CAMBODIA

Energy Sector Strategy Review
Issues Paper
CURRENCY AND EXCHANGE RATES

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ABBREVIATIONS AND ACRONYMS

ADB  Asian Development Bank
AusAID Australian Agency for International Development
Bn  Billion
BPD  Barrels Per Day
BTU  British Thermal Unit
COM  Council of Ministers
CNPA  Cambodia National Petroleum Authority
CPSS  Cambodia Power Sector Strategy (IBRD, 1999)
CR  Cambodian Riel
DFID  Department for International Development (UK)
EAC  Electricity Authority of Cambodia
EDC  Electricite du Cambodge
E&P  Exploration and Production
ESS  Energy Sector Strategy
FRP  Financial Recovery Plan
GDP  Gross Domestic Product
GMS  Greater Mekong Sub-region
GOC  Government of Cambodia
gwh  Gigawatt-hour (1,000 Kilowatt-hour)
HFO  Heavy Fuel Oil
HV, EHV  High Voltage, Extra High Voltage
ICB  International Competitive Bidding
IDA  International Development Agency
IMF  International Monetary Fund
IPP  Independent Power Producers
IRITWG  Infrastructure & Regional Integration Technical Working Group
JBIC  Japan Bank for International Cooperation
JICA  Japan International Cooperation Agency
kwh  Kilowatt-hour (1,000 Watt-hour)
LDO  Light Diesel Oil
LV, MV  Low Voltage, Medium Voltage
MMCFD  Million Cubic Feet Per Day
MEF  Ministry of Economy and Finance
MIME  Ministry of Industry, Mines and Energy
MOC  Ministry of Commerce
OMC  Oil marketing company
PDP  Power Development Plan
PPIAF  Public Private Infrastructure Advisory Facility
RE  Rural Electrification
REEs  Rural Electrification Enterprises
RETP  Rural Electrification and Transmission Project (IDA)
RGC  Royal Government of Cambodia
T/A  Technical Assistance
TOR  Terms of Reference
TRANSCO  Transmission Company
USc  US cents
VAT  Value Added Tax
WB  World Bank
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Cambodia: Energy Sector Strategy Review
Issues Paper

Table of Contents

Currency and Exchange Rates ........................................................................................................ ii
Abbreviations and Acronyms .......................................................................................................... iii
Acknowledgements .......................................................................................................................... iii
Table of Contents ........................................................................................................................... iii
Executive Summary ........................................................................................................................ iii
Energy Sector Strategy Review ...................................................................................................... iii
Strategic View of the Energy Sector ............................................................................................... iii
Electric Power Sub-Sector .............................................................................................................. iii
Rural Electrification ....................................................................................................................... iii
Petroleum Industry ........................................................................................................................ iii
Issues in the Development of the Sector ....................................................................................... iii
Actions and Thematic Studies under the Next Step Work Program ........................................ iii
   Table E1: Activities for the Strategy Exercise Program ..................................................... iii
Chapter 1. Energy Strategy for Cambodia..................................................................................... 3
   Introduction and Overview ........................................................................................................ 3
Chapter 2. The Strategic Context .................................................................................................. 3
   Energy Challenges in Cambodia .............................................................................................. 3
      Box 2.1: Cambodian Rectangular Strategy: The Four Growth Rectangles 3
   Considerations for Energy Strategy Study ............................................................................... 3
   Strategic Considerations .......................................................................................................... 3
   Linkages to National and Social Objectives ........................................................................... 3
   Strategic Vision for the Energy Sector ................................................................................... 3
Chapter 3. Electric Power in Cambodia.......................................................................................... 3
   Overview .................................................................................................................................. 3
      Legal and institutional framework ....................................................................................... 3
      Electricity generation and supply ......................................................................................... 3
      Table 3.1: Installed Capacity/Peak Output (MW) and Energy Output (Gwh); EDC Supply Areas ...................................................... 3
      Tariffs and losses .................................................................................................................. 3
      Table 3.2: Electricity Tariffs in Phnom Penh and Adjustments in Late 2005 ...................................................... 3
      Power demand ...................................................................................................................... 3
      Table 3.3: Electricity Growth Forecast .................................................................................. 3
      Table 3.4: System Expansion Plan ....................................................................................... 3
      Hydropower .......................................................................................................................... 3
      Table 3.5: Potential Hydropower Projects ......................................................................... 3
      Issues and constraints of the power sub-sector ................................................................ 3
      Greater Mekong sub-region (GMS) ..................................................................................... 3
      Imported Fuel and Electricity Generation .......................................................................... 3
      Tax Structure for Imported Oil and Petroleum Products ................................................. 3
      Table 3.6: Retail Fuel Prices in ASEAN Countries ............................................................ 3
Executive Summary

Electricity generation .................................................................................. 3
Electricity costs versus levies .................................................................... 3
Factors Influencing Electricity Costs ............................................................ 3
  High tariffs imposed on imported oil and petroleum products ............... 3
  Table 3.7: Heavy Fuel Oil (HFO) Price Structure .................................. 3
  Table 3.8: Diesel Oil (DO) Price Structure .......................................... 3
Efficiency of power plants ......................................................................... 3
Non-competitive deals with the IPPs .......................................................... 3
  Table 3.9: Electricity production cost in 2003 of selected IPPs ............ 3
Overall Actions to Reduce Electricity Costs .................................................... 3
  Short term actions ................................................................................... 3
  Medium term measures .......................................................................... 3
  Long term measures ............................................................................... 3
The power sector in the context of GMS power trade ................................ 3

Chapter 4. Rural Electrification and Renewable Energy .................................. 3
  Introduction .............................................................................................. 3
  Rural Electrification ............................................................................... 3
    EDC grid-extension .............................................................................. 3
    Rural electric enterprises (REEs) ......................................................... 3
  Renewable Energy .................................................................................. 3
    Mini and micro hydro resources ...................................................... 3
    Solar energy ....................................................................................... 3
    Table 4.1: Number of Households capacity of Standard BCS .......... 3
    Wind power ....................................................................................... 3
    Biomass energy ............................................................................... 3
    Biogas ............................................................................................. 3
  Policy and Institutional Issues .................................................................. 3

Chapter 5. Petroleum Industry and Coal Mining ............................................. 3
  An Overview of the Petroleum Industry .................................................. 3
  Table 5.1: Retail fuel prices in selected ASEAN countries ..................... 3
  Key Issues ............................................................................................... 3
    Table 5.2: Indicative List of Areas for Technical Support in the Sector .. 3
  Legal and Regulatory Framework for Upstream Operations ................. 3
    Petroleum Law .................................................................................. 3
    Decrees/Regulations ......................................................................... 3
    Model contract .................................................................................. 3
    Petroleum revenue management ....................................................... 3
  Petroleum Downstream Operations .......................................................... 3
  Coal Mining ......................................................................................... 3

Chapter 6. The Way Forward ......................................................................... 3
  Pending Issues and Follow-up Actions for the Power Sub-sector ............ 3
    Box 6.1: Key Messages from the 1999 Cambodia Power Sector Strategy Report .......................................................... 3
  Other Actions and Thematic Studies .......................................................... 3
  Summary of the Sector Strategy Program ............................................... 3
Figure 6.1: Proposed process of energy sector strategy and implementation plan formulation

Table 6.1. Activities for the Energy Sector Strategy Study Program

ANNEX 1 TOR’s - Consulting Study Power Development Master Plan

ANNEX 2 TOR’s - Consulting Study for Hydropower Master Plan

ANNEX 3 TOR’s Regulatory Framework for Oil and Gas E&P

ANNEX 4 TOR’s Power Sector Efficiency Consulting Study

ANNEX 5 Background Note: Biomass Energy in Cambodia

ANNEX 6 Background Note: Upstream Oil and Gas Industry
EXECUTIVE SUMMARY

ENERGY SECTOR STRATEGY REVIEW

1. **Cambodia’s energy sector is facing major challenges.** Despite considerable progress in expanding the capacity and coverage of electricity supply in recent years, electricity costs remain to be among the highest in the world, and electrification rate, one of the lowest in Asia. As Cambodia’s power supply relies heavily on imported fuels, a new challenge is emerging due to the increases of international fuel prices. At the moment, the government is exploring new sources of energy, including hydropower, offshore and onshore oil and gas, and renewable energy. There is a consensus between the government and international development agencies that a coherent energy sector strategy is needed and that its formulation should be based on careful assessment of various energy sources and the policy and institutional framework for their development.

2. **This issues paper completes the first phase of a three-year program in Cambodia to create a strategic framework to govern the systematic development of the energy sector and to formulate a coherent energy sector strategy and implementation plan.** This exercise is proposed to be undertaken in a participatory manner, with the Royal Government of Cambodia (RGC) taking a lead and the donors, namely ADB, IDA, JICA and JBIC, providing appropriate technical and financial resources. The scope of the exercise will cover the entire energy sector. Its outcome is expected to be the RGC’s adoption of the strategy and the implementation plan, which will help define a coherent framework for sector development and donor assistance.

3. **The exercise will be undertaken in three phases:**
   - **Phase 1:** Identification and preliminary analysis of issues, and justification and proposal for a subsequent work program with associated thematic studies. All elements are summarized in this issues paper, along with the terms of reference (TOR) for some priority thematic studies.
   - **Phase 2:** Preparation of priority thematic studies and assistance to RGC in developing an energy sector strategy and implementation plan; and
   - **Phase 3:** Revision/modification of legal, regulatory and institutional frameworks, implementation of an agreed sector and institutional structure according to the sector strategy, capacity development of the institutions, and finalization and implementation of an agreed investment plan taking into account ongoing investments.

4. **The activities and studies currently envisaged and the key issues they address is presented in Chapter 6 of the main text and summarized in Table E-1 at the end of the Executive Summary.** Details including appropriateness of activities, priorities, the timeframe of the activities, and the responsible agencies for each of the activities will be tentatively finalized following review and discussion of the issues paper.

STRATEGIC VIEW OF THE ENERGY SECTOR

5. **A strategic concept of an ideal generic energy sector strategy and a description of linkages it should maintain with the economic and social objectives of the RGC is presented at the beginning of this paper as a guiding framework for the study in Chapter 1.**
ELECTRIC POWER SUB-SECTOR

6. The foundation for the development of Cambodia’s power sector was formulated in the Cambodia power sector strategy (CPSS) proposed in 1999, and the national power development plan (PDP) formulated on the basis of least-cost principle in 1998. Many observations made in the CPSS remain valid today. Over the last six years dramatic progress has taken place in the power sub-sector in all fields, yet much remains to be done. The PDP is now outdated and a complete update is being arranged under the World Bank funded Rural Electrification and Transmission Project (RETP).

7. In February 2001, the Electricity Law of the Kingdom of Cambodia was disseminated and an independent sector regulator, Electricity Authority of Cambodia (EAC), was created. These are landmark legal and regulatory developments, the likes of which have not yet taken place in neighboring countries, Lao PDR, Thailand and Vietnam. Of particular significance is that the law lays the foundation for the future unbundling of the power sector, and the creation of a transmission company (TRANSCO), a dispatching entity (System Operator) and a competitive wholesale power market, through which generators could contract directly with distributors. In April 2005, another landmark piece of legislation was passed, the sub-decree on tariffs, which determines basic principles for EAC to set electricity tariffs of the licensees.

8. A competitive wholesale power market currently does not exist within the greater Mekong sub-region (GMS); however, RGC and other GMS countries are close to adopting bilateral trading mechanisms as a collective first step towards regional power trade.

9. EAC currently enjoys a reasonable degree of autonomy overall in the management of its affairs, and in a detailed sense, for example, for issuing licenses to small-scale operators and in setting and enforcing laws and standards. It recently played an instrumental role in restructuring the electricity tariffs, effective on July 1, 2005, to respond to the impact of escalating international oil prices. However, the involvement of the Ministry of Industry, Mines, and Energy (MIME) in almost all of EAC’s activities continues to blur the distinction between its roles as policy maker and policy implementer. On the other hand, EAC’s limited capabilities preclude it from playing the role of regulating Electricité du Cambodge (EDC). The energy sector strategy should take into consideration both the autonomy of EAC as well as its strengthening for major sector regulation. Strengthening EAC in routine aspects of regulation is an ongoing activity that needs to be continued.

10. The Electricity Law defines the role of MIME to set and administer the government policies, strategies and planning in the power sector. In practice, its administrator role has extended to detailed planning, involvement in the procurement and licensing process for private power, and managing the rural and provincial electrification programs. The pervasive role of MIME threatens the autonomy of EAC and EDC, both of which should have an arms-length relationship with the Ministry. An energy sector strategy for Cambodia should help shape the role of MIME to that of a policy maker, leaving administration and implementation to the line agencies. It also needs to help strengthen the institutional capacities of EAC and EDC to enable them to operate as independently as possible from MIME.

11. The Electricity Law’s framework allows for the promotion of private participation in the electrification of Cambodia; however, the processes and mechanisms to ensure private participation in practice have not been formulated. To assist the RGC to clearly

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define the rules, the World Bank through the Public Private Infrastructure Advisory Facility (PPIAF), produced a series of reports that will help RGC prepare a private power policy paper. One of the reports defines the roles and responsibilities of the various private and public sector stakeholders, and helps to clarify areas in which members of the private and public sectors should participate or take a leading role. It also establishes criteria to help level the playing field. For example, in regards to the procurement of independent power producers (IPPs), the report proposes the following:

- **Large power generation projects.** The addition of new generation capacity will be based on specific projects consistent with the strategic planning policies issued by RGC; and, the procurement process will be transparent, driven by competitive mechanisms, based on the guidelines, pre-established oversight procedures that reflect the roles of all parties involved in the process, and disclosure through publication of information necessary to guarantee transparency in the entire procurement process; and

- **Small power generation projects.** These will have simplified mechanisms for procurement and pricing to encourage private investors’ access to this segment of the power sector.

12. **It is understood that RGC has not yet neither adopted nor published the intended private power policy paper, which could serve as a cornerstone of the RGC’s energy sector strategy.** This document will go far to help establish a level playing field for private participation and ensure transparency in private procurement at least cost.  

13. **While both CPSS and the Electricity Law allow for a future unbundled electricity market structure with a TRANSCO, a system operator and a competitive wholesale market, such a transformation is unlikely to emerge in the near term for three reasons.** Firstly, neither a clear policy has been defined nor a road map created to achieve this structure. Secondly, while it is planned that over time the role of EDC diminish as a generator, a time limit has not been set for terminating its generation license. Finally, no clear strategy has evolved to suggest EDC continue or cease as a distributor (currently EDC is slated to take over distribution in an increasing number of provincial towns), or whether EDC is the choice for the prospective TRANSCO entity.

14. **The policy uncertainties are understandable given the current state of the sector.** However, policy is an important component of Cambodia’s energy sector strategy; therefore, it is imperative that RGC articulate its plan for the evolution of the industry so that steps taken in the near- to medium-term—for example, the organizational restructuring of EDC—are in concert with the ultimate goal.

15. **In the six years since the CPSS was disseminated, EDC has made tremendous strides in its operations through commendable efforts of RGC, and the EDC management and staff, supported in large part by ADB, IDA, JICA and other donors.** Despite this success, issues lurk; among them some are urgent, as follows:

a) **Still weak financial position.** While the financial position of EDC has improved from “near bankruptcy” to “almost break even,” it continuous to remain precarious.

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2 The practice of securing power supplies is not consistent. For recent generation IPP’s for Phnom Penh, RGC has required a competitive process, but in another very recent case (Thailand-Siem Reap transmission line), RGC accepted direct negotiations.
b) High power generation costs are primarily due to the following: (i) a lingering stock of non-competitively bid, high-priced IPPs of the early years; (ii) an inefficient stock of EDC’s own diesel generation plant, many of which are working on expensive diesel oil; (iii) recent steep increases in international fuel oil prices; and (iv) a high level of duties and taxes levied by RGC on fuel. EDC has proposed several measures, but it is not clear how far and how fast they will help to improve the financial health of EDC.

c) Still significant distribution losses. With distribution losses decreased to a commendable level of 12.7 percent in 2004, a complacency to take further measures to reduce losses may developed. EDC does not appear to have a comprehensive plan for further reduction of losses. In fact, the distribution loss has increased to 14.6 percent in recent months, indicating the need for concrete measures to reduce losses.

16. While EDC enjoys considerable autonomy in managing its operations and has achieved a measure of financial autonomy evidenced by the fact it does not receive any budgetary support from RGC, it is still subject to substantial control by MIME, which is part owner, along with the Ministry of Economy and Finance (MEF). It was contemplated in the CPSS that EDC be regulated through a performance-based contract with MIME. This has not been achieved, except in a rudimentary manner of a brief monthly report to MIME, and should be revisited. Key elements to commercializing EDC include the following:

a) Increasing EDC’s financial strength to a level that enables it to raise its own finances on favorable terms;

b) Improving EDC’s overall performance, if practicable, through pragmatic performance contracting that tightens its operational efficiency, and later regulating it through EAC;

c) Rationalizing electricity tariffs (through measures such as the introduction of fuel adjustment clauses) to levels that enable EDC not only to break even but also to finance a reasonable portion (e.g., 15 percent) of its investment program;3

d) Strengthening EAC’s role in tariff setting and utility regulation; and

e) Creating a more arm’s-length structure with MIME that sets it on the path of restructuring.

17. A prelude to these actions would be a clear articulation of RGC policy on EDC’s role five to ten years from now. Based on this policy, RGC should formulate internal restructuring that will, for example, create “cost” and later “profit” centers within EDC. In this regard, in the near future, a holistic review of EDC’s operations, operational efficiency, systems and procedures, and human resource development and the development of comparative benchmarks is an imperative step to formulating the energy sector strategy.

18. A holistic framework for planning for electricity growth includes a series of activities which contribute to the orderly development of the power sector, with the overarching objective of increasing electricity supplies to enhance the country’s economic and social development, in the most cost-effective manner. The menu of key complimentary development options available to the planner may be classified under a series of five master

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3 Fuel adjustment clauses were recently introduced by EAC as part of the response to rising international oil prices.
plans, which taken as a whole constitute an important cornerstone of the energy sector strategy for Cambodia. The plans which require development are the following:

a) **Master plan for development of the national HV/EHV grid and the associated generation sources.** Until such time that Cambodia develops a reasonable HV/EHV transmission network—that (i) enables exploitation of economies of scale in regard to type and location of generation, and (ii) facilitates import of low cost power from and eventually export of large scale hydropower to neighboring countries, Vietnam and Laos—the country will not be able to achieve a significant reduction in electricity costs. While power development planning in countries which have mature grids and adequate planning expertise is relatively straightforward, Cambodia faces two challenges: The first is demand forecasting. What is required as a key planning tool is a rigorous demand forecasting capability and the institutionalizing of this activity. The second is planning tools and planning capability. For this, consulting assistance is required to install appropriate planning hardware and software, train the staff of MIME and EDC in its use, and assist them in developing and updating a power sector master plan.

b) **Master plan for hydropower development.** For a meaningful formulation of the power development plan, one must reasonably estimate the cost of developing the large array of hydropower projects, which entails fairly expensive pre-feasibility studies. The TOR’s for the hydropower master plan have been drafted and commented upon by MIME hydropower specialists. The TOR’s cover the following: (i) project ranking; (ii) development of models for hydropower preparation and financing (public/private financing possibilities); (iii) transfer of technology and training; and (iv) advice and overall supervision of hydropower work in Cambodia. MIME plans to seek assistance from JICA for this master plan.

c) **Master plan for reducing distribution losses (technical and non-technical).** Reduction of losses is effectively the same as the creation of a generation source. While losses have been reduced from the highs of 30 percent to about 12.7 percent today, loss reduction should continue to be an ongoing activity; for this to happen a master plan document needs to be formulated. As the demand for electricity grows, losses increase, unless commensurate measures are taken to strengthen the distribution networks. A cost-benefit analysis should be undertaken to assess the point at which the cost of incremental investments equals the benefit of reduced losses, as a guide to distribution network development.

d) **Master plan for reducing costs of diesel generation.** While the main transmission grid evolves in the medium- to long- term, and until such time that more cost effective large-scale domestic generation sources and low-cost electricity imports occur, Cambodia must rely on diesel/HFO based generation in the near- to medium-term. It is imperative to create a master plan for generation cost reduction, which will serve as one of the underpinning documents of the energy sector strategy.

e) **Master plan for demand side management and efficiency improvement (DSM).** While supply side efficiency improves and yields tangible benefits, more cost-effective benefits could result from investments in DSM. No energy strategy would be complete without a master plan for DSM. The foundation for this is being laid under IDA’s RE&T Project.

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4 This work will be carried out soon through a consultancy under the World Bank funded Rural Electrification and Transmission Project.
19. **The tariff structure is one that the industrial and commercial consumers are effectively cross-subsidizing residential consumers who often pay a lower rate for the same service.** As a result, because of the unreliability of EDC supply, most large consumers, especially hotels, have installed their own generators, which has resulted in loss of some of the highest demand consumers. The proliferation of low level domestic consumers who cannot afford electricity service for the whole day may also cause the distributor to experience high distribution losses. The regressive industrial/commercial tariff may be justifiable from an economic pricing point of view, but it could be counterproductive for electricity conservation goals. The domestic tariff structure is progressive (increasing with higher levels of consumption), which should encourage conservation.

20. **EDC recently adjusted tariffs based on its review of tariffs in response to growing financial difficulties caused by increasing international oil prices.** However, further review of tariffs is necessary, especially for the Phnom Penh market. A review may take into consideration the following broad guidelines:

- Tariffs should ensure financial viability of EDC, allowing a reasonable level of self financing;
- In regard to domestic tariff, the life line rate should be set to consider affordability, which may be higher than expected. Further, there seems to be no reason to afford the life-line rate as a first-slab rate (or 0-25 kwh) to those who have higher consumption levels;
- Any major reduction in the industrial and commercial tariff should be in accordance with a reduction in the costs of generation through new low priced IPPs and import from Vietnam, improved system reliability through network strengthening, and availability of adequate generation to avert blackouts;
- Tariffs should be based on economic principles related to costs of supply, but should also foster electricity conservation and efficient use. Consideration should be given to the introduction of two-part (demand and energy) tariffs and time-of-use tariffs for large consumers;
- The goal for uniform tariffs throughout Cambodia should be shelved by EDC until an HV/EHV grid has been established. The current policy which links tariffs to the costs of supply (a pre-eminent requirement in the recent tariff sub-decree) is a step in the right direction.

21. **It has been debated whether the heavy fuel levy should be reduced or eliminated as one way to reduce costs of electricity.** The levy has an impact on the power sector, directly through cost pass-through to users, and indirectly through fuel smuggling—that may be the last resort of captive generators—thus, reducing the demand for EDC services. However, it is simplistic to say that the high costs of electricity should be reduced by reducing the heavy levy on fuel oil. Abolishing levies would reduce the cost of diesel fuel generation by about 16.5 percent. However, this will also result in a sizable loss of revenue to RGC. Unless this loss of revenue results in a commensurate (if not higher) gain in economic and social development of the country, it is counterproductive. A cost-benefit analysis of this aspect should be conducted (which is a complicated modeling) before any decision is taken on reducing taxes and duties on fuel oil. It is more important to consider such a fiscal decision within the context of broad tax reform policy.
22. **The question of reducing electricity costs should be viewed within a holistic framework; key elements are outlined below.** There are no quick fixes to this issue. Cambodia will continue to face supply shortages and high costs of electricity until the transmission lines from Vietnam and Thailand are completed and operational for the Phnom Penh and Siem Reap markets. A great deal could be done in the short term, however, to alleviate the problems.

a. **Short Term Actions**

i) **Electricity tariffs:** Electricity tariff policy is one tool to control losses and wasteful consumption. The tariff policy needs to be reviewed in order to encourage industrial and commercial use and foster more conservative and efficient domestic use (with life line protection for the weaker sections of the society). Proliferation of domestic consumers, out of synch with commercial and industrial consumers, would result in an increase in distribution losses. Also, any initiatives to increase electricity consumption should be in line with the availability of adequate reserves of generation.

ii) **Reduction of distribution losses:** While commendable progress was made in 2004 to reduce distribution losses to about 12.7 percent, there is no reason why the losses could not be reduced to ten percent or even lower. A cost benefit analysis of distribution investments vis-à-vis a gain in efficiency is needed, as well as a master plan for loss reduction (technical and non-technical).

iii) **Improving the overall efficiency of diesel fuel generation:** A series of time-bound actions, comprising inter-alia replacement of old, inefficient sets, fuel substitution from light diesel oil (LDO) to heavy fuel oil (HFO), and the procurement of new IPPs at low cost through competition, will contribute significantly to cost reduction. The actions could be worked out through a master plan process.

iv) **Improving the efficiency of EDC’s operations:** A master plan to improve EDC’s operational efficiency in all fields (in particular, improved fuel procurement practices, better plant maintenance, and higher efficiency of manpower utilization) will contribute greatly to electricity cost reduction.

b. **Medium Term Measures**

i) Significant reduction in electricity costs will accrue only when Cambodia: (i) has established a reasonable high-voltage/extra-high-voltage (HV/EHV) network that enables exploitation of economies of scale and advantages of site in generation planning. A master plan for power development and a master plan for hydropower development are key steps towards achieving this goal. And (ii) it has explored all avenues for and established power imports at low cost from the neighboring countries, Thailand and Vietnam.

ii) Implementation of a master plan for demand side management, to improve the efficiency of electricity consumption, is an effective demand-side response to reducing electricity costs.

c. **Long Term Measure.** In the long term, Cambodian consumers would benefit from lower prices if the large hydropower potential for export were exploited. Hydropower has other attractive features. It is a renewable energy resource unaffected by oil prices. As a domestic energy
resource, it will contribute to national energy security, and when well developed, it is a significant part of the optimal energy mix.

23. **Cambodia has been through some very difficult years of electric power shortages.** With donor assistance and private sector participation, the RGC has managed to provide only the very basic electricity services to the main load centers. The supply capacity is far below the rapidly growing demand. Electricity prices remain among the highest and electrification rates among the lowest in east Asia. The small size of the markets also creates difficulty to achieve economies of scale in power generation, which is a key factor of production costs. By taking advantage of the GMS power trade initiatives, RGC is securing power supply from Vietnam and Thailand. The supply situation is expected to improve markedly in the next two to three years.

24. **Currently, RGC is taking a forward-looking view and contemplating the development of large power plants, through private sector participation, to supply markets in both Cambodia as well as in neighboring countries.** This will be a major change from the current approach of chasing demand “one small step at a time” rather than making a bold move to take advantage of emerging business opportunities created by the GMS power trade market. While this is consistent with the GMS power trade concept, RGC has important groundwork to conduct in the future to move into this new business development model. First, a strategy needs to be carefully aligned with the national power development master plan and the GMS power trade development framework. **Second**, RGC needs to adopt private participation policies that are transparent, competitive and consistent with international practices. **Third**, RGC should begin development of national environmental and social safeguard policies and procedures, and capacity building that is in line with international good practices.

**RURAL ELECTRIFICATION**

25. **RGC has made commendable efforts placing rural electrification (RE) at the forefront of its poverty reduction strategy and to improve standards of living in the rural areas, in which almost 85 percent of the Cambodian population resides.** In support of this, RGC has prepared a ten year, three-phase renewable energy action plan (REAP). Its laws and regulations also reflect the importance of RE. For example, RGC set a goal of raising the access rate by rural households to reliable grids and affordably priced electricity to 70 percent by 2030. This is an ambitious plan that deserves support to the extent it is economical.

26. **However, development of the RE sector faces several major constraints.** In order to make a significant contribution to Cambodia’s RE goals, rural electricity enterprises (REEs) must expand their scale of operations and reduce costs and prices, all of which are interrelated. Meanwhile, the REE operations are constrained by the Cambodian banking system, which is relatively fragile, and operates mostly on short-term capital with high interest rates. Moreover, management systems are weak in rural areas, and technical know-how and maintenance skills are in short supply.

27. **The RE sector policy and regulatory framework is nascent and evolving, and needs support and strengthening.** Currently, there is no renewable energy policy in Cambodia, although RGC has adopted REAP and expressed its commitment to promote renewable energy for remote applications.

28. **While there is adequate information available relating to solar energy, similar systematic assessments on resource and market potential need to be undertaken for mini-hydro, wind and biomass.** There is a lack of information on various renewable energy options
and their costs and benefits. Efforts at information dissemination are feeble, and marketing of products non-existent.

29. **In the short to medium terms, the REAP should be rigorously pursued.** Further, as a component of its overall energy sector strategy, RGC needs to consolidate a rural electrification policy paper, which clearly articulates its policy, strategies and procedures and that will give a degree of comfort necessary for the private sector to participate in the electrification of rural Cambodia.

