ETSAP Annex IX Technical Conference
Energy Models Users’ Group, Global and Regional Energy Modelling

Analysis of Power Supply Options for the Interconnected Grid

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Country Profile of Energy Sector

- Territory: 181,035 sq. km
- Borders: THL-West, VN-East, LAO PDR-North, Gulf-south
- Population: 12 million
- GDP US$ 280 per capita

- Lowest energy consumption: 45 kWh/capita
- Highest electricity price in the region
- High potential of hydroelectricity:
  - 10,000 MW in northern and 1,000 MW in Western
  - Long distance between sources and load center:
  - Difficult to developed
Country Profile of Power Sector (continued)

• Main Energy consumption: Wood

• Electrification rate:
  – Connect to the grid: 15%
    • Urban: 53.6%, Rural: 8.6%
    • Tariff: US¢ 9 – 25 per kWh
  – Rural generation and battery: 35%
    • Tariff: US¢ 40 – 80 per kWh

• Principal generation Fuel Oil (DO and HFO)

• Main consumption sector: Household
Installed electricity capacity in 2000, MW

- Medium Speed Diesel: 34%
- Low Speed Diesel: 25%
- High Speed Diesel: 27%
- Steam: 13%
- Hydro: 1%
Current Structure of Electricity Sector

Royal Government of Cambodia

Electricity Authority of Cambodia

Ministry of Industry, Mines and Energy

Ministry of Economic and Finance

Cambodia’s Electricity Business

PEU

IPP

PEC

EDC

Ownership of EDC

Policy; Planning; Development; Technical standard

Tariff, license, Review the Planned Investments, finances and performance; Enforce the regulations, rules and standards
Power Sector Policy

- To provide an adequate supply of energy throughout Cambodia at reasonable and affordable price,

- To ensure a reliable and secured electricity supply at reasonable prices, which facilitates the investments in Cambodia and developments of the national economy,

- To encourage exploration and environmentally and socially acceptable development of energy resources needed for supply to all sectors of Cambodia economy,

- To encourage the efficient use of energy and to minimize the detrimental environmental effects resulted from energy supply and consumption.

Promoting Private sector Participation in these development is needed

• 2004: Commissioning 10 MW HFO in Siem Reap (Japanese Grant Aid).
• 2005: Develop an IPP-KEP of 32 MW
• Import from Thailand for North-Western Grid
• 2006: Expect to add 10 MW HFO (Japanese Grant Aid).
• 2007: Import from Vietnam 80 MW for the first step from Thailand 20 MW
• 2008: Commissioning of Kirirom III 13 MW Hydropower Plant
Electricity Demand Forecast - GWh

- North West (isolated)
- North East (isolated)
- South West (isolated)
- Phnom Penh (isolated)
- Interconnected system
## Seasonal and Diurnal Time Definitions

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<tr>
<th>Time Slice</th>
<th>Description</th>
<th>Season</th>
<th>Time</th>
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<td>I-D</td>
<td>Partial peak - Wet</td>
<td>May</td>
<td>October</td>
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<td>I-N</td>
<td>Partial peak - Dry</td>
<td>November</td>
<td>April</td>
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<td>S-N</td>
<td>Off peak - Dry</td>
<td>November</td>
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MARKAL Representation of the Electricity System
MARKAL Modelling of Electricity Trade
Long Run Marginal Costs at Consumer Level

Consumer LRMC contributions by time slice (Usc/kWh) - Case - BASE - Base data - Crude
40$/bbl - No trade
Import Energy and Capacity Contributions

Electricity Imports by Time Slice (GWh) - Case - IN50 -
Electricity import with no capacity credit

Electricity Import Capacity (MW) - Case - IN50 -
Electricity import with no capacity credit
Hydro Development Scenario for Optimum Exports

Hydro Installed Capacity (MW) - Case - X87 - Export energy 87%

- Kirirom hydro
- Stung Atay hydro
- Sambor hydro (storage)
- Battambang 2 hydro
- Sambor hydro (run of river)
- Middle Russey Chrum hydro
- Lower Russey Chrum hydro
- Lower Sre Pok 2 hydro
- Battambang 1 hydro
- Upper Russey Chrum hydro
- Stung Cheay Areng hydro
- Lower Sesan 2 hydro
- Kamchay hydro
- Battambang 3 hydro
- Stung Metoeuk hydro
- Stung Tatay
CONCLUSIONS

1. System expansion Using Existing Supply Options

- Cambodia has the highest electricity generation cost in the region.

- There is a substantial potential for developing local hydro, to operate in conjunction with the thermals. The hydro production is seen to be extremely seasonal, with the price of electricity still dictated by the HFO diesel plant in the dry season and the wet season peak. Due to this reason, even with the full flexibility of hydro development, the marginal electricity costs at consumer level is seen fall only to around 8 USc/kWh.

- The seasonality of hydro generation indicates a strong possible electricity export potential in the wet season.
CONCLUSIONS (Cont.)

2. Electricity Trade Options

- Due to the strong seasonality of hydro generation, electricity imports are only viable in the dry season and exports only in the wet season.

- With the import capacity limit of 15% of total generation, for maximum imports during dry season only, the long run average incremental value of imports is about 7.8 USc/kWh with only HFO diesels providing the thermal alternative in local generation. This means that Cambodia stands to gain for any negotiated import price of less than this amount for maximum imports during the dry season from 2010.

- The long run incremental cost of electricity exports for a 3000 MW export capacity with maximum exports during the wet season only is around 1.7 USc/kWh. This means that Cambodia stands to gain for any negotiated export price of more than this amount for maximum exports during the wet season from 2020.
Thank you for your attention