



# Promotion for renewable energy in Laos and Cambodia

Construction of a 4 m<sup>3</sup> biogas plant in Cambodia

**Rural areas in Laos and Cambodia have significant structural shortcomings. The REEPRO project, an advanced training activity conducted by several European and Asian partners, brings know how into these regions to sustainably overcome the deficits.**

**R**ural areas in both countries, especially those far away from bigger cities, have significant structural deficits. In particular the electricity supply is almost not available in rural areas as no area-wide energy grid exists. The expansion of the energy grid proceeds slowly due to limited financial resources of both countries and due to the low population density in combination with low income levels of the inhabitants. The low incomes and the poor standard of the electrical applications in common households – a household is normally equipped with 3 to 5 lamps and a TV – cause low consumption rates. These factors make it difficult to operate an economical sound grid due to its construction and maintenance expense. Actually, 45 % of the households in Laos and 15 % in Cambodia are connected to energy grids.

Subsequently, electrical energy for rural areas is produced with obsolescent diesel based generators of mostly Chinese origin. Very common is the use of diesel

generators in smaller business units. All these systems are not efficient and expensive as the diesel fuel costs between US\$ 0.90 and 1.00. Meanwhile this type of generator is only employed for special applications in remote Laotian areas, it is the most common source for electricity in Cambodia. The prime costs are between 0.50 and 1.00 US\$/kWh.

Households, not being able to afford a diesel generator, use car batteries for their electricity demands, i.e. lighting and watching TV. These batteries are charged weekly in one of several battery charging stations. These stations are normally operated with diesel generators.

The single charge of a battery with an capacity of 129 Ah will cost 2,000 Riel, the Cambodian currency, that equals to US\$ 0.50. The fare for the transport from the household to the charger and back has to be paid additionally. The total price for one charging can vary between US\$ 0.50 and 1.50. One battery charge is sufficient to operate the lamps, TV and radio for approximately one week.

## Efficient rural electrification

One possibility to overcome the energy deficits in the rural areas of Laos and Cambodia is the local use of re-



A diesel-based generator used for the production of electricity for lighting during a wedding celebration in Cambodia.

Photos (10): REEPRO



A battery charging station in a small Cambodian village

newable 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.

The potentials were recognised in both countries and there exist several funding schemes for the promotion of renewable energy applications. The most important obstacle for the sustainable use of renewable energy is the lack of knowledge and experience of the end users. Existent funding and the multitude of technologies available are not known to the rural population. Even engineers, technicians and experts are lacking knowledge. 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 ineffectively 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 on 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%.

### The REEPRO training approach

The training of domestic experts, technicians, and customers in a three-stage training programme is the main objective of the REEPRO project. It has been started in February 2007 and will be finished by the end of 2010. The project is conducted by several European and



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**Train the trainer: PV course in Laos.**

Asian partners and lead-managed by the German Society for Solar Energy (DGS). The REEPRO project receives funding from the European Commission within the Intelligent Energy Europe COOPENER Programme.

The training programme enables the participants to identify and to implement adequate renewable energy applications in their local areas. The first stage of the education, the "Level 1" courses approaches local planners and engineers with a certain technical background. The participants of the "Level 1" courses will instruct themselves technicians "Level 2" in selected pilot villages in a second stage. The technicians are the source of information for the end users "Level 3", i.e. the inhabitants of the rural pilot villages. The courses, designed in three levels, will not only transfer target-adopted technical knowledge but also basic knowledge of financing, project management, and entrepreneurship.

The project team will select minimum six communities for the implementation of the level 2 and 3 training programmes. Those communities will be encouraged to develop and implement RES show cases – pilot applications of renewable energy technologies.

The teaching materials are developed for each level in close co-operation with local experts to meet domestic requirements. Main contents of educational actions are photovoltaics, solar thermal installations, biomass gasification, and digestion (biogas). Several sets of teaching materials, e.g. slides, handbook, manuals, videos and handouts are developed in the domestic languages Khmer and Laotian. Training materials will be used to proceed with environmental education by local trainers without external help.

From January to August 2008 one Level 1 Train-the-Trainer (TOT) training and two Level 1 expert trainings were organised in Laos and Cambodia. Subsequently, the TOT programme will be presented in detail.

### **Level 1 – Train the Trainer programme**

The REEPRO training started with two parallel 14-day Train-the-Trainer seminars in January 2008 in Cambodia

and Laos. The international project team chose participants using a pre-defined selection scrutiny. Basic demands for the participants were a good command of English and an existent technical understanding. The selection procedure yielded 22 participants in Cambodia and 16 in Laos, originating from NGOs, educational institutions, governmental and private sector. Those 38 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 trainings were planned trying to involve local experts and institutions, as well as local entrepreneurs. The private company Sunlabob Renewable Energy Ltd. in Laos and members of the National Biodigester Programme (NBP) in Cambodia participated in the education. Training contents were beside the beforementioned technical topics economical aspects of the installation and operation of renewable energy facilities, entrepreneurship, project development, and management. Case studies, practical works, and excursions completed the teaching. Target of the Level 1 TOT course was the general information of the participants about the possibilities of renewable energies. Participants were encouraged to choose one or two topics for extended studies. Contact to the teachers is established by email and phone. Furthermore, frequent meetings are another possibility for personal contacts.