**PETROLEUM INDUSTRY**

30. **Cambodia’s petroleum industry is in the early stages of development.** Due to years of civil war and unrest, there have been little exploration and production (E&P) activities, and fuel needs have been met entirely through imports. The petroleum industry activities are mainly confined to marketing and distribution of imported products. Import of oil products is mainly in small parcels, and the inadequacy of a petroleum handling and transport infrastructure causes relatively high delivery costs. The demand pattern is lopsided, as well, with diesel consumption unnecessarily high for power generation (which could be substituted with other fuels with some effort). The quality of the products imported and delivered to consumers is inconsistent, apparently due to poor enforcement of penalties.

31. **Currently, in the petroleum sector, there is a lack of a policy framework for competitive consumer pricing, public advocacy or consumer rights groups, or public awareness or involvement.** There also appears to be no incentives to the existing oil marketing companies (OMC) to invest in infrastructure that includes a port, jetty, storage tanks, high-capacity barges, and pipelines. The safety of fuel supply is also a major issue. Moreover, RGC relies on heavy import duties and taxes on petroleum products for a substantial portion of its revenues, and there is a limited ability to generate alternate revenues. The import duties and taxes increase fuel prices which are much higher than those in neighboring countries, leading to widespread cross-border fuel smuggling.

32. **E&P is a relatively new phenomenon, but is attracting growing attention given Chevron-Texaco’s December 2004 offshore oil discovery.** In the wake of the discovery, a likely issue concerns petroleum revenue management. International experience suggests that if revenues are not managed appropriately, Cambodia could face major governance and macroeconomic implications. Notwithstanding the early stages of development, the industry also faces sector-wide issues and a lack of clarity on the potential market structure. RGC’s policy is unclear on the following: (i) the industry structure, private sector participation and competition; (ii) pricing and taxation; (iii) infrastructure investments including in refineries and the associated incentives; and (iv) regulation of externalities. Furthermore, the government’s responsibilities, including in distributing roles, appears to be fragmented among MIME, CNPA, and other petroleum industry entities. Moreover, a number of questions highlighted below require a rapid response.

- **Upstream E&P:** Will both offshore as well as onshore blocks be competitively bid out in the future? In the event of the discovery of natural gas, what will the role of state/international oil companies in its utilization be? Who will develop and own the gas infrastructure?
Energy Strategy for Cambodia

- **Petroleum/gas midstream**: Who will be responsible for processing/refining facilities, terminals and transmission pipelines? What will the framework for private-sector investments, tariff for midstream operations, and extent of regulation be?

- **Petroleum downstream**: Will these activities be completely competitive? If so, who will be responsible for enforcement of competition and maintaining a level playing field? What will the long-term ownership structure and rules for entry be?

- **Regulatory authority**: Should a regulatory authority for natural gas and monopolistic segments of petroleum markets be established? When?

33. **At a strategic level, key issues in the overall energy framework and specifically concerning petroleum markets are the following:**

   a) Long-term energy mix, and allocation of resources for creating the enabling environment and institutions for development of future hydrocarbon resources;

   b) Integration of policy-formulation and planning responsibilities;

   c) Promotion of building capacity and skills for a cadre of professionals;

   d) Marketing of Cambodia’s hydrocarbon potential in international markets, and soliciting E&P interest from International Oil Companies; and

   e) Creation of a competitive environment, level playing field, and the promotion of petroleum downstream markets in Cambodia.

**ISSUES IN THE DEVELOPMENT OF THE SECTOR**

34. **Cambodia’s mineral resources are largely unexplored and unexploited mainly because of wars and a subsequent lack of capital, specialists, and technology.** Coal mining and utilization has not begun because of a variety of policy, institutional, fiscal and infrastructure-related issues, as follows:

   a) Policy issues: the extent of State’s participation; treatment of domestic and international joint-ventures; and creation of level playing field for investors.

   b) Regulatory issues: absence of clear mineral exploration rules and regulations; approval process for mineral title applications; and handling of externalities.

   c) Fiscal and taxation issues: clarity on profit taxes, royalties, incentives, and other issues.

   d) Infrastructure and human resource issues: Who develops infrastructure, communications, transport and utilities for key mining areas? What is Cambodia’s mapped inventory of coal resources?

35. **If biomass resources are to continue to provide fuel supplies to a large proportion of the population, the following issues merit urgent consideration:**

   - Absence of the woody biomass and other vegetation by agro-ecological zones, and assessment of its sustainable production and regeneration
• The absence of information on consumption patterns
• A lack of knowledge on trading patterns and margins for commercially-traded biomass
• Lack of information on the sustainability of biomass supplies to meet demand
• Lack of knowledge on biomass consumption devices

36. **This paper also presents issues related to solar energy as follows:**
• Scarcity of surveys on solar energy potential and data
• Only donor-funded projects have been implemented
• Lack of financial mechanisms to spread the upfront capital cost for use of solar energy by households

37. **The issues related to wind energy plants included the following:**
• Wind energy data for potential sites is largely unavailable; the few locations for which it is available, it is not updated.
• Inconsistent wind patterns, and the current back-up diesel sets with high generation costs. The high delivery costs of electricity are not analyzed.
• Institutional arrangements for developing and operating wind energy plants do not exist.

**ACTIONS AND THEMATIC STUDIES UNDER THE NEXT STEP WORK PROGRAM**

38. **A draft issues paper was disseminated and discussed during a stakeholder workshop held in Phnom Penh on October 27, 2005.** There is a high level of consensus on the required next-step analytical works and policy actions. The following is agreed:

a) The formulation of the official energy sector strategy should not wait for the completion of on-going and planned analytical works. The government should begin drafting the sector policy and strategy documents and implementation plan. The official strategy should be the sectoral extension of the Government’s rectangular strategy. It should be a living document, updated from time to time, as appropriate, in order to incorporate the findings and recommendations of the planned analytical work.

b) The private power policy should be formally adopted as soon as possible. EAC would take the lead to implement it.

c) The proposed studies on the oil and gas regulatory framework, power sector efficiency, and hydropower master plan are integral to analyses for the energy sector strategy.

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39. **It is envisaged that many thematic studies are required to address key issues, and to provide the basis for the formulation of an overall energy sector strategy and implementation plan.** Details including appropriateness of activities, priorities, the timeframe of the activities, and the responsible agencies for each of the activities will be tentatively provided following review and discussion of the issues paper. Among these, four completed studies are highly relevant to the sector strategy. Other studies are either underway or would be undertaken by donors in the next two years.

40. **Recently completed, relevant studies include the following:**

   a) **IPP model concession document and guidelines for competitive process:** This study was completed under the PPIAF in 2003.

   b) **Regional indicative master plan on power interconnection in the GMS:** Technical Assistance (T/A) funded by ADB (T/A No. 5920) and prepared by NorConsult, assesses electric power demand and reviewed generation and transmission master plans in GMS countries, updates information on power grid interconnections based on revised supply and demand projections, formulates an indicative master plan to promote regional power trade, and identifies the institutional and regulatory issues to be addressed for proper plan implementation.

   c) **Economic analysis of electric power supply options to Siem Reap:** An economic study of import of power from Thailand to Battambang, Bantey Meanchai and Siem Reap was completed by IDA in August 2004.

   d) **Capacity building of electricity authority of Cambodia (EAC):** T/A funded by ADB (T/A No. 4169-CAM) and completed by the National Economic Research Associates in August 2004.

41. **On-going studies are**

   a) **Capacity and institutional building of the electric sector:** This is a JICA-funded capacity building project for EAC and EDC. It is expected to be completed by September 2007.

   b) **Power development (master) plan update:** Funded under the IDA Rural Electrification and Transmission Project (RETP), the consultant work is ongoing. TORs are in Annex 1.

   c) **Renewable energy strategy study:** The study is ongoing by JICA and expected to be completed by June 2006.

   d) **Cambodia infrastructure review study:** This is ongoing by DFID, with a focus on infrastructure, including energy, service delivery to the poor segments of society.

   e) **GMS energy sector strategy study:** This is an ongoing T/A funded by ADB and its findings and recommendations will be highly relevant to the Cambodia energy sector strategy.

42. **Committed or proposed studies include the following:**

   a) **Hydropower master plan study:** TOR’s were drafted under this strategy review exercise (Annex 2) and commented upon by the MIME hydropower specialist. The study is
expected to take two years and cost US$1 million. MIME is seeking technical assistance from JICA to undertake this study.

b) **Rural electrification master plan**: Preparation of the RE master plan is funded by IDA under the ongoing RETP.

c) **Power sector efficiency study**: This study will be comprehensive with distinct modules that examine the sector policies, the sector management structure, the performance of the sector entities, the sector’s technical efficiency, (in terms of distribution, losses, diesel-generation), financial performance involving tariffs, demand-side management (DSM), and the future evolution of the sector structure. It will propose recommendations to improve the overall efficiency of the power sector. The study is expected to provide a basis for the formulation of three master plans mentioned earlier, i.e., master plan for reducing distribution losses, master plan for reducing costs of diesel generation, and master plan for DSM. The TOR’s are prepared by IDA in consultation with the Government and donors. Estimated cost is US$750,000. IDA will seek trust funds, possibly from ESMAP.

d) **Study on the legal and regulatory framework for the oil and gas industry**: The TOR’s were drafted under this exercise (Annex 3). It will be funded by one or more donor agencies in a coordinated manner.

e) **Study on the strategic roadmap of CNPA**: This is a capacity building T/A proposed by AusAID mainly for the CNPA.

f) **Petroleum import tariffs and taxes study**: This is a highly sensitive topic due to fuel smuggling and fiscal impact. IMF is looking into the issue.

g) **Petroleum revenue management mechanism**: This subject will be addressed through the Cambodia Public Finance Management (PFM) Reform Program, which is supported by a number of donor agencies, including IDA, IMF, and UNDP.

43. **Table E1 provides an overview and status of the above studies within the overall energy sector strategy exercise program.**
Table E1: Activities for the Strategy Exercise Program

<table>
<thead>
<tr>
<th>Activity</th>
<th>Status</th>
<th>Primary Provider of Technical Assistance</th>
<th>Funding Sources</th>
<th>Expected Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phase 1: Issues Identification and Program Concept Development</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Issues paper and TORs for selected thematic studies</td>
<td>Completed</td>
<td>IDA</td>
<td>IDA</td>
<td>October 2005</td>
</tr>
<tr>
<td>Dissemination workshop</td>
<td>Completed</td>
<td>IDA</td>
<td></td>
<td>October 2005</td>
</tr>
<tr>
<td><strong>Phase 2: Priority Thematic Studies and Formulation of Sector Strategy and Implementation Plan</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power development master plan update</td>
<td>On-going</td>
<td>IDA</td>
<td>RETP/IDA</td>
<td>June 2006</td>
</tr>
<tr>
<td>Renewable energy strategy study</td>
<td>Near completion</td>
<td>JICA</td>
<td>JICA</td>
<td>June 2006</td>
</tr>
<tr>
<td>Cambodia infrastructure review study</td>
<td>On-going</td>
<td>DFID</td>
<td>DFID</td>
<td>June 2006</td>
</tr>
<tr>
<td>Hydropower master plan</td>
<td>Proposed</td>
<td>RGC request for JICA assistance</td>
<td></td>
<td>June 2007</td>
</tr>
<tr>
<td>Rural electrification master plan</td>
<td>Planned</td>
<td>IDA</td>
<td>Provided under the IDA funded RETP</td>
<td>Dec. 2006</td>
</tr>
<tr>
<td>Power sector efficiency study</td>
<td>Proposed</td>
<td>IDA and/or interested donors ADB</td>
<td>Seeking ESMAP ADB</td>
<td>June 2007</td>
</tr>
<tr>
<td>Legal and regulatory framework for oil and gas industry</td>
<td>Proposed</td>
<td>ADB</td>
<td></td>
<td>Dec. 2006</td>
</tr>
<tr>
<td>Strategic roadmap of oil and gas sector</td>
<td>Proposed</td>
<td>Donor Working Group IMF</td>
<td>Donors</td>
<td>Dec. 2006</td>
</tr>
<tr>
<td>Petroleum import tariffs and taxes study</td>
<td>Proposed</td>
<td>IDA, IMF, UNDP</td>
<td>PFM Reform program</td>
<td>To be determined</td>
</tr>
<tr>
<td>Assistance to RGC for the formulation of energy sector strategy and implementation plan</td>
<td>To be planned</td>
<td>To be determined</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Phase 3: Implementation of Priority Actions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacity and institutional building project for EAC and EDC</td>
<td>On-going</td>
<td>JICA</td>
<td>JICA</td>
<td>Sept. 2007</td>
</tr>
<tr>
<td>EAC staff training on power sector regulation</td>
<td>Proposed</td>
<td>IDA</td>
<td>Seeking PPIAF</td>
<td>Continuous</td>
</tr>
<tr>
<td>Planning capacity building of EDC</td>
<td>Consultant</td>
<td>IDA</td>
<td>RETP/IDA</td>
<td>June 2006</td>
</tr>
<tr>
<td>Strategic roadmap for Cambodia National Petroleum Authority</td>
<td>Planned</td>
<td>AusAID</td>
<td>AusAID</td>
<td>Dec. 2006</td>
</tr>
<tr>
<td>Other activities to be determined</td>
<td></td>
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</table>
Chapter 1.

ENERGY STRATEGY FOR CAMBODIA

INTRODUCTION AND OVERVIEW

1.1 Cambodia’s energy sector is facing major challenges. Despite considerable progress in expanding the capacity and coverage of electricity supply in recent years, electricity costs remain to be among the highest in the world, and electrification rate, one of the lowest in Asia. As Cambodia’s power supply relies heavily on imported fuels, a new challenge is emerging due to the increases of international fuel prices. At the moment, the government is exploring new sources of energy, including hydropower, offshore and onshore oil and gas, and renewable energy. There is a consensus between the government and international development agencies that a coherent energy sector strategy is needed and that its formulation should be based on careful assessment of various energy sources and the policy and institutional framework for their development.

1.2 The main objective of this review is to create a strategic framework that governs the systematic development of the energy sector in Cambodia and leads to the formulation of a coherent energy sector strategy and implementation plan. The framework embodies a program of diagnostic and analytical work, and technical assistance and institutional building activities. Over the past few months, substantial preparatory work has been undertaken by IDA in association with RGC and donors, under the umbrella of a Concept Note prepared by IDA. This issues paper lays out the findings to date and seeks to provide detail for the strategy review work framework. Its finalization will consolidate a base document that guides a next-step work program.

1.3 The exercise is proposed to be undertaken in a participatory manner, with RGC taking a lead and the donors—ADB, IDA, JICA, and JBIC—providing appropriate technical and financial resources. Over the past few months, discussions have been held between RGC and donors, and a tentative work program identified. This program was presented in the Infrastructure Workshop on the Energy Sector Development of Cambodia—Strategy and Programs, held in Phnom Penh on March 10, 2005, and attended by relevant government agencies (MIME, MEF, EDC, EAC, and CNPA) and donors (ADB, IDA, JBIC, and JICA). At this workshop, the Concept Note prepared by IDA and commented upon by donors was presented. The participants agreed to the following:

- The scope of the study should cover the entire energy sector (including liquid fuels and other resources) and not be limited to the electric power sector as earlier contemplated by IDA.

- RGC will be in the driver’s seat, which will foster its commitment to actions, especially in the area of sector governance which is in need of strengthening.

- A government-owned sector development strategy agreed by major donors will constitute the basis for a sector-wide approach governing all future donor assistance, especially on the investment side.
• A joint effort by various donors with complementary expertise and resources will eliminate overlapping work, optimize utilization of donor resources and contribute to better quality strategic work and subsequent sector thematic studies.

• MIME, the line ministry for the energy sector, will lead the study effort. The Ministry of Economy and Finance (MEF) will be closely involved, especially in aspects relating to tariffs, taxation, and state-owned enterprise reform. The Cambodia National Petroleum Authority (CNPA) will be intimately involved in aspects relating to the petroleum sector.

• The Infrastructure and Regional Integration Technical Working Group (IRITWG) established by the RGC for the purpose of the annual consultative group meeting will be the primary coordinating vehicle between the government and donor community. IRITWG comprises participants from several infrastructure sector line ministries (energy, transport, water and sanitation, and telecommunications), and is chaired by the Minister of Public Works and Transport, and co-chaired by ADB and JICA. MIME will assume a leading role for the IRITWG discussion of energy issues.

1.4 The tentative phasing of the review is provided below:

• **Phase 1**: issues paper (terms of reference for priority studies)

• **Phase 2**: Implementation of the constituent studies and preparation of an overall energy sector study, and assistance to RGC in developing an energy sector strategy and implementation plan

• **Phase 3**: Revision/modification of legal, regulatory, institutional frameworks, and implementation of an agreed sector and institutional structure according to the sector strategy; capacity development of the institutions; finalization and implementation of an agreed investment plan taking into account the ongoing investments.

1.5 The studies should be coordinated and conducted in parallel. In this regard, particular attention should be placed on the separate funding of studies by multiple donors that follow different implementation schedules and procurement procedures, as a lack of coordination could pose an enormous challenge in integration of outputs. This an unavoidable challenge. Sub-sector studies will be grouped under distinct tasks. To accomplish the various technical studies, which will underpin an integrated sector strategy, will also require consensus building among donors.

1.6 The integrated study should be formulated modularly to include various sub-sector studies and diagnoses of specific issues such as the following: operational and financial efficiency of EDC; regulatory issues governing licensing, tariff, and regulation of REEs; demand forecasting and preparation of a least cost investment plan; energy security and investment choices in the context of the regional electricity market; financing options including potential public-private partnerships and how to secure investment efficiently and economically; the future sector structure; and other relevant issues.

1.7 Given RGC’s urgency to address some issues immediately, there may be priority exceptions, such as the development of a legal and regulatory framework for oil and gas exploration, and an analysis of high cost (and tariffs) of power supply in Cambodia. The review exercise should be harmonized with regional studies, especially under the GMS Economic Cooperation Program.
1.8 A broad-based steering committee comprising representatives of relevant ministries, government agencies, and the funding donors is required to ensure implementation and quality. While IRITWG, with its broad mandate for the entire infrastructure sector (including water and sanitation, telecommunication, transport), will provide oversight, a separate specific energy sector steering committee, with obligation to report to IRITWG, is a practical mechanism. The steering committee can be strengthened by appointing one or two energy experts.

1.9 The issues paper was disseminated and discussed in a stakeholder workshop held in Phnom Penh on October 27, 2005. The workshop generated a number of useful comments and feedback on the issues paper and other ongoing studies. There was consensus on the need for an official sector policy and strategy for other key policy and actions, such as the implementation of private power policy and guidelines for independent power producer (IPP) procurement. The final version of this issues paper has incorporated the comments and feedback generated by the workshop.

1.10 The issues paper discusses the following sub-sectors: (i) electricity, (ii) petroleum products, (iii) natural gas, (iv) coal, and (v) biomass and renewable energy. The sub-sectors are being covered for two principal reasons. First, if energy supplies are assured in an efficient and cost-effective manner, they have significant impact on economic growth and improved quality of life for the population. Second, effective engagement in these sub-sectors with RGC is essential for the transition to well-regulated market-based structures.

1.11 The issues paper begins with a description of a generic strategic view of the energy sector, and provides a description of the linkages with the economic and social objectives of the Government in Chapter 2. In Chapters 3, 4, and 5, a brief background is provided of different energy sub-sectors, issues relating to the sub-sectors are discussed, and relative priorities are attached. Chapter 6 provides tentative recommendations on a program of studies, with questions regarding appropriateness, priority, time frame, potential grouping, and donor primary responsibility for execution.

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Chapter 2.

THE STRATEGIC CONTEXT

ENERGY CHALLENGES IN CAMBODIA

2.1 A major segment of the Cambodian population, especially the 85 percent who live in rural areas, suffers from what can be called “energy poverty.” While the country has made significant progress in energy service provision in the last decade, population has expanded faster than energy coverage, and Cambodia remains one of the lowest electrified countries in Asia. The country suffers from another drawback: the cost of the electricity is among the highest in the world. As Cambodia’s supply is heavily reliant on imported fuels, a new challenge is emerging from the increase of international fuel prices. The high costs and electricity supply shortages are identified by firms as a main constraint to business growth. The constraint is particularly serious at a time when the economy is diversifying from its reliance on the garment industry as a primary economic growth source to other sources such as agriculture and tourism.

2.2 The RGC has identified the country’s major constraints to growth and development and collated them into the rectangular strategy, a comprehensive strategy to plan and organize economic priorities. The RGC identifies four pillars to growth, that is, the growth rectangles, which include agriculture, private sector development, capacity building and human resources, and infrastructures (see Box 2.1). Infrastructure includes energy policies and the expansion of power grids as priorities, and by articulating this, the Government acknowledges the importance of energy in the overall development of the country, while reasserting its commitment to collaborate in the formulation of a comprehensive strategy for the coming years. Furthermore, energy underlies many of the other priorities in the strategy.

<table>
<thead>
<tr>
<th>Box 2.1: Cambodian Rectangular Strategy: The Four Growth Rectangles</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Growth rectangle 1: Agriculture</strong></td>
</tr>
<tr>
<td>- improved productivity and diversification</td>
</tr>
<tr>
<td>- land reform and mines clearance</td>
</tr>
<tr>
<td>- fisheries reform</td>
</tr>
<tr>
<td>- forestry reform</td>
</tr>
<tr>
<td><strong>Growth rectangle 2: Private sector</strong></td>
</tr>
<tr>
<td>- strengthened private sector and investments</td>
</tr>
<tr>
<td>- promotion of SMEs</td>
</tr>
<tr>
<td>- creation of jobs and improved working conditions</td>
</tr>
<tr>
<td>- establishment of social safety nets for workers</td>
</tr>
<tr>
<td><strong>Growth rectangle 3: Infrastructure</strong></td>
</tr>
<tr>
<td>- transport infrastructure</td>
</tr>
<tr>
<td>- water resources management and irrigation</td>
</tr>
<tr>
<td>- <strong>energy and power grids</strong></td>
</tr>
<tr>
<td>- information and communication technology</td>
</tr>
<tr>
<td><strong>Growth rectangle 4: Capacity building and HR</strong></td>
</tr>
<tr>
<td>- enhanced quality of education</td>
</tr>
<tr>
<td>- improved health services</td>
</tr>
<tr>
<td>- greater gender equity</td>
</tr>
</tbody>
</table>

2.3 Faced with rising international oil prices, the government is exploring new sources of energy, including hydropower, offshore and onshore oil and gas, and renewable energy. However, these activities are being carried out in a fragmented manner; there is no strategic framework to guide the development of the energy sector. For example, an enabling legal and
regulatory framework needs to be put in place for the development of the offshore and onshore oil and gas industry. It is recognized that a coherent energy sector strategy is needed and that its formulation should be based on careful assessment of various energy sources, the policy and the institutional framework for their development.

**CONSIDERATIONS FOR ENERGY STRATEGY STUDY**

2.4 To set the tone and guide the deliberations for the energy strategy study, key generic considerations drawn from similar studies apply, as outlined below. The Government’s major long-term objectives for the development of the energy strategy could be envisaged as follows:

- Establishment of the medium- to long-term industry structure, consistent with international practice, and in keeping with the requirements of a developing economy like Cambodia. Inter alia, this requires the development/refining of the policy, regulatory, fiscal and taxation, commercial and institutional arrangements for different energy sub-sectors.

- The outline of a restructuring and reform program, whereby a transition to medium- to long-term structure, is assured without any disruption of energy services or supplies;

- Development of a framework for enhancing quality of supply, and reduction of delivered cost of energy, through system efficiency and other incentives; and

- Establishment of a framework for private-sector and other investments to expand access to energy supplies on a sustainable basis.

**STRATEGIC CONSIDERATIONS**

2.5 Governments all over the world are duly concerned with the question of energy supply security, especially when facing dependence on imported sources. Cambodia currently relies on imports for all its liquid fuel requirements, and to generate power (predominantly, through thermal energy) is, in turn, dependent on imported fuels. Therefore, it is of utmost importance to map domestic energy resources, and shift towards an energy-mix, which is consistent with the natural endowment. Long-term development of the energy sector is envisaged to take advantage of economic and technologically-feasible indigenous resources while using imported supplies in a sustainable manner.

2.6 One of the goals of the Government remains to enhance access to clean and affordable energy, and give the population and institutional consumers a wide array of choices. Provision of modern forms of energy improves quality of life and promotes social equity among different segments of the population. Similarly, access to commercial sources of energy leads to economic activity, which in turn fosters income generation and economic growth. In order to assure affordability of energy supplies, differentiated services should be designed with varying prices for different segments of the population.

2.7 Efficiency of operations as a means for the provision of high quality cost-effective services is the hallmark of energy sectors in many countries. International experience indicates that efficiency at the production and consumption levels can be achieved through improved sector governance, market opening and competition, independent regulation, market-based pricing, and improved public information system.
2.8 *Incorporation of health, safety and environment (HSE) standards is getting more important as energy sector operations become more complex.* The consequences of poor fuel quality, or unsafe operations in a petroleum facility or a power plant, are simply too grave to contemplate. Governments all over the world have a responsibility to adequately handle the externalities of the energy sector such as products specifications, environmental conservation, competition, safety of installations, customer services, and strategic stocks.

**LINKAGES TO NATIONAL AND SOCIAL OBJECTIVES**

2.9 *The major goal of all governments is to stimulate economic growth through the provision of reliable and cost-effective energy supplies.* There is sufficient evidence of a strong positive correlation between energy consumption and GDP growth rates (usually energy consumption tends to be higher than the GDP growth rate in developing countries, given the state of development and nature of technology employed). Economic development creates labor opportunities, for example, in farms, commercial establishments, industries or in service centers, and contributes to poverty alleviation. When a population is gainfully employed, they possess the resources to purchase appliances and use commercial energy for an overall improved quality of life. This circular flow of consumed goods and services by people, who in turn work for the production of necessary supplies, is fueled by energy resources.

2.10 *There is strong evidence that access and provision of commercial forms of energy such as electricity, petroleum products, and natural gas, promotes urban-rural equity and has profound social consequences.* Population migration to urban centers can be stemmed and discord can be quelled between urban and rural populations, since both groups experience the same level of comfort through household appliances, or have access to the worldwide information network. Availability of energy choices is, therefore, a significant balancing factor. There is also evidence that once commercial forms of energy are provided to a majority of the population, there is (a) significantly reduced time required for collecting the fuel from long distances, primarily for women and children; (b) because of the time saved, there is more time for alternative activities that generate incremental income; (c) incremental income helps to pay for purchased energy, and also facilitates the acquisition of more production equipment; (d) because of a switch to cleaner biomass fuels, environment conservation is facilitated; and (e) there is a positive improvement in the health of women and children, because of reduced indoor air pollution.

2.10 *The above economic and social objectives could be achieved through the following means and measures:*

a) **Maintaining financially-sustainable services:** Unless the provision of energy services is financially-viable, one cannot expect private sector interest or a significant increase in the coverage for the population. To determine financial viability, it is necessary to ensure consumers are not burdened with undue costs or inefficiency of the utilities. However, consumers must be made aware of all prudent costs and be prepared to pay efficient prices.

b) **Ensuring reliability and quality of services/products:** If energy utilities are not financially-viable, the first casualty is the reliability and quality of supplied services. Often it is not realized what the foregone cost is or if the energy is of poor quality. A sound energy supply ensures that a certain minimum of standards, reliability and quality of service for different consumer categories are maintained, and consumers pay in accordance with the quality of service received.
c) **Alleviating poverty through access to modern energy.** Providing access to modern energy is a key means to alleviate poverty in different countries, and many rural electrification programs are designed on that basis. There is strong evidence of higher household income in electrified versus non-electrified villages. Provision of other forms of commercial energy (natural gas, LPG, kerosene, etc) has similar consequences.

d) **Integrating Cambodian energy sector with ASEAN.** Energy sectors in different countries are becoming integrated, and trading in electricity, natural gas through pipelines, and LNG, is common in Europe, North America and South America. Integration of the energy sector is also becoming apparent in Asia, and ASEAN is in the lead in this regard. Integration of the Cambodian energy sector under the greater Mekong system (GMS) will not only contribute significantly to access to alternative supplies, but will also provide an outlet to energy markets in the region.

e) **Mitigating environmental risks.** With the tightening of environmental safeguards, it has become imperative for all countries to assess risks and devise mitigation measures against environmental disaster. While this may seem to be an additional cost, given the recent tsunami experience, global warming, climatic changes, and volcanic activity under the sea (or elsewhere), it is well worth mitigating the risks to the best extent possible.

**STRATEGIC VISION FOR THE ENERGY SECTOR**

2.12 The strategic vision for the energy sector of any Government, by and large, is to meet the energy needs of the economy, and the population at large, in an efficient and cost-effective manner while ensuring the financial and institutional sustainability of the sector.

