

**Ministry of Industry, Mines and Energy  
in the Kingdom of Cambodia**

**THE MASTER PLAN STUDY  
ON  
RURAL ELECTRIFICATION  
BY  
RENEWABLE ENERGY  
IN THE KINGDOM OF CAMBODIA**

**FINAL REPORT  
VOLUME 2: MASTER PLAN**

**June 2006**

**Japan International Cooperation Agency**

**NIPPON KOEI CO., LTD., Tokyo  
KRI INTERNATIONAL CORP., Tokyo**

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Cooperation Agency

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## Preface

In response to the request from the Government of the Kingdom of Cambodia, the Government of Japan decided to conduct the Master Plan Study on Rural Electrification by Renewable Energy in the Kingdom of Cambodia, and entrusted the Study to the Japan International Cooperation Agency (JICA).

JICA sent the Study Team, headed by Mr. Akio KATAYAMA of Nippon Koei Co., Ltd. and organized by Nippon Koei Co., Ltd. and KRI International Corp., to Cambodia six times from October 2004 to June 2006.

The Study Team had a series of discussions with the officials concerned of the Government of the Kingdom of Cambodia and Ministry of Industry, Mines and Energy, and conducted related field surveys. After returning to Japan, the Study Team conducted further studies and compiled the final results in this report.

I hope that this report will contribute to the promotion of the plan and to the enhancement of amity between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Kingdom of Cambodia, Ministry of Industry, Mines and Energy for their close cooperation throughout the Study.

June 2006

Tadashi IZAWA  
Vice President  
Japan International Cooperation Agency



**NIPPON KOEI CO., LTD.**

*in association with*

***KRI International Corp.***

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**Japan International Cooperation Agency (JICA) Study Team**

The Master Plan Study on the Rural Electrification by Renewable Energy in the Kingdom of Cambodia

Address: JICA Study Team, C/O Ministry of Industry, Mines and Energy

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June 2006

Mr. Tadashi IZAWA,  
Vice President,  
Japan International Cooperation Agency  
Tokyo, Japan

**LETTER OF TRANSMITTAL**

Dear Sir,

We are pleased to submit herewith the Final Report of the Master Plan Study on Rural Electrification by Renewable Energy in the Kingdom of Cambodia. We, Nippon Koei Co., Ltd. and KRI International Corp., studied the Master Plan for about twenty months from October 2004 to June 2006 under agreement with your Agency.

Presented in the Master Plan are goals of the rural electrification sector of Cambodia with planning time horizon in 2020 as well as the proposed short-term and medium-term policy measures essential for achieving the goals. It has been planned that the rural electrification in Cambodia be accomplished by utilizing two main vehicles, viz., government driven grid extension (on-grid) and private/community driven electrification in the off-grid areas surrounding the on-grid areas.

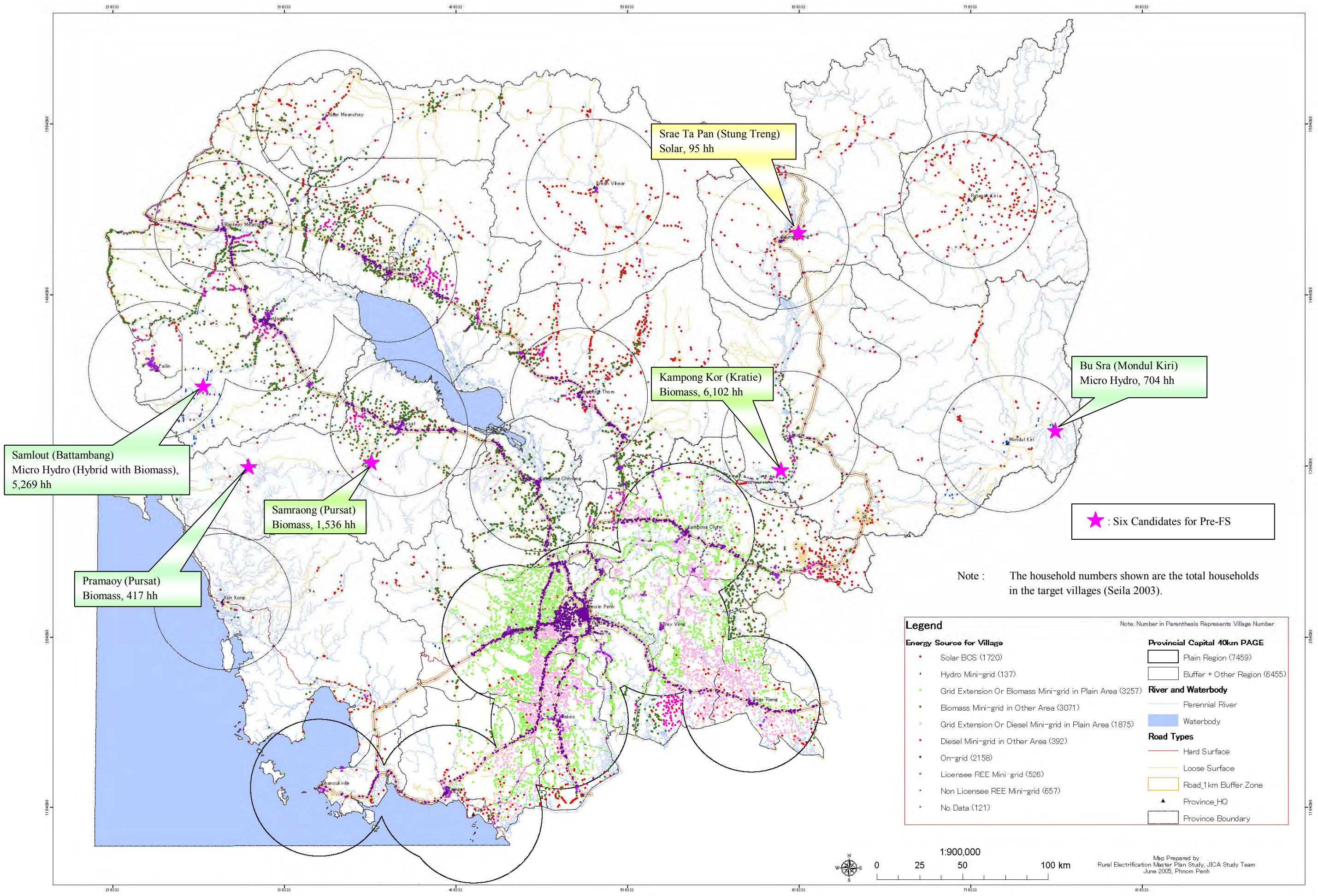
In order to promote awareness and understanding of the private/community driven electrification projects in the off-grid areas, we have - in addition to the Final Report - prepared a visual guide to serve as an illustrated version of the electrification manual. The Visual Guide is in Khmer and English. We hope that the Final Report and the Visual Guide will be instrumental in improving the level of rural electrification as well as for rural development.

We wish to take this opportunity to express our sincere gratitude to entities such as, the Ministry of Industry, Mines and Energy (MIME), Electricity Authority of Cambodia (EAC), Electricite du Cambodge (EdC), and the other related ministries in the Kingdom of Cambodia. We also wish to express our deep gratitude to the Embassy of Japan in Cambodia, the JICA Headquarter, the JICA Cambodia Office, and JICA experts, for the cooperation and assistance they extended to our Study Team during field investigations and studies in the Kingdom of Cambodia.

Very truly yours,

Akio KATAYAMA, Team Leader,

The Master Plan Study  
on Rural Electrification by Renewable Energy  
in the Kingdom of Cambodia



Samlout (Battambang)  
Micro Hydro (Hybrid with Biomass),  
5,269 hh

Samraong (Pursat)  
Biomass, 1,536 hh

Pramaoy (Pursat)  
Biomass, 417 hh

Srae Ta Pan (Stung Treng)  
Solar, 95 hh

Kampong Kor (Kratie)  
Biomass, 6,102 hh

Bu Sra (Mondul Kiri)  
Micro Hydro, 704 hh

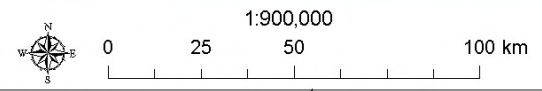
★ : Six Candidates for Pre-FS

Note : The household numbers shown are the total households in the target villages (Seila 2003).

**Legend**

Note: Number in Parenthesis Represents Village Number

<b>Energy Source for Village</b>	<b>Provincial Capital 40km PAGE</b>
• Solar BCS (1720)	□ Plain Region (7459)
• Hydro Mini-grid (137)	□ Buffer + Other Region (6455)
• Grid Extension Or Biomass Mini-grid in Plain Area (3257)	<b>River and Waterbody</b>
• Biomass Mini-grid in Other Area (3071)	— Perennial River
• Grid Extension Or Diesel Mini-grid in Plain Area (1875)	■ Waterbody
• Diesel Mini-grid in Other Area (392)	<b>Road Types</b>
• On-grid (2158)	— Hard Surface
• Licensee REE Mini-grid (526)	— Loose Surface
• Non Licensee REE Mini-grid (657)	— Road_1km Buffer Zone
• No Data (121)	▲ Province_HQ
	□ Province Boundary



Map Prepared by  
Rural Electrification Master Plan Study, JICA Study Team  
June 2005, Phnom Penh

Source of Energy by Village and 6 Candidates for Pre-FS

### Abbreviations

Abbreviation	Description
ADB	Asian Development Bank
Ah	Ampere hour
ASEAN	Association of South East Asian Nations
ATP	Ability to Pay
BCS	Battery Charging Station
CBO	Community Based Organization
CDC	Council of Development for Cambodia
CDM	Clean Development Mechanism
CEC	Community Electricities Cambodia
CF	Community Forestry
CFR	Complementary Function to REF
CIDA	Canadian International Development Agency
DAC	Development Assistance Committee
DIME	Department of Industry, Mines and Energy
DNA	Designated National Authority
EAC	Electricity Authority of Cambodia
EdC	Electricite du Cambodge
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
ESA	Energy Service Agent
ESCO	Energy Service Company
EU	European Union
FIRR	Financial Internal Rate of Return
FS	Feasibility Study
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gas
GIS	Geographic Information System
GS	Grid Substation
GWh	Giga Watt hour (one million kWh)
ha	hectar
HQ	Head Quarters
HV	High Voltage
IBRD	International Bank for Reconstruction and Development
IEE	Initial Environmental Examination
IEIA	Initial Environmental Impact Assessment
IMF	International Monetary Fund
IPP	Independent Power Producer
IRR	Internal Rate of Return
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
KfW	Kreditanstalt für Wiederaufbau
kW	kilo Watt
kWe	kW-electricity
kWh	kW-hour
kWp	kW-photovoltaic
MDG	Millennium Development Goals

<b>Abbreviation</b>	<b>Description</b>
MEF	Ministry of Economy and Finance
MHP	Micro-hydro Power
MIME	Ministry of Industry, Mines and Energy
MOE	Ministry of Environment
MOI	Ministry of Interior
MOWRM	Ministry of Water Resources and Meteorology
MP	Master Plan
MRC	Mekong River Commission
MV	Medium Voltage
MW	Mega Watt
NASA	National Aeronautics and Space Administration
NEDO	The New Energy and Industrial Technology Development Organization
NGO	Non-Governmental Organization
NIS	National Institute of Statistics
O&M	Operation and Maintenance
ODA	Official Development Assistance
PAGE	Potential Area of Grid Electrification
PEC	Provincial Electricity Company
PEU	Provincial Electricity Utility
PPP	Public Private Partnership
RDB	Rural Development Bank
REE	Rural Electricity Enterprise
REF	Rural Electrification Fund
RET	Renewable Energy Technology
RFP	Request for Proposal
RGC	The Royal Government of Cambodia
RPC	Regional Power Company
SA	Special Account
Seila	Seila is a Khmer word that means a foundation stone. The Seila Program initiated officially in 1996 institutes decentralized systems and strategies for poverty alleviation and good governance at the provincial and commune levels.
SHS	Solar Home System
SMEC	Small and Medium Enterprise Cambodia (NGO)
SPC	Special Purpose Company
SW	Scope of Works
TA	Technical Assistance
UNDP	United Nations Development Program
USAID	United States Agency for International Development
VAT	Value Added Tax
VO	Village Organization
WB	World Bank
WTP	Willingness to Pay
WWII	World War II

