The Current Status of Renewable Energy, Energy Efficiency Development in Cambodia

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II. ENERGY EFFICIENCY ACTIVITIES IN CAMBODIA
1. Background Situation for Renewable Energy Development in Cambodia (1/3)

- At present, the development of RE sources in Cambodia is slow in comparing with other countries in the region, because of the lack of experiences, funds, and inadequate data in this field,

- Current status of RE Technologies in Cambodia mainly in research development and demonstration stages,

- Renewable Energy will reduce the impact on climate change/ decrease the CO2 emissions and contributed to global warming reduction
Renewable Energy Potential

- **Solar Energy**: The average sunshine duration of 6-9 hours per day, giving an average of 5kWh/day. Thus, considerable potential of solar energy.

- **Wind Energy**: The southern part of the great lake Tonle Sap, the mountainous districts in the southwest and the coastal regions, such as Sihanoukville, Kampot, Kep and Koh Kong have the annual average wind speed of 5m/s or greater. The total area around 5%.

- **Hydro**: The potentiality (10,000MW, but current contribution to electricity production less than 20MW).
1. Background Situation for Renewable Energy Development in Cambodia (3/3)

**Renewable Energy Potential**

- **Biomass:** The report prepared by NEDO on “the Assistance Project for the Establishment of an Energy Master Plan” identified significant biomass energy resources from a variety of agricultural residues such as rice husk, acacia, Cassava Luscenia, Coconut, ..

- **Biogas:** The effectiveness of small scale biogas has been demonstrated in Cambodia by a number of different projects. The use of animal wastes to generate high quality gas for cooking has significant economic, health, social and environment benefits for poor rural households.

- **Biofuel:** Jatropha – 200 ha (Fencing), Palm Oil – 4,000 ha (recently) and can be 10,000 ha and sugar cane 20,000 ha.
2. Completed and on Going Activities Related to Renewable Energy (1/3)

- **Solar Photovoltaic**: Project with NEDO Japan, SIDA, other international and national institutions including Prime Minister project we had installed around 1.5 MW in the country.

- **Biomass Gasification**: Project with Canada in Battambang (7kw + 20kw) and with DEDE Thailand in Kompong Cham (30kw). On going project in Sambour District, Kompong Thom Province with the capacity 30kw by FONDEM France by 2009 and a number of biomass gasifiers done by local investors.

- **Microhydro**: On Going Project with UNIDO capacity 65kw two units (130 kw), Grant from JICA 2 micro hydropower plants 370 kw already put in operation in Nov. 2008.
2. Completed and on Going Activities Related to Renewable Energy (2/3)

- **Bio-fuel**: Have more than 10 companies doing with Jatropha, planting around 1,000 ha, no once do with big scale yet.

- **Bio-Energy**: One company from Korea doing on this field with the production capacity of ethanol 36,000 t/year from 100,000 tons of cassava.

- The WB assist to Rural Electrification Fund (REF) by providing granted (GEF) and IDA Loan Aprox. USD 12 mil. to implement the following projects:
  1. Expansion off-grid new 50,000 connections with subsidy $45/connection,
  2. Install 12,000 SHS to people in rural areas – people have to pay back all the cost during 3-5 yrs period.
2. Completed and on Going Activities Related to Renewable Energy (3/3)

- The F/S LFG Power Generation Project 2 MW was submitted by Korean Company to MIME.

MIME supports this project as it is the multi-purposes project such:
- to generate electricity by using landfill gas that has been emitted to the air since 1975,
- to reduce Green House Gas, In order to participate in international challenge to cope with climate change,
- to make clean environment In order to eliminate bad smell, fire smoke, fire, and explosion of landfill,
3. Plan for Future Renewable Energy Development

• **GOAL** To improve the current level of electrification and for the poverty reduction as well as enhancing education and medical treatment in the rural areas.

• **PURPOSES**
  - Study of policies to promote electrification in those areas not yet serviced
  - Introduction and development of Renewable Energy Technologies
    - Study of institution and organization for sustainable operation and maintenance supported by the appropriate business model, including the financial procurement plan.

