Smart Grid Status in Bangladesh Power System

Presented By

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Bangladesh at a Glance

- **Official Name**: People’s Republic of Bangladesh
- **Political System**: Parliamentary Democracy
- **Area**: 147,570 km²
- **Population**: 170 million
- **Total Exports**: USD 37 billion
- **Total Imports**: USD 59 billion
- **Remittance**: USD 15.9 billion
- **GDP Per Capita**: USD 1,827 (Jun 2019)

Bangladesh GDP growth rate 8.13% for 2018-19
Vision & Mission of Power Division

Vision

Universal access to quality electricity in a cost-effective and affordable manner.

Mission

Ensuring reliable electricity for all by 2021 through integrated development of power generation, transmission and distribution system.
Structure of the Power Sector

Power Division

(Ministry of Power, Energy & Mineral Resources)

BERC

Power Cell

Generation

BPDB
APSCL
NWZ
PGC
EGCB
RPCL
IPP
RPP
QRPP
IMPORT
SIPP

Transmission

PGCB

Distribution

DESCO
DPDC
WZPDCO
NESCO
BREB
BPDB

PBSs
Bangladesh’s Power Sector: At a Glance

Installed Generation Capacity (Approx incl. Captive Power) = 22,500 MW

Captive Power : 3,500 MW (approx)

Grid Connected Power System

- Installed Capacity : 19,195 MW (Sept, 2019)
- De-rated Capacity : 18,672 MW (Sept, 2019)
- Highest so far : 12,893 MW (29 May’ 2019, 21:00 hr)
- Electricity Growth : 10-13 %
- Access to Electricity : 94 % (Including RE)
- Per Capita Generation : 477 kWh (Including Captive Power)
- RE Energy Penetration : 3.08%
Government Vision
Electricity for All by the year 2021.

Power System Master Plan (up to 2041)

- Updates of PSMP 2006: Due to change of planning perspective
- PSMP 2010: Long term planning up to 2030
- Study completion: February 2011
- Updates of PSMP 2016: Vision 2041
- Findings:
  - Generation capacity requirement by 2021: 24,000 MW
  - Generation capacity requirement by 2030: 40,000 MW
  - Generation capacity requirement by 2041: 60,000 MW

Fuel Mix: Coal: 35%, NG: 35%, RC+NUKE+RE+Other: 30%
### Power System of Bangladesh (2009 to 2018)

<table>
<thead>
<tr>
<th>Year</th>
<th>Inst Cap.</th>
<th>Max Gen.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>5803</td>
<td>4296</td>
</tr>
<tr>
<td>2010</td>
<td>6488</td>
<td>4699</td>
</tr>
<tr>
<td>2011</td>
<td>8033</td>
<td>5174</td>
</tr>
<tr>
<td>2012</td>
<td>8931</td>
<td>6350</td>
</tr>
<tr>
<td>2013</td>
<td>10213</td>
<td>6675</td>
</tr>
<tr>
<td>2014</td>
<td>10648</td>
<td>7418</td>
</tr>
<tr>
<td>2015</td>
<td>12071</td>
<td>8177</td>
</tr>
<tr>
<td>2016</td>
<td>13179</td>
<td>9212</td>
</tr>
<tr>
<td>2017</td>
<td>13846</td>
<td>9507</td>
</tr>
<tr>
<td>2018</td>
<td>17685</td>
<td>11623</td>
</tr>
</tbody>
</table>

**Growth of Installed Capacity (2009 base)=304 %**

**Growth of Max Generation (2009 base)=270%**
## Installed Capacity (Grid Connected) (July 2019)

<table>
<thead>
<tr>
<th></th>
<th>Gas</th>
<th>HFO</th>
<th>HSD</th>
<th>Coal</th>
<th>Hydro</th>
<th>RE</th>
<th>Import</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installed Capacity</td>
<td>10877</td>
<td>4770</td>
<td>1370</td>
<td>524</td>
<td>230</td>
<td>30</td>
<td>1160</td>
<td>18961</td>
</tr>
<tr>
<td>Percentage</td>
<td>57.37%</td>
<td>25.16%</td>
<td>7.23%</td>
<td>2.76%</td>
<td>1.21%</td>
<td>0.16%</td>
<td>6.12%</td>
<td>100%</td>
</tr>
</tbody>
</table>

### Pie Chart
- **Natural Gas, 10877**
- **Furnace Oil, 4770**
- **Diesel, 1370**
- **Coal, 524**
- **Hydro, 230**
- **Renewable Energy, 30**
- **Power Import, 1160**

### Public & Private Ratio
- **Public**: 8294 (44%)
- **Private**: 9507 (50%)
- **Import**: 1160 (6%)
Transmission Network’s Expansion of Bangladesh