**THE MASTER PLAN STUDY  
ON  
RURAL ELECTRIFICATION BY RENEWABLE ENERGY  
IN THE KINGDOM OF CAMBODIA**

**FINAL REPORT  
MASTER PLAN**

Volume 1	Summary
Volume 2	Master Plan
Volume 3	Manuals
Volume 4	Pre-feasibility Study
Volume 5	Appendices



# Volume 2 Master Plan

<b>Part 1</b>	<b>Baseline Study</b>
<b>Part 2</b>	<b>Master Plan</b>
<b>Part 3</b>	<b>Rural Electrification Plans</b>

THE MASTER PLAN STUDY  
ON  
RURAL ELECTRIFICATION BY RENEWABLE ENERGY  
IN THE KINGDOM OF CAMBODIA

FINAL REPORT  
VOLUME 2 : MASTER PLAN

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## Part 1 Baseline Study

### 1. INTRODUCTION

#### 1.1 BACKGROUND TO THE STUDY

Following the end of the recent turbulent history in the Kingdom of Cambodia since 1970s, economic activities have focused on the commercial sector within urban areas, having investments from foreign aid agencies. As a result of this urban revival, the disparity between the urban and rural areas have increased substantially in living standards, resulted from different household income, wealth, and poverty level. This has subsequently resulted in social difficulties.



Current Condition of Rural Electrification in Cambodia

It has been recognized worldwide that rural electrification should be a part of comprehensive rural development for poverty alleviation and mitigation of the urban-rural disparity. Therefore, the Royal Government of Cambodia (RGC) plans to promote the rural electrification with a challenging target to achieve 100% level in village electrification by the year 2020. The electrification will be implemented by installing mini-grids powered by renewable energy sources as well as solar power systems. Maximum use of the renewable energy is planned in order to achieve sustainable power supply for rural electrification without substantially increasing fuel import of Cambodia. The Ministry of Industry, Mines and Energy (MIME) and Electricite du Cambodge (EdC) are going to launch an implementation of trunk lines of the National Grid. The Grid will be extended towards Provincial capitals and further to respective peripheries. In parallel with these Grid works, the rural electrification in off-grid areas has been envisaged for implementation as part of the national policy of alleviating the urban-rural disparity.

As the initiative of the policy of the rural electrification sector above, RGC officially requested, in October 2003, implementation of a Master Plan Study on Rural Electrification by Renewable Energy (the Study) from the Government of Japan (GoJ). In response to the request, the Japan International Cooperation Agency (JICA) dispatched a project formation study team in March 2004, which was followed by the preliminary study team in June 2004, to confirm the background and scope of the Study. It was then confirmed that electrification of rural areas, where some 90% of the Nation's population reside suffering from poverty, was an essential issue of the Nation. The electrification has been long awaited by the rural people together with improvements in education and medical treatment. Subsequently, Minutes of Meeting (M/M) for the Study was signed by the Cambodian and JICA on 12 August, 2004. The Study will be conducted based on the M/M and S/W.

## 1.2 OBJECTIVES OF THE STUDY AND SCOPE OF WORK

The overall goal of the Study is to contribute to enhancing the rural living standard in education and medical treatment in the rural areas of Cambodia by improving the current low level of electrification and reducing the high level of power tariff. The purposes of the Study are 1) study of policies to promote electrification in those off-grid areas not serviced yet excluding urban areas and those provinces/districts that can be readily electrified through extension of the transmission system, 2) introduction of renewable energy such as small-hydro, solar/wind power, and biomass energy, and 3) study of institution and organization for sustainable operation and maintenance supported by the appropriate business model, including financial procurement plans. These are aimed at achieving the following objectives:

- (i) To clarify the policy for promoting electrification schemes in rural areas in Cambodia by formulating the Master Plan for rural electrification by renewable energy;
- (ii) To improve the skills of counterparts through joint undertaking of the Master Plan Study and Pre-feasibility Study and to incorporate the necessary technologies identified and outlined during the Study into Manuals; and
- (iii) Through the preparation and finalization of the Manuals, it is expected that the counterparts would gain technologies not only for promoting rural electrification projects but also for reviewing and updating the electrification development plans by themselves.

The JICA Study is to prepare a Master Plan for rural electrification of the off-grid rural areas that supplements the main grid electrification plans. Since there have been a number of existing and ongoing studies and plans similar to the Study like the WB master plan, and NEDO studies, RGC is expecting the JICA Study to organize these existing plans. The JICA Study Team will review and analyze these existing studies and plans; make additional studies and analyses to supplement these; and eventually will produce a comprehensive and integrated Master Plan for the rural electrification of the off-grid areas by renewable energy.

Regarding the relation between the Renewable Energy Action Plan (REAP) and the JICA Master Plan, the JICA Study is positioned in a “Plan” while the REAP in “Actions” as defined in the Policy Framework given in REAP (Diagram 6, p. 43). So it can be said the JICA Master Plan is an upper plan governing the REAP.

The work items to be conducted in the Study are as follows:



**Table 1.1.1 Study Objectives and Scope of Works**

No.	Study Objectives	Scope of Work to Achieve Objectives
1	Master Plan on rural electrification based on renewable energy	Master Plan with planning horizon in the year 2020
2		Development plan of renewable energy on village basis (type and scale of electrification in each scheme)
3		List of electrification schemes in priority order on village basis
4		Project cost estimates, economic and financial analyses
5		Recommendations on institution and organization to promote rural electrification
6	Pre-feasibility Study of candidate sites	Six candidate sites consisting of small hydro (assumed to be 3 sites) and renewable energy such as solar power (also assumed to be 3 sites)
7		Preliminary design, construction plan and project cost estimates
8		Formulation of business model, initial environmental impact assessment if required
9	Manuals to formulate rural electrification plan based on renewable energy	Revision of Master Plan rural electrification utilizing renewable energy
10		Preparation of Manuals for execution of Pre-feasibility Study
11		Methodologies for collection of socioeconomic data, analyses and demand forecasting
12		Methodologies for economic and financial analyses and environmental impact assessment

### 1.3 THE STUDY AREA

S/W defines the Study area as follows:

The Study would cover the rural area of the whole Cambodian territory, excluding Phnom Penh Municipality, urbane areas of Sihanouk Ville, Kep and Pailin and provincial capitals, and their environs.

Areas which have been and will be electrified by grid according to the Transmission Master Plan and EdC's grid extension plan and IPP service areas are excluded. However, areas which have been electrified by battery are included in the Study area.

The Study area above may be redefined as shown in a figure attached to the top of this Interim Report and described below:

(1) Potential Area of Grid Extension (PAGE)

This is an area covered by 22 circles, each of 40 km in radius and centered in respective provincial capitals except for Phnom Penh-Kandal and Kampot-Kep, each group of which is allocated one common circle for their proximity. PAGE should be electrified by both grid extension and the rural electrification program for the off-grid areas as prepared and proposed in the Master Plan.

## (2) National Grid (= EdC grid)

This is defined as the HV transmission grid of EdC and its MV lines extended to outside the EdC supply area.

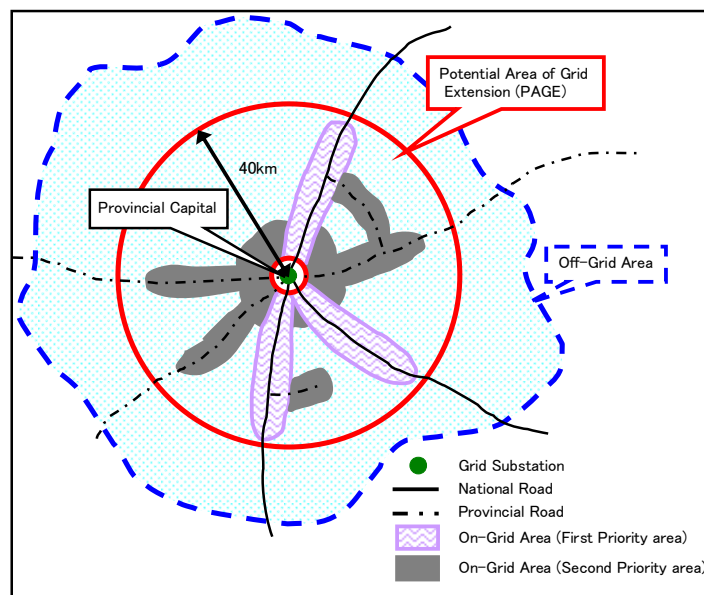
## (3) On-Grid Area

This is defined as those areas that are being serviced, or decided to be covered, by the national grid including MV and LV distribution lines of REE/CBO that have been or decided to be connected to the national grid. As of June 2005, the On-Grid Area is only the one serviced by the Phnom Penh grid of EdC.

## (4) Off-Grid Area

This is the study area (target area) of the Master Plan and can be defined as the whole country area less the On-Grid Area above. It is noted that the On-Grid Area will gradually extend from year to year while the Off-Grid Area will shrink along with progress of the grid extension works. The Off-Grid Area should be electrified by renewable energy in accordance with the program developed and recommended in the Master Plan.

PAGE, the On-Grid Area, and the Off-Grid Area are illustrated below for one province:



Source: JICA Study Team

**Figure 1.3.1 Definition of PAGE, Off-Grid Area, On-Grid Area**

## 1.4 PROFILE OF THE STUDY AREA

The land area of Cambodia is 179,059 km<sup>2</sup>. The population is 12.4 million with an average density 69 person/km<sup>2</sup>. A 50% of the population live in the Plain Region that covers five provinces; Phnom Penh, Kandal, Kampong Cham, Svay Rieng, Prey Veng, and Takeo, where the density is 256 person/km<sup>2</sup>. The density in the other regions is as low as 65 person/km<sup>2</sup> in Tonle Sap Lake Region, 48 in Coastal Region, and 19 in Plateau and Mountain Region with the lowest province at 3 in Mondul Kiri. A 15.0% (1.9 million) of the population reside in urban area while the rest 85.0% (10.9 million) in rural area. The

number of total households is 2,457,074 and average household size is 5.1 person.

Administratively, there are 20 provinces and 4 special cities, 185 districts, 1,621 communes, and 13,911 villages (Seila 2003). The electrification level by grid is 15.4% (8.4% by EdC, 2.9% by REE, and 4.0% by non-licensed REE) including Phnom Penh. Average electricity consumption is 50 kWh per month in the EdC grids. According to a hearing survey to 15 DIME made in 2004/05, about 50% of the rural households have batteries for home lighting.

## 1.5 ORGANIZATION OF MASTER PLAN

The Master Plan for Rural Electrification by Renewable Energy in the Kingdom of Cambodia will be prepared in the following three parts:

- Part 1 Baseline Study
- Part 2 Master Plan
- Part 3 Rural Electrification Plans

The Baseline Study is to review the current situation of the rural electrification sector in order to identify issues and provide basis for developing strategy for promoting rural electrification. It covers organizational structure and institution of rural electrification sector; present situation and issues; socio-economy and electrification demand; present uses, development potential and issues of renewable energy.

