>All Nuclear</td>
<td>$24.55</td>
</tr>
<tr>
<td>All Coal</td>
<td>$33.17</td>
</tr>
<tr>
<td>All Natural Gas</td>
<td>$34.44</td>
</tr>
</tbody>
</table>

Source: Ventyx
Regional Low-Cost Electricity

Average retail electricity prices - EIA

<table>
<thead>
<tr>
<th>State</th>
<th>Average Price (cents)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ND</td>
<td>7.1</td>
</tr>
<tr>
<td>MN</td>
<td>8.4</td>
</tr>
<tr>
<td>CA</td>
<td>13.1</td>
</tr>
<tr>
<td>CT</td>
<td>17.4</td>
</tr>
<tr>
<td>HI</td>
<td>25.1</td>
</tr>
</tbody>
</table>
North Dakota’s Answer

- Increased R&D
  - $5m from last session
North Dakota’s Answer

- Increased R&D
- New Power Cycles
  - Supercritical CO2
North Dakota’s Answer

- Increased R&D
- New Power Cycles
- Oil partnerships
  - CO2 for re-use could extract billions more in Oil revenue
North Dakota’s Answer

- Increased R&D
- New Power Cycles
- Oil partnerships
- Biggest Challenge is time
- Keep coal industry up to date, alive while pursuing technology