

EIE-06-256 REEPRO

Intelligent Energy  Europe

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

**REEPRO Level 1 Train the Trainer Programme –  
Basic Knowledge for Renewable Energy Promotion**

**Cambodia January 7<sup>th</sup> to 18<sup>th</sup>, 2008**

**Report**

## **Location**

COMPED Trainings Centre  
Phoum Ralous  
Sang Kat Choeung Ek  
Khan Dang Kor  
Phnom Penh

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## 1 Introduction and Course Concept

The REEPRO project is motivated by the fact that poor households in Developing Countries often lack access to basic energy services. The REEPRO 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. Therefore, REEPRO intends to perform an extensive training and information campaign in the target countries Laos and Cambodia. These trainings target politicians, engineers, technicians and community stakeholders to overcome barriers to renewable energy sources (RES) utilisation characterised by lack of technology knowledge and awareness of RES financing options and models.

The training is the first level Train the Trainers organised under partnership of REEPRO to build capacities of human resources in Cambodia and Lao. The trained participants have become a major source of expertise and advice on renewable energy in their respective countries. The training will enable the participants to deliver similar training and assist in implementing renewable energy activities thus creating local multiplier effect.

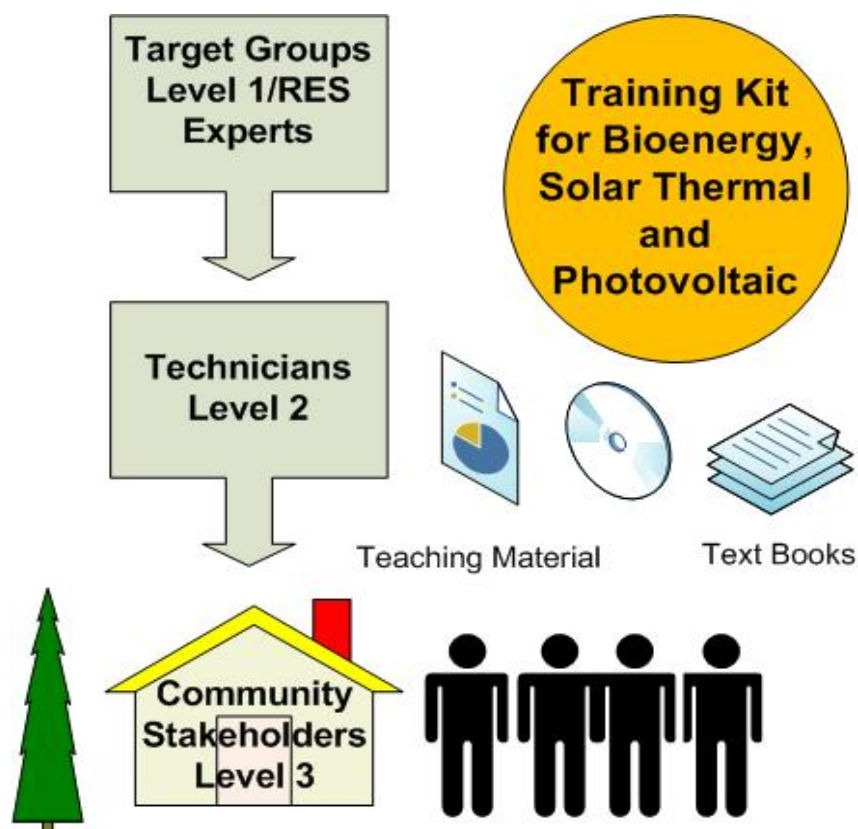


Figure 1: Conceptual framework of REEPRO Project Training

## 2 Training Programme Objectives and Methodologies

The objectives of the training programme are:

- Increase the electrification ratio from Laos and Cambodia by the provision of training
- Development of adapted training materials and performance of trainings for
  - **Level 1** – Renewable energy experts 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
- Encouraging local entrepreneurs to become active in the renewable energy sector

