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Intelligent Energy  Europe

Promotion of the Efficient Use of Renewable Energies in Developing Countries

Report on WP 2.05

Appropriate technologies scan in Cambodia

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List of Acronyms

CBO	Community Based Cooperative
CEC	Community Energy Cooperative
DAHP	Department of Animal Health and Production
GEF	Global Environment Facility
JICA	Japanese International Cooperation Agency
MIME	Ministry of Industry Mine and Energy
NBP	National Biodigestor Program
NEDO	New Energy and Industrial Technology Development Organization
REE	Rural Electricity Enterprise
RES	Renewable Energy Expert
RET	Renewable Energy Technology
SME	Small and Medium Enterprise
SNV	Development Organization of the Netherlands
UNDP	United Nation Development Program

1 Introduction

The REEPRO project is motivated by the fact that poor households in Developing Countries often lack access to basic energy services. Currently the situation for many rural communities of developing countries is characterized by energy poverty and stagnation. The proposed project shall lead to the provision of energy services to those currently un-served or underserved by higher quality energy services on the basis of an introduction of renewable energies and energy efficiency. To achieve the overall objective, the development of a RES training kit in 3 levels is pursued, which targets country RES stakeholders with different educational background from RES experts (1) over technician (2) to community stakeholders (3). The performance of training courses for the 3 levels and the implementation of RES pilot projects in local communities are essential objectives in the project to ensure a sustainable and locally transferable project success.

The main direct outcome of the proposed project will be the Lao and the Cambodian RES training kits and the training of RES experts, technicians and local stakeholders in the pilot and project communities in the target countries. Per country 120 RES experts will be trained in 4, 150 technicians in 5 and 200 local stakeholders in 10 trainings. Hence the REEPRO project will build the capacity of the target countries to implement RES based projects by the generation of technical, policy, organisational and economic intermediations skills. Additionally to this knowledge generation pilot projects will serve as a hands-on implementation in project communities. The training kit, the established RES expert network, the project web page and the RES pilot projects will provide the basis for a sustainable education in the target countries. The resulting multiplication factor of the project results will lead to the implementation of sustainable RES projects in further small rural communities in need.

The training kits will be produced by adapting the existing Bio energy, solar thermal and Photovoltaic Guide books of the ALTENER GREEN-pro project. These existing manuals will be complemented and modified as needed in order to comply with the local situation of the targeted countries. Local data collection is very important in this step. It serves for shaping the content of the training documents. Several types of data need to be collected: socio economic study, educational competence scan (finance and economics), educational competence scan (technology understanding), appropriate technology scan and financial tool scan.

This individual report will describe the task on appropriate technology scan performed in Cambodia. The same task will also be done in Laos. Appropriate technical solutions for renewable energy conversion on the national and international level within technical associations, donor agencies and project experiences were scanned by the ITC. The results of this scan are presented in this paper.

2 Overview about the renewable energy applications in Cambodia

2.1 Background

Nearly 85% of the Cambodian population still live in the rural areas, and only 13% of the rural households have access to grid-quality electricity. The Royal Government of Cambodia has set the goal of raising the access rate to the reliable, grid quality electricity services, to 70% of the rural population, by the year 2030. To achieve this target many tasks have been done since 2001, institutional framework establishment, project implementation using loan and grant of donors etc. One example of the project is “Rural Electrification and Transmission (RET) project” which is supported by the World Bank.

An important component of RET project is promotion of renewable energy technologies to reach the electricity services to those rural areas which are not likely to be covered by grid extension in the near future. It is in this background, that Ministry of Industry Mine and Energy is formulating a rural electrification (RE) strategy and plan based on renewable energy technologies. This strategy and plan has the following objectives:

- Widely expand the access for electricity services to the rural population through development of appropriate programs and action plans to promote renewable energy technologies;
- Expand the supply base for renewable energy services by promoting the participation of private entrepreneurs so as to provide efficient and cost-effective services, at affordable price to the rural population;
- Facilitate systematic market and institutional development in renewable electricity sector by creating a comprehensive legal and regulatory framework to enable effective participation of government, private and community based entities in providing electricity services to the rural consumers;
- Ensure a wide and equitable access of electricity services to all sections of the rural population by developing appropriate tariff policies and instituting a rational tariff regime;
- Promote environmentally sustainable renewable energy technologies on-grid and off-grid mode in order to create wide access for rural consumers to affordable electricity services; and
- Contribute to empowerment of the rural poor by creating economic opportunities and uplifting standards of living through electricity services, and through involving them in planning, operation, maintenance and management (OM&M) of programs providing those services.

