2006 – 2007 Final Report

Sub-Project Symbol: 06 / AB / THA / CM / 200 and 07 / AB / THA / CM / 200

Sub-project Title: *Establishment of hybrid solar/diesel systems for powering computer rooms and skills training for refugees in using renewable energy in 7 Karen refugee camps along the Thai – Myanmar border.*

Reporting Period: July 2006 – June 2007

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SUB-PROJECT MONITORING REPORT – Narrative Report

1. Sub-Project Overview

Per the Sub – Project Proposal Submitted to UNHCR *"During 2005, as a donation from the Belgian Government, Common Facility Computer Rooms (CFCRs) had been established in all seven refugee camps in which ZOA is implementing activities. The CFCRs provide an opportunity to different groups within the camp community to acquire basic computer skills. With enhanced prospects of resettlement for a growing number of refugees, the relevance of basic computer courses is clearly present. Diesel generators power the computers that are used in the CFCRs. Given the large quantities of fuel that are needed to run the computer courses, and the current high level of fuel prices, the running costs of the CFCRs are very high. In fact, we have to limit the number of training hours as a result of these high costs, despite an overwhelming demand for computer courses from the camp communities. The solution is to establish hybrid energy systems, using a combination of solar and diesel energy. In the longer term, this is more cost-effective and additionally, it is significantly more environment-friendly."*

During 2006 – 2007, Border Green Energy Team (BGET) worked in the following Karen Refugee Camps along the Thai / Burma border (Mae La, Umpiem Mai, Nu Po, Mae La Ma Luang, Ma La Oon, Ban Don Yang, Tham Hin) alongside Karen students from Engineering Studies Program (ESP) in Mae La camp and CFCR trainers and Generator Caretakers to install solar / diesel ***"Hybrid"*** power systems and to train local technicians in solar and renewable energy, provide equipment and renewable energy trainings to the greater refugee communities. The solar system and equipment upgraded the "*diesel only*" power system for the Common Facility Computer Rooms (CFCRs) to a Solar / Diesel ***"Hybrid"*** power system. Diesel is a non-renewable polluting fossil fuel, expensive and difficult to transport. The "***Hybrid***" system increases and diversifies the available power supply, allows computer training class hours to be expanded, reduces diesel costs, and offers a future option to further reduce diesel costs, expand class hours, and / or add additional computers. This future option should be explored by integrating the newly established ***"Hybrid"*** systems with a combination of addressing demand – side considerations such as computer settings, replacing inefficient power supplies et al and supply – side considerations by adding additional batteries and solar panels and / or integrating wind turbines or micro hydropower.

The objectives of the project are multi-dimensional:

Objective 1:

Diversify the power supply from "*Diesel only*" system to a Solar and Diesel ***"Hybrid"*** system to power computer training centers in seven agreed upon refugee camps.

Objective 2:

Training in four separate components to refugees in the camps:

1. The first component of training is hands-on, practical training as we work as a team to install the system. This includes on-site technical training as well as classroom training. The students of this hands-on training include five ESP students, the computer center trainers and generator caretakers. Typically, two – five laborers are hired to assist with land clearing.

2. The second component of training is to teach the generator caretakers and the computer technicians in system attendance, system maintenance, and their role in this system. These individuals are also present throughout the installation and at the one – two day solar training. These individuals are requested to keep a log of data on the system and provide this to ZOA and BGET on a monthly basis.

3. The third component of training is to provide a solar training for all interested members of the refugee camp. The topics discussed included sustainability of this system and the cooperation between BGET and ESP, the role and responsibility of the camp community, a tour of the system and a discussion of each of the parts of the system, system design, solar fundamentals, basic electricity, the flow of electricity, the role of the batteries and battery safety, installation of the system, maintenance of the system, and other ways to use renewable energy in a Karen Community. Topics are taught by any combination of BGET Staff, ESP Intern and ESP students. Participant class sizes have ranged from 38 – 95 people ranging in age from 16 – 79 years.

4. The fourth component Engineering graduate intern to work as BGET staff during duration of project. Saw E Maw Lay, graduate of ESP school and Mae La camp resident, worked as BGET intern for the duration of the project. E Maw Lay was intimately trained in technical skills, system specifications, budgeting, managing project, teaching. E Maw Lay successfully led the installation of the training system at Engineering Studies School and co-led the installations and related trainings at each of the seven respective Karen Refugee Camps.

System Design

BGET's staff and partners include leading experts in designing and implementing solar technologies in conjunction with local capacity building in the developing world. BGET designed the system that would be installed at each camp based on myriad factors

including budget, availability, purchasing regulations, site locations, cost, quality and computer center need et al.

