UNDP Project Document

Government of Thailand

United Nations Development Programme

Promoting Renewable Energy in Mae Hong Son Province

Brief Description

Despite the government's commitment to Renewable Energy, there have been constraints to the wider and more sustained application of Renewable Energy Technologies in Thailand. This project will overcome barriers that currently prevent widespread and sustainable utilization of Renewable Energy Technologies for the provision of energy services in rural areas of Thailand. The project will work initially in Mae Hong Son province, which the Ministry of Energy has identified as its target to be the first energy self-sufficient province in Thailand, in conformity with the king's sufficiency economy concept. Furthermore, the project will also work in the neighboring provinces Chiang Mai, Chiang Rai and Tak. These provinces have comparable geographic and economic situations and RE potential. By including these provinces a critical mass is created to leverage change in national policies and governmental planning processes regarding RE development and utilization in Thailand's rural areas. The project will facilitate an integrated RE planning process at provincial and local level, in order to translate targets set at national level to local level and into real action. Various new approaches, concept and policies will be developed and applied, e.g. new ownership models for RE systems, improvements to tariff system and loan management to be endorsed by the government and applied elsewhere in Thailand. Furthermore information on existing incentives/policies for RE promotion which are available but sometimes seldom used will be disseminated and promoted. The project will also contribute to the broader Goal of reducing GHG emissions in Thailand. The 4 components deal with (a) institutional capacity development for planning and implementing RE programmes; (b) access to financing; (c) technical training and education and (d) policies for up-scaling and replication.

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Acronyms

APR	Annual Project Report
AWP	Annual Work Plan
BGET	Border Green Energy Team
CBO	Community-Based Organization
CHP	Combined Heat & Power
CO	Country Office/UNDP Country Office
DANIDA	Danish International Development Agency
DEDE	Department of Alternative Energy Development and Efficiency
DOLA	Department of Local Administration
DOPA	Department of Provincial Administration
EGAT	Electricity Generating Authority of Thailand
EPPO	Energy Policy and Planning Office
FAO	Food and Agricultural Organization of the United Nations
GEF	Global Environment Facility
Gg	Gigagrams
GHG	Greenhouse gases
GPP	Gross Provincial Product
GW	Gigawatts
HVDC	High Voltage Direct Current
IR	Inception Report
IW	Inception Workshop
kWh	Kilowatt hour
LEP	Local energy planning
LPG	Liquefied petroleum gas
M&E	Monitoring and Evaluation
MDG	Millennium Development Goals
MEA	Metropolitan Energy Agency
MHS	Mae Hong Son
MOI	Ministry of the Interior
MSW	Municipal Solid Waste
MW	Megawatt
MWh	Megawatt hour
NEPC	National Energy Policy Council
NESDB	National Economic and Social Development Board
NEX	National Execution
NGO	Non-governmental Organization
OPS	Office of the Permanent Secretary
PAO	Provincial Administration Office
PEA	Provincial Energy Agency
PIR	Project Implementation Review
PPG	Project Preparation Grant
PRO-SE	Provincial Programme for Sustainable Energy
PSCO	Policy and Strategy Coordination Office
PV	Photovoltaic
RCU	Regional Coordination Unit
RE	Renewable Energy
REO	Renewable Energy Office
RET	Renewable Energy Technologies
RTG	Royal Thai Government
SML	Small, Medium and Large
SP	Strategic Programme
SPP	Small Power Producer
TAO	Tambon (Sub-district) Administrative Organization
toe	Tonnes of oil equivalent
ToR	Terms of Reference
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UTEP	UNDP-Thailand Environment Programme
VSPP	Very Small Power Producer

SECTION I: Elaboration of the Narrative

PART I: Situation Analysis

A) National level

1.1 Energy sector in Thailand

Thailand's INC states that the energy sector has become the largest source of CO_2 emissions in Thailand, accounting for more than half of the country's total CO_2 emissions in recent years (approximately 125,000 Gg[1] of a total 241,000 Gg). If the present trends continue and policy changes[2] are not specifically adopted to encourage CO_2 reduction, these emissions would increase fourfold by 2020, an average annual increase of around 4%. In order to be consistent with the National Economic and Social Development Board (NESDB) evaluation on development progress during the 9th National Plan (2002-2006), it is thus of necessity to increase the efficiency of energy use and to promote alternative energy. The national target for RE as a percentage of total energy supply is set at 8% by 2011, the current achievement is only about 4%.

For the past 15 years, the rate of growth in energy consumption in Thailand has outpaced the growth of the economy by a factor of 1.4: 1. Energy intensity per unit/GDP in developed economies: such as the United States of America, decreased to 0.8%; to 0.95% in Japan; and there were similar reductions in the European Union. Recent trends in growth in energy demand are shown in Figure 1, below. Whereas the demand for energy grew by 7.6% between 2003 and 2004, the economic growth rate was 6.9 and 6.1% respectively during those two years. Commercial energy accounts for 83% of all energy, whereas currently, only 4% of the total comes from RE (Figure 2).

Figure 1: Demand, Production and (Net) Import of Primary Commercial Energy [(a)] [3]

Unit : ktoe

	2003	2004	Change (%)
Demand[(b)]	67,219	72,292	7.6
Production	33,382	33,695	1.0
(Net) Import	43,368	49,460	14.0
Import/total demand (%)	64.0	68.0	
Economic Growth Rate (%)* (*Source : NESDB)	6.9	6.1	

(a) Commercial primary energy comprises crude oil, natural gas, condensate, petroleum products, hydro-electricity and coal/lignite

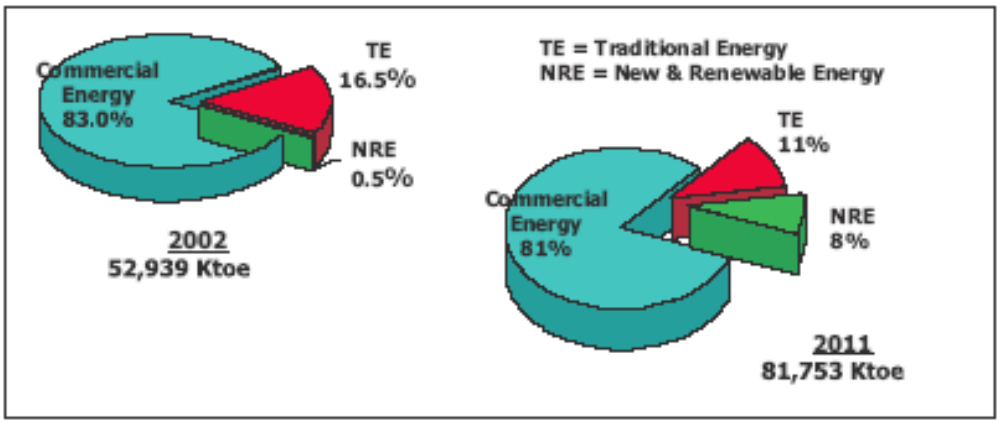
(b) Exclusive of stock change and non-energy use, i.e. use of asphalt, NGL, condensate, LPG and naphtha as feedstock in the petrochemical industry.

1 1 Gg = 1 kton

[2] Under the 10th NESDB Plan, economic structures for sustainable and balanced development are promoted that includes finding ways and means to increase the use of RE through restructuring of the service sector. Further, it promotes the development of self-sufficinet energy sites that respond to long-term energy demands and supported by increased energy efficiency in the transportation and industrial sectors as well as at the household level.

3 1 ktoe = kilo tonne oil equivalent, which is equivalent to 11.6 kWh

Figure 2: Share of Thailand's final fuel mix in 2002, and target for 2011



Thailand has introduced two innovative schemes to promote increased use of renewable energy. These are described in the following paragraphs.

1.1.1 Small Power Producer (SPP) program

Thailand's Small Power Producer (SPP) laws were passed in 1992, allowing grid-interconnection and sale of electricity by private sector renewable energy or clean combined heat and power (CHP) installations of up to 90 MW per facility.

In 2001 the government further encouraged renewable energy by offering a bidding program that provided subsidies to biomass generators. Candidate renewable SPPs were invited to submit bids for the amount of subsidy that they would be willing to accept. Bids were sorted lowest-to-highest and lowest bids were accepted. The program was initially capped at 300 MW, but subsequently the cap was revised – see below. Sixteen SPPs were awarded subsidies which are currently operating. The subsidy is averaging 0.17 baht per kWh sold to EGAT for the first 5 years of operation. Because bids were only solicited once, all projects before and after this cutoff date have not been eligible for any subsidy.

On 9 April, 2007 the National Energy Policy Council (NEPC) issued a new SPP regulation that called for a new SPP subsidy program. Subsidies shown below in Table 1 are in addition to wholesale and "Ft" tariffs (a fuel adjustment charge that allows fuel price volatility to be passed through to consumers) – averaging at around 2.65 baht/kWh.

Experience from capped programs in Thailand and other countries indicates that a cap (now set at 100 MW for MSW, 115 MW for wind, 15 MW for solar, 300 MW for biomass) will likely present a barrier at some point. As the total number of applicant's approaches each particular cap, the risk that the project is unable to qualify to receive the subsidy becomes high, thus providing a disincentive to further invest in RETs.

Table 1: Subsidy Arrangement for SPP Announced 9 April, 2007

Fuel type	**Adder (baht/kWh)**	**Purchase capacity cap (MW)**
MSW	2.5 (fixed)	100
Wind	2.5 (fixed)	115
Solar	8.0 (fixed)	15
Other RE	0.30 (bidding ceiling)	300
	Total	**530**

As of May 2007, more than 1.16 gigawatts (GW) of installed renewable energy capacity were built under the SPP program[1], and a further 370MW was awaiting approval. This is significant, considering that Thailand's total peak load in 2006 was just over 21GW. Renewable energy projects developed under the SPP programme so far have been exclusively biomass fuelled, with the majority (34 out of 66 projects) using bagasse from sugar mills (EPPO, 2007).

1.1.2 Very Small Power Producer (VSPP) program

In May 2002, Thailand was the first developing country to adopt net metering regulations (known in Thailand as the Very Small Power Producer (VSPP) program) that facilitate interconnection of renewable energy generators under 1MW in size. Under these regulations, generators can offset their own consumption at retail rates. If net surplus of electricity is generated, the VSPP regulations stipulate that Thai distribution utilities – Metropolitan Electricity Authority (MEA) in Bangkok and Provincial Electricity Authority (PEA) in the rest of the country – must purchase this electricity at the same tariff as they purchase electricity from the utility, EGAT. This is typically about 80% of the retail rate. Generators receive higher tariffs during peak times.