Overall, the Primary Objective of the RE strategy is to initiate the process to maximize the use of local natural resources to provide least-cost options in the power sector, and thus create equitable access to electricity services and associated opportunities for increased social welfare, education, health and economic uplift through income generating activities.

2.2 Renewable energy resources and its application

From the available information based on various studies and pilot initiatives conducted in different parts of the country, the RE strategy would consider the following categories of renewable energy projects in the rural areas:

2.2.1 Small hydropower stations for mini-grids

Of the 15,000 MW hydropower potential of Cambodia, only 1 MW at the O Chum-II hydro-power station (Ratanak Kiri) and 12 MW at the Kirirom-I station (Kampong Speu) have been developed as of 2004. Some micro/pico hydros are in operation or proposed as shown in figure below.

The application of hydro power plant varies depending on the size of the plant. Large size (small; medium and large) hydro power plant will connect to the national grid. For small size (mini; micro and pico) plant, they are normally used as decentralized power plant. The later one will be set up in relatively high concentration of demand. The electricity produced by these plants will be sold to the consumers such as households, small business or institutions. Sometimes, productive use and income generating activities will be considered as priority consumer for this kind of power plant.

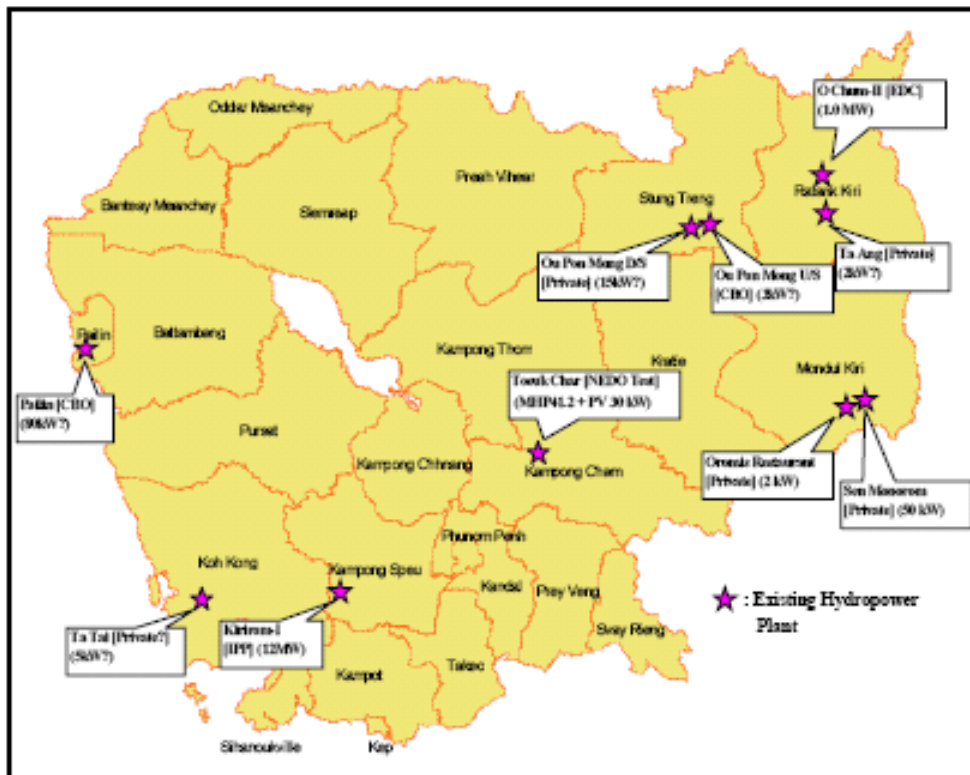


Figure 1: Existing hydropower plant (Energy master plan of MIME)

2.2.2 Solar Photovoltaic Systems

The annual average irradiation is 4.7 kWh/m²/day in the lowest area, 5.3 kWh/m²/day in the highest area, and 5.1 kWh/m²/day is an average over the country. According to the record of MIME, the installed capacity of solar PV is listed in the table below.

