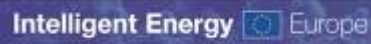


EIE-06-256 REEPRO



# **Promotion of the Efficient Use of Renewable Energies in Developing Countries**

**Report on WP 2.04**

**Financing Tools Scan in Cambodia**

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## List of Acronyms

ABC	Angkor Bio Cogen
ADB	Asian Development Bank
ARM	Angkor Kasekam Roongroeung
BOT	Build Operate Transfer
CB	Commercial Bank
CDC	Council for Development of Cambodia
CDM	Clean Development Mechanism
CIB	Cambodian Investment Board
CIGAR	Covered In Ground Anaerobic Reactor
CRDB	Cambodian Rehabilitation and Development Board
DNA	Designated National Authority
EAC	Electricity Authority of Cambodia
FDI	Foreign Direct Investment
GEF	Global Environment Facility
HFO	Heavy Fuel Oil
IFC	International Finance Corporation
IRR	Internal Rate of Return
LDC	Least Development Country
MEF	Ministry of Economy and Finance
MFI	Micro Finance Institute
MIME	Ministry of Industry Mine and Energy
MOC	Ministry of Commerce
NBC	National Bank of Cambodia
NEDO	New Energy and Industry Technology Development Organization
ODA	Official Development Assistance
PDD	Project Design Document
PPA	Purchase Power Agreement
RDB	Rural Development Bank
RE	Renewable Energy
REE	Rural Electricity Enterprise
REF	Rural Electrification Fund
RET	Renewable Energy Technology
SB	Specialized Bank
SIDA	Swedish International Development Agency
SNV	Development Organization of the Netherland
UNDP	United Nation Development Program
VC	Venture Capital
W2E	Waste to Energy
WSL	Waste Solutions Ltd

## **1 Introduction**

### **1.1 Background on financing RE projects in Cambodia**

Renewable or sustainable energy projects do not normally have the large scale viability of conventional energy projects, and therefore do not enjoy the financing opportunities and terms that are given to the larger and more financially attractive energy projects.

In many cases, financing of renewable energy (RE) projects particularly in developing countries is a challenging exercise. Normally, commercial financiers are risk-averse. When considering a project, a financier will prepare a risk/return analysis to assess each major risk and the means to mitigate its potential impact on the project. Assessing the return involves verifying potential costs if something goes wrong and the project revenue projections, and then comparing the financials of the project and its cost of financing. Unfamiliar technologies, inexperienced developers, risky jurisdictions are some of the major risks that financiers factor in when considering financing renewable projects. Because of these perceived risks, too often large financiers are not keen on financing renewable.

Renewable energy projects tend to have high initial costs and low operating costs compared to conventional technologies. The success of any financing approach for these options depends on the degree to which it meets and completes several key tasks including finding sustainable financing mechanisms, making strategic alliances, reducing transaction costs and minimizing risks. Moreover, broad institutional groundwork is needed including good pricing policies, efficient power sector management, viable lending institutions, credible regulatory policies and solid legal frameworks. Success will also depend on conducive frameworks for market and investment growth. Projects using renewable energy sources use traditional financing routes and sources that are available to investors of other energy installations. However, because of the nature, size and peculiarities of these types of projects, these normally are not adequate to attract funds to finance renewable energy investments. Thus, newer and innovative schemes are evolving.

### **1.2 Financing mechanism and options for renewable energy projects**

In order to facilitate financing of renewable energy projects, a number of innovative financing mechanisms have become available. By combining the traditional sources and the innovative schemes of financing the affordability can be improved. Some of the traditional sources and newer schemes are listed below.

- Equity
- Debt financing
- Sales-Lease-back arrangement
- Public support schemes

### **1.3 Scope of the present work package “financing tools scan”**

Scan of options for mini and micro project financing as well as commercial project support schemes from banks, donor organizations and state authorities with catalogue of options for innovative financing tools and credit schemes for small scale projects. A catalogue of inno-

vative financing tools will be developed and presented within the report. This report will provide data for the financing part of the training manuals and further project decisions.

## 2 Equity

Equity can take the form of direct investment of

- own resources and capital, or
- as third party capital inputs, e.g. in the form of risk capital by venture capital
- funds or simply by funds from family members

There is an expectation on the part of debt providers that all projects will be at least part-financed through equity. Lenders demand that borrowers take an equity stake in their own right (to build their commitment to their stakeholding). In practice, lenders normally look for a minimum of around 20% of the project cost to come in the form of borrower equity. RET with higher risks are expected to have a corresponding higher equity ratio.