2.13 **Long-term goals:**

- a) Ensure the security of the energy supply;
- b) Enhance access to energy sources, and provide clean and affordable energy;
- c) Improve the efficiency of the operation of the energy system; and
- d) Assure effective handling of externalities, so that adverse consequences of energy production, generation and consumption are minimized.

2.14 **To achieve the long-term goals, a number of medium-term strategies could be adopted as follows:** (a) creation of an industry structure which fosters competition; (b) promotion of private sector participation using incentive mechanisms; (c) setting market-based pricing to reduce impact on the national budget; (d) providing targeted and time-bound subsidies to reduce fiscal burden; and (e) enhancing access to energy sources using innovative approaches.

2.15 **Notwithstanding the long-term goals, and strategies to be followed in the medium-term, the immediate short-term priority remains the reduction in the cost of delivered energy based on efficiency of operations.** This may require a careful balancing of Government’s fiscal targets and increased revenue generation due to stimulation of economic activity.
Chapter 3.

ELECTRIC POWER IN CAMBODIA

OVERVIEW

3.1 Cambodia has one of the lowest electrification rates in Asia with only approximately 15 percent of the population, or 13 million, connected to a power supply. The national per capita consumption is just 45 kWh per annum. Electricity costs and tariffs are among the highest in the world. These three aspects are partly connected and partly the consequence of Cambodia’s turbulent history: the country has only recently emerged from a lengthy period of conflict, civil war and invasion; civil peace was restored only in 1998. Private independent power producers (IPPs) were engaged in early 1994 to revive supplies. The dependable total system capacity in 2004 was 109 MW. There is no national grid, and most towns are supplied through isolated systems.

Legal and institutional framework

3.2 The legal framework for the electricity sector is underpinned by the Electricity Law of the Kingdom of Cambodia, which was promulgated by Royal Decree in February 2001. The law’s key elements are the following: (i) establishing the principles for operation of the sector; (ii) establishing favorable conditions for competition, private investments in, and private ownership and commercial operation of the electric power industry; (iii) establishing and defining the functions of the Electricity Authority of Cambodia (EAC); and (iv) defining the functions of the Ministry of Industry, Mines and Energy (MIME).

3.3 Key licenses permitted under the law are the following: (i) Generation license, or the right to build, own and operate from specific facilities; (ii) National transmission license, granted to EDC to construct the country’s main network; (iii) Special purpose transmission license, or the right to build, own and operate specific transmission lines; (iv) Distribution license, or the right to distribute in a specific territory; and (v) Consolidated license, or the right to generate and distribute, which was generally granted to EDC but also to operators in isolated systems. The Electricity Law is supported by sub-decrees, the latest being a sub-decree on tariffs adopted in May 2005.

3.4 The principal entities in the electricity sector are:

a) The Ministry of Industry, Mines and Energy (MIME) was established in 1992, and is responsible for setting and administering government policies, strategies, development and investment plans for the power sector. Its functions encompass power sector restructuring, electricity trade with neighboring countries, major investment projects and full management of the rural electrification sector. Excluded from its purview is the oil and gas sector, which comes under the Cambodian National Petroleum Authority (CNPA). In partnership with the Ministry of Economy and Finance (MEF), MIME is the owner of the Electricite du Cambodge (EDC).

b) The Electricity Authority of Cambodia (EAC) is the power sector regulator, an autonomous body, created in 2001, responsible for licensing, approving tariffs, setting and enforcing performance standards and settling disputes. EAC comprises three members (one chairman and two vice-chairmen) appointed by the Prime Minister and a
secretariat headed by an executive director and comprising the Departments of Legislation, Financial/Pricing, Electricity Regulation, and Administration and Personnel.

c) The Electricite du Cambodge (EDC): In 1996, EDC became a wholly state-owned limited liability company, with responsibility to generate, transmit and distribute electricity throughout Cambodia. On a national scale, its key functions are the creation of the main transmission grid and the import and export of electricity to and from neighboring countries. EDC functions under a seven-member Board of Directors, and is managed by a managing director and three deputy managing directors. The entity comprises the following: (i) the Departments of Generation, Corporate Planning and Projects, Transmission and Distribution, International Energy; (ii) Departments of Administration, Training, Provincial Affairs, Technical; (iii) Departments of Financing and Accounting, Business, Internal Audit; and (iv) 13 Provincial Electricity Units. There were a total of 1,996 employees as of December 2004, of which 13 percent were engineering staff, 44 percent were skilled and 43 percent were unskilled.

Electricity generation and supply

3.5 In Cambodia, electric power is generated and distributed by the following: (i) the state-owned enterprise, EDC and (ii) private entities including Independent Power Producers (IPP) in the provincial town capitals, licensees in small towns, and Rural Electricity Enterprises (REEs) in the rural areas.

3.6 EDC has a consolidated generation and distribution license for supplying power in Phnom Penh, Sihanoukville, Siem Reap, Kampong Cham, Takeo, Battambang, Kampot, Prey Veng, Banlung (Rattanakiri) and four border areas (Phhea Kreak, Memut, Baveth, and Kampong Trach). It also plans to take over the supply to the provincial towns of Kampong Speu, Kampot, Svey Rieng, Stung Treng and Bantey Mean Chey. In Table 3.1 below, the installed generating capacity in the major provincial towns, their annual energy generation and imports of capacity and energy from Vietnam are summarized:

<table>
<thead>
<tr>
<th>Province</th>
<th>2002 Capacity/Peak Output</th>
<th>2003 Capacity/Peak Output</th>
<th>2004 Capacity/Peak Output</th>
<th>Energy Output (Gwh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phnom Penh</td>
<td>124/101</td>
<td>124/101</td>
<td>124/101</td>
<td>485.5</td>
</tr>
<tr>
<td></td>
<td>EDC</td>
<td></td>
<td></td>
<td>555.7</td>
</tr>
<tr>
<td></td>
<td>IPP’s -1</td>
<td>35/30</td>
<td>35/30</td>
<td>128.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>151.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>248.4</td>
</tr>
<tr>
<td></td>
<td>Jupiter</td>
<td>15/15</td>
<td>15/15</td>
<td>79.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>116.1</td>
</tr>
<tr>
<td></td>
<td>CETIC</td>
<td>12/6</td>
<td>12/6</td>
<td>29.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>40.6</td>
</tr>
<tr>
<td></td>
<td>NEW IPP</td>
<td></td>
<td></td>
<td>n.a.</td>
</tr>
<tr>
<td>Sihanoukville</td>
<td>10/10</td>
<td>20.5</td>
<td>10/10</td>
<td>n.a.</td>
</tr>
<tr>
<td>Kampong Cham #</td>
<td>3.59/2</td>
<td>6.3</td>
<td>3.59/2</td>
<td>n.a.</td>
</tr>
<tr>
<td>Takeo (Rented)</td>
<td>1.1/0.9</td>
<td>2.0</td>
<td>1.1/0.9</td>
<td>n.a.</td>
</tr>
<tr>
<td>Battambang %</td>
<td>6.16/5</td>
<td>11.4</td>
<td>6.16/5</td>
<td>n.a.</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>157.4</td>
<td>547.9</td>
<td>158.4</td>
</tr>
</tbody>
</table>

# Private Generation. *Baveth, Mermot, Pohnea Krack, Kampong Trach. % Mostly IPPs
3.7 **Between 2002 and 2003, electricity energy generation registered a growth of about 15 percent, whereas peak output stagnated at approximately 158 MW due to severe shortage of installed capacity.** Phnom Penh accounted for almost 88.5 percent of EDC sales in 2003 and its customer base increased from 132,795 to 140,611, a growth of about 5.9 percent. Energy consumption in Phnom Penh is distributed as follows: domestic – 47.5 percent, commercial – 23.1 percent, government – 14.3 percent and industrial – 12.4 percent.

3.8 **The IPPs form a major group of electric power generation in Cambodia.** Of EDC’s total generation requirements, eight IPPs supplied about 67 percent, EDC’s generated about 32 percent on its own (of which about 6.4 percent is hydro, 4.6 percent steam (HFO) and the rest diesel/HFO), while about one percent was imported from Vietnam.

3.9 **There are about 85 licensees in small towns and rural electricity enterprises, 77 of which are consolidated generation and distribution.** They operate diesel-based generators in small towns, accounting for about five percent of Cambodia’s total consumption, and about 150,000 consumers. Their licenses are issued by EAC, even though some of the licensees also hold agreements with MIME. The licensees near the borders purchase power from neighboring countries under MIME’s authorization, and the agreement is executed with MIME. The licensees who have taken over electricity facilities earlier owned by MIME in some provincial towns have executed agreements with MIME.

3.10 **Four of the licensees import energy from Thailand (PEA) at medium voltage (MV) for supplying their franchise areas of Kamrieng/Phnom Preuk/Sampeou Loun (2.1 Gwh), Phum Phsar Prum (3.2 Gwh), Ochraov district (28.6 Gwh), Koh Kong/Osmarch (11.6 Gwh).** On average, the import tariff from Thailand is about USc 7/kwh at 22 kV. According to a recent survey, about 600 small private entrepreneurs in the countryside supply about five percent of the total consumption and about 17,000 consumers.\(^7\)

**Tariffs and losses**

3.11 **The purchase tariffs from IPPs range from USc 7.0/kwh for the Kirirom Hydro Plant to about 13 to USc 18.0/kwh from the diesel-based IPPs.** The latest IPP contracted on a competitive basis has a purchase tariff of only about USc 10.0/kwh (based on HFO price of US$230/ton; current price of HFO is about US$540/ton). The import tariff from Vietnam at MV is USc 6.9/kwh. The tariff for purchase of power from EGAT in Thailand (currently under consideration for supply to Siem Reap, Bantay Meanchai and Battambang) is about USc 6.25/kwh at the border at 115kV level. Sales tariffs vary from province to province.

3.12 **In Phnom Penh, the tariff categories are distributed as follows (in USc/kwh): Residential: Lifeline – 8.75, Maximum – 16.25 (progressive); Industrial: 12.5 to 15.0 (regressive); Commercial: 12.5 to 16.25 (regressive); Government Institutions: 17.5; Embassies, etc.: 20.** In Siem Reap, tariffs range from 15 to USc 19.5/kwh and in Sihanoukville from USc 12.5 to 19/kwh. In Kampong Cham, Takeo and Battambang tariffs range from USc 21.5 to as high as 24/kwh. The sales tariffs in areas supplied from Vietnam are USc 16.25/kwh LV and USc 12.5/kwh MV. Table 3.2 below presents the current electricity tariffs in Phnom Penh, that is before the proposed June 2005 revision.

\(^7\) These figures need to be verified. According to the EAC there are only about 250 REEs that qualify for a license.
Table 3.2: Electricity Tariffs in Phnom Penh and Adjustments in Late 2005

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential (LV)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-50 Kwh</td>
<td>350</td>
<td>350</td>
</tr>
<tr>
<td>51-100 Kwh</td>
<td>550</td>
<td>550</td>
</tr>
<tr>
<td>&gt; 100 kwh</td>
<td>650</td>
<td>650</td>
</tr>
<tr>
<td>Industrial</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small (no minimum guaranteed off-take)</td>
<td>600</td>
<td>650</td>
</tr>
<tr>
<td>Medium (minimum off-take 20,000 kWh)</td>
<td>550</td>
<td></td>
</tr>
<tr>
<td>Big (minimum off-take 50,000 kWh)</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>MV (guaranteed minimum off-take 80,000 kWh)</td>
<td>480</td>
<td></td>
</tr>
<tr>
<td>Commercial &amp; Service Sectors (MV)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small (No guaranteed minimum off-take)</td>
<td>650</td>
<td>650</td>
</tr>
<tr>
<td>Medium (Guaranteed minimum off-take 20,000 kWh)</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>Big (Guaranteed minimum off-take 50,000 kWh)</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>MV (Guaranteed minimum off-take 80,000 kWh)</td>
<td>480</td>
<td></td>
</tr>
<tr>
<td>Embassy, Foreigners, NGOs</td>
<td>800</td>
<td>800</td>
</tr>
<tr>
<td>Government Institutions (paid from Govt. budget)</td>
<td>700</td>
<td>700</td>
</tr>
</tbody>
</table>

3.13 Distribution losses in the Phnom Penh system were reduced from 25.4 percent in 1999 to 15.7 percent in 2000 and progressively to 12.7 percent in 2003, due to rehabilitation and reinforcement of the network. Losses will come down further when provincial systems are rehabilitated under ADB’s projects.

Power demand

3.14 MIME projects growth in the electricity requirement from 273 MW, 1,036 Gwh in 2004 to 746 MW, 2,634 Gwh in 2016, an average growth rate of about 8.7 percent per annum (see Table 3.3).

Table 3.3: Electricity Growth Forecast

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Power MW</td>
<td>273</td>
<td>331</td>
<td>404</td>
<td>477</td>
<td>558</td>
<td>651</td>
<td>746</td>
</tr>
<tr>
<td>Energy Gwh</td>
<td>1036</td>
<td>1215</td>
<td>1454</td>
<td>100</td>
<td>1968</td>
<td>2292</td>
<td>2634</td>
</tr>
</tbody>
</table>

3.15 The power system expansion plan currently prepared by MIME envisages the following generation capacity addition and HV/EHV grid development, see Table 3.4:
Table 3.4: System Expansion Plan

<table>
<thead>
<tr>
<th>Year</th>
<th>Generation</th>
<th>Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>Siem Reap - 10 MW HFO</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>Khmer Electric Power – 32 MW HFO</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>Phnom Penh C5 – 10 MW HFO</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>Phnom Penh – 80 MW Import from VN</td>
<td>220 kV Viet Nam – Phnom Penh</td>
</tr>
<tr>
<td></td>
<td>Siem Reap – 20 MW Import, Thailand</td>
<td>115 kV Thailand – Banteay Meanchay</td>
</tr>
<tr>
<td></td>
<td></td>
<td>115 KV GS1 – NPP and S/S at NPP</td>
</tr>
<tr>
<td>2008</td>
<td>Kirirom III – 13 MW Hydro</td>
<td>220 kV Takeo – Kampot and S/S at Kampot</td>
</tr>
<tr>
<td>2009</td>
<td>Phnom Penh – 120 MW extra from VN</td>
<td>220 kV WPP – Kampong Cham</td>
</tr>
<tr>
<td></td>
<td>Kamchay – 180 MW Hydro</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td></td>
<td>230 kV WPP–Kampong Chhnang–Pursat-Battambang and S/Ss at Kampong Chhnang, Pursat</td>
</tr>
<tr>
<td>2011</td>
<td>Lower Russei Chrum – 125 MW Hydro</td>
<td>230 kV Sihanoukville – WPP</td>
</tr>
<tr>
<td>2012</td>
<td>Stung Atay – 110 MW Hydro</td>
<td>115 kV Phnom Penh –Neak Loeung- Svay Rieng and S/Ss at Neak Loeung, Svay Rieng</td>
</tr>
<tr>
<td></td>
<td>Battambang II – 36 MW Hydro</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Coastal – 300 MW Steam</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>Battambang I and II -60MW Hydro</td>
<td>230 kV Sihanoukville-Kampong Cham</td>
</tr>
<tr>
<td>2015</td>
<td>Middle Russei Chrum -125 MW Hydro</td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td>Upper Russei Chrum – 35 MW Hydro</td>
<td>230 kV Stung Atay Hydro - Pursat</td>
</tr>
<tr>
<td>2017</td>
<td>Lower Se San II – 207 MW Hydro</td>
<td></td>
</tr>
<tr>
<td>2018</td>
<td>Lower Sre Prok II – 222 MW Hydro</td>
<td>230 kV Sambor Hydro-Kampong Cham</td>
</tr>
<tr>
<td></td>
<td>Stung Chay Areng – 260 MW Hydro</td>
<td>230 kV Kampong Cham- Kompong Thom- Siem Reap</td>
</tr>
<tr>
<td>2020</td>
<td>Sambor Hydro – 467-3300 MW Hydro</td>
<td>500 kV Sambor - Stung Treng – Lower Se San – Lower Srepok – ASEAN Grid (Viet Nam, Thailand, Laos )</td>
</tr>
<tr>
<td></td>
<td>Stung Treng – 980 MW Hydro</td>
<td></td>
</tr>
</tbody>
</table>

Hydropower

3.16 The theoretical hydropower potential of Cambodia is estimated at 10,000 MW. However, the realistically exploitable potential in the mid- to long-term, for which desk studies support, is about 1,900MW; 9,000 Gwh p.a., at an average cost of about US$1,668/kW, or USc 3.5/kwh (See Table 3.5).
### Table 3.5: Potential Hydropower Projects

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kirirom IV</td>
<td>23</td>
<td>102</td>
<td>56</td>
<td>2,435</td>
<td>5.5</td>
<td>DS</td>
</tr>
<tr>
<td>2</td>
<td>Kirirom III</td>
<td>13</td>
<td>70</td>
<td>29</td>
<td>2,230</td>
<td>4.1</td>
<td>FS</td>
</tr>
<tr>
<td>3</td>
<td>Kamchay</td>
<td>180</td>
<td>550</td>
<td>220</td>
<td>1,222</td>
<td>4.0</td>
<td>FS and Bid</td>
</tr>
<tr>
<td>4</td>
<td>Battambang II</td>
<td>36</td>
<td>187</td>
<td>65</td>
<td>1,806</td>
<td>3.5</td>
<td>DS</td>
</tr>
<tr>
<td>5</td>
<td>Battambang I</td>
<td>24</td>
<td>120</td>
<td>49</td>
<td>2,041</td>
<td>4.1</td>
<td>DS</td>
</tr>
<tr>
<td>6</td>
<td>Stung Atay</td>
<td>110</td>
<td>588</td>
<td>156</td>
<td>1,418</td>
<td>4.1</td>
<td>FS China</td>
</tr>
<tr>
<td>7</td>
<td>Middle Russey Chrum</td>
<td>125</td>
<td>668</td>
<td>275</td>
<td>2,200</td>
<td>4.1</td>
<td>DS</td>
</tr>
<tr>
<td>8</td>
<td>Lower Russey Chrum</td>
<td>125</td>
<td>656</td>
<td>130</td>
<td>1,040</td>
<td>2.0</td>
<td>DS Japan</td>
</tr>
<tr>
<td>9</td>
<td>Upper Russey Chrum</td>
<td>32</td>
<td>221</td>
<td>65</td>
<td>2,031</td>
<td>2.9</td>
<td>DS</td>
</tr>
<tr>
<td>10</td>
<td>Stung Cheay Areng</td>
<td>260</td>
<td>1350</td>
<td>502</td>
<td>1,931</td>
<td>3.7</td>
<td>DS</td>
</tr>
<tr>
<td>11</td>
<td>Stung Tatay</td>
<td>80</td>
<td>250</td>
<td>215</td>
<td>2,608</td>
<td>8.6</td>
<td>DS</td>
</tr>
<tr>
<td>12</td>
<td>Sambor</td>
<td>467</td>
<td>2,800</td>
<td>700</td>
<td>1,499</td>
<td>2.5</td>
<td>DS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3,300</td>
<td>14,870</td>
<td>3,940</td>
<td>1,194</td>
<td>2.6</td>
<td>DS</td>
</tr>
<tr>
<td>13</td>
<td>Lower Sre Pok II</td>
<td>222</td>
<td>1,174</td>
<td>339</td>
<td>1,527</td>
<td>2.9</td>
<td>PrS</td>
</tr>
<tr>
<td>14</td>
<td>Lower Se San II</td>
<td>207</td>
<td>1,065</td>
<td>374</td>
<td>1,807</td>
<td>3.5</td>
<td>PrS Vietnam</td>
</tr>
<tr>
<td></td>
<td>Total Sambor (Low)</td>
<td>1,904</td>
<td>9,001</td>
<td>3,175</td>
<td>1,668</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sambor (High)</td>
<td>4,737</td>
<td>21,071</td>
<td>6,415</td>
<td>1,354</td>
<td>3.0</td>
<td></td>
</tr>
</tbody>
</table>

DS = Desk Study; PrS = Pre-feasibility Study; FS = Feasibility Study

### Issues and constraints of the power sub-sector

3.17 In 1999, with the Cambodia power sector strategy, the foundation for the development of Cambodia’s power sector was set (see Box 6.1). Many observations within the document remain valid today. Over the last six years, dramatic progress has taken place in the power sector in all fields; however, much remains to be done.

3.18 The promulgation in February 2001 of the Electricity Law of the Kingdom of Cambodia and the creation of an independent sector regulator (EAC) are landmark developments, the likes of which have not occurred in neighboring countries, Lao PDR, Thailand and Vietnam. The Law has the stated objective of “creating favorable conditions for investments in and the commercial operation of the electric power industry.” While detailing the more “narrow” framework for the electric power supply and services (through outlining the role and responsibilities of MIME and establishing the EAC as an independent sector regulator, with an exhaustive elaboration of its role) the Law implicitly envisions and provides for the future unbundling of the power sector, albeit at a distant point in time. The key concepts underlying “unbundling” are the creation of a transmission company (TRANSCO), a dispatching entity (or system operator) and a competitive wholesale power market, where generators could contract directly with distributors. A competitive wholesale power market currently does not exist within any of the GMS countries, per se, and the functioning of such a market across the GMS region is still far off. However, RGC, along with other GMS countries, is close to adopting bilateral trading as a first step towards regional power trade.

3.19 An important piece of legislation was passed by RGC in April 2005: The sub decree on electricity tariffs, which determines the basic principles of electricity business that EAC shall apply in setting electricity tariff of licensees in accordance with the Electricity Law. EAC is required to ensure that licensees’ costs are only recovered where they are reasonable and in accordance with the principles set out in the sub-decree, and EAC shall not require licensees to provide electric power services where reasonable costs cannot be recovered in full through tariffs, except to the extent that specific subsidies are provided. IS THIS VERBATIM? The
determination of reasonable cost of licensees’ electricity business, allowed to be recovered through tariffs, shall be carried out in accordance with basic principles specified in the sub-decree. EAC shall, subject to the provisions of the Electricity Law and this sub-decree, issue regulations on detailed principles and a methodology for calculation and quantification of the above reasonable costs.

3.20 The CPSS foresaw the need for EAC’s autonomy. The Law provides for key mechanisms that promote the autonomy of EAC (such as directly reporting to the Prime Minister, composition of the EAC Board and the terms of appointment of its members, self-financing through licensing fees, etc.). Likewise, the law enunciates economic principles for setting tariffs and the need for contracting electricity services in a least-cost manner.

3.21 As a result of initial technical assistance, EAC has performed the function of licensing well. It has also issued a number of regulations and procedures to regulate the relationships between the supplier and consumer, quality of supply and service, and handling complaints. It has now actively taken up the required legislative documents required for tariff determination, and had the RGC issue the sub-decree on reasonable costs. The approval for the regulations and procedures required for determination of tariff is imminent.

3.22 Recently, EAC has taken up the case of tariff determination for EDC, initiated in early 2005, as a result of EDC declaring financial difficulties due to increasing international oil prices. The tariff of EDC at Phnom Penh was last fixed assuming the subsidy policy for domestic consumers. Before making changes, EAC consulted the Government on its tariff and subsidy policies. Through EAC’s initiative, the Government issued the revised subsidy policy for domestic consumers. The tariff of EDC for Phnom Penh likely to be revised soon.

3.23 EAC currently enjoys a reasonable degree of autonomy in the overall management of its affairs and specifically in issuing licenses to small-scale operators, and in setting and enforcing laws and standards. However, much remains to be done to bolster EAC’s autonomy in the following: (i) the procurement process for IPPs; (ii) the setting of tariffs especially in provincial towns and Phnom Penh; and (iii) assuming the true role of regulating the country’s main utility, EDC, through modern day regulatory methods such as price caps, rates of return, etc. MIME’s involvement in almost all of EDC’s activities blurs the distinction between its roles as policy maker and policy implementer. On the other hand, EAC’s limited capabilities preclude it from playing the role of regulating EDC. The Energy Sector Strategy needs to take into consideration EDC’s autonomy and strengthening for major sector regulation. EAC has benefited enormously through ongoing strengthening support in the routine aspects of regulation under IDA’s Rural Electrification and Transmission Project (RE&T) and also under ADB’s projects and technical assistance grants. These activities need to be continued.

3.24 The Electricity Law states that “MIME shall be responsible for setting and administering the government policies, strategies and planning in the power sector.” Further, MIME shall provide to EAC information on policies, strategies, and planning in the power sector and its decisions on the following: (i) investments in the rehabilitation and development of the power sector; (ii) restructuring, private sector participation and privatization of public utilities; (iii) promotion of the use of indigenous energy resources; (iv) planning and agreement on export and import of electricity; (v) subsidies for specific classes of consumers; (vi) promotion of efficiency in generation, transmission and consumption of electricity, and formulating a comprehensive electricity conservation program for Cambodia; and (vii) electricity sector emergency and energy security strategies.
While the span of MIME’s responsibilities is rational, though extensive, the nuance of its administration role in practice stretches to detailed planning; for example, operating the software for power development planning, which should be in the domain of EDC; involvement in the procurement and licensing process for private power which should largely be within the domain of EAC and EDC; and managing the rural and provincial electrification programs, which could be passed on to the provincial authorities. The current all pervading role of MIME impinges on the autonomy of both EAC and EDC, both of which should have an arms-length relationship with the Ministry. An Energy Strategy for Cambodia needs to help evolve the role of MIME so that it increasingly leans more towards policy making and less on administration and implementation, which are functions better suited to the line agencies.

Although the Electricity Law defines an overall framework that promotes private participation in the electrification of Cambodia, the processes to ensure this in practice have not been formulated. To assist RGC to define clearly the rules, the Bank through its Private Provision of Infrastructure Advisory Facility (PPIAF) has produced a series of reports. These reports are intended to help RGC prepare a private power policy paper and sub-decrees for the main Electricity Law. The first report articulates the policy that should be followed for: (i) New generating Capacity investment (distinguishing between large projects five MW and above and small projects below five MW); and (ii) private sector participation in rural electrification. The paper defines the roles and responsibilities of the various stakeholders to implement the policy and clarifies where the private and public sectors should participate or lead. It establishes criteria that would level the playing field. More importantly, it states the following:

- **Large Power Generation Projects.** The addition of new generation capacity will be based on specific projects that are consistent with the strategic planning policies issued by RGC; and the procurement process will be transparent, driven by competitive mechanisms, based on the Guidelines, pre-established oversight procedures that reflect the roles of all parties involved in the process, and disclosure through publication of information necessary to guarantee transparency in the entire procurement process.

- **Small Power Generation Projects.** These procedures will have simplified mechanisms for procurement and pricing intended to encourage access by private investors to this segment of the power sector. They are designed to attract investment particularly in off-grid areas where existing generation projects do not exceed the forecasted demand and where transmission or distribution interconnections do not exist. The simplified procedures are intended to facilitate project development with less complexity and cost to speed up the installation of the required new small-scale generation capacity and expand national electrification. In isolated areas, distribution licensees may be allowed to own generation assets arising from these mechanisms by means of consolidated licenses. Mergers and interconnections between rural electrification enterprises (REEs) will be encouraged to capture economies of scale. Economic incentives or subsidies will be

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8 Four among the reports are 1) Policy paper on private participation in the power sector of Cambodia; 2) Proposed sub-decree on private participation in the power sector; 3) Encouraging a level playing field for private investors in rural electrification; and 4) Cambodia rural electrification enterprises: Incentives for efficiency.
available through the Rural Electrification Fund (REF) to encourage REE mergers and for network expansion and small scale power projects.

3.27 It is understood that the RGC has so far not adopted or published the intended private power policy paper. Such a paper will form the cornerstone of RGC’s Energy Sector Strategy. It would clearly establish a level playing field for private participation and ensure transparency in private procurement at least cost.

3.28 While both CPSS and the Electricity Law created a long term vision of an unbundled electricity market structure with a TRANSCO, a system operator and a competitive wholesale market, such a transformation is unlikely to come about within the next five to ten years, for some of the following reasons:

- Neither a clear policy has been defined nor a road map charted to achieve this structure;
- While it is planned that EDC’s role of generator will diminish, a time limit has not been specified for terminating its generation license;
- It is not clear whether EDC will continue or cease to perform as a distributor (currently EDC is slated to take over distribution in an increasing number of provincial towns), or whether EDC would be the choice for the prospective TRANSCO.

3.29 The key question is how to move to the envisaged market structure suitable for Cambodia. The policy uncertainties are understandable given that the main HV/EHV transmission backbone will take several years to assume any significant proportions. Further, construction of the MV (and to a limited extent the LV) distribution networks in the heart of the provincial towns could be achieved by EDC at much higher technical standards than by private distributors, and these well-constructed networks could always be leased out at a later date to private distributors when it is decided to eliminate distribution from EDC’s portfolio. However, being an important component of Cambodia’s energy strategy, it is imperative that RGC articulates in clear terms its policy and timeframe for the evolution of the contemplated power industry structure, so that steps taken in the near- to medium-term (such as, for example, the organizational restructuring of EDC) are in harmony with the ultimate distant goal.