The rate is adjusted every three months in response to changes in natural gas prices. In March 2007, VSPP plants received 3.7 baht (US cents 10.6) per kWh during peak hours (weekdays 9 am to 10 pm) and about 1.85 baht (US cents 5.3) per kWh for off-peak hours (weekends, holidays and night time).

As of March 2007 (just over four years), 98 generators had received notification of acceptance under the "1 MW VSPP regulations", with a total of 17.8 MW generating capacity. Compared with SPP generators, the VSPP programme involves a much wider range of fuels from solar photovoltaic (PV) (66 installations) through biogas (16 installations) to various types of biomass (total of 15 installations).

In December 2006, VSPP regulations were further expanded to provide similar terms for renewable energy projects up to 10MW per installation, as well as an additional "feed-in tariff" adder (Table 2). The feed-in adder, which depends on the type of renewable energy, is additional to rates previously paid to VSPP generators and will be paid for the first seven years after each generator's commissioning date for all projects submitted before December 2008. As of April 2007, 43 projects with installed generating capacity of 364 MW have submitted applications for the "10 MW VSPP regulations" (PEA 2007).

Table 2: Subsidy Addition for Renewable VSPP

Fuel	**Renewable energy adder (Baht/kWh)**
Biomass & biogas	0.3
Hydropower <50 kW	0.8
Hydropower >50 kW but <200 kW	0.4
Wind and municipal waste	2.5
Solar	8

A NEPC resolution on 4 June 2007 provided an additional incentive of 1.5 baht/kWh (wind & solar) or 1.0 baht/kWh (other renewable energy resources) for projects located in the three southern provinces (Pattani, Yala, Narithiwat) in an effort to stimulate investment in the region which has suffered in the past few years from considerable violence.

B) Mae Hong Son

1.2 Description of Mae Hong Son province

[1] Of which 585MW was sold to the grid, with the remainder providing electricity directly to factories.

Mae Hong Son is located in the North-west of Thailand, approximately 924 kilometers from Bangkok, sharing a border with Myanmar. It has a total area of 12,681 km^2 or approximately 7,925,750 rai*, the third largest province in the north, or the seventh of the whole kingdom. It has the highest numbers of mountains. 90% of its area is thick forest, while only 3% is suitable for agriculture use. There is also approximately 3% that is unclassified deteriorated forest area (Office of Natural Resource and Environment, 2005).

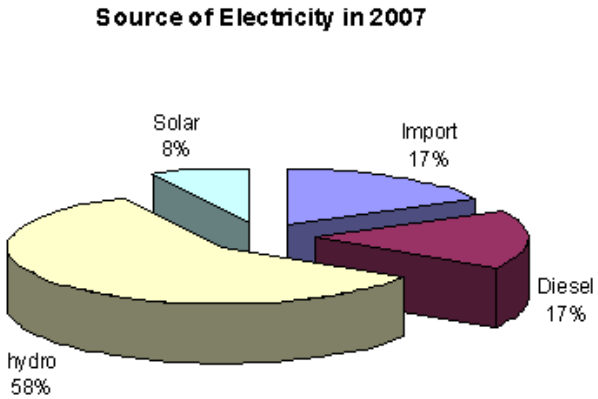
Mae Hong Son is the poorest province in Thailand. Thailand defines the income required to meet Minimum Basic Needs to be THB 20,000/person/year, and in 2004 61.2% of households in Mae Hong Son fell below this threshold. The seriousness of the situation in Mae Hong Son was recently recognized where NESDB, with support from UNDP worked with the provincial authorities in Mae Hong Son to localize the Millennium Development Goals and prepare Thailand's first Provincial MDG Report.

Only 7.4% of the provincial population of 249,000 resides in urban areas. Apart from those living on the plains, there are 7 ethnic groups living in the mountains, the largest such group being the Karen. Approximately 74% of the employed earn their income from agriculture, and forestry; with hunting providing supplements in terms of meat supply and, in some cases, extra income. However, income from agriculture only accounts to 30% of the total provincial income. As a result, purchasing power, or per-capita income, of Mae Hong Son citizens was only 31,151 baht/year in 2005. The poverty situation and access to basic services for all the population is further challenged by the ongoing migration of a significant number of refugees from Myanmar crossing the border into Mae Hong Son. Detailed information on the socio-economic context in Mae Hong Son can be found in Annex 1.

1.2.1 Energy Supply and Demand in Mae Hong Son

Power supply in Mae Hong Son comes from grid connected power plants (mainly hydro, solar and diesel plants) owned by the government and/or utilities, and from imports from the neighboring province (Chiang Mai) as well as from a large number of independent non-grid connected units using diesel, hydro and solar power (see Figure 3). During the wet season, excess electricity production in MHS will be exported through the grid to Chiang Mai, while this same grid line serves as back-up in the dry season. The net import of electricity by MHS was approximately 1,067 toe in 2007.
97% of the MHS population has power supply. 228 villages (55%) have access to the grid, while 173 villages (42%) are supplied by off-grid modules like diesel gensets, micro hydro and PV. These off-grid energy sources account for only 10% of the province's power generation, with the large majority of the off-grid modules being diesel.

Figure 3: Sources of Power Supply in Mae Hong Son in 2007

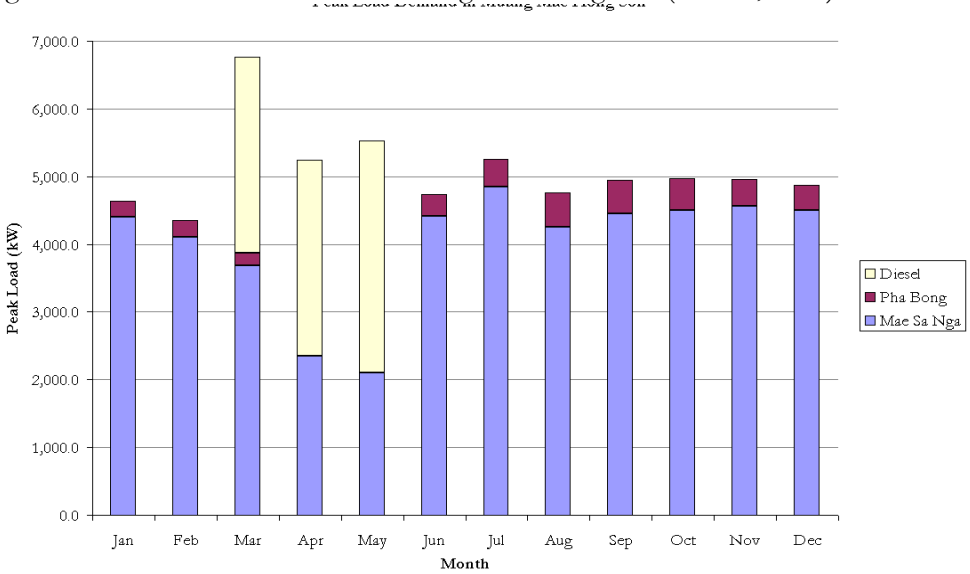


1.2.2 Energy Demand in Mae Hong Son

* 1 rai = 1,600 m^2

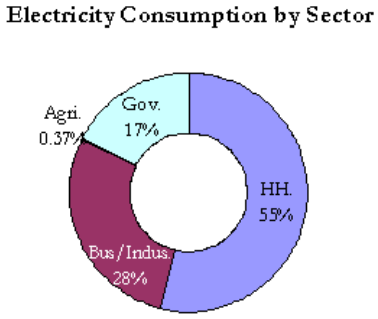
In Mae Hong Son Province 6,162 toe (71,529 MWh) of electricity was consumed in 2007, including 1,067 toe (12,386 MWh) of imported electricity. Electricity consumption peaks in May (see Figure 4). In the dry season (March-May) Mae Hong Son has to rely heavily on the diesel plants since the hydro power plants generate less due to low water levels. Daily peak demand occurs at around 7 p.m. (EGAT and DEDE, 2007).

Figure 4: Peak Load Production in Muang Mae Hong Son (EGAT, 2007)



Households are the major electricity consumer in Mae Hong Son. Approximately 55% of electricity consumed in the province is in this sector (see Figure 5). The business and industrial sector has only 28% of the share, since this sector is comparatively small in Mae Hong Son. Roughly 4% of the total electricity (according to a survey done by REO 10 in 2005.) consumption is for water heating in hotels (there are 1,428 hotel rooms with electrical water heaters).

Figure 5: End-Use Electricity Consumption in Mae Hong Son



LPG Demand

The LPG (Liquefied Petroleum Gas) market in Mae Hong Son is rather small. According to interviews with officials, most of the rural population still uses firewood for cooking. LPG is imported from Chiang Mai by small traders. These traders are not registered at the Department of Energy Business in Mae Hong Son; therefore, there is no official record on MHS LPG consumption. However, it is estimated that Mae Hong Son currently consumes approximately 2,368 toe (approximately 2,000 tons) of LPG per year, an average of 7-8 kg per person per year.

Firewood Demand

Firewood accounts for approximately 13% of MHS total energy consumption. Over 65% of the MHS population uses wood as their primary cooking fuel. They consume currently around 4,469 toe, or 11,768 tons, of wood per year (calculated from REO 10, 2005). 17% of this wood is made into charcoal using traditional methods which are highly inefficient and emit the potent greenhouse gas methane. The use of firewood has also been reported as the main cause of indoor pollution and respiratory disorders (FAO, 1997). This 4,469 toe of wood only provide 861 toe of heat due to low stove efficiency.

On the hills, wood is being derived from forests. The villagers spend approximately 1 month/year collecting and preparing wood for storage. According to the Department of Forestry, this is one of the causes for deforestation. Efforts have been made through community forest projects and other education activities to address this problem. It is estimated that people in MHS consume an average of 45 kg (0.017 toe) of wood per person per year.

Diesel Demand

In Mae Hong Son, diesel is mainly used in the transportation sector, which is the largest energy consumer. 93.5% of diesel consumption is for transportation; 6.4% (1,067 toe) is for power production, and 0.01% is for agricultural heavy machines. Mae Hong Son is consuming 16,416 toe (approximately 18,870,000 liters) of diesel per year (calculated from REO 10, 2005). Despite a dramatic growth in biodiesel trade elsewhere in Thailand, none is currently available in Mae Hong Son.