Table 1: Total installed PV capacity (Cambodia country report for RETs project)

Applications	Capacity (kWp)
Lighting	55.9
Pumping	13.3
Refrigerator	7.8
Computers	6.9
Radio repeater	1.9
Telecommunication equipments	1,050.0
Total	1,135.8

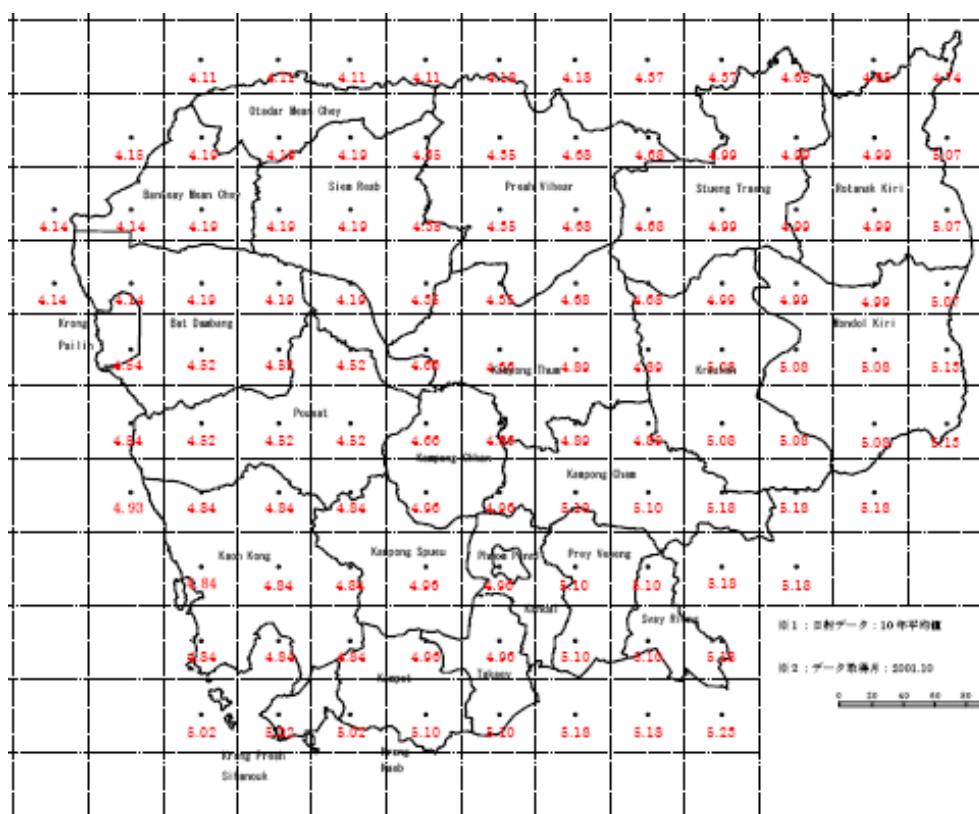


Figure 2: Solar energy resource map (Energy master plan of MIME)

The solar photovoltaic systems will cover the following end-uses:

- enhance the quality of life of domestic households by providing solar PV systems on commercial terms, after smart (or one time investment) subsidies at least on the medium term basis, to meet requirements of lighting and power for small appliances, e.g. TV on educational and health programs, clean water supply, etc.;
- provide lighting and power for running small businesses (e.g. telecommunications), leading to income generation and rural employment;

- Meet energy requirements of community institutions like rural health centres, pagodas with religious and social functions, and residential primary and middle schools.

2.2.3 Biomass resources

Biomass resources such as wood and agricultural residues are abundant in Cambodia. It is estimated that biomass fuel accounted for some 80% of the national energy consumption (MIME 2001) but biomass fuel used for power generation is limited for a few small-scale projects and negligible amount among the total national power production. Woody biomass accounts for more than 95% of the biomass energy used in the country.

According to the study team of JICA, it is stated that rice husk and some other agricultural residues, old rubber wood occurred as the result of new planting and forest wood from plantations and managed natural forests are high potential energy source for electricity generation.

2.2.4 Wind resources

According to the data from the satellite, the country annual average wind speed at 50 m is around 3.5 m/sec and at 20 m is around 2.6 m/sec. The wind speed is higher towards the eastern and southern regions and the maximum is around 4.6 m/sec on an annual average.

According the ATLAS OF SOUTHEAST ASIA, it is stated that Cambodia has not much wind potential comparing to the other neighbouring countries. There may be some specific sites, often called local wind corridor, where high speed wind locally prevails. Such sites need detailed site assessment to evaluate the local potential.

