Renewable Energy in India

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Outline

• Key drivers
• Rationale for renewables
• Enabling environment
• Investments & growth
• India’s strength
• Conclusions
Key drivers

• Energy scenario
  – The demand for energy in the country has been growing rapidly
  – Electricity supply suffering from huge shortages
  – Over 289 million people without access to electricity
  – Electricity supply situation is generally poor even in electrified villages
  – Over 80% of rural India dependent on traditional fuels for cooking

• Security of energy supply
  – The import dependency in 2031 could reach
    ○ Oil: 88%
    ○ Coal: 72%

• Environmental concerns
  – Macro level
  – Micro level
Rationale for renewables

• India is endowed with good renewable energy resources like solar, wind, small hydro, and biomass.
• Renewables energy technologies can work equally well in
  – Centralized, large power generation
  – Decentralized, distributed energy generation
• Renewable energy markets
  – Utility-scale electricity
  – Off-grid or distributed electricity systems
  – Decentralized energy systems
Enabling environment

- **Policy frameworks**
  - Electricity Act 2003
  - National Electricity Policy 2005
  - Rajiv Gandhi Grameen Vidyutikaran Yojna (RGGVY) 2005
  - National Tariff Policy 2006
  - Integrated Energy Policy 2006
  - National Action Plan on Climate Change 2009
  - Jawaharlal Nehru National Solar Mission 2010
  - 12th Five Year Plan
  - State-level RE/Solar policies
Grid connected RETs
(as on March 31, 2014)

- Total RETs: 31.70 GW
- Share in overall electricity mix: ~13%
- Off-grid power: 1022 MW

Source: MNRE
RE development scenario in India

To meet 17% NAPCC target by 2021-22, 98.5 GW wind installation will be required apart from 20 GW solar
Main focus on capturing the easily available options in solar-thermal and on promoting off-grid systems to serve populations without access to commercial energy and modest capacity addition in grid-based systems.

Capacity will be aggressively ramped up to create conditions for up-scaled and competitive solar energy penetration in the country after taking into account the experience of the initial years.

To create favorable conditions for solar manufacturing capability, particularly solar thermal for indigenous production and market leadership.

Launched in 2008
• **Regulatory facilitation**
  – Renewable Purchase Obligation
    o Separate quota for solar and biomass
  – Feed-in tariff
  – Renewable Energy Certificates
  – Access to grid
  – Wheeling of electricity
  – Banking of electricity
  – Third party sale
Green corridor

• It is envisaged that about 41 GW of RE capacity may be added during 2012-17 (~ 66 GW cumulative)
  – Wind (30 GW)
  – Solar (9.5 GW)
  – Small Hydro (1.5 GW), thus

• Transmission system strengthening to facilitate
  – transfer of RE power from the RE rich States (viz. Tamil Nadu, Karnataka, Andhra Pradesh, Gujarat, Maharashtra, Rajasthan & Himachal Pradesh) to other States

• Estimated cost: USD 7 billion
The renewable electricity space witnessed 32 private equity (PE) and merger and acquisition (M&A) deals worth $129 billion in 2013.

Source: UNEP, Bloomberg New Energy Finance
Private & public R&D investment, 2013 and growth on 2012, $Bn

<table>
<thead>
<tr>
<th>Region</th>
<th>Corporate R&amp;D</th>
<th>Government R&amp;D</th>
<th>Growth:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe</td>
<td>2.0</td>
<td>1.3</td>
<td>-1%</td>
</tr>
<tr>
<td>China</td>
<td>0.5</td>
<td>1.5</td>
<td>-3%</td>
</tr>
<tr>
<td>United States</td>
<td>1.1</td>
<td>0.9</td>
<td>-1%</td>
</tr>
<tr>
<td>ASOC (excl. China &amp; India)</td>
<td>1.0</td>
<td>0.6</td>
<td>-19%</td>
</tr>
<tr>
<td>AMER (excl. US &amp; Brazil)</td>
<td>0.05/0.1</td>
<td></td>
<td>-3%</td>
</tr>
<tr>
<td>Brazil</td>
<td>0.01/0.1</td>
<td></td>
<td>-2%</td>
</tr>
<tr>
<td>India</td>
<td>0.06/0.05</td>
<td></td>
<td>25%</td>
</tr>
<tr>
<td>Middle East &amp; Africa</td>
<td>0.005/-</td>
<td></td>
<td>-3%</td>
</tr>
</tbody>
</table>

Source: Bloomberg, Bloomberg New Energy Finance, IEA, IMF, various government agencies
Wind power growth trends

Policy interventions from time to time have helped wind energy grow from a few MW to 30,130 MW by the end of 2013.
Market Shares of Top 10 Wind Turbine Manufacturers, 2013

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Market Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vestas (Denmark)</td>
<td>13.1%</td>
</tr>
<tr>
<td>Goldwind (China)</td>
<td>11.0%</td>
</tr>
<tr>
<td>Enercon (Germany)</td>
<td>9.8%</td>
</tr>
<tr>
<td>Siemens (Germany)</td>
<td>7.4%</td>
</tr>
<tr>
<td>GE Wind (U.S.)</td>
<td>6.6%</td>
</tr>
<tr>
<td>Others</td>
<td>30.5%</td>
</tr>
<tr>
<td>Gamesa (Spain)</td>
<td>5.5%</td>
</tr>
<tr>
<td>Suzlon Group (India)</td>
<td>5.3%</td>
</tr>
<tr>
<td>United Power (China)</td>
<td>4.0%</td>
</tr>
<tr>
<td>Mingyang (China)</td>
<td>3.5%</td>
</tr>
<tr>
<td>Nordex (Germany)</td>
<td>3.3%</td>
</tr>
</tbody>
</table>

