Renewable Energy Data in Lao PDR

Institute of Renewable Energy Promotion
Ministry of Energy and Mines

12-14/12/2016
Bangkok, Thailand
Outline

1. Introduction
2. Current energy situation and outlook.
3. Power potential in Lao PDR
4. Energy Sector Policy
5. Conclusion
BASIC FACTS ABOUT LAOS

- Area: 236,800 km²
- Capital: Vientiane
- Population 2015
  - Total 6.5 millions
  - Density 27 person/km²
- Total Share of GDP 2015
  - GDP per Capita 1,947 US$
  - Growth rate of GDP: 7.56%
- Share of GDP 2015
  - Agricultural: 21.80%
  - Industry: 32.70%
  - Services: 35.95%
  - Taxes on products and Import duties, net: 9.55%
1. Current Energy Situation and Outlook

• Energy Development in Lao PDR has been rapidly increasing in parallel with the domestic demand. Additionally, Lao Government has supported and encouraged private to invest in energy sector. Compare of increasing by the year of 2010, the total install capacity is increased from 2,546.7 MW to 5,806 MW in 2016.
1. Current Energy Situation and Outlook
## 1. Current Energy Situation and Outlook

**Energy Supply:**
Lao PDR has potential of Hydropower about 28,600 MW with 409 projects

<table>
<thead>
<tr>
<th></th>
<th>Project Amount</th>
<th>Install Capacity (MW)</th>
<th>Energy Generation (GWh/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing Projects</td>
<td>40</td>
<td>6,290</td>
<td>33,590</td>
</tr>
<tr>
<td>Under construction Projects and expect to complete construction by 2020</td>
<td>50</td>
<td>5,820</td>
<td>27,502</td>
</tr>
<tr>
<td>Expect to complete construction by 2025</td>
<td>35</td>
<td>4,147</td>
<td>20,106</td>
</tr>
<tr>
<td>Expect to complete construction by 2030</td>
<td>58</td>
<td>4,434</td>
<td>18,272</td>
</tr>
<tr>
<td>MOU signed</td>
<td>246</td>
<td>8,480</td>
<td>30,119</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>429</strong></td>
<td><strong>29,171</strong></td>
<td><strong>129,589</strong></td>
</tr>
</tbody>
</table>

Sourced: The 6th Report on Hydropower Development Projects in Lao PDR (30 June 2016), by DEPP
NONE Hydro RE projects

**WIND:** 2000-3000 MW

- 600 MW (1st phase: 250MW) under negotiation for development in Sekong Prov.
- 3 additional projects under field investigation

**SOLAR:**

- Only Home Solar System (SHS) (50-100W) (25,000 HH)
- 700 kW grid connected (demonstration project by Japanese grant)
- 500 MW solar farm under study
- 100 MW Solar and Wind Hybrid Project
- 10 MW solar Farm under Construction
None Hydro RE projects

Biomass: 1000-2500 MW

• 39 MW in operation
• 20 MW is under Construction

Biogas:

10000 kg/day to replace the LPG import

Livestock Farms
1. Current Energy Situation and Outlook

**Energy Demand:**

<table>
<thead>
<tr>
<th>No.</th>
<th>ลำดับ (Descriptions)</th>
<th>Units</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>Growth Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Energy Demand (Excluding system losses) (GWh)</td>
<td></td>
<td>4.321</td>
<td>4.665</td>
<td>6.131</td>
<td>13,253</td>
<td>22,407</td>
<td>30,680</td>
<td>23.2%</td>
</tr>
<tr>
<td>2</td>
<td>System Losses (%)</td>
<td></td>
<td>10.4%</td>
<td>10.5%</td>
<td>9.7%</td>
<td>7.8%</td>
<td>6.9%</td>
<td>6.8%</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Energy Demand (Including system losses) (GWh)</td>
<td></td>
<td>4.823</td>
<td>5.213</td>
<td>6.789</td>
<td>14,378</td>
<td>24,057</td>
<td>32,923</td>
<td>22.5%</td>
</tr>
<tr>
<td>4</td>
<td>Peak Load (MW)</td>
<td></td>
<td>960</td>
<td>1,056</td>
<td>1,349</td>
<td>2,723</td>
<td>4,395</td>
<td>5,892</td>
<td>20.9%</td>
</tr>
<tr>
<td>5</td>
<td>Load Factor (%)</td>
<td></td>
<td>57.3%</td>
<td>56.3%</td>
<td>57.5%</td>
<td>60.3%</td>
<td>62.5%</td>
<td>63.8%</td>
<td></td>
</tr>
</tbody>
</table>