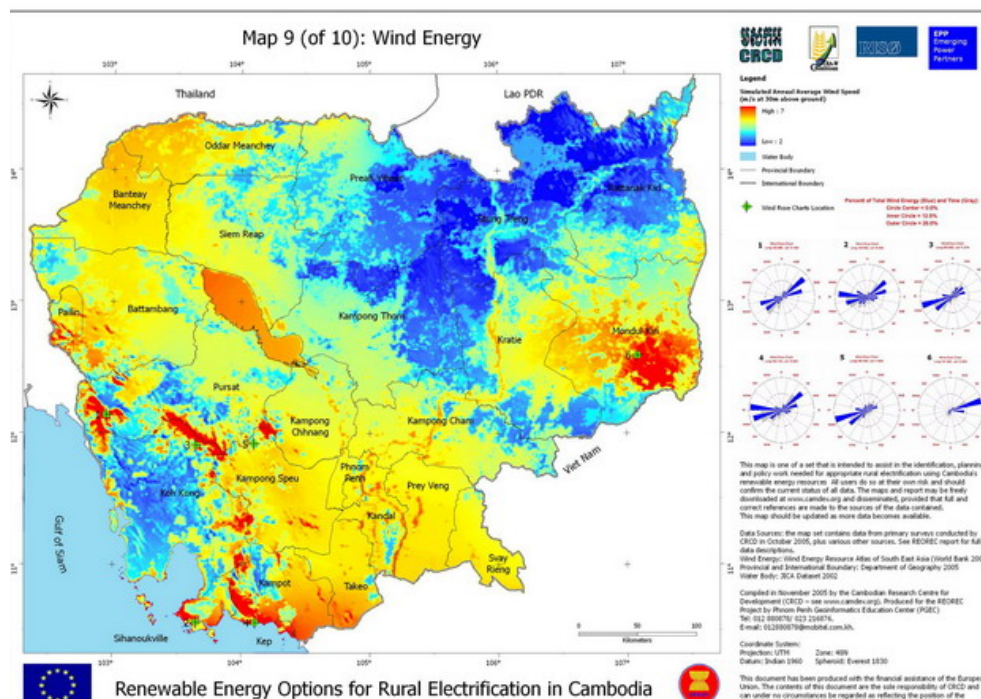


Figure 3: Wind energy resource map (Renewable Energy Assessment and Cluster Identification - CRCD)

There is one small few hundred Watts wind turbine installed in cooperation with NEDO (Bangkok) as a hybrid system in Kampot province. Unfortunately it is not working at present. The wind turbine stopped operation few months after the installation. The cause of damage is not known. There is no information on any other wind power installations by NGO's or private sector.

2.3 Barriers to renewable energy

In order to promote the decentralized, demand-driven approach to rural electrification and to facilitate private sector involvement, a number of serious barriers need to be overcome. Renewable energy technologies face several impediments, which are summed up below.

Lack of policy and legal framework

There is no renewable energy policy in Cambodia as yet, though the government has expressed its commitment to promote renewable energy for remote applications. The legal and policy framework needs to be put in place.

Access to financing of renewable energy devices

Cambodian banking system operates mostly on short-term capital with high interest rates. The high initial cost of renewable energy technologies acts as a deterrent for the banks to finance them. Other factors acting as barriers to financing are:

- Very low to moderate incomes in rural areas and consequently low creditworthiness,
- General shortage of capital, mostly accessed for promoting direct income generating activities, and renewable energy is not being a top priority,
- Lack of long term funds for REEs preventing them from investing in downstream activities (distribution, alternative technologies, etc.),
- High administrative costs for servicing micro finance in rural areas, and
- No legal framework to deal with collaterals, bankruptcy, etc.

Lack of information on market characteristics, resource potential

A detailed market assessment is needed to evaluate the prospects of renewable energy as an alternative to diesel stations or batteries in different provinces/municipalities of the country.

Institutional capacity for planning, implementation and maintenance

Lack of experience in operation, maintenance and management; limited training possibilities; low volume of renewable energy installations so far; no network for service outlets and supply of spare parts are some of the factors causing institutional barriers.

General lack of awareness

Lack of information on different renewable energy options and their costs and benefits is a big barrier in creating awareness, which is presently very low among the population in general. Efforts of information dissemination are feeble, and marketing of products non-existent. Low literacy levels in rural areas, and non-availability of Khmer literature on renewable energy also contribute to the general lack of awareness.