• **TARGET** To achieve 100% Electrification of Rural Villages by the year 2020.
Framework
Goals and Targets

Goal
- Reduce poverty level
- Improve living standard
- Foster rural economic development

Effects of RE

Targets of Rural Electrification Sector

(1) 100% village electrification by 2020
(2) 70% household electrification with grid-quality electricity by 2030
Levels of Rural Electrification

- Three levels of electrification

1. Battery lighting
   - off-grid areas

2. Mini-grids

3. National Grid (grid electrification)

Use of renewable energy

- Mini-grids: biomass and micro hydro
- BCS: solar, (locally wind)
Village Electrification Plan

Level-up Plan of Village Electrification Ratio
(including Battery Lighting)

Short-term Policy Measures
SP1 to SP3

Mid-term Policy Measures
MP1 to MP3

Electrification Strategies
ES1 to ES3

- Soar BCS & SHS
- Diesel Mini-Grid
- Biomass Mini-Grid
- Micro Hydro Mini-Grid
- Grid Electrification
Household Electrification Plan

Level-up Plan of Household Electrification Ratio with Grid Quality

- Diesel Mini-Grid
- Biomass Mini-Grid
- Micro Hydro Mini-Grid
- Grid Electrification

Short-term Policy Measures: SP1 to SP3
Mid-term Policy Measures: MP1 to MP3
Electrification Strategies: ES1 to ES3

2004 to 2030
Candidate Energy Sources by Village
WB-GEF PROGRAM

National Policy on Rural Electrification by Renewable Energy

1) endeavor to provide access to reliable, safe electricity services, with insignificant impact on the environment and at an affordable price for rural communities,

2) provide effective legal, regulatory frameworks and various encouragements and train the private sector to participate in providing electricity services by renewable energy in the rural areas;

3) act as a market enabler, through various incentives, for enabling equity in access to reliable and safe electricity services, with insignificant impact on the environment, at an affordable price for the rural communities;
4) encourage the efficient generation, transmission and distribution of electricity using the renewable energy technologies, through tariffs, which are in conformity with the Electricity Authority of Cambodia (EAC)'s regulations;

5) promote electricity systems by renewable energy at least cost for rural communities, through research and pilot development, as part of RGC’s portfolio on grid and off-grid technologies; and

6) ensure adequate resources, appropriate institutional mechanisms and training to empower the poor involving in rural electrification to participate.
# FINANCIAL RESOURCES (WB/GEF)

- Donations & grants and
- Other sources from the government e.g. the government loans from IDA/WB

## Summary of the project cost

<table>
<thead>
<tr>
<th>Type</th>
<th>Local (US$ M)</th>
<th>Foreign (US$ M)</th>
<th>Total (US$ M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>REE off-Grid Extension (40000 HH)</td>
<td>1.82</td>
<td>4.11</td>
<td>5.93</td>
</tr>
<tr>
<td>Mini hydro (6.0 MW)</td>
<td>2.81</td>
<td>6.37</td>
<td>9.18</td>
</tr>
<tr>
<td>SHS (12000) (GEF US$ M1.2)</td>
<td>0.79</td>
<td>3.19</td>
<td>3.98</td>
</tr>
<tr>
<td>Village hydro (850kw) (GEF US$M 0.30)</td>
<td>0.53</td>
<td>1.25</td>
<td>1.78</td>
</tr>
<tr>
<td>Sub-total REF Component</td>
<td>5.95</td>
<td>14.92</td>
<td>20.87</td>
</tr>
<tr>
<td>Type</td>
<td>Grant proposed, US$ per household connected</td>
<td>Estimated total cost/unit in US$</td>
<td></td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>---------------------------------------------</td>
<td>-----------------------------------</td>
<td></td>
</tr>
<tr>
<td>New household connected (diesel)</td>
<td>45 $</td>
<td>150 $</td>
<td></td>
</tr>
<tr>
<td>Mini hydro from 0.5 MW up to 5 MW</td>
<td>400$/kW installed</td>
<td>1744$/kW installed</td>
<td></td>
</tr>
<tr>
<td>Micro hydro From 50 kW up to 500 kW</td>
<td>400$/kW installed</td>
<td>2700$/kW installed</td>
<td></td>
</tr>
<tr>
<td>Solar Home System</td>
<td>100$/set</td>
<td>400$/set of 40 Wp</td>
<td></td>
</tr>
<tr>
<td>Energy Source</td>
<td>Number of villages</td>
<td>Number of households</td>
<td>Number of households to be electrified</td>
</tr>
<tr>
<td>---------------------------------------------------</td>
<td>--------------------</td>
<td>---------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Grid Extension</td>
<td>753</td>
<td>208,520</td>
<td>208,250</td>
</tr>
<tr>
<td>Solar BCS</td>
<td>1,720</td>
<td>237,570</td>
<td>190,000</td>
</tr>
<tr>
<td>Individual SHS (planned by the WB)</td>
<td></td>
<td></td>
<td>12,000</td>
</tr>
<tr>
<td><strong>Mini grid</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Micro hydro</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hybrid (micro hydro and biomass gasification)</td>
<td>137</td>
<td>18,541</td>
<td>14,833</td>
</tr>
<tr>
<td>Biomass gasification</td>
<td>3,071</td>
<td>501,636</td>
<td>804,844</td>
</tr>
<tr>
<td>Grid extension or Biomass gasification</td>
<td>3,257</td>
<td>504,397</td>
<td></td>
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<tr>
<td>Diesel</td>
<td>392</td>
<td>69,390</td>
<td>291,011</td>
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<tr>
<td>Grid extension or Diesel</td>
<td>1,875</td>
<td>294,374</td>
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<tr>
<td><strong>Sub Total</strong></td>
<td><strong>11,205</strong></td>
<td><strong>1,834,428</strong></td>
<td><strong>1,521,208</strong></td>
</tr>
<tr>
<td>Indirect costs (Sub Total x 30%) (including the administrative management, technical and operational supports, and reserves)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>11,205</strong></td>
<td><strong>1,834,428</strong></td>
<td><strong>1,521,208</strong></td>
</tr>
</tbody>
</table>
Bio-Fuel