Gasoline Demand

The demand for gasoline in Mae Hong Son is 6,843 toe (approximately 9,132,000 liters) per year. 94% of this amount is for motorcycles, while the rest is for other vehicles (REO 10, 2005). Hence, all the gasoline consumed is in the transportation sector.

Conclusions on Electricity Demand in Mae Hong Son

MHS spends 776 million baht, or approximately 10% of its GPP, on energy. Natural gas supplies about 71% of Thai electricity fuel mix, and coal another 14%; with oil & diesel another 4.4%. (Source: Ministry of Energy). Based on the emission factor for the national grid of 0.51 tCO2e/MWh, MHS emits about 83 million tons of CO_2 per year (not including transportation, cooking, etc.).

MHS energy demand has been calculated for each source of energy as shown in Figure 6. The figure for diesel includes both the use of diesel to generate electricity (in generators) and diesel used for others purposes such as transportation. Figure 7 shows shares of energy demand by end-users.

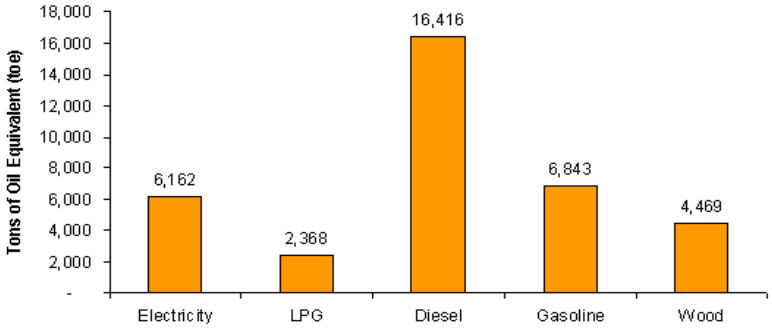


Figure 6: Demand for different categories of energy in MHS (2007)

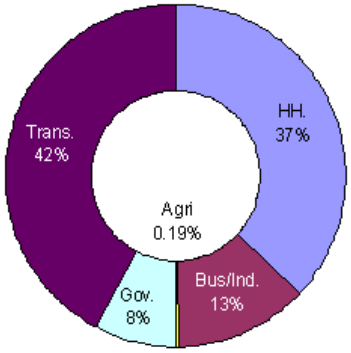


Figure 7: Shares of energy consumption by each economic sector in MHS

1.2.3 Energy supply in Mae Hong Son

On-Grid Power Supply

Mae Hong Son is the only province in Thailand that has no access to the national 115 kV transmission system owing to topography and the prevalence of forest conservation areas, through which power lines may not run. Currently, its main source of power supply is from small hydro power plants belonging to the Department of Alternative Energy Development and Efficiency (DEDE), and the 22 kV transmission line of the Provincial Electricity Authority (PEA) from Mae Rim, Chiang Mai. The transmission line is 430 km long and is accessible to 55% of Mae Hong Son's population.

During the dry season (March-May) when the hydro power plants operate with reduced capacity, diesel generators of the Electricity Generation Authority of Thailand (EGAT) are being used as backups. In 2004, EGAT has installed the largest photovoltaic power plant in Thailand in Pha Bong, Mae Hong Son, as a pioneering and research project. Its PV farm has 1,680 panels of 300 watt installed. Overall efficiency of the panels, which was expected at 12%, has dropped to 9.5% due to 4 months/year of forest fire smoke. This results in a higher cost of solar power production, i.e. 13.35 baht/kWh compared to 2 to 3 baht/kWh (typical retail tariffs paid by residential and commercial customers). Power generation statistics are as shown in Table 3. In 2008, DEDE will finish constructing another hydro power plant with a capacity of 2,520 kW in Mae Sangaa complementary to the existing 2 hydro power plants on this site with a 271 million baht budget. (This hydropower plant is included in the business as usual/baseline scenario; see section 2 Part 1 "incremental cost analysis" of this document).

Figure 8: Power Distribution in Different Zones of Mae Hong Son (EGAT, 2007)

Table 3: On-grid Power Plants in Mae Hong Son as of 2007

Name	No. of plants	Total Installed Capacity (kW)	Generating Capacity (kW)		Total Output	
			wet season	dry season	kWh/year	toe/year
Hydro - Mae Sangaa	2	5,040	4,700	2,000	25,196,500	2,147
Hydro - Pha Bong	1	850	350	350	2,191,000	187
Hydro - Mae Sarieng	2	1,250	1,000	500	5,477,500	467
Hydro - Mae Pai	2	2,000	1,800	800	9,703,000	827
Diesel - Mae Sarieng	2	2,000	2,000	1,800	2,817,000	240
Diesel - Mae Hong Son	3	3,000	3,000	3,000	4,695,000	400
Diesel - Mae Hong Son	3	2,400	2,400	2,400	3,756,000	320
PV - Pha Bong	1	500	200	200	490,365	42
Total	**16**	**17,040**	**15,450**	**11,850**	**54,326,365**	**4,629**

Source: 1) *Report on the Project for Composing MHS Integrated Framework for Energy Strategic Plan*, Regional Energy Office 10 (Chiang Mai), 2005
2) Total output was calculated by assuming that the dry season is 3 months and the plants run 20 hours a day, 6 days a week on average according to interviews with plant operators (approx. 54% load)
3) Output of PV power plant refers to the 2005 statistics from EGAT.

MHS is currently utilizing the diesel power plants at full capacity. From interviews with responsible authorities (EGAT, PEA, DEDE), the cost of diesel-generated electricity is 9 baht/kWh, whereas it is sold at 2.7 baht, a loss of approximately 70 million baht/year in total.

Demand has outgrown the capacity of the existing 22kV line, resulting brownouts (low voltage) or blackouts 2-3 times/day. These power quality problems are especially frequent at night, and worst during periods when many people are using electricity concurrently – for example during a popular football match. This is because there is no stable electrical potential difference, or voltage, in the system. EGAT has not had a solid plan to invest any further in Mae Hong Son; therefore, PEA, the distributor, decided to cope with this problem by connecting to a 115 kV line from Mae Taeng, Chiang Mai. The line is currently under construction, with completion expected sometime during 2010. Although the 115kV line offers the potential to import large amounts of electricity from other provinces, the constraint of running the line through difficult topography and long distances due to prohibitions against the line running through conservation forest, means that it will inevitably be liable to frequent outages. Locally generated electricity will therefore continue to be of high priority for MHS.

After the announcement of SPP and VSPP schemes in 2004, a total of 184 small and very small producers countrywide have been granted contracts. Out of this number, there is none in Mae Hong Son.

Off-Grid Projects

For areas that have no access to the grid, the Department of the Interior and the Department of Alternative Energy Development and Efficiency has made efforts to provide electricity. Village-scale micro hydro power plants with capacities ranging from 20-25 kW have been installed by DEDE. There are currently 4 such plants in Mae Hong Son providing approximately 563 MWh of electricity/year or 48 toe/year for 311 off-grid households (Table 4).

Table 4 Details of Off-grid Micro Hydro Projects in Mae Hong Son

S/N	Project	Location		Capacity (kW)	Date of Completion	No. of Households
		Amphur	Province			
1	Na Pu Pom	Pang Ma Pha	MHS	20	1995	67
2	Huay Han Ded	Pang Ma Pha	MHS	25	2003	77
3	Huay Mak Rang	Muang	MHS	25	Dec. 2005	105

4	Por Nor Dee	Muang	MHS	20	Dec. 2005	62

Source: Regional Energy Office 10

For these projects, DEDE provided machinery and equipment as well as technical support, whereas the villagers provided labor and some construction material. They formed, or used existing, village cooperatives to administer the plants and the cooperatives themselves or the tambon administrative office (TAO) became, thereafter, responsible for maintenance costs. Book keeping and tariff collection for the micro hydro projects in MHS has not been closely administered by the cooperatives. Costs of maintenance are still being subsidized out of TAO budget.

According to an interview with a major service provider, nationwide about 10% of the units break down and are not repaired within the first few years after installation. However, when grid lines become accessible to villages which have benefited from DEDE efforts to build micro-hydro systems, DEDE will help them register and operate their hydropower plant in the VSPP scheme so that the units would continue to be used instead of being discarded as in the past. The Ministry of Energy has allocated 150 million baht to retrofit existing micro-hydropower projects in Thailand for grid-interconnection in communities with grid power. No resources have been allocated to MHS so far.

The Department of Alternative Energy Development and Efficiency (DEDE) has established 59 micro-hydro projects with a total capacity of 2 MW in Northern Thailand since 1979, but by the end of 2003, only 25 sites are still operational. The failures are due to the lack of involvement of the communities, and improper maintenance of the systems. In particular, investments in small-scale RE systems made with government financing are considered government assets which cannot easily be transferred to private or communal ownership. Therefore, communities have not been able to benefit financially from such systems by selling power to the national grid. Another government agency that is addressing the provision of electricity to off-grid communities is the Ministry of Interior, working through the PEA. Since 2005, PEA has been distributing photovoltaic systems of 120 W_p capacity for each of the Thai households in the off-grid areas under the Solar Home System project. Such system would supply enough electricity for several 20W light bulbs as well as a 14-inch TV set (50 W), a motorized sewing machine (75 W), a water pump (100 W) or a radio (15 W). The Solar Home Systems including installation are provided free of charge. In MHS, the service provider is Solartron Plc., who also provides warrantee for the equipment. Technical training is under the responsibility of PEA, while costs of maintenance out of warrantee will have to be borne by the owners or the tambon administrative office should they organize to collect tariff on the utility.

There were 15,790 eligible applicants for the Solar Home Systems in Mae Hong Son (PEA, 2006), approximately 8,338 units had been installed by 2006 and the rest were anticipated to be installed by April 2007. It is estimated that around 14,800 systems have finally been distributed in Mae Hong Son. According to a survey on 405 systems in Tak province by the Border Green Energy Team (BGET) in 2006, roughly 1 year after installation, failure rate of these Solar Home Systems was 22.5% mainly because of manufacturing defect and improper installation/utilization. The French Development Agency AFD assesses, according to a mission reports from a visit to Mae Hong Son in 2007, that as many as 80% of the 300,000 solar kits installed in the entire country might have broken down.[1]

Prior to the Solar Home System scheme, village battery charging stations were provided by DEDE under the Renewable Energy for Rural Village Project. These stations are common utility of each village. But due to improper utilization and maintenance, most of the installed units had failed and the Ministry of Interior opted for the Solar Home Systems instead. Table 5 shows a list of off-grid PV projects in Mae Hong Son which have been implemented. On a yearly average, these panels will receive 6 hours of sunlight per day.