3.30 In the five years since the CPSS, EDC has made tremendous strides in its operations, through commendable efforts of RGC, EDC management and staff, and support from IDA, ADB and other donors. There have been notable achievements over this period. For example, sales have more than doubled, with an average annual growth rate of about 14 percent (the customer base has also almost doubled). Assets have increased by about 50 percent. The distribution networks in Phnom Penh and about 12 provincial towns have been rehabilitated and reinforced (and this activity is still ongoing). Distribution losses have consequently progressively decreased from 25.4 percent in 1999 to 12.7 percent in 2003, which is a remarkable achievement by any standard. Reasonably cost power imports from Vietnam have commenced at MV in the border areas. The terms for bulk power purchases at HV/EHV from Vietnam and Thailand have been negotiated. A 220 kV line from Vietnam to Phnom Penh now figures in ADB’s ongoing power credit, while a contract has just been negotiated (albeit on a non-competitive basis) for transmitting power from Thailand at 115kV to the provinces of Battambang.

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9 The Bank itself has not endorsed the contents of the proposed private policy paper. IDA has, however, drawn from the PPIAF reports in the design of the RE&T project, especially on rural electrification.
10 See footnote #2.
Bang, Banteay Meanchai and Siem Reap. EDC has taken over distribution in six provincial towns and expects to add seven more towns in the next couple years. EDC is poised to meet a demand growth of about 12 percent per annum over the next five years. EDC’s staff strength has increased by about ten percent. With an ADB grant in 2000, a training center was built in Phnom Penh and several hundreds of staff members have received training in various fields. With ongoing support from donors, EDC’s management systems have undergone considerable strengthening.

3.31 **Despite the success, a list of issues requires attention.** They include the following:

a) **Still weak financial position.** While the financial position of EDC has improved from “near bankruptcy” to “almost break even”, it continues to remain precarious due to: (i) non-shielding of EDC from import fuel prices and currency fluctuations, which RGC does not allow to be indexed in the tariff; (ii) large payment arrears especially from government offices; and (iii) while EDC pays VAT on its power purchases, it is not allowed to pass this on to consumers in its electricity bills, thereby subsidizing consumers at the expense of EDC.

b) **High power generation costs.** This is primarily due to: (i) a lingering stock of non-competitively bid high-priced IPPs from the early-years; (ii) an inefficient stock of EDC’s own diesel generation plant, many of which work on expensive diesel oil; (iii) recent steep increases in international fuel oil prices; and (iv) a high level of duties and taxes levied by RGC on fuel. Remedial measures proposed by EDC include: (i) procurement of fuel on the basis of competitive bids; (ii) conversion of plants running on diesel to cheaper heavy fuel oil (HFO); (iii) installation of new competitively bid IPP plants to substitute costly generation from EDC’s plants and meet “pent up” demand; and (iv) renegotiating with existing IPPs to reduce power off-take once new IPPs start operating, which is a legally onerous task. It is not clear how far or fast this will improve the financial health of EDC.

c) **Still significant distribution losses.** With distribution losses decreased to 12.7 percent (well below levels agreed with IDA under the ongoing RET credit), a complacency to take further measures to reduce losses may develop. EDC does not appear to have a plan for further reduction of losses. It is understood to implement a non-technical loss reduction program by improving metering, setting targets for each branch and arranging to maintain power load factors at each substation.

3.32 **While EDC enjoys considerable operational management autonomy and has achieved a measure of financial autonomy, in as much as it does not receive any budgetary support from RGC, it is still subject to substantial control by MIME, which is its part owner.** It was contemplated in the CPSS that EDC would be regulated through a performance based contract with MIME; however, this has not been achieved, except in a rudimentary manner through a sparse monthly report to MIME. Likewise, the suggestion in the CPSS to create a strategic partnership with a foreign electricity utility has been discarded as the cost of such an arrangement (pursued with Electricité de France) was found to be relatively high. Such an arrangement is unnecessary now and need not be pursued.

3.33 **Key elements of the commercialization of EDC are the following:**

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11 The issues regarding arrears and VAT are addressed under IDA’s RET credit and the situation is expected to improve with RGC taking specific actions.
• Increasing the financial strength of EDC to a level that enables it to raise its own finances on favorable terms;

• Improving the overall performance of EDC through pragmatic performance contracting that tightens EDC’s operational efficiency; later regulating it through EAC;

• Rationalizing tariffs through fuel adjustment clauses, etc., to levels that enable EDC to not only break even but also to finance a reasonable portion, perhaps 15 percent, of its investment program;

• Expanding EAC’s role to tariff setting and in utility regulation; and

• Creating a more arms-length operation from MIME to set it on the path to restructuring and even privatization when the time is appropriate.

3.34 A prelude to these actions should be a clear articulation of RGC policy on the role that EDC will operate, perhaps, five to ten years from now; and based on this policy, a formulation of internal restructuring that would create “cost” and “profit” centers within EDC. Related to this, a “holistic” and timely review of EDC’s operations and operational efficiency, systems and procedures, human resource development (setting of comparative benchmarks) is an imperative step to formulating the energy strategy.

3.35 A holistic planning framework for electricity growth subsumes a series of activities, all of which contribute to the orderly development of the power sector, with the overarching objective of increasing electricity supplies to enhance the country’s economic and social development, in the most cost-effective manner. The menu of key complementary development options available to the planner may be classified under a series of five “master plans,” which taken as a whole constitute important cornerstones of Cambodia’s energy strategy. They are as follows:

a) Master plan for development of the national HV/EHV grid and the associated generation sources

Until such time Cambodia develops a reasonable HV/EHV transmission network that—(i) enables exploitation of economies of scale in regard to type and location of generation; and (ii) facilitates import of low cost power from and eventually export of large scale “hydro” power to neighboring countries, Vietnam and Laos—it will not be able to achieve significant reduction in electricity costs.12

While power development planning in countries which have mature grids and adequate planning expertise is relatively straightforward, Cambodia faces two challenges: (i) demand forecasting, and (ii) planning tools and planning capability.

Demand forecast. The rate at which the grid can economically expand or replacement of local diesel-based generation justified, depends on how fast the demand grows. In Cambodia, due to the high costs of electricity, there will be a large pent-up demand and possibility of switch-

12 The key document that underpins power development planning in Cambodia is “Power Transmission Master Plan and Rural Electrification Strategy (KH-SE-45254)” by HECEC Australia Pty. Ltd., June 1998. The most recent document that lays out development plans for generation and transmission is “Cambodia energy sector strategy”, a draft, MIME, 2004. This document needs updating.
over from captive generation to the grid. In Phnom Penh, there is high potential demand for own generators for hotels and factories, whose capacity is estimated to be almost same as the total capacity of EDC. This potential demand will become obvious once the imports from Vietnam are commissioned. Demand forecast should take these kinds of factors into consideration. What is thus required as a key planning tool is a rigorous demand forecasting capability; in fact, an institutionalizing of this activity.

Planning tools and planning capability. Past consulting exercises in power development planning have resulted in plans but have resulted in hardware and software tools or adequately trained staff in system planning. The terms of reference for a consulting study (under IDA funded RETP) to install appropriate planning hardware and software, train MIME and EDC staff in its use, and assist them to develop a master plan is provided in Annex 1. Further, this study (under Japanese PHRD funds administered by IDA) will also prepare urgent investment components for priority cross-border transmission projects linked with power imports from Vietnam and Lao PDR and pre-feasibility studies of two priority hydropower projects in Cambodia.

b) Master Plan for hydropower development

For a meaningful formulation of the power development plan, a key input is a reasonably accurate cost to develop the hydropower projects, which in turn requires fairly expensive pre-feasibility studies to be carried out. The theoretical hydropower potential of Cambodia is estimated at 10,000 MW, 50 percent of which is in the Mekong River basin, on the Mekong mainstream and its tributaries. The realistically exploitable potential in the mid- to long-term, for which desk studies support, ranges from about 1,900 MW and 9,000 Gwh p.a. to about 4,700 MW and 21,000 Gwh p.a., depending on the scale of development of Sambor Hydro. Following the recent rehabilitation of the Kirirom I project (12 MW), five other hydropower projects are being considered for priority development (for domestic supply). These are the Battambang I (24 MW), Battambang II (36 MW), Stung Russei Chrum (125 MW), Stun Atay (100 MW) and Kiriron III (13 MW). Most of the identified projects have been studied at desk/reconnaissance level and are not ready for implementation in the short term. The terms of reference for the hydro master plan (Annex 2) cover: (i) project ranking (after upgrading the potential hydropower projects to pre-feasibility level); (ii) development of models for hydropower preparation and financing (public/private); (iii) transfer of technology and training; and (iv) advice and overall supervision of hydropower work in Cambodia.

c) Master plan for reducing distribution losses (technical and non-technical)

Reduction of losses is effectively the creation of a generation source. While losses have been reduced from the highs of 30 percent to about 12.7 percent today, loss reduction should continue to be an ongoing activity and a master plan document should be formulated.\textsuperscript{13} As the demand for electricity grows, losses will increase, unless commensurate measures are taken to strengthen the distribution networks, especially in Phnom Penh. Further, a cost-benefit analysis should be undertaken to assess the point at which the cost of incremental investments equals the benefit of reduced losses, as a guide to distribution network development.

\textsuperscript{13} While cross country comparisons may not be rational, due to different customer and geographical characteristics, it would be informative to note that the distribution losses of PEA (the provincial electricity distributor in Thailand) are below 6%. EDC’s efforts towards further reduction in losses to economically achievable levels are thus warranted. Growing demand can increase losses if appropriate and timely network reinforcements are not made, especially when demand comes from low level domestic consumers.
d) Master plan for reducing costs of diesel generation

While the transmission grid evolves in the medium- to long-term, and until such time that more cost effective large-scale domestic generation sources and low-cost electricity imports are available, Cambodia must rely on diesel/HFO based generation in the near- to medium term. As noted earlier, EDC is making efforts to reduce costs; however, it is still imperative to create a master plan for generation cost reduction, which will serve as one of the underpinning documents of the energy sector strategy.

e) Master plan for demand side management and efficiency improvement (DSM)

While supply side efficiency improvement appears to yield “tangible” benefits, more “cost-effective” benefits could result from investments in DSM. No energy strategy would be complete without a master plan for DSM and the foundation for this is being formulated under the IDA funded RETP.

3.35 Average electricity tariffs are very high by international standards, exceeding 500 Riels or USc 12.5/kwh. This is ultimately due to the very high cost of imported fuel, mainly, diesel and heavy fuel oil, the high cost of purchases from old IPPs, inefficient generation plant, heavy taxes on imported fuel, and high distribution losses, all of which have to be recovered from the consumer.

3.36 The tariff structure is one in effect that the industrial and commercial consumers cross-subsidize domestic consumers. Partly because of this and partly because of supply security concerns, most high-volume consumers, especially hotels, have installed their own generators, which has resulted in a loss of some of the highest demand consumers. It is no surprise that domestic consumption in Phnom Penh is almost 140 percent of the industrial plus commercial consumption. The large number of low level domestic consumers is also conducive to high distribution losses (approaching the characteristic of rural electrification).

3.37 The lifeline rate of 350 Riels or USc 8.75/kwh appears to be low as the affordability threshold for poor sections of the society could be around USc 16/kwh. However, there seems to be no reason this cannot be a preliminary rate for those who have higher consumption levels. The regressive industrial/commercial tariff may be justifiable from economic pricing considerations, but it could be counterproductive to electricity conservation goals. The domestic tariff structure is progressive (increasing with higher levels of consumption) which should encourage conservation. The tariffs are flat rates and do not reflect costs of supply during peak/off peak periods; the daily load curve is comparatively flat.

3.38 EDC’s tariffs were increased overall by about 39 percent in February 1999. These increases were borne by commercial/industrial customers whose rates went up nearly 90 percent and by Government agencies whose tariffs doubled. Meanwhile, residential users’ rates were unchanged. Prices for residential use have declined in terms of US cents since 1995 from about USc 13/kWh to below USc 10/kWh at the end of 1999. Many others consumers have experienced sharp reductions as a result of the termination of franchises of most of the wholesalers (who had charged much higher rates to their customers). In the tariff revision of 2000, the tariff for domestic consumers was increased and the tariff for industrial and commercial

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14 A social assessment prepared by F.H. Braun (Fichtner) in March 2000 for ADB’s TA 3256-CAM concluded that affordable electricity should not cost more than Riels 600/kWh or about USc 16 based on monthly household consumption of 30 kWh.
consumers decreased. Since 2000, there have been no changes in the tariffs in Phnom Penh. As indicated earlier, EAC is now reviewing EDC tariffs for Phnom Penh and Kandal Province, and changes in the tariffs are expected as a result of the review.

3.39 Further review of tariffs, especially in Phnom Penh, is necessary, and it should take into consideration the following broad guidelines:

a. Tariffs should ensure financial viability of EDC, and allow for a reasonable level of self financing;

b. In regard to domestic tariff, the lifeline rate should be set considering affordability, which may be higher than expected. Further, there seems to be no reason to afford the lifeline rate as a first-slab rate to those who have higher consumption levels.

c. Any major reduction in the industrial and commercial tariff, should be in synch with a reduction in generation costs (new low price IPPs and import from Vietnam); improved system reliability (through network strengthening); and availability of adequate generation to avert black outs.

d. Tariffs should not only be based on economic principles related to costs of supply, but also foster electricity conservation. The introduction of two part (demand and energy) tariffs and time-of-use tariffs for large consumers should be considered.

e. The vision of uniform EDC tariffs throughout Cambodia should be shelved until an HV/EHV grid is established. The current policy which links tariffs to the costs of supply (a pre-eminent requirement in the recent tariff sub-decree) is a step in the right direction.

f. The impact of reduction in taxes on fuel should be evaluated carefully, weighing the negative consequences of loss of revenue vis-à-vis benefits of higher economic growth due to increased levels of electricity consumption (especially in the productive industrial and commercial sectors).

Greater Mekong sub-region (GMS)

3.40 Interconnecting with neighboring countries Laos, Thailand and Vietnam, which is a key ingredient of the GMS strategy, is an important consideration for Cambodia’s overall planning process. Beginning with cross border exchanges with Thailand and Vietnam, already occurring at a 22kV level, there are plans for the import at 115 kV level from Laos and Thailand (the former under Bank’s GMS initiative and the latter being directly negotiated with a private provider), subsequently to be stepped up to 220 kV level with Vietnam supplying power to Phnom Penh under an ADB Credit, escalating to the 500 kV level in the long run when large hydropower plants are developed in Cambodia.

IMPORTED FUEL AND ELECTRICITY GENERATION

3.41 Cambodia is highly dependent on commercial energy imports. It imports all its fuel supplies from Thailand and Singapore markets. Principal fuels imported are motor gasoline, kerosene, diesel oil (both as automotive fuel as well as for power generation), and heavy fuel oil (almost exclusively for power generation).
3.42 A recent IMF study found that imported petroleum products for 1994-2003 reached 750,000 tons in 2001. The records obtained from the government suggest imports nearly doubled between 1994 and 2003. The volume increased by an average 9.5 percent annually during the period. Diesel imports grew by 13.5 percent annually, but declined from the peak in 2001. Kerosene and fuel oil import rose by an average of 20 percent per annum.

3.43 Fuel oil imports have increased on average by 22 percent annually since 1995. In 2003, fuel oil imports amounted to 72,000 tons, or one-fifth of total petroleum imports.

Tax Structure for Imported Oil and Petroleum Products

3.44 Since 1994, tax on imported oil or petroleum products has been imposed by the Government. This includes (i) an import duty tariff, (ii) a consumption tax, and (iii) a military tax. The IMF study notes:

a) Rates have risen considerably since then: excises were introduced on gasoline in 1995 and a number of changes adopted in subsequent years. For gasoline, the import duty was raised from 45 percent to 50 percent in 1995 and then reduced to 35 percent on July 1, 2001.

b) The four percent consumption tax was converted into a VAT at ten percent in 1999 and was levied on import values inclusive of import duty and excises. The conversion of the consumption tax to a VAT provided relief to exporting firms who were eligible for a refund.

c) The excise on gasoline products was raised in 2001 to compensate for the reduction in the import duty. A similar pattern was followed for diesel on which import duties were reduced in July 2001 and, to compensate, the excise was raised. Only VAT was levied on kerosene until 2004 when an import duty and excise were introduced.

3.45 As a result of a high import tariff, Cambodia’s market prices of fuel are much higher than in neighboring countries that also import fuels. Table 3.6 illustrates the fuel prices in the ASEAN countries, studied by the German Agency for Technical Cooperation (GTZ) in the first quarter of 2005, which also found that Cambodia’s fuel taxation is a major national budget contributor.
Table 3.6: Retail Fuel Prices in ASEAN Countries
(Prices in US cents per liter at filling stations)

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<td>28</td>
<td>10</td>
</tr>
<tr>
<td>Timor Leste</td>
<td>65</td>
<td>65</td>
<td>65</td>
<td>65</td>
<td>65</td>
<td>65</td>
<td>65</td>
<td>12</td>
<td>12</td>
<td>28</td>
<td>10</td>
</tr>
</tbody>
</table>

(Source: GTZ)

3.46 RGC’s policy of collecting revenues by imposing high import tariffs and taxes on fuel has raised prices and reduced electricity demand. And this policy requires careful analysis by estimating the revenues that government might be able to collect if the taxes are imposed on the consumption side instead of the supply side.

Electricity generation

3.47 According to EAC, the regulator, electricity is being generated by the following: (i) the independent power producer(s) who have generation licenses and sell electricity to a supplier through a power purchase agreement, and (ii) the supplier who has consolidated license and supply electricity through its distribution system (EDC and others). As of December 2003, 85 licenses have been issued by EAC. They include:

- One consolidated license consisting of generation, transmission and distribution;
- Eight generation licenses
- Seven distribution licenses
- Sixty-nine consolidated licenses consisting of generation and distribution

3.48 The proportion of the in-country electricity power generation is recorded as 89 percent of electric power as generated by diesel/HFO power plants, five percent by steam (burn HFO) power plants and six percent by hydropower plants, or 94 percent of electricity power is generated from DO/HFO power plans.
Electricity costs versus levies

3.49 The power plant used for analysis is EDC’s power plant No. C6, considered a high efficiency plant. It uses about 0.2683 liter per kilowatt-hour (DO) and 0.2506 liter per kilowatt-hour (HFO). The analysis has been done for various scenarios of imported duties, as follows: (i) Case one with the current tax structure, (ii) Case two with no import tax imposed on fuel oil for power generation, (iii) Case three with no import tax and VAT imposed on fuel oil for power generation, and (iv) Case four with no import tax and VAT, interest deferred and other charges imposed on fuel oil for power generation. As a result, the average cost of case one, USc 9.42/Kwh, case two, USc 8.46/Kwh, case three, USc 8.20/Kwh, and case four, USc 7.86/Kwh.

FACTORS INFLUENCING ELECTRICITY COSTS

3.50 Apart from high international fuel prices, there are other factors influencing electric power generation costs. They include (a) high tariffs imposed on imported oil and petroleum products; (b) poor efficiency of power plants; and (c) non-competitive deals with IPPs.

High tariffs imposed on imported oil and petroleum products

3.51 As approximately 94 percent of electricity power is generated from DO/HFO power plants, the elevated tariff imposed on imported oil and petroleum products has contributed to high electricity costs. With the current international oil price and Cambodia’s current tax structure, the electric power generation costs at the power plants range approximately from USc 6.64 to USc 11.07 per kilowatt-hour and more. EDC’s average generation cost at the power plant is USc 9.42 per kilowatt-hour.

3.52 Aside from the tax, VAT and other government charges, the EDC interest deferred charges have added noticeably to the electricity costs. Tables 3.7 and 3.8 below illustrate the current tax structure’s impact on fuel oil on EDC.

<table>
<thead>
<tr>
<th>Table 3.7: Heavy Fuel Oil (HFO) Price Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HFO</strong></td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>ICBP</td>
</tr>
<tr>
<td>HFO-SF</td>
</tr>
<tr>
<td>Transport &amp; Insurance</td>
</tr>
<tr>
<td>Subtotal</td>
</tr>
<tr>
<td>Import Duty (7%) **/</td>
</tr>
<tr>
<td>Contribution to Army</td>
</tr>
<tr>
<td>Price Excluding VAT</td>
</tr>
<tr>
<td>VAT (10%)</td>
</tr>
<tr>
<td><strong>Price Including VAT</strong></td>
</tr>
</tbody>
</table>

Note: */ International crude oil price X 6.763 (conversion factor) **/ based on reference price, Source EDC
Table 3.8: Diesel Oil (DO) Price Structure

<table>
<thead>
<tr>
<th>LDO</th>
<th>Unit</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$/bbl</td>
<td>27.00</td>
<td>23.00</td>
<td>25.00</td>
<td>30.00</td>
<td>30.00</td>
</tr>
<tr>
<td>LDO-Singapore FOB */</td>
<td>$/ton</td>
<td>223.87</td>
<td>196.63</td>
<td>210.25</td>
<td>244.30</td>
<td>244.30</td>
</tr>
<tr>
<td></td>
<td>$/ton</td>
<td>20.00</td>
<td>20.00</td>
<td>20.00</td>
<td>20.00</td>
<td>20.00</td>
</tr>
<tr>
<td>Insurance 0.5%</td>
<td>$/ton</td>
<td>1.22</td>
<td>1.08</td>
<td>1.15</td>
<td>1.32</td>
<td>1.32</td>
</tr>
<tr>
<td></td>
<td>$/ton</td>
<td>25.00</td>
<td>25.00</td>
<td>25.00</td>
<td>25.00</td>
<td>25.00</td>
</tr>
<tr>
<td>Sea Freight</td>
<td>$/ton</td>
<td>2.70</td>
<td>2.43</td>
<td>2.56</td>
<td>2.91</td>
<td>2.91</td>
</tr>
<tr>
<td></td>
<td>$/ton</td>
<td>56.40</td>
<td>56.40</td>
<td>56.40</td>
<td>56.40</td>
<td>56.40</td>
</tr>
<tr>
<td>Bank Fee 1%</td>
<td>$/ton</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$/ton</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excise (Import) Tax</td>
<td>$/ton</td>
<td>20.00</td>
<td>20.00</td>
<td>20.00</td>
<td>20.00</td>
<td>20.00</td>
</tr>
<tr>
<td></td>
<td>$/ton</td>
<td>2.70</td>
<td>2.43</td>
<td>2.56</td>
<td>2.91</td>
<td>2.91</td>
</tr>
<tr>
<td></td>
<td>$/ton</td>
<td>56.40</td>
<td>56.40</td>
<td>56.40</td>
<td>56.40</td>
<td>56.40</td>
</tr>
<tr>
<td>Subtotal</td>
<td>$/ton</td>
<td>329.19</td>
<td>301.51</td>
<td>315.37</td>
<td>349.93</td>
<td>349.93</td>
</tr>
<tr>
<td>Evaporation Loss</td>
<td>$/ton</td>
<td>4.94</td>
<td>4.52</td>
<td>4.73</td>
<td>5.25</td>
<td>5.25</td>
</tr>
<tr>
<td></td>
<td>$/ton</td>
<td>10.00</td>
<td>10.00</td>
<td>10.00</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>Road Freight to Power Plants</td>
<td>$/ton</td>
<td>32.92</td>
<td>30.15</td>
<td>31.54</td>
<td>34.99</td>
<td>34.99</td>
</tr>
<tr>
<td></td>
<td>$/ton</td>
<td>377.05</td>
<td>346.22</td>
<td>361.63</td>
<td>400.17</td>
<td>400.17</td>
</tr>
<tr>
<td>Total Delivered Price</td>
<td>$/ton</td>
<td>16.97</td>
<td>15.58</td>
<td>16.27</td>
<td>18.01</td>
<td>18.01</td>
</tr>
<tr>
<td></td>
<td>$/ton</td>
<td>3.94</td>
<td>3.62</td>
<td>3.78</td>
<td>4.18</td>
<td>4.18</td>
</tr>
<tr>
<td>Interest Deferred Payment 4.5%</td>
<td>$/ton</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$/ton</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gov’t Charge 1%</td>
<td>$/ton</td>
<td>397.95</td>
<td>365.42</td>
<td>381.68</td>
<td>422.36</td>
<td>422.36</td>
</tr>
<tr>
<td></td>
<td>$/ton</td>
<td>0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price Excluding VAT</td>
<td>$/ton</td>
<td>397.95</td>
<td>365.42</td>
<td>381.68</td>
<td>422.36</td>
<td>422.36</td>
</tr>
<tr>
<td></td>
<td>$/ton</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAT</td>
<td>$/ton</td>
<td>397.95</td>
<td>365.42</td>
<td>381.68</td>
<td>422.36</td>
<td>422.36</td>
</tr>
<tr>
<td></td>
<td>$/ton</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.53 The analysis of import levies on fuel oil shows that the electricity costs can be trimmed substantially by removing VAT, duties and other charges currently imposed on fuel oil for power generation.

Efficiency of power plants

3.54 Some of the current on-duty EDC power plants have been commissioned since 1967 and 1973 and are not well maintained. According to EDC’s latest statistics, capacity factors and efficiencies of the power plants vary from 24.70 percent to 50.8 percent and from 0.2506 l/kWh to 0.4251 l/kWh, respectively. Based on current international oil prices, electric power generation costs of these power plants are remarkably high, about US$ 11.27 per kilowatt-hour (HFO), compared to the newly installed, similar capacity power plants’ cost US$ 6.64 (HFO). There is, therefore, an urgent need to improve efficiency of the power plants and meet international standards for new power plant installations.

Non-competitive deals with the IPPs

3.55 The IPPs are a major source of electric power generation. The group generated 76 percent of required electric power or 476.1 million kWh in 2003. Almost all existing IPPs were directly negotiated without going through a transparent, competitive process. These IPP’s are extremely expensive deals, and pass the high costs of electricity to end users. Table 3.9 below highlights negotiated production costs of selected IPPs in 2003, and the high tariffs ranging from US$ 12.46 to 17.73 per kilowatt-hour. Lack of open competition in power generation and transmission seriously undermines the principle of least-cost supply, the foundation for encouraging private investment, and the enforceability of regulatory decisions.

---

15 Source EDC
16 Source: Report on Power Sector on the Kingdom of Cambodia for the year 2003, EAC.
17 The Government very recently announced that a competitive process will be adopted to secure the next power generation contract for Phnom Penh.
Table 3.9: Electricity production cost in 2003 of selected IPPs

<table>
<thead>
<tr>
<th>IPP Name</th>
<th>Average (negotiated) production cost in 2003 (US Cent/kwh)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Aver Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec</td>
</tr>
<tr>
<td>CETIC, Kirirom*</td>
<td>7.00 7.00 7.00 7.00 7.00 7.00 7.00 7.00 7.00 7.00 7.00 7.00 7.00</td>
</tr>
<tr>
<td>Jupiter, Pursat</td>
<td>17.48 16.86 17.54 18.73 19.22 16.96 16.72 16.81 16.75 17.53 17.48 17.5 17.73</td>
</tr>
<tr>
<td>Jupiter, Kg. Chhnang</td>
<td>17.48 16.86 17.54 18.73 19.22 16.96 16.72 16.81 16.75 17.53 17.48 17.5 17.73</td>
</tr>
<tr>
<td>GTS, Kg. Cham</td>
<td>15.23 15.01 15.44 16.39 16.11 14.67 14.5 14.56 14.6 15.24 15.24 15.26 15.76</td>
</tr>
<tr>
<td>GPS, Prey Veng</td>
<td>16.00 16.00 16.00 16.00 16.00 16.00 16.00 16.00 16.00 16.00 16.00 16.00 16.00</td>
</tr>
</tbody>
</table>

(Source: Electricity Authority of Cambodia, * Hydropower plant)

Thus, there is an urgent need to address the non-competitively bid deals with IPPs either through renegotiation of tariffs or phasing out the plants.

**OVERALL ACTIONS TO REDUCE ELECTRICITY COSTS**

3.56 Under debate is whether the heavy fuel levy should be reduced or eliminated as one way to reduce costs of electricity. The heavy levy does have an impact on the power sector, directly through costs passed through to users, and indirectly through the fuel smuggling, a last resort by captive generators, thus reducing the demand for EDC services. It is simplistic to state that the high costs of electricity should be reduced by reducing the heavy levy on fuel oil. The analysis in the previous chapter shows that abolishing levies will reduce the cost of diesel fuel generation in Cambodia by about 16.5 percent. However, this will also result in a sizable loss of revenue to the Government. Unless this loss of revenue results in commensurate if not higher gains in economic and social development of the country, it is counterproductive. A cost benefit analysis of this aspect needs to be made (a complicated modeling) before any decision is made on reducing taxes and duties on fuel oil. It is more important to consider such a fiscal decision within the broad tax reform policy context.