On the other hand, the typical project developer has only limited own funds to make this essential contribution to the whole financial package. This creates the need for the participation of additional investors in equity. Equity investors have the potential for unbounded returns from project (or firm) success and will therefore take high-risk investments if the potential rewards are large. Investments are analyzed from a risk-return trade-off with a strong inclination on the expected investment return, what is reflected in the top position of venture capital (VC) in ranking of return targets of the alternative financing sources

Private equity is not generally interested in renewables, as it does not meet the return targets, has long hold periods, and only limited public exit routes. However, alternative fund managers are attracted by sector growth. Thus, venture capital funds have funded renewable energy businesses, but only on a very limited basis since more profitable shorter term opportunities abound elsewhere. They tend to be very selective: a deal-closure-ratio on proposals of only 5% is not unusual.

Core required characteristics of RE to attract alternative investors are:

- Returns consistent with alternative assets classes with similar risk profiles:
- 14 – 20% IRR.
- Larger scale transactions - 5-10 million minimum investment
- Ability to exit – within 10-15 years.

### 2.1 Local entrepreneurs

In Cambodia so far there are no implemented renewable energy projects whose financial sources come from local entrepreneurs. There are several small and medium renewable energy projects which come from foreign investment under the form of BOT (Build Operate and Transfer) or demonstrative research projects. Only some household size renewable energy projects whose financial sources come from their own capital or equity. These projects include solar home system, biogas and Pico hydro power plants.

Contrarily to the RE projects on which there is no investment from local entrepreneurs, there are a lot of Rural Electricity Enterprises (REEs) operated in Cambodia. These REE's busi-

nesses are developed using their own capital. Their business is to produce electricity and sell it to consumers in the villages. In order to do this kind of business they have to get license from the Electricity Authority of Cambodia (EAC).

From this point of view, it can be stated that REE will be the potential local entrepreneurs who will be interested in developing renewable energy projects in the future.

### 2.1.1 Target group

It was estimated by EAC that there are currently more than 600 REEs which are operated in Cambodia. Only around 120 REEs among them which got licenses from EAC to generate and distribute electricity. For the purpose of our survey we selected 20 REEs among 120 licensed REEs for the interview. These REEs are located in different provinces throughout Cambodia, therefore the interview was done using telephone.

### 2.1.2 Result

The questions are about their awareness of the renewable energy projects investment opportunity, interest in the investment, the amount of investment and their expectation on the investment. The result is shown in Table 1 .

**Table 1 Result of the survey on REEs**

Questions	Number of positive respondents	Percentage
Awareness of RE investment opportunity	20/20	100%
Interest in the investment	16/20	80%
Amount of the investment	< 2,000	1/16
	2,000 – 5,000	4/16
	5,000 – 20,000	9/16
	> 20,000	2/16
		6.25%
		25%
		56.25%
		12.5%

When asking about the investment expectation, specifically on return of investment, only a few of the interviewees expect a return of investment lower than 15% per annum. Other REE expect a return on investment much higher than 15%, mostly 25% to 33%. This figure is true for their current business which relies on diesel genset. It requires much lower investment cost than that of the renewable energy projects. On the other hand the exit period is much shorter than that of the renewable energy projects. Low investment cost, short exit period and relatively high electricity price are the three main factors that can give a high rate of return to the REEs.

Therefore, most of the REEs expect a high rate of return as the one they got in their current business and which is not true at all for the investment in renewable energy projects.

## 2.2 Foreign Direct Investment (FDI)

The institutional and legal frameworks for investments in Cambodia are specified in the Law on Investment (promulgated in 1994 and amended in 2003). The Council for the Development of Cambodia (CDC) is the agency responsible for the development and management of foreign direct investment (FDI). The Council for the Development of Cambodia (CDC) was

established in 1994 after passing of the Law on Foreign Investment. The CDC is chaired by the Prime Minister and composed of senior ministers from related government agencies.

CDC is composed of two executive boards: the Cambodian Rehabilitation and Development Board (CRDB), and the Cambodian Investment Board (CIB). CRDB manages the international assistance and public investment while CIB coordinates private investments. Local investors may register directly with the Ministry of Commerce (MOC) and are not required to apply for a license with the CDC. CDC provides a one-stop service for rehabilitation, development and investment activities in Cambodia. Renewable energy project developers are required to obtain an investment license from CDC. The license is in return required for application of incentives and preferential taxation. The current services provided by CDC include the following: information, investment application and approval, customs duty and tax exemption, visa and work permits, and company registration. The process in obtaining an investment license is summarized below:

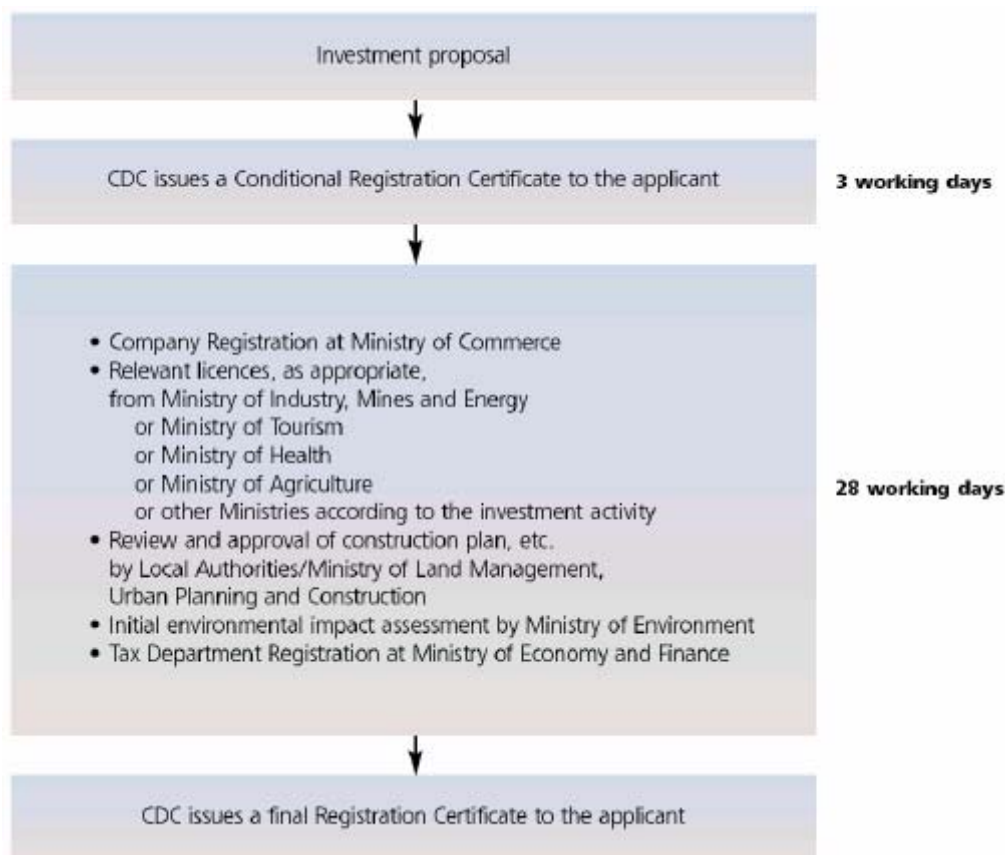
- Submission of application to the Cambodian Investment Board (CIB) of the Council for the Development of Cambodia (CDC), which should include memorandum, articles of association, and a feasibility study.
- Meeting with members of the CIB/CDC to provide additional information during the review process.
- Approval by the CIB/CDC within 28 days.
- Commercial registration of the company with the Ministry of Commerce.

The CDC's website includes a list of twenty investment types that are considered to be a high priority for Cambodia, including the construction of physical infrastructure such as for power production. The CDC can offer a range of incentives to entice potential investors, including (UN 2003):

- An automatic tax holiday of three years, with up to three additional years depending on the activity or sector, the tax holiday to commence with the first year in which profit is made but no later than the fourth year of operation;
- 100% exemption from import duties on construction materials, production equipment, machinery, intermediate goods, raw materials and spare parts used for exports;
- Guarantee against nationalization;
- Renewable land leases of up to 99 years on concession land for agricultural purposes and land ownership permitted to joint ventures with over 50% equity in Cambodian hands;
- No price controls;
- No discrimination between foreign and local investors;
- A one-stop service in the CDC to facilitate and speed up the investment process and to provide a Conditional Registration Certificate (CRC) or Letter of Non- Compliance within three working days and a Final Registration Certificate within 28 working days from the date of issuance of the CRC.

The standard process for a potential investor to apply for approval and assistance through the CDC is depicted below in Figure 1.

