Wind Development in China

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Energy sector overview

- Population: 1370 M
- Electrification rate: 99.6%
- Population unconnected to grid: 5 Million
- Deficit in energy in 2008:
  - Total energy available for consumption 2.87 B tce
    - Primary energy output: 2.60 B tce
    - Imports: 370 M tce
    - Exports: 99 M tce
  - Total energy consumption 2.91 B tce
Energy consumption

- Quick economic increase brings quick increase of energy consumption
  - More than expected

- Demand for RE also increases

- RE must be faster than expected
<table>
<thead>
<tr>
<th></th>
<th>capacity</th>
<th>generation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GW</td>
<td>%</td>
</tr>
<tr>
<td>total</td>
<td>962</td>
<td></td>
</tr>
<tr>
<td>hydro</td>
<td>213</td>
<td>22%</td>
</tr>
<tr>
<td>coal</td>
<td>707</td>
<td>73%</td>
</tr>
<tr>
<td>nuclear</td>
<td>11</td>
<td>1%</td>
</tr>
<tr>
<td>wind</td>
<td>31</td>
<td>3%</td>
</tr>
<tr>
<td>others</td>
<td>0.26</td>
<td>0%</td>
</tr>
</tbody>
</table>
Energy consumption

• Total energy consumption
  - 2009: 3.06 B tce, increase rate 5.2%
  - 2010: 3.25 B tce, increase rate 5.9%

• Composition in 2009
  - Coal: 70.4%
  - Crude oil: 17.9%
  - Natural gas: 4.3%
  - Hydro-power, nuclear power, wind power: 7.8%
• Renewable energy target: 15% in 2020

• Barrier: energy consumption increase very quickly, renewable energy target had to change
RE development situation 2010

- Total RE: 286 M tce, 8.8% of energy consumption
  - Hydro power: 213 GW, 78% of RE
  - Wind capacity: 31 GW, 5% of RE
  - PV: 800 MW
  - Solar water heater: 170 M m², 19.55 M tce, 6.8% of RE
  - Biomass: 22.66 M tce, 9% of RE

- Comparing:
  - 2009: 258 M tce, 8.34%;
  - 2008: 250 M tce, 8.8%

- RE developed very quickly, but proportion didn’t increase
Renewable energy policy

- **Wind:**
  - Onshore: fix price according to wind resource
  - Offshore: concession projects bidding
  - VAT: 50% off

- **PV:**
  - Subsidy for roof system
  - Bidding price for large scale PV concession projects

- **SWH:** commercialized already
  - Subsidy for rural customers
  - Mandatory installation by local governments

- **Biomass:**
  - Fix price for biomass generation, but not for co-firing
  - Subsidy for pullet
Wind developed very quickly

- New installation doubled in last 5 years
- Total capacity more than 44GW

单位：MW

数据来源：CWEA
Manufacture developed very quickly

- Top 10 manufactures cover more than 85% of total market
- 40 assembling companies
- Capacity
  - Sinovel, Golden Wind, Dongqi are more than 2000MW respectively
  - Union Power and Mingyang are more than 1000MW
- Output
  - Golden wind, Sinovel and Dongqi are more than 10 GW
- Foreign companies’ share decreased

### Top 10 manufactures for new installation

<table>
<thead>
<tr>
<th></th>
<th>Company</th>
<th>Capacity MW</th>
<th>Market share</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>华锐</td>
<td>4386</td>
<td>23.2%</td>
</tr>
<tr>
<td>2</td>
<td>金风</td>
<td>3735</td>
<td>19.7%</td>
</tr>
<tr>
<td>3</td>
<td>东汽</td>
<td>2623.5</td>
<td>13.9%</td>
</tr>
<tr>
<td>4</td>
<td>联合动力</td>
<td>1643</td>
<td>8.7%</td>
</tr>
<tr>
<td>5</td>
<td>明阳</td>
<td>1050</td>
<td>5.5%</td>
</tr>
<tr>
<td>6</td>
<td>Vestas</td>
<td>892.1</td>
<td>4.7%</td>
</tr>
<tr>
<td>7</td>
<td>上海电气</td>
<td>597.85</td>
<td>3.2%</td>
</tr>
<tr>
<td>8</td>
<td>Gamesa</td>
<td>595.55</td>
<td>3.1%</td>
</tr>
<tr>
<td>9</td>
<td>湘电风能</td>
<td>507</td>
<td>2.7%</td>
</tr>
<tr>
<td>10</td>
<td>华创风能</td>
<td>486</td>
<td>2.6%</td>
</tr>
<tr>
<td></td>
<td>其它</td>
<td>2411.99</td>
<td>12.7%</td>
</tr>
<tr>
<td></td>
<td>总计</td>
<td>18927.99</td>
<td>100%</td>
</tr>
</tbody>
</table>
Wind price and distribution