3 Appropriate technologies

Several applications of renewable energy technology will be presented in this chapter. It ranges from a very small scale for household application to a larger scale for community application. Two main renewable energy resources are selected to present in this chapter: biomass and solar energy.

3.1 Technology description

3.1.1 Biomass conversion technology

Two biomass conversion technologies will be discussed: gasification technology and anaerobic digestion technology.

National Biodigester Program (NBP)

The technology used under the scope of this project is anaerobic digestion. The main input material is cow dung which comes from cows raised by the family himself. It will be mixed with water with the ratio 1:1 and will be fed into the digester. Methane and other gas such as carbon dioxide will be produced. Carbon dioxide will be filtered out and only methane will remain and will be used for gas stove and gas lamp.

This technology is simple and need less maintenance. The biomass resource come from the family himself so there is no need to spend money on the resource. Furthermore, the waste exit of the digester will be used as fertilizer for agricultural activity.

Community Based Renewable Energy Project

The technology used under the scope of this project is a 100% based renewable energy resource for electricity generation. The main resource is Leuceana which can be bought from the households nearby around the generation plant. The Leuceana tree are cut into small pieces and dried to get 20% moisture content. These small pieces of Leuceana are fed into the gasifier and the output gas is used as fuel for the engine to generate electricity.

The technology is a little bit complicated and requires much maintenance. Nevertheless, it could be considered as the most appropriate option for the community. Growing Leuceana not only can improve soil quality but also can generate income for people in this community. Furthermore, access to electricity generated using these Leuceana trees as resources can improve significantly their livelihood.

3.1.2 Solar energy conversion technology

There are several applications of solar energy such as solar photovoltaic, solar water heating, solar air heating, solar drying, solar cooking etc. Only two systems are in practice in rural area of Cambodia. Those are solar PV system and solar drying. Solar water heating system is also in use in Cambodia but it is mainly used by hotel for hot water service.

Several applications of PV system are presented here. Electricity produced by solar panel can be used for various applications. It can be a solar home system in which the output of

the PV supplies household appliances such as lighting, television, radio etc. it can be used for pumping water, battery charging using smart controller.

3.2 Operational environment restrictions

There have been remarkable renewable projects in Cambodia implemented by aid agencies of developed nations and international organizations. Regrettably, some of these projects are not successful. The main reason for the failures was not technology, but could be one of the following institutional reasons:

- Lack of rural electrification plan by central government
- Lack of participation from the local community and neglect of local needs in the planning stage of renewable energy projects
- Lack of tariff collection from villagers for proper maintenance of equipment
- Lack of income generating activities using electricity produced by renewable energy;
- Lack of training for local people
- Lack of maintenance services by suppliers

3.3 Costs structure and economics

Most of the projects presented in the data sheet below received grant from bilateral or international donors. Most of them are developed for research or demonstrative purpose only. Therefore economic viability of the projects has not been taken into account in the project cycle. The price of the output of the plant (Heat, Lighting, Electricity...) surely is affordable by the consumers. But they are not economic viable in term of project development.

Two of the projects presented below can be considered as economic viable projects. Those are national bio digester program and renewable energy based projects.