**Figure 1: Standard process to apply for approval through CDC (An investment guide to Cambodia)**



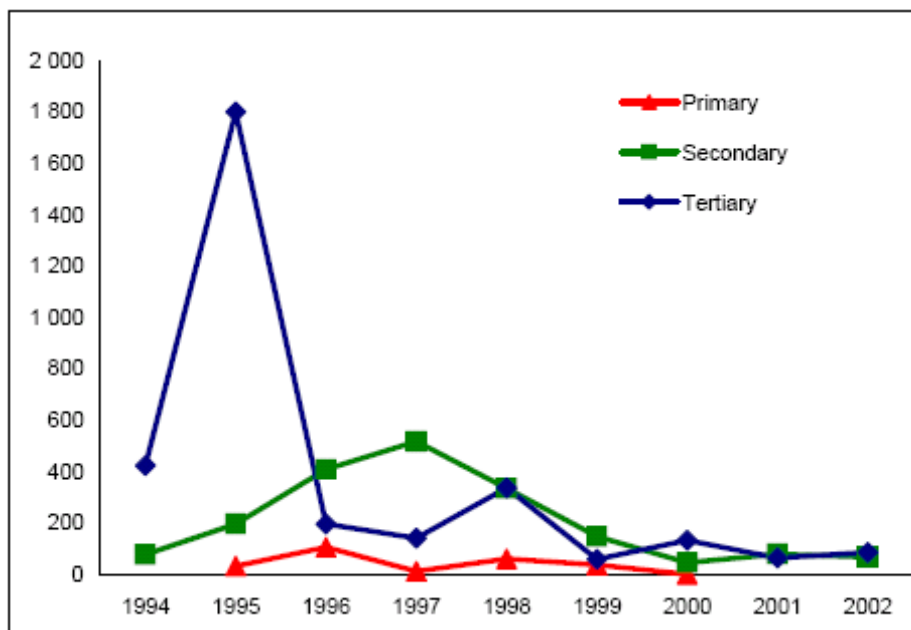
FDI stocks in Cambodia rose from \$356 million in 1995 to an estimated level of \$2,471 million in 2005, while outward stock remained insignificant and stagnant. Figure 2 shows FDI flow and FDI stocks in Cambodia from 2000 to 2005.

**Table 2: FDI flows in Cambodia (World investment report 2006)**

		1990-2000 (Average)	2002	2003	2004	2005
FDI flows (in million US\$)	Inward	155	145	84	131	381
	Outward	12	6	10	10	6

The secondary sector, except for 1995, was the principal recipient of FDI flows to Cambodia (See the figure below). Most FDI to the secondary sector went to textiles and garment activities. In 1995 and 2000, the tertiary sector was the dominant FDI recipient. By 2002, wood and wood products, textiles and hotels - the three largest recipient industries - accounted for more than 50 per cent of the FDI stock in the country. Malaysia, Taiwan and Singapore are the three largest investment partners in term of FDI stock by 2002 (See the table below).

**Figure 2: Sector of principal recipients of FDI flows to Cambodia (World investment directory online)**



**Table 3: Largest recipient industries of FDI flows to Cambodia (World investment directory online)**

	Inward FDI stocks
The three largest investment partners	Malaysia (23%), Taiwan (14%), Singapore (12%)
The three most important industries	Wood (23%), Textiles (14%), Hotels and restaurants (12%)

### 3 Dept financing

#### 3.1 Concept

Classical debt financing is done with (fixed) interest rates and repayment schedules, but in different ways by the source of finance:

- Other private persons or institutional investors provide conventional commercial bank loan and credits. Loans and Credits as instruments are known and practiced all over the world. With the microfinance revolution credits have reached even the poorest in the most remote areas also in small-scale renewable energy project like Solar PV. However the higher the amount needed and the risk, the more difficult for RE projects to find adequate credits for their project. Here, RE projects have to face the same barrier, which is common to many private enterprises, especially in LDCs.
- Most lenders tend to be far more risk averse than equity investors. The debt contract is a fixed obligation and the lender does not profit beyond a certain level from project success.

- Unlike equity investors, lenders typically analyze a project (or firm) from a worst-case perspective. Thus RE project developers have to be very careful to shape and structure their project in a way, that even its worst case will still meet the requirements of the lenders. Particular in LDC's the capacity to handle project structuring is very limited, so that the access to credits is further impeded.
- Up to the limit of unacceptable risk, lenders adjust (i.e. increase) debt interest rates and terms with increasing default risk.

In many LDCs, banks are reluctant to extend long-term loans, however sometimes offering instead a mid-term loan with a potential follow-up finance at the end of the term. This creates the problem of higher amortizations or the risk of follow-up financing. A third party liquidity guarantee for the follow-up financing allows the extension of maturities to RE compatible length by the up-front signing of a two step loan, of which the first will be a bullet loan with an adequately adjusted repayment schedule paid back mainly with a bullet at the end of its term. The bullet payment is refinanced by the second loan, which then has to be repaid with annual payments until the end of the total maturity.

Therefore, although there are instruments to cope with the shortage of own capital in the financial sphere, these instruments are especially scarce in LDCs as a consequence of the limited accumulation. In emerging markets, experience has shown that there is a substantial potential for the use of equity. However, RET has yet shown only limited success in attracting these funds. However, specialized equity funds have been created to invest in environmentally and commercially sound energy companies providing equity investment capital. Some are in the private sector (e.g. Triodos bank in the Netherlands) and others are sponsored by the multilateral organizations (IFC, GEF).

