Small Hydropower Development in Sri Lanka

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21st International Training Course on Small Hydropower Development at IIT, Roorkee from 15th to 26th September 2014
OUTLINE

* About Sri Lanka
* Power Sector & Energy Status
* National Policy on Renewable
* Status of Non Conventional Renewable Energy (NCRE)
* Development Plan & Growth Rate
* SHP Development & Success Factors
* Pico Hydro’s & their Developments
The Pearl of the Indian Ocean
## About Sri Lanka

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area (sqkm)</td>
<td>65610</td>
</tr>
<tr>
<td>Population (million)</td>
<td>21</td>
</tr>
<tr>
<td>Population Density(/sqkm)</td>
<td>326</td>
</tr>
<tr>
<td>Literacy (%)</td>
<td>91.3</td>
</tr>
<tr>
<td>Temperature (deg.)</td>
<td>15-32</td>
</tr>
<tr>
<td>Annual rainfall (mm)</td>
<td>750 - 6000</td>
</tr>
<tr>
<td>Per Capita Electricity Consumption (kWh)</td>
<td>490</td>
</tr>
</tbody>
</table>
Monsoons in Sri Lanka

- North East (NE) Monsoon
- 1st Inter Monsoon
- South West (SW) Monsoon
- 2nd Inter Monsoon

- December – February
- March – April
- May – September
- October - November

Annual Rainfall: 750 – 6000 mm
Humidity: 70% (Day), 90% (Night)
Temp: 15-32 °C
- Sri Lanka is a land of rivers
- 103 nos. of river basins
Power Sector & Energy Status

* Ministry of Power & Energy
* Ceylon Electricity Board (CEB)
* Lanka Electricity Company (LECO)
* Independent Power Producers (IPP)
* Regulator: Public Utilities Commission of Sri Lanka (PUCSL)
* Sri Lanka Sustainable Energy Authority (SEA)
<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Installed Capacity</th>
<th>MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydro</td>
<td>1361</td>
<td></td>
</tr>
<tr>
<td>Small Hydro</td>
<td>267</td>
<td></td>
</tr>
<tr>
<td>Thermal Oil</td>
<td>564</td>
<td></td>
</tr>
<tr>
<td>Coal</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>IPP</td>
<td>771</td>
<td></td>
</tr>
<tr>
<td>NCRE</td>
<td>96</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3359</strong></td>
<td></td>
</tr>
</tbody>
</table>

Source: Energy Statistics of CEB, 2013
Power Sector & Energy Status Contd..

Daily Load Pattern

Typical System Load Profile of Sri Lanka

Maximum demand = 1954.7 MW, has occurred at 19:00

Minimum demand = 871.6 MW, has occurred at 02:00

Average Demand = 1325.6 MW, is shown by a red line.
* Source: Ceylon Electricity Board Statistics 2013
Hydro Classification

Classification by Sri Lanka

* Major Hydro - Large > 10MW
* Mini Hydro - 10 MW > Mini > 1 MW
* Micro Hydro - 1 MW > Micro > 1 kW
* Pico Hydro - Less than 1 kW

Major Hydro Projects Underway

* Uma-Oya - 120 MW
* Broadlands - 37.5 MW
* Moragolla - 27 MW
* Moragahakanda - 25 MW

Out of the total potential, all economically feasible large hydro sites have been utilized in the country.
Ensuring energy security in SL

Promoting,
- energy efficiency
- energy conservation
- indigenous resources
- appropriate pricing

Access to electricity - 98% of the households by 2016

Currently 94% electrified
2020 Policy  (20% of grid electricity from NCRE by 2020)

**Current Status 10.8% 2013**

(Clause 4.4 of National Energy Policy May 2008)

- Standard Power Purchasing Agreement (SPPA) for plants less than 10 MW
# Status of NCRE Sector as at 31/12/2012