Thematic coverage and content of the training included:

- Introduction of REEPRO project and training programme
- Basic knowledge on renewable energy and non-renewable energy; biogas; Biofuel; gasification; photovoltaic and solar thermal
- Interactive studies were also focussed about the subjects of Entrepreneurial, Financing, RES Policy Planning, International Trade and Project Development.
- Case studies on Anlong Tamrey gasifier and the village with electricity
- Group works on considering appropriate technology of three sites in Stoeung Treng, Kratie and Pursat provinces, Cambodia
- Group works on project development of four sites of possible prospective pilot communities
- Excursion and practical work were implemented on Solar PV and Biodigester

The training was designed and carried out through various learning mechanisms, such as presentations, discussions, case studies, group work, participant presentation on project proposals, and questions and answers.

## 3 Participants

The 22 participants including two participants from COMPED and one from ITC came from different institutes and are either professionals in the fields of electrical engineering, technology or environment. The list of participants with detailed information is given in Annex A.

## 4 Trainers/Facilitators

The training package and program were prepared and delivered by various project partners and external resource person as below:

Dr. Jan	Kai Dobelmann	DGS President	Germany
Ms. Antje	Klauss-Vorreiter	DGS Vive-president	Germany
Dr. Matthias	Klauss	DGS	Germany
Dr. Jyrki	Luukkanen	Turku School of Economics	Finland
Mr. Juha	Leppänen	TAMLINK	Finland
Mr. Yrjo Majanne	Majanne	TSE	Finland
Mr. Duong	Kakada	Economic Institute of Cambodia	Cambodia
Mr. Vorng	Phirom	National Biodigester Program	Cambodia
Mr. Bun	Long	ITC	Cambodia

Ms. Antje Klauss-Vorreiter represented REEPRO and facilitated parts of the training together with Mr. Chau Kim Heng Director of COMPED and colleagues from COMPED.

## **5 Description and Outcome of the Training**

The schedule and programme of the training is given in Annex B.

Day 1 was dedicated to the understanding as below:

- Introduction of REEPRO project, summary, background, approaches and expectation of the project given by Ms. Antje Klauss-Vorreiter from DGS
- Basic knowledge about renewable energy and non-renewable energy; energy sources; basic electrical applications and construction basics; and assessment of possible energy sources in Cambodia presented by Mr. Bun Long from ITC

Day 2 was offered to trainees to understand about:

- RES policy planning and a case study of Anlong Damrey gasifier in Cambodia brought by Dr. Jyrki Luukkanen from Finland
- Project management and business management including sensitivity and risk Analysis and financial Management given by Mr. Juha Lepp from Finland

Day 3 was to give chance to participants to learn about:

- Group work and discuss about case study and project management organised by Dr. Jyrki Luukkanen and Mr. Juha Leppänen.
- Financing tool in Cambodia: Introduction, equity, debt financing, sales-lease-back arrangement and public support schemes given by Mr. Bun Long
- International trade: form of exporting, agents and distribution networks, financial transaction: mode of payments, sale terms custom procedures, and trader manual for Cambodia presented by Mr. Duong Kakada, Economic Institute of Cambodia

Day 4, participants were trained about:

- Project work to consider appropriate energy technology of three-village sites facilitated by Mr. Chau Kim Heng. The results of the four group work were reported by each group representative.
- Power transmission and storage on selection of network configuration, electric conductor and balance of three phases; and various types of energy storage and battery introduced by Mr. Bun Long
- Photovoltaics on solar energy conversion basic definition, direct and diffuse radiation, solar path over seasons; and PV systems and application; PV cell, types and module; power on temperature, shading; grid and off-grid energy; connector technology and solar batteries brought in by Dr. Jan Kai Dobelmann, DGS.

Day 5 also carried on training about PV by Dr. Kai in the morning and in the afternoon, practical work was done on Solar PV at Kamworks including a presentation made by Arjen Luxwolda, Managing Director of Kamworks.

