

# DGS Publications



## REEPRO

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



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## 1 Background

### Legal frame work Laos

Since the early 1980s, the government of the Lao PDR has embarked on a program of the legislative structure regulation in order to create an environment favourable to the promotion of the socio-economic development. There is currently no legislation dealing specifically with renewable energy production. Nevertheless, the Electricity Law (1997) provides a solid basis to formulate specific legislations on energy renewable, especially under those laws dealing with Rural Electrification. In addition, the Power Sector Policy Statement emphasizes the use of local resources in the production small-scale hydropower, solar, wind, thermal, coal, biogas and biomass, to produce energy in local and rural areas while supporting the development of rural livelihoods in remote areas.

The Lao government set with the "National Environmental Strategy for 2001-2020" among others the objectives to strengthen the environmental protection, to electrify 90% of the country's households by 2020 and to promote application of new renewable energy resources. The government established an off-grid programme intending to supply rural areas without road access and designed grid extension electrification plans to supply urban and rural areas with road excess. In the context of rural electrification, the government focuses on mini or micro-hydroelectric generating station with a mini-grid connection: to serve one or some nearby located villages and solar home systems for individual households or pico-hydro stations serving several households in unconnected clusters.

In the frame of the second stakeholder dialogue "Biomass and Solar Energy Potential and Feasibility in Lao PDR" organised by DGS and CDEA in the frame of the Asia Pro Eco Project "Diagnostic Study on Renewable Energy Potential and Feasibility in Southeast Asia" the clear statement of the participants (key persons from the government, NGO's, companies, farmers and international organisations) was that the main obstacle for a successful implementation of RE in Laos is missing education (training, awareness raising, promotion campaigns).

### Legal frame work Cambodia

Currently the situation for many rural communities of Cambodia is characterised by energy poverty and stagnation. Energy prices in Cambodia are extremely high with between 0,50 to 1 US \$ per kWh, far away from affordable for the rural poor. The development of energy services based on local available renewable energy resources (RES) instead of expensive fossil fuels could lead to affordable energy prices.

The Renewable Electricity Action Plan (REAP) of the Cambodian Government provides the framework for supporting the small-scale generation of electricity by local communities. According to Cambodia's leading proponent of the REAP, Dr. Sat Samy, Director of the Department of Energy and Technique in the Ministry of Industry, Mines and Energy, "Promoting renewable energy technologies to produce electricity can boost the rural electrification efforts to help us achieving the goal...[to] provide a safe reliable supply electricity of 70 per cent of the population in the year 2030." The REEPRO project will support the Cambodian government in achieving this aim.

### Inefficient use of Fossil Fuels

Presently, out-dated diesel generators are the main electricity source in rural areas in Laos and Cambodia. They are used to run battery charging stations (Figure 2), village grids or single applications as rice mills (Figure 1).



**Figure 1: Rice mill generator, Laos**

Those systems are inefficient and expensive. The diesel costs raise permanently, 2007 one litre of diesel cost 0,90 US \$ and in July 2008 already 1,2 US \$. Next to the high price, the high environmental damages (green house gas emissions, dust) using the diesel in inefficient generators are an enormous problem. The use of diesel generators to feed electrical village grids is very common in Cambodia. Rural Energy

enterprises offer this diesel based electricity for 0,50 US \$ to 1,00 US \$ per kWh. Many households can not afford this high electricity prices.

Car batteries are another common source of electricity. Batteries are charged at central battery charging stations, mainly operated again with diesel generators. Figure 2 shows a battery charging station and its price list in Cambodia. The charge of one 120 Ah battery costs 2000 RIEL (0,50 US \$). The charging stations are situated at central locations in the villages or districts inducing additional costs for the transport of the batteries from home to the charging station and vice versa. So that the average cost for one charge range between 0,50 to 1,50 USD per charge. Typical batteries can operate lamps, CD-player, radios and TVs 3 hours a day for one week.

**Renewable Energies – The solution for efficient rural electrification**

One possibility to overcome the energy deficits in the rural areas of Laos and Cambodia is the local use of renewable energy sources (RES). The use of locally available RES as the sun and biomass can bring a multitude of benefits for the region as: independence of grid connection and imported fossil fuels, generation of new jobs in the energy sector and by pure availability of energy, increase of the quality of life and thus reduction of rural migration.