Table 5: Existing Off-grid PV Projects in Mae Hong Son

[1] Source: French Development Agency AFD, Thailand Mission Report August 2007, Rouland Louvel.

S/N	Projects	Agency	Type of Current	Size (kW)	No. of Units	Total (kW)
1.	Solar Home System	PEA	AC	0.12	14,800	1,776
2.	RE for Rural Village	DEDE	DC	3	72	216
3.	Border Schools	DEDE	AC	3	5	15
4.	Rural Schools	DEDE	AC	5	17	85
5.	PV water pump systems	DEDE	AC	2	3	6
6.	Village Learning Centers	DEDE	AC	1.5	3	5
7.	Soldier base	DEDE	DC	3	19	57
8.	Community health clinics	DEDE	AC	2	10	20
Total						**2,179**

Source: PEA and Regional Energy Office 10

There are currently 14 villages, or approximately 500 households, in Mae Hong Son that are still un-electrified. These are all located in the 1A forest area where public land use has been prohibited since 1989 for conservation purposes. Use of water resources for electricity generation is prohibited, and although PV systems could be used, the villages are unable to benefit from government programmes because, strictly speaking, they are illegal as they are located within protected forest areas.

Other Projects

The Office of the Permanent Secretary (OPS), Ministry of Energy had implemented the "Project for Integrative Provincial Energy Strategy" during the period 2004-2006. Under this project, 12 Regional Energy Offices (REO) had energy strategies laid out for all the 76 provinces including Mae Hong Son. The Mae Hong Son energy strategy, however, has not yet been adopted by the local administration and is not reflected in the provincial plan and budget. One reason for this is simply that the Ministry of Energy did not include sufficiently provincial authorities in drafting the strategy (Please refer to Annex 3 for details of the MHS Energy Strategy report by Regional Energy Office 10).

In 2006, the OPS, through the Policy and Strategy Coordination Office (PSCO) and Regional Energy Offices, implemented an energy project in the context of the sufficiency economy concept to celebrate the 80th birthday of H.M. the King in 80 tambons nationwide in addition to the 24 pioneers in the previous project. This project aims at facilitating energy plans to be designed and implemented by locals in selected tambons as well as increasing energy efficiency in government offices. Among the 80 tambons subject to energy planning in 2006, 1 was located in Mae Hong Son (Tambon Mok Cham Pae, Muang District). In 2008, 162 tambons are engaging in the process, with 2 locations in Mae Hong Son (Tambon Wieng Tai, Pai District, and Tambon Sob Moey, Sob Moey District). Regional Energy Office staff in charge of coordinating sub-district energy plans were found to have better understanding in local issues and practices as aresult of engaging in the process. They were able to communicate more effectively with local stakeholders, especially when local coordinators continued their work and where Chairman of the Sub-district Administration Organization (Nayok TAO) and heads of sub-districts (Kamnun and President of Sub-district House of representatives) participated in the training. Local stakeholders had more understanding of energy issues and more awareness of renewable energy technologies and energy efficiency practices; however, they admitted that their capacity is still limited to the household level, and not the community level; hence broader impacts were limited.

The Renewable Energy for Rural Village project by DEDE, which aims at distributing RE and energy efficient equipment to households in poor villages, is also being continued this budget year. Under this project, energy demand and local resources of target villages will be evaluated by DEDE before a list of recommended equipment is presented to village members to choose from.

1.3. *Potential Renewable Energy Resources in Thailand and Mae Hong son*

1.3.1 Mae Hong Son

Wind, geothermal

According to studies carried out by REO 10 in 2005, MHS does not have enough wind for power generation (MHS wind speed is in Power Class 1, 0.0 – 5.6 m/s, whereas useful wind speed must be at least in Power Class 4 or 7.0 – 7.5 m/s). Recent studies suggest however that there might be some wind potential to generate electricity. Mae Hong Son has 7 hot springs; none has potential for geothermal energy.

Biomass

According to REO 10 (2005), MHS has significant renewable resources such as agricultural residues; municipal waste and manure (see Table 6, below).

Table 6: Estimated availability of biomass residues and biomass waste products in MHS in 2005

Type of Resource	Amount		Remark
	tons	toe	
Municipal organic waste	**11,640**	**384**	1 ton of organic waste gives 0.6 ton of liquid pulp, 1 ton of liquid pulp gives 100 m^3 biogas
Manure (cow, buffalo, pig only)	**12,918**	**1,790**	1 ton of manure gives 252 m^3 of biogas There are 10 pig farms in MHS that have roughly 100 pigs. (Farm sizes are rather small)
Agricultural Residue	**54,161**	**24,460**	
Rice Husk	7,873	3,556	Rice husk is approx. 14% of all agricultural residue.
Straw	21,228	9,587	
Other crops	25,060	11,318	
Total	**78,719**	**26,634**	

Reference: Reviewed in REO 10, 2005 Manual for Local Energy Planning in Thailand, PRO-SE, 2002

Information from the Office of Agricultural Economics, Mae Hong Son Province (2007), shows that the cultivation of paddy rice has significantly increased during the last few years. In 2007 more than 40,000 tons of rice husk and straw was produced annually. According to local officials currently the production is higher, and most of the rice husk and straw is not being used and left to decay. Currently there are 8 rice mills (2 large mills and 6 small ones).

Mae Hong Son is one of the largest wood producing provinces in Thailand, there are 12 saw mills producing a significant amount of wood residues, most of it is being left to decay.

Local officials estimate that the potential for biomass based (agricultural residues, wood waste, etc.) electricity generation in Mae Hong Son is more than 60 MW. This has not yet been confirmed by independent studies.

Table 7 shows that Mae Hong Son was producing 750 and 12,073 tons of peanut and soybean per year in 2005. Mae Hong Son has 3% of infertile or deteriorated forest area, which is approximately 380 km^2 or 237,773 rai. In case oil producing crops would be cultivated on these degraded lands, around 47 million liters of oil could be produced, which is around 36,000 toe. Should land use for community forest be granted and 1% of this land is used for oil-yielding plants, 360 toe of oil could be derived from it on a yearly basis.

Table 7: Mae Hong Son Agricultural Produce, 2005

(tons/year)

Produce	Rainy season	Dry season	Total
Rice	69,429	-	69,429
Peanut	748	2	750

Soybean	8,992	3,081	12,073
Green mung bean	13	14	27
Corn	1,307	790	2,097

Source: Mae Hong Son Office of Statistics

Solar

Solar radiation in Mae Hong Son is 18.23 MJ/m^2/day, or 5 kWh/m^2/day, on average (Reviewed in REO 10, 2005). This amount of solar radiation is enough for solar water heating panels, but cannot optimize PV panels. A thermal solar collector with 56% efficiency heat generation normally produces 800 kWh/m^2 per year, whereas Photovoltaic technologies with 9% efficiency power production normally produce 220 kWh/m^2 per year.

Hydropower

A study performed by the Electricity Generation Authority of Thailand in December 2006 indicates that there are 41 potential hydropower sites in Mae Hong Son, with a total capacity of 217.8 MW. More detailed feasibility studies are required to determine whether hydropower plants (and which) on these locations are actually economically feasible.
As for stability of voltage in the system, DEDE is of the opinion that installing small hydro power plants at ends of the grid line in MHS will be beneficial. DEDE has developed some plans to develop small hydropower plants in MHS. Also for these potential projects, DEDE hasn't made any decision yet concerning investments.

Figure 9: MHS Energy Resource Mapping with some of the potential sites


Existing small hydro
Existing PV power plant
Diesel power plant
Potential small hydro
Pig farm with approx. 100 pigs
Na Pu Pom
Pang Ma Pha
Tam Lod
Mok Cham Pae
Pang Ma Pha
Huai Pha
Soo Pong
Mae Na Teang
Wiang Nua
Pang Mhu
Muang Mae Hong Son
wiang Tai
Pai
Mae Hee
Pha Pong
Huay Pu Ling
Tung Yao
Muang Paeng
Pong Sa
Huay Pong
Khun Yuam
Mae U-kor
Mae Ngao
Khun Yuam
Mae Yuam Ni
Muang
Mae Ki
Mae Tho
Khun Mae La Noi
Mae La Luang
Santi
Mae Na Chang
Sao Hin
Mae La Noi
Mae La Noi
Ta Pha
Huay Hom
Baan Kad
Pa Pae
Mae Kong
Mae Hoh
Mae Sariang
Pa Pon
Mae Yuam
Mae Sariang
Mae Ka Tuan
Kong Koy
Sob Moei
Mae Sam Saeb
sob Moei
Mae Suad
Map of Mae Hong Son Province

1.3.2 Potential Renewable Energy Sources in Thailand

Thailand's Ministry of Energy[1] estimates that the potential of power generation in Thailand from biomass residues (bagasse, paddy husk and woodchips) and (biogas from) municipal wastes (MSW) is around 3,700 MW. Other sources with good potential are biogas from pig farms and other types of agro-industry, corn cob, wastes from palm oil factories, and micro hydro. This means that there is a potential to generate another 1,700 MW of power from renewable energy (excluding wind and solar energy).

A study on wind potential and wind map was made available to the public in 2002. It is suggested to take more measurements in a number of selected areas.

The total renewable energy potential in Thailand from biomass residues, hydropower and biogas is therefore estimated to be around 5,400 MW.

c) Barrier analysis

Sustainable deployment of renewable energy in Mae Hong Song and other rural provinces in Thailand is constrained by a variety of factors which can be grouped into five categories: (1) Capacity (2) Policy/regulatory/legal (3) Organizational (4) Economic and financial, and (5) Technical/environmental. Table 10 below summarizes these barriers, and a more detailed description of barriers by technology is provided in Annex 4.