4 Technology data sheets

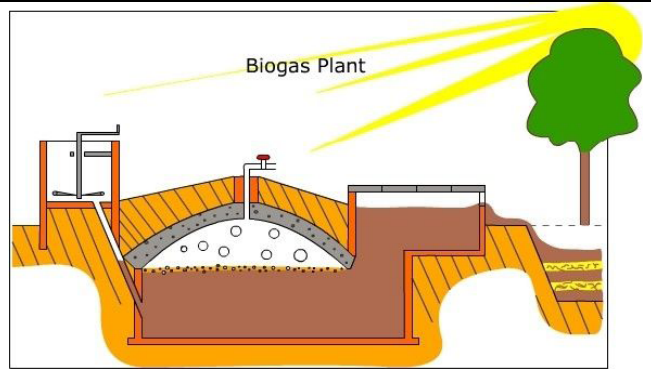
4.1 National biogas program data sheet

Type of project: (tick off the type)	PV	Solar Thermal	Biomass to Energy	
			X	
Project name:	National Biogas Program (NBP)			
Location of the plant:	6 provinces through out Cambodia (Kandal, Kompong Speu, Takeo, Prey Veng, Svay Rieng and Kompong Cham)			
Year of Implementation:	2005			
Operator: (Name and address)	End user (House hold member)			
Planner: (Name and address)	Expert from Department DAHP of Ministry of Agriculture and from SNV of the Netherland			
Detailed description of the installation: (technology, function, benefit for users, etc. max 150 words)	<p>The National Biogas Program is a joint intervention between Ministry of Agriculture of Cambodia and the SNV of the Netherlands. The objective of the program is to disseminate the technology of the biogas plant to the rural household and make it commercially available in some selected provinces.</p> <p>The Deenbandhu fixed dome of India has been adopted and modified to suit the local condition of Cambodia. Input materials are cattle dung, pig or chicken dung. The volume of the plant varies depends on the animal waste available and the income of the rural household.</p> <p>Biogas is a secured and reliable energy source for rural household in Cambodia. By using biogas plant, people in rural area can save time for fuel wood collection. They can save money by buying charcoal for cooking or gasoline for lighting. Furthermore, the waste of biogas plant can be used as nutrient for plantation.</p>			
Generated Energy service: (tick off the energy type)	electricity	Heat	gas	Light
		X		X
Power output of installation: (kWel, m ³ biogas, kW th, etc.)	Depend on the volume of the biogas plant - 4 m ³ : 3.5-4 h for biogas stove and 8-10 h of biogas lamp - 6 m ³ : 5.5-6 h for biogas stove and 12-15 h of biogas lamp - 8 m ³ : 7.5-8 h for biogas stove and 16-20 h of biogas lamp			
Financing (tick off the financing type)	private investment	Loan	Donation	Grant
	X		X	
Investment costs in US\$	Depend on the volume of the plant. 4m ³ 320 \$US, 6m ³ 375 \$US, 8m ³ 430 \$US, 10m ³ 490 \$US, 15m ³ 755 \$US			
Maintenance costs in US\$	Regular expense on the replacement of the lamp (0.1 \$US per lamp)			
Savings:	- 1 to 2 hours time saving used for fuel wood collection - 0.4 to 0.7 \$US saved by saving money for fuel wood, charcoal, gasoline or battery charging			
Energy sale income in US\$:	No			

Comments:

The project has been proved to operate very successfully in the selected provinces during the early stage of the first phase of the project (2005-2009). Each household received 100 \$US from the program for any volume of the plant. The program aim to produce 17500 plants by the end of phase 1 of the project.

Pictures and grafics



4.2 Community based renewable energy project data sheet


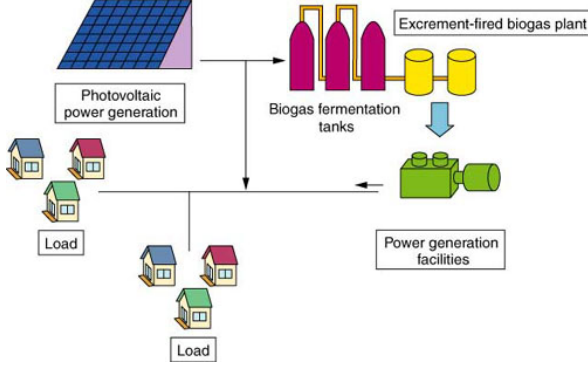
Type of project: (tick off the type)	PV	Solar Thermal	Biomass to Energy		
			X		
Project name:	Community Based Renewable Energy Project				
Location of the plant:	Anlong Tamey Village, Bannan District, Battambang Province				
Year of Implementation:	2004				
Operator: (Name and address)	Community Energy Cooperative				
Planner: (Name and address)	Staff from SME Cambodia (Local NGO)				
Detailed description of the installation: (technology, function, benefit for users, etc. max 150 words)	<p>The project was implemented by SME Cambodia with financial support from the Canada Fund and US-AID for the first phase and from UNDP/GEF for expansion in the second phase.</p> <p>The system is a 100% renewable based technology. It uses Leuceana for the gasification. The engine appropriate for using with gas is imported from India. The fuel resource comes from the fast growing, tropical legumes trees (Leuceana) which are planted, harvested and sold by local farmers.</p> <p>The use of electricity generated from renewable source is an environmentally friendly energy service. This leads to reduced greenhouse gas emissions and pressure on local forests from firewood collection. The electricity price is much lower than that of the diesel based REE.</p>				
Generated Energy service: (tick off the energy type)	electricity	Heat	Gas	Light	
	X				
Power output of installation: (kWel, m ³ biogas, kW th, etc.)	9 KWe in the first phase and expanded to 29 KWe by adding a new 20 KWe engine				
Financing (tick off the financing type)	private investment	Loan	Donation	Grant	
				X	
Investment costs in US\$	Investment cost is 24,000 US\$ for the first phase and 76,600 for the second phase.				
Maintenance costs in US\$	<p>Direct Cost:</p> <p>Fuel wood \$47.00</p> <p>Labour \$80.00</p> <p>Lubricant \$15.00</p> <p>Indirect Cost</p> <p>Maintenance \$15.00</p> <p>Salary for accountant \$20.00</p> <p>Depreciation \$112.33</p> <p>Others \$8.00</p> <p>Total \$297.33</p> <p>(This figure is only for the first phase project)</p>				
Savings:	Cheaper electricity price				
Energy sale income in US\$:	- 0.4 \$US/KWh and 0.3 US\$ per charging of a 50 Ah battery				