*Sourced: Demand forecast 2016-2030 Report (February 2016), by EDL*
Energy demand in Lao PDR

Figure 1.6 Estimate of energy demand in Lao PDR by 2025 (MEM)
Trend of Total Energy Demand

 tambourina domas tao thamaluamphi duam mueaw haawat​aats. kTOE

- Existing statistic
- Future predict

5,600 kTOE

2,510 kTOE

Agriculture
Residential
Business
Transport
Industrial
Grid to Grid memoranda on Power Export by 2020

<table>
<thead>
<tr>
<th>Export to</th>
<th>MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thailand</td>
<td>7,000 MW expanded with 2000 MW</td>
</tr>
<tr>
<td>Vietnam</td>
<td>3,000 MW</td>
</tr>
<tr>
<td>Cambodia</td>
<td>2,000 MW, initial</td>
</tr>
<tr>
<td>Myanmar</td>
<td>3,000 MW, to be initialed</td>
</tr>
<tr>
<td>China (Yunan Province)</td>
<td>12,000 MW, being discussed</td>
</tr>
</tbody>
</table>
GMS Power Grid

1. Nabong (Laos) - Oudon (Thailand)

2. Hatsan (Laos) – Pleiku (Vietnam)

3. Hongsa (Laos) - Thailand

4. Nam Ou (Laos) - Thailand

5. Luangphabang (Laos) - Nho Quan or Than Hoa Vietnam

6. Xayabouli (Laos) – Khon Ken (Thailand)

7. Pakbeng (Laos)-Thailand
Livestock waste (Example)

<table>
<thead>
<tr>
<th>Livestock</th>
<th>2010 Production (million heads)</th>
<th>Daily Manure Production Factor (kg/animal)</th>
<th>Substrate Quantity (kg/day)</th>
<th>Dry Matter Factor (%)</th>
<th>Total Dry Matter Available (kg/day)</th>
<th>Mean Biogas Yield Factor (m³/kg dry matter)</th>
<th>Daily Biogas Production (m³/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffalo</td>
<td>1.183</td>
<td>8.00</td>
<td>9,464,000</td>
<td>16</td>
<td>1,514,240</td>
<td>0.250</td>
<td>378,560</td>
</tr>
<tr>
<td>Cattle</td>
<td>1.475</td>
<td>8.00</td>
<td>11,800,000</td>
<td>16</td>
<td>1,888,000</td>
<td>0.250</td>
<td>472,000</td>
</tr>
<tr>
<td>Pigs</td>
<td>2.752</td>
<td>2.00</td>
<td>5,504,000</td>
<td>17</td>
<td>935,680</td>
<td>4.200</td>
<td>3,929,856</td>
</tr>
<tr>
<td>Chicken</td>
<td>24.078</td>
<td>0.08</td>
<td>1,926,240</td>
<td>25</td>
<td>481,560</td>
<td>0.575</td>
<td>276,897</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>5,057,313</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

kg = kilogram, Lao PDR = Lao People’s Democratic Republic, m³ = cubic meter.