[1] Source: Alternative Energy, Cogeneration and Distributed Generation: crucial strategy for sustainability of Thailand's energy Sector, by Piyasvastiamranad (Thailand's Energy Minister, October 2006- February 2008)

Table 10: Barriers to sustainable RE in Mae Hong Son and other rural provinces in Thailand

Barrier	*Solar electricity*	*Micro-hydro*	*Biomass/ Waste*	*Wind*
1. Capacity (institutional and individual)				
Lack of awareness about correct operations & maintenance procedures	Little or no training accompanied installation. Equipment failures due to inadequate maintenance: i.e. distilled water needed for batteries; shading of panels	Equipment failures associated with inadequate maintenance. In designing the system and tariff structure, provisions were not made to align collective user behavior with the system limits.	Capacity to properly operate and maintain biomass power plants do not exist yet in MHS. Maintenance issues related to tars (bio-gasifiers) or desulfurization (biogas)	No wind power installations exist
Lack of awareness of appropriate technology for economic/social context		Many villages with potential micro-hydropower resources are unaware of power potential	Biomass not recognized by many as a potential fuel for power generation	
Limited educational opportunities in RE	Yes	Yes	Yes	Yes
Lack of local competent human resources to design/build/instal l/repair	No renewable energy companies in MHS. No knowledge or expertise center easily accessible			
Limited capacity of RE private industry; excessive focus on government contracts	Industry is at early stages of development; few companies sell RE equipment; RE companies advertise very little in newspapers, magazines, or broadcast media, and companies have not had a strong retail customer orientation, partly due to past focus on the government as a customer through off-grid hand-out programs.			
Limited capacity of government to identify and support the development and use of renewable energy resources	Changwat (provincial) and tambon (county) governments lack knowledge about how to survey and quantify resource potentials, and also lack familiarity with renewable energy technologies to identify applications that make sense.			
2. Policy/regulatory/legal				
Lack of legal rights to resources		Existing forestry regulations restrict use of water without approval	Existing forestry regulations restrict use of forest products without approval. Agro residue belongs to agro-processing industries (e.g. rice mills), No benefits for the farmers.	
Technology users not aware of warranty rights	Especially problem for SHS			

Difficulties or delays in getting reimbursement for import tax on RE equipment	Exempt, but in practice "pay upfront and reclaim later". "Reclaiming later" is uncertain & difficult			
Onerous requirements to be VSPP / SPP generator	VSPP & SPP projects need to obtain a variety of legal and regulatory approvals, from local authorities to environmental authorities, licensors and regulators. These present a considerable hurdle to project developers and are costly in terms of time and money. Efficient procedures and effective guidance for approvals must be developed to promote RE power projects;			
Metering arrangements mean that subsidies only apply to renewable energy production in excess of customer consumption	Thai utilities typically arrange meters so that self-consumption (consumption of electricity on the customer premises) is subtracted from electricity generated by the renewable energy generator before the electricity goes through the meter that is used to calculate cumulative subsidies. In contrast, in Germany, Spain, and other countries with feed-in tariff policies, the renewable energy generator (turbine, solar panel, etc.) is metered separately so that all electricity produced by the renewable energy generator receives a subsidy and electricity consumed on the customer premises is purchased separately.			
Tariff structural bias towards fossil-fuel generation	FT charge lowers risk for fossil-fuelled generators by passing fuel price volatility to consumers, no IRP, high discount rate in planning discounts future payment streams making choices with low upfront costs appear attractive.			
3. Organizational				
Lack of coordination among government organizations/ministries	Efficient coordination between different levels of government (central, provincial, community) as well as in between government institutions involved in RE planning and implementation (DEDE, EGAT, PEA, etc) is lacking. Especially true for biomass technologies for which ministries of agriculture, industry, finance, environment and energy are involved.			
Manufacturer Association of RE technologies does not exist	A manufacturer association would be an important lobbying voice for regulatory and tariff changes in favor of RE, but such an association is absent at this point.			
Differing local vs. national priorities	Climate change mitigation does not matter much to local communities, but does to the national government.			
Lack of tradition of cooperatively-owned renewable energy systems	RE installations are considered government assets which cannot be easily transferred to private or communal ownership. Cooperative ownership has been key in development of wind power in particular in Europe, and is promising for micro-hydropower which uses water flows that are community resources.			
4. Economic/financial				
High equipment/installation/ operational costs	High equipment costs	High equipment costs	High equipment costs for small systems. Fuel (or collection) costs can also be high.	High equipment costs
Financial incentives (VSPP tariffs, adder, etc.) provided to RE often insufficient to motivate investment	Production subsidy 8 baht/kWh not commercially attractive given high upfront costs	Production subsidy 0.4 to 0.8 baht/kWh may or may not be attractive; DEDE's investment support is limited by budget	Production subsidy 0.3 baht/kWh may or may not be attractive. 2.5 baht/kWh for MSW	Production subsidy 2.5 baht/kWh may or may not be attractive
High transaction costs for small systems	Yes	Yes	Yes	Yes
Lack of access to favorable financing	Yes	Yes	Yes	Yes

High import tax on equipment	30% tax but refundable (in theory) import tax on imported equipment			
Low purchasing power/income/ ability to pay	Small scale technologies too expensive for poor communities			
5. Technical/environmental				
Limitations of renewable energy resource	Clouds / smoke / fog	Insufficient water (especially in dry season)	Detailed assessments of biomass resources (biomass waste products and biomass non-waste products) are not available. For non-biomass waste products: available resources may be in restricted areas or may be hard to collect and sustainable supply may be an issue.	Wind speeds not well characterized. Believed to be low
Technology available in Thailand has quality control or durability challenges.	SHS: Inverters & ballasts have high failure rates SBCS: Bypass diodes should have been removed	Failure of automatic voltage regulator (AVR) is common. This is compounded by collective over-consumption.	Biomass gasification – issues with tar buildup. Biogas -- Sulfur dioxide can lead to engine corrosion Different technologies needed for different kinds of biomass. Not all the technologies are available or have been tested in Thailand	
Lack of proven cases	Few long-term successes, lots of failed systems in remote areas	No single project developed by private sector in Thailand. Many failed government projects	No/few projects in Mae Hong Song	No projects in Mae Hong Song. Very limited experience in Thailand.

d) Institutional, sectoral and policy context

Central (national) level

The executive branch of the central government comprises 20 ministries, including the Office of the Prime Minister. Regarding the development of rural RE systems, two Ministries are particularly relevant.

Ministry of Energy

The Ministry of Energy is relatively young, established in 2002, with a mission to:

- Study, survey, analyze, assess, monitor, and evaluate energy-relating situations; as well as serve as an information center on energy
- Determine energy-relating policies, planning, and measures
- Procure energy, alternative energy, and renewable energy
- Supervise and control as well as prescribe measures, rules and regulations, governing energy-relating operations
- Conduct research and development on energy
- Promote and support the procurement, development and conservation of energy
- Transfer technological know-how and develop personnel who possess in-depth knowledge of energy-relating issues
- Act as coordinator in managing energy-relating affairs at international level

Four key agencies under the jurisdiction of the Ministry are the Department of Alternative Energy Development and Efficiency (DEDE), the Energy Policy and Planning Office (EPPO), Policy Strategy Co-ordination Office (PSCO) and the Electricity Generating Authority of Thailand (EGAT).

The role of DEDE is to:

- Promote, support and regulate energy conservation
- Research and develop alternative energy
- Establish rules, standards, dissemination and technology transfer on energy production, transformation, transmission, utilization and conservation.
- Monitor and evaluate alternative energy development and energy conservation

In addition, DEDE is responsible for promoting the development of the SPP and VSPP schemes.

The roles and responsibilities of EPPO mainly focus on recommending and setting energy policies, measures and plans so as to effectively satisfy energy needs of the country and leads to sustainable energy security. This includes setting tariffs for the SPP and VSPP schemes. EPPO has the following roles:

- Recommend policies and measures on national management and development of energy.
- Establish measures on energy conservation and make budget allocation plan for energy conservation
- Establish measures to prevent shortage of fuels.
- Coordinate, monitor and evaluate implementation according to policies and measures on national management and development of energy.

Among other activities, EPPO is organizing and mobilizing the formulation and implementation of community-based energy plans in both rural and urban areas through participatory approaches. These local energy plans seek to promote renewable and energy efficient options at the community and householder level.

EGAT is a state enterprise under the Ministry of Energy whose mission is to:

- Generate, acquire, and transmit electric energy to the Metropolitan Electricity Authority (MEA), the Provincial Electricity (PEA), other electric energy consumers under the law thereon and neighboring countries.
- Undertake various activities concerning electric energy. Energy sources deriving from natural resource for the production of electric energy and other activities which will promote the purposes of EGAT.
- Undertake businesses concerning electric energy and other businesses concerning with the activities of EGAT, or collaborate with other persons for the said activities.
- Produce and sell lignite, or collaborate with other persons for the said activities.

EGAT presently builds, owns and operates several types and sizes of power plants across the country with a combined installed capacity of 15,000 MW, accounting for about 59 percent of the country's 25,602.8 MW generating capacity. EGAT also purchases electric power from private power companies and neighboring countries. EGAT develops, owns and operates the national transmission network. Its grid system mainly operates at 500 kV, 230 kV and 115 kV voltages; EGAT's power system operation is divided into five geographical areas: metropolitan, central, northeastern, southern and northern regions. From the National Control Center based at EGAT's Headquarters and other five regional control centers, EGAT plans, operates and controls the least cost dispatch of generated power from its power plants as well as from private power plants to load centers via its high voltage transmission lines. EGAT's grid system is presently linked to Laos by 115 kV and 230 kV lines and to Malaysia by 115 kV, 132 kV and the new 300 kV HVDC lines.

EGAT is obliged to supply and sell virtually all of the energy output from its own generation facilities and from private power sources to two distributing authorities, namely the Metropolitan Electricity Authority

(about 35% of the total supply) and the Provincial Electricity Authority (about 63%) which then deliver electricity to end users across the country. EGAT's direct customers also include a small number of large industries prescribed by the Royal Decree. Cross-border power trades are also made with Laos and Malaysia

Ministry of Interior

In addition to staffing the positions of provincial governors and district officials, the Ministry of Interior is also responsible for the Provincial Electricity Authority (PEA), which is a government enterprise primarily concerned with the generation, distribution, sales and provision of electric energy services to the business and industrial sectors as well as to the general public in provincial areas, with the exception of Bangkok, Nonthaburi and Samut Prakran provinces. The PEA's three major objectives are:

- To continue to improve its provision and distribution services of electric energy for customers: to achieve the highest possible level of sufficiency, efficiency and reliability in power distribution commensurate with safety practices; to meet the timely need of customers; and to keep pace with changing circumstances.
- To optimize its business and operations in order to be more profitable and thereby achieve sufficient revenues to facilitate further development.
- To develop its organizational structure, man power and resources management in order to achieve the highest level of efficiency and effectiveness.