Each computer center was already outfitted by ZOA with between eight to nineteen desktop computers, one printer, two to four fluorescent lights and two standard oscillating fans.

This specific sub-project installed the following solar system equipment:

- Fifteen *Kaneka* - 64W panels on a stainless steel PV rack
- Twelve *3K* - 12V , 125Ah batteries
- *Outback* – VFX 3048E inverter,
- *Outback* – MX-60 charge controller
- *Outback* - Mate.

Project Status

In 2006, the BGET team performed installations in three camps: Mae La, Umpiem Mai, and Nu Po. In 2007, the BGET team performed installations in the remaining four camps: Mae La Ma Luang, Mae La Oon, Ban Don Yang, and Tham Hin. Each installation took two weeks and accomplished aforementioned two objectives. Also in 2007, the ESP students led by E Maw Lay, installed a similar system at their ESP school in Mae La camp. This system will act as a training system for future engineers in the program.

BGET works directly with the Engineering Studies Program (ESP), a four – year further studies program in Mae La Camp. BGET hired a graduate of the engineering studies program, Saw E Maw Lay, to work as a technician intern (BGET staff) for the project. Also, BGET has brought five different ESP students and / or teachers to each installation, providing them with practical and theoretical engineering training as well as immeasurable life experiences.

2. Description of Beneficiaries

BGET installed the Solar Cell PV / Diesel ***"Hybrid"*** System in seven Karen refugee camps along the Thai / Myanmar (Burma) border. The beneficiaries of this project include the refugees who received on-the-job technical training, those that received attendance and maintenance training, those from the camp community that received a one or two-day solar training, and those who will benefit in the future from increased class hours at the Common Facility Computer Rooms (CFCR). Further beneficiaries include organizations that benefit from reduced fuel costs, reduced environmental impacts, various laborers in camps who participated in installation, and informal students (various community members who participated in sections of installation or training). Indirect beneficiaries include those persons who suffer from the air and noise pollution of running the generator, which will run less often.

Following is a table showing the number of refugees who participated in each aspect of the training on the system.

Training Statistics:

Karen Refugee Camp	Year	On the Job Training - Men	On the Job Training - Women	On the Job Training Total	Attendance and Maintenance Training - Men	Attendance and Maintenance Training - Women	Attendance and Maintenance Training - Total	1-day Solar Training
Mae La	2006	7	1	8	4	0	4	45
Umpiem Mai	2006	4	3	7	2	1	3	N/A
Nu Po	2006	5	2	7	3	2	5	38
Mae La Ma Luang	2007	6	3	9	3	1	4	79
Mae La Oon	2007	7	2	9	4	0	4	49
Ban Don Yang	2007	7	2	9	3	2	5	73
Tham Hin	2007	7	3	10	4	2	6	95
Total		43	16	**59**	23	8	**31**	**379**

Detailed Statistics

2007 Refugee Camp One-Day Solar Training						
Age Group	**Female**	**(in %)**	**Male**	**(in %)**	**Total**	**(in %)**
15-20	11	19%	27	11%	38	13%
20-40	37	63%	158	67%	195	66%
40-60	9	15%	50	21%	59	20%
>60	2	3%	2	1%	4	1%
Total	**59**	100%	**237**	100%	**296**	100%

Future Beneficiaries:

One of the main objectives of this project was to diversify the power supply, thus decreasing the amount of fuel consumed by the computer centers. The intention of this project is to reduce diesel costs by 25% or to increase the number of classes offered to the camp community by 1.5 hours. This would provide more Karen Refugees with computer skills. These computer courses provide the refugees with knowledge and skills, and empower them as people. As an increasing number of refugees resettle to third countries, these computer skills and this experience will be very valuable.

BGET installed a training system at the sight of the Engineering Studies Program (ESP) in Mae La Refugee Camp. This system will act as a training tool to future engineers who study with this program. The “Keystone” of the project was the ESP school “Solar System” installation installed completely by ESP students, led by BGET technician, Saw E Maw Lay. BGET Project Manager performed system check and Karen Engineering Systems installed system flawlessly to Western Professional Standards. Classes

regarding solar electricity will be taught to future ESP students, and they will be able to enhance this learning through hands on experience. The BGET intern and ESP graduate will prepare a training curriculum to be taught to the students and will assist ESP with this training. Knowledge in solar and renewable energy is extremely beneficial for these students as the demand for renewable energy alternatives increases around the world.