Source: Renewable energy developments and potential in the Greater Mekong Sub region
Agriculture waste (Example)

<table>
<thead>
<tr>
<th>Biomass Residue</th>
<th>Total Yearly Biomass Production ($10^3$ tons)</th>
<th>Total Theoretical Energy Potential ($10^6$ GJ)</th>
<th>Total Theoretical Energy Potential (GWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice husks</td>
<td>767</td>
<td>9.86</td>
<td>2,740</td>
</tr>
<tr>
<td>Rice straw</td>
<td>1,013</td>
<td>6.12</td>
<td>1,700</td>
</tr>
<tr>
<td>Maize or corn cobs</td>
<td>255</td>
<td>3.66</td>
<td>1,017</td>
</tr>
<tr>
<td>Cassava stalks</td>
<td>64</td>
<td>0.44</td>
<td>123</td>
</tr>
<tr>
<td>Sugarcane tops and trash</td>
<td>247</td>
<td>1.66</td>
<td>462</td>
</tr>
<tr>
<td>Sugarcane bagasse</td>
<td>205</td>
<td>1.32</td>
<td>366</td>
</tr>
</tbody>
</table>

GJ = gigajoule, GWh = gigawatt-hour, Lao PDR = Lao People’s Democratic Republic.

Source: Renewable energy developments and potential in the Greater Mekong Sub region
Power Generation Share

- Total Install Capacity 6,264.9 MW [November 2016]
2. Power potential in Lao PDR

- **HYDRO POWER POTENTIAL OF ABOUT 26,000 MW.**
  - Small Hydro Power $\leq 15$ MW: 2,000 MW

- **Wind $\sim 182,000$ MW, very good 2,000-3,000 MW**
  - 600 MW (phase 1: 250MW) under negotiation for development in Sekong Prov.

- **Solar:** irradiation 3.6-5.5 kWh/m$^2$ (1800-2000hrs/y)

- **Biomass $> 938$ MW

- **Biogas $> 313$ MW**
3. Energy Sector Policy

- Increase electrification ratio to 98% by 2025 and make modern energy more affordable and accessible for every Lao citizen even in the remote areas;
- Promote energy efficiency and conservation by reducing 10% of energy consumption in 2030;
- Increase energy export to boost national socio-economic development;
- Reserve coal for domestic use and power generation;
- Increase power export to 12,000 MW by 2020, 7,000 MW to Thailand and 5,000 MW to Viet Nam;
- Increase a share of other renewable energy to 30% in the total energy mix by 2025;
**Objective:** Ensure energy security, sustain socio-economic development, and enhance environmental and social sustainability

**Financial Incentive for Investors**


**Develop and Modify Legal documents (laws, regulations and guidelines)**

**Target:** increase RE use to 30% of national demand by 2025 (bio-fuel production to account 10%)

**Support Mechanism**

- **Establish Renewable Energy Fund**
- **Financial Mechanism:**
  - Import duty free on production machinery, equipment and raw materials
  - Import duty free on chemical materials necessary for biofuels production within 7 years
  - Profit tax is divided in to 3 categories: 20%, 15% and 10%. Profit tax exemption is possible for a certain period depending on activities, investment areas and size investment
- **Subsidies on unit product price depending on energy type and times period**

**For Electricity**

- **Wind:** 73 MW
- **Solar:** 106 MW
- **SHP:** 400 MW
- **Biofuels (ML):**
  - Ethanol: 97.64 ML
  - Biodiesel: 194.44 ML

**Heat**

- **Biomass:** 113 ktoe
- **Biogas:** 178 ktoe

**Bio-Energy**

- **Wind:** 73 MW
- **Solar:** 106 MW
- **SHP:** 400 MW
- **For Electricity:**
  - Biomass: 58 MW
  - Biogas: 51 MW
  - Waste: 36 MW
- **Biofuels (ML):**
  - Ethanol: 97.64 ML
  - Biodiesel: 194.44 ML

- Develop legal documents
- Study & development models
- Market assessment and energy source studies

2011-2015

- Promote the RE energy technology industry,
- Formulate a clear framework for a midterm program (increased competition)
- Support the full development of RE
- Increased competition and reduced dependency

2016-2020

- Promote new, economically viable, RE technologies
- Encourage full competition based on equality.