1972  
2003  
2019
National Grid : At a Glance

Sub Station

<table>
<thead>
<tr>
<th>Category</th>
<th>HVDC (BtB)</th>
<th>400/230 kV</th>
<th>400/132 kV (Inc. Switching)</th>
<th>230 kV</th>
<th>132/33 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nos.</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>27</td>
<td>129</td>
</tr>
</tbody>
</table>

Transmission line

<table>
<thead>
<tr>
<th>Voltage Level</th>
<th>400 kV</th>
<th>230 kV</th>
<th>132 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circuit km</td>
<td>698</td>
<td>3406</td>
<td>7545</td>
</tr>
</tbody>
</table>

Total Number of Power Plants: 136

Transmission Loss : 3.0% (approx)

Optical Fiber Ground Wire Network (OPGW) : 5500 km
Cross-border and Regional Power Trade

AS per Power System Master Plan (PSMP)

- Cross-border and Regional Power Trade

  - By 2041: **9000 MW (16%)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>500</td>
</tr>
<tr>
<td>2016</td>
<td>600</td>
</tr>
<tr>
<td>2020</td>
<td>1500</td>
</tr>
<tr>
<td>2021</td>
<td>2000</td>
</tr>
<tr>
<td>2025</td>
<td>2500</td>
</tr>
<tr>
<td>2030</td>
<td>5000</td>
</tr>
<tr>
<td>2035</td>
<td>7000</td>
</tr>
<tr>
<td>2041</td>
<td>9000</td>
</tr>
</tbody>
</table>
Drivers for Smart Grid in Bangladesh

Power Utilities

- Increase system reliability & efficiency.
- Reduction of distribution line losses in all utilities.
- Improved collection efficiency (reduce nontechnical losses)
- Rapid restoration of system
- Peak load management (consumer participation)
- Better asset management
- Increased grid visibility
- Close interaction with consumer & improved service.
- Renewable integration
Drivers for Smart Grid in Bangladesh

**Consumers**
- Expand access to electricity – “Electricity for All”
- Improve reliability of supply to all customers – no power cuts
- Improve quality of supply – stable voltage & frequency
- Provision of selling excess power to DNO- revenue for consumer
- Options to save money by shifting loads from peak to off-peak periods
- User friendly and transparent interface with utilities

**Government and Regulators**
- Reduction of CO2 emission.
- Fuel diversity- reduction of dependency of fossil fuel.
- Satisfied consumers
- Modern, efficient & financially sound utilities.
## Renewable Energy Potential

<table>
<thead>
<tr>
<th>Resources</th>
<th>Potential</th>
<th>Entities Involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar</td>
<td>Enormous (Avg daily solar radiation of 4-6.5 kWh/m²)</td>
<td>Public and Private sector</td>
</tr>
<tr>
<td>Wind</td>
<td>Complete Wind Mapping is required (few areas with 5-6 m/s)</td>
<td>Public sector / PPP</td>
</tr>
<tr>
<td>Hydro</td>
<td>Limited potential for micro or mini hydro (max. 5 MW). Est. potential: approx. 500 MW</td>
<td>Mainly public entities</td>
</tr>
<tr>
<td>Domestic Biogas System</td>
<td>8.6 Million Cubic Meter of Biogas</td>
<td>Public and Private sector</td>
</tr>
<tr>
<td>Biomass Gasification</td>
<td>300 MW considering 2 kg of husk consumption per kWh</td>
<td>Mainly private sector</td>
</tr>
<tr>
<td>Cattle waste based Biogas power plants</td>
<td>350 MW considering 0.752 m³ of biogas consumption per kWh.</td>
<td>Mainly private sector</td>
</tr>
</tbody>
</table>
Renewable Energy Status of Bangladesh

- The present share of renewable energy is only 3.08%.
- The Policy envisions 10% of total generation from renewable sources by 2020.

Institutional Development (Participating Organization)
- Sustainable & Renewable Energy Development Authority (SREDA)
- Bangladesh Power Development Board (BPDB)
- Infrastructure Development Company Limited (IDCOL)
- Rural Electrification Board (REB)
- Local Government Engineering Directorate (LGED)
- Private Sector agencies including NGOs
- Public Universities and their affiliated Institutes are involved in research and development
Renewable Energy & Distributed Generation (DG)

- Kaptai Hydro Power Station (230 MW)
- Number of SIPPs (350 MW) are connected as DG (11 & 33 kV).
- MW level solar/ wind farm connected at distribution network (56 MW)
- Very small sized (<100 W) PV panels are used in stand-alone mode (SHS) at the off-grid sites (total more than 4.5 million SHSs with approximately 300 MW).
- PV systems with roof top kW sized PV modules in urban sites near the grid are being installed or planned.
- Captive generation plants with a total of about 3500 MW are operated by some industries near the grid.
- Government is trying to actively support the renewable energy sources. i.e. solar (up to 200 MW), onshore & offshore wind, biomass, micro hydro etc which will come as DGs.
Achievement in Renewable Energy Development