Part 2 forms the main part of the Master Plan. It consists of development strategy and development scenario. Covered under the development strategy are policy targets; delineation of the target area; identification of non-electrified villages and demand for rural electrification; renewable energy potential; development frameworks for demand-supply balance, legal institutions and organization for implementation; and power tariff and subsidy system. Development scenario covers basic policy of nationwide electrification and rural electrification policy of off-grid areas.

Part 3 will present guidelines for electrification in the off-grid areas by mini-grids of micro-hydro and biomass power as well as by battery charging stations (BCS) powered by solar panels. These electrification schemes are assessed in view of environmental and economic impacts as well as financial and social impacts. Six priority schemes will be selected for implementation in accordance with established criteria using GIS database.

Volume 3 presents the following two manuals.

- (1) Manual for Updating the Master Plan
- (2) Manual for Planning Rural Electrification by
  - Micro Hydro
  - Biomass Gasification Power
  - Solar BCS

The Manual for updating Master Plan will provide officers in-charge of MIME with procedures to update the village list covering electrification status, to review promising source of energy, and to re-evaluate the priority of implementation.

The Manual for planning rural electrification will introduce to REEs, CEC (Community Electricity Cambodia), DIME officers, NGOs, and villagers what are micro hydro, biomass gasification power, and solar BCS; how to select the most appropriate energy to a village of interest; the procedure to be taken towards implementation. The Manual is a guidebook to understand available options for electrification and required procedures up to application to REF rather than technical references for design.

## 1.6 PRE-FEASIBILITY STUDY OF 6 PROJECTS

M/M prescribes six sites for pre-feasibility study should be selected. In the course of preparing the Master Plan, a long list of village electrification was prepared. Of these, 30 priority schemes were selected in accordance with proposed criteria, followed by field survey. Of the 30 it is further narrowed down to 10 for village survey, which will be continued to August 2005.

The six sites for pre-feasibility study are provisionally selected as listed below:

**Table 1.6.1 List of Six Projects for Pre-Feasibility Study**

No.	Province	Name of Scheme	Type	Nos. of hh to Electrify	Installed Capacity (kW)
Micro Hydro Power					
1	Battam bang	Samlout	Hybrid	4,216	582
2	Mondul Kiri	Bu Sra	Mini-grid	936	80
3	Pursat	Pramaoy	Hybrid	334	45
Biomass Power					
4	Pursat	Samraong	Fuel wood farming	1,230	180
5	Kratie	Kampong Kor	Community forest	4,882	640
Solar Power					
6	Stung Treng	Srae Ta Pan	BCS + PV system	89	4
Total	-	-	-	11,687	1,531

Source: JICA Study Team

The pre-feasibility study on the above was conducted from September 2005.

## 2. LEGAL AND INSTITUTIONAL FRAMEWORK OF RURAL ELECTRIFICATION SECTOR

### 2.1 LEGAL AND REGULATORY FRAMEWORK

The legal and regulatory framework of the rural electrification sector of Cambodia is governed by the following laws:

- Electricity Law
- Royal Decree on Rural Electrification Fund
- Other applicable laws, polices and regulations

#### 2.1.1 Electricity Law

The electricity sector of Cambodia is administered and managed under the Electricity Law which was passed in February 2001. The Law provides a policy framework for the development of a largely unbundled sector, with substantial private sector participation in generation and distribution on a competitive basis. The Law aims to establish:

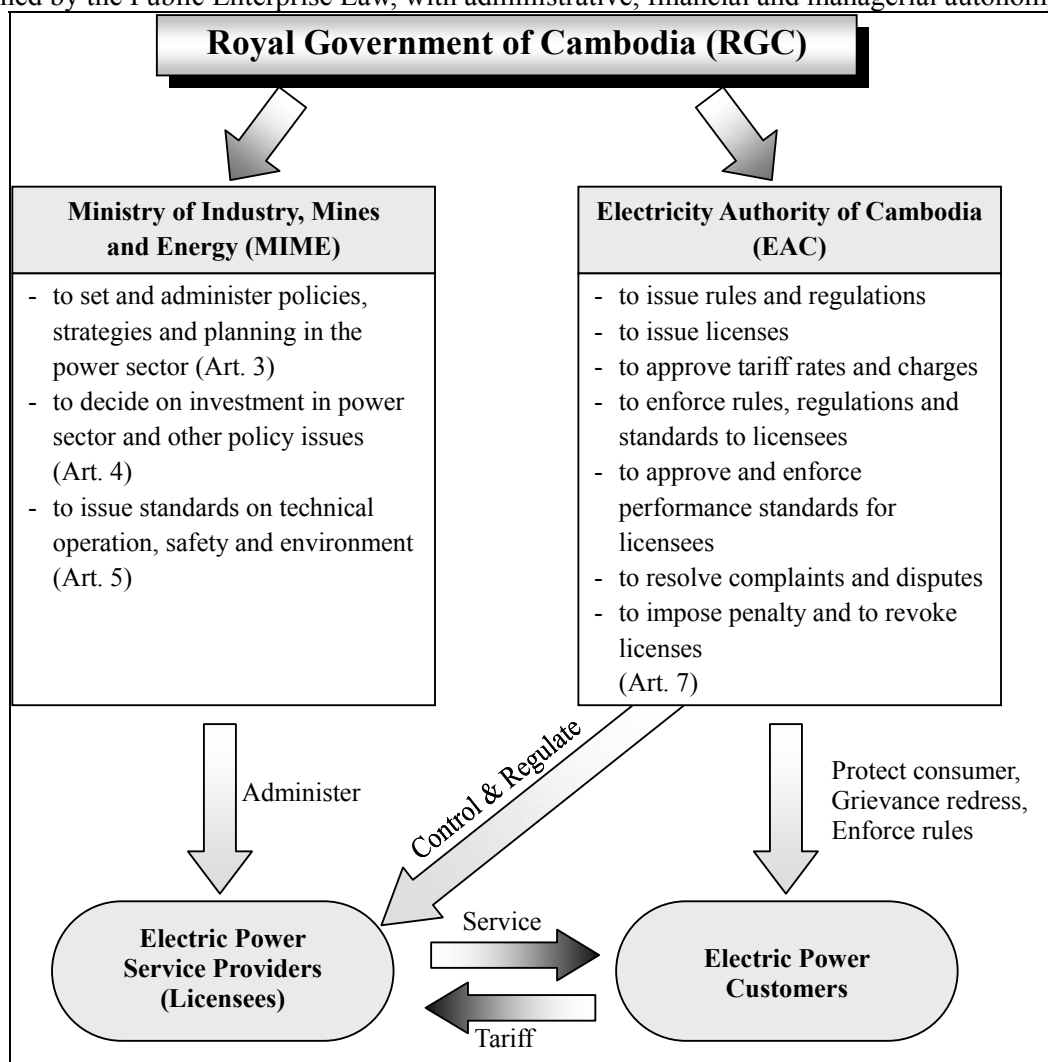
- (a) the principles for operations in the electric power industry;
- (b) favourable conditions for investment and commercial operation;
- (c) the basis for the regulation of service provision;
- (d) the principles for
  - (i) protection of consumers interests to receive reliable services at reasonable cost;
  - (ii) promotion of private ownership of the facilities; and
  - (iii) establishment of competition.
- (e) the principles for granting rights and enforcing obligations;
- (f) the Electricity Authority of Cambodia (EAC) for regulating the electricity services

The Law has two key objectives: (i) establishing an independent regulatory body, EAC; and (ii) liberalizing generation and distribution functions to private sectors. Two functions of policy making and regulation are clearly separated as shown in Figure 2.1.1. The Ministry of Industry, Mines and Energy (MIME) is responsible for policy making roles, including drafting laws, declaring policies, formulating plans, deciding on investments, etc. EAC is responsible for regulatory functions, including licensing service providers, approving tariffs, setting and enforcing performance standards, settling disputes, etc. The liberalization and deregulation of the sector has stimulated the private sector with resulting proliferation of independent power producers (IPP) and rural electricity enterprises (REE) in addition to the traditional public utility, the Electricite du Cambodge (EdC). There are several IPPs in operation and the number of REEs willing to invest in the RE sector is growing rapidly after the Law went into effect.

Each service provider is required to have licenses issued by EAC and to abide by the provisions of the

Law and those of its license, regulations and procedures of EAC. The EAC will see if the licensees use the standards on technical operation, safety and environment issued by MIME. There are 8 types of licenses: transmission, dispatch, distribution, bulk sale, retail, subcontract, and consolidate.

The EdC is a leading service provider and a 100% state-owned power company responsible for generating, transmitting and distributing electric power throughout Cambodia. EdC is a juridical organization established by the Public Enterprise Law, with administrative, financial and managerial autonomy.



Source: JICA Study Team

**Figure 2.1.1 Institutional Responsibility of Electric Power Sector (Stipulated by the Electricity Law)**

## 2.1.2 Decree on Rural Electrification Fund

To promote and stimulate private sector investment into the rural electrification sector, the Rural Electrification Fund (REF) is being established (as of June 2005) as an autonomous public institution under a Royal Decree passed in December 2004. As of June 2005, the REF Board consisting of representatives of 11 stakeholders has been constituted. The objectives of the REF Decree are:

- (a) to promote equitable rural electrification coverage;
- (b) to promote and encourage private sector participation in providing sustainable rural electrification services; and
- (c) to make maximum use and promotion of new and renewable energy technologies

The REF aims at promoting traditional energy-based and renewable energy-based rural electrification by private sector participation.

Under the oversight of the Board the REF Secretariat will provide actual services, including (i) to produce and provide project information; (ii) to evaluate and approve applications for the grant funds; (iii) to undertake planning and project preparation activities; (iv) to monitor and evaluate the performances of the projects supported by the REF; and (v) to maintain a national rural electrification database. After establishing the REF Secretariat (scheduled September 2005), most of the RET-related administrative works MIME is currently undertaking will be transferred to the REF. The MIME will then monitor the compliance of REF funding policies and operations with the national RE policies and strategies.

The REF will be developed by stages under the World Bank (WB) support<sup>1</sup>. The REF-supported RE program would be piloted in the first year of the operation by capping the number of transactions to 6-10 sub-projects in 3-4 provinces rather than a full-fledged implementation of the REF from the start. It is the WB intention that, based on the experience and lessons gained from the pilot REF project, the REF criteria and operations would be revised before proceeding with the main phase.

### 2.1.3 Other Applicable Laws, Policies and Regulations

The general legal framework applicable to RE sector development includes the following though legislation remains incomplete or unclear:

- Decree on private participation in the electric power sector;
- Commercial, corporate and bankruptcy laws;
- Laws of land and right-of-way; and
- Environmental laws.

The Sub-Decree on promoting Private Sector Participation (PSP) on which the Electricity Law lays stress has been drafted. The objectives of the Sub-Decree are: (i) to attract private sector investment in the power generation and RE projects; (ii) to clarify under what rules and conditions the private and public sector entities can develop, construct and operate the electric power projects; (iii) to clarify the public sector roles and responsibilities; and (iv) to establish a transparent and efficient procurement process for private power projects. This law stipulates a transparent and predictable process of investment promotion, including clear division of roles and duties of public and private entities, which is one of the key factors in the private sector decision to enter the RE market.

Legislation governing land ownership, resettlement and compensation in Cambodia includes the Land Law of 1992 (being revised) and the Constitution. There are further decrees and edicts that affect land

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<sup>1</sup> The Rural Electrification and Transmission (RE&T) Project approved by WB in Dec. 2004. MIME website ([www.recambodia.org/](http://www.recambodia.org/)) reveals the outline of the REF pilot scheme.

ownership. In Prime Ministerial Edict of 1999, measures to eliminate anarchical grabbing, declares public land on the verge of roads and railways must not be occupied.

The status and relevance of consumer and business protection, taxation and company law has been published in a guide to investment in Cambodia by the Dept. of Legal Affairs, including Laws & Regulations on Investment of 1999.

