Outlook on Renewable Energy in Asia

Asia Clean Energy Forum 2017,
Asian Development Bank Headquarters

Ali Izadi

June 05, 2017
Analysis to help you understand the future of energy and transport
Global carbon emissions from fossil fuels

Source: IEA; CDIAC; BP; Bloomberg New Energy Finance
Clean energy finance and installations have quadrupled

Clean energy annual asset finance and installations

Asset finance by country/region

Source: Bloomberg New Energy Finance
Technology is fundamentally changing the energy landscape

Crystalline silicon solar PV experience curve

Since 1975:
- 28% decrease in price for every doubling of production
- 99% decrease in unit cost
- 115,000x increase in cumulative installations

Historic prices
Chinese module price
Cumulative capacity (MW)

Source: Bloomberg New Energy Finance, Paul Maycock
Using solar to cut telecom tower costs

Cost of electricity for off-grid cell tower sites

### Cost of electricity ($/kWh)

- **India (Uttar Pradesh)**
  - Diesel only: 0.98
  - Diesel + Lead-Acid Battery: 0.69
  - PV + Diesel + Lead-Acid Battery: 0.33
  - PV + Diesel + Li-ion Battery: 0.31

- **Nigeria**
  - Diesel only: 0.82
  - Diesel + Lead-Acid Battery: 0.58
  - PV + Diesel + Lead-Acid Battery: 0.29
  - PV + Diesel + Li-ion Battery: 0.33

Annual diesel cost for off-grid cell tower sites

### Annual diesel cost (U.S. dollar)

- **India (Uttar Pradesh)**
  - Diesel only: 12,433
  - Diesel + Lead-Acid Battery: 7,422
  - PV + Diesel + Lead-Acid Battery: 1,692
  - PV + Diesel + Li-ion Battery: 1,444

- **Nigeria**
  - Diesel only: 9,946
  - Diesel + Lead-Acid Battery: 5,937
  - PV + Diesel + Lead-Acid Battery: 1,213
  - PV + Diesel + Li-ion Battery: 1,011

Source: HOMER, Bloomberg New Energy Finance

Note: Diesel pilferage was taken into account as cost - 20% of diesel price assumed.
Price of renewable energy in India

“The cost of solar power is now cheaper than coal in this country.”

Piyush Goyal
Minister of State for Power, Coal, New & Renewable Energy and Mines, India
Levelised cost of electricity of super-critical coal power generation by coal transport distance in India

Source: Bloomberg New Energy Finance. Note: SECI is the Solar Energy Corporation of India
Global auctioned and tendered renewables capacity

Source: Bloomberg New Energy Finance. Note: The chart excludes Chile where contracts are awarded for generation. The country has procured around 46 TWh of electricity generated by renewables since 2006.
Impact of policy on renewable costs: solar example

Current levelised cost of electricity from utility-scale PV – no tracking

BNEF expectations on solar capex convergence as a result of subsidy / barrier phase outs


Source: Bloomberg New Energy Finance.
Annual green bond issuance

Annual green bond issuance by issuer type

<table>
<thead>
<tr>
<th>Category</th>
<th>Subcategory</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
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<td>1.77</td>
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<td>Total Total</td>
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<td>37.75</td>
<td>49.59</td>
<td>95.65</td>
<td>111.39</td>
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Annual green bond issuance by region

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<tr>
<th>Region</th>
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<th>2015</th>
<th>2016</th>
<th>2017</th>
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<td>8.00</td>
<td>10.22</td>
<td>2.63</td>
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Source: Bloomberg New Energy Finance. Note: 2017 forecast is based on compound annual growth rate between 2013 and 2016 inclusively. 2017 extrapolation is based on rate of issuance in 2017 year to date. SSA stands for supranational, sovereign and agency bonds. US muni are US municipal bonds. 2017 is year to date. SNAT is supranational. Undisclosed supranational numbers do not match supranational numbers on the left, because it is based on geographic disclosures.
Who supplies the world’s solar market?

Annual module production by company HQ location

Annual inverter production by company HQ location

Source: Bloomberg New Energy Finance
Who supplies the world’s wind market?

