Current Status and Development of Smart Grids in Sri Lanka

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Structure of Electricity Industry
(Subsequent to Sri Lanka Electricity Act 2009)

- Policies
  (Government, Ministry of Power & Energy)

- Regulator
  (Public Utilities Commission of Sri Lanka)

- Generation Licensee
  (Ceylon Electricity Board)

- Generation Licensees
  (Private)

- Transmission Licensee
  (Ceylon Electricity Board)

- Distribution Licensee 1
  (CEB)

- Distribution Licensee 2
  (CEB)

- Distribution Licensee 3
  (CEB)

- Distribution Licensee 4
  (CEB)

- Distribution Licensee 5
  (LECO)

- Consumers
Statistics...

- Installed Capacity: 4,018MW
- Maximum Demand: 2,537MW
- Average cost per unit: LKR 20.32 / USD 0.113
- Average selling price: LKR 16.26 / USD 0.09
- Number of customers: 7Mn
## Generation Statistics

<table>
<thead>
<tr>
<th>Ownership</th>
<th>Type</th>
<th>No. of Power Stations</th>
<th>Installed Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEB</td>
<td>Hydro</td>
<td>17</td>
<td>1384</td>
</tr>
<tr>
<td></td>
<td>Thermal (Oil)</td>
<td>7</td>
<td>604</td>
</tr>
<tr>
<td></td>
<td>Thermal (Coal)</td>
<td>1</td>
<td>900</td>
</tr>
<tr>
<td></td>
<td>ORE (Wind)</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>PPP</td>
<td>ORE (Mini Hydro)</td>
<td>182</td>
<td>354</td>
</tr>
<tr>
<td></td>
<td>Thermal (Oil)</td>
<td>6</td>
<td>629</td>
</tr>
<tr>
<td></td>
<td>ORE (Wind)</td>
<td>15</td>
<td>128</td>
</tr>
<tr>
<td></td>
<td>ORE (Other)</td>
<td>18</td>
<td>77</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>24</strong></td>
<td><strong>4018</strong></td>
</tr>
</tbody>
</table>
• Distribution Division 1
• Distribution Division 2
• Distribution Division 3
• Distribution Division 4
• LECO Distribution
Significant achievements ....

- 100% electrified
- 8.45% G+T+D Losses
- 24x7 power supply
- Reasonable subsidised tariff for low end customers
- Subsidized tariff for industries – Rs 12 = US Cents 6.50
- Renewable absorption 30% to 50%
- 18,000 Roof Top Net Energy Metering Solar Customers
- 170 MW Roof Solar + 60 MW other solar
- Mini Hydro – 354 MW
- Wind – 128 MW
- SAIDI – Approximately 100 Hrs/Consumer/Annum
Futuristic goals of CEB

- Transition to low carbon technologies for power generation.
- Modernization of Grid to enhance reliability and to integrate large quantities of renewable energy, electric vehicles, distributed generation etc.
- Enable seamless digital customer experience.
- Business excellence through digital transformation.
Drivers of Digital Transformation in Power Utilities

- Higher customer expectations
- Regulatory requirements
- Demand for higher efficiency and effectiveness
- Reduction in technical & commercial losses
- Demand side management (TOU Tariff—Dynamic pricing based for peak demand)
- 24x7 power for all
- Outage reduction
- Renewable energy integration
- Improved energy efficiency
- Reliable grid stability
- Grid flexibility
- Reduction in peak demand
- Reduction in power purchase cost
Key elements of Digital Transformation of Power Utilities

- Information Technology (IT)
- Enterprise Resource Planning (ERP)
- Smart Grid
Digital Transformation Roadmap for CEB

The key elements of digital transformation roadmap of CEB includes

- Development and implementation of Information Technology Roadmap of CEB
- Development and Implementation of Enterprise Resource Planning System for the CEB.
- Upgrading of the existing Grid as a Smart Grid in CEB
IT Roadmap

- IT Roadmap Projects
Digital Transformation Roadmap for CEB

The key elements of digital transformation roadmap of CEB includes

• Development and implementation of Information Technology Roadmap of CEB

• Development and Implementation of Enterprise Resource Planning System for the CEB.