With regards to environmental laws, policies and regulations, the Ministry of Environment (MoE) prepared a “National Environmental Action Plan 1998-2002”. The Action Plan has been adopted, reviewed and revised in a rolling plan system, which includes the following regulations applicable to the electricity sector: (i) environmental and safety standards; (ii) guidelines for prospective investors on Environmental Impact Assessment (EIA); (iii) Sub-Decree specifying requirements and procedures for EIA and Initial EIA; (iv) specific guidelines for environmental assessment for thermal power stations and for power transmission lines; and (v) Sub-Decree for water pollution ; and (vi) national resettlement policy for Cambodia.

#### **2.1.4 Renewable Energy Policy**

The renewable energy policy is being drafted as of May 2005. The RGC has expressed its commitment to promote renewables for rural electrification and has adopted a 10-year Renewable Energy Action Plan (REAP) prepared in May 2003 (see Chap. 3.8.2 for details). The REAP, the renewable energy strategy program, bore fruits in realization of WB-financed Rural Electrification and Transmission Project and succeeding legislation of the REF as mentioned above. The role of renewable energy policy implementation will be gradually transferred from the MIME (policy maker) to the REF (policy implementer) from now on<sup>2</sup>.

## **2.2 ADMINISTRATIVE STRUCTURE**

### **2.2.1 Outline**

The main institutions in the electricity sector are the MIME, EAC, and service providers (public and private operators). Institutional responsibilities of main players are shown in Figure 2.2.1. Responsibility for public electricity supply rests with MIMI and EdC. For the RE sector EdC is responsible for on-grid system and MIME, for off-grid system (mini-grid), though demarcation of the two systems is not clearly defined.

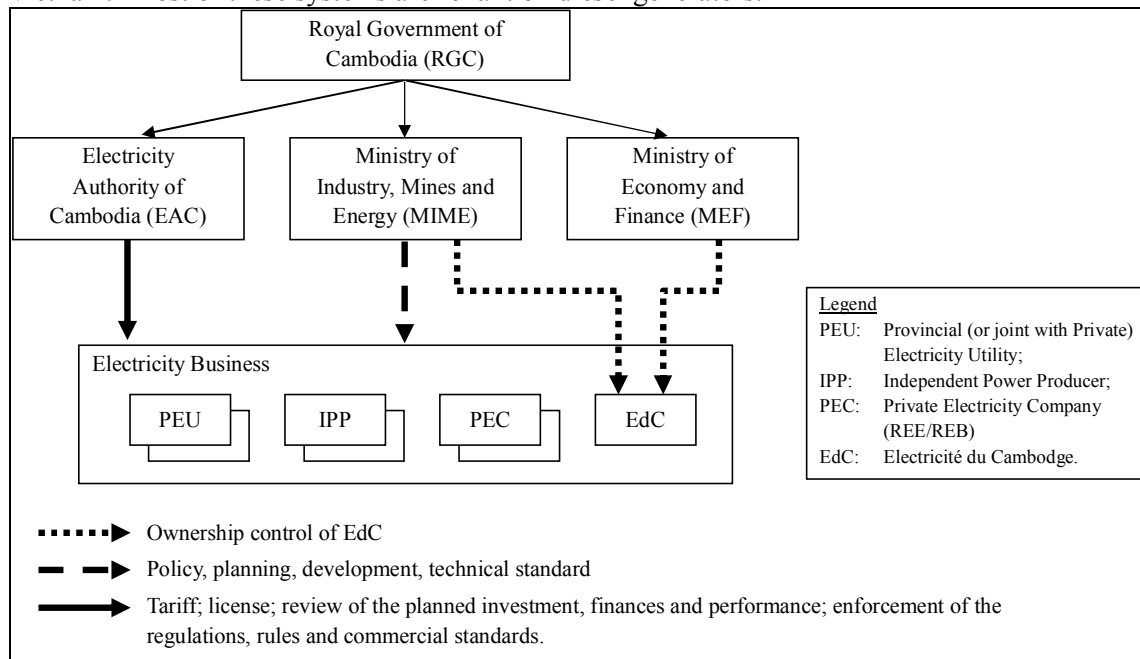
As discussed in Chap.3, the present electric supply system is fragmented into 24 isolated power systems centered on major cities and provincial towns. In addition, according to the Meritec Report<sup>3</sup>, there are estimated 600 REEs of various sizes operating mainly in rural areas. There is also a mix of household

<sup>2</sup> In our progress report (May 2005) we discussed the need of renewable energy law and setting up of a renewable energy center . This idea, however, failed to obtain unanimous supports from the parties concerned, including WB officials and MIME officials concerned. They argued the REF is now launching to take the proposed role and cannot see any strong reason to establish a separate institution. If the pilot REF project needs improvement as it goes, there might come up with possibility of discussion of such idea, but it is not appropriate time to discuss the idea now.

<sup>3</sup> Meritec: “Final Report on RE Strategy & Programme (Task V)”, March 2001



stand-alone systems such as battery systems (most popular) and limited numbers of solar PV and Pico hydro systems. Moreover, recently, cross-border supplies at LV and MV are formalized with Thailand and Vietnam. Most of these systems are reliant on diesel generators.



Source: MIME

**Figure 2.2.1 Structure of Cambodia’s Electric Power Sector**

The lack of HV transmission systems, absence of large scale thermal and hydropower stations under operation and the high cost of diesel fuel oil have resulted in Cambodia suffering from high price for electricity as discussed in Chap. 2.3.

### 2.2.2 Ministry of Industry, Mines and Energy (MIME)

MIME is responsible for setting and administrating the government policies, strategies and planning in the power sector. More specific responsibilities include<sup>4</sup>:

- Approval of investments in the rehabilitation and development of power sector in the short, medium and long term;
- Developing policies and strategies related to restructuring, private sector participation and privatization of public utilities;
- Promotion of the use of indigenous energy resources in the generation of electricity;
- Planning related to the export and import of electricity, as well as approval of electricity export/import agreements;
- Planning/approval of subsidies to specific classes of customers and priorities regarding consumers of electricity;
- Promotion of efficiency in generation, transmission, distribution and consumption of electricity;
- Creation of a comprehensive electricity conservation program for Cambodia;
- Development of electricity sector emergency and energy security strategies; and
- Issuing and publishing standards related to technical operation, safety and environment.

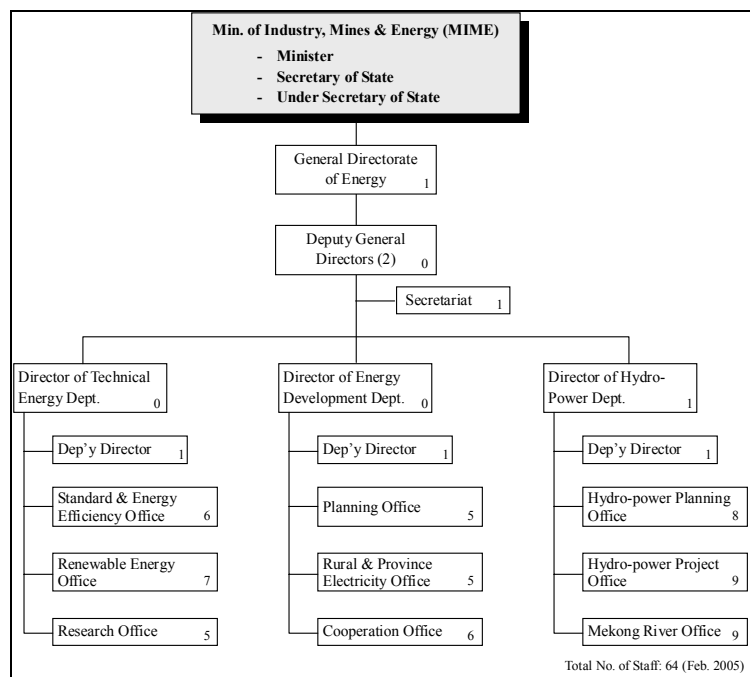
Under the Minister of MIME, the Secretary of State and the Under Secretary of State are in charge of the energy sector. The General Directorate of Energy has three departments of technical energy, energy development and hydropower, as shown in Figure 2.2.2. One of the MIME's important activities is its leading role in encouraging the development of renewable energy technologies (RETs) in the rural areas. This activity is carried out by the Technical Energy Department and currently includes solar, biomass/biogas as well as pico hydro systems. Meanwhile, the Hydro-Power Department deals with the identification and development of mini, small, medium and large hydro systems. It is not clear which department deals with micro hydro (1 to 500kW). This should be clarified. Overall power sector policy planning is handled by the Department of Energy Development.

Before EAC was established, MIME managed the registration and licensing of REEs. Enterprises that owned a total generating capacity of 125kVA or more registered at MIME offices in Phnom Penh and those having less than 125kVA registered with DIMEs (provincial offices of MIME). After EAC was established in 2001, MIME/DIMEs have appraised and approved investment proposals submitted by REEs by issuing concession letters to them. The authorized REEs then apply for licenses to EAC according to the Electricity Law.

In the provinces, DIMEs have managed the provincial systems. After enactment of the Electricity Law demanding separation of policy making and operation, ownership and operational responsibility are gradually transferred to EdC and PEC. As of Feb. 2005, of the 24 provincial towns and cities, 10 systems are owned by DIMEs and 14 ones are managed by EdC. O&M of 9 DIMEs' owned systems are transferred to PEC (Provincial Electricity Company).

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<sup>4</sup> Based on Articles 3, 4 and 5 of the Electricity Law.



Note: The member of each block indicates the number of staff as of Feb. 2005.

Source: MIME

**Figure 2.2.2 Organization Chart of MIME Energy Department**

### 2.2.3 Electricity Authority of Cambodia (EAC)

The EAC was established in 2001 under the Electricity Law. The EAC is responsible for control and regulation of the provision of electricity services in Cambodia. The responsibilities of EAC includes<sup>5</sup>:

- (a) to issue, revise, suspend, revoke or deny the licenses for the provision of electric power services;
- (b) to approve tariff rates and charges and terms and conditions of electric power services of licensees;
- (c) to enforce regulations, procedures and standards for investment programs by licensees;
- (d) to review the financial activities and corporate organization structure of licensees;
- (e) to approve and enforce the performance standards for licensees;
- (f) to evaluate and resolve consumers complaints and contract disputes involving licensees;
- (g) to approve and enforce a uniform system of accounts for all licensees;
- (h) to prepare and publish reports of power sector and relevant information received from licensees;
- (i) to prescribe fees applicable to licensees;
- (j) to determine the procedures for informing the public about its activities within its duties;
- (k) to issue rules and regulations and to make appropriate orders, and to issue temporary and permanent injunction for electric power services;
- (l) to impose monetary penalty, disconnect power supply, suspend or revoke the license for violations of the Law, standards and regulation;

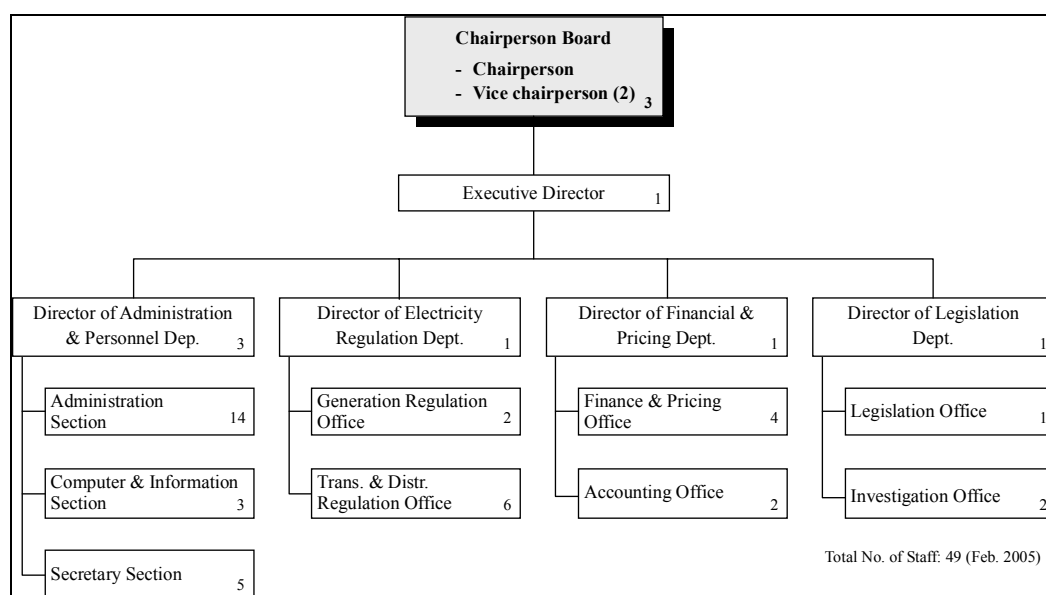
<sup>5</sup> Based on Article 7 of the Electricity Law.