3. Implementation Arrangements

The implementation procedures as set out in the project description took place accordingly. BGET performed the system design, installation and training for all seven Karen refugee camps with logistics assistance from ZOA Refugee Care (ZOA). Follow-up and required maintenance plans are in progress between BGET and ZOA. System sustainability, maintenance, and further capacity building will be a combined effort of ZOA, BGET, Engineering Studies Program (ESP) and prospectively UNHCR with future integrations into project.

4. Impact on the Protection Situation of the Beneficiaries and UNHCR's Policy Priorities

a) The protection of the beneficiary population;

This project is an unambiguous action towards empowering camp populations on the Thai-Myanmar border as it promotes self-reliance of refugees through upgrading their abilities. The education and training activities under this sub-project provide refugees with the opportunity to be involved in meaningful activities, which means a reduction in the risk of social apathy and malice and increase the protection of refugee women and men. This project directly benefits those refugees who are otherwise not able to leave the camp. An average of 5 students from ESP school at Mae La camp participated in installation and training at all other camps. The opportunity to temporarily legally leave Mae La camp is empowering to all involved. Most importantly, during renewable energy trainings, Karen refugee community members learn many practical renewable energy technologies that can be used in a traditional Karen community at a very low cost point. For those who participate in the actual 2 week installation, they learn technical skills that an entry level solar installer in a western country would learn. If given the opportunity to resettle, this skill is highly marketable and in increasing demand.

b) The environment:

The installation of this solar/diesel hybrid system diversifies and increase the power supply for the computer lab, without an increase in diesel requirements. This renewable power supply helps reduce, as a percentage of total power produced, the amount of air and noise pollution caused by diesel burning.

The training also aims to educate the communities about renewable energy, basic global warming concepts, and introduction to appropriate technologies. It educates them on the

harm done to the environment by burning fossil fuels such as diesel. Environmental respect is a critical training curriculum bullet point. This project is providing a greater awareness of what renewable energy means, what are ways to use renewable energy in their own lives, and why they should protect their environment.

c) Refugee women / gender equality:

BGET strongly advocates gender equality. Our program director is a Thai woman and project manager for this specific project is also a woman. All female students and teachers at Engineering Students Program (ESP) joined BGET for a minimum of one training and solar / diesel "Hybrid" installation. All female computer center trainers were required to complete two week training and solar / diesel "Hybrid" installation in respective camp. BGET encourages Engineering Studies Program (ESP) to continue to encourage women to join the typically male dominated industry of engineering.

5. Related Inputs and Projects

N/A

6. Reporting on Progress against Indicators

Impact Indicator	Actual Progress
• 25% saved on fuel consumption	See accompanying graph with estimated fuel savings. Data over an extended period of time is still in the process of being collected. * It is important to note solar power output is directly related to hours of sunlight. Actual progress in relation to Impact Indicators will be different between wet and dry season. *
• The computers using time increased by 1.5 hours a day	See accompanying graph with estimated increased daily class hours. * It is important to note solar power output is directly related to hours of sunlight. Actual progress in relation to Impact Indicators will be different between wet and dry season. *
• Participation increased from 1800 to 2300 a year	1 year time has not passed. This data is not currently available.
• 350 participants a year receive training in renewable energy	The third component of training as discussed in the Overview is to provide a solar training for all interested members of the refugee camp. In 2006, BGET held a two-day solar and renewable energy training at Mae La and a

	one-day solar and renewable energy training at Nu Po. In 2007, BGET held a one-day solar and renewable energy training at all four camp installations and the ESP students held a two-day solar training in Mae La. Topics are taught by any combination of BGET Staff, ESP Intern and ESP students. As of June 2007, BGET taught renewable energy trainings to **379** refugees from seven camps. See more detailed statistics in the Description of Beneficiaries section.
Performance Indicator	**Actual Progress**
• The end of 2006; in 3 camps increases the running hours and enrollment of computer course participants by 25%.	As of December 2006, BGET successfully performed installations in three camps including Mae La, Umpiem Mai, and Nu Po. Increased computer course running hours and participants is a decision made by ZOA. Successful installation of 3 systems in aforementioned camps provides the additional power supply to meet this performance indicator. See accompanying graph.
• The end of June 2007; in the remaining 4 camps increases the running hours and enrollment of computer course participants by 25%.	As of June 2007, BGET performed installations in four camps including Mae La Ma Luang, Mae La Oon, Ban Don Yang, and Tham Hin. Increased computer course running hours and participants is a decision made by ZOA. Successful installation of 3 systems in aforementioned camps provides the additional power supply to meet this performance indicator. See accompanying graph.
• In 3 camps at least 5 refugees concerned with the CFCR received technical training.	The second component of training as discussed in the Overview is to teach the generator caretakers and the computer technicians in system attendance, system maintenance, and their role in this system. These individuals are also present throughout the installation and at the one – two day solar training. They are requested to keep a log of data on the system and provide this to ZOA and BGET on a monthly basis. As of December 2006, 12 individuals involved with the CFCR received a technical training taught by BGET. See more detailed statistics in the Description of Beneficiaries section.
• In the remaining 4	In the remaining four camps installed during 2007, 19

	camps at least 5 refugees concerned with the CFCR received technical training.	individuals involved with the CFCR received a technical training taught by BGET. See more detailed statistics in the Description of Beneficiaries section.