**Figure 2: Battery charging station (left) and price list (right), Cambodia**

The governments of both countries already recognized the potential of renewable energies and support its used as described before. But the main obstacle for the sustainable implementation of renewable energies in Laos and Cambodia is the limited knowledge and awareness of all stakeholders from engineers to villagers. The rural population, but also technicians, engineers, and experts do not know the existing funding programmes and the possibilities of RES. Additionally, all lack economic understanding. They only see that the first investment in renewable energy (RE) technologies is often higher than in conventional, energy fossil technologies. They, never think about comparison of the investment plus operation costs to get a real cost picture. Another problem is the wrong installation and the missing maintenance of applied RE technologies. Solar home systems are very often completely or partly shaded, dirty or installed facing the wrong direction. Small scale biogas plants are often operated ineffective and some times out of order. Installers and users are not aware of the right installation and operation. They do not know the negative influences of shading, dust and wrong installation of the efficiency of PV modules. Solar systems can suffer a great deal of power reduction if shaded. A solar system with mere 10% of its module area covered by close shading from leaves etc. will suffer a power loss of up to 90%.



Trainings will be offered in Lao and Khmer for the following 3 levels:

- **Level 1 – Energy experts, multipliers**  
Trainer and multiplier (scientists, engineers, architects etc. with a higher education degree as well as local and national government representatives)
- **Level 2 – Technicians**  
with basic understanding of engineering subjects
- **Level 3 – Community stakeholders**  
with often very basic education level

Common subjects in the training kits will be presented at those 3 levels, considering the knowledge and abilities of the respective target group. To guarantee this adaptation the target groups will be involved in the training kit development level by level as shown below. This structure ensures the development of target group-oriented training kits, the training by local trainers and the multiplication of the projects results after the end of the project.

### 3 Main steps of the REEPRO project

REEPRO is a co-operation project between three European, three Lao and two Cambodian partners headed by the German Solar Energy Association (DGS e.V.). The project receives funding from the European Commission within the Intelligent Energy Europe COOPENER Programme. REEPRO is a three year project, which started in January 2007 and lasts until December 2009. The European partners German Solar Energy Association DGS e.V., European Forum for Economic Co-operation and the Finland Futures Research Centre, Turku School of Economics advise the Asian partners Cambodian Education and Waste Management Organisation, Institute of Technology of Cambodia, National University of Laos, Lao Technology Research Institute and the Lao Community Development and Environment Association in developing and implementing the REEPRO trainings.