- (m) to require the electric power service providers and the consumers to obey the rules relating to the national energy security, economic, environmental and other government policies;
- (n) to perform any other function incidental or consequential to any of the duties; and
- (o) to establish the terms and conditions of employment of the officers or employees.

The organization chart of EAC is shown in Figure 2.2.3. The Chairperson Board consisting of three members (Chairperson and two vice chairperson) is the top decision making organ. Under the Chairman Board, a secretariat is organized. An Executive Director is assigned as the top of the secretariat which is composed of 4 departments.

The expenditure of EAC for its management and operation is borne by all the electric power service providers in the form of paying license fees. The fees are set by types of licenses<sup>6</sup>. The maximum amounts of license fees were determined by a Sub-Decree issued in Dec. 2001.

Licensing status is as follows. As of Nov. 30, 2004, EAC issued a total of 107 licenses with a breakdown of 88 consolidated, 11 generations, and 8 distributions<sup>7</sup>. The locations of licensees service areas are shown in Figure 2.2.4. About 90 licensees are operating in rural areas, which indicates there has been significant private sector investment by the REEs in recent years (after enactment of the Electricity Law). The EAC anticipate 8 REEs will be licensed by the end of 2005 and the total licensees will reach about 115. Majority of REEs (estimated at 600) have not obtained the EAC licenses. This low capture of EAC licenses by remaining REEs is caused by various reasons, including (i) lack of reliable and continuous supply of services; (ii) status of more than one operators serving the same area (EAC only able to license one operator for one area); and (iii) difficulty in identifying operators in remote, isolated areas.



Source: EAC, Note: The member of each block indicates the number of staff as of Feb. 2005.

**Figure 2.2.3 Organization Chart of EAC**

In addition to licensing operation EAC is also active in drafting and issuing of various regulations,

<sup>6</sup> Fees as of Feb. 2005 are: 1.60 Riels per kWh for generation/power purchase; 0.60 Riels per kWh for transmission; 1.10 Riels per kWh for distribution and sale; and 0.50 Riels per kWh for retail.

<sup>7</sup> See EAC website ([www.eac.gov.kh](http://www.eac.gov.kh)) for details of the licensees.

procedures, rules, etc as stipulated by the Electricity Law. As of Feb. 2005, the documents have been already prepared or to prepared include:

Regulations:

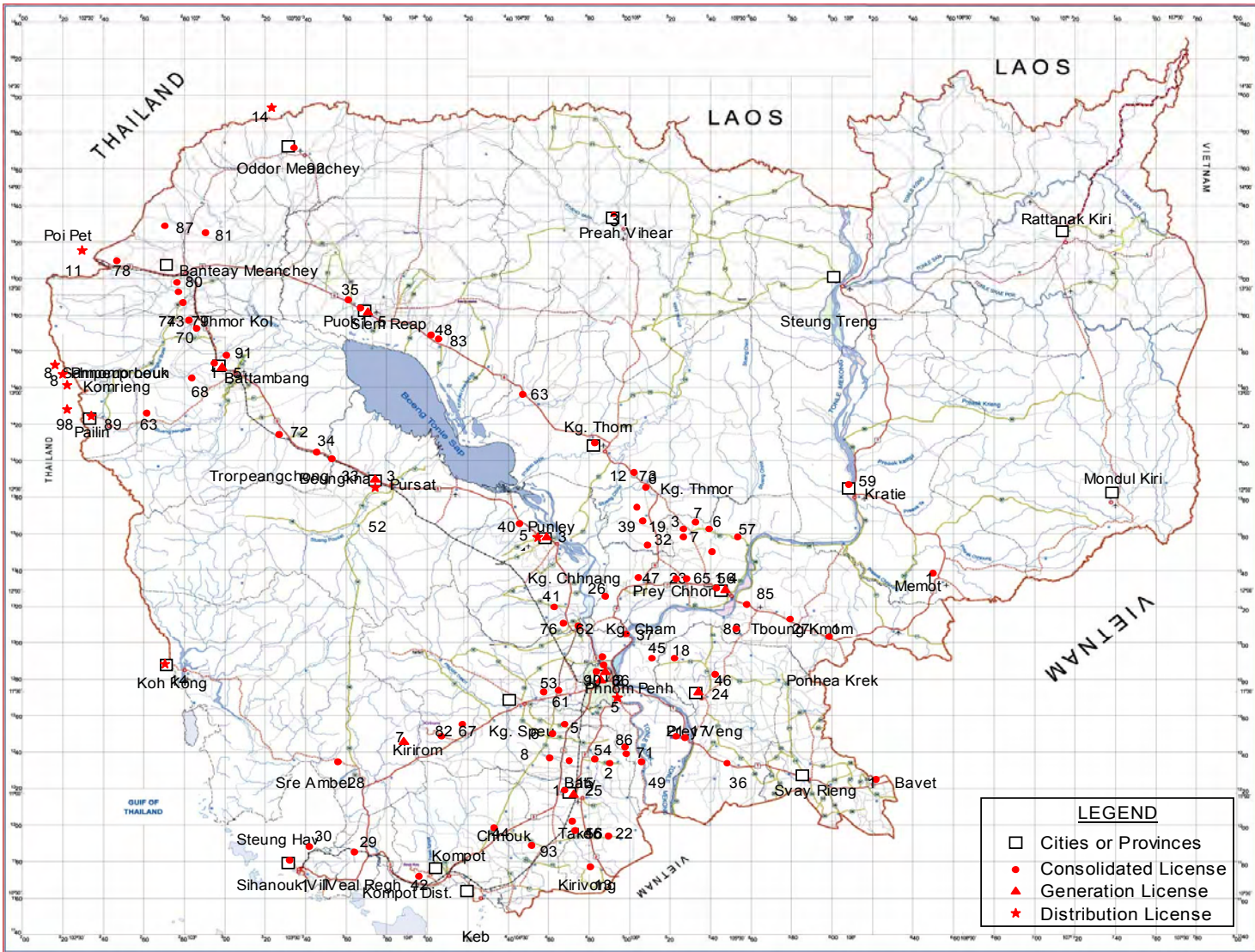
- Regulation on overall performance standards;
- Regulation on general conditions of supply of electricity;
- Regulation on extension of transmission and distribution lines;
- Regulation on complaint handling;
- Regulation for imposing sanctions and penalties;
- Regulation on submission of information by licensees;
- General principles for regulating electricity tariff;
- Principles and conditions for issuing special purpose transmission license.

Procedures:

- Procedures for issuing, revising, suspending, revoking or denying licenses;
- Draft procedures for data monitoring, application, review and determination of electricity tariff.

Codes:

- Grid code;
- Distribution code.



Source: EAC

Figure 2.2.4 Location of EAC Licensees Service Areas

## 2.2.4 Electricite du Cambodge (EdC)

EdC is a 100% state-owned limited liability company under control of MIME and the Ministry of Economy and Finance (see Figure 2.2.1). EdC acquired the consolidated license from EAC in Feb. 2002. EdC is a juridical organization with administrative, financial and managerial autonomy, so that it is responsible for its profit and losses and liable for its debts to the extent of the value of its assets.

EdC is authorized to undertake the following functions<sup>8</sup> by the Royal Decree effected in March 1996:

- Generation of electricity for the purpose of satisfying the needs of consumers;
- Generation of electricity for purposes of importing from and exporting to neighboring countries;
- Construction and operation of national grid transmission networks to ensure the reliable delivery of electric power and rural electrification;
- Construction and operation of subsidiary networks for the distribution of electric power, and coordination of EdC operation and connection to other distribution networks;
- Sale of electricity and associated services;
- Acquisition, transfer and exchange of electric power; and
- Enact all legal acts necessary to achieve its commercial and corporate objectives

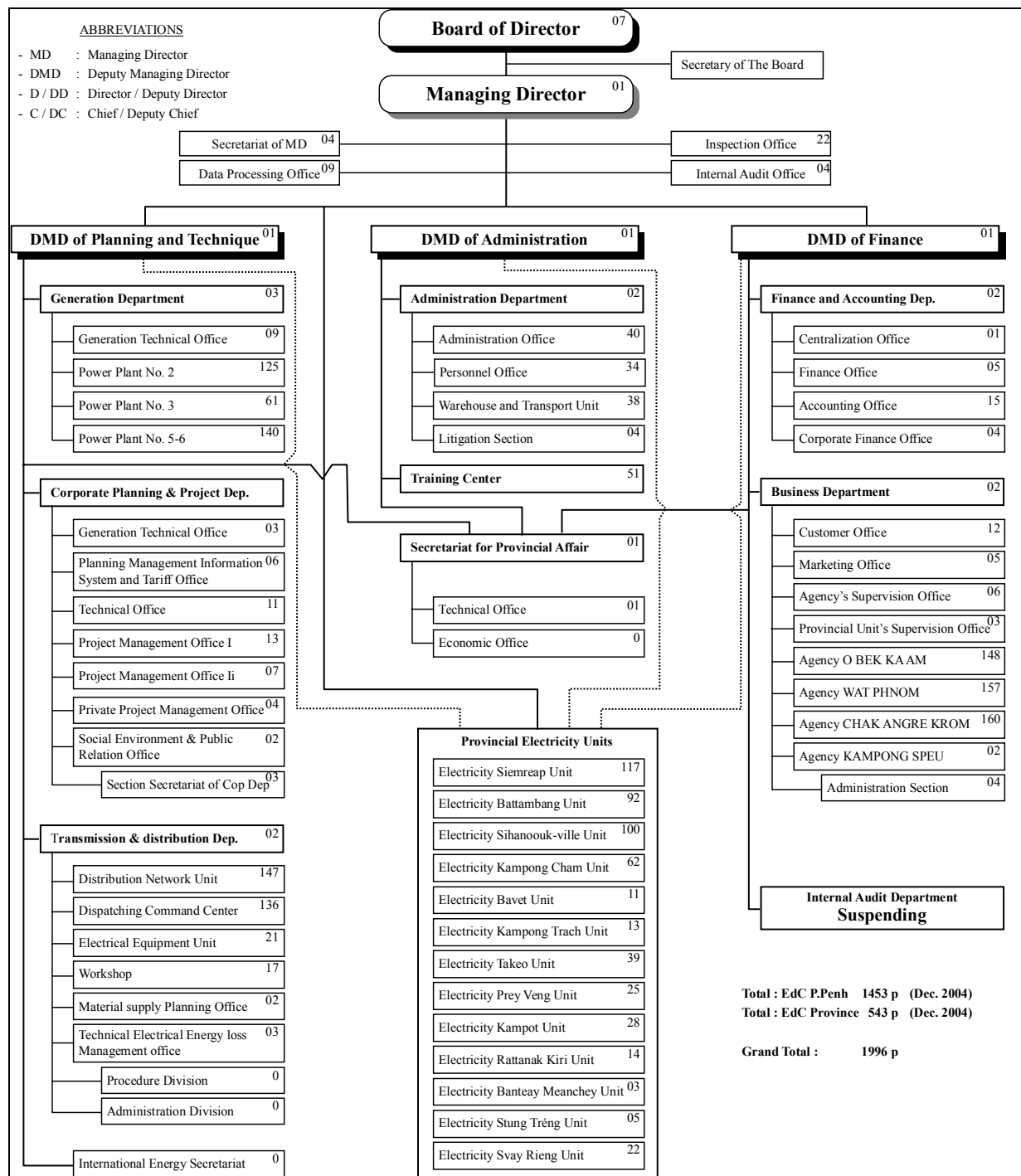
Figure 2.2.6 shows an organization chart of EdC. It is managed by a Managing Director (MD) who reports to a Board of Directors which in turn reports to the shareholding ministers (MIME and MEF). The MD is assisted by three Deputy MDs, eight Directors and a Secretariat for Provincial Affairs. EdC has a large public entity employing about 2,000 persons and consists of seven departments (generation, corporate planning & project, transmission & distribution, administration, finance & accounting, business and internal audit), a Training Center and 13 provincial electricity units.