3.57 The question of reducing electricity costs should be viewed in a holistic framework whose key constituents (which contributes to reduction in losses) will be as outlined below. There are no quick fixes to this issue.

**Short term actions**

a) **Electricity tariffs**: Electricity tariff policy is one tool to control losses and wasteful consumption. As discussed in Chapter 3, the tariff policy needs to be reviewed, to encourage industrial and commercial use and discourage domestic use (with lifeline protection for the weaker sections of the society). Proliferation of domestic consumers, out of sync with commercial and industrial consumers, would result in increase in distribution losses. Also, initiatives to increase electricity consumption, when adequate reserves of generation are not available, could be disastrous.

b) **Reduction of distribution losses**: While commendable progress has been made in reducing distribution losses to about 12.5 percent, there is no reason why the losses cannot be reduced to, for example, 10 percent. A cost benefit analysis of distribution
investments vis-à-vis a gain in efficiency is needed as also a master plan for loss reduction (technical and non-technical).

c) Improving the overall efficiency of diesel fuel generation: A master plan that comprises a time-bound series of actions (comprising inter alia replacement of old inefficient sets, fuel substitution from LDO to HFO, procurement of new IPPs at low cost through competition, etc.) will help contribute significantly to cost reduction.

d) Improving the efficiency of EDC’s operations: A master plan to improve EDC’s operational efficiency in all fields (in particular, improved fuel procurement practices, better plant maintenance, and higher efficiency of manpower utilization) would make a useful contribution to electricity cost reduction.

Medium term measures

3.58 As indicated in Chapter 3, significant reduction in electricity costs will accrue only when Cambodia accomplishes the following: (i) has established a reasonable HV/EHV network that enables exploitation of economies of scale and advantages of site in generation planning. Finalization of a master plan for power development and a master plan for hydropower development are key steps towards achieving this goal; (ii) has explored all avenues for and established power imports at low cost from the neighboring countries Thailand and Vietnam.

3.59 Institution of a master plan for demand side management and improving the efficiency of electricity consumption would be an effective demand-side response to reducing electricity costs.

Long term measures

3.60 In the long term, exploitation of the large hydropower potential for export would earn significant revenues, enhance the overall financial viability of the power sector, and secure cost relief for consumers in Cambodia. Moreover, hydropower has other attractive features: It is a renewable resource that is not affected by oil prices. As a domestic energy resource, it would contribute to energy security. It is a significant part of the optimal energy mix, when well developed.

The power sector in the context of GMS power trade

3.61 Cambodia has gone through some very difficult years of electric power shortages. With donor assistance and private sector participation, RGC has managed to provide only the very basic electricity services to the main load centers. The supply capacity is way below the rapidly growing demand. Electricity prices remain among the highest and electrification rate among the lowest in east Asia. The small size of the markets also makes it difficult to achieve economies of scale in power generation, which is a key factor in production costs. By taking advantage of the Greater Mekong Subregional (GMS) power trade initiatives, RGC is securing power supplies from Vietnam and Thailand. The supply situation is expected to improve markedly in the next two to three years.

3.62 Currently, RGC is taking a forward-looking view and contemplating the development of large power plants, through private sector participation, to supply markets in both Cambodia and neighboring countries. This will be a major change, from the current approach that chases demand one small step at a time, to a bold approach that takes advantage of
opportunities created by the GMS power trade market. While this idea is consistent with the GMS power trade concept, there is important groundwork RGC needs to undertake in the near future to move into this new business development model:

- First, the thinking needs to be carefully aligned with the national power development master plan and the GMS power trade development framework.

- Second, RGC needs to adopt private participation policies and procedures that are transparent, competitive and consistent with international practices.

- Third, RGC should begin to develop national environmental and social safeguard policies and procedures and build capacity in line with international good practices.
Chapter 4.

RURAL ELECTRIFICATION AND RENEWABLE ENERGY

INTRODUCTION

4.1 About 85 percent of Cambodia’s population of 13.5 million lives in rural areas. Only about six percent of Cambodia’s rural households have access to a supply of electricity, of which two percent through EDC (which hopes to connect an additional 50,000 customers in the next six years) and four percent though REEs (an estimated 600 privately operated mini-grids serve between 60,000 and 100,000 rural customers).18 Another three percent have some type of individual power generating unit. The remaining 91 percent of the rural population either use automobile batteries (costing US$2-3.5/kWh) for occasional and limited use or have absolutely no electricity. In order to increase access to electricity in the rural areas, the Government plans to increase coverage from about ten percent today to 70 percent by 2030, largely through improving the enabling environment for REEs and fostering use of renewable energy.

RURAL ELECTRIFICATION

4.2 In order to achieve this significant increase in rural access, both grid extension as well as off-grid/mini-grid options including renewable energy will need to be judiciously utilized. The existing roughly 600 rural electric enterprises (REEs) provide a possible private sector-led framework for developing local systems. To make significant contributions to Cambodia’s rural electrification goals, however, the REEs must expand their scale of operations significantly and reduce costs and prices, all of which are interrelated. Renewable energy technologies are environmentally benign and are modular in nature so that they could be competitively disseminated in remote and inaccessible areas. However, technological maturity varies across different renewable energy technologies (RET), and the potential is location-specific. Nonetheless, if the key barriers to large-scale promotion are addressed, RETs can become effective alternatives in Cambodia especially since rural people presently pay high prices for electricity services based on diesel and batteries.

EDC grid-extension

4.3 Currently, the extent of rural electrification through EDC grid extension is quite limited and covers only about two percent of the households. The areas selected for grid extensions will be those exhibiting among the highest levels of per capita income, population and load density, and where clearly the extension of EDC’s grid is the least cost option. The methodology for the final selection is based on the valuation of the cost per connection for each customer, based on the MV and LV length of the conductors selected, as well as the number of distribution transformers, isolating transformers, poles and meters. If the projected load for the next ten years is less than 500kVA, then a single wire earth return (SWER) is also possible. EDC hopes to connect approximately an additional 50,000 customers in the next six years.

4.4 The main criteria for the selection of the grid extension to rural areas are:

18 Numbers to be verified.
a) Expansion of the EDC grid to rural areas which are already provided with electricity by EDC, or under contractual arrangement with MIME, or areas which are not currently electrified; 

b) Villages within 40 km surrounding EDC’s distribution grid; 

c) Villages with reasonable access to roads, where there are populations already living along the road, for ease of installation, as well as operation and maintenance; 

d) Villages in which the population is ready to make a partial contribution to electrification and are able to pay their electricity bills; 

e) Villages that have development potential for agriculture, forestry, handicrafts, or other income generation opportunities 

f) Villages where investments in infrastructure and electrification will assist the Government programs for stopping internal migration, reducing nomadic farming and deforestation, or helping in the development of communes or villages; 

g) Villages within cost-effective reach of the grid, or cross-border points of supply.

4.5 Where possible, grid extension for rural electrification is the less expensive way to supply reliable services to rural areas. The question is how to promote more and faster grid extension. Currently, EDC’s rural electrification program is financially supported by ADB and the World Bank. Expectations are high for the agencies to help scale up the program.

Rural electric enterprises (REEs)

4.6 In Cambodia, isolated mini-grids are the predominant service model providing electricity service in rural areas. An estimated 600 privately operated mini-grids serve between 60,000 and 100,000 rural customers. The existing roughly 600 REEs provide a possible private sector-led framework for developing local mini-grid systems.

4.7 To make significant contribution to Cambodia’s rural electrification goals, however, the REEs must significantly expand their scale of operations and reduce costs and prices, all of which are interrelated. Many REEs are having difficulties accomplishing this. REEs face problems of low quality, low connections and high tariffs. Though at present REEs are operating commercially, their very high tariffs (average of USc 51/kWh) severely constrain access to rural consumers, particularly the poor. Setting affordable tariffs is a challenge. As Cambodia relies mainly on the private REEs to provide services in rural areas, the tariff should be set at the level to recover the full costs of service provision. Government subsidies for rural electrification, where justified, should be targeted to improving access instead of reducing tariff.

4.8 Lack of adequate technical capacity and use of sub-standard equipment also results in poor service standards. There are no incentives for growth of REE businesses, and economies of scale in service delivery are not being achieved. They remain small and scattered. Provision of public support for this rural program through technical assistance and co-financing grants will help REEs overcome these problems and establish businesses that have a built in incentive for growth and improved service delivery.
RENEWABLE ENERGY

Mini and micro hydro resources

4.9 Cambodia has good potential for mini\(^{19}\), micro\(^{20}\) and pico hydro technologies; however, total estimates are not available. Pre-feasibility studies undertaken by donors including the World Bank and Asian Development Assistance Facility (ADAF) of the New Zealand Government have resulted in a pipeline of about 12 mini-hydro and micro-hydro projects. Kampot, located on Cambodia’s southern ocean side, Kampong Cham in central Cambodia, Siem Reap to the north, and Ratnakiri in the east are some of the most suitable areas for micro, mini-hydro development. The studies indicate production costs in the range of US$ 0.03 - 0.06/kWh for mini-hydro projects, which are attractive where a grid is available. Currently, there are private developers from China who are actively pursuing mini-hydro development. Micro-hydro mini-grid projects have a much higher production cost (over US$0.2/kwh) as they include a distribution system and require substantial social mobilization efforts.

4.10 Future development of mini- and micro-hydro power plants would face some difficulties and constraints. For example, there is lack of knowledge on small water streams, feasible for mini- or micro-hydro plants. There is absence of pre-feasibility (or feasibility) studies, with little updated technical or financial data of different small-scale projects. The one-window operation on mini- and micro-hydro plants is absent, with unclear incentives for the private sector. All these difficulties and constraints need to be overcome.

Solar energy

4.11 Cambodia has a tropical climate with favorable conditions for solar energy. Temperature measurements conducted in Phnom Penh during 1981-88 indicate a range of 6.1 to 9.7 sunshine hours per day. A study undertaken by NEDO indicate a good source of stable solar radiation, with monthly average radiation ranging between 4.1 and 6.0 kwh per square meter (NEDO, 2002). NASA satellite data also indicated that average annual irradiation is 4.7 kwh per square meter in the lowest areas, 5.3 kwh per square meter per day in the high areas, and 5.0 kwh per square meter per day is an average over the country.

4.12 In sparsely-populated areas, a significant amount of capital investment is required for electrification by grid extension. In such areas, renewable energy is an option, of which solar energy can the most promising to electrify small, scattered villages and households. This is considered feasible for several reasons: High solar irradiation is almost uniformly available throughout the country. Unit size of the solar power system is flexible to match the varying level of demand (from one to 100 households). The design and installation can be standardized, and villages can take care of O&M, if initial training is provided. No equipment replacement is required for the first ten to 20 years.

4.13 Currently, Cambodia has solar photovoltaic (PV) installations amounting to more than 250 kWp. Almost 80 percent of the installations are on telecommunication repeater stations in remote areas of the country. According to the current JICA study, due to scope and scale of the power demand in the rural areas, the following three types of PV can be applied to Cambodia: (i) Solar BCS, (ii) SHS type (at public facilities), and (iii) hybrid system. The table below shows the BCS standard in supplying PV power to the households.

\(^{19}\) 300 kW to 5 MW
\(^{20}\) 50 kW to 300kW
Table 4.1: Number of Households capacity of Standard BCS

<table>
<thead>
<tr>
<th>Group</th>
<th>No. of HH to be covered</th>
<th>% of batteries to be charged by the system</th>
<th>No. battery to be charged each day</th>
<th>System Capacity</th>
<th>System cost (before tax)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>50Ah</td>
<td>70Ah</td>
<td>100Ah</td>
<td>Value</td>
</tr>
<tr>
<td>1</td>
<td>Up to 25</td>
<td>5</td>
<td>1</td>
<td>6,279</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>From 26 to 50</td>
<td>10</td>
<td>2</td>
<td>12,458</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>From 51 to 75</td>
<td>15</td>
<td>3</td>
<td>18,636</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>From 76 to 100</td>
<td>20</td>
<td>4</td>
<td>24,815</td>
<td></td>
</tr>
</tbody>
</table>

Source: JICA Study

4.14 Relative to expenditures incurred by rural households on batteries, a 50 Wp solar home system more than doubles the amount of useful electricity available to a rural household at a significantly higher level of convenience. Solar market assessments undertaken by the UNDP and the World Bank place the demand for solar home systems (SHS) between 250,000 and 450,000 systems (UNDP, 2002). Approximately 85 percent of the market appears to be in the 30-40 Wp systems, that offers the capacity to supply one or two lamps and a black/white TV.

4.15 Currently, three companies import and sell almost all solar products in Cambodia, including systems for telecommunications and solar home systems. They are Khmer Solar Company, Metrofield Engineering Co. Ltd and R.M Asia Ltd. In addition, several international PV manufacturers such as Photowatt, Shell (Siemens), Solarex, Unisolair and BP Solar have either a national or local presence. Selco, a regional solar PV company with operations in India, Sri Lanka and Vietnam is also considering Cambodia as a future market.

4.16 A number of issues should be considered to explore and develop solar energy in an economically feasible way. Few surveys have been conducted on sunshine and solar energy potential, and potential investors have little data upon which to base projects. So far, only donor-funded projects have been implemented, and there has been little attempt to internalize the experience. There is an upfront capital cost for use of solar energy by households, and no financial mechanisms have been developed by the Government to spread this cost. Even after meeting the upfront capital cost, the delivered cost of solar energy is higher than conventional electricity. No financial mechanism exists to offset or share the additional cost.

Wind power

4.17 Wind power is one of the options for rural electrification in the areas where wind potential is high and can be adopted where wind speed reaches 7m/s. The wind power system is very site-specific like micro-hydropower and the unit cost of small wind turbines is much higher than the large one. There are only a few observation stations for wind power in Cambodia, supported under a research project of NEDO. The project has installed one small (of a few hundred watts) wind turbine as a hybrid system in Kampot province; however, it is currently not operational. No further details on the wind power system installed by the NGOs or the private sector is available.

4.18 The country’s annual average wind speed at 50 meters high is around 3.5m/sec and at 20 meters is around 2.6m/sec. The wind speed is higher towards the eastern and southern regions and the maximum is around 4.6m/sec. When the wind data are converted to the required lower high wind, speed varies upon vegetation type on the ground, which is below required speed for system installation. Therefore, due to the insufficient surface wind data and pace of wind speed, the ongoing JICA master plan study for rural electrification by renewable energy excludes wind power from the master plan. It is difficult to locate the potential site for the generation. To
explore wind power there is a need to install surface wind data measuring stations at the high-speed mountainous and coastal areas.

4.19 **A regional wind analysis undertaken by the World Bank in 2001 indicates that Cambodia has relatively little potential for scalable wind power application except in coastal areas and islands in the southwest.** The NEDO study (2002) also indicates that most of Cambodia’s regions have an average wind velocity of under three m/s, and as a whole, the wind conditions are not very favorable, although there are a few areas with an average wind velocity of over five m/s. These include the southern Tonle Sap lake region located in central Cambodia, the mountain area in the southwest, and the southern coastal area. Sihanoukville has an annual average wind velocity of around five m/s, and a pilot wind power project is being considered. Wind home systems (WHS), which are micro-wind turbines suitable for household use, could also be explored in these areas.

4.20 **A number of issues will be encountered when the country moves forward to explore and develop wind energy.** Wind energy data for potential sites is not available, and for the few locations for which it has been available, it is not updated. Issues relating to inconsistent wind patterns, and having back-up diesel sets with high generation cost, and therefore, high delivered cost of electricity have not been analyzed, and no suitable technical and financial framework developed. Institutional arrangements for developing and operating wind energy plants do not exist.

**Biomass energy**

4.21 **Traditional biomass supplied by fuel-wood, charcoal and crop waste accounts for over 90 percent of the rural energy.** Around six million cubic meters of fuel-wood is produced annually in Cambodia (which theoretically can produce about 600 MW of power). The other major source of biomass is rice husk. Around 3.5 million tons of rice is produced annually, which generates about 0.5 million tons of rice husk. This has a theoretical potential of generating around 50 MW of power. Sugar cane is the other main crop in Cambodia with about 160,000 tons of sugarcane per year. Since most potential biomass resources are already used for other purposes, it will not be easy to harness them for electrical generation use. More details of biomass energy in Cambodia are in Annex 5.

4.22 **Considering biomass resources will continue to provide fuel supplies to a large proportion of the population, following issues merit urgent consideration:**

- Absence of the woody biomass and other vegetation by agro-ecological zones, and assessment of its sustainable production and regeneration

- Lack of information on consumption patterns of households by income groups (end-uses, monthly expenditure for purchased fuel, collection time, etc.), and preference scheme for fuel substitution (crop/animal residue, woody biomass, commercial fuels, etc.)

- Lack of knowledge on trading patterns and margins for commercially-traded biomass fuels

- Lack of information on sustainability of biomass supplies to meet demand, and ecological damage, if any
4.23 To date, biomass energy has received little attention in energy planning. A biomass policy and planning framework does not exist and is needed. The framework should consider both electric and thermal (cooking and industry) applications, as well as the planning, harvesting, transport, processing of biomass resources. A baseline study on biomass potential, supply, demand, consumption, incentives, technologies and sustainability is essential. This will help determine the current sources and supply sustainability and help to plan for options that maximize efficiency and long term sustainable supply. Technical standards should be developed for the construction, and operation of the device should be considered, to ensure the integrity and quality of plants used.

4.24 It is important to integrate biomass into the existing planning development processes (such as rural and community development plans, rural electrification plan, and national energy plan). All relevant ministries should be brought together, particularly MIME and the Forestry Administration. In the short term, the RGC should consider the implementation of pilot demonstration projects and undertake studies to identify financing schemes and the potential contribution from carbon finance and clean development management (CDM) initiatives.

Biogas

4.25 Since the 1970’s about 3,000 systems are known to have been constructed using a tubular type plastic digester, though no feedback is available on their performance and functionality. Cattle waste and pig waste are used for biogas production. The energy potential of biogas from recoverable animal wastes is estimated at 228 kilotons of oil equivalent per year. Currently, a new biogas program with support from the Dutch government is being launched. More details on biogas are discussed in Annex 5.

POLICY AND INSTITUTIONAL ISSUES

4.26 Given the key role that new and renewable resources could fill in meeting the energy needs of dispersed populations, the following policy, technical, financial, institutional and commercial issues need urgent attention:

- **Policy and legal framework:** The sub-sector policy and regulatory framework is fairly new and evolving, and needs support and strengthening. There is no renewable energy policy in Cambodia, although RGC has expressed its commitment to promote renewable energy for remote applications by adopting a ten-year Renewable Energy Action Plan (REAP).

- **Access to financing of renewable energy devices (which have high front-end costs):** The Cambodian banking system is relatively fragile, and operates mostly on short-term capital with high interest rates. Key deficiencies are (a) general shortage of capital; (b) lack of long term funds for REEs; (c) high administrative costs for servicing microfinance in rural areas; and (d) lack of legal framework to deal with collateral, bankruptcy, etc.

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• **Incentive mechanism for private sector investment:** Tax incentives for renewable energy equipment manufacturing would greatly assist the upfront cost differential of renewable energy products compared to standard fossil fuel plants. A standardized power purchase agreement would also help reduce legal/transaction costs, particularly for small rural renewable electricity systems.

• **Limited information on market characteristics and resource potential:** There is a lack of information on various renewable energy options and their costs and benefits. Efforts at information dissemination are feeble, and marketing of products non-existent. While there is adequate information available relating to solar energy, similar systematic assessments on resource and market potential need to be undertaken for hydro, wind and biomass energy resources also. Some of this work is planned under the ongoing World Bank-GEF project and by JICA.

• **Institutional capacity for planning, implementation and maintenance:** Management systems are weak in rural areas and technical know-how and maintenance skills are in short supply. Lack of coordination among concerned stakeholders (RGC, donors, NGOs, private sector, financial sector) also acts as an institutional barrier in the absence of a comprehensive policy on renewable energy development.

• **Public awareness and political support:** Presently, active support for renewable energy as well as REEs is not forthcoming from all the political powers, and there are few “champions” promoting the REEs and renewable energy. A recent development in this regard is the formation of the Renewable Energy Private Sector Association (REPSA), a renewable energy lobby group. However, a similar association does not exist for supporting REEs and championing their concerns.

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22Comment by EAC: “An association of REEs is welcome, provided its aims are to improve the technical and business awareness, quality of supply and service and help the REEs in general. It should not be used to foster the narrow interest of only a few REEs. Such was the case, when an association was formed under a project funded by World Bank. Its main actions were limited to oppose the Government policies and did not work for the general good of the REEs and the consumers served by them.”
Chapter 5.

PETROLEUM INDUSTRY AND COAL MINING

AN OVERVIEW OF THE PETROLEUM INDUSTRY

5.1 Cambodia’s petroleum industry is in the early stages of development. Due to years of civil war and unrest, little exploration and production (E&P) activities were undertaken, and the country’s fuel needs have been met entirely through imports, largely from Singapore, Thailand and Vietnam. The Government, however, created the Cambodian National Petroleum Authority (CNPA) in 1998. CNPA has since successfully revived international interest in long dormant upstream projects, both onshore and offshore in Cambodia.

5.2 A reported offshore oil discovery by ChevronTexaco in December 2004 has generated great interest in hydrocarbons industry in the country. A number of exploratory and appraisal wells have been drilled, and another ten appraisal wells are expected to be drilled in 2006. The discovery is now believed to contain predominantly crude oil; however, the size of the discovery and the likely production levels are expected to be firmed up by the end of 2006. Legal, contractual and institutional arrangements for commercial production by 2009 are also being developed. The RGC is keen to foster private sector interest in oil and gas for the speedy development of the sector.

5.3 There is no comprehensive Petroleum Law covering upstream, midstream and downstream activities for the sector in Cambodia. The first “Petroleum Regulation” was promulgated in 1991, and amended in 1998 and 1999. A Royal Decree signed by the King in 1998 led to the creation of CNPA. In 1996, ADB provided technical assistance through which a draft Petroleum Law was prepared by consultants, but it has not been adopted by the Government. Despite the existence of the Petroleum Regulation, the legal and regulatory framework for the development of the sector is essentially fragmented and incomplete.

5.4 CNPA started with two main mandates: (i) negotiation with Thailand on overlapping claim areas (OCA) for joint development agreement in the sea; and (ii) giving license to firms for exploration and production (E&P) and overseeing the activities. Since the reported oil discovery in December 2004, CNPA has been increasingly engaged in both policy and commercial functions. It is asked by the RGC to provide policy recommendations for the oil and gas sector development. It also signs joint venture agreements with foreign firms on behalf of the RGC. CNPA reports directly to the Council of Ministers.

5.5 In addition to CNPA, the Ministry of Economy and Finance (MEF) manages fuel imports and the fuel import tax and excise tax, while the Ministry of Commerce (MOC) issues licenses to fuel distributors. The Ministry of Industry, Mining and Energy (MIME) is not involved in the oil and gas sector and does not have oil and gas sector-specific human resources. The management structure of the sector is fragmented, and the roles and responsibilities of

23 Quote from the Royal Decree: “Article 1: Establish the Cambodia National Petroleum Authority in order to manage, govern, and provide the RGC with recommendation on the policy guidelines and also to facilitate petroleum exploration and petroleum resource development on overall petroleum business operations activities both Upstream and Downstream including exploration, exploitation, assessment, development, production, processing, transportation, storage, refinery, petrochemical products, export-import and marketing, etc. in accordance with agreement or contract with the individual, legal person or entity or authority or petroleum companies.”
relevant agencies should be revisited and clearly defined before the sector develops into a full spectrum covering upstream, midstream and downstream activities.

5.6 **The RGC demarcated a number of offshore and onshore block areas for exploration operations.** So far, three offshore block Petroleum Agreements have been awarded: Block A to ChevronTexaco and Mitsui; Block B to PTTEPI, SPC, Cooper Energy and Resourceful Petroleum Company; and Block D to Kensteel Energy and Slumberger.

5.7 **CNPA uses a model production sharing contract drafted with assistance from an Australian law firm, Allens Arthur Robinson.** The key parameters in the model contract include the following: (i) royalty is set at 12.5 per cent of the total revenue; (ii) the revenue net of royalty consists of two components—cost recovery and profit; (iii) profit sharing for oil—company 52 percent and government 48 percent for production less than 30,000 barrels per day, and company 40 percent and government 60 percent for production over 30,000 barrels per day; and (iv) profit sharing for gas: company 65 percent and government 35 percent.

5.8 **The blocks are awarded to interested parties through a competitive bidding process, and the prevailing regime defines the rights and obligations of the E&P companies, as follows:**

- **Terms of the award:** (a) maximum initial duration of an exploration period, and extensions; (b) relinquishment at the end of exploration period; (c) minimum work and expenditure obligations; (d) maximum number of awards to a single bidder; (e) production period; and (f) provisions for commercial discovery.

- **Fiscal and taxation regime:** (a) profit-sharing (after cost recovery) under production sharing arrangements; (b) royalty payments; (c) cost recovery provisions; (d) income tax obligation; and (e) taxation on imports of equipment and infrastructure.

5.9 **The contracting process involves the following steps:** (i) E&P bidders submit proposal to CNPA; (ii) CNPA reviews and compares capabilities, oil splits and royalties, prepares comparison report and submits it to the Council of Ministers; (iii) the Council of Minister reviews and approves; (iv) Prime Minister makes final decision and gives power of attorney; and (v) CNPA Chairman signs and Director General implements the production sharing contract.

5.10 **There is currently very limited downstream infrastructure to meet the growing petroleum products demand in Cambodia.** There is no refining capacity in the country (a 0.5 million tons per annum refinery in Sihanoukville was built in 1969 with French assistance, but was destroyed by Khmer Rouge), and all products (diesel, fuel oil, motor gasoline and kerosene) are imported by the oil marketing companies (OMC), and transported through either barges or road tank-lorries from the coast to Phnom Penh. Supplies are received through the Mekong River from Vietnam, and some limited unloading facilities and storage tanks are available along the river. Currently, there are nine OMCs, both national and international, with a total of about 360 retail outlets, of which about 200 are located in the greater Phnom Penh area.

5.11 **Accurate estimates of consumption of petroleum products are difficult to make on account of reported widespread smuggling from Thailand and Vietnam.** However, annual

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24 The level of smuggling may have gone down recently because there was a sharp increase in domestic prices in Thailand and Vietnam, and the differential with domestic Cambodian prices has reduced somewhat.
consumption is estimated at over one million tons. Historical growth rate in consumption of petroleum products is estimated at four to five percent per annum for different products. There is currently no piped natural gas consumption in Cambodia.

5.12 Petroleum products prices in Cambodia are one of the highest in the ASEAN region, due to very high level of taxation. Taxes on petroleum products account for about one-fifth of the total government revenues. Table 5.1 provides an overview of recent diesel and gasoline prices.