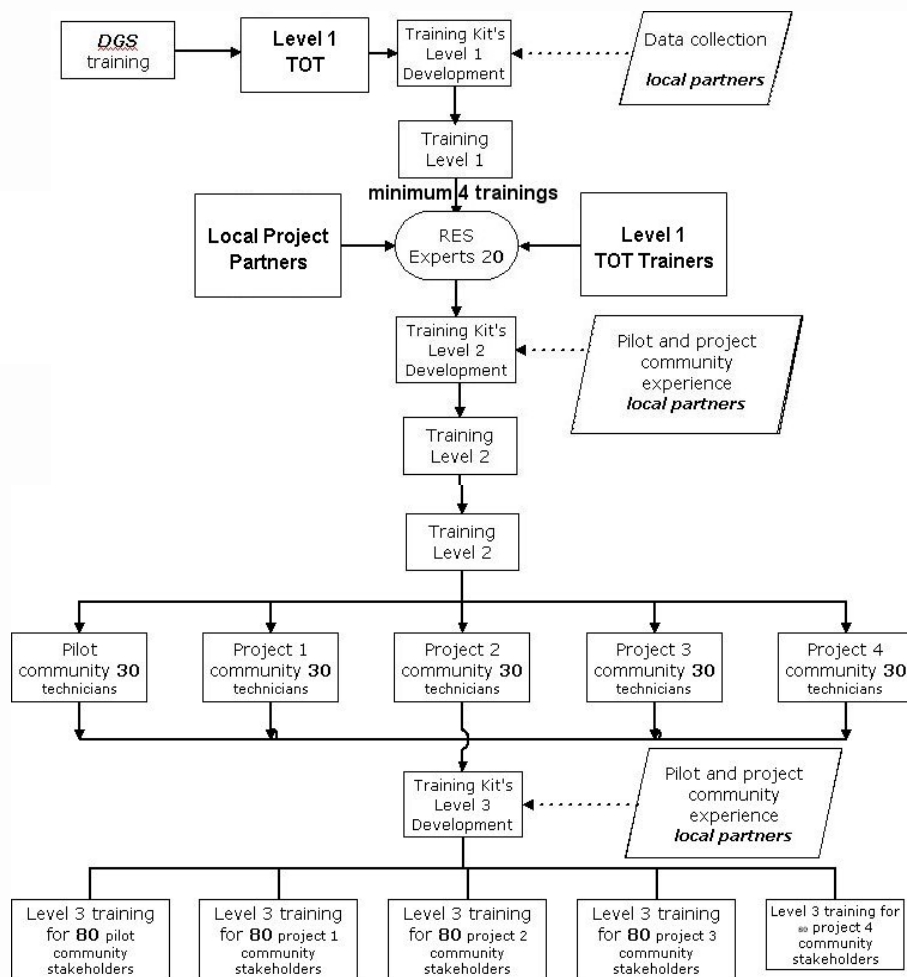


Figure 6: REEPRO project structure (RES-Renewable Energy Source)

### 3.1 Training material (training kits) development

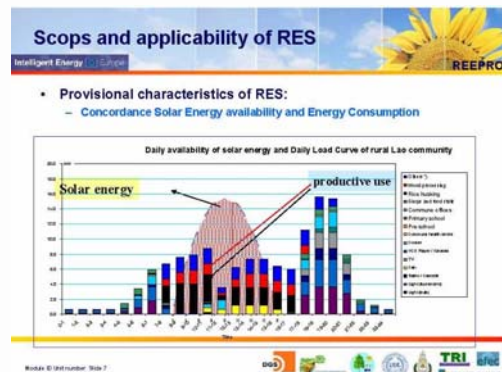
The REEPRO team develops training kits for each level, based on the existing DGS photovoltaic, solar thermal and bio-energy guidebooks, training material of the Asian partners and demand surveys performed in the first REEPRO project year. The different local framework conditions, such as educational competence, available and appropriate technologies, economic situation, available biomass etc. will be considered during the preparation of local training kits especially for the generation of localized chapters for the training of economical skills. The level 1 of the local training kits will be developed in English and afterwards translated into Lao and Khmer. This proceeding assures transparency on the detailed content of the local training kit versions.

The levels 2 and 3 of the training kits will be developed in Lao and Khmer and only the final version will be translated into English. All first versions of the training kits will be further developed according the lessons learned during its application. The final versions of the training kits will be prepared in the last semester of the project. The interim versions of all 3 levels will be published on CD. The first and the final version of the text book will be published as hard copies.

**Table 1: Media and material for the levels**

Media	Material
<b>Level 1 -Energy experts, multipliers</b>	
<ul style="list-style-type: none"> <li>Lecturers,</li> <li>workshop,</li> <li>project work,</li> <li>practical work &amp; excursion</li> </ul>	<ul style="list-style-type: none"> <li>Scientific textbooks,</li> <li>Slides with explanatory text for the trainers,</li> <li>handouts,</li> <li>videos, practical training equipment,</li> <li>Excel calculation tools for planning and dimensioning RE projects</li> </ul>
<b>Level 2 - Technicians</b>	
<ul style="list-style-type: none"> <li>Practical work,</li> <li>lecturers,</li> <li>excursion</li> </ul>	<ul style="list-style-type: none"> <li>Technical textbook/manuals with experiences/handouts,</li> <li>videos,</li> <li>practical training equipment</li> </ul>
<b>Level 3 - Community stakeholders</b>	
<ul style="list-style-type: none"> <li>Stakeholder workshops,</li> <li>coaching,</li> <li>meetings,</li> <li>consulting</li> </ul>	<ul style="list-style-type: none"> <li>Handouts,</li> <li>Poster,</li> <li>comics,</li> <li>videos etc.</li> </ul>

The training kits will be developed based on the demand and abilities of the different levels. Table 1 gives an overview on the media and material used for the different levels. Selected examples of the level 1 training media are presented below.



Slide of the basic module

#### Practical training equipment SOLAR



Mini Solar home system

**Provisional characteristics of RES**

- Both Energy demand varies with times
  - Usually electricity demand is higher in the morning and evening hours, and lower at night times
  - In cold climate regions, heat for water and space heating is highest during winter months and lowest in summer period

→Therefore, energy planning aims to finding the solutions for achieving appropriate concordance between provisional characteristics of energy resources and consumers, for examples:

- to use when energy is available
- to store energy for later use
- to supply energy by consumers' groups accordingly to resource availability

Explanatory text for this slide



PV teaching case

The described compilation of material will allow every trainee to perform trainings by himself.