Biofuel description:
- Biofuel: Liquid and gaseous fuel
- Liquid fuel: Straight Vegetable Oils, Bio-diesel, and ethanol

Potential Fuel Crops:
- Jatropha (*Lahong kwong*) and cassava are potentially used for production of biofuel (biodiesel and ethanol, respectively).

Biofuel Application:
- Biofuels: biodiesel and ethanol (petroleum fuels)
- Jatropha Oil biofuel: older diesel engines to generate electricity, power, and water pump
Why the Rural Electrification Enterprise Plant Jatropha and Use Jatropha Oil:

- High Price of Diesel Oil
- Participated in various workshop and seminar on Jatropha
- Get assistance from SME Cambodia and Development Advance Technology (DATe)
II. EE & C Activities in Cambodia

1. ESMAP-WB (1997)
2. ASEAN Energy Cooperation on EE & C (2001-present)
5. UNDP-GEF (2005)
6. JETRO (2005)
II. EE & C Activities in Cambodia (Cont.)

**BUILDING**

* Energy Audit Training and Site Visit for building
  + Sofitel Angkor Phokeethra Golf & Spa Resort, Siem Reap Province, 2004
  + Cambodiana Hotel, 2007
  + Sorya Supermarket, 2007
  + Angkor Century Resort & Spa, Siem Reap province 2009
  + Sothea Hotel, Siem Reap province 2009
  + Angkor Phokeethra Golf & Spa Resort, Siem Reap Province, 2009
  + Sokha Hotel, Siem Reap Province, 2009

* Seminar-Workshop on Energy Conservation for Buildings in Southeast Asia
  + Phnom Penh Hotel, 23 September 2004
  + Cambodiana Hotel, 05 October 2007
  + Angkor Century Resort & Spa, Siem Reap province, 25 September 2009
II. EE & C Activities in Cambodia (Cont.)

**INDUSTRY**

- Energy Audit training and site visit for Industry
  + M&V International Manufacturing, 2002-2003 (Phnom Penh City)
  + June Textile Co.Ltd., 2002-2005 (Phnom Penh City)
- Seminar-Workshop on PROMEEC for Major Industry in South East Asia
  (2005 Phnom Penh, Cambodiana Hotel)

**Energy Management**

- Intensive Seminar Workshop
  1) Cambodiana Hotel on 11 Sep, 2006, 41 participants
  2) Ministry of Industry Mine and Energy (MIME) on 19 Sep 2007, 33 participants
  3) Cambodiana Hotel on 15-16 Sep 2008, 42 participants
II. EE & C Activities in Cambodia (Cont.)

- **Site Visit of Factory and Building**
  1) Electricite du Cambodge; 2) Electricity Authority of Cambodia; 3) Cambodia Hotel Association; 4) The Garment Association; 5) Cambodia Electricity Private; 6) Cambodia knitting Factory; 7) Cambodiana Hotel; and 8) Ly Ly Food Industry

  Date of visits:
  - 13 September 2006
  - 21 September 2007
  - 17 September 2008

- **Training on Energy Management Handbook**
  1) MIME Conference room, on 20 Sep. 2007, 33 participants
  2) Cambodiana Hotel, on 17 Sep. 2008, 31 participants
II- EE & C Activities in Cambodia (Cont.)

2- ASEAN Energy Cooperation on EE & C

2.2- ASEAN Energy Awards:

- Le Royal Hotel (Retrofitted), year 2001, No.10
- Angkor Century Hotel (New and Existing), 2003. No.7
- Sofitel Angkor Phokeethra Golf & Spa Resort
  1. New and Existing, 2002, No.8
  2. Retrofitted, 2005, No.3
  3. Tropical, 2007, No.2
Thank You!

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