### **3.2 Target group**

The financial institutions of Cambodia are classified to three types of bank. As of August 2005, there are 15 commercial banks (CBs), 3 specialized banks (SBs), and 15 micro finance institutions (MFIs) 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 and MFIs which are engaged in rural finance.

Among these banks and MFIs only some of them are considered as the most active in term of their performance operation. Standing of this point of view we selected 4 commercial banks and 8 Micro Finance Institutes as our interviewees.

### 3.3 Result

**Table 4: Result of survey on Cambodian banks and micro finance institutes**

	Commercial Banks		Micro Finance Institute	
<b>Loan service</b>				
Maximum loan	2,000,000		10,000	
Minimum loan	500		50	
Maturity	Up to 10 years		3-24 Months	
Own equity	At least 20 % to 30%		30%	
Interest rate	10% - 18% per p.a		2 – 3% per month	
Collateral	Land or house properties		Land properties	
<b>Experience of banks in RET projects</b>				
	Negative response	Positive response	Negative response	Positive response
Experience in financing RE projects	4	0	8	0
Experience in RE risk mitigation	4	0	8	0
Interest to learn more about RE business opportunity	1	3	3	5
Interest to learn more about international cooperation opportunities in RET financing	1	3	3	5

## 4 Sales-Lease-Back arrangements

### 4.1 Concept

Leasing is a potentially interesting instrument for financing private RE projects in developing countries:

- Since the financing institution maintains ownership of the financed assets, the need for other collateral is largely eliminated.
- Local banks, which for various reasons may be able to provide short-term finance only, can be drawn into RE-financing in the initial project development stage.

A strong virtue of the lease-buy-back instrument is its flexibility. Depending on the situation in the country and the RE-project it can be applied in different ways. The upfront project development cost up to the point of commissioning can be financed by the bank, which subsequently acts as lessor, by a different bank, by suppliers credits, or by a combination of all three. The lessor can be a bank or the off-taker of the power supply if the power utility signing off the long-term PPA with the RE-project has access to long-term finance at favourable conditions.

### 4.2 Status of the sales-lease-back arrangement in Cambodia

No formal financial leasing companies exist so far. But there are reportedly several other companies or individuals who are conducting leasing activities. These activities can be found in various sectors such as land, building, house, car, truck, generator etc.

Thank to the effort of the government, there will hopefully have such leasing company operated in Cambodia. Currently, a leasing law has been drafted and is waiting for its enactment. This Leasing law serves to protect property rights and interests of those involved, as well as appropriately address any risks to financial stability. At the same time, much will be required to support implementation of the new system, including regulations, training and administrative support. After leasing law has passed, market development could be undertaken.

### 4.3 Banks experiences in leasing activities

The result of the survey on the experiences in leasing activities shows that none of the banks and neither micro financial institute have experience in leasing business. But some of them are interested to learn about such business opportunity.

**Table 5: Result of survey on the experiences in leasing activities**

Questions	Commercial Banks		Micro Finance Institute	
	Positive response	Negative response	Positive response	Negative response
Experience in leasing in general	0	4	0	12
Experience in leasing for RE projects	0	4	0	12
Interest to learn about the leasing business	4	0	4	8
Interest to learn about the leasing business for RE projects	3	1	3	9

## 5 Public support schemes

However, from the instruments described above it appears that commercial markets do not readily provide a satisfying set of financial instruments in LDCs. Therefore, in most regions, policy makers and donors have to look for additional financial support instruments to make economic viable RE projects and programs financially possible.

Such financial supporting instruments may include:

- ODA-instruments as grants, soft loans, promotional credits and other financial supporting instruments as guarantees as well as financial instruments provided by private sector promoting DFIs.
- International promotional schemes like CDM and GEF.
- Subsidies, which could be used by policy makers, electricity providers, and third parties as donors.

Such instruments could play an important role to improve the financial viability of RE projects

- by an approach to increase funding availability for renewable energy investments, aiming at leverage of private finance,

- with a risk-sharing approach,
- and the facilitation of the bundling of (small) projects to help absorb their higher proportional level of transaction costs

### **5.1 Role of energy service in poverty reduction**

National poverty reduction strategy was adopted in 2002. In this paper, the government had set 6 priority actions leading to poverty reduction as follow:

- Promoting income earning opportunity
- Expanding job opportunity
- Improving capabilities
- Institutional strengthening and improvement
- Reducing vulnerability
- Promoting gender equity

Energy service is one of the components in the second priority action (Expanding job opportunity). The government has taken into account of the improvement of energy availability as part of industrial sector development. Once the industrial sector has been developed job opportunity for Cambodian people will be automatically expanded. “Improved energy availability” action has two specific objectives:

- Provide an adequate, and reliable supply of energy for household uses and development of agriculture related industries through public investment
- Ensure reliable, secure electricity supply (environmentally and socially acceptable standards) at prices, which facilitates investment in Cambodia and development of the national economy

To achieve these two objectives the government has set some actionable measures:

- Construct national grid across Thailand and Vietnam’s border to Phnom Penh or to the provinces closed to the border
- Integrate Cambodian power system with the ASEAN interconnection
- Establish Rural Electrification Fund
- Develop small scale energy to facilitate job creation in rural communities
- Seek financing or investment for construction of large hydro power plant
- Seek fund to improve energy conservation and efficiency project

### **5.2 International and bilateral donors**

There are a number of international and bilateral donors who provide grant for renewable energy projects. Some project fact sheets will be shown in the following table.