A number of NGOs are also active in different parts of Thailand promoting sustainable energy options. Some key NGOs are:

The North-Eastern Thailand Foundation (NET Foundation)

The NET Foundation is a local NGO hosting Surin E&E Office established by the Provincial Programme for Sustainable Energy (PRO-SE), which has been serving as an information centre for local energy management and a secretariat of Surin Energy Civil Society since 2002. Before being officially registered as an NGO in November 1986, the NET Foundation had started its development work as the 'Project for Surin Borderline Village Development', a project of 7 years in 52 villages of the refugee-concentrated Thai-Cambodian border, i.e. Kabchueng, Buashade, and Sangkha districts. Before the project ended, the parties involved had an intention to use the experience and lessons from the work to benefit other areas, thus, they established the foundation in Surin Province.

The objectives of the organization are:

- To arrange for a learning centre to improve the quality of living of the people
- To carry out development work using the process of community study
- To cooperate with organizations working on community development
- To work for the benefits of the public or coordinating with other public organizations for public interest
- To coordinate and cooperate with organizations, both in the government and private sector domestically and internationally that pursue similar objectives
- To be a supporting organization for community-based organizations and community development civil societies
- To carry out works for natural resource, energy and environment management

Palang Thai

Palang Thai is a Thailand-based non-profit organization that works to ensure that the transformations that occur in the region's energy sector are economically rational and that they augment, rather than undermine, social and environmental justice and sustainability. Palang Thai currently works on The Thai Net Metering Project (VSPP), which promotes the implementation of small-scale grid-connected renewable energy projects and on the public interest energy policy analysis, working with Thai NGOs, universities,

businesses and government agencies to analyze electricity planning and policy from a public interest perspective. Palang Thai also provides the hands-on solar and micro-hydro training for villages on both sides of the Thai / Burma border on behalf of The Border Green Energy Team (BGET) (see below)

The Border Green Energy Team (BGET)

The Border Green Energy Team (BGET) provides hands-on appropriate technology training and financial support to village innovators in ethnic minority areas on both sides of the Thai/Burma border. BGET works to increase awareness and practical knowledge regarding renewable energy applications, to promote the use of renewable energy, and to ensure that where these technologies are used, they work as effectively as possible. Specifically, BGET works to identify promising potential micro-hydro sites in Tak province, and to cooperate with villagers and, if necessary, local experts to install micro-hydro systems at these sites. BGET also works to improve the sustainability of the Thai SHS program by conducting training to increase awareness about the warrantees for the components of the solar systems, as well as to train local technicians who will be qualified to perform routine maintenance and troubleshooting of the SHS.

The Thailand Environment Institute (TEI)

The Thailand Environment Institute (TEI) is a Thai-based non-profit, non-governmental organization focusing on environmental issues and the conservation of natural resources in Thailand, Regionally and Globally. It works with the private sector, government, local communities, other civil society partners, and academia and in international circles with international organizations to help formulate environmental directives and link policy with action to encourage environmental progress. Among the range of environmentally related activities that the Institute undertakes, of specific relevance is it work in promoting awareness and action on climate change within Thai schools, municipalities and general society, conducting energy audits, undertaking environmental audit and conducting training and approval of ISO certification for industry and municipalities.

Appropriate Technology Association (ATA)

The Department of Engineering, Chulalongkorn University, and other professional engineers formed a group in 1978 to develop, promote, and support the utilization of appropriate technologies for communities, organizations and interested parties to improve the living conditions of the people. The team, called 'Villagers' Technology', or Adaptive Technology Group (ATG), served developing communities by training, publicizing documents, designing and installing artesian water rigs, bamboo-reinforced cement water tanks, windmills, etc. By mid 1985 this had evolved into the "Appropriate Technology Association". The Objectives of ATA are to:

- To gather and disseminate information regarding appropriate technologies
- To research and develop simple and economical technologies using local wisdom and resources
- To transfer appropriate technologies to target groups through education activities.

Local level

Thailand's 76 provinces (75 regional provinces plus Bangkok) are subdivided into districts *(amphoe)*, municipalities *(tesaban)*, subdistricts *(tambon)* and villages *(moo bahn). Tambons* are rural sub-districts. In urban areas, this level of government is known as "municipalities" (*tessabon*), which are governed in the same way as *tambons*. In regional provinces the Ministry of Interior appoints staff members from its Department of Local Administration (DOLA) to act as provincial governors and as the heads of districts. The heads of provincial and district line agencies are officials appointed by different ministries of the central government.

The Provincial Administrative Organization (PAO) is a relatively new institution of local government, comprising an elected provincial council that functions as a legislative branch, and an executive board. Until 1997 the provincial governor was by law the chief executive of a PAO. The amendment of the Provincial Administrative Organization Act in 1997 established the position of an elected chair-person,

who is elected by the councilors. There are 75 councils in the country and thus 75 provincial administrative organizations. The Provincial Administrative Organization represents all rural areas of a province.

The Tambon Council and Tambon Administration Organization (TAO) Act 2537 (1994) strengthened the role of local government in managing local natural resources, forest use, and planning and decision making under the relevant laws and regulations. All Tambon Councils were upgraded to Tambon Administration Organizations (Or-Bor-Tor). The Or-Bor-Tor is an elective body drawn from the village level from which two representatives are elected. The organization plans activities to spend local taxes that the Or-Bor-Tor is mandated to collect (housing tax, land tax, signboard tax and slaughtering tax), part of which goes towards resource management and protection activities. Only 3% of the revenue collected by the Or-Bor-Tor goes to the central government with the remainder used locally. The Tambon council is a separate body and cannot decide how taxes are spent locally at the district and sub-district level (although its members can sit with the Or-Bor-Tor).

Before the more recent policies that encourage private-sector investment in renewable energy were put in place, the Thai government has for over two decades played an active role in installing solar electric and micro/small hydropower systems in remote communities in Thailand, shown below in Table 11:

Table 11: Thai Government Programs to Install Solar and Micro/Small Hydropower

Program	*Capacity per system (kW)*	*Renewable energy technology*	*Agency(ies)*	*Year initiated*	*Number of systems*
Solar Home System (SHS)	0.12	Solar PV	Provincial Electricity Authority (PEA)	2003	300,000
Solar Battery Charging Stations (SBCS)	0.6 to 0.9	Solar PV	Department of Public Works (DPW) and the Department of Alternative Energy and Energy Efficiency (DEDE)	1990s	1,660
Micro-hydropower	10 to 40	Pelton or crossflow micro-hydropower	DEDE	Early 1980s	>60
Small and micro-hydropower (grid-connected)	20 to 2000	Pelton, cross-flow or Francis hydropower	DEDE, Royal Irrigation Dept (RID), PEA	Early 1980s with new target set in 2003.	Including micro-hydropower (counted already above), 728 projects totaling 350 MW by year 2011.

Stakeholder analysis

During the project preparation process, many forums were held (see Annex 5 for a summary of those events) as well as a series of interviews and dialogue sessions to gain perspectives and feedback from numerous stakeholder groups. Two meetings with the 'Provincial Working Group', a 'community-based meeting', consultative meetings with key stakeholders and the first 'LFA Meeting' were the formal forums. This participatory process was seen not only as a means to gain information, but also as an opportunity to contribute to the design and structure of this project at an early stage.

With respect to the project strategy, a "long list" of possible stakeholders was prepared, guided by the general categories of stakeholder groups (1) local and (2) national, regional and international. Within these categories, a number of sub-groups were identified: based on sector of origin: government organizations/

agencies, NGOs/CBOs, private sector, educational institutions, and international organizations, identifying those which:

- Are affected by, or significantly affect, the issue;
- Have information, knowledge and expertise about the issue; and
- Control or influence implementation instruments relevant to the issue.

The "long list" of stakeholders (see Annex 6) was subsequently analysed using different criteria thus helping determine clusters of stakeholders that may exhibit different levels of interest, capacities, and relevance.

The roles of key stakeholders engaged in the promotion of RETs in Thailand are:

National Government: Efforts of the Thai government to rationalize energy governance saw the establishment of the Ministry of Energy in 2002. Within this relatively new ministry, three governmental agencies, Energy Policy and Planning Office (EPPO), Department of Alternative Energy Development and Efficiency (DEDE) and the Office of Policy and Strategy Co-ordination are involved with renewable energy. EPPO responds to the planning, enforcement and promotion of energy policies, including the SPP and VSPP renewable energy programs. DEDE is responsible for implementation and evaluation of RE based projects and the Policy and Strategy Co-ordination is pursuing locally-base energy plan formulation and implementation.

The Ministry of Interior (MOI) has supported a number of RE projects at the rural level typically being implemented through the Tambon Administrative Organizations (TAO).

The Ministry of Natural Resources and Environment (MONRE), while having no direct participation in national RE projects, institutionally supports initiatives and investigates development projects that have potential to reduce environmental impacts and degradation. Additionally, MONRE functions as the Focal Point for GEF and the conventions.

Public Utility Organizations: The Electrical Generating Authority of Thailand (EGAT) is the primary agency responsible for installing and expanding the electrical grid in the Kingdom. Local service is maintained through the Provincial Electrical Authority (PEA), operating under the Ministry of Interior, which has a mandate to provide electricity to communities even if heavy subsidies are, required as part of the national social welfare objectives. EGAT is increasingly testing and using RE technology, with a solar power facility recently established in Mae Hong Son.

Private Sector: There are no major private sector providers of RE services. There are a few notable developments intended to serve individual private developments with a number of private projects participating under the SPP and VSPP programs.

Sub-national Level: At the local government level, there are three local government actors (provincial, municipal and tambon). Additionally, there is also territorial administration under the appointed Provincial Governor's Office and at the district level through the Chief District Officer.

