The State of the Wind Industry

Michael Skelly
Clean Line Energy

March 2013
Renewables currently constitute a relatively small portion of the U.S.'s electricity generation mix... 

U.S. Net Electricity Generation By Fuel Type  
2012 Year-To-Date

- Coal: 38% 
- Natural Gas: 19% 
- Other Fossil Fuel: 7% 
- Nuclear: 3% 
- Conventional Hydroelectric: 1% 
- Wind: 2% 
- Other Renewables: 3%

Some states have a larger percentage of wind in their energy mix:
- Oklahoma: 10.5% 
- Texas: 7.4% 
- Iowa: 24.5%

1. Includes generation from Wood, Waste, Geothermal, and Solar

Source: EIA
...but are an increasingly large proportion of new generating capacity

U.S. New Generation Capacity Additions
Gigawatt

In 2012, 13.1 GW of new wind generation facilities were installed in the U.S.

Source: EIA; AWEA
Improving wind turbine technology is increasing capacity factors and reducing wind costs . . .

**Net Capacity Factor**
At 8.5 meters per second wind speed

+29% improvement

---

**Improving GE 1.5-1.6 MW Turbine from 2005 - 2010**

<table>
<thead>
<tr>
<th>In meters</th>
<th>Rotor Diameter</th>
<th>Hub Height</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>77</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>82.5</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

1. Assumptions: shear alpha = 0.2, Rayleigh distribution, 17% losses from GCF to NCF

**CLEAN LINE ENERGY PARTNERS**
The “Wind Belt” consists of the 13 states where the wind resource is the strongest: CO, IA, KS, MN, MO, MT, NE, NM, ND, OK, SD, TX, and WY.

Source: DOE 2011 Wind Technologies Market Report
Wind in the central US is the lowest cost renewable option

Declining technology costs combined with increased efficiency is pushing the price for renewables to new lows, intensifying competition to build transmission to connect low-cost regions with demand

High capacity factor wind is competitive with other sources of new generation, including gas at $4.50/MMBtu

Levelized Cost of Energy\(^1\)

\[ \text{\$/MWh} \]

<table>
<thead>
<tr>
<th>Source</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean Line Delivered Cost</td>
<td>23.0</td>
</tr>
<tr>
<td>Wind with PTC(^4)</td>
<td>54.0</td>
</tr>
<tr>
<td>Wind without PTC(^4)</td>
<td>48.0</td>
</tr>
<tr>
<td>Combined Cycle Gas Turbine(^5)</td>
<td>75.0</td>
</tr>
<tr>
<td>Nuclear</td>
<td>95.5</td>
</tr>
<tr>
<td>Coal</td>
<td>101.5</td>
</tr>
<tr>
<td>IGCC</td>
<td>102.0</td>
</tr>
<tr>
<td>Solar PV Thin-Film</td>
<td>122.0</td>
</tr>
<tr>
<td>Solar Thermal</td>
<td>173.5</td>
</tr>
</tbody>
</table>

1. Cost of generation based on mid-point of Lazard’s LCOE estimates. Unless noted, costs shown are unsubsidized.
2. Assumes ~725 miles of transmission at $2 m per mile, end-point converter costs of $300 m each and mid-point converter at $150 m, & development cost of ~$100 m.
3. Assumes capex costs of $1,700/kW, O&M costs of $10/MWh, Production Tax Credit, cost of capital of 9%.
4. High capacity factor wind cost uses low-end Lazard estimates for which the capacity factor is 48% and capex cost is $1,500/kW.
5. Assumes $4.50/MMBtu gas price. With ±25% variation in the fuel price, the Combined Cycle Gas Turbine LCOE ranges from $61 - $89/MWh and the IGCC LCOE ranges from $88 - $116/MWh.

Source: Clean Line, Lazard’s 2012 Levelized Cost of Energy Analysis
Clean Line’s projects connect the best wind resources to load centers
What Motivates Clean Line Employees?

• Having the unique opportunity to develop infrastructure responsibly

• Working at the frontier of the energy industry

• Thinking big and coming up with the right solutions to big problems

• Believing in the Clean Line philosophy on the right way to work with the public
Getting the Social License to Build

Listen and Address Stakeholder Concerns

Support Local Vendors

Involve the Community

Garner 3rd Party Endorsements

“Clean Line’s project is another great example of Oklahoma’s strong legacy as an energy leader. Energy projects like the Plains & Eastern Clean Line are opportunities to develop Oklahoma’s resources, create jobs and spur energy innovation.”

--Mary Fallin, Governor of Oklahoma
Green Enterprises Have to Live Up to Higher Expectations

To successfully build large-scale infrastructure projects like transmission lines, siting must be a collaborative effort with the communities affected and with the environmental agencies that have regulatory authority.