	<ul style="list-style-type: none"> - The generator runs for about 4 to 5 hours per day - The average number of battery is around 30
<p>Comments:</p>	<p>The project provides electricity to 241 households among 290 households in the village who was not electrified prior the pilot project. The community Energy Cooperative (CEC) is the first Cambodian member owned energy cooperative that operates its own electricity generation and distribution system. The project has been recognized nationwide as an important demonstration that has wide application throughout rural Cambodia.</p>

Pictures and grafics



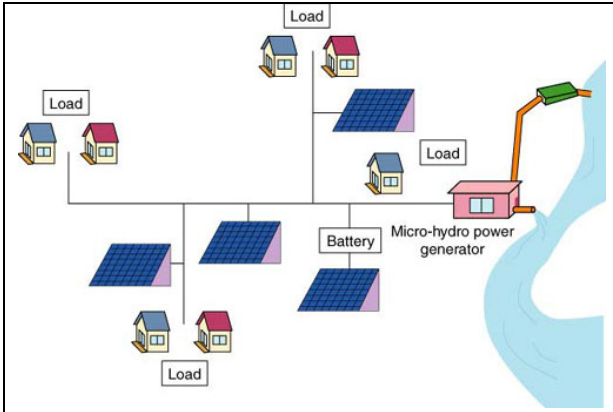
4.3 Demonstrative Research on Combined Photovoltaic Power Generation System data sheet

Type of project: (tick off the type)	PV	Solar Thermal	Biomass to Energy			
	x		x			
Project name:	Demonstrative Research on Combined Photovoltaic Power Generation System					
Location of the plant:	Prey Nob, Sihanouk Ville					
Year of Implementation:	2002					
Operator: (Name and address)	Technician recruited by Ministry of Industry Mine and Energy					
Planner: (Name and address)	Shikoku Research Institute Inc.					
Detailed description of the installation: (technology, function, benefit for users, etc. max 150 words)	This hybrid system consists of both photovoltaic (PV) and biogas power generation systems. The PV plant is designed to send a fixed amount of power output to a distribution network (grid). Surplus power is directed to the biogas plant where it can be used for the fermentation process. This will help to alleviate the possible effects of output fluctuations on the grid. Biogas generated in the biogas plant can also be used for power generation. Demonstrative research is under way to verify the cost effectiveness of the combined plant as a total system and to verify the system's commercial viability.					
Generated Energy service: (tick off the energy type)	electricity	Heat	Gas	Light		
	X					
Power output of installation: (kWel, m ³ biogas, kW th, etc.)	50 KWp of PV combined with 2*35 KW generators using gas from the bio digester as fuel source					
Financing (tick off the financing type)	private investment	Loan	Donation	Grant		
				X		
Investment costs in US\$	500,000					
Maintenance costs in US\$	500 – 600 US\$ (Dialogue with MIME personnel)					
Savings:	---					
Energy sale income in US\$:	0.25 \$US/KWh					
Comments:	---					
Pictures and grafics						
						