Table 5.1: Retail fuel prices in selected ASEAN countries
(USc/liter at the filling station)

<table>
<thead>
<tr>
<th>Country</th>
<th>Diesel</th>
<th>Super Gasoline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaysia</td>
<td>17</td>
<td>16</td>
</tr>
<tr>
<td>Vietnam</td>
<td>26</td>
<td>27</td>
</tr>
<tr>
<td>Thailand</td>
<td>27</td>
<td>35</td>
</tr>
<tr>
<td>Singapore</td>
<td>36</td>
<td>38</td>
</tr>
<tr>
<td>Cambodia</td>
<td>28</td>
<td>44</td>
</tr>
<tr>
<td>Lao PDR</td>
<td>24</td>
<td>32</td>
</tr>
</tbody>
</table>

Source: GTZ (last survey Nov 17-20, 2004)

KEY ISSUES

5.13 Given the early stage of sector development and the huge potential for future growth, a number of sector issues should be carefully considered. As a point of departure, we highlight in Table 5.2 the policy, institutional, regulatory, and technical areas that require consideration and actions.
Table 5.2: Indicative List of Areas for Technical Support in the Sector

<table>
<thead>
<tr>
<th>Area</th>
<th>Overall Policy</th>
<th>Regulation</th>
<th>Fiscal / Taxation</th>
<th>Institutional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upstream Oil &amp; Gas (E&amp;P)</td>
<td>Overall petroleum policy, including E&amp;P policy</td>
<td>Review of legal and regulatory framework</td>
<td>Petroleum Revenue Management</td>
<td>Restructuring of CNPA; capacity-building of staff, and skilled worker</td>
</tr>
<tr>
<td>Midstream Oil (refineries, terminals, pipelines, etc)</td>
<td>Feasibility studies</td>
<td>Options for enforcing competition; regulation of technical aspects</td>
<td>Taxation regime for investments in midstream oil</td>
<td>Capacity-building of CNPA staff, designated for midstream oil</td>
</tr>
<tr>
<td>Downstream Oil (transport, storage, distribution, etc)</td>
<td>Enforcement of competition</td>
<td>Handling of externalities (safety, specs, etc); strategic stocks</td>
<td>Pricing formula; taxation regime for petroleum products</td>
<td>Clarification of mandate (MOC; MEF, MIME, CNPA, etc); capacity-building of CNPA staff, designated for downstream oil</td>
</tr>
<tr>
<td>Midstream Gas (Processing, LNG facilities, Pipelines, etc)</td>
<td>Feasibility studies</td>
<td>Overall regulatory framework; economic and technical regulation</td>
<td>Taxation regime for investments in midstream gas</td>
<td>Capacity-building of CNPA staff, designated for midstream gas</td>
</tr>
<tr>
<td>Downstream Gas (distribution network/sale etc)</td>
<td>Feasibility studies, especially for gas for power generation</td>
<td>Overall regulatory framework; economic and technical regulation</td>
<td>Taxation regime for investments in downstream gas</td>
<td>Capacity-building of CNPA staff, designated for downstream gas</td>
</tr>
</tbody>
</table>

5.14 **Notwithstanding the early stage of development, an unclear market structure and other sector-wide issues are perhaps the most serious barrier for the healthy development of the industry, as highlighted below:**

- **Absence of comprehensive policy** on petroleum activities (especially midstream and downstream activities) along with the appropriate law, rules and regulations (decrees) for the long-term development. In particular, government policy is unclear regarding: (a) private sector participation and competition; (b) pricing and taxation; (c) investments in refineries and other infrastructure, and associated incentives; and (d) regulation of externalities.

- **Upstream E&P:** Will both offshore as well as onshore blocks be competively bid out in future? In the event of a natural gas discovery, what will be the state/IOC’s role in its utilization? Who will develop or own gas infrastructure, when needed?

- **Petroleum/gas midstream:** Who will be responsible for processing and refining facilities, terminals, and the transmission pipeline? What will the framework for private-sector investments, tariff for midstream operations, and extent of regulation be?

- **Petroleum downstream:** Will these activities be completely competitive? If so, who will be responsible for the enforcement of competition and level-playing field? What will the long-term ownership structure and rules for entry be, and how will externalities be handled?
Thus, one major need is for RCG to clarify roles of various ministries and Government agencies in policy formulation, regulation, fiscal and taxation matters, enforcement of competition, and handling of externalities. It is crucial that the petroleum sector structure is built to facilitate the most efficient and healthy development of the industry. Currently, CNPA has a primary role in sector regulation, but is also engaged in developing policy options for consideration by the Council of Ministers, and signing joint venture (JV) Agreements for E&P activities on behalf of RGC. The multiplicity of often-conflicting functions and roles of CNPA needs urgent clarification. Similarly, regulation of petroleum downstream activities is divided among several ministries, which results in fragmentation and distortion.

Long-term planning for the petroleum industry should be carefully considered, and on account of the intrinsic endowment of hydrocarbon resources in Cambodia’s onshore and offshore areas. The following issues, beyond the petroleum sector, require action:

- Long-term energy mix, and allocation of resources to improve the enabling framework and institutions for development of hydrocarbon resources in the future
- Integration of policy-formulation and planning responsibilities for all energy sub-sectors (including power, hydrocarbons, coal, biomass, and new and renewable energy resources)
- Institutional arrangements for coordination among different government institutions and agencies, and the private-sector entities, for the development of energy resources
- Promotion of capacity and skills to prepare a cadre of professionals for policy formulation, planning, regulation, operation (technical, financial, commercial, human resource development, contractual), and research and development (R&D)
- Marketing of Cambodia’s hydrocarbon potential in international markets, and solicitation of E&P interest from international oil companies
- Establishing a competitive environment and level-playing field, for the promotion of Cambodia’s petroleum downstream markets.

The issues relating to consumer pricing, taxation and consumption are identified below:

- Absence of competitive consumer pricing framework, with incentives for efficiency improvements in imports, transportation, distribution and sale
- Products imported in small parcels and transported inadequately causing delivered cost to be relatively high
- Unsustainable taxation on petroleum products with domestic price distortion versus the prices in neighboring countries (leading to widespread cross-border smuggling)
- Heavy dependence of the Government on tax receipts on petroleum products, and limited flexibility to generate alternate revenue in the short-term.
- No incentives for existing oil marketing companies to invest in the infrastructure (port, jetty, storage tanks, high-capacity barges, pipelines, etc.)
• Lopsided demand pattern, with unnecessarily high diesel consumption even for power generation (which could be substituted with other fuels with some effort)

• Inconsistent quality of the products imported and delivered to consumers, apparently due to poor enforcement of penalties

• Fuel supply safety (storage facilities, LPG bottles, retail outlets, etc) is a major issue.

• No public advocacy or consumer rights groups leading to a lack of consumer awareness and involvement in the development of the petroleum sector.

LEGAL AND REGULATORY FRAMEWORK FOR UPSTREAM OPERATIONS

5.18 To develop and refine an applicable legal and regulatory framework for upstream operations in Cambodia, international best practice should be consulted. There are four major areas which need thorough review: (a) the petroleum law; (b) the regulations or the decrees; (c) model contract, based on production-sharing agreements; and (d) petroleum revenue management.

Petroleum Law

5.19 The main rationale behind the preference for a brief but thorough Petroleum Law is to cover all essential concepts required in a modern, enabling Petroleum Law while not "setting in concrete" an unnecessary level of detail. In other words, detail should be reserved for subsidiary instruments such as the enabling decrees or regulations and the model contract, which should not be required to be submitted to the legislature for amendment or change. In addition, the best approach, whenever possible, is to package the legal, contractual, and fiscal regime for petroleum operations into a self-contained, coherent legislative framework consistent with the overall legal system of the government and with any applicable principles of international law. This is a great incentive to attract significant foreign investment into the sector. The essential elements of a recommended Petroleum Law, regulations or decrees and model contract format include provisions that address all of the following elements:

5.20 Through a state property in petroleum provision the state asserts and confirms that all petroleum lying within its jurisdiction, both onshore and offshore—including offshore areas where it exercises exclusive economic interest over such resources—is the exclusive property of the state.

5.21 The Petroleum Law should clearly identify a single government agency (or competent authority) vested with the exclusive mandate to implement government policy in this area of petroleum development. The competent authority represents the state in negotiating and contracting with foreign investors and in regulating and administering, from a technical compliance viewpoint, the implementation of contracts once they have been signed. However, policy-setting functions remain the responsibility of the government or the relevant ministry.

5.22 A provision governing conduct of petroleum operations is essential with a two-fold purpose: First, it is meant to ensure that petroleum operations are conducted only under a duly issued permit or license from the competent authority, in such form and on such terms as are prescribed in the Petroleum Law, the regulations, and, where applicable, a petroleum agreement, the terms of which must be consistent with the enumerated requirements thereof in both the Petroleum Law and the regulations. Second, it is intended to give the state the maximum possible
flexibility in conducting petroleum operations. This may be through a state authority, such as a
national oil company (NOC); through a private entity, such as an incorporated joint venture; or in
any other manner that it may deem appropriate.

5.23  **Under this provision of the Petroleum Law, the concept and outlined contents of a
model contract are introduced.** It authorizes the competent authority to have prepared and made
available model contracts to potential applicants as the state's starting point for the negotiation of
an exploration and production petroleum agreement. The Petroleum Law should be understood in
terms of permissive, minimal contents of a model contract, without legislating the provisions in
detail. This is the "generic" aspect of such a Petroleum Law, which provides only the legal
underpinnings and thereby leaves the state with maximum negotiating options.

5.24  **Regulations should be subsidiary instruments to the Petroleum Law and should not
themselves be enacted as law.** Rather, this section of the Petroleum Law should expressly
authorize the competent authority to make regulations from time to time, consistent with the
policy and objectives of the Petroleum Law. Provision such as assignment of rights in a contract,
or land use for licensed activities could be provided through appropriate regulations.

5.25  **Qualifications, duties, and rights of rights-holder or contractor.** In the Petroleum
Law, the rights holder’s duties to be specifically mentioned, and replicated as terms in all
petroleum agreements, include reporting the discovery of any petroleum to the competent
authority; presenting the competent authority in a timely fashion with a development plan for
commercial petroleum discoveries and promptly taking all reasonable steps to develop and
produce the discovery; conducting all petroleum operations in accordance with good international
petroleum industry practice, including measures to promote conservation, safety, and
environmental protection; and indemnifying the competent authority against all claims. In return,
the fundamental right granted is the exclusive right to carry out petroleum operations within the
area covered by the petroleum agreement, for the time period(s) specified therein, subject to the
provisions of the petroleum agreement.

5.26  **Taxation of profits.** Normal practice is to establish the essential elements of the
applicable fiscal and tax regime in the Petroleum Law in such a way that the potential investor
may easily gain a full understanding of the applicable regime; compute, without excessive
uncertainty, the amount of taxes to be paid under such fiscal package; and consider such a fiscal
package—taking into account the contractual arrangements—as reasonably competitive with
other, similar worldwide investment opportunities.

5.27  **Other taxes, duties, and exchange controls.** Most petroleum laws and petroleum
agreements specify that rights holders, and those contractors and subcontractors working for
them, are free to import and export supplies and equipment authorized under the petroleum
agreement for petroleum operations, free of customs duties and taxes of any type. Expatriate
employees of these parties receive the same treatment for their household goods and personal
effects.

5.28  **Fiscal stability.** After a petroleum agreement has been concluded, the investor should be
secured where possible from the adverse economic effects of certain new statutes, regulations,
and laws. One way this may be achieved in both the Petroleum Law and the petroleum agreement
is by using certain limited stabilization or renegotiation provisions. These provisions would
mitigate the effects of any new enactments that either increase the burdens on rights holders or
reduce their original rights and economic benefits. As a further qualification, they would not
apply to new laws imposing safety, conservation, or environmental restraints, upon which the state must be free to act to protect the public interest.

5.29 Established practice today is to include a more comprehensive obligation for environmental protection and safety in the Petroleum Law and then to provide more details on specific actions and requirements in both the regulations and the model contract or petroleum agreement. Almost without exception, these details include a requirement for an environmental assessment study and an environmental management plan to be carried out prior to the commencement of petroleum operations as well as a social impact assessment.

5.30 Natural gas development. Particularly in areas that are known or expected to have gas resources, it is advisable for the Petroleum Law to provide for special incentives and priorities to encourage the development of natural gas. Sound, modern petroleum laws have specially tailored gas development and commercialization provisions to encourage positive action on gas discoveries because of the long lead time required to build up the market and infrastructure. These include provisions to allow the rights holder a longer development or retention period to conduct a market feasibility study and optionally to develop natural gas jointly with the state in a negotiated joint venture. Price negotiations for gas also take longer because the value of the gas depends on the size of the local market and its value in that market.

Decrees/Regulations

5.31 The second essential component of successful petroleum legislative frameworks for exploration and development are the regulations to the Petroleum Law. The Petroleum Law should authorize the competent authority expressly to make regulations, from time to time, providing the detail and procedures by which to implement the policy and objectives of the Petroleum Law, by reference to specific, enabling provisions thereof. The regulations are subsidiary instruments to the Petroleum Law, not intended for legislative consideration or enactment. The benefit of this practice is that maximum flexibility is maintained, allowing for timely response to any current developments that would require changes in the regulations. The safeguard, always, is that the regulations, and any changes thereto, should never be inconsistent with the policy, objectives, or letter of the Petroleum Law. Consistent with the types of legislative formats discussed here, the regulations to the type of Petroleum Law will follow the Petroleum Law's format, adding the detail necessary to effectuate the intent of its enabling provisions. This may be quite extensive or not, depending on many factors. Regardless of length or brevity, however, particular attention and elaboration in the regulations should always be given to the core items described under Petroleum Law.

Model contract

5.32 The final essential component of successful petroleum legislative frameworks is one or several variants of a model contract. A state is best served by having its own contractual format from which to commence negotiations of petroleum agreements. The model contract(s) should be included in the bid tender package, requiring applicants to identify any exceptions thereto as part of their bid.

Petroleum revenue management

5.33 Potential petroleum revenues provide Cambodia with a unique opportunity to lift itself out of its extreme poverty—if the oil revenues are managed efficiently and
transparently, and are applied to poverty-reduction programs. The key features of a petroleum revenue management program are as follows:

- Annual oil revenue estimates are made, and key priority sectors for poverty reduction are identified such as infrastructure, education, health and social affairs, and rural development, including agriculture and livestock, and environment and water resources. Broad financial allocation for these priority uses is made upfront.

- In order to assure that petroleum revenues are managed effectively, a small percentage of total annual revenues, perhaps, ten percent, could be held in trust for future generations. Of the remaining revenues, a significant percentage, perhaps 80-85 percent of royalties and dividends could be used for education, health and social services, rural development, basic infrastructure, and environmental and water resource management, and the remaining royalties or dividends are earmarked for regional development.

- An oversight committee to monitor the use of petroleum revenues is also established. This committee includes representatives of the Government, Parliament, Supreme Court and civil society. Without its specific approval, direct oil revenues can be neither allocated nor disbursed toward specific programs.

**PETROLEUM DOWNSTREAM OPERATIONS**

5.34 Petroleum downstream operations are primarily competitive, and generally require little to no economic regulation. However, countries where there is little tradition of competitive markets, consumers may suffer in the short- to medium-term on account of collusive practices if no safeguards are built. Similarly, there is a real risk that industry players may cut costs on safety or customer service in the event of poor enforcement capabilities of the authorities. In order to overcome these problems, one could take advantage of international experience to ensure a transition to a competitive market as follows:

- **Product imports**: The import regime should be liberalized, and any qualified party or entity (both in technical and financial terms) should be allowed to import petroleum products, after it has been granted a license by the competent authority.

- **Petroleum products marketing and distribution**: Rules for entry in the oil marketing business should be clearly specified (technical qualifications, and financial capability), and any meeting the entry criteria should be issued the license.

- **Regulation of licensed activities**: Except for prices which are determined by licensees in accordance with competitive markets, should be done by the designated competent authority(ies). These functions may include safety and environmental compliance, customer service, products specifications, weights and measures, competition, and strategic stocks.

- **Petroleum products prices**: A system of regional price caps are introduced, whereby the competent authority notifies fortnightly the maximum depot price as a price cap, under which all qualified parties or entities may sell their product. The price cap is established as follows:

\[
\text{Price-cap} = \text{Import Parity Price} + \text{Ave. Inland Transport Cost} + \text{Margins} + \text{Volumetric Tax}
\]
• **Tax on petroleum products:** Tax should be volumetric (Riels/litre), such that the following broad principles are adhered to:

  - Realistic annual tax receipt targets should be identified before the beginning of the year in the budget, and should take into account consumption estimates, market growth, past year collection, and taxation level in neighboring countries.
  
  - The Government should institute a system of monitoring international prices, and based on the above formula, should compute the price cap (less taxation) for every fortnight.
  
  - It should also monitor the consumer price for each petroleum product in neighboring countries (Thailand, Vietnam, Laos), especially in the border districts, and determine the maximum cushion available to impose volumetric tax in Cambodia.
  
  - To the extent possible, there should not be too much of difference of volumetric tax on different products (say motor spirits and kerosene), so that inter-product pricing is not distorted too much.
  
  - In order to provide price stability to the consumers, attempt should be made to adjust taxation once every quarter, unless warranted by major fluctuations in international oil markets, or more frequent adjustments in the neighboring countries.
  
  - Fortnightly estimate of tax receipts on account of petroleum products is made, and continuously compared with annual targets. In the event of any major variation at the end of each quarter, revision/adjustment of taxation targets should be made.

5.35 **Handling of externalities is a major concern in the petroleum industry.** Several countries have created competition-enforcement authorities for the entire set of economic activities, and not exclusively for the petroleum industry. This is because investigation of collusive practices and monopoly behavior requires special skills (e.g., economic, financial, accounting, legal), which are scarce, difficult to assemble separately for each sector, and not cost-effective. However, wherever such authorities do not exist, responsibility for the enforcement of competition and level-playing field is usually entrusted with the sector regulator. Other areas of handling externalities include inter alia: (a) product specification conformance; (b) weights and measures, and customer service; (c) safety of operations/installations; and (d) strategic stocks. Competition and regulatory authorities usually engage private-sector parties for certification and enforcement of standards, in accordance with its rules and regulations.

5.36 **Institutional measures.** Many functions in the petroleum sector are highly diffused, and need to be clarified for the long-term development of the sector. Similarly, development of capacity and preparation of a skilled workforce is necessary, if the sector has to make rapid strides in the wake of recent oil discovery. The following is suggested as the proposed program for institutional development, helping to clarify roles of different institutions:

   a) Policy formulation and development should be undertaken by a hydrocarbons division under MIME.
b) The owners-representative function should be performed by an independent directorate of CNPA, who should represent the state in all PSA (or production concession agreement, if adopted).

c) Award, administration and oversight of E&P licenses should be performed by an independent directorate of CNPA as a one-window operation for IOCs.

d) For regulating the petroleum downstream industry, consideration may be given to the consolidation of currently-dispersed responsibilities into a single regulator. There are several countries where the energy regulator is tasked with the regulation of all sub-sectors (e.g., in the UK), that is, power, petroleum products and natural gas, and if this is accepted, the mandate of EDC could be expanded.

e) The Board of Directors of petroleum sector entities should be free to take all managerial decisions consistent with the company laws, and be answerable to state authorities in the same way as any other private company operating in Cambodia.

5.37 In order to prepare for the challenges of petroleum sector development, MIME may institute a capacity building study to:

a) Establish skill-sets required in different disciplines in the short-, medium- and long-term

b) Ascertain the availability of professionals in different disciplines, and the shortfalls

c) Identify options on filling the professional gap, that is, education and training in local vocational schools, colleges and universities, education and training abroad, on-the-job attachment

d) Develop a financing plan for capacity building and institutional strengthening

e) Develop an implementation plan for capacity building over the next one to three years

COAL MINING

5.38 The country’s mineral resources are largely unexplored and unexploited mainly because of wars during the 1960’s and 1980’s, and a lack of capital, specialists, and technology in the 1990’s. Based on preliminary studies, the identified mineral resources are ruby, sapphire, and zircon in the northwestern Battambang province, and manganese, phosphate, and salt in the central part of the country. Other mineral potential in Cambodia includes bauxite, coal, natural gas, iron ore, kaolin, peat, petroleum, silica sand, slate, and tin.

5.39 To attract domestic and foreign mining companies to invest in mineral exploration and development, the Law of Minerals Management and Mining of Cambodia was promulgated by the Government on July 13, 2001, and the Ministry of Industry, Mines, and Energy (MIME) is mandated as the main Government agency. During the 1990s, MIME issued 11 licenses for exploration for different minerals; however, no significant findings have been reported so far. Production of minerals in Cambodia is limited to small-scale mining and quarrying of construction aggregates, phosphate rock, quartz sand, sand and gravel, salt, and stone. Preliminary estimate of coal deposits is about 7 million tons; however, there has been no
significant finding and production of coal in Cambodia, although two exploration licenses have been granted to local/regional companies, which run up to FY2007.

5.40 Coal mining and utilization has not begun on account of a variety of policy, institutional, fiscal and infrastructure-related questions that remain unanswered:

a) Policy issues: What will the extent of the state’s participation be? How will domestic and international joint-ventures treated? How will a level-playing field for domestic and foreign investors be assured? What will be the state’s right to percentage share of profits? What, if any, will the privatization program in mining industry be?

b) Regulatory issues: Absence of clear mineral exploration rules and regulations; approval process for mineral title applications; and handling of externalities; for example, how will a consistent application of rules and regulations be assured to investors?

c) Fiscal and taxation issues: Clarity on profit tax, royalty, and incentives; for example, what difference, if any, will there be for tax exemption rules for local and foreign investors? What assurances on repatriation of profits, and stability of fiscal and taxation regime could be provided?

d) Infrastructure and human resource issues: Who develops infrastructure, communications, transport and utility to key mining areas? What is the inventory (mapping) of coal resources in Cambodia? How is availability of comprehensive, accessible geological and mineral database assured? What institutional mechanisms to assure availability of health and education facilities, skilled mining workforce, technicians, and professionals, could be put in place?
Chapter 6.

THE WAY FORWARD

6.1 The previous chapters complete a process of issues identification, preliminary analyses of the identified issues, and justification and proposal for the next step work program and associated thematic studies. Before mapping the way forward, it is important to repeat the main objective of this review: that is, to create a strategic framework that governs the systematic development of Cambodia’s energy sector and leads to the formulation of a coherent energy sector strategy and implementation plan. It is also important to repeat that the framework embodies a program of diagnostic and analytical work, and technical assistance and institutional building activities.

6.2 Amid rising international oil prices that seriously affect Cambodia’s energy costs, it is increasingly clear that a coherent energy sector strategy covering all energy sources is needed. The analyses presented in the previous chapters point to the need for a number of diagnostic and thematic studies to form the building blocks of the energy sector strategy. However, these studies will require at least one to two years to complete. Thus, it is important that the Government move forward quickly with policy actions identified by previous studies, especially for the power sector, without waiting for the completion of ongoing studies. Policy actions can be taken while carrying out the necessary studies for the energy sector strategy.

6.3 The roadmap discussed below is a combination of actions and continuing studies. It was the key agenda for discussion during the draft issues paper dissemination workshop—Energy for Development: Building Consensus for A Way Forward—held in Phnom Penh on October 27, 2005. The key actions and studies, including their timeframe, milestones, and responsible agencies, were discussed and agreed through the workshop and subsequent consensus building activities.

PENDING ISSUES AND FOLLOW-UP ACTIONS FOR THE POWER SUB-SECTOR

6.4 As power sub-sector development has been the focus of the energy sector for the last approximately ten years, a starting point to identify the follow-up actions may be the “Cambodia Power Sector Strategy, Report No. 19382-KH of June 1999, World Bank” (CPSS), which laid the foundation for the development of Cambodia’s power sector. Its key observations and recommendations, many of which are valid today, are summarized in Box 6.1.

Box 6.1: Key Messages from the 1999 Cambodia Power Sector Strategy Report

General Observations (i) In most cities, power supply is deficient due to weak management and poor conditions of the generation and distribution plant; (ii) Lack of a transmission system prevents a more efficient use of power in terms of economies of scale, fuel options and site advantages; (iii) Weak domestic revenue mobilization and inefficient public expenditure management; (iv) Efficient power sector development, open to private participation is crucial for sustainable economic growth and social development; and (v) Private investment is crucial to support power investments for 1999-2003, expected to reach 2-2.5% of GDP and 11% of domestic investment.

Power Supply Constraints: Observations (a) Lack of legal and regulatory framework; (b) Lack of transparency and competition in the current process for private sector entry; (c) Poor technical, commercial
and financial performance of the sector; (d) Weak investment planning; (e) Lack of resources and strategy to provide electricity services to rural areas; and (f) Weak human resource base.

Proposed Strategy (a) Upon passing of the Electricity Act, the role of the private sector will increase in power generation, distribution and commercial services in most provincial towns; (b) Desirable evolution of the sector structure from a single-buyer model to a wholesale market could include the following steps, although is not likely to develop within 5-6 years: (i) EDC’s consolidated license for generation, transmission and distribution should be for a limited period and discontinued thereafter; (ii) Conditions for wholesale market would include enactment of Electricity Act; effective functioning of EAC; development of a transmission system linking the more important load centers; and presence of a minimum number of competing suppliers (5 to 6).

Short to medium term (3-4 years) options to improve sector efficiency (a) Introduce a suitable bidding process for IPPs; (b) improve long-term contracts to minimize operation distortions; (c) allow new IPPs to sign contracts directly with large consumers; (d) create a parallel market, competition for bilateral contracts between generators and distributors to move gradually to a fully competitive wholesale market; (e) compel EDC to operate on commercial principles (commercializing EDC, including a tariff reform to expand its market share) through (i) introduction of a performance based contract with RGC to be followed by a strategic partnership; (ii) privatizing EDC’s once its performance is improved; and (iii) considering the current single buyer structure, the international nature of future transmission, the decreasing role of EDC as a generator, and distributor, EDC would eventually become a transmission company.

List of Strategic Actions (a) Enact the Electricity Act; (b) Establish EAC, develop regulations, train EAC staff; (c) RGC to respect independence of EAC; (d) Formulate procedures for competitive bidding for IPPs; (e) Lay down transparent and predictable RGC policies for private sector entry; (f) Develop a marketing plan for IPPs; (g) remove infrastructure constraints; (h) Define and implement short and medium term expansion plans; (i) Negotiate for power import from Vietnam and Thailand; (j) Initiate hydropower feasibility studies; (k) Define financing plan and marshal financing sources; (l) Develop rural electrification strategy; (m) Commercialize and corporatize EDC (Introduce performance based Contract between EDC and RGC and Create a Strategic Partnership for EDC; (n) RGC to respect EDC’s commercial autonomy; (o) Restore EDC’s financial health, (p) New tariff structure should reflect marginal costs; (q) Improve EDC’s collection of arrears; (r) Implement fuel conversion in EDC diesel plants; (s) Provide training for EDC staff; and (t) EAC to review and improve power services in provincial towns (licensing and competition).

6.5 Over the last seven years since the completion of the CPSS, dramatic progress has taken place in the power sector. As indicated in the analyses presented in Chapter 3, many issues and policy actions identified in the CPSS are still relevant and should be the basis for further attention of the Government agencies and donors. This issues paper recommends immediate actions to adopt the private power policy and IPP competitive bidding procedures.

6.6 Moreover, our recommendations include analytical works to form part of the basis for the energy sector strategy, and works that lead to immediate impact electricity cost reduction and electricity supply efficiency. For example, the national power development plan should be updated as soon as possible. Short- to medium-term measures to reduce electricity costs and increase supply efficiency, as recommended in Chapter 3, should be implemented. The implementation framework for rural electrification should be put in place.

a) Master plan for hydropower development. For a meaningful formulation and update of the power development plan, one must reasonably estimate the cost of developing the hydropower projects, which in turn requires carrying out of fairly expensive pre-feasibility studies. The terms of reference for the hydropower master plan (Annex 2) cover: (i) project ranking, after upgrading the potential hydropower projects to pre-feasibility levels; (ii) development of private and public models for hydropower
preparation and financing; (iii) transfer of technology and training; and (iv) advice and overall supervision of hydropower work in Cambodia. Terms of reference for this study were prepared by IDA and submitted to MIME. The T/A is likely to be financed by JICA, and will be overseen by IDA.

b) **Master plan for reducing distribution losses (technical and non-technical).** The reduction of losses can effectively be considered the creation of a generation source. While losses have been reduced from the highs of 30 percent to about 12.7 percent today, loss reduction should continue and a master plan document formulated. As the demand for electricity grows, losses will increase unless commensurate measures are taken to strengthen the distribution networks, especially in Phnom Penh. Further, as a guide to distribution network development, a cost-benefit analysis should be undertaken to assess the point at which the cost of incremental investment equals the benefit of reduced losses.

c) **Master plan for reducing costs of diesel generation.** While the transmission grid evolves in the medium- to long- term, and until such time that more cost effective large-scale domestic generation sources and low-cost electricity imports enter, Cambodia will need to rely on diesel/HFO based generation in the near- to medium term. As noted earlier, EDC is making efforts to reduce costs; however, it is still imperative to create a master plan for generation cost reduction, to serve as one of the underpinning documents of the energy strategy.

d) **Master plan for demand side management and efficiency improvement (DSM).** While supply side efficiency improvement appears to yield “tangible” benefits, more “cost-effective” benefits could result from investments in DSM. No energy strategy would be complete without DSM master plan and the foundations for this are being laid under IDA’s RETP.

6.7 The formulation of the latter three proposed master plans (b, c, and d) could be based on the findings of a proposed thematic study on power sector efficiency, described in the next sub-section.

**OTHER ACTIONS AND THEMATIC STUDIES**

6.8 During the October 27, 2006, draft issues paper dissemination workshop, a high level of consensus was reached that an official energy sector strategy should not be shelved until completion of on-going and planned analytical works. The Government should begin drafting the sector policy, strategy documents and implementation plan. The official strategy should be the sectoral extension of the Government’s rectangular strategy. The strategy document should be a living document, updated from time to time, as appropriate, to incorporate the findings and recommendations of the planned analytical works.

6.9 Other thematic studies include the following:

a) **Renewable energy strategy study:** It is being undertaken by JICA.