Following the policy of the Government, EdC has rehabilitated and expanded in provincial towns by taking over PEUs and PECs. EdC also contributes to rural electrification by extending distribution lines (grids) towards rural areas to whole-sale the electricity to REEs.

For EdC to cope with RE tasks its financial situation must be sound and sustainable. EdC recorded positive operating incomes (profit before interest charges) since 2001 up to now. However, EdC recorded net losses (after interest charges and taxes) all time at high levels. EdC's liquidity and financial operations remain unsatisfactory and would continue to remain so as long as: (i) electricity supplies are based on almost entirely on high cost imported fuel or purchased power from IPPs; (ii) outstanding Government arrears continue to be large; and (iii) EdC is unable to recover costs through tariff increases. Consequently, EdC will not be able to generate sufficient revenues to self-finance any significant investment for rehabilitation or expansion. With proper countermeasures taken, this situation could change. A financial action plan to improve EdC's finances was prepared in June 2003 to cope with key financial issues like insufficient electricity tariffs, high electricity production costs, outstanding Government arrears, high distribution losses, etc. More detailed analysis and discussion are presented in Appendix E.

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<sup>8</sup> Based on EdC Annual Report 2003 (p.4)



Note: The number of each block indicates the number of staff as of Dec. 2004  
 Source: EdC

**Figure 2.2.5 Organization Chart of EdC**

**2.2.5 Private Sector Entities**

The private sector is allowed to enter the electricity service industry under the regulation and oversight of EAC. First they entered as IPPs selling electricity to EdC: 5 licensed IPPs are operating as of Nov. 2004. At the same time, private distribution companies emerged buying electricity from MIME or EdC and supplying it to customers: 9 distribution licensees are operating as of Nov. 2004. These private electricity companies are mostly running business in urban areas (major cities and provincial towns).



About 6% of the rural households have access to mini-grids and approx. 50% to battery charging services. Nearly all of these services are provided by small-scale Rural Electricity Enterprises (REEs), operating on a commercial basis (full-cost recovery from customers) by local businesspersons and small entrepreneurs.

The Meritec Report<sup>9</sup> estimates some 600 REEs have been operating as of March 2001 (about 400 in the 15 more populated provinces and 200 in the remaining 9 provinces). The number of REEs providing mini-grid services is estimated at 218 and the remaining 380 are understood to be battery charging operations. A summary of the 218 REEs identified by the Meritec as mini-grid operators indicates the following features:

Item	Minimum	Maximum	Average
System Capacity	5 kW	620 kW	105 kW
No. of Customers	10	1,800	192
Tariff Charged	30 ¢/kWh	91 ¢/kWh	54 ¢/kWh
Service Continuity	-		4 hours

It should be noted that the tariff levels charged by REEs are extremely high. The tariff issues will be discussed in Chap. 2.3.

MIME, the provincial DIMES, provincial authorities or commune leaders had given licenses to most REEs before establishing EAC in 2001. Thereafter, the licensed REEs by EAC are few, estimated at only some 90 (as of Nov. 2004). This low capture is caused by poor technical and operational performances of most REEs, far below the license requirements. For example, the Meritec Report observed most REEs performances as follows:

- Profitability: higher diesel prices and inability to increase tariffs reduced profitability. Diesel fuel costs make up 70% to 90% of all the production costs. When electricity tariffs are raised, most customers cut back consumption proportionally to keep electricity payment within their limits of affordability.
- System construction: REE systems are usually constructed using used or overhauled diesel generation equipment. Equipment breakdowns are common.
- System losses: System losses are generally high (20 to 30%).
- Safety: System safety is poor. Most systems are unsafe.
- Technical skills: Few REE operators have any technical training.
- Access to finance: Few REEs had borrowed money from financial institutions. The fund sources used by most REEs are local moneylenders and village-based micro-credit programs (credit unions, etc) of which capital costs are expensive. (see Chap. 2.2.8 for further details.)
- Renewable energy technologies (RETs): Knowledge of RETs among REEs was limited and no renewable energy sources were used among the surveyed REEs, though they would consider investing in or switching over to the RETs if they are less costly than diesel generator sets.

<sup>9</sup> Ibid.

The EAC shares the same view regarding REEs performances. Their observation is as follows<sup>10</sup>:

“Except for EdC, IPPs and few licensed PECs, most REEs:

- have electricity facilities which are in poor condition, sub-standard, unsafe for operation and use and this has brought down their service efficiency;
- do not have enough technical knowledge to operate their electric services efficiently and safely; and
- do not have enough skills to manage their business, finance, accounting, organization and customer relations.”

The Study Team believes without significant improvement of technical, operational, financial and managerial capacities and performances of REEs it is difficult to achieve the government goals of RE development in terms of implementation capability and capacity of REEs who are main players for RE programs and projects. Provision of financial and technical support for REEs by the Government is definitely needed. Intervention of MIME, EAC and EdC is indispensable in this respect.

### 2.2.6 Community-based Organizations (CBO)

Though REEs are the main player of off-grid rural areas, there are likely to be areas (to be electrified), but of low income and with lack of private sector interests. For these areas a CBO or local community model is workable if the areas are with high possibility of formation of cooperative or association of communities or customers benefiting RE. This includes:

- willing to provide free labors to erect lines and install plants and equipment; and
- able to manage the operation, collect revenues from sales and organize maintenance of the system.

At present there are few CBO-grid systems under commercial operation. We see the following areas as candidates for the CBO model, subject to further investigation based on the socio-economic surveys:

- South-western area including Pursat, Koh Kong and parts of Kampot and Battambang provinces;
- Northern area including parts of Siem Riep and Preah Vihar provinces; and
- Eastern area including Ratana Kiri, Stung Treng and Mondul Kiri provinces.

Pro-CBO advocates (NGOs) see pure private business-minded REEs entering remote rural areas are very few and many target REEs are essentially CBOs with features similar to NGOs. The JICA Study Team shares this view and explore the possibility of RE options using the NGO-CBO model.

### 2.2.7 Cross-sectoral Development

It is the Government basic policy to integrate RE with rural development and poverty alleviation agenda<sup>11</sup>. There are RE programs/projects that have several cross cutting issues with other ministries: e.g., with

- Ministry of Agriculture, Forestry and Fisheries on biomass and biogas development;
- Ministry of Environment on EIA processing;

<sup>10</sup> Based on the EAC Chairman’s statement at the Workshop on “Evaluation of Licensees and Suggested Improvement” held in Phnom Penh on Dec. 20, 2004.

<sup>11</sup> MIME: “Cambodia Energy Strategy Paper (Draft)”, January 2005, p. 17

- Ministry of Planning on integration of RE with provincial/district development plans;
- Ministry of Rural Development on integration of RE with commune/village development plans; and
- Ministry of Water Resources & Meteorology on developing multi purpose dam projects including mini/micro hydropower components.

Provincial governments also have a role to play, advising central government on provincial development strategies, particularly in ensuring that the government is aware of development needs in each province. These inputs will be multi-sectoral in nature and will be directed through the Ministry of Planning and other agencies (Min. of Rural Development, SEILA, etc). We assume that inputs of this type will reach the RE sector through MIME and its provincial DIMEs. Especially, possibility of tying the REF support program with the SEILA program<sup>12</sup> should be pursued as a new integrated rural development approach.

### 2.2.8 Financial Institutions

The financial institutions of Cambodia are classified to four types of bank as shown in Figure 2.2.6. As of August 2005, there are 15 commercial banks (CBs), 3 specialized banks (SBs), 15 micro finance institutions (MFIs), and 25 credit operators (or registered NGOs) under the supervision and oversight of the National Bank of Cambodia (NBC). Here SBs are established by special legislations (sub-decrees) for achieving specific public policies. For example the sub-decree of the Rural Development Bank (RDB) stipulates RDB would operate as a wholesale bank to channel funds to CBs, MFIs and credit operators, which are engaged in rural finance.

Cambodia's rural renewable energy market has great potential, but the necessary financing for ventures is difficult because the local debt market is weak in terms of interests and maturity of loans. Within the power sector, in addition to the REEs' own equity funds, small-scale projects such as solar home system installations, small-scale hydropower, and biomass/biogas projects would benefit from the support of micro-finance institutions. There are currently sufficient capital resources to meet the needs of micro-financing in the rural areas in the short term. The performances of top 12 banks for micro-finance operations are indicated in Table 2.2.1. As seen from the table, ACLEDA bank has an outstanding performance in this field.