**Table 6: International and bilateral donors involving in financing RE projects (To be retrieved from website of each of the agencies)**

Name of donors	Name of projects	Project description
NEDO	Demonstrative Research on Combined Photovoltaic Power Generation System	NEDO commissioned a biogas-fired electricity generation project in February 2004 near Sihanoukville. The project combines biogas and PV technologies to supply a peak 120 kW of power to a number of local villages. The biogas is generated from cattle manure from a feedlot and palm oil waste and then is used to fire two 35 kW gas engines driving a generator. The PV has a total capacity of 50 KWp.
	Demonstrative Research on Dispersed Photovoltaic Power Generation Systems	A hybrid PV and mini-hydropower system was installed in Kompong Cham province. The project was commissioned in January 2004 and consists of two 20 kW hydro turbines, on the outlet of an existing irrigation reservoir, plus a total of 108 kWp of PV capacity which is dispersed in a number of sites throughout the nearby village
	Demonstrative Research on PV battery charging station	6 wind and PV hybrid systems, in a village in Takeo Province in 2001 as part of a demonstration project. Each of the houses was equipped with a 400W wind turbine and 2*108Wp PV system plus battery charging equipment. This household which is equipped with this hybrid system is responsible for charging the battery from the household nearby.
SIDA	Renewable Energy Technologies in Asia	Under support from the Swedish International Development Agency (SIDA), 109 solar home systems were installed in some villages of the two provinces (Sihanouk Ville and Pursat Province). Most of all SHS has a capacity of 12 W. These SHS were installed at rural household, health center, pagoda, school etc.
WORLD BANK-GEF	Rural Electrification Fund	The objective of the REF is to implement an innovative mini, and off-grid electrification program, as a transparent institutional mechanism for promoting rural electrification, established by the Government with administrative, managerial, technical and financial autonomy to channel sub-grants and technical assistance to the private sector, and rural communities. The REF will assist private sector developers in providing new connections, electricity to households using solar home systems, and add as well mini-hydro, and micro hydro capacity.
UNDP-GEF	Community Based Renewable Energy Project Expansion at Anlong Tamey	The project aims to electrify a rural village using 100% renewable energy sources. The source of biomass will be locally farmed trees no wood from natural forests will be harvested. The species of trees proposed in the project, Leuceana, is native to Cambodia. Leuceana is a fast growing, tropical legume tree (nitrogen fixing) which will improve soil fertility. Leuceana thrives on less fertile non-irrigated land often currently underutilized by farmers. The tree branches will be harvested 2-3 times per year through "coppicing" to yield a continuous supply of biomass (short rotation coppicing).
SNV	National biodigester Program	Under support from SNV of the Netherlands, grant has been provided to any rural households in the selected area who are willing to install biogas plant at their home. This grant will be used as a partial capital cost for the construction of the system. Each household can get only 100 US\$ for what ever the size of the biogas plant.

### 5.3 Public subsidy schemes

Recently there is an institution which is established by a Royal Decree of 4th December 2004 namely Rural Electrification Fund (REF). It is an autonomous public institution whose mission is to promote equitable rural electrification coverage and to encourage private sector to participate in providing sustainable rural electrification services. The ultimate aim is to reduce poverty in rural areas.

In its policy on rural electrification, the Government has set the following goals and REF shall contribute to achieve these goals:

- 100% level of village electrification including battery lighting by the year 2020
- 70% level of household electrification with grid electricity by the year 2030

#### 5.3.1 REF current activities

Currently REF:

- Provides grant as 45 US\$ per new household connection to Rural Electricity Enterprise (REE) for 50,000 new household connections
- Provides grant as 100 US\$ per Solar Home System (SHS) to firms for supplying 12,000 SHS for household in rural area
- Provides grant as 400 US\$ per Kilowatt for development of 850 KW of micro hydro power plant (average 50 KW)
- Provides grant as 400 US\$ per KW for development of 6,000 KW of mini hydro power plant (750-5,000 KW)

#### 5.3.2 Organization structure of REF

REF is operated under the monitoring of two ministries: Ministry of Industry Mine and Energy (MIME) and Ministry of Economy and Finance (MEF). MIME is in charge of monitoring of REF funding policies and strategies for the national objectives for rural electrification. And MEF is in charge of mobilizing national and international sources of funding for REF. The organization structure of REF is depicted in the figure below.