2021-2025
# GOL Target on RE Sector

<table>
<thead>
<tr>
<th>No</th>
<th>RE TYPE</th>
<th>Potential</th>
<th>Existing</th>
<th>Target 2010-2015</th>
<th>Target 2016-2020</th>
<th>Target 2021-2025</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>MW</td>
<td>MW</td>
<td>MW</td>
<td>Ktoe</td>
<td>MW</td>
</tr>
<tr>
<td>A</td>
<td>Electricity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Small Hydropower</td>
<td>2,000</td>
<td>12</td>
<td>80</td>
<td>134</td>
<td>400</td>
</tr>
<tr>
<td>2</td>
<td>Solar</td>
<td>511</td>
<td>1</td>
<td>22</td>
<td>36</td>
<td>33</td>
</tr>
<tr>
<td>3</td>
<td>Wind</td>
<td>&gt;40</td>
<td>6</td>
<td>12</td>
<td>8</td>
<td>73</td>
</tr>
<tr>
<td>4</td>
<td>Biomass</td>
<td>938</td>
<td>13</td>
<td>13</td>
<td>24</td>
<td>58</td>
</tr>
<tr>
<td>5</td>
<td>Biogas</td>
<td>313</td>
<td>10</td>
<td>19</td>
<td>12</td>
<td>51</td>
</tr>
<tr>
<td>6</td>
<td>Municipal Solid Waste</td>
<td>216</td>
<td>9</td>
<td>17</td>
<td>11</td>
<td>36</td>
</tr>
<tr>
<td>7</td>
<td>Geothermal</td>
<td>56</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Biofuels</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Ethanol</td>
<td>600</td>
<td>10</td>
<td>106</td>
<td>150</td>
<td>279</td>
</tr>
<tr>
<td>2</td>
<td>Biodiesel</td>
<td>1,200</td>
<td>0.01</td>
<td>15</td>
<td>205</td>
<td>300</td>
</tr>
<tr>
<td>C</td>
<td>Thermal Energy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Biomass</td>
<td>227</td>
<td></td>
<td>17</td>
<td>22</td>
<td>109</td>
</tr>
<tr>
<td>2</td>
<td>Biogas</td>
<td>444</td>
<td></td>
<td>22</td>
<td>44</td>
<td>178</td>
</tr>
<tr>
<td>3</td>
<td>Solar</td>
<td>218</td>
<td></td>
<td>17</td>
<td>22</td>
<td>109</td>
</tr>
</tbody>
</table>
### CURRENT STATUS OF SOLAR DEVELOPMENT

<table>
<thead>
<tr>
<th>Type of System</th>
<th>Unit</th>
<th>Ins Cap (kW)</th>
<th>Supporter</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHS</td>
<td>16,570</td>
<td>459.57</td>
<td>JICA, WB</td>
<td>End of 2013</td>
</tr>
<tr>
<td>BCS</td>
<td>3</td>
<td>8</td>
<td>JICA</td>
<td></td>
</tr>
<tr>
<td>Hybrid</td>
<td>1</td>
<td>100/70</td>
<td>NEDO</td>
<td>(Solar for Pump + MH)</td>
</tr>
<tr>
<td>Hybrid</td>
<td>1</td>
<td>110/40</td>
<td>NEDO</td>
<td>(MH + Solar for Pump)</td>
</tr>
<tr>
<td>Hybrid</td>
<td>1</td>
<td>36/60/1.5</td>
<td>Private</td>
<td>(MH/Gen-set/Solar)</td>
</tr>
<tr>
<td>Stand alone</td>
<td>1</td>
<td>6.5</td>
<td>EEP/FONDEM</td>
<td>Luang Prabang Prov</td>
</tr>
<tr>
<td>Hybrid</td>
<td>1</td>
<td>4.8/5</td>
<td>FONDEM</td>
<td>Solar + Diesel</td>
</tr>
<tr>
<td>Solar roof</td>
<td>1</td>
<td>236</td>
<td>JICA</td>
<td>Wattay Airport</td>
</tr>
<tr>
<td>Solar roof</td>
<td>1</td>
<td>150</td>
<td>JICA</td>
<td>EDL’ Building (UC)</td>
</tr>
<tr>
<td>Solar crop dryers</td>
<td>2</td>
<td></td>
<td>ACMEC/University</td>
<td>For community and university</td>
</tr>
<tr>
<td>Telecom</td>
<td></td>
<td>155</td>
<td>Telecom</td>
<td>57 station</td>
</tr>
</tbody>
</table>
Potential: 2,000 MW (Less than 15 MW)
- Exiting Projects: 23 projects, 76 MW,
- Under Construction: 18 projects, 166 MW
- Under study: 142 projects, 1263 MW
**CURRENT STATUS OF BIOMASS DEVELOPMENT**