0.58 RMB/kWh

0.51 RMB/kWh

0.54 RMB/kWh

0.61 RMB/kWh
1 GW offshore wind concession projects have been confirmed

<table>
<thead>
<tr>
<th>省</th>
<th>场址</th>
<th>开发商</th>
<th>制造商</th>
<th>项目类型</th>
<th>安装台数</th>
<th>容量</th>
</tr>
</thead>
<tbody>
<tr>
<td>江苏</td>
<td>大丰</td>
<td>中电投</td>
<td>上海电气</td>
<td>滩涂/潮间带</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>江苏</td>
<td>响水</td>
<td>三峡/长江新能源</td>
<td>上海电气</td>
<td>滩涂/潮间带</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>江苏</td>
<td>如东</td>
<td>龙源</td>
<td>上海电气</td>
<td>滩涂/潮间带</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>江苏</td>
<td>如东</td>
<td>龙源</td>
<td>明阳</td>
<td>滩涂/潮间带</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>江苏</td>
<td>如东</td>
<td>龙源</td>
<td>联合动力</td>
<td>滩涂/潮间带</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>江苏</td>
<td>滨海云港</td>
<td>中能联合</td>
<td>海装</td>
<td>滩涂/潮间带</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>江苏</td>
<td>盐城陈家港</td>
<td>三峡/长江新能源</td>
<td>东能</td>
<td>滩涂/潮间带</td>
<td>41</td>
<td>61.5</td>
</tr>
<tr>
<td>山东</td>
<td>莱城</td>
<td>华锐</td>
<td>华锐</td>
<td>滩涂/潮间带</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>上海</td>
<td>东海大桥</td>
<td>华锐</td>
<td>上海风电示范项目</td>
<td>21</td>
<td>63</td>
<td></td>
</tr>
<tr>
<td>汇总</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>75</td>
<td>89</td>
</tr>
</tbody>
</table>

*国家发展和改革委员会能源研究所
*Energy Research Institute National Development and Reform Commission*
Wind target

- Wind Target in 2007
  - 2010: 5 GW
  - 2020: 30GW

- Wind target discussed now
  - 2015: 100 GW
  - 2020: 150-200GW
  - 2030: 300 GW, 10% of total electricity

2010 real: 45GW
## Electricity Cost: Subsidies and Incentives

- **RE Subsidies**

<table>
<thead>
<tr>
<th>RE Source</th>
<th>Base Rate ($/kWh)</th>
<th>Subsidy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind</td>
<td>0.51-0.61 RMB/kWh</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.078-0.094 $/kWh</td>
<td></td>
</tr>
<tr>
<td>Solar</td>
<td></td>
<td>• 50% for on-grid systems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 70% for off-grid systems</td>
</tr>
<tr>
<td>Biomass generation</td>
<td>0.75 RMB/kWh</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.115 $/kWh</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fossil Fuel</th>
<th>Base Rate ($/kWh)</th>
<th>Subsidy ($/kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>0.23-0.44 RMB/kWh</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td>0.035-0.067 $/kWh</td>
<td></td>
</tr>
</tbody>
</table>
Wind Resource Potential

- Exploitable potential:
  - >150W/m² at 10 m height (5.4 m/s)
  - >300W/m² at 50 m height (6.7 m/s)

- Following number are at 50 m height, announced by Wind and Solar Resource Center:

<table>
<thead>
<tr>
<th>Region</th>
<th>Total area (10⁴km²)</th>
<th>Wind resource coverage (10⁴km²)</th>
<th>Exploitable potentials (10⁸kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onshore (50m height, 2009)</td>
<td>≈960</td>
<td>146.4</td>
<td>23.8</td>
</tr>
<tr>
<td>Offshore (&lt;Water depth 25)</td>
<td>20.6</td>
<td>20.6</td>
<td>2.1</td>
</tr>
</tbody>
</table>
Wind map in 10 m height

- Exploitable potentials $2.97 \times 10^8$ kW
- Wind resource coverage: $20 \times 10^4$ km$^2$
• **Region I**  
  \(<300\text{W/m}^2\)

• **Region II**  
  \(300\text{W/m}^2 - 400\text{W/m}^2\)

• **Region III**  
  \(400\text{W/m}^2 - 500\text{W/m}^2\)

• **Region IV**  
  \(\geq 500\text{W/m}^2\)
Major barriers

• Grid connection is biggest challenge
  – Grid planning can’t match wind planning
  – Wind farm in 2010 didn’t connect to the grid on time

• Order of wind market development is lack
  – Without planning, or not according to planning
  – Wind developer has serious competition

• Over supply of wind turbine appears
  – Domestic manufactures development very quickly
  – International manufactures also enter China
  – Wind turbine price is lower than 4000RMB/kW (615$/kW)

• Quality of domestic wind turbine need to be proofed
Wind resource concentrated
Grid connection is largest challenge
Next step

• Wind energy will keep high increase rate

• Three changes need be done:
  – Wind development speed
    → wind development quality
  – Installed capacity
    → wind electricity generation
  – Concentrated and scale-up wind farm
    → scale-up wind farm and distributed wind farm
Thanks!

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