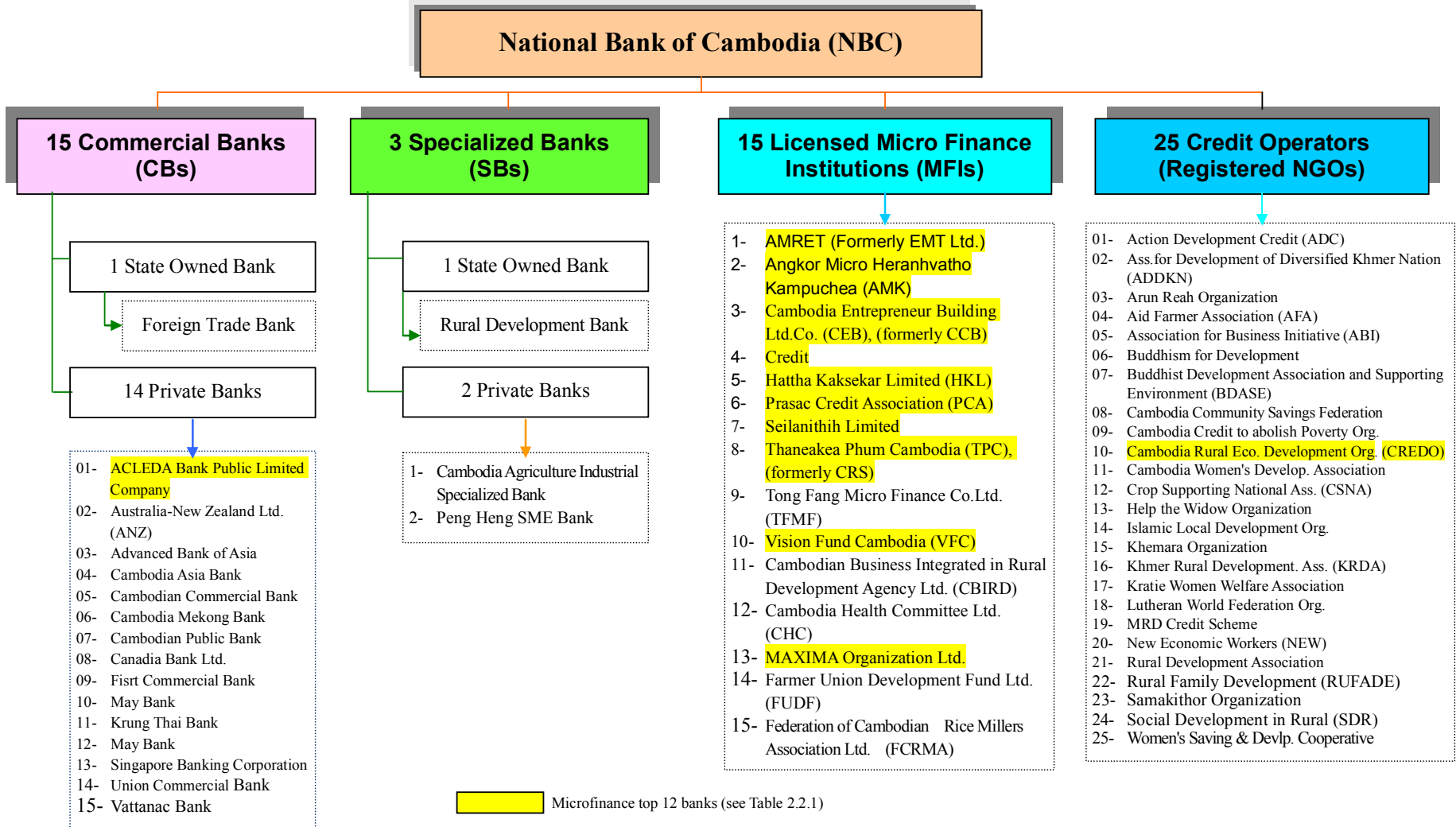
The existing REEs have obtained financing from local banks, in particular ACLEDA bank (see Table 2.2.2). These loans are primarily for diesel fuelled generators supplying mini-grids or battery charging operations. As of December 2004, ACLEDA has financed 79 mini-grid projects with the loan outstanding amount of \$205,436, and 134 battery charging projects with the loan outstanding amount of \$ 263,495. Loan conditions are not disclosed, but the bank usually lends for less than one or two years at 18 to 30% annual interests. This short-term financing is possible for diesel gensets because the initial capital costs are low (most gensets are second-handed) and cost recovery is quick due to high tariff setting.

On the contrary to this short-term financing, renewable energy-based rural electrification is featured by high upfront investment costs and low operating revenue, so that the maturity or loan repayment period is

<sup>12</sup> Electrification distribution systems are eligible Commune/Sangkat sub-projects under the SEILA program. However, MIME/DIME has not participated in the program, so there have been no rural electrification projects realized under the SEILA program.

quite long (usually 5 or 6 years or longer). However, the long-term financing in the rural areas is not available at present. Lack of long-term financing blocks promotion of RET-based RE development. The desired long-term loan financing is only possible by donors assistance under the present condition of the local banks unable to provides such financing.

Donors should be encouraged to develop alternative financial structures to complement the present weak financing institution, as WB or JBIC has done successfully in several countries, where specialized renewable electricity funding is available to rural electrification developers based on bankable financial and business plans. The experiences of these donor agencies is key to the successful financing of rural electrification projects. Further discussion on this matter will be made in Chap. 2.2.5 of Part 2 of this report.



(Source) Rural Development Bank

**Figure 2.2.6 Organization of Financial Institutions in Cambodia**

**Table 2.2.1 Microfinance Operation Performance of Top 12 Banks  
(as of June 2005)**

Bank	No. of Provinces	No. of Operating Areas			Loan Outstanding		Deposit Balance	
		District	Commune	Village	Amount (Mil. Riel)	No. of Borrowers	Amount (Mil. Riel)	No. of Depositors
ACLEDA	21	158	1,365	8,613	326,690	130,267	215,067	74,310
AMRET	11	52	330	1,250	37,588	106,926	834	99
PRASAC	11	79	684	3,931	37,512	68,263	823	293
CEB	5	38	319	1,067	20,006	9,838	913	9,838
TPC	9	55	383	1,633	16,227	41,078	1,942	80,367
HKL	5	33	181	1,112	11,536	7,512	492	8,917
VFC	7	29	172	831	10,194	22,014	23	297
CREDIT	6	46	249	743	8,348	12,056	972	12,056
AMK	6	23	154	707	8,212	28,758	29	1,630
SEILANITHIH	5	33	153	420	6,242	4,103	831	4,103
MAXIMA	1	8	24	70	1,092	1,048	76	6
CREDO	4	10	34	99	428	2,402	94	1,658
Total	91	564	4,038	20,476	484,075	434,265	222,095	193,574

(Source) Association of Microfinance Institutions in Cambodia

**Table 2.2.2 ACLEDA Bank Lending Operation for Rural Electrification Business  
(As of Dec. 2004)**

- Riels Loan

Branch Offices	Diesel-based Mini-grids		Diesel-based BCS		Total	
	No. of Projects	Loan outstand.	No. of Projects	Loan outstand.	No. of Projects	Loan outstand.
Siem Reap-Otdar Meanchey	3	6,481,100	11	12,347,200	14	18,828,300
Banteay Meanchey	-	-	-	-	-	-
Battambang-Pailin	-	-	7	12,586,400	7	12,586,400
Pursat	-	-	-	-	-	-
Kampong Speu	-	-	7	5,699,500	7	5,699,500
Sihanouk Ville-Koh Kong	-	-	4	4,360,700	4	4,360,700
Kampot-Kep	2	906,700	9	4,231,000	11	5,137,700
Takeo	-	-	5	7,433,500	5	7,433,500
Phnom Penh-Kandal	9	4,497,800	32	25,861,300	41	30,359,100
Kampong Cham-Kratie	-	-	-	-	-	-
Kampong Thom-Preah Vihea	-	-	4	3,646,900	4	3,646,900
Kampong Chhnang	1	2,282,900	-	-	1	2,282,900
Svay Rieng	-	-	6	13,580,000	6	13,580,000
Prey Veng	-	-	-	-	-	-
Operation Office	-	-	-	-	-	-
<b>Total:</b>	<b>15</b>	<b>14,168,500</b>	<b>85</b>	<b>89,746,500</b>	<b>100</b>	<b>103,915,000</b>

Table 2.2.2 (Continued)

**- Bahts Loan**

Branch Offices	Diesel-based Mini-grids		Diesel-based BCS		Total	
	No. of Projects	Loan outstanding.	No. of Projects	Loan outstanding.	No. of Projects	Loan outstanding.
Siem Reap-Otdar Meanchey	-	-	7	66,300	7	66,300
Banteay Meanchey	-	-	4	17,600	4	17,600
Battambang-Pailin	-	-	1	12,557	1	12,557
Pursat					-	-
Kampong Speu					-	-
Sihanouk Ville-Koh Kong	-	-	-	-	-	-
Kampot-Kep					-	-
Takeo					-	-
Phnom Penh-Kandal					-	-
Kampong Cham-Kratie					-	-
Kampong Thom-Preah Vihea					-	-
Kampong Chhnang					-	-
Svay Rieng					-	-
Prey Veng					-	-
Operation Office					-	-
<b>Total:</b>	-	-	12	96,457	12	96,457

**- Dollars Loan**

Branch Offices	Diesel-based Mini-grids		Diesel-based BCS		Total	
	No. of Projects	Loan outstanding.	No. of Projects	Loan outstanding.	No. of Projects	Loan outstanding.
Siem Reap-Otdar Meanchey	3	4,636.21	3	3,448.65	6	8,084.86
Banteay Meanchey	4	4,652.73	2	1,179.00	6	5,831.73
Battambang-Pailin	11	32,705.29	3	1,572.77	14	34,278.06
Pursat	2	1,379.15	-	-	2	1,379.15
Kampong Speu	4	17,116.00	5	6,941.68	9	24,057.68
Sihanouk Ville-Koh Kong	5	18,973.00	1	400.00	6	19,373.00
Kampot-Kep	1	133.00	-	-	1	133.00
Takeo	3	27,950.00	2	4,134.00	5	32,084.00
Phnom Penh-Kandal	27	68,042.00	15	10,966.00	42	79,008.00
Kampong Cham-Kratie	2	18,330.00	-	-	2	18,330.00
Kampong Thom-Preah Vihea	-	-	2	3,246.60	2	3,246.60
Kampong Chhnang	-	-	-	-	-	-
Svay Rieng	1	1,000.00	1	400.00	2	1,400.00
Prey Veng	-	-	3	2,550.00	3	2,550.00
Operation Office	1	7,000.00	-	-	1	7,000.00
<b>Total:</b>	64	201,917.38	37	34,839	101	236,756.08

**- Consolidate in USD**

Branch Offices	Diesel-based Mini-grids		Diesel-based BCS		Total	
	No. of Projects	Loan outstanding.	No. of Projects	Loan outstanding.	No. of Projects	Loan outstanding.
Siem Reap-Otdar Meanchey	6	6,245.62	21	7,156.70	27	13,402.32
Banteay Meanchey	4	4,652.73	6	1,349.41	10	6,002.14
Battambang-Pailin	11	32,705.29	11	4,819.85	22	37,525.14
Pursat	2	1,379.15	-	-	2	1,379.15
Kampong Speu	4	17,116.00	12	8,357.00	16	25,473.00
Sihanouk Ville-Koh Kong	5	18,973.00	5	1,482.87	10	20,455.87
Kampot-Kep	3	358.16	9	1,050.66	12	1,408.81
Takeo	3	27,950.00	7	5,979.92	10	33,929.92
Phnom Penh-Kandal	36	69,158.91	47	17,387.98	83	86,546.89
Kampong Cham-Kratie	2	18,330.00	-	-	2	18,330.00
Kampong Thom-Preah Vihea	-	-	6	4,152.21	6	4,152.21
Kampong Chhnang	1	566.90	-	-	1	566.90
Svay Rieng	1	1,000.00	7	3,772.24	8	4,772.24
Prey Veng	-	-	3	2,550.00	3	2,550.00
Operation Office	1	7,000.00	-	-	1	7,000.00
<b>Total:</b>	79	205,435.76	134	58,059	213	263,494.59

(Source) ACLEDA Bank

## 2.3 FINANCING ARRANGEMENT AND TARIFF POLICY

### 2.3.1 Public Investment for Electric Power Sector

MIME formulates a national power sector program and prepares a rolling 3-year plan with assistance of EdC. The latest 3-year rolling plan (2004-2006) is shown in Table 2.3.1. There are two ongoing and six under-negotiation projects. Meanwhile, the WB estimates annual public capital expenditure plans for power sector as given in Table 2.3.2. The 8-year investment plan requires about 200 M\$ in total with an annual average disbursement of 25 M\$. The ODA funds are the main fund sources for the first 5 years and the EdC own funds, for the latter 3 years.

**Table 2.3.1 Investment Program for Electricity Sector**

#### A. On-Going Projects:

Note: Estimated price submitted by Ministry/Agency.