**Hoang Anh Sugar Mill**
Phouvang, district
Attapeu Province
Install Capacity: 30 MW
Feedstock: Bagasse

**Mit Lao Sugar Mill**
Xaibury, district
Savannakhet Province
Install Capacity: 9.7 MW
Feedstock: Bagasse
### Pig Farm Viravong
- **30 kW**
- Viengkam District
- Vientiane

### UD Pig Farm
- **260 kW**
- Phohong District
- Vientiane Province

**Biogas Project/ DFL (MAF)**
- 5,003 HHs in Year 2012
BIOFUEL DEVELOPMENT

<table>
<thead>
<tr>
<th>Plantation-Area</th>
<th>Harvest-Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palm oil</td>
<td></td>
</tr>
<tr>
<td>300+800 ha</td>
<td>60 ha (2016)</td>
</tr>
<tr>
<td>FFB</td>
<td>173,640 kg</td>
</tr>
<tr>
<td>CPO</td>
<td>33,000 L</td>
</tr>
<tr>
<td>B100</td>
<td>20,000 L</td>
</tr>
<tr>
<td>Biodiesel Plant: 20,000 L/day</td>
<td></td>
</tr>
</tbody>
</table>

**Extraction Plant**: 20 tons/day

<table>
<thead>
<tr>
<th>Vernicia Montana</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>12,350</td>
<td>3,000 ha</td>
</tr>
<tr>
<td>Fruit collection</td>
<td>75,000 kg</td>
</tr>
<tr>
<td>B100</td>
<td>18,000 L</td>
</tr>
<tr>
<td>Biodiesel Plant: 1,000 L/day</td>
<td></td>
</tr>
</tbody>
</table>

**Extraction Plant**: 2 tons/day

In 2017 new Plant 2 units; Each unit 15 t/day

| B100             | 18,000 L |

**Bio ethanol: June 2014**

The GOL signed MOU with 2 local private company to conduct feasibility study of bio ethanol production from cassava (each 200,000 L/day)

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**CURRENT STATUTE**

**BIO-DIESEL PRODUCTION B100 [L]**

- 2011: 100,000
- 2012: 105,000
- 2013: 120,000
- 2014: 127,000
- 2015: 200,000

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**Lao-Agrotech Co., Ltd**

Naxaythong, district Vientiane Capital

**Biodiesel-Makao Oil Lao Co., Ltd**

Luangprabang, district Luangprabang Province
CHALLENGE

- Lack of information on resources available and sustainability, in particular with regard to biomass
- Geographic location, no access road (cannot access during raining season)
- Limited budget for collecting RE data
- Lack of appropriate mechanism to promote RE statistics
Conclusion

- Capacity building among technical level and community level about RE statistic
- Knowledge and Information sharing
- Capacity building and promotion regional cooperation to develop tools, database development.
Khop Jai Laiy Laiy!

Thank you