Source: Bloomberg New Energy Finance
Renewable energy deployment in Southeast Asia

Renewable capacity commissioned by country

<table>
<thead>
<tr>
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<tr>
<td>Thailand</td>
<td>506</td>
<td>485</td>
<td>731</td>
<td>1,025</td>
<td>1,359</td>
<td>2,203</td>
<td>2,742</td>
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<tr>
<td>Philippines</td>
<td>342</td>
<td>290</td>
<td>143</td>
<td>184</td>
<td>200</td>
<td>192</td>
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<tr>
<td>Indonesia</td>
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<td>281</td>
<td>702</td>
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<td>Vietnam</td>
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<td>506</td>
<td>485</td>
<td>1,025</td>
<td>1,359</td>
<td>2,203</td>
<td>2,742</td>
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Renewable capacity commissioned by sector

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<tbody>
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<td>Wind</td>
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<td>485</td>
<td>731</td>
<td>1,025</td>
<td>1,359</td>
<td>2,203</td>
<td>2,742</td>
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<tr>
<td>Solar</td>
<td>92</td>
<td>115</td>
<td>154</td>
<td>133</td>
<td>253</td>
<td>233</td>
<td>98</td>
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<td>Geothermal</td>
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<td>728</td>
<td>262</td>
<td>251</td>
<td>251</td>
<td>996</td>
<td>1,818</td>
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<td>Biomass &amp; Waste</td>
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<td>196</td>
<td>124</td>
<td>599</td>
<td>797</td>
<td>141</td>
<td>528</td>
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<tr>
<td>Small hydro</td>
<td>551</td>
<td>599</td>
<td>996</td>
<td>1,359</td>
<td>2,203</td>
<td>2,742</td>
<td>1,359</td>
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</tbody>
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Source: Bloomberg New Energy Finance
Renewable energy asset finance in Southeast Asia

Asset finance for ‘new-build’ by country, $bn

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<td>0.3</td>
<td>0.4</td>
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Asset finance for ‘new-build’ by sector, $bn

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</tr>
</thead>
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<tr>
<td>Solar</td>
<td>1.9</td>
<td>0.3</td>
<td>0.4</td>
<td>1.5</td>
<td>0.3</td>
<td>0.6</td>
<td>1.0</td>
</tr>
<tr>
<td>Biomass &amp; Waste</td>
<td>0.9</td>
<td>0.5</td>
<td>1.2</td>
<td>1.5</td>
<td>0.6</td>
<td>2.5</td>
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<tr>
<td>Geothermal</td>
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<td>0.5</td>
<td>0.5</td>
<td>0.3</td>
<td>0.7</td>
<td>1.6</td>
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<tr>
<td>Wind</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.6</td>
<td>0.7</td>
<td>2.5</td>
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<tr>
<td>Small hydro</td>
<td>1.5</td>
<td>0.5</td>
<td>1.2</td>
<td>1.5</td>
<td>0.6</td>
<td>1.8</td>
<td></td>
</tr>
</tbody>
</table>

Source: Bloomberg New Energy Finance
BNEF NEO2016 and International Energy Agency capacity forecasts

BNEF New Energy Outlook 2016

GW

2040 capacity forecasts

Utility-scale PV: 2,400GW 19x growth
Small-scale PV: 1,500GW 12x growth
Onshore wind: 1,600GW 4x growth
Offshore wind: 131GW 11x growth
Flexible capacity: 1,000GW 8x growth

Source: Bloomberg New Energy Finance, IEA
Power generation capacity additions in APAC, 2015 - 2040

Source: Bloomberg New Energy Finance
Global generation by technology (TWh)

Source: Bloomberg New Energy Finance
Power sector CO₂ emissions

Emissions (MtCO₂)

Normalised to 2012

Source: Bloomberg New Energy Finance
Power sector CO₂ emissions – 2 degrees scenario (MtCO₂)

Emissions (MtCO₂)

Total investment in zero-carbon technologies (trillion dollars)

Source: Bloomberg New Energy Finance
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