Provincial Level: The provincial level has the mandate to co-ordinate the planning and service delivery of the various agencies and offices operating at the provincial level. This authority extends to a number of actors involved in the provision of RE and other energy related services. However, effective co-ordination is hampered by overlapping authorities and issues of allegiance between national and local authorities. MOI (DOLA and DOPA) are attempting to structure a clearer division of authority and responsibility for the provincial level, but the picture still remains unclear as to determine definition of jurisdiction and authority.

There are still a number of un-resolved questions that affect delivery of RE services, particularly with regard to the division of functions between the elected PAO, the representation of the state at regional level (the governor or CEO-governor, and the representatives of the line ministries and departments who have constituted the traditional provincial authority) and other provincial bodies. Additionally, the roles of the

various national ministries which operate at the provincial level remain somewhat unclear. Most of these units appear to have potentially conflicting objectives, implementing national policies at the sub-national level, while also providing technical and professional support to the local level for their own locally-driven initiatives.

Municipal level: Municipalities have several functions involving management and planning, as well as policy implementation. To date, there has been very little initiative to participate in RE related initiatives, as all urban areas are connected to the national grid. For any significant infrastructure development, the municipalities have so far relied on the central departments to make the planning as well as the implementation. In some cases the central agencies have undertaken the operation and maintenance of the systems (e.g. water supply), but in other cases the infrastructure has been handed over to the municipalities with little consideration on how to organise and pay for the operation and maintenance.

Many changes in the municipal political and administrative structure have been implemented in Thailand during the past two decades, which allow municipalities to take greater responsibility for urban planning, development and environmental management that could have an impact upon locally implemented RE services especially for low-income and slum communities. Parallel to this process of decentralization and increased municipal autonomy, is a growing expectation among all level of stakeholders that solutions for urban environmental problems can be found mainly at the municipal level. This has put the spotlight on municipal governments to take the initiative to implement innovative policies, programmes and projects in order to protect the urban environment in a concerted and coordinated manner. Municipalities have also been expected to create a more facilitative environment where active stakeholder participation can take place.

Tambon Administrative Organizations: Like municipalities, these local government units also assume planning and management tasks. While most cover rural areas, there are an increasing number, especially adjacent to existing municipalities that cover urban areas. Under the decentralization policy, these administrative units are receiving increasing levels of funding that allow them greater autonomy for implementing infrastructure projects. So far Tambon involvement in RE has mainly been one of implementing MOI renewable energy initiatives (such as solar) at the village level.

Villages: SML (Small, Medium and Large) projects saw the transfer of financial resources directly to the village level, effectively by-passing elected bodies at the provincial, tambon and municipal levels. Through such funding transfers, villages are becoming increasingly responsible for identifying and implementing development projects. While this may offer opportunities to see the village level initiate independent RE solutions, there is a need to ensure that such local initiatives be co-ordinated with the Tambon level to help ensure sustainability and ongoing support.

Community: Under section 66 and 67 of the new Constitution (2007), both an individual and a local community is entitled to have more rights than before in protecting as well as utilizing natural resources and the environment. The framework of the new constitution has been set in order to strengthen local communities, and civil society to manage their own resources sustainably, and ensuring public participation, transparency and development at local level during the decentralisation process. To be effective, a special challenge is the development of a public participation culture, which on the one hand raises important issues for discussion and on the other hand maintains the flexibility and ability to gain influence and find solutions for the common best. For more information, see the Stakeholder Participation Plan in Section IV Part II

Business-as-Usual scenario

The business as usual scenario for Mae Hong Son is that energy consumption will continue to grow at the predicted rate from 36,258 toe in 2007 (see Figure 6) to 40,600 toe in 2012 (Figures 10, 11). However, by 2010 MHS will start to import more and more electricity since the growing energy demand eventually outgrows constant energy generation and the new 115kV power line will be completed by then.

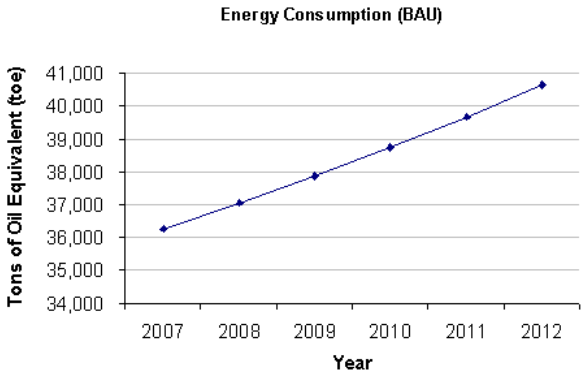


Figure 10: Energy consumption. Mae Hong Son

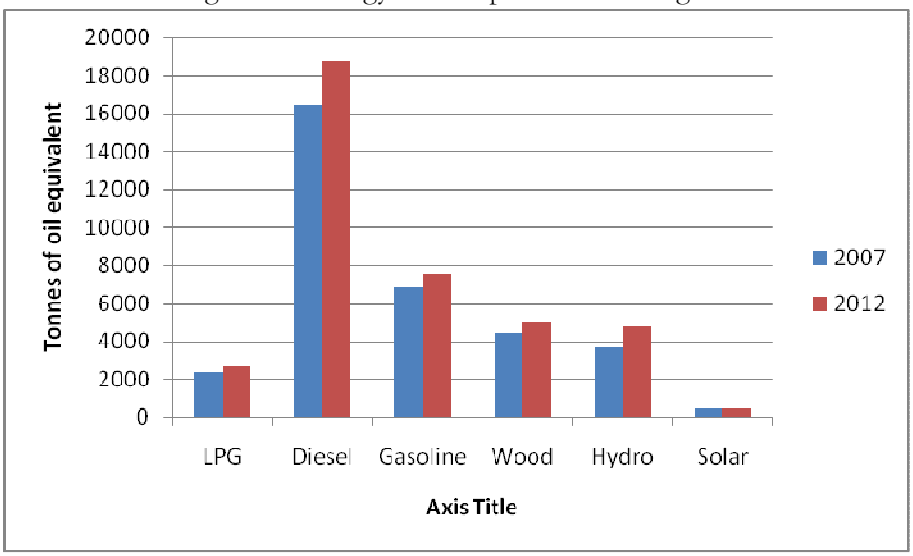


Figure 11: Fuel consumption (BAU)

PART II: Strategy

a) Project Rationale and Policy Conformity

Despite the government's commitment to RE, it is clear that some of the key barriers restricting widespread adoption of RE systems would not be addressed in the absence of the project. These include social/economic/financial barriers such as access to financing and training, policy/regulatory/legal barriers such as contested resource rights and metering arrangements, and organizational barriers such as the institutional structures required for community ownership of RE systems. This project is pursuing a barrier removal approach so as to promote widespread adoption of rural, grid-connected RE systems.

The project is consistent with CC-SP3, as it will increase the quantity of electricity generated from economically viable renewable sources and promote the adoption of policies promoting on-grid RE. It is also consistent with SP4, as it will introduce sustainable practices in biomass use as energy.

Previous initiatives on sustainable rural energy have yielded lessons that have informed the design of the project strategy. For example, the Provincial Programme for Sustainable Energy or PRO-SE in 5 north-eastern provinces of Thailand (funded by DANIDA) focused on developing approaches and tools for Local Energy Planning (LEP). Experience with this approach demonstrated that rural communities in Thailand are motivated to address sustainable energy only within the context of integrated socio-economic planning, and sustainable civil society organizations need to be formed to undertake planning activities.

Similarly, the high failure rate of past government-sponsored community level RE installations indicate that unless communities have the capacity to manage such systems, the sustainability of such systems is significantly compromised. Also important is that the communities are motivated and see the potential for financial benefits as well as the provision of relatively cheap electricity.

Consequently, the project will adopt an approach that will include promotion of on-grid and off-grid applications, as locally relevant. GEF funding will be used to support the installation and sustainable management of grid-connected RE systems by overcoming barriers that currently constrain the development of such systems, and co-financing will be used to address off-grid electrical and non-electrical sustainable energy needs.

Policy Linkages and UNDP Strategy in Thailand

In line with the development results identified in the UN Partnership Framework with the Royal Thai Government (UNPAF 2007-2011), where Mae Hong Son was indicated as a priority geographical focus area for UN system's contribution, this project aims to improve sustainable utilizations and management of natural resources and the environment at national and community level through demonstration of sustainable use of renewable energy in Mae Hong Son province. With an area-based approach, the success will be replicated as a means to achieve MDG 7 and the national target of expanding use of renewable energy from 4.5 to 8% by 2011.

The project expected outcomes are also in line with the UNDP Country Programme Action Plan (CPAP) 2007 – 2011 on Energy and Environment for Sustainable Development, and Decentralization and Local Governance. The aligned outcomes are:

- Increased capacity of national focal points in removal of barriers in pursuing local sustainable management of natural resources and environment and promotion of area-based renewable energy application.
- Demonstration of sustainable management in applicable sustainable energy consumption and production
- Efficient community work in sustainable use of local natural resources and energy with engagement in policy and decision making process.

The project will build on UNDP successful record of partnership with Thai counterparts in a number of key development areas. Specifically, UNDP has long worked in Thailand to promote community participation in natural resources and environmental management. Local administration and key national agencies responsible for renewable energy promotion are key beneficiaries and targets for capacity building. The project will be complementary to other GEF projects working on sustainable energy in Thailand.

UNDP will work closely with other relevant agencies on renewable energy and sustainable development, as well as the provincial and local authorities in establishing the necessary policy, capacity strengthening in both technical and managerial skills, which are considered critical for the success and sustainability of the project. Furthermore, UNDP will facilitate and provide necessary intervention as follows:

a) Dialogues among all stakeholders;
b) Enhancing market feasibility for renewable energy options with private sector engagement
c) Capacity building of local government and community groups;
d) Establishment of coordination mechanism between communities, vulnerable groups and local governments.

Results of pre-feasibility assessments

During implementation of the PPG, assessments were made of the feasibility of various RE technologies in MHS. The technologies and their typical capacities included in the study were selected based on recommendations of a team of (local) experts. Table 12 shows the options that were reviewed, while Table

13 shows the financial returns, emission estimates and local employment opportunities provided by the different technologies.

Financial Feasibility of Technologies

Table 14 shows that power generation from PV is not financially viable. From the technologies reviewed, the most attractive investments are in a 150 kW husk-fired generator, a 16 m^3 biodigester, and solar water heaters.

The sensitivity analysis suggests that PV is less sensitive to change in capital investment and electricity sale price than the other technologies reviewed. It was also found that steam turbines and off-grid village hydropower are all sensitive to change in electricity sale price.