### **Photovoltaics and biogas excursion in Laos**

The Laotian village Ban Sorge, approximately 70 km away from Vientiane in the Sangthong district, was visited during the field trip. The community is the home of 1,400 inhabitants in 224 households, living mainly from subsistence farming. The village possesses a small biogas plant, several PV systems – communal and private ones – and a technician to take care of these PV systems.

The community operates a solar driven water pump to supply several taps connection close to the houses. Energy for pumping comes from a sun-tracked 110 W panel. A smaller 40 W panel supplies the tracker motor. This panel is shadowed during midday. 6,400 Laotian solar home systems (SHS) existed in 2006 because of a governmental funding programme and private initiatives. Common SHS have capacities between 20 and 40 W, and are equipped with a simple charge controller and a battery. Such SHS are employed to operate a TV and / or radio and some energy saving lamps. Voltage is usually 12 V. The figures show some typical examples and it can be seen that some panels are shadowed – a typical installation failure that lowers extremely the system performance. Another problem apparently unknown to its owners is the dust evolved by traffic on the unpaved lanes. Frequent cleaning would eradicate this problem.

The Dutch SNV (Stichting Nederlandse Vrijwilligers) has started a pilot biogas programme in co-operation



Water tank with PV-operated pump in Ban Sorge (Laos)



This solar home system in Laos is shadowed.



Common solar home system in Laos

with the Laotian Ministry of Forrestry and Agriculture. This 4-year programm (2007 - 2010) intends to construct 6,600 small biogas plants until 2010. The programme consists of several components: advisory services, construction, financing, education of end users and guaranties for plants construction and operation. According to the Vientiane Times, the programme is delayed with almost no plant construction in 2007. The small biogas plant in Ban Sorge was constructed by a private iniative (though externally sponsored), but never went into regular operation.

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Mixing pit for anaerobic digestion processes



Small biogas plant in operation (Cambodia)



### TOT Excursion: biogas in Cambodia

The Dutch SNV and the Cambodian Ministry of Agriculture, Forestry and Fisheries (MAFF) run an extended funding and promotion programme – the National Biogas Programme (NBP) – to foster the installation of up to 17,500 small biogas plants in rural areas until 2009. Offered is an extended service from educational activities to financing services. The NBP offers standardised plants from 4 to 10 m<sup>3</sup>. These plants cost between US\$ 336 (4 m<sup>3</sup>) and US\$ 517 (10 m<sup>3</sup>) and are paid by the private owners. The NBP provides all needed material and advisory service during planning, construction, and start-up. An additional incentive is the US\$ 100 subsidy paid after the construction of the plant. This grant is independent from the plant size.

Input materials for anaerobic digestion processes are mainly cow manure, organic household waste, feces and urine. The manure has to be collected manually as the cattles are not fenced. All materials, excluding faeces, are inserted in a mixing pit. The water content is adjusted by adding liquids if necessary. Digested material is applied in the gardens as fertilizer. Biogas is used for lighting and cooking purposes.

### Pilot communities

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 technical 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 as 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.

The project team visited several potential pilot communities in Laos and decided that the first pilot community will be the Hoon district in Oudomxay province. The Hoon District is one of the seven Districts in the province mentioned above, it is located at about 95 km from Oudomxay capital, consisting of 14 zones and comprising 10,515 households including 3,413 households in poor condition. The total population is 63,985 persons. 31,407 are female (statistic of Oudomxay Province). Corn is the second crop after rice. The total area is 17,500 ha (Ministry of Agriculture).

The Government has 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 areas 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 US\$ 1.5. As there are only some villages, households are likely to access to solar energy and pico-hydro power.

### Khamphong Thom Orphanage

In 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 province of the same name and the Okjai Village in the Battambang Province.

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 US\$/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 three step concept with the orphanage:



Installation of PV systems for the orphan houses in Khamphong Thom (Cambodia)

- 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 finalised successfully a contact to the REEPRO project could be established. This enabled the project team to run step 3 concurrently with step 2. Two 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. And 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 eleven student houses and one 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 four 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 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 dimensioning including all steps from data survey to maintenance.

## Enormous chances for RES

The potential for the application of renewable energy is exceptional in both countries. Most people there are lacking knowledge about these possibilities leading to non-working plants and wrong installation. REEPRO will improve the capacity of people with different knowledge levels 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 and to implement RE projects for their communities. \*

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