7. Overall Assessment of sub-project results

a. Overall impact of sub-project

The overall impact of the Hybrid System Project was highly successful. The seven solar / diesel ***"Hybrid"*** systems were implemented on time and are working successfully. Training in solar and renewable energy was provided to **379** refugees in seven different camps, and the training will continue in the future. 100% of ESP students and teachers were able to participate in 1 or more installations and trainings. At the time of writing (May 2007) all systems are operating as designed.

b. Cooperation with other actors

ZOA and BGET worked together to implement this project.

c. Unmet needs

From a renewable energy, environmentally friendly, consistent energy supply perspective there are many unmet needs within the refugee camps. Currently there are few electricity options within camps. Options that do exist are costly diesel generators, low capacity costly 12 volt batteries, and dangerous candles. The majority of camp residents cannot afford these costly options. Electricity grids are not available to camp residents. Education facilities, particularly those that require electricity inputs like computers, are limited to costly, limited diesel supplies. Renewable energy options are myriad within the camps ranging from electricity supplied by solar panels, falling water (micro – hydro), cooking using gas from food, animal, and human waste, solar water pumping, solar cooking, individual solar home systems, LED lighting and solar lamps, solar driers, solar water purification, biomass, solar composting toilets, et al. Renewable energy options indicate many possible solutions to the myriad issues faced within refugee camps.

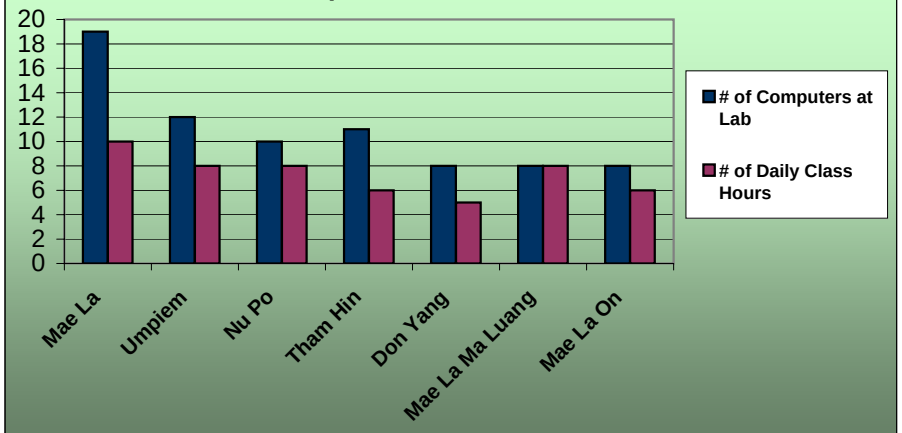
d. Lessons learned and recommendations for the future

Any project related to renewable energy inherently has a limitation related to sustainability. As long as the camps exist, this project will require ongoing maintenance and training. As computer center trainers and generator caretakers leave their positions for whatever reasons, it is critical their training and responsibilities are passed on to subsequent operators of the system. Also, inherent in any solar system with a battery backup will be replacement batteries within 3 – 10 years. It is important ZOA and BGET

ensure the hiring of a long-term local technician who is an employee of one of these organizations and has in his / her job description and responsibilities to be properly trained in this system and to be responsible for continued maintenance, capacity building, and future trainings.