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25 While cross-country comparisons may not be rational because of varied customer and geographical characteristics it is informative to note that the distribution losses of PEA (the provincial electricity distributor in Thailand) are below 6%. EDC’s effort towards further reduction in losses to economically achievable levels is thus warranted. Growing demand can increase losses if appropriate and timely network reinforcements are not made, especially when demand comes from low level domestic consumers.
b) Cambodia infrastructure review study: Initiated by DFID, the study will focus on infrastructure service delivery (including energy) to the poor segments of the society. DFID discussed with IDA linkages of the study with the energy sector strategy review program. The findings of study will be relevant to the formulation of the energy sector strategy.

c) National power development master plan update: Terms of reference for this study have been prepared by IDA under its Transmission and Rural Electrification Project and implementation is underway (see Annex 1).

d) Rural electrification master plan: This is provided for under IDA’s Rural Electrification and Transmission Project (RETP).

e) Power sector efficiency study: This study would be an all-encompassing study having distinct modules examining the sector policies, the sector management structure, the performance of the sector entities, the sector’s technical efficiency (distribution, losses, diesel-generation etc.), financial performance (tariffs), demand-side management (DSM), and the future evolution of the sector structure, and propose recommendations to improve the overall efficiency of the power sector. The study is expected to provide a basis for the formulation of the three master plans mentioned earlier, i.e., the master plan for reducing distribution losses, master plan for reducing costs of diesel generation, and the master plan for DSM. The TOR’s will be prepared by IDA in consultation with the Government and donors. Estimated cost is US$750,000-1,000,000. IDA will seek trust funding, possibly from ESMAP.

f) Petroleum import tariffs and taxes study: A very preliminary analysis was carried out as part of the issues paper, but more work is required for this highly sensitive topic. In response to a request from the Ministry of Economy and Finance, IMF’s Fiscal Affairs Department is looking into the oil and gas sector tax issues, particularly issues relating to possible conflict between the Law on Taxation and the petroleum regulations (1991) and tax clauses in Cambodia’s standard petroleum agreements.

g) Strategic roadmap of the oil and gas sector: IDA intends to provide technical support and policy advice to the Government and donor working group through a few thematic missions to Cambodia.

h) Study on the legal and regulatory framework for the oil and gas industry: The TOR’s have been drafted under this exercise (Annex 4). ADB intends to fund the consultant study.

i) Strategic roadmap for CNPA: This is a capacity building T/A to be undertaken by AusAID.

j) Petroleum revenue management mechanism: IDA, IMF, and UNDP intend to support the technical work and policy dialogue throughout the on-going Public Finance Management (PFM) Reform Program.
SUMMARY OF THE SECTOR STRATEGY PROGRAM

6.10 A summary of the activities and their status in the overall energy sector strategy study program is shown in Figure 6.1 and Table 6.2 below.

Figure 6.1: Proposed process of energy sector strategy and implementation plan formulation

Formulation of Coherent Energy Sector Strategy and Implementation Plan

Through: High level of dialogue and consultation with the government, development partners and other stakeholders

Pending issues to be followed-up (from 1999 CPSS)

Players
- Led by Government (MIME, MEF, EAC, EDC) supported by development partners

Actions:
- Adopt transparent and competitive bidding procedures for IPPs to promote more orderly entry of FDI in power sector
- Improve EDC efficiency through strong focus on improvement of its commercial and business functions
- Continue the strengthening of EAC’s role, autonomy, and capacity
- Develop, in the context of GMS power trade, national environmental and social safeguard policies, procedures, and capacity
- Promote a more efficient supply and downstream market for petroleum products

Studies:
- A comprehensive power master plan
- Hydropower development plan
- Power sector efficiency study
- A comprehensive transmission and interconnection plan
- Rural electrification by renewable energy master plan study

New areas/issues to be focused

Players
- Led by Government (MIME, MEF, EAC, EDC) supported by development partners

Studies:
- Petroleum import tariffs and taxes study
- Study on the legal and regulatory framework for oil and gas Industry
- Strategic roadmap of oil and gas sector
- Strategic roadmap of CNPA
- Petroleum revenue management
- Cambodia infrastructure review study
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ANNEX 1

Cambodia: Power Development Master Plan
Terms of Reference for Consulting Study

Study Composition

The consulting study is proposed to be structured under the following main headings:

A. Developing a Master Plan for Power System (Generation and Transmission) Expansion – involving updating of the Power Development Plan currently being used.

B. Institutionalizing Demand Forecasting - establishing appropriate methodologies for forecasting electricity demand and setting up an institutional framework for its accomplishment.

C. Building Capacity in Power Development Planning - setting up a cell within EdC/MIME for power development planning with necessary personnel, computer software and hardware.

Objectives and Scope

The objectives to be attained and the scope of work to be covered are detailed below:

A. Developing a Master Plan for Power System Expansion


The scope of the HECEC study encompassed:

- Review of Load Forecast and Potential Generation Sites based on Indigenous/Imported Sources which covered:
  - Development of demand forecast scenarios.
  - Identification of potential hydro and thermal generation sites.
  - Preparation of generation development plans and corresponding investment scenarios for the period 1996 – 2015.
  - Evaluation of potential for regional interconnections.
• Training of EdC staff in load forecasting, generation expansion planning and economic evaluation of options.

• Developing a Transmission Master Plan which covered:
  o Establishing planning and design criteria.
  o Developing a planning methodology.
  o Assisting EdC in developing the transmission plans.
  o Recommending the least cost transmission developments.
  o Training of EdC staff in the areas of system studies, long term transmission development planning and economic evaluation of options.

Taking into account that major changes have taken place since the study was completed in 1998, the Consultant shall:

1) Assess whether the basic planning methodology and criteria used in the study are acceptable and appropriate in the present context of Cambodia’s power system, the developments that have taken place in the Greater Mekong Subregion (GMS) and resources of the electricity entity EdC.

2) Suggest (with proper justification) changes, if any, necessary in the current planning methodology and criteria.

3) Review and update the basic assumptions in planning related inter-alia to: (i) sources of generation (types and location); (ii) plant efficiencies, outage rates, fuel types and fuel price projections; (iii) discount factors and shadow exchange rates; (iv) loss of load probability (LOLP) and valuation of lost energy; (v) planning horizon; (vi) load factors and loss levels; (vii) capital, operation and administration costs; (viii) valuation of environmental externalities; (ix) parameter variations for sensitivity analyses (e.g. demand forecast, fuel prices, capital costs).

4) Review and update the current status of feasibility studies for the hydropower plants. The costs of the candidate power plants which are predominantly hydro need to be determined with a greater degree of accuracy. While several ranking studies have been done in the past, considerable updating is required in regard to hydrology, feasibility level engineering and accounting for Environmental and Social costs using modern valuation techniques.

5) Develop alternative generation expansion scenarios taking into consideration current IPP proposals and estimating future costs of IPP generation.

6) Assess ongoing and prospective developments in regional power trade (taking into account developments in the GMS ) and factor into the generation candidates import of power in the near term and export in the long term.
7) Develop alternative scenarios for demand growth (Base, High, Low).

8) Develop alternative transmission expansion scenarios and determine the least cost option for various generation expansion plans, establishing the proper sequence of connecting the demand centers vis-a-vis local generation.

9) Determine the capital investment and operation costs for the various expansion scenarios and evaluate their impact on the utility finances, long run marginal costs, revenue requirements, tariff levels and affordability by various consumer classes.

10) Evaluate the Economic Internal rate of Return (EIRR) of the development plans assuming suitable values for distribution costs.

B. Institutionalizing Demand Forecasting

Several studies in the past have developed methodologies for demand forecasting and have prepared demand forecasts that have been used in planning studies. It is believed that past demand forecasts may not have adequately taken into account the impact of factors such as: (i) pent up demand; (ii) conversion of industrial and commercial consumers from diesel-based generation to grid supply as the reliability of the grid supply increases and tariff levels decline; (iii) group metering of loads; (iv) recent drives for increasing rural electrification and the prospects of the local grid- or renewable energy-based electrification transferring the demand to the central grid. Further, adequate mechanisms are not in place, nor resources provided, at the central (EdC/MIME), provincial and rural levels for socio-economic data compilation, necessary for periodic updating of the demand forecasts. It is therefore necessary to establish appropriate methodologies for forecasting electricity demand and putting into place an institutional framework for its accomplishment.

To achieve the aforementioned objective, the Consultant would inter-alia need to:

1) Review past methodologies use for forecasting demand and recommend methodologies that are most appropriate for this process in the present Cambodian context (considering factors such as GDP growth rates, end use models, sector-wise consumption, planned electrification targets etc.).

2) Identify mechanisms (in terms of organization, manpower, hardware/software, data collection formats, data transmission and financial resources) for collecting socio-economic data at the town, province and rural levels on a periodic basis and consolidating the data at the central level.

3) Identify, in consultation with MIME/EdC the composition of a high level committee to oversee and contribute to the demand forecasting exercise (benefiting from examples in neighboring countries, such as the Thailand Load Forecasting Committee).

4) Implement the system and assist in the preparation of the demand forecasts for the planning studies under the assignment.

C. Building Capacity in Power Development Planning
The HECEC study referred above did provide training to the staff of EdC and MIME in various aspects of power system analysis and least-cost planning and to some extent hands-on training in developing the load forecasts and expansion plans for the study. However, it could not develop and perpetuate on a sustainable basis an institutional set up that could undertake power system analysis and least cost generation and transmission expansion planning, on its own (as for example in neighboring GMS countries like Thailand, China and Vietnam). A key objective of the proposed Consulting study is to set up a cell (or group) within EdC/MIME for power development planning - with necessary personnel, computer software and hardware. The Consultant would be required to:

1) Determine the basic manpower needs for undertaking power development work on a sustainable basis. Review the current manpower availability within EdC and MIME to fulfill this task, recommend additional recruitment if any and identify the training needs.

2) Based on the methodologies proposed for power development planning, and a review of the planning tools currently available with EdC/MIME, recommend the necessary hardware and software to be acquired (this shall include but not be limited to; Generation Expansion Planning, Transmission Expansion Planning, Load Flows, Short Circuits, Transient and Steady State Stability and System Over-voltages and Demand Forecasting).

3) Train the power planning staff in the use of the software and assist it in developing the generation and transmission expansion plans required to be prepared under the study.

Conduct of the Study

The study is proposed to be conducted in two phases as below:

Phase 1 (Diagnosis) Months 1 - 2

In this phase the Consultant would review the current status and outline the methodologies, assumptions and steps it proposes to take to fulfill the requirements of the TOR. This diagnostic phase is envisaged to basically cover items under A – 1), 2) and 3); B – 1), 2) and 3) and C – 1) and 2). An Interim Report would be prepared and discussed with the stakeholders – EdC, MIME, IDA and ADB (most probably in a workshop) – and agreement reached on the various study methodologies, assumptions and parameters, before embarking on Phase 2.

Phase 2 (Implementation) Months 3 - 8

In this phase the Consultant would undertake the study by having the counterpart staff carry out the actual work. At the end of this phase a Draft Final Report would be submitted and discussed with the stakeholders (most probably in a workshop), following which a Final Report would be submitted, taking the stakeholders’ comments into consideration.

Consulting Expertise and Duration

The following key consulting expertise is contemplated:

<table>
<thead>
<tr>
<th>Expertise</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generation Expansion Plan Specialist</td>
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</tr>
<tr>
<td>Transmission Specialist</td>
<td>5 SM</td>
</tr>
<tr>
<td>Hydro Power and Environmental Specialstists</td>
<td>3 SM</td>
</tr>
<tr>
<td>Demand Forecasting Specialist</td>
<td>3 SM</td>
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</table>
Economist/Financial Analyst 4 SM

The entire study will be carried out in Cambodia with very little support from the Consultant’s home office.
ANNEX 2

Cambodia: Hydropower Master Plan
Terms of Reference for Consulting Study

Introduction

1. The theoretical hydropower potential of Cambodia is estimated at 10,000 MW, fifty per cent of which is in the Mekong River basin, on the Mekong mainstream and its tributaries. The practically exploitable potential in the mid- to long-term for which desk studies have been made ranges from about 1,900 MW, 9,000 Gwh p. a. to about 4,700 MW, 21,000 Gwh p. a., depending on the scale of development of Sambor Hydro. The status of preparation of the hydropower projects is indicated in the attached Table. Currently five projects are under active consideration, while the technical assistance (TA) on Power System Development Plan under the proposed IDA Credit for the Greater Mekong Sub-region (GMS), provides for pre-feasibility level studies for about four projects and feasibility level studies for two projects.

Following the recent rehabilitation of the Kirirom I project (12 MW), five other hydropower projects are being considered for priority development (for domestic supply). These are the Battambang I (24 MW), Battambang II (36 MW), Lower Stung Russei Chrum (125 MW), Stun Atay (100 MW) and Kiriron III (13 MW). The Sambor project (465 MW - 3,300 MW) on the mainstream is viewed as an important long-term project (for export). Most of the identified projects have been studied at desk/reconnaissance level and are not ready for implementation in the short-term.

Study Objectives

2. The study has the following key objectives:

a) Project Ranking: Upgrade the current level of information on potential hydropower projects in Cambodia to pre-feasibility level and create a Ranking Table that takes into account the projects’ technical and economic viability and environmental and social costs. (Recommendations of the World Commission on Dams provide some guidelines in this regard).

b) Models for Hydropower Development and Financing:

- Taking into account other possible energy sources, and the EDC/MIME power development plans, devise models for development and financing arrangement for promising hydropower projects in the near- mid- and long-term,
- In consultation with the concerned institutions, characterize projects for domestic use and for export and suggest their timeframe for development with a view to pooling resources with other initiatives such as GMS and ASEAN.

c) Transfer of Technology and Training:

- Effect transfer to the relevant agencies such as Ministry of Industry, Mines and Energy (MIME), the relevant software for Hydropower Planning (including
Hydrological Modeling, Basic Engineering Designs, Economic and Financial analysis, Valuation of Environmental and Social Impacts, etc.), and

- Train concerned staff of MIME in the use of the software. Set up flow and other measuring stations for more reliable and extensive data collection, if required.

**d) Advice and Overall Supervision of Hydropower Development in Cambodia:** The Consultant appointed for the study would be required to advise MIME in overall supervision of ongoing hydropower development work in the country to ensure uniformity of approach to hydropower planning, design and construction, and monitoring/evaluation.

**Scope of Work**

3. The study shall be undertaken in two Phases, with the scope of work under each to include, but not be limited, to the following:

**Phase I**

**Project Ranking:**

a) Review and collate information available in past studies and identify data gaps, including, but not limited to, the compilation of relevant topographical maps, meteorological and hydrological data;

b) Review ongoing work on hydropower development, assess whether it is proceeding on appropriate lines and suggest remedial and/or reinforcing measures if any;

c) Propound models that would be used for converting field data into basic design parameters for the hydropower projects as also models for optimizing the design parameters;

d) Propound models - for the quantification in monetary terms (or using other techniques such as muti-criteria analysis, as deemed appropriate) of environmental and social impacts - that would be used for the present study as also for other ongoing work, to establish a uniform/agreed evaluation methodology. Specify the field data requirements for input to the models;

e) Propound models for extrapolation of sparse hydrology data;

f) Based on the above, prepare the detailed scope and methodology for work to be undertaken under the present study.

**Development and Financing Models:**

a) Review current practices in the development of hydropower in Cambodia, assess their appropriateness and transparency;

b) Propound preliminary models for development and financing (including private, public/private, suggesting risks mitigation measures on private financing) for hydropower projects in the near- to medium-term for domestic use and in the long-term for export to
neighboring countries taking into account the regional interconnection and power trade scenarios (GMS and ASEAN)

c) Based on the above, suggest further detailed work to be undertaken in Phase II.

Transfer of Technology and Training:

a) Develop and transfer (preferably user-friendly) design, hydrological, environmental, social and financial models to be used for the studies and for use by agencies involved in hydropower development;

b) Implement hands-on training in the methodology and programs/models and transfer know-how to MIME staff. Propose/recommend ways to ensure sustainability of the technology transfer.

Workshop

4. At a workshop to be attended by various stakeholders (Electricite du Cambodge (EDC); IDA, ADB and other parties involved in hydropower development), present the findings of Phase I, discuss the methodology and work plan and reach consensus on the scope of work for Phase II. This would include demarcation of work to be carried out under the present study and ongoing work by other agencies, to avoid duplication of effort.

Phase II

5. The scope of work under Phase II would comprise but not be limited to:

a) Update hydrology and hydro-meteorology data (including recommendations for and installation of gauging stations for future data collection);

b) Extrapolate hydrology data as necessary and determine annual average and peak flows;

c) Review and update geological and geo-technical data; undertake key additional site tests as necessary and feasible;

d) Assist MIME in developing: (i) Basic Designs; (ii) Capital Cost Estimates; and (iii) Environmental and Social Impact Evaluations;

e) Using the agreed design, hydrological, environmental, social and financial models, developed in Phase 1, develop a Project Ranking Table for hydropower projects (including, interalia MW Capacity, Gwh capability, capital costs, economic and financial indicators, weighted per capita costs that include environmental and social impacts);

f) In coordination with the Power System Development Plan Study (para. 1), establish the most appropriate sequence for development of hydropower for domestic use and export, taking into consideration the domestic power demand and the salability of Cambodian hydropower to neighboring countries;
g) Propose development and financing strategies for selected hydropower projects and prepare detailed documents for a Pilot project (including solicitation, Implementation Agreement (IA) and PPA);

h) In line with the objective C, provide on the job training and hands on know-how to MIME staff on project planning, engineering and design works and in field data collection.

Reports

6. The following reports shall be submitted:

   a) An Inception Report - within one month of commencement of study outlining the Consultant’s preliminary findings and proposals.

   b) Phase I Report – within 3−6 months of commencement of the study, providing information detailed in para. 3 above for discussion at a workshop.

   c) Phase II Report (Draft Final) – within 12 months of approval to proceed following the Workshop.


   e) Progress Reports – Quarterly, outlining work progress and highlighting issues.

Conduct of the Assignment

7. With a view to maximizing transfer of technology and achieving hands-on training of staff of MIME, it is expected that almost 90% of the staff effort for the study would be expended in Cambodia.

Expertise and Effort

8. The following expertise is envisaged for the study (tentative):

   Hydropower Planner/Hydropower Economist 12 SM
   Hydrologist/hydrological modeler 3 SM
   Environmental and Social Expert(s) 3 SM

References

- Mekong mainstream Run-Of-River Hydropower – Acres International Ltd., 1994
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DS = Desk Study;  PFS = Pre-feasibility Study; FS = Feasibility Study
ANNEX 3

Cambodia: Regulatory framework for Oil and Gas Exploration and Production

Terms of Reference

Introduction

1. Cambodia’s petroleum industry is in the early stages of development. Due to years of civil war and unrest, little exploration and production activities were undertaken, and fuel needs have been met entirely through imports. Oil and gas exploration and production (E&P) is a relatively new phenomenon in Cambodia, and a reported offshore discovery in December 2004 has created great interest in hydrocarbons industry in the country. Government of Cambodia is keen to foster private sector interest in the exploration and production of oil and gas in the offshore and onshore blocks and related infrastructure, and is also prepared to forge public-private partnerships, if required. However, for attracting private investments, it is imperative that a clear, predictable and transparent regulatory framework exists so as to provide a level-playing field to all parties concerned. In this respect, a study is proposed to be undertaken to assess the existing situation and recommend improvements in the overall regulatory framework for upstream (off-shore- and onshore) Exploration & Production (E&P) activities.

Study Objectives

2. The study would have the following major objectives:

   e) Assess the existing legal and regulatory framework for the upstream activities and associated infrastructure, to establish the extent to which it is consistent with the national hydrocarbons potential;

   f) Review how policies in effect are formulated and implemented, and how licensing, tariff and other related rules and regulations, model contracts, etc are enforced;

   g) Recommend improvements in the legal and regulatory framework, including fiscal and institutional aspect, as appropriate, for sustainable E&P activity and infrastructure; and

   h) Assist in consensus-building among all stakeholders on regulatory reforms, to enable private-sector participation in the oil and gas sector.

Scope of Work

3. The Consultant shall review all available documents, and conduct meetings with concerned officials, to develop a good understanding of the existing legal and regulatory framework applicable to the upstream activities. In this regard, following would be given particular attention:

   a) Policy framework for energy sector in general, and hydrocarbons in particular. This would also encompass a review of the current framework for private domestic and foreign direct investments, and the actual achievements in recent years.

   b) Current E&P activities (offshore and onshore):
• Negotiation and award of blocks, and monitoring of companies under contract;
• Management of the national petroleum data base; and
• Promotion of new acreage, and use of the data base as a promotional tool.

c) Existing institutional arrangements:
• Institutional responsibilities, and available capacity;
• Finances for promotion, monitoring and oversight of E&P operations; and
• Other related matters.

4. Based on the above review, the Consultant is expected to prepare a General Market Framework (GMF), which would outline the short-, medium- and long-term market structure for the petroleum sector, including description of how the E&P activities would be organized.

5. Major elements of the policy, legal and regulatory framework for E&P activities and related infrastructure development would be identified, and described in some detail. While not being prescriptive, the study is inter alia envisaged to propose:

a) Policy incentives for private sector participation in E&P activities and infrastructure.

b) Revisions, as necessary, in the Petroleum Law, the Regulations (or the Decrees and sub-Decrees), and the Model Contract (based on production-sharing agreements), consistent with good international practices and what is being offered by countries in the region.

c) Modern methodology and approach to handle:
• management of the national petroleum data base, including geological and geophysical maps, magnetic tapes, well logs, cores, etc;
• process under which new concessions are negotiated/awarded;
• promotion of new acreage;
• use of the data base as a promotional tool for private sector upstream investments;
• monitoring of companies under contract; and
• other relevant factors.

d) Measures for the development of related infrastructure.

6. Potential petroleum revenues provide Cambodia with a unique opportunity to lift itself out of its extreme poverty—if the oil revenues are managed efficiently and transparently, and are applied to poverty-reduction programs. The Consultant would be expected to outline an overall framework, which would inter alia include:
• methods for estimation of potential petroleum revenues;
• identification of financial arrangements for holding petroleum revenues (trust funds, etc);
• principles for allocation of petroleum revenues among key priority sectors; and
• oversight arrangements.

7. The Consultant is expected to clarify institutional responsibilities and recommend measures for implementation of the proposed arrangements for organizing the E&P activities and related development of infrastructure in Cambodia. This would also include identification of appropriate capacity-building activities for different institutions.
8. Based on the recommendations of this Study, the consultant is expected to make recommendations on further work on the major components of the regulatory framework, along with time and cost estimates, including *inter alia*: (a) redrafting of Laws, Rules, Regulations and Model Contracts; (b) design of E&P data bases and promotional programs; (c) incentive package for the development of related infrastructure; (d) capacity-building for monitoring and oversight of E&P operations; and (e) petroleum revenue management program.

**Consultation with stakeholders, consensus-building and dissemination workshop**

9. In view of the importance of this Study, it is envisaged that the Consultant would hold detailed consultations with stakeholders (Government, EAC, CNPA, IOC, Donor agencies, etc) at each stage. This is considered essential in order to evolve consensus on the revisions to the existing regulatory framework, and in order to enable the private sector to play a more significant role in the oil and gas sectors. It is also expected that the results of the Study at its conclusion would be disseminated at a Workshop among a wider cross-section of the society, so that there is a broad agreement on the long-term regulatory framework for the E&P activities in Cambodia.

**Schedule of Work and Deliverables**

10. The consultant is expected to provide the required services at various places and times, as required by the Government of Cambodia. The estimated total effort is 10 man-months, and the Study is estimated to be completed in about 6 months. Following are expected to be the major deliverables:

- **Inception Report**: The Consultant would be required to submit the inception report followed by a detailed presentation, no later than four weeks of the date of contract signing. The report shall encompass progress made by the Consultant in the first four weeks. It shall provide activity plan / flow chart, detailing milestones and respective indicative completion dates. It shall also include details of resources being employed to meet the specified milestones / deadlines.

- **Draft Report on the Existing situation**: The Consultant would submit a draft report on review of the existing situation no later than ten weeks of the date of contract signing, which would *inter alia* include:
  - Diagnosis of the policies in effect, origin, appropriateness and relevance;
  - Diagnosis of the legal framework from the perspective of policy tools, and its consistency in terms of modern approaches etc.;
  - Existing situation *viz-a-viz* E&P activity, infrastructure development and private sector participation;
  - Diagnosis of institutions capability to deliver – staff, means, results etc.

- **Draft Report on the Proposed Framework, and Consultation**: The Consultant would formulate its recommendations on policy, legal and regulatory, and institutional issues, and also outline an implementation plan, which would be placed before the stakeholders for consultations, no later than twenty weeks of the date of contract signing.

- **Draft Final Report**: The Consultant would provide the report covering all aspects of the Study, including the description of the existing situation, proposed framework,
in institutional aspects, petroleum revenue management and recommendations on further work, no later than twenty-four weeks from the date of contract signing.

- **Dissemination Workshop, and Final Report:** The Consultant would organize the Workshop, and submit the Final Reports, prior to the conclusion of the Study in twenty-six weeks from the date of contract signing.

**Coordination**

11. The consultant is expected to maintain close coordination with the client, and with all entities in the petroleum sector in Cambodia. The consultant is also expected to maintain close liaison with donor agencies (World Bank, ADB, JBIC, -----, etc). The Client and donor agencies would try to facilitate provision of earlier studies, data, and access to other information and also assist in arranging meetings with concerned officials.

**Expertise and Effort**

12. Based on the overall effort estimated for the Study, following skills are envisaged:

- Sector restructuring and reforms specialist 2 man-months
- E&P specialist 2 man-month
- Regulatory design expert 5 man-months
- Institutional design and capacity-building expert 1 man-month
ANNEX 4

Power Sector Efficiency
Performance of Electricité du Cambodge (EDC)
Consulting Study – Terms of Reference
Draft

Introduction

With the objective of assisting the Government of Cambodia (GOC) in formulating an Energy Strategy for Cambodia, a recent World Bank Paper26 (attached) reviews the progress made by Cambodia’s Energy Sector over about the last decade, presents its current status and identifies issues that need to be addressed for an efficient evolution of the sector. The Paper proposes conducting a number of in-depth consulting studies, whose findings would underpin the sector’s strategy. In regard to the Power Sub-Sector, these consulting studies are grouped under three key Modules – Module I (Power Sector Governance - Roles of the concerned Ministries and formulation of Overall Sector Policy); Module II (Power Sector Regulation – Regulatory Framework and the role of the Electricity Authority of Cambodia {EAC}); and Module III (Power Sector Efficiency and the performance of the Electricité du Cambodge {EDC}). The Terms of Reference for this consulting study pertain to Module III.

Objectives and Scope

The main objective of the proposed consulting study is to arrive at short- to medium-term recommendations to enhance the “efficiency” of the Power Sub-Sector as a whole, focusing on certain specific aspects of the operations of its key player, the Electricité du Cambodge (EDC). The scope of the study would be classified under the following three heads:

• A. Institutional Efficiency: This would cover, but not be limited to: (i) Organizational Structure; (ii) Administration; (iii) Materials Management (Purchasing and Stores); (iv) Human Resources Management (Staff Development); (v) Accounting, Auditing, Finance and Financial Management; (vi) Operation and Maintenance Practices; (vii) Marketing and Sales (Metering and Billing);

• B. System Efficiency: This would cover: (i) Power Generation Efficiency and Reliability; (ii) Distribution System Efficiency and Reliability; and (iii) Demand Side Management and Electricity Utilization Efficiency; and

• C. Tariffs and Taxation Efficiency: This would cover: (i) Electricity Tariffs and their rationalization; and (ii) Taxation of Fuel and Electrical energy and its impact on the sub-sector and the economy.

Specifically excluded from the scope of this study is consideration of: (i) Rural Electrification; (ii) Renewable Energy development; (iii) Power Development Planning; and (iv) Hydropower Planning.

Issues to be Addressed and Outputs

The Consultant is expected to develop a set of practical and implementable proposals for improving the efficiency of the power sector and its key stakeholder, EDC. In developing its detailed work-plan, the Consultant would be required to: (i) refer to issues that have been identified in the aforementioned World Bank Paper (only some of which may be repeated here); (ii) identify further issues, if any, through discussions with the Ministry of Industry, Mines and Energy (MIME) and EDC; and (iii) refer to existing and ongoing studies so that its work is not duplicated (see References attached). In all areas of its work the Consultant should deliver an implementation plan, cost estimates, and draft TORs for those recommendation for which the client will need to engage implementation consultants. The Consultant is expected to draw comparisons with relevant utilities in the region and outside, and set appropriate efficiency benchmarks.