### 3.2 Training performance

#### 3.2.1 Level 1 Train the Trainer programme

The training started with two parallel 2-week train-the-trainer (TOT) seminars in January 2008 in Cambodia and Laos. 20 RES experts each country participated in this seminar. Those 40 Level 1 trainers will be involved in the whole project, in the training of further trainers, the training material development and in the development and implementation of the community showcases. These persons will serve as the seeds for further development in their countries sector. The REEPRO team offers frequent further seminars for these TOT participants.

The TOT included lectures and practical work on the following subjects.

- Basic Knowledge on renewable energies and electricity
- Power Transmission and Storage
- Biogas
- Biofuels
- Gasification
- Photovoltaic
- Solar Thermal
- Entrepreneurship
- Micro-Financing
- Renewable Energy Sources Policy Planning
- International Trade
- Project Development

#### 3.2.2 Level 1 Expert Training

For the level 1 training schedules for 2 one week course where developed. Every course contains 20 units á 90 minutes, thus 30 hours. The BIOMASS course contains 9 and the SOLAR course 8 different modules, which are listed below.

**Table 2: Level 1 courses BIOMASS**

ID	module name	Units
IN	Introduction	0,5
BA	Basics	0,5
PT	Power Transmission, Storage	1,0
BG	Biogas	3,0
BF	Biofuel	0,5
GA	Gasification	0,5
BU	Business (EN, FI, PD)*	4,0
CS	Project (Case study)	2,0
EW	Excursion/Practical Work	8,0
	<b>Total</b>	<b>20,0</b>

**Table 3: Level 1 courses SOLAR**

ID	module name	Units
IN	Introduction	0,5
BA	Basics	0,5
PT	Power Transmission, Storage	1
PV	PV	3
ST	Solar Thermal	1
BU	Business(EN, FI, PD)*	4
CS	Project (Case study)	2
EW	Excursion/Practical Work	8
	<b>Total</b>	<b>20</b>

\*Entrepreneurship, financing, project development

Additionally one special 5 day entrepreneurship course is offered in co-operation with the Cambodian - Indian Entrepreneurship Training Centre in Phnom Penh.

The TOT participants offer about 8 trainings á 30 hours for 20-30 participants from April 2008 to June 2009. The targeted participants are public and private sector RES experts, officials and politicians from the target countries. The trainees will be enabled to become level 1 RES trainers or RES consultants.

Those trainings will be offered in Lao and Khmer.

#### 3.2.3 Level 2 Technician Training

The level 1 trainees from the TOT and further courses will organise 5 trainings á 60 hours for each 20 to 30 technicians in the geographical areas of the pilot communities from September 2008 to April 2009. The trainees will be enabled to become level 2 and 3 trainers and to develop and implement RES projects in their communities. The trainings will focus on specific subjects, such as:

- Photovoltaics
- Biogas
- Biofuel
- Gasification
- Business management

The level 2 trainings will have a strong focus on practical work and excursions.

#### 3.2.4 Level 3 Community Stakeholder Training

The level 1 and 2 trainers will organise trainings, workshops, meetings and consultations in each pilot community from June 2008 to August 2009. The targeted participants are local stakeholders in the geographical areas of the pilot

communities, such as politicians, civil servants, entrepreneurs, teachers etc.

The REEPRO trainees will inform the local stakeholders in the selected pilot communities about the technical and economical options of renewable energies. The local stakeholders will be enabled to understand the economical and technical benefits of adequate RES technologies for the well being of their communities. The community stakeholders (level3) and the technicians (level 2) will be guided by the level 1 trainers to identify the right RES for their demand and to draft RES master plans. The trainings in the pilot communities will be accompanied by hands-on RES project implementations, the so-called community show cases.



**Figure 7: Stakeholder dialogue and individual meetings/consultation in the pilot communities**

### 3.3 Community Showcases

The community stakeholders will apply their knowledge gained in the REEPRO trainings and select and implement renewable energy based electrification projects suitable for their communities. The intention is to establish – within the overall framework of community training – live showcases, which are the results of practical training activities and complement the theoretical lessons within the community and technician

training courses, further enabling project replication.

For the installation of the pilot projects the REEPRO team is looking for available funding sources from credits to donations.