- Participants were assigned and worked in groups to measure PV cells in series and in parallel directed to the sun and in shading and presented their finding to the audience.

- PV module, charger, installation and facilities at Kamworks were also explained by Mr. Arjen

Day 6, participants were introduced about:

- Solar thermal concept and installation by Dr. Kai
- Biogas on: microbial basics, anaerobic digestion processes, input and output materials, small biogas plants, Components of Anaerobic Digestion Systems and example calculation including types and quantities of biomass and analytical methods-sampling and water content by Dr. Matthias Klauss, DGS

Day 7, participants kept on learning about biogas about example calculation of biogas and energy yields, plant operation presented by Dr. Matthias and introduction of biodigester technology, advantage and benefit introduced by Mr. Vorng Phirom from NBP.

Day 8 focused about:

- Entrepreneurship on basics of business; characteristics of a micro-enterprise; business cycle; factors affecting the success or failure of business; common weaknesses and constraints of micro-entrepreneurs; and type of project assistance for micro-entrepreneurs and calculation on income and expenses and business development presented by Dr. Kai. Moreover, group work of participants was initiated to develop their business plan in case the of Choeung Ek area where COMPED training centre located.
- Biofuel on types of biofuels; basics and definitions; and generation, production and utilization of biofuels contributed by Dr. Matthias

Day 9, an excursion on biomass was conducted to Muk Kampol district, Kandal province to four different places, where biodigester stoves were being constructed; 50% constructed; being used and long time utilized by farm households. In the afternoon, group work was also established to discuss about possible four pilot communities in Battambang province on project planning including appropriate technology and calculation of energy use.

A training evaluation was made at the end of the last session to obtain participants feedback on the training as well as needs for future follow up support from European Commission. The participants were given either presentation handouts and two CDs of training materials and extra important materials, which are the output of REEPRO project in hand to make them easy in developing training kit step by step approach guide.

The main outcome of the training is:

- Participants are acquainted with the knowledge of renewable energy, business management of being entrepreneur, concepts of current energy trend and modern technology in energy conversion for meeting energy demands of human and sustainable natural resources management
- Identified follow up activities to be implemented with participants for the upcoming training of the project and will assist in training kit improvement and finalization.

## 6 Follow Up Activities

The trainees were requested to give their interesting in three alternatives to joint training kit workshop and development as below. Bioenergy refers to gasifier, biogas and biofuel; solar energy indicates to Solar PV and solar thermal; and project planning and management covers RES planning, management, international trade and business.

**Table 1: Groups of Interesting for Training Kit Workshop Development**

No.	Solar Energy	Bioenergy	Project Management
1	Thourk Mony	Tang Sochettra	Heng Chan Ran
2	Sean Simalay	Mao Seima	Sok Pal
3	Phin Ramine	Bun Pheng	Ngor Bun Hok
4	Chrun Rithy	Chhay Vicheth	
5	Chay Viceth	Ngor Bun Hok	
6	Sok Sarin	Sok Sarin	
7	Duong Sophal	Chrun Rithy	
8	Kong Hieng Lyhul	Kong Hieng Lyhul	
9	Kim Pisey	Lay Meng Hort	
10	Hun Bunroeun	Kim Pisey	
11	Lay Meng Hort		
12	Heng Cham Ran		
13	Tang Sochettra		

As discussed with participants, structure of training kit for expert training is given:

Method 1:

- current situation; current and future solution
- renewable energy and advantage
- comments from participants
- Project planning and budget planning with example
- Loan source and technical support
- Pictures and video

Method 2:

- Renewable energy technology and advantage
- Current problem solution and in the future
- Comment from participants
- Project planning and financial planning with examples
- Loan means
- Pictures and video

## 7 Evaluation of the Training Programme

All the 19 participants contributed to the evaluation of the training workshop. The overall rating of training is very good and useful. Participants and the partners involved were all satisfied with the results of the training including training contents, organization and logistics.