Unit in 1,000 US\$

PIP No.	Project Name/Title	Source of fund	Type of fund	Implementation Period	Total Project Cost	Expenses before year 2004		Level of Investment per year				Remaining Capital	Provided Capital		Capital Demand
			1).			2).	3).	2004	2005	2006	Total of 3 years		Government	Fund	
347	8 Provincial Towns Electrification Project	ADB, National budget, ADF	Capital	2001-2004	24,000	1,000	13,000	10,000	-	-	10,000	-	700	9,300	-
757	Construction of generation plant in Siem Reap	Japan	ITA	2003-2004	17,048	-	9,048	8,000	-	-	8,000	-	-	8,000	-
<b>Total</b>					<b>41,048</b>	<b>1,000</b>	<b>22,048</b>	<b>18,000</b>	<b>-</b>	<b>-</b>	<b>18,000</b>	<b>-</b>	<b>700</b>	<b>17,300</b>	<b>-</b>
<b>B. Negotiating-Highly prioritized:</b>															
769	Construction of micro hydropower, O Rumleng	Japan	Capital	2004-2005	1,000	-	-	700	300	-	1,000	-	-	-	1,000
676	Study on hydropower development plan, Sesan and Srae Pok River	N/A	FTC	2004-2005	800	-	-	460	340	-	800	-	-	-	800
675	Micro hydropower, Doeuk Doeur Channel	N/A	FTC	2004-2005	830	-	-	445	385	-	830	-	-	-	830
348	Study on hydropower development plan, Battambang River	N/A	FTC	2004-2005	650	-	-	360	290	-	650	-	-	-	650
556	Rural Electrification and Transmission Project	ADB, WB, National budget, NDF	Capital	2004-2008	70,000	-	-	1,000	1,000	1,000	3,000	67,000	-	-	70,000
652	Master Plan Study on Rural Electrification by Renewable Energy	Japan	TA	2004-2006	700	-	-	200	300	200	700	-	-	-	700
<b>Total</b>					<b>73,980</b>	<b>-</b>	<b>-</b>	<b>3,165</b>	<b>2,615</b>	<b>1,200</b>	<b>6,980</b>	<b>67,000</b>	<b>-</b>	<b>-</b>	<b>73,980</b>

Source: Data of Public Investment Program, 2004-2006, Ministry of Planning.

**Table 2.3.2 Annual Capital Expenditures for Electric Power Sector**

Unit: US\$ million

	2003	2004	2005	2006	2007	2008	2009	2010	Total
Annual Capital Expenditures									
- Generation projects	13	27	1	0	0	0	0	0	41
- Transmission projects	0	2	18	38	14	7	0	0	79
- Distribution projects	0	1	5	18	14	18	12	13	81
<b>Total</b>	<b>13</b>	<b>30</b>	<b>24</b>	<b>56</b>	<b>28</b>	<b>25</b>	<b>12</b>	<b>13</b>	<b>201</b>
Financing Plan									
- ADB	10	10	19	48	23	7	0	0	117
- WB (IDA)	0	1	4	8	3	2	0	0	18
- Government	0	20	2	0	0	0	0	0	22
- EdC funds	3	-1	-1	0	2	16	12	13	44

Source: WB, Project Appraisal Document of Rural Electrification and Transmission Project, Dec. 2003

Approx. 120 M\$ out of the total 200 M\$ come from the RE&T Project. This project includes an RE component (15 M\$ of which 13 M\$ from IDA loans) and an REF component (28.2 M\$ of which 7.6 M\$ from ODA and 20.6 M\$ from private sector). The details of the project are presented in Chap. 3.9.



The national budget expenditures of RGC for Cambodia are in the range of 680 M\$ p.a. and growing at approx. 12 to 15% p.a. The share of the electric power sector therein is approx. 3 to 4% with an annual average of 25 to 30 M\$ p.a. This is considered as a measure of annual budget available for this sector in terms of historical budget allocation.

Besides the above public sector investment significant capital investments by IPPs and REEs have been realized to date. The amounts of the private sector contribution are not available, but are estimated to be comparable to those of the public sector.

### 2.3.2 Tariff Policy

All the electric power service providers run the business under the self-financing and users-pay principles. The costs of services are in principle fully recovered by tariff revenues. The operators have not received any subsidy or subvention from the government, although some cross-subsidy mechanisms are introduced between poor and non-poor domestic customers, and between domestic and non-domestic customers<sup>13</sup>.

Article 41 of the Electricity Law specifies that:

“Licensees shall not be required to provide electric power services, the costs of which can not be recovered through electricity tariffs, except to the extent specific funds are provided to subsidize consumers and the licensee is agreeable to this arrangement.”

Thus the Law basically supports full-cost recovery by tariff revenues.

Tariffs are set out individually by licensees based on the full-cost-recovery-from-users principles. The tariff levels and structures vary considerably from licensees to licensees or from one place to another, as indicated in Table 2.3.3. In terms of price per kWh the lowest is Riel 350 for the lifeline tariff in Phnom Penh and the highest is nearly 10 times of it in remote, small-scale sites. This gap comes from the differences in supply capacity, low load factor due to lighting demand limited only to nighttime, transportation cost of fuel oils, procurement cost of capital finance, losses of supply systems, and risk premium for rural customers' low affordability to pay. Figure 2.3.1 shows strong correlation between installed capacity and lifeline tariffs. The more capacity is, the lower the tariff is.

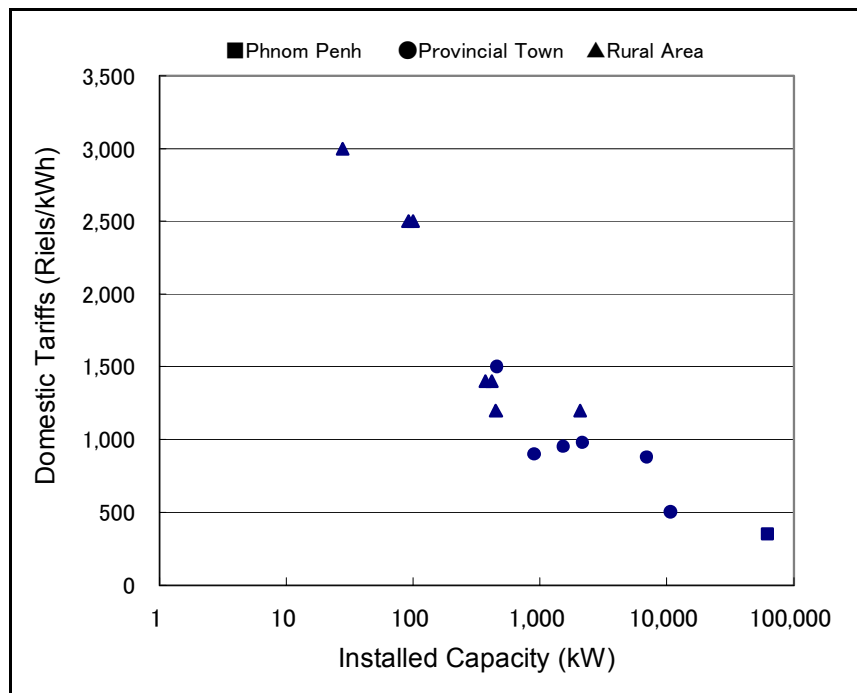
Such large discrepancy of tariff levels between urban and rural areas cannot be left out. In terms of social equity of public service provision, similar services should be provided with similar prices. To deal with this tariff gap issues the Government (especially EAC) has been drafting a sub-decree, regulations and procedures for regulating electricity tariffs (as of Feb. 2005). These rules will specify detailed methodology for calculation and quantification of costs, components of costs by type of businesses, consideration of subsidy or cross-subsidy for reduction of the tariff for rural customers, acceptable or allowable levels of rate of return (RoR), etc.

In April 2005 was passed the Sub-Decree on Tariff which stipulates the basic policy for evaluating the cost of electricity business in order for EAC to set the electricity tariff.

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<sup>13</sup> The World Bank informed the JICA study team that at present the subsidy to the urban poor apply only to consumers of EdC electricity in Phnom Penh. A new tariff adjustment took effect in November 2005 in Phnom Penh.

Actual tariff tables under these rules will be prepared under ADB assistance and this work will be started in mid 2005. The tariff tables are to be designed by supply zones or areas considering size and type of system, number of customers, affordability/ability to pay, type of generation, conditions of subsidy/grant, location, local conditions of the areas, etc. More detailed discussion on tariff policy will be presented in Part 2 (Master Plan), Chap. 1.7.



Source: Developed from Table 2.2.

**Figure 2.3.1 Relation of Domestic Tariffs and Installed Capacity**

**Table 2.3.3 Comparison of Operation Performance of Typical Licensees**

No. of Licenses	Service Area	Number of Consumers	Installed Capacity (kW)	Energy Generated and purchased (MWh) (year 2003)	Energy Sold (MWh) (year 2003)	Losses (%)	Domestic Tariffs Riels/kWh
<b>(Phnom Penh)</b>							
EDC	Phnom Penh	140,611	62,000	547,838	475,207	13.3	350 (less than 50kWh) 550 (51-100 kWh) 650 (more than 101kWh)
<b>(Provincial Town)</b>							
EDC	Sihanouk ville	8,166	10,722	20,853	18,452	11.5	500
EDC	Provincial Town Siem Reap	9,580	6,950	22,925	19,129	16.6	880 (less than 20,000kWh/month) 19.3 USCent(20001-50000kWh/month) 17.6 USCent(50001-110000kWh/month) 16.2 USCent(more than 110000kWh/month)
EDC	Provincial Town Battambang	12,108	2,160	13,255	10,196	23.1	24.5 USCent
EDC	Provincial Town Takeo	2,483	900	2,047	1,848	9.7	900
Chilbo Industrial Co.	Provincial Town Kampong Thom	2,900	1,520	2,015	1,561	22.5	950
Duty Free Shop Co	Koh Kong Provincial Town	1,320		11,253	10,647	5.4	600 (LV) 500 (Government) 300 (own company)
Mr.Chan Thon	Provincial Town Preah Vihear	550	460	49	34	30.0	1500
Sovanny Electricity Devel	Provincial Town Kampong Chhnang	3,600		2,526	2,147	15.0	1200
Nareth Electricity Devel	Provincail Town Pursat	4,890		2,732	2,049	25.0	1200
<b>(Rural Area)</b>							
Mr.Huor Pheng	Kampong Thom	1,063	420	598	447	25.3	1,400
Franasie Import & Eport	Komrieng (Battambang)	288		2,303	2,066	10.3	500 (MV) 600 (LV) 450 (Casino)
Franasie Import & Eport	Phnom Proek (Battambang)	240		364	301	17.3	750
Franasie Import & Eport	Sampeu Loun (Battambang)	756		474	411	13.2	750
MSP Development Co	Phsar Prom Town (Krong Parlin)	1,104		3,218	3,080	4.3	500 (MV) 600 (LV)
Anco Brothers Co	Ochraov District (Banteay Meanchey)	3,900		28,572	25,715	10.0	600 (LV) 500 (Medium Consumers) 430 (Big Consumers)
Mrs.Bun Liv	Estern Neakleung, Peamro District(Prey Veng)	1,962	2,072	1,283	898	30.0	1,200 1,000 (Ferry Station)
Mr.Nov Sokha	Western Neakleung Town (Kandal)	729	448	500	325	35.0	1,200 1,000 (Ferry Station)
Mr.Khun Sambo	Phsar Prey Toteung Town (Kampong Cham)	650	371	318	226	30.0	1,920 (more than 100kWh/month) 1,400 (less than 100kWh/month)
Mr.Chhour Nguon	Phsar Beungknar Town (Pursat)	380	100	104	73	29.9	2,000 (more than 10kWh/month) 2,500 (less than 10kWh/month)
Mr.Toem Touch	Khum Trapeang Chhonhg (Pursat)	220	92	108	75	30.0	1,500 (more than 100kWh/month) 1,800 (5 - 100 kWh/month) 2,500 (less than 5kWh)
Mr. Park Hean	Phsar Preysandek Town (Takeo)	181	28	27	19	28.3	2,000 (more than 10kWh/month) 2,300 ( 4-10 Kwh/month) 3,000 (less than 4kWh/month)

Source: EAC Annual Report 2003 (Oct. 2004)