<table>
<thead>
<tr>
<th>Description</th>
<th>Project Type</th>
<th>No. of Projects</th>
<th>Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commissioned Projects</td>
<td>Mini Hydro Power</td>
<td>107</td>
<td>234.100</td>
</tr>
<tr>
<td></td>
<td>Biomass-Agricultural &amp; Industrial Waste Power</td>
<td>2</td>
<td>11.000</td>
</tr>
<tr>
<td></td>
<td>Biomass- Dendro Power</td>
<td>1</td>
<td>0.500</td>
</tr>
<tr>
<td></td>
<td>Solar Power</td>
<td>4</td>
<td>1.378</td>
</tr>
<tr>
<td></td>
<td>Wind Power</td>
<td>9</td>
<td>73.650</td>
</tr>
<tr>
<td>Total - Commissioned</td>
<td></td>
<td>123</td>
<td>320.628</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Project Type</th>
<th>No. of Projects</th>
<th>Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standardized Power Purchase Agreements (SPPA) Signed Projects</td>
<td>Mini Hydro Power</td>
<td>76</td>
<td>171.612</td>
</tr>
<tr>
<td></td>
<td>Wind Power</td>
<td>4</td>
<td>21.300</td>
</tr>
<tr>
<td></td>
<td>Biomass-Agricultural &amp; Industrial Waste Power</td>
<td>2</td>
<td>4.000</td>
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<tr>
<td></td>
<td>Biomass-Dendro Power</td>
<td>11</td>
<td>61.770</td>
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<tr>
<td></td>
<td>Biomass-Dendro Power</td>
<td>1</td>
<td>10.000</td>
</tr>
<tr>
<td>Total – SPPA Signed</td>
<td></td>
<td>94</td>
<td>268.682</td>
</tr>
</tbody>
</table>

**LOI Issued Projects** – 280 MW SHP as at 2012
### Development Plan

<table>
<thead>
<tr>
<th>Year</th>
<th>Biomass</th>
<th>Hydro</th>
<th>Wind</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>1</td>
<td>119</td>
<td>3</td>
<td></td>
<td>123</td>
</tr>
<tr>
<td>2008</td>
<td>11</td>
<td>155</td>
<td>3</td>
<td></td>
<td>169</td>
</tr>
<tr>
<td>2009</td>
<td>15</td>
<td>165</td>
<td>14</td>
<td></td>
<td>194</td>
</tr>
<tr>
<td>2010</td>
<td>15</td>
<td>200</td>
<td>34</td>
<td>1</td>
<td>250</td>
</tr>
<tr>
<td>2011</td>
<td>20</td>
<td>225</td>
<td>34</td>
<td>1</td>
<td>280</td>
</tr>
<tr>
<td>2012</td>
<td>20</td>
<td>280</td>
<td>35</td>
<td>1</td>
<td>336</td>
</tr>
<tr>
<td>2013</td>
<td>20</td>
<td>295</td>
<td>85</td>
<td>2</td>
<td>402</td>
</tr>
<tr>
<td>2014</td>
<td>30</td>
<td>310</td>
<td>85</td>
<td>2</td>
<td>427</td>
</tr>
<tr>
<td>2015</td>
<td>40</td>
<td>330</td>
<td>85</td>
<td>5</td>
<td>460</td>
</tr>
</tbody>
</table>

* Achievement by 2013 – 267 MW (90.51%)
Status of NCRE Sector Contd...

- Growth in SHP

![Cumulative Growth Graph](image-url)
Key Factors for the SHP Development

* Availability of
  - profitable sites
  - loan funding
  - technical Expertise
  - reliable data to carry out feasibility studies available.
  - standard PPA and Technical guidelines
  - BOI concessions
Success factors for SHP

* **Virtually free from market risks**
  * What ever produced will be purchased
  * Guaranteed floor price

* **Availability of an SPPA**
  * Simple approach
  * Acceptable to banks
  * Low transaction costs

* **Resource allocation – Sustainable Energy Authority**
  * First come first served basis
  * Devoid of cumbersome competitive processes
Success factors for SHP contd...

* Financing mechanism in place
  * Two consecutive World Bank projects (ESDP and REREDP) with a sound disbursement procedure

* Technology development keeping pace
  * Local Engineering know how developed to commendable levels
  * Capacity of construction companies developed

* Availability of the National Grid
  * 94% electrified by 2013
  * High reliability of the grid
Some of the SHP in Sri Lanka

Name: Kiriwana Eliya
Capacity: 4.56 MW
Net head: 200 m
EM: Voith Siemens Energy
Energy: 16 GWh

Name: Erathna SHP
Capacity: 10 MW
Net head: 426 m
EM: Voith Siemens Energy
Energy: 40 GWh

Name: Katapola Village
Capacity: 220 W
Net head: 19 m
Flow Rate: 3 l/s
Development in Pico Hydro

Indigenous PH
Overall efficiency 8%(60W)

1st development
PH Overall efficiency 20%(130W)

Final technology development
Overall efficiency 45% (280W)

Data
Development in Pico Hydro Contd..

- **Fiber runner with Concrete turbine**
  - Brass pelton turbine runner 225mm PCD – Rs 20,000
  - Alu. pelton turbine 225mm PCD – Rs 15,000
  - **Fibered turbine 225mm PCD** – Rs 8,000
Sri Lanka is located on the southern tip of India.
THANK YOU