Table 12: List of selected and reviewed RE technologies

No.	Technology	Size (kW)	Energy Prod./Saving (MWh/yr.)	Eff. (%)	Life Span (Yr.)	Investment (Baht)	O&M costs (Bt/yr.)	Fuel Costs (Bt/MWh)
1.	1 Biogas (Manure, 16 m^3)	3	22	0.25	15	50,000	6,000	-
2.	1 Biogas (Manure, 5 m^3)	1	7	0.25	15	30,000	4,000	-
3.	1 Biogas (Municipal Waste)	10	71	0.25	15	2,200,000	50,000	-
4.	1 Biomass Gasification	100	312	0.07	15	1,200,000	300,000	30
5.	1 Husk-fired Generator	150	468	0.08	15	500,000	328,000	38
6.	1 Steam Turbine (Agri Res.)	3,000	19,500	0.25	20	240,000,000	4,800,000	30
7.	1 Steam Turbine (Wood)	3,000	19,290	0.27	20	225,000,000	2,500,000	200
8.	4 Small Hydro projects	3,707	20,307	1.00	20	204,000,000	1,440,000	-
9.	1 Village Hydro - Off grid	40	219	1.00	20	3,200,000	30,000	-
10.	1 Village Hydro - On grid	40	219	1.00	20	4,000,000	30,000	-
11.	10 kW PV	10	22	1.00	20	2,000,000	5,000	-
12.	1000 m^2 Solar Water Heaters	2,000	876	1.00	20	9,000,000	-	-

Note: No.1, 2 and 12 do not produce electricity. No. 1 and 2 produce biogas, a substitution of cooling fuel, No. 12 produces heat in substitution for electricity, the rest produces electricity.

Table 13: Comparison of Financial Returns, Emissions and Local Employment between Selected and reviewed Technologies

Technology	NPV (1000 Bt)	IRR (%)	Pay-back Period (Yr.)	Resource Consumed (MWh/y)	Available Resource (MWh/y)	Resource Utilization		Energy Cost (Bt/kWh)	Emissions (Tons/Year)			Local Employment (persons)		
						(%)	(tons/y)		SO_2	NO_x	CO_2	Construction	Annual	Person-year/TJ
1 Biogas (Manure, 16 m^3)	202	46	2.3	87	23,393	0.37	n/a	0.5	-	0.06	-	0.90	0.16	2.81
1 Biogas (Manure, 5 m^3)	30	17	5.3	27	23,393	0.12	n/a	1.0	-	0.02	-	0.54	0.10	5.39
1 Biogas (Municipal Waste)	-742	-1	16.2	285	1,514	19	n/a	3.9	-	0.21	-	6.60	1.33	6.92
1 Biomass Gasification	848	14	6.2	4,457	298,558	1	780	1.8	1.6	2.09	-	25.60	11.57	11.82
1 Husk-fired Generator	5,974	117	1.1	5,850	38,771	15	1,476	1.3	2.11	2.75	-	11.00	14.59	9.08
1 Steam Turbine (Agri Res.)	325,362	18	5.6	78,000	298,558	26	18,720	1.4	28.08	36.66	-	1,200.00	152.00	3.02
1 Steam Turbine (Wood)	197,842	14	6.9	71,444	n/a	n/a	n/a	1.9	3.858	22.862	-	1,125.00	427.70	6.97
4 Small Hydro projects	328,239	16	6.0	20,307	n/a	n/a	n/a	1.4	-	-	-	882.00	38.40	1.13
1 Village Hydro - Off grid	2,202	12	7.4	219	n/a	n/a	n/a	1.5	-	-	-	76.80	0.80	5.88
1 Village Hydro - On grid	2,568	12	7.6	219	n/a	n/a	n/a	1.9	-	-	-	96.00	0.80	7.10
10 kW PV	-1,229	-5	35.0	22	n/a	n/a	n/a	8.6	-	-	-	2.67	0.00	1.69
1000 SWH	20,877	25	4.1	876	n/a	n/a	n/a	0.9	-	-	-	144.00		2.28

Table 14: Sensitivity Analyses of the Selected and reviewed Technologies

Feas. Technologies	Basic Calculation				Investment +50%				O&M +50%				Elec. Sale Price -50%			
	Unit cost	NPV	IRR	Payback	Unit cost	NPV	IRR	Payback	Unit cost	NPV	IRR	Payback	Unit cost	NPV	IRR	Payback
1 Biogas (Manure, 16 m^3)	0.5	202	46%	2.3	0.6	178	31%	3.3	0.6	168	40%	2.6	0.5	44	16%	5.7
1 Biogas (Manure, 5 m^3)	1.0	30	17%	5.3	1.2	16	10%	7.8	1.2	10	10%	7.9	1.0	(19)	(8%)	32.4
1 Biomass Gasification	1.8	848	14%	6.2	2.0	1,813	17%	5.3	2.3	705	13%	6.7	1.8	(1,807)	n/a	(17.4)
1 Husk-fired Generator	1.3	5,974	117%	1.1	1.3	5,736	79%	1.4	1.6	4,141	84%	1.4	1.3	(312)	(7%)	30.3
1 Steam Turbine (Agri Residue)	1.4	325,362	18%	5.6	2.0	211,076	11%	8.1	1.6	291,841	16%	5.9	1.4	(1,467)	5%	12.8
1 Steam Turbine (Wood)	1.9	197,842	14%	6.9	2.4	90,699	8%	10.1	1.9	180,383	13%	7.2	1.9	(125,468)	(3%)	30.0
4 Small Hydro projects	1.4	328,239	16%	6.0	2.1	188,239	10%	8.8	1.5	318,980	16%	6.0	1.4	14,860	6%	12.0
1 Village Hydro - Off grid	1.5	2,202	12%	7.4	2.2	679	7%	11.0	1.6	2,009	12%	7.7	1.5	2,202	12%	7.4
1 Village Hydro - On grid	1.9	2,568	12%	7.6	2.7	663	6%	11.3	1.9	2,375	11%	7.9	1.9	(814)	2%	16.0
1000 SWH	0.9	20,877	25%	4.1	1.3	16,591	17%	5.9	n/a	n/a	n/a	n/a	0.9	6,362	12%	7.6
Unfeas. Technologies	**Basic Calculation**				**Investment -50%**				**O&M -50%**				**Elec. Sale Price +50%**			
	Unit cost	NPV	IRR	Payback	Unit cost	NPV	IRR	Payback	Unit cost	NPV	IRR	Payback	Unit cost	NPV	IRR	Payback
1 Biogas (Municipal Waste)	3.9	(742)	(1%)	16.2	2.3	306	9%	8.3	3.5	(462)	2%	13.5	3.9	214	6%	9.6
10 kW PV	8.6	(1229)	(5%)	35.0	4.3	(276)	1%	17.7	n/a	n/a	n/a	n/a	8.6	(891)	(1%)	23.4

Having considered the needs, general conditions and financial conditions, grid-linked power production from PV is not recommended for MHS.

On the basis of these pre-feasibility studies, and taking account of barriers to the development of sustainable RE systems in Mae Hong Son and other rural provinces in Thailand, and more generally, in Thailand, a project strategy was developed to overcome these barriers. The project strategy is described in the following section. Table 15 below indicates how project interventions will address each of the barriers described previously in Section I, Part I.

Barriers to sustainable RE systems are categorized under the headings Capacity, Policy/regulatory/legal, Organizational, Economic and financial, and Technical/environmental. Project interventions to address Capacity and Organizational barriers are largely accounted for by Outputs contributing to Outcome 1 (as well as by some Outputs under other Outcomes). Outputs leading to Outcome 2 are designed to overcome financial and economic barriers, through which the project will support both rehabilitation of existing RE systems and installation of new RE systems in Mae Hong Son. Technical barriers are largely addressed through Outputs leading to Outcome 3. Policy and regulatory barriers will be overcome through Outputs in several Outcomes, but most importantly, the policy and regulatory barriers currently preventing widespread adoption of RE technologies will be addressed through Outcome 4.

Table 15: Project interventions matched with barriers

Barrier type	Barrier	Project intervention
Capacity (intuitional and individual)	Lack of awareness about correct operations & maintenance procedures	Output 3.4
	Lack of awareness of appropriate technology for economic/social context	Output 2.1
	Limited educational opportunities in RE	Output 3.1
	Lack of local competent human resources to design/build/install/repair	Output 3.3
	Limited capacity of RE private industry; excessive focus on government contracts	Output 3.1
	Limited capacity of government to identify and support the development and use of renewable energy resources	Outputs 1.2, 3.2, 4.1
Policy/legal	Lack of legal rights to resources	Outputs 1.4, 2.5
	Technology users not aware of warranty rights	Outputs 3.4, 4.6
	Difficulties or delays in getting reimbursement for import tax on RE equipment	Output 4.4
	Onerous requirements to be VSPP / SPP generator	Outputs 2.2, 4.6
	Metering arrangements mean that subsidies only apply to renewable energy production in excess of customer consumption	Output 4.3
	Tariff structural bias towards fossil-fuel generation	Output 4.3
Organizational	Lack of coordination among government organizations/ministries	Output 1.2
	Manufacturer Association of RE technologies does not exist	Output 3.5
	Differing local vs. national priorities	Project strategy adopts integrated planning approach used in previous initiatives
	Lack of tradition of cooperatively-owned renewable energy systems	Output 1.3; 1.4
Economic/ financial	Financial incentives (VSPP tariffs, adder, etc.) provided to RE often insufficient to motivate investment	Outputs 2.7, 4.3
	High transaction costs for small systems	Output 2.7
	Lack of access to favorable financing	Output 2.3, 2.7
	High import tax on equipment	Output 4.2, 4.4
	Low purchasing power/income/ ability to pay	Output 2.7
Technical/ environmental	Unclear/lack of data on possible renewable energy resources	Addressed through pre-feasibility studies
	Technology available in Thailand has quality control or durability challenges.	Output 3.5
	Lack of proven cases	Project strategy is to generate proven cases; Output 4.6
	High equipment/installation/ operational costs	Output 2.3

b) Project Goal, Objective, Outcomes and Outputs/activities

The **Project Objective** is "To overcome barriers to the provision of Renewable Energy (RE) services in integrated provincial renewable energy programmes in Thailand". This will contribute to the broader **