<table>
<thead>
<tr>
<th>Technology</th>
<th>Off-Grid</th>
<th>On-Grid</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar</td>
<td>295.63</td>
<td>55.05</td>
<td>350.68</td>
</tr>
<tr>
<td>Wind</td>
<td>2</td>
<td>0.90</td>
<td>2.90</td>
</tr>
<tr>
<td>Hydro</td>
<td>-</td>
<td>230</td>
<td>230</td>
</tr>
<tr>
<td>Biogas to Electricity</td>
<td>0.68</td>
<td>-</td>
<td>0.68</td>
</tr>
<tr>
<td>Biomass to Electricity</td>
<td>0.40</td>
<td>-</td>
<td>0.40</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>298.71</strong></td>
<td><strong>285.95</strong></td>
<td><strong>584.66</strong></td>
</tr>
</tbody>
</table>
Renewable Energy in Bangladesh

- Kaptai Hydro PS
- Kutubdia Wind Power
- Teknaf 20 MWp Solar Power Plant
- Biomass Gasification
## Future Plans and Target (Renewable Energy)

<table>
<thead>
<tr>
<th>RE Technology</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>Total (Incl. existing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar</td>
<td>350.68</td>
<td>300</td>
<td>250</td>
<td>901</td>
</tr>
<tr>
<td>Wind</td>
<td>2.90</td>
<td>300</td>
<td>300</td>
<td>603</td>
</tr>
<tr>
<td>Biomass</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>18</td>
</tr>
<tr>
<td>Biogas</td>
<td>0.68</td>
<td>0.5</td>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td>Hydro</td>
<td>230</td>
<td>2</td>
<td>2</td>
<td>234</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>584.66</strong></td>
<td><strong>608.5</strong></td>
<td><strong>558.5</strong></td>
<td><strong>1752</strong></td>
</tr>
</tbody>
</table>
National Load Dispatch Centre (NLDC)

- A new dimension of Bangladesh’s Power Sector
Forecasted & Actual Load (EMS Software)

Load Forecast Results and History

Thu 21-Jul-2016

PGCB

Forecast Load - Actual Load - Override Load

MW

21 Thu Jul 2016  3AM  6AM  9AM  12PM  3PM  6PM  9PM  12 Fri
Typical Daily Load Curve Of Bangladesh
Summer (29 May 2019)

- Peak Load: 12893 MW at 21:00
- Base Load: 8842 MW at 7:00
- Off Peak Hours
- Peak Hours

Difference of Peak & Off Peak Load is = 4051 MW

Increase of Peak load w.r.t Base load = 45.81%
Present infrastructure for Smart Grid

Communication system & IT
• PGCB owns an optical fiber backbone network covering BPDB and major IPP owned power stations and all 230kV/132 kV/33 kV and 132kV/33 KV grid substations.
• The Bangabandhu Satellite-1 (1st Bangladeshi geostationary communications and Broadcasting Satellite) launched on 11 May 2018
• Last mile fiber connectivity is offered by a number of BTRC approved private link providers.
• Mobile phone operators (06) have wireless connectivity all over the country (internet availability).
• DNO offers online/mobile bill payment facility, different information & data, answers of queries for consumers.

Metering system
• Meters with AM/RM (automatic/remote metering) facilities have already been installed for a significant number of bulk consumers at 11 kV and 400 volts level.
• Prepayment meters are installed at many areas for single phase consumers.
• Net-metering system for grid connected SHS is under implementation.
Communication Network & RTU Locations

Optical Fiber Ground Wire (OPGW)
Network: 5500 km
Limitations for Smart Grid/RE Development

• Still focus on centralized generation for meeting demand growth (10-13%).
• Grid Code, Distribution Code & Standards for SG not yet implemented
• Lack of Automatic Frequency/Voltage control mechanism.
• Lack of automation in ANM/EMS/DSM
• Slow growth in Renewable Energy Sector (Proper Policy required)
• Poor affordability of consumers to smart appliances.
• Dynamic pricing of electricity is difficult to be implemented for the majority of consumers due to various reasons.
• Lack of Distribution SCADA & Communication facilities
• Distribution network is not up to the mark
• Not sufficient R&D for RE and SG
• Lack of affordable and maintainable technology, and significant quanta of surplus power from captive and urban site PV systems for injection at the grid (132 or 230 kV) buses.
Thank You