These pilot projects will serve a showcase for the level 2 and 3 training courses. Possible thematic areas for the pilot projects are:

- Building and implementation of efficient biomass stoves on the gasification-clean burning principle
- Biomass and wood gasification technology for power generation
- Solar Home Systems for household electrification
- Solar hot water systems for hygiene and cleaning purposes
- Solar cookers for boiling (installed in over 1 million households)
- Small scale biogas installations for cooking

The pilot activities will be chosen and implemented jointly from the project team, the trainers and the involved community.

### Pilot Communities Laos

The project team visited several potential pilot communities and decided that the first pilot community will be the Hoon district in Oudomxay province. The Hoon District is one of the 7 Districts in the province mentioned above, it is located at about 95 km from Oudomxay capital on the way to Pakbeng District, consisting of 14 zones and comprising 10,515 households included 3,413 households are in poor condition. The total population is 63,985 persons included 31,407 of female (statistic of Oudomxay Province). Corn is the second crop after rice. The total area is 17500 ha (Ministry of Agriculture).

The Government have planned to extend the electricity line along the main road to the districts. But there are many villages far away from the main road in remote area that won't get access to the electricity grid. The main source of energy is firewood, especially for daily cooking in household. The quantity of firewood used per year is about 3 to 5 m<sup>3</sup>. For lighting and rice milling they use diesel engines consuming 10 to 20 litres per month, at costs of diesel nearly 1.5 \$. There are only some villages and households can access to solar energy and pico-hydro power.

### Pilot Communities Cambodia

The project team visited several potential pilot communities in the provinces Battambang and Kampong Thom. The first selected pilot communities are:

- The Kampong Thom Orphanage in the Kampong Thom province and
- The Okjai Village in the Battambang Province

### Khamphong Thom Orphanage

The Khamphong Thom Orphanage is not a typical community but a settlement with an electricity problem which is exemplarily for Cambodia. The orphanage is connected to the electricity grid but the quality and stability is very low. The local energy service company charges 0,45 USD/kWh. In the evening, when the students want to learn and the teachers want to offer further education courses the needed electricity is mostly not available.

To overcome this problem, the German-speaking Catholic Community St. Elisabeth in Singapore, already supporting this orphanage in different ways, developed a 3 step concept with the orphanage:

- Step 1: Using a special environmental educational concept: Train the trainer, conduct workshops with the children/students in Singapore and in Cambodia
- Step 2: First installations of solar plants at the orphanage together with the students to enable them for further installations and maintenance
- Step 3: Extending the project in collaboration with larger institutions to ensure future activities and professional support

After step 1 was finalized successfully a contact to the REEPRO project could be established. This enabled the project team to run step 3 concurrently with step 2:

- 2 members of the orphanage are joining the REEPRO level 1 train the trainer programme in Cambodia
- The orphanage will be a pilot community within the REEPRO project
- The installation of the houses will be done together in order to train the orphans and the trainees of the REEPRO project.

The goal is to electrify the 11 student houses and 1 office with photovoltaic based island systems. Thanks to the financial support of the German Embassy in Cambodia and of the German-speaking Catholic Community St. Elisabeth in Singapore the first 4 houses could be equipped with PV systems in June 2008. This was the first time that REEPRO trainees participated in practical installations in one of the REEPRO pilot communities.

The material was mainly be supplied by the Cambodian solar energy company Kamworks. The installation was done by the REEPRO trainees guided by DGS and Kamworks. The installation was accompanied by a theoretical training programme on solar home system (SHS) dimensioning including all steps from data survey to maintenance.





**Figure 8: Installation of the PV systems for the orphan houses**

#### **4 Benefit from the REEPRO Project**

REEPRO aims to improve the capacity of the target group to deal with RES themes coupled with the build up of technical, policy, organisational and economic intermediations skills.

Participants of the training programmes will be encouraged to:

- Run further training programmes
- Build up their own business in the RE sector
- Implement RE projects for their communities

Your benefits of joining the REEPRO project are:

- Get clean electricity in your community
- Become a renewable energy expert
- Open your own business as
  - Renewable energy trainer
  - Renewable energy consultant
  - Renewable energy craftsman

#### **Stakeholder Pool**

To join the project's Stakeholder Pool please register on:

<http://www.dgs.de/1916.0.html>

#### **Become RES Trainer or Project Partner**

To participate in the projects training programme or to apply to become a show case community please contact:

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