4.4 Demonstrative Research on Dispersed Photovoltaic Power Generation Systems data sheet

Type of project: (tick off the type)	PV	Solar Thermal	Biomass to Energy	
	x			
Project name:	Demonstrative Research on Dispersed Photovoltaic Power Generation Systems			
Location of the plant:	Teuk Chha, Kompong Cham Province			
Year of Implementation:	2002			
Operator: (Name and address)	Community Energy Cooperative			
Planner: (Name and address)	Tokyo Electric Power Services Co., Ltd./ Toshiba Plant System & Services Corporation			
Detailed description of the installation: (technology, function, benefit for users, etc. max 150 words)	Under this project, a hybrid dispersed power generation system using photovoltaic and micro-hydro generation is linked to a small grid. By combining PV and hydropower generation systems, this demonstrative research focuses on the feasibility of improving the power generation efficiency, alleviating the possible effects of output fluctuations to the grid, maintaining the power supply during the dry season and reducing the required capacity of the storage batteries.			
Generated Energy service: (tick off the energy type)	electricity	Heat	Gas	Light
	X			
Power output of installation: (kW _{el} , m ³ biogas, kW _{th} , etc.)	87 kW _p of PV combined with 2*20 KW hydraulic turbine			
Financing (tick off the financing type)	private investment	Loan	Donation	Grant
				X
Investment costs in US\$	700,000 US\$			
Maintenance costs in US\$	Can not be estimated (Dialogue with the operator of the plant)			
Savings:	---			
Energy sale income in US\$:	0.25 \$US/KWh			
Comments:	The project has been down for two year due to the willingness to pay of the consumers. During the start of the project, the electricity costs 0.16 US\$. But this tariff can not even cover the operational and maintenance cost. To cover this, it is decided to raise the electricity from 0.16 to 0.25 US\$. Unfortunately, the consumers are not willing to pay at this price. Therefore, the plant stops their operation.			
Pictures and grafics				





4.5 Demonstrative Research on PV battery charging station data sheet

Type of project: (tick off the type)	PV	Solar Thermal	Biomass to Energy	
	x			
Project name:	PV battery charging station (Demonstration project)			
Location of the plant:	Chiso Mountain, Takeo province			
Year of Implementation:	2001			
Operator: (Name and address)	Household			
Planner: (Name and address)	Staff from NEDO			
Detailed description of the installation: (technology, function, benefit for users, etc. max 150 words)	<p>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. The household which is equipped with this hybrid system is responsible for charging the battery from 6 other households nearby. One battery will be charged per day. So the 7 households will rotate during the week.</p> <p>A similar system was also installed nearby in a pagoda on top of Phnom Chiso, a hill which attracts tourists to visit some Angkor era ruins near the pagoda. Unfortunately it appears that none of the wind turbines are operating at the time of writing this report. The turbines in the village had been disconnected from the battery charging system because the regulators were thought to be malfunctioning.</p>			
Generated Energy service: (tick off the energy type)	electricity	Heat	Gas	Light
	X			
Power output of installation: (kWel, m³ biogas, kW th, etc.)	6 hybrid system of 400 W wind turbines combined with 2*108 Wp PV			
Financing (tick off the financing type)	private investment	Loan	Donation	Grant
				X
Investment costs in US\$	6 US\$ / Wp (Current market)			
Maintenance costs in US\$	---			
Savings:	People can save from 0.1 US\$ to 0.2 US\$ for every charging of a 50 Ah battery			
Energy sale income in US\$:	0.05 US\$ per charging the battery of 50 Ah			
Comments:	---			
Pictures and graphics				



4.6 Photovoltaic Program in Cambodia data sheet

Type of project: (tick off the type)	PV	Solar Thermal	Biomass to Energy	
	x			
Project name:	Renewable Energy Technologies in Asia (Photovoltaic Program in Cambodia)			
Location of the plant:	Several village in two provinces of Cambodia: Sihanouk Ville and Pursat Province			
Year of Implementation:	1997			
Operator: (Name and address)	House holds			
Planner: (Name and address)	Personnel from Ministry of Industry Mine and Energy			
Detailed description of the installation: (technology, function, benefit for users, etc. max 150 words)	<p>109 solar home systems were installed in several villages in two provinces of Cambodia (Sihanouk Ville and Pursat Province). Mostly each system has a capacity of 12 W and a few of them has a capacity of 24 W and 36 W. These solar home systems were installed for household, health centre, pagoda and school.</p> <p>These solar home systems were design mainly for lighting application for household in rural area. The energy provided by PV during day time is stored in battery via charge controller and it is used then for lighting during night time.</p>			
Generated Energy service: (tick off the energy type)	electricity	Heat	Gas	Light
	X			
Power output of installation: (kWel, m ³ biogas, kW th, etc.)	Depend on the PV capacity. It can be 12, 24 or 36 W			
Financing (tick off the financing type)	private investment	Loan	Donation	Grant
				X
Investment costs in US\$	---			
Maintanance costs in US\$	---			
Savings:	---			
Energy sale income in US\$:	---			
Comments:	---			
Pictures and grafics				
				



5 List of references

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