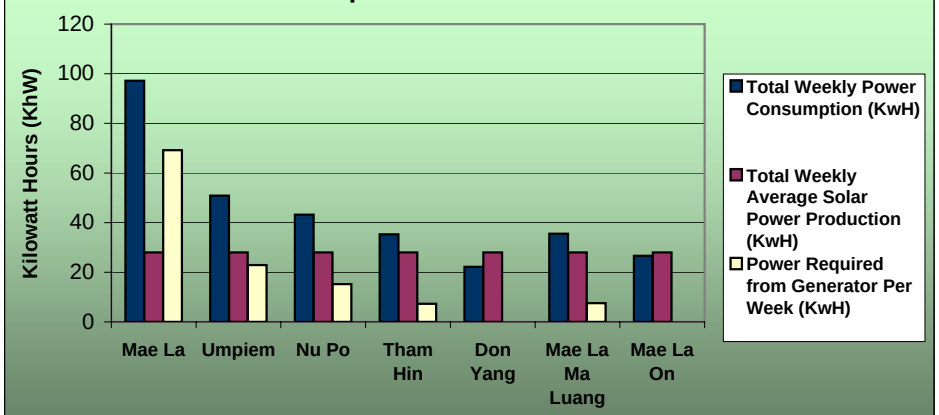
2006 - 2007 Solar / Diesl Hybrid Power Supply System for Computer Centers at Karen Refugee Camps

of Computers and # of Class Hours



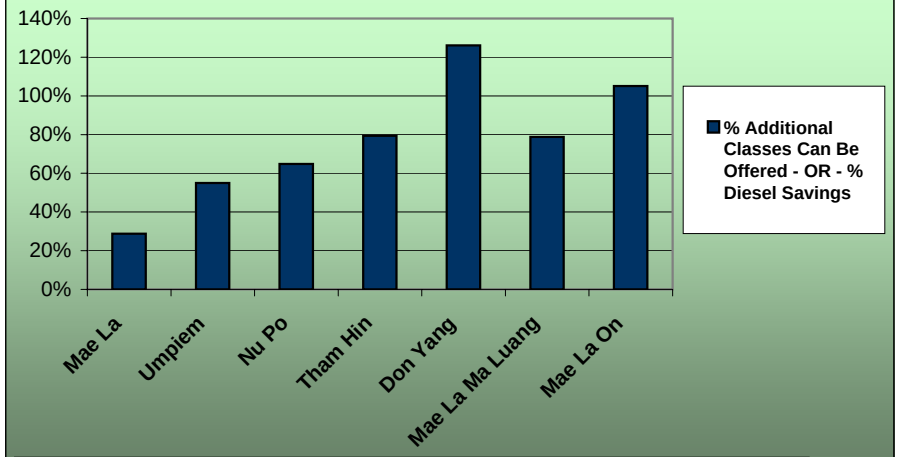
Note: Chart Shows # of Computers and # of Daily Class Hours at each Refugee Camp's Computer Lab. All Camps have classes 6 days per week.

Power Consumption and Solar Power Production



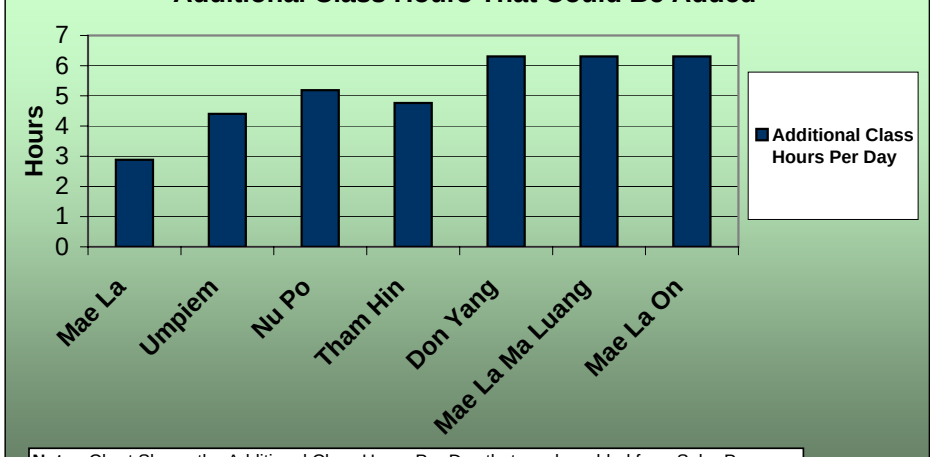
Note: Chart Shows Average Weekly Power Consumption in Computer Lab based on 80 watts per hour per computer and a fixed 100 watts per hour for lights, printers, fans, etc. Based on data from October 2006 - March 2007, average daily solar production at all camps is conservatively ~ 4KwH.

Additional Classes - OR - Diesel Savings



Note: Chart Shows the Percentage (%) of Additional Classes - **OR** - % of Diesel Savings by Installing the Solar System

Additional Class Hours That Could Be Added



Note: Chart Shows the Additional Class Hours Per Day that can be added from Solar Power **without** Reducing Diesel Use

***** Data is for provided to provide a general picture how the same solar system installed at many different camps can affect generator use and additional class hours dramatically.*****