• Upgrading of the existing Grid as a Smart Grid in CEB
# Implementation Plan of the ERP Project

<table>
<thead>
<tr>
<th>No</th>
<th>Sub Project Name</th>
<th>Description</th>
<th>Project Cost Mn. USD</th>
<th>Funding</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Preparation of FRS, RFP and Tender Documents of the ERP</td>
<td>M/s KPMH Sri Lanka was appointed as the Consultant</td>
<td>0.6</td>
<td>CEB</td>
<td>2017 June to 2018 October</td>
</tr>
<tr>
<td>2</td>
<td>Selection of suitable System Integrator for the ERP Project</td>
<td></td>
<td></td>
<td></td>
<td>2018 November to 2019 March</td>
</tr>
<tr>
<td>3</td>
<td>Implementation of the Phase 01 of the ERP Project</td>
<td></td>
<td>7.0</td>
<td>ADB</td>
<td>2019-2021</td>
</tr>
<tr>
<td>4</td>
<td>Implementation of the Phase 02 of the ERP Project</td>
<td></td>
<td>1.6</td>
<td>ADB</td>
<td>2021-2022</td>
</tr>
</tbody>
</table>
• **Phase 01**

• **Phase 02**
  Asset Management, Maintenance Management, Fuel Management, Fleet Management during the year 2021
Digital Transformation Roadmap for CEB

The key elements of digital transformation roadmap of CEB includes

- Development and implementation of Information Technology Roadmap of CEB
- Development and Implementation of Enterprise Resource Planning System for the CEB.
- Upgrading of the existing Grid as a Smart Grid in CEB
Upgrading of the existing Grid as a Smart Grid in CEB

- Upgrading of Distribution Grid as Smart Grid
- Upgrading of Transmission Grid as Smart Grid
Upgrading Distribution Grid as a Smart Grid

• Roadmap for Advanced Metering Infrastructure (Smart Metering)

• Roadmap for Implementation of Advanced Distribution Management System with Outage Management Systems (ADMS - DMS)

• Roadmap for Implementation of Geographical Information System

• Implementation Plan for Home Area Network

• Implementation Plan for V to G and G to V
Roadmap for deployment of Advanced Metering Infrastructure (AMI) for CEB

- AMI Projects for Areas
- AMI Project for Bulk Supplies in the CEB
- AMI Project for Power Quality Management
- AMI for Distribution Transformer Monitoring System
## Category 01 Areas

<table>
<thead>
<tr>
<th>CEB Distribution Divisions</th>
<th>Area Engineers Units which under Category 01</th>
<th>No. of Retail Customers in March 2018</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DD-1</strong></td>
<td>Colombo North</td>
<td>51,293</td>
</tr>
<tr>
<td></td>
<td>Colombo South</td>
<td>48,960</td>
</tr>
<tr>
<td></td>
<td>Colombo West</td>
<td>31,732</td>
</tr>
<tr>
<td></td>
<td>Colombo East</td>
<td>44,217</td>
</tr>
<tr>
<td></td>
<td>Kandy City</td>
<td>43,205</td>
</tr>
<tr>
<td><strong>DD-2</strong></td>
<td>Negombo</td>
<td>106,922</td>
</tr>
<tr>
<td></td>
<td>Kalmuneni</td>
<td>86,072</td>
</tr>
<tr>
<td></td>
<td>Ja-Ela</td>
<td>94,181</td>
</tr>
<tr>
<td></td>
<td>Kelaniya</td>
<td>128,264</td>
</tr>
<tr>
<td><strong>DD-3</strong></td>
<td>Sri Jayawardanapura</td>
<td>102,461</td>
</tr>
<tr>
<td><strong>DD-4</strong></td>
<td>Dehiwala</td>
<td>49,461</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>786,768</td>
</tr>
</tbody>
</table>
AMI Projects for Areas

• AMI Projects
AMI for Bulk Supplies in the CEB

• There are about 11500 bulk supplies in the CEB and at present remote reading is possible for all the bulk supply energy meters.
• However these installations are not equipped with smart meters and other functionalities of a smart metering system.
• There are many different types of meters installed and different software has to be used to remote read the meters. After reading the meters, meter readings have to be manually entered into the bulk supply billing system for the preparation of bills.
• The present system has facility only to remote read the meter.
• There are many added befits to CEB as well as customers when a fully pledged smart bulk metering system is installed for the CEB including a smart bulk meter, communication network and meter data management system.
• CEB should finance the above program and GPRD/3G/4G/Fiber technology could be used to communicate between the smart meter and the Meter Data Management System.
## AMI Project for Bulk Supplies in CEB

<table>
<thead>
<tr>
<th>Sub Project Name</th>
<th>Description</th>
<th>Project Cost (USD Million)</th>
<th>Funding</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMI Project for Bulk Supply Customers of the CEB</td>
<td>AMI Project for Bulk Supply Customers of the CEB</td>
<td>2.0</td>
<td>CEB</td>
<td>2019 - 2020</td>
</tr>
</tbody>
</table>
AMI Project for Power Quality Management

- With smart meters in the network, the utility will be capable of measuring specific aspects such as power factors and voltages in near real time. This will enable the utility to take appropriate actions to enhance the power quality and reliability.