Based on total sales of ~37.5 GW

The average size of turbines delivered to market in 2013 was 1.3 MW in India.
Solar PV growth trends

Cumulative installed capacity (MW)

- 31st March 2010: 10.28
- 31st March 2011: 37.66
- 31st March 2012: 941.28
- 31st March 2013: 1686.4
- 31st March 2014: 2647
CSP in India

1. Aurum Renewable Energy
2. Corporate Ispat Alloys
3. Diwakar Solar
4. Godawari Green Energy
5. KVK Energy Ventures
6. Megha Engineering
7. Rajasthan Sun Technique


<table>
<thead>
<tr>
<th>Project</th>
<th>Promoter</th>
<th>Technology</th>
<th>Size (MW)</th>
<th>Bid (₹/kWh)</th>
<th>Supplier(s)</th>
<th>EPC Contractor</th>
<th>Location</th>
<th>Financing (Lead)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Aurum Renewable Energy</td>
<td>Aurum</td>
<td>Linear Fresnel</td>
<td>20</td>
<td>12.19</td>
<td>Sumitomo Shin Nippon</td>
<td>Indure</td>
<td>Mitrala, Porbandar, Gujarat</td>
<td>SBI</td>
</tr>
<tr>
<td>2 Corporate Ispat Alloys</td>
<td>Abhijeet</td>
<td>Parabolic Trough</td>
<td>50</td>
<td>12.24</td>
<td>Siemens turbine &amp; receivers</td>
<td>Shriram EPC</td>
<td>Nokh, Pokaran, Rajasthan</td>
<td>BOI and IOB</td>
</tr>
<tr>
<td>3 Diwakar Solar</td>
<td>Lanco</td>
<td>Parabolic Trough</td>
<td>100</td>
<td>10.49</td>
<td>Siemens</td>
<td>Lanco Solar &amp; Initec Energía</td>
<td>Askanda, Nachna, Rajasthan</td>
<td>Axis</td>
</tr>
<tr>
<td>4 Godawari Green Energy</td>
<td>Hira Group</td>
<td>Parabolic Trough</td>
<td>50</td>
<td>12.20</td>
<td>Siemens, Schott Glass, Flabeg, Aalborg</td>
<td>Lauren, Jyoti Structures</td>
<td>Nokh, Pokaran, Rajasthan</td>
<td>Bank of Baroda led consortium</td>
</tr>
<tr>
<td>5 KVK Energy Ventures</td>
<td>Lanco</td>
<td>Parabolic Trough</td>
<td>100</td>
<td>11.20</td>
<td>Siemens</td>
<td>Lanco Infratech</td>
<td>Askanda, Nachna, Rajasthan</td>
<td>ICICI</td>
</tr>
<tr>
<td>6 Megha Engineering</td>
<td>Megha Engineering Limited</td>
<td>Parabolic Trough</td>
<td>50</td>
<td>11.31</td>
<td>GE</td>
<td>MEIL Green Power Limited</td>
<td>Anantapur, Andhra Pradesh</td>
<td>IDBI led consortium</td>
</tr>
<tr>
<td>7 Rajasthan Sun Technique</td>
<td>Reliance</td>
<td>Compact Linear Fresnel</td>
<td>100</td>
<td>11.97</td>
<td>Areva</td>
<td>Reliance Infrastructure</td>
<td>Dahanu, Pokaran, Rajasthan</td>
<td>ADB, US Ex-Im, FMO</td>
</tr>
</tbody>
</table>
### Annual investments/net capacity additions/production in 2013

<table>
<thead>
<tr>
<th></th>
<th>China</th>
<th>Turkey</th>
<th>Brazil</th>
<th>Vietnam</th>
<th>India</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydropower capacity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSP capacity</td>
<td>USA</td>
<td>Spain</td>
<td>UAE</td>
<td></td>
<td>India</td>
</tr>
<tr>
<td>Wind power capacity</td>
<td>China</td>
<td>Germany</td>
<td>UK</td>
<td></td>
<td>Canada</td>
</tr>
<tr>
<td>Solar water heating</td>
<td>China</td>
<td>Turkey</td>
<td></td>
<td>Brazil</td>
<td>Germany</td>
</tr>
</tbody>
</table>
## Total capacity or generation as of end-2013

<table>
<thead>
<tr>
<th>Renewable power (excluding hydro)</th>
<th>China</th>
<th>USA</th>
<th>Germany</th>
<th>Spain/Italy</th>
<th>India</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biopower generation</td>
<td>USA</td>
<td>Germany</td>
<td>China</td>
<td>Brazil</td>
<td>India</td>
</tr>
<tr>
<td>Wind power capacity</td>
<td>China</td>
<td>USA</td>
<td>Germany</td>
<td>Spain</td>
<td>India</td>
</tr>
</tbody>
</table>
India’s strengths

- Well-developed R&D infrastructure
- Wide network of academic and research institutions
- Large manufacturing base, spanning all the areas
- Availability of skilled manpower
- Strategic location: access to the vast upcoming markets
Conclusions

- India has abundant renewable energy resources, which can contribute towards reduction in dependency on imported fossil fuels.
- Renewables assume special significance in India considering its geographic diversity and size, not to mention the size of its rural economy.
- India has an ambitious RE plan.
Thank You!

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