Detailed evaluation table can be found in Annex C.

## 8 Annex

### 8.1 Annex A: List of Participants

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## 8.2 Annex B: Schedule and Programme of the Training

**Table 2: WEEK 1: REEPRO Level 1 Train the Trainer Programme Cambodia– Basic Knowledge for Renewable Energy Promotion**

	07.01.2008	08.01.2008	09.01.2008	10.01.2008	11.01.2008
Units	Monday	Tuesday	Wednesday	Thursday	Friday
9:00-10:30	<b>Introduction Basics</b> BA01 - Renewable Energy (RE), Basics and Definitions BA02 - Sources for RE  <i>Mr. Bun Long, ITC</i>	<b>RES policy planning</b> RP01 - Strategic planning of energy systems, introduction RP02 - Guidelines for strategic planning  <i>Dr. Jyrki Luukkanen, TSE</i>	<b>Case Study</b> Group Work  <i>Dr. Jyrki Luukkanen, TSE</i>	<b>Project Work</b> Appropriate Technology Of three-village sites  <i>Mr. Bun Long, ITC</i>	<b>PV</b> PV04 - PV System planning  <i>Dr. Jan Kai Dobelmann, DGS</i>
11:00-12:30	<b>Basics</b> BA03 - Fundamentals of Electricity and Construction BA04 - Assessment of possible sources  <i>Mr. Bun Long, ITC</i>	<b>RES policy planning</b> RP03 - Stakeholder involvement + International and regional energy planning context RP04 - RES policy in Laos / Cambodia  <i>Dr. Jyrki Luukkanen, TSE</i>	<b>Case Study</b> Group Work  <i>Dr. Jyrki Luukkanen, TSE</i>	<b>Power transmission and storage</b>  <i>Mr. Bun Long, ITC</i>	<b>PV</b> PV05 - PV System commissioning and maintenance  <i>Dr. Jan Kai Dobelmann, DGS</i>
13:30-15:00	<b>Gasification</b> BF01 - Types of Gasifiers, Basics and Definitions BF02 - Sources for gasifier power generation  <i>Yrjo Majanne, TSE</i>	<b>Project Management</b> PD01 - Project development  <i>Juha Leppanen, TSE</i>	<b>Financing</b> FI03 - Available Financing Tool in Laos  <i>Mr. Bun Long, ITC</i>	<b>PV</b> PV01 - PV System Types and applications PV02- PV Cell Types  <i>Dr. Jan Kai Dobelmann, DGS</i>	<b>Practical work PV</b> Kamworks <i>Uch Rithy, COMPED; Dr. Jan Kai Dobelmann, DGS</i>
15:30-17:00	<b>Gasification</b> BF03 -Fundamentals of gasification production BF04 - Utilization of producer gas  <i>Yrjo Majanne, TSE</i>	<b>Project Management</b> PD02 - Project management  <i>Juha Leppanen, TSE</i>	<b>International trade</b> <i>Mr. Duong Kakada, Economic Institute of Cambodia</i>	<b>PV</b> PV03 - PV System Components  <i>Dr. Jan Kai Dobelmann, DGS</i>	<b>Practical work PV</b> Kamworks <i>Uch Rithy, COMPED; Dr. Jan Kai Dobelmann, DGS</i>