The Consultant is required to organize workshops of key stakeholders at various stages of the consulting services, to discuss the diagnostic assessment of identified issues and current institutional arrangements, and later, draft and final recommendations and proposals. Key proposals and findings will also need to be made available in an appropriate format so that they can be posted on a relevant website for wider dissemination. Moreover, the Consultant is expected to develop an appropriate training program to develop and further strengthen the capacities of EDC so that it could carry out its functions and responsibilities in relation to this Study. The training program will be expected to include the dissemination of all procedural guideline documents.

The following paras. outline the study’s key requirements and highlight the emphasis to be placed in developing the outputs and recommendations:

- **A. Institutional Efficiency:** In formulating recommendations on the Organizational Structure, the Consultant would need to identify ways in which distinct institutional arrangements between the Government and EDC would maximize EDC's operational efficiency and sustainability. It should take into account: (i) the Government’s vision and plans for future structure of the industry and the market, assess its appropriateness and timing and propose preparatory steps for internal restructuring of EDC (cost- and profit-centers approach); and (ii) the evolution of the role that EDC should assume as sector reforms unfold, including its autonomy as a Corporation. The Consultant should analyze the level of EDC's autonomy and devise solutions that would ensure that EDC (i) has clear and consistent objectives, i.e. its long term corporate objectives are clearly established, that these would ensure adequate operational and financial performance, and that EDC management has sufficient autonomy to operate according to its corporate objectives; (ii) daily operations are insulated from external political pressure; (iii) management could hire and fire employees and to negotiate conditions of employment; and (iv) control its employees' salaries.

The overall Institutional Efficiency improvement should focus on top management and the Consultant should make recommendations that would strengthen EDC's corporate planning department including the establishment of: (i) appropriate and consistent annual operating objectives; (ii) appropriate management information and reporting system; (iii) appropriate performance indicators to measure achievement of objectives; (iv) properly processed and analyzed operational and performance reports; (v) clear communication channels between upper and lower levels of management; (vi) properly coordinated budgetary procedures and corporate planning; (vii) continuous and adequate monitoring on ongoing projects; (viii) action plans to remedy shortcomings; and (ix) measures that
would hold management accountable for its performance. Likewise, staffing, skills-mix and training would be the key issues in Human Resources Management and the Consultant should provide recommendations to put in place a system of performance-based incentives and an adequate training program that has sufficient resources, structured courses, qualified and motivated trainers and where participants have adequate time for training and incentives to participate. The Consultant should devise a system for manpower planning (including incentive indicators) to measure at the very least manpower turnover as percentage of average workforce, rate of absenteeism, staff vacancies, training costs by employees and the number of employees per MW sold should be designed.

- The review of Financial aspects should concentrate on measures aimed at achieving the financial viability and improving the commercial operation and accounting practices of EDC. Of particular concern should be overdue accounts, disconnection policies for nonpayment, service connection and reconnection policies, outstanding accounts receivables of private and government customers, ageing of accounts receivables, bad debts, billing lags, and variances between planned budget and actual expenditures. It is to be understood that the objective of this study is not to develop detailed forms, charts and procedures for administration and management (most of which have been or are being developed) but to review their appropriateness and make recommendations on improvement in the light of contemplated reforms. Materials management should focus not only on procurement of fuel oil, which is the single largest component of EDC’s operational expenses, but also on inventory and stores control, purchasing and transportation. Operations and Maintenance should emphasize reduction of costs and improvements in reliability. Questions that need to be posed and examined by the Consultants, for instance, should include: (i) Are there appropriate procedures to check the quality and reliability of fuel supply and lubricants? (ii) is maintenance performed according to set schedules? (iii) is dispatch performance optimized?, etc.

- **B. System Efficiency:** The World Bank Issues Paper has recommended the development of five Master Plans for improving the efficiency of the power system. Development of three of these plans would form key outputs of this Consulting study. These are:

  - **Master Plan for Reducing Distribution Losses (Technical and Non-Technical) and Improving System Reliability:** Distribution losses have been reduced from the highs of 30% a decade ago to about 12.7% today. As the demand for electricity grows, losses would increase, unless commensurate measures are taken to strengthen the distribution networks, especially in Phnom Penh and in major provincial towns. It is, therefore, proposed that loss reduction be continued as an ongoing activity and the Consultant would need to prepare a Master Plan document for loss reduction. This exercise, would inter-alia require a cost-benefit analysis to assess the point at which the cost of incremental investments equals the benefit of reduced losses, as a guide to distribution network development. The Master Plan should also cover the complimentary aspect of improving the system reliability, balancing the cost of increased reliability with the benefits to consumers, more of which would take supply from EDC rather than self-generate, if EDC supply were reliable.

  - **Master Plan for Reducing Costs of Diesel Generation:** While the national Transmission Grid would evolve in the medium- to long-term, and till such time that more cost effective large-scale domestic generation sources and low-cost
electricity imports come into play, Cambodia would perforce have to rely on diesel/HFO based generation in the near- to medium term. EDC is already making concerted efforts to reduce costs, through measures such as rehabilitation and replacement of inefficient generator sets. The Consultant would need to review these ongoing efforts and come up with a Master Plan for generation cost reduction and improvement in reliability.

- Master Plan for Demand Side Management and Efficiency Improvement (DSM): While supply side efficiency improvement would appear to yield “tangible” benefits, more “cost-effective” benefits could result from investments in DSM. Currently there is no systematic effort in the fields of DSM and Energy Efficiency in Cambodia. (see ESMAP Report xxxx, by Charpantier, probably unpublished). The Consultant would need to identify opportunities and barriers to DSM and prepare a Master Plan that would lay the foundations for DSM in Cambodia, including an analysis of costs and benefits and identification of institutional requirements. (for guidance, see World Bank Project Appraisal Document - Laos SPRE II Project ,where a similar exercise is being undertaken).

- C. Tariff and Taxation Efficiency: EDC cannot, and does not operate efficiently because its revenues do not cover its costs, which in turn, is due to its inability to charge adequate tariffs. However, average electricity tariffs in Cambodia, the poorest country in East Asia in per capita terms, are very high by international standards, exceeding USc 12.5/kwh; a key contributor being the high cost of imported fuel oil, exacerbated by very heavy taxes. A thorough review of the level and structure of tariffs, especially in Phnom Penh is now imperative, taking into consideration: (i) the financial viability of EDC; (ii) the long run marginal costs of system expansion; and (iii) distortions in the tariff structure leading to heavy and un-healthy cross-subsidization of domestic consumers by commercial and industrial consumers. Likewise, the impact of heavy taxes on fuel oil needs to be carefully evaluated, weighing the positive impact of a possible reduction in taxes on electricity demand (and perhaps the economy in general) as well as fuel smuggling, vis-à-vis its negative impact on Government revenues. The Consultant would need to provide recommendations on Electricity Tariffs in the near- to medium- term; and develop an econometric model that would enable assessment of impact on the economy of taxes on fuel.

Conduct of the Study

The study should be conducted in close cooperation with MIME and EDC and with interaction to the extent necessary with the Electricity Authority of Cambodia (EAC), the Sector Regulator. On matters related to taxation, the Consultant would need to cooperate, additionally with the Ministry of Economy and Finance (MEF) and the International Monetary Fund (IMF) which is currently engaged in Cambodia. The study is proposed to be conducted in two phases as below:

- Phase 1 (Diagnostic) Months 1 - 2

In this phase the Consultant would review the current status of the Power Sub-Sector and outline the key issues that it sees and proposes to address in the study, including the methodologies proposed to be adopted and steps proposed to be taken to fulfill the requirements of the TOR. Special emphasis would be given to the model proposed for the econometric analysis on taxation and data collection for formulating the DSM Master Plan. An Inception Report would be prepared and discussed with the stakeholders –
EDC, MIME, IDA and ADB (most probably in a workshop) – and agreement reached on the various study methodologies, assumptions and parameters, before embarking on Phase 2.

- **Phase 2 (Implementation) Months 3 - 8**

  In this phase the Consultant would undertake the detailed work and produce draft reports for each of the three key “efficiency” themes. In order to make more effective use of management resources of EDC and MIME for reviewing the outputs and recommendations of the study, the Consultant would consolidate these recommendations into the final report. At the end of this phase a Draft Final Report of key proposals and recommendations and steps for implementation of the training program would be submitted and discussed with the stakeholders, in English and Khmer, in both electronic and hard copies. The Consultant is required to facilitate a workshop with a wider group of key stakeholders, following which a Final Report would be submitted, taking the stakeholders’ comments into consideration.

**Consulting Expertise and Duration**

The following key consulting expertise is contemplated. The staff-months are only indicative.

<table>
<thead>
<tr>
<th>Expertise</th>
<th>Staff Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity Utility Management Expert</td>
<td>4 SM</td>
</tr>
<tr>
<td>Financial/Economics Expert (s)</td>
<td>3 SM</td>
</tr>
<tr>
<td>Distribution System Planning Expert</td>
<td>3 SM</td>
</tr>
<tr>
<td>Diesel Power Plant Expert</td>
<td>3 SM</td>
</tr>
<tr>
<td>DSM Expert</td>
<td>3 SM</td>
</tr>
<tr>
<td>Econometric Modelling Expert</td>
<td>3 SM</td>
</tr>
</tbody>
</table>
ANNEX 5

Background Note: Biomass Energy in Cambodia

Biomass is the dominant source of energy used in Cambodia. Biomass fuels make up 85% of the total energy consumption in Cambodia, mainly fuelwood and charcoal, and a small amount from agricultural wastes, straw, palm and dung. Conventional fuels, such as oil for transport make up only 15% of total energy demand. (MIME, 1996)27.

Despite being the most significant energy resource consumed in Cambodia, biomass resources, mainly fuelwood for cooking, have been largely overlooked in energy and forestry planning. Preliminary data from the 2004 Cambodia Socio Economic Survey indicate the rural population, particularly the poor, faces increasing difficulty in accessing forest resources. This is due to depletion of forest resources resulting in larger travel distances28, and security issues from patrols paid by landlords to protect land. The recent Millennium Development Goals and Energy report (UN Energy, 2005) highlights the need for the energy sector reforms to focus on the poor, particularly pertinent given that almost 40% of Cambodia’s population live below the poverty line.

Household Biomass Consumption and Supply

Household energy consumption makes up 86% of all energy consumed in Cambodia, 95% of which is fuelwood, charcoal and less than 2% from other biomass such as rice husk, straw, palm, dung, waste. There are significant differences between rural and urban areas. For example, in Phnom Penh 39% of households use charcoal while in rural areas use 97% fuelwood. The majority of household fuelwood is used for cooking and water boiling, with some used for heating for on cold nights or care for newborn babies.

27 Despite this data being almost 10 years old, this is the most recent energy balance study conducted in Cambodia. See Research and Data Collection for current activities.
28 Interestingly, the typical scenario of women and children facing the burden of collecting firewood does not appear to be significant from the recent CSES. This is assumed to be related to the security issue in forests where the men are more involved in collecting fuelwood.
Wood fuels originate from a variety of sources including natural forests, agricultural land, land conversion, around houses, canals roads and wastes from timber industry and construction. Most fuelwood is collected by rural people in the accessible forest areas or woodlands (Heng, 2002). Land ownership and land rights impact methods and sustainability of extraction. The depletion of forest resources and security access issues is making it increasing difficult for the rural population to access fuelwood from forests. Regions that are forest poor, mainly the central and south east, have a network of fuelwood and charcoal traders that sell fuelwood from other regions.

A rough estimate indicates that 6 million m$^3$ of fuelwood is extracted each year (World Bank et al, 1995), based on an estimate that each person consumes 0.6 m$^3$/year. It is assumed that half of that fuelwood is extracted from forests (Hong, 1997), although this is not backed up by any accurate data or field monitoring. Stock and yield tables for different land types are unavailable, as is information on the sustainability of extraction of fuelwood. MRC/GTZ (1997) classifies 58.6% of land as forest, with a wide difference in forest cover between and within provinces.

The Forest Administration manages the firewood coupe system, with over 15,000 ha devoted to the system (Heng, 2002). The provincial forestry department submits land areas assigned for firewood coupes on an annual basis to the FA and auctioned to companies to exploit, while forestry officials provide technical advice in coupe management (MIME, 2004). However, illegal encroachment by local communities and armed forces, as well as the difficulty in competing with freely exploited wood energy cut illegally from forests outside this system.

A fuelwood flow study for Phnom Penh showed that wood and charcoal was sourced from distant surrounding areas such as Kompong Speu, Kompong Thom, Kompong Chhnang, Kratie, Pursat and that fuelwood extraction is leading to forest loss (FAO, 1998). However, this trading system is intricate and complicated (Burgess some of this fuelwood is made available from landuse change - from areas that are being cleared for agricultural purposes.

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<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Households</strong></td>
<td>81.53</td>
<td>81.39</td>
<td>93.81</td>
<td>108.24</td>
<td>110.601</td>
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<tr>
<td>Wood</td>
<td>77.33</td>
<td>77.33</td>
<td>88.98</td>
<td>102.55</td>
<td>104.73</td>
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<tr>
<td>Charcoal</td>
<td>0.94</td>
<td>0.93</td>
<td>1.05</td>
<td>1.179</td>
<td>1.135</td>
</tr>
<tr>
<td><strong>Service Sector</strong></td>
<td>0.92</td>
<td>0.99</td>
<td>1.42</td>
<td>2.10</td>
<td>3.10</td>
</tr>
<tr>
<td>Wood</td>
<td>0.23</td>
<td>0.23</td>
<td>0.10</td>
<td>0.05</td>
<td>0.03</td>
</tr>
<tr>
<td>Charcoal</td>
<td>0.15</td>
<td>0.15</td>
<td>1.43</td>
<td>1.52</td>
<td>0.165</td>
</tr>
<tr>
<td><strong>Industry</strong></td>
<td>0.40</td>
<td>0.41</td>
<td>0.68</td>
<td>1.10</td>
<td>1.76</td>
</tr>
<tr>
<td>Wood</td>
<td>0.37</td>
<td>0.37</td>
<td>0.62</td>
<td>1.00</td>
<td>1.61</td>
</tr>
<tr>
<td>Charcoal</td>
<td>0.01</td>
<td>0.01</td>
<td>0.22</td>
<td>0.36</td>
<td>0.58</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>94.19</td>
<td>94.58</td>
<td>115.10</td>
<td>138.46</td>
<td>152.24</td>
</tr>
<tr>
<td>Wood</td>
<td>77.72</td>
<td>77.72</td>
<td>89.62</td>
<td>103.55</td>
<td>106.34</td>
</tr>
<tr>
<td>Charcoal</td>
<td>1.10</td>
<td>1.10</td>
<td>1.21</td>
<td>1.37</td>
<td>1.36</td>
</tr>
<tr>
<td>Other biomass</td>
<td>1.75</td>
<td>1.64</td>
<td>1.60</td>
<td>1.56</td>
<td>1.35</td>
</tr>
</tbody>
</table>

Source: MIME, Department of Energy Technique (Heng, 2002)
Industrial and Commercial Biomass Consumption and Supply

Data from MIME’s 1995 energy statistics indicate that 35% of industrial and commercial energy consumption was supplied from biomass energy, mainly fuelwood and charcoal. No recent data exists for the energy demand and supply for this sector and it is assumed to have expanded significantly in the ten years since the data was collected.

Biomass resources, mainly fuelwood and charcoal, are used for a number of industrial activities including brick and tile production, tobacco drying, animal feed production, palm sugar production, rice wine production, fish smoking, bakeries and handicrafts such as pottery. Commercial users include restaurants, street food vendors, laundries and animal rearing. Firewood and charcoal is also used in ceremonies such as weddings, funerals and cremation and daily pagoda life (Burgess, 2000). Fuelwood is also used to produce charcoal, where CFSP estimate that the current inefficient kilns use a ratio of 6:1 (ie 6kgs of fuelwood to produce 1kg of charcoal).

There is little data on the supply sources of fuelwood or this sector. Table 4 highlights some volumes of agricultural wastes that may be available for use in industrial activities.

Table A5-2. Agricultural Crop-Waste Availability

<table>
<thead>
<tr>
<th>Agricultural Product</th>
<th>Production</th>
<th>Fuel Availability</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>47,000 k tones/yr</td>
<td>1,000 k tones/yr</td>
<td>Rice husks are used in brick kilns, particularly in NW and for cooking mainly in forest poor areas.</td>
</tr>
<tr>
<td>Rubber Trees</td>
<td>40k tones rubber</td>
<td>25k tones/yr</td>
<td>Mostly used in brick kilns. It is unknown what quantities, if any, are available for other uses.</td>
</tr>
<tr>
<td>Cashew Nuts</td>
<td>14k tones/yr</td>
<td>10k tones/yr</td>
<td>Most is exported to Vietnam for processing, so most of the waste would be unavailable</td>
</tr>
<tr>
<td>Sugar Cane</td>
<td>160k tones/yr</td>
<td>48k tones/yr</td>
<td>Theoretical value for bagasse production (30% bagasse). There is no sugar refineries in Cambodia and most is used for drinking</td>
</tr>
<tr>
<td>Coconut</td>
<td>? 27k ha</td>
<td>?</td>
<td>There is no coconut processing, and most are transported to towns for drinking and used for unknown purposes.</td>
</tr>
<tr>
<td>Cassava</td>
<td>331k tones/yr</td>
<td>?</td>
<td>Woodchips sold at $23/t</td>
</tr>
</tbody>
</table>

Source: JICA Study, 2005

Biogas

The energy potential of biogas from recoverable animal wastes is estimated at 228 kilotonnes of oil equivalent per year. Since the 1970’s around 500 biogas systems have been installed in Cambodia, using cattle, pig and human waste for gas production. Most systems installed have been the plastic tube digester, which is less durable and many of the systems installed have now failed. Currently a new biogas program, with support from the Dutch government, is being established. They will establish a Biogas Support Program within the agriculture department of MAFF, and aim to subsidize and support the installations of over 17,000 durable biogas units until 2009.
Biomass for Electricity Production

There are only 4 biomass electricity generation facilities in Cambodia, most of which are very small or for research purposes:

- SME Cambodia has installed a 9kwe gasification system as a community energy cooperative. It is fueled from community planted leucaena.
- Nearby, a farmer has built his own gasifier running on rice husks for water pumping.
- CelAgrid (the Centre for Livestock and Agriculture Development) also have a 9kwe system, where staff are researching biomass resources for suitability and efficiency.
- Japan’s NEDO constructed a hybrid biogas engine (2x35kwe) /solar photovoltaic (50kw) system on Mongrethy Co.’s cattle and palm oil farm in Sihanoukville. Cattle excrement and some palm oil wastes are used. The system is mainly a demonstration and research venture, costing over $3m to construct.

A 1.5MW rice husk fired cogeneration unit is proposed by the large rice miller Angkor Kaesekam Roongroong. However, to date they have not been able to achieve financial closure for the project. They will use the waste rice husk that they produce onsite from their rice milling operation.

Currently the REF does not include support for biomass fired electricity generation, however there are plans to incorporate biomass for subsequent phases of the program.

Biofuels

The biofuel industry is showing early signs of development in Cambodia, led by the increasing international demand and sustained increases in oil prices. The Cambodian Government through MIME, is currently negotiating with the Thai Government\(^{29}\) to support the development of biofuels in Cambodia. The program is expected to operate for 18 months, and will involve investigation of opportunities for export of bio-oils. Currently, a local organization, Buddhism for Development, based in Battambang is producing and exporting bio-oils to Thailand.

A local Cambodian organization, Date, are conducting trials of the use of jatropha and kapok oils mainly for direct use in diesel engines, such as those used by REEs. They are also investigating the mechanisms and costs for collection, pressing and quality testing. The Cambodia GVEP team developed a business plan for biofuel production in Cambodia. Recently Mongrethy Co announced they would produce biofuels from their palm oil production in Sihanoukville.

Institutional Arrangements for Biomass and Wood Energy

While MIME are responsible for the management and planning of energy resources, the Forestry Administration of MAFF are responsible for the management and protection of forest resources in Cambodia. Co-operation between these institutions is essential to develop successful wood energy planning, however to date co-operation between FA and MIME is limited. However, the Department of Energy Development is now working to establish a wood energy

\(^{29}\) The Thai Government has established a $3.2 billion biofuel program in Thailand to invest in plantations and biodiesel refineries.
cross sectoral working group. It will comprise participants from MIME, FA, MOE, CFSP (Cambodia Fuelwood Saving Project) and organizations involved in community forestry and forest protection.

MIME is responsible for policy formulation, strategic planning and technical standards for the energy sector Cambodia. The Department of Energy Development is responsible for energy sector planning, consumption and data collection. To date MIME’s planning and strategy focus has been on electricity, including hydropower and renewable electricity to a small extent. MIME’s draft Energy Strategy (2004) includes increased attention to woodfuels.

MAFF is responsible for the management of Cambodia’s forests for the sustainable future and stability of biodiversity through the management of fuel-wood, concession areas and reforestation in concession forestry and community forestry. The objective of the Government is to mobilize the forest resources for socio-economic development ensuring a viable forest industry, to ensure appropriate government revenue and to meet the wood and non-wood product needs of communities and protect its ecological system (Heng, 2002).

Local Commune Planning and Decentralization

The RGC’s decentralization process involves the village and commune planning processes and DANIDA is supporting a Natural Resource Management program under the SEILA process and wood energy could be incorporated. To date, there has been limited incorporation of biomass for energy within this planning process.

Data collection and Research

The Department of Energy Development is currently undertaking primary data collection of household energy demand (including electrical, transport, biomass) across Cambodia, as part of the JICA sponsored updated energy balance for Cambodia. The team have currently surveyed households within 5km radius of each provincial town, totaling over 14,000 households in 24 provinces. A second phase of random sample collection of 20,000 households outside the 5km radius will be conducted late 2005.

A critical gap in data is the source of biomass used by households and industry, particularly the source of fuelwood. There is little information on the sustainability of fuelwood extraction from forests, both directly for nearby communities and for supply to the commercial fuelwood trade. In addition, the most recent research on the commercial fuelwood trade and wood flows was carried out over 8 years ago. It needs to be updated and the scope expanded to across the country and to include both supply and demand.

Biomass Energy Issues Recommendations

It is clear that biomass will be the dominant energy resource consumed in Cambodia for the short and medium term, therefore it is essential to incorporate recognize the contribution of wood energy in the energy balance and to plan for a continued and sustainable supply (Burgess, 2000). This is particularly pertinent given the disparity in fuel wood resources within and between provinces, and the significant impact the lack of access to biomass has on the poor. It is essential to establish good co-operation between the relevant ministries responsible for energy and forestry.
Considering that biomass is the dominant form of energy used in Cambodia, the following issues merit urgent consideration:

- **Policy and Planning** - Historical lack of attention to biomass and wood energy in the energy and forestry planning processes, and limited co-operation between the key institutions responsible for strategy development and planning. Absence of a biomass/wood energy policy framework (including systems for updating information to feed into policy development). Lack of integration of wood energy in poverty reduction strategies and decentralized commune planning process.

- **Sustainability of Supply** - Lack of information on the sources and sustainability of biomass supplies to meet demand and its’ ecological and social impacts. Lack of knowledge of opportunities and preferences for fuel switching.

- **Commercial Biomass Trade** - Absence of a formal and regulated biomass trading and production systems which ensures equitable prices, sustainability of supply and the acknowledgement of its’ contribution to the economy (and avoidance of importation of fossil fuels). Lack of knowledge about the industry, including wood flows across the country, production zones, trading patterns, and its’ overall sustainability.

- **Enhance Biomass Supply** - Lack of attention to proactive programs to enhance biomass supplies and reduce pressure on forest resources, such as village woodlots, tree planting in public areas, agro-forest activities (for household usage) or large scale sustainable biomass supply such as biofuels (for transport) or energy crops or agriculture wastes (for renewable electricity production).

- **Efficiency of Biomass Consumption** - The upcoming closure of funding for the Improved Cookstove Program which is one of the few programs to support wood energy and has successfully disseminated quality cookstoves reduce fuelwood consumption for households and small industries (operated by CFSP and supported by MIME).

In addition, MIME’s draft energy strategy (2004) includes a detailed wood energy section that outlines a number of interventions to improve the sustainable supply and use of biomass in Cambodia, as follows:

- **Improved Forest Management** – resource planning and policy development for sustainable extraction of woodfuels; integration of wood fuel production into community forestry activities; prevention of forest fires during the dry season; prevention of the use of brush parks (an illegal traditional fishing method using branches to create a forest environment in open water);

- **Proactive planting of woodfuels** - tree planting in public areas, village woodlots and agro-forest/on-farm tree farming using fast growing nitrogen fixing species such as leucaena or gliricidia; and encouraging establishment of plantations for dendro power systems, particularly small scale decentralized community participative systems.

- **Efficiency Improvements** – encourage the use of more efficient combustion appliances, such as improved cookstoves for both household and industries (particularly palmsugar, rice wine production and brick kilns). Improving the efficiency of charcoal production (which relates to formalizing the charcoal sector) is essential. Activities in these areas are currently supported by CFSP – Cambodia Fuelwood Saving Project.

- **Fuel switching** - encourage LPG substitution (particularly for household and small industry), use of reliable biogas systems, and accelerated rural electrification.
ANNEX 6

Background Note: Upstream Oil and Gas Industry

China conducted limited geological surveys around the country in the 1950’s. A few years later, Soviet and Polish teams continued to identify the nation’s mineral resources with geological and structural mapping. A joint Cambodian and French effort continued their work in the late 1960’s and eventually in 1972 an Elf and Exxon consortium began offshore drilling. Several dry holes were completed 150km off the Cambodian coast in the Khmer Trough, before the ongoing war put a stop to all activities until the mid-1980’s when survey work was resumed by Vietnamese and Soviet geologists. This work successfully identified Cambodia’s six main basins: Tonle Sap; Mekong; Chung; Khorat; Preah and Kampong Som.

Following political reforms in 1992, a Government licensing round awarded Production Sharing Contracts (PSCs) to drill at offshore Blocks I-IV to Enterprise, Campex and a partnership of Premier Oil and Idemitsu. Nine wells were drilled in the 5,000 km Blocks and three discoveries were made of limited amounts of waxy crude with a low sulphur content and condensate and light gas, but the contracts were all abandoned by the end of 1997 as world oil prices fell dramatically. However, a consortium of two Australian firms, Woodside Petroleum and Cambodian Resources, was awarded PSCs and began exploration of Blocks V and VI in the same year. Again, despite positive 2D seismic survey results, the Blocks were both relinquished after two years.

In recent years attention has moved away from Blocks I to VI to focus on Block A which lies 140 km off Sihanoukville and is comprised of the western parts of Blocks I to IV, the remainder of which have been regrouped into a single study area. In March 2002, exploration rights of Block A were awarded to Chevron Overseas Petroleum and Moeco Cambodia Co., Ltd. a subsidiary of Japan’s Mitsui Oil Exploration Co. The Operator, Chevron, initially owned a 70 percent stake in the 6,278 sq km Block, but later sold a 15 percent interest to LG Caltex, itself a 50/50 joint venture between South Korea’s third largest LG group and Chevron Texaco. Preliminary studies suggested that an estimated 400 million barrels of crude and three trillion cubic feet of gas might be recoverable from the area.

It is generally known that two wells in Block A, Angkea Sel and Kdang Ngea, became operational in early 2003. An aggressive exploration and production program is planned (3D seismic survey, exploration wells, etc). The two current wells are both located in the Khmer Trough, as all previous wells have been, a basin which is considered to share geological similarities with the highly productive Pattani Basin in the Gulf of Thailand.

Part of the Khmer Trough is located in the long contested Overlapping Claims Area (OCA). The history of the 25,000 sq km OCA, which encompasses parts of the Pattani Basin as well, stretches back to 1922 when Thailand and Cambodia both declared an interest in it. Thailand began awarding acreage in the OCA in 1971 to US firm Unocal and British Gas. Later rights were awarded to Japan’s Idemitsu, Chevron Texaco and Anglo-Australian firm Rio Tinto with Japan’s Mitsui. In late 1997 Cambodia awarded the same rights to ConocoPhillips and Idemitsu; Anglo-Australian firm BHP Billiton with Japan’s Inpex; and BHP Billiton with Shell. Cambodia’s onshore basins are also contentious for environmental reasons. In the late 1990’s the Japanese National Oil Corporation (JNOC) conducted US$ 20 million dollars’ worth of aeromagnetic and gravity surveys over the Tonle Sap and Mekong Delta basins. The survey area covered 54,000 sq km and identified two deep sedimentary features in the Tonle Sap basin and a
third in the Mekong basin. The Tonle Sap features lie to the North and West of the lake at depths between 3,500 and 4,500 metres. The CNPA is currently marketing JNOC’s data to international companies who may wish to explore the area further and develop its potential hydrocarbon resources. This is part of the CNPA’s energy strategy that includes completing seismic surveys in the rest of the country, laying pipelines, building power plants and eventually developing large-scale industrial parks.