- In order to achieve above it is recommended to install a smart meters with AMI infrastructure and functionalities to all LV feeder ends (about 100000 in numbers) of CEB and to use AMI system of the utility to measure power quality parameters in near real time.

- This will enhance power quality, meet regulatory requirements and for operation and planning of the distribution network. This should be done using CEB finances.
AMI for Distribution Transformer Monitoring System

• Remote monitoring and control of distribution transformers will prevent overloading, phase imbalance and burn outs.
• This will transform into huge financial savings taking into account the high technical losses that occur in the system owing to phase imbalance – one phase gets overloaded while other two phases are low on load.
• With monitoring systems in place the loads can be distributed to remove such imbalances on transformers. Also this will facilitate real-time energy auditing of each feeders.
• “Supporting Electricity Supply and Reliability Improvement Project” which is funded by the ADB has called for tenders to procure 25,000 Nos.
# AMI Project for Power Quality Management

<table>
<thead>
<tr>
<th>Sub Project Name</th>
<th>Description</th>
<th>Project Cost (USD Million)</th>
<th>Funding</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMI Project for Distribution Transformer Monitoring</td>
<td>A Commercial Project for monitoring of 25000 distribution transformers in the CEB</td>
<td>3.5</td>
<td>ADB for Meter and the Balance from CEB</td>
<td>2019 - 2020</td>
</tr>
<tr>
<td>AMI Project for power quality management</td>
<td>A Commercial Project for power quality monitoring and management for 100000 feeder ends of the CEB distribution Transformers</td>
<td>11.0</td>
<td>CEB</td>
<td>2020 to 2022</td>
</tr>
</tbody>
</table>
Advanced Distribution Management System with SCADA and ADMS

- From a SCADA Control Center, operators can control the distribution network efficiently and effectively. Advance Distribution Management System (DMS) is a collection of application design to monitor and control entire distribution network efficiently and reliably.

- ADMS functions are:
  - Network Visualization and Support Tools
  - Applications for Analytical and Remedial Actions
  - Utility Planning Tools
  - System Protection Schemes
ADMS  current status

- **DD1**
  - Colombo City has commissioned a SCADA operated ADMS in the year 2009
- **DD2**
  - Western North
- **DD3**
  - Central / Eastern
- **DD4**
  - All 03 Provinces
  - Not at present

Another three Control Centers are established and operated at present in North Western Province (at Kuliapitiya), North Central Province (at Anuradhapura) and Northern Province (at Chunnakam) to monitor and control the overhead distribution network.
Roadmap for ADMS

• Roadmap for Advanced Distribution Management System
## Geographical Information System

<table>
<thead>
<tr>
<th>No</th>
<th>Sub Project Name</th>
<th>Description</th>
<th>Project Cost</th>
<th>Funding</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GIS for DD1</td>
<td>Establishment of a GIS for all the Provinces of DD1. (MV network of North Western Province is already mapped with GIS)</td>
<td>100 Million</td>
<td>AFD</td>
<td>2021-2022</td>
</tr>
<tr>
<td>2</td>
<td>GIS for DD2</td>
<td>Establishment of a GIS for all the provinces of DD2. (MV network of Western Province North is already mapped with GIS)</td>
<td>100 Million</td>
<td>AFD</td>
<td>2021-2022</td>
</tr>
<tr>
<td>3</td>
<td>GIS for DD3</td>
<td>Expansion or review of existing GIS already installed in all three Provinces of DD3.</td>
<td>50 Million</td>
<td>AFD</td>
<td>2021-2022</td>
</tr>
<tr>
<td>4</td>
<td>GIS for DD4</td>
<td>Establishment of a GIS for all the Provinces of DD4</td>
<td>150 Million</td>
<td>AFD</td>
<td>2021-2022</td>
</tr>
</tbody>
</table>
Home Area Network / V to G and G to V

• After implementing the Smart Meters in Areas
Smart Grid Functionalities of Transmission Segment

• Supervisory Control and Data Acquisition (SCADA) System
• Energy Management System (EMS) at Transmission Level
• Wide Area Monitoring System (WAMS)
• Substation Automation
• Renewable Integration
• Demand Response
• Energy Storage
Upgrading Transmission Grid as a Smart Grid

- Smart Transmission Grid Implementation Plan
Customer Care Solution
LECO Smart Grid