**Table 3: WEEK 2: REEPRO Level 1 Train the Trainer Programme Cambodia– Basic Knowledge for Renewable Energy Promotion**

	14.01.2008	15.01.2008	16.01.2008	17.01.2008	18.01.2008
Units	Monday	Tuesday	Wednesday	Thursday	Friday
9:00-10:30	<b>Solar thermal system</b> ST01 - Solar thermal system Types and applications <i>Dr. Jan Kai Dobelmann, DGS</i>	<b>Biogas</b> BG04 - Components of AD Systems <i>Dr. Matthias Klauss, DGS</i>	<b>Entrepreneurship</b> EN04 - Business <i>Dr. Jan Kai Dobelmann, DGS</i>	<b>Practical Work/ Excursion Biomass</b> National Biogas Program/ SNV <i>Uch Rithy, COMPED; Dr. Matthias Klauss, DGS</i>	<b>Evaluation discussion of further work</b> <i>Uch Rithy, COMPED; Dr. Matthias Klauss, DGS; Dr. Jan Kai Dobelmann, DGS</i>
11:00-12:30	<b>Solar thermal system</b> ST03 - Solar thermal system installation and commissioning <i>Dr. Jan Kai Dobelmann, DGS</i>	<b>Biodigester</b> Technology, advantage and benefit <i>Mr. Vorng Phirom</i>	<b>Entrepreneurship</b> EN04 - Group work <i>Dr. Jan Kai Dobelmann, DGS</i>	<b>Practical Work/ Excursion Biomass</b> National Biogas Program/ SNV <i>Uch Rithy, COMPED; Dr. Matthias Klauss, DGS</i>	<b>Evaluation discussion of further work</b> <i>Uch Rithy, COMPED; Dr. Matthias Klauss, DGS; Dr. Jan Kai Dobelmann, DGS</i>
13:30-15:00	<b>Biogas</b> BG01- Microbial Basics and BG02 - Processes and Parameters of AD Systems <i>Dr. Matthias Klauss, DGS</i>	<b>Biogas</b> BG05 - Example Calculation of Biogas and Energy Yields, Plant Operation <i>Dr. Matthias Klauss, DGS</i>	<b>Entrepreneurship</b> EN04 - Calculation <i>Dr. Jan Kai Dobelmann, DGS</i>	<b>Project work</b> <i>Uch Rithy, COMPED; Dr. Matthias Klauss, DGS; Dr. Jan Kai Dobelmann, DGS</i>	
15:30-17:00	<b>Biogas</b> BG03 - Input and Output Materials and their Use <i>Dr. Matthias Klauss, DGS</i>	<b>Biogas</b> BG05 - Example Calculation of Biogas and Energy Yields, Plant Operation <i>Dr. Matthias Klauss, DGS</i>  <i>Mr. Chau Kim Heng</i>	<b>Biofuel</b> BF01 Types of Biofuels, Basics and Definitions BF02 Generation BF03 Production BF04 Biofuel utilization <i>Dr. Matthias Klauss, DGS</i>	<b>Project work</b> <i>Uch Rithy, COMPED; Dr. Matthias Klauss, DGS; Dr. Jan Kai Dobelmann, DGS</i>	

### 8.3 Annex C: Training Evaluation on Basic Knowledge for Renewable Energy Promotion

All the 19 participants contributed to the evaluation of the training workshop. The overall rating of training is good and useful and meets their expectation.

Majority of the participants considered the overall course performance was good (see Table 4). However, a number of participants felt the length of the lunch break was short and they suggested starting from 8:00-11:00 am and 2:00-11:00 pm. Moreover, they would like to get hand-out one day before training schedules, so that we can read and prepare questions in advance or easily take note to key points or technical words. Good presentations were given and well presented. However, more practices on installing the equipments, examples, calculations and group discussion were needed. In addition pedagogical tool should be improved for training, practice and shows. Some participants gave comment not to speak so fast and wanted a Khmer translator and Khmer translated lecture. One participant thought that the handout documents should not be much general, just only focusing on each topic for future oneself training; and the importance is that our trainers will train technical trainees, so one needs more confidentially before giving training programme.