REF managed by the REF Board, its day-to-day Management assured by the REF Secretariat, which is led by Executive Director. The REF Board consists of 11 members come from relevant ministries and institutes.

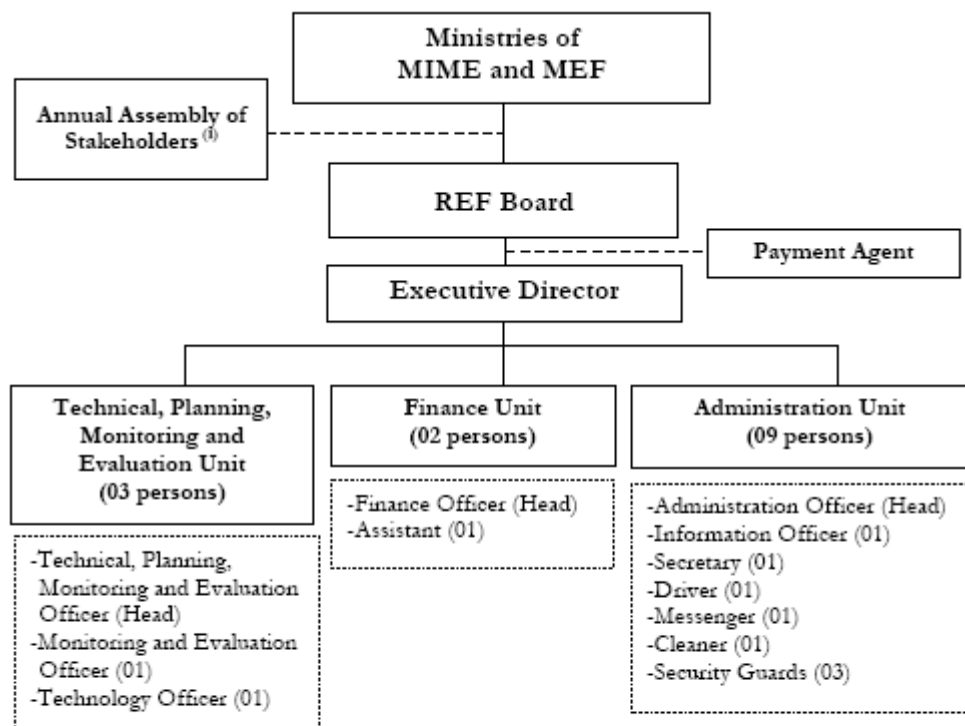
#### 5.3.3 Sources of funding

REF sources of funding are from:

- Donations and grants
- Other sources from the government, which have the characteristics of being regular and sufficiently important, in order to fulfill the government rural electrification policy and goals.

Currently, REF operates with a credit and grant from the World Bank (International Development Association and the Global Environmental Fund) and the government counterpart fund.

**Figure 3: Organization structure of Rural Electrification Fund (REF operation manual)**



**Remark:** (1)-Annual Assembly of Stakeholders consist of REF Board Members and REF Executive Director, a Representative of each Donor providing Fund to REF, Representatives from Financial Institution, Rural Electrification Enterprises, Suppliers of Rural Electrification - Goods and Services, and NGOs involve in Renewable Energy and Rural Electrification Projects, and Senior Representative from the Ministries which are involved in Rural Electrification.

## 5.4 GEF

There are remarkable projects implemented in Cambodia using grant from the Global Environment Facility (GEF). GEF provides grant by focusing on a number of focal areas, and most of the GEF projects implemented in Cambodia are related to biodiversity and climate change. The table below shows some of the GEF projects implemented in Cambodia.

**Table 7: Examples of projects receiving grants from GEF (To be retrieved from GEF website)**

Name of implementing agency	Name of projects	Project description
Local Capacity Builder (NGO)	Solar Bicycle Improvement Research	This solar bicycle development research project is a new innovation not only for SGP but Cambodia as a whole. The main objectives of the project are that by the end of its 6 month duration two new models of solar bicycles, which will be created using diverse technologies from Japan and China, will be introduced to the public and will increase awareness of the importance of environmental issues and protection within Cambodia. Aside from creating two new models of solar bicycles for transportation purposes they will also be used for charging cell phones or powering a laptop or a light.

Name of implementing agency	Name of projects	Project description
ADB	Tonle Sap Conservation Project	The project would assist the Government of Cambodia to conserve and sustainably manage biodiversity and its natural resources in one of the world's most important biodiversity sites. Proposed project objectives are: (i) to support economic development and natural resources management; (ii) to strengthen community-based natural resources management systems for rural development; and (iii) to conserve globally significant biodiversity through protection and/or sustainable use of resources in threatened components of the ecosystem and critical habitats. The project will do so through the strengthening of institutional capacity at key levels such as government and local communities and long-term management of the core and buffer areas of the Tonle Sap.
Ministry of Environment	Programme of Action for Adaptation to Climate Change	The main objective of the NAPA is to identify priority activities and urgent actions needed by a Least Developed Country (LDC) to expand the current coping range and enhance resilience in a way that would promote the capacity to adapt to current climate variability and extremes, and consequently to future climate change.

## 5.5 CDM projects

The topic of Clean Development Mechanism has been attracted by the government of Cambodia several years ago. Since then, capacity building has been conducted by various bilateral or international agencies to provide initiative and concept of CDM to the personnel from relevant ministries and NGOs.

So far there is only one project which has been registered for CDM project. And another project is already proposed Designated National Authorities (DNA) for approval. The scope of these two projects is about energy industry. These two projects are:

- Angkor Bio Cogen (ABC) rice husk power project
- T.T.Y Tapioca starch biogas project

### 5.5.1 Angkor Bio Cogen rice husk power project

Angkor Bio Cogen Co., Ltd. (ABC) is a special purpose company established for the rice husk power generation project in Cambodia established in August 2004. ABC is aiming to reduce GHG emission by means of avoiding CH<sub>4</sub> generation from decayed rice husk and utilizing it as biomass fuel for power generation as a small-scale CDM project, the "Angkor Bio Cogen Rice Husk Power Project". In the project, ABC will construct a boiler/turbine power plant with a generation capacity of 2.0 MW by firing 33,419 tonnes of rice husk annually. This will result in a supply of 13,464 MWh/yrs. electricity generated to an adjacent rice mill owned and operated by Angkor Kasekam Roongroeng Co., Ltd. (ARM) which supplies the rice husk to ABC and to the neighbouring factory via ARM. ARM and ABC are exploring

a possibility of providing a small volume of the electricity to the Ang Snoul Village, which is not currently electrified. However, this activity is not included in the small-scale CDM project proposed by the PDD. Approximately 10% of the steam generated by the rice husk fired boiler will be consumed for drying rice paddy. However, this is also not included in the small-scale CDM project.

The project is expected to contribute to sustainable development of Cambodia by improvement of the environment through prevention of uncontrolled piling of rice husk left to decay and rural electrification of a neighboring village.

An operational lifetime of the project is supposed to be more than twenty one (21) years and the project participants chose “renewable crediting period” with the first crediting period of seven (7) years. ABC will claim the credit of 51 620 tCO<sub>2</sub>e annually between 2007-2014 (7 years) by avoiding CH<sub>4</sub> generation/emission by means of combustion of waste instead of piling this to decay, and by displacing electricity currently generated by diesel oil. The project proponent intends to seek approval for 2 subsequent crediting periods as applicable.

### **5.5.2 T.T.Y Tapioca starch biogas project**

The purpose of the TTY Biogas project is to:

- Build a Biogas Project at the T.T.Y Tapioca Starch Factory in Memot, Cambodia.
- Capture biogas emitted from the anaerobic digestion of organic matter in wastewater that is currently discharged from the tapioca starch factory into large deep lagoons
- Create and use renewable biogas energy to replace the heavy fuel oil (HFO) currently used in the heaters to dry the starch in the factory
- Create renewable electricity from the biogas to displace electricity from the local electricity grid which is solely supplied from the Vietnamese electricity grid
- Create Certified Emission Reductions from the project

The project activity involves the installation of a CIGAR (Covered In-Ground Anaerobic Reactor) designed by Waste Solutions Ltd (WSL) of New Zealand and construction coordinated by Waste to Energy Pte Ltd (W2E) of Singapore. The CIGAR creates an enclosed and anaerobic environment which enables bacteria to convert organic matter into biogas. The captured biogas will be piped to the heaters on site, which will be converted to use biogas fuel and up to 3MW generation to produce electricity. Any excess biogas will be flared.

The baseline scenario of the project will be the continued use of the existing deep lagoon wastewater treatment process, which currently emits methane to the atmosphere. In addition, the factory will continue to use HFO in the heaters to dry the starch, and electricity will be purchased from the local electricity grid.

In the project scenario, the project will capture and burn the methane, thus reducing the potent greenhouse gas. The renewable biogas burned in the heaters will displace the need to burn fossil fuel HFO and the associated emissions, while the renewable electricity produced from burning the biogas will displace the need for electricity to be produced from fossil fuels like coal and gas in Vietnam.

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