**Table 4: Overall course performance of the training programme**

Overall course performance	Not mention	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Not sure	Total
This course meets my expectations	0	0	0	1	16	2	0	19
The content is relevant to my job	1	0	0	3	9	4	2	19
The mixture of technical and entrepreneurial issues was appropriate	0	0	0	4	11	1	3	19
The material was presented in a manner that was understandable	0	0	1	2	13	3	0	19
The teaching materials were appropriate	1	0	0	2	11	3	2	19
The activities gave me sufficient practice and feedback	0	0	1	1	13	3	1	19
The difficulty level of this course was appropriate	2	0	0	7	6	2	2	19
The combination of lecturers, workshop, practical work was appropriate	0	0	0	3	12	3	1	19
I would have preferred more lecturers	1	0	0	1	9	8	0	19
I would have preferred more workshops	0	0	0	1	11	7	0	19
I would have preferred more project work	0	0	0	1	10	8	0	19
I would have preferred more practical work	0	0	0	1	6	12	0	19
I would have preferred more excursions	2	0	1	1	10	5	0	19

Various components of the training were beneficial and useful (See Table 5). Specific suggestions for adding additional topics to the level 1 training programme included:

- More practice about PV, biogas, gasification and biofuel
- Solar water heating and solar air heating calculation; principle of hydro power plant; biomass conversion and combustion;
- Adding more material related to renewable energy,
- Training to install its PV and how to connect its system
- Engineering level for calculation of the system
- Hydro energy system, mini and micro hydro power plant
- Energy Project Management, Project Development, Entrepreneurial and Financing
- Energy efficiency in industrial and rural and urban electrification.

**Table 5: Training subject component evaluation**

The subject was presented in a manner that was understandable	Not mention	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Not sure	Total
IN - (Introduction)	0	0	1	1	13	3	1	19
BA - (Basics)	0	0	1	0	12	5	1	19
PT - (Power Transmission, Storage )	0	0	1	0	8	9	1	19
BG - (Biogas)	0	0	1	0	9	7	2	19
BF - (Biofuel)	0	0	1	3	11	4	0	19
GA - (Gasification)	0	0	0	5	9	3	2	19
PV - (PV )	0	0	0	1	11	6	1	19
ST - (Solar Thermal )	0	0	0	2	11	6	0	19
EN - (Entrepreneurial)	0	0	0	4	9	3	3	19
FI - (Financing)	1	0	0	6	10	2	0	19
RP - (RES policy planning)	0	0	0	4	11	1	3	19
IT - (International trade)	0	0	0	3	9	3	4	19
PD - (Project development)	0	0	0	6	9	4	0	19
CS (Project (Case study)	0	0	0	4	12	2	1	19
The teaching materials were appropriate								
IN - (Introduction)	0	0	0	3	13	3	0	19
BA - (Basics)	0	0	0	0	16	3	0	19
PT - (Power Transmission, Storage )	0	0	2	1	11	4	1	19
BG - (Biogas)	0	0	0	1	11	7	0	19
BF - (Biofuel)	0	0	0	2	12	3	2	19
GA - (Gasification)	0	0	0	4	10	4	1	19

<b>The subject was presented in a manner that was understandable</b>	<b>Not mention</b>	<b>Strongly disagree</b>	<b>Disagree</b>	<b>Neutral</b>	<b>Agree</b>	<b>Strongly agree</b>	<b>Not sure</b>	<b>Total</b>
<b>PV - (PV )</b>	0	0	0	2	<b>8</b>	8	1	19
<b>ST - (Solar Thermal )</b>	1	0	0	2	<b>11</b>	3	2	19
<b>EN - (Entrepreneurial)</b>	0	0	1	3	<b>11</b>	1	3	19
<b>FI - (Financing)</b>	0	0	1	4	<b>10</b>	3	1	19
<b>RP - (RES policy planning)</b>	0	0	1	5	<b>11</b>	2	0	19
<b>IT - (International trade)</b>	0	1	0	5	<b>9</b>	2	2	19
<b>PD - (Project development)</b>	0	0	1	4	<b>11</b>	2	1	19
<b>CS (Project (Case study)</b>	1	0	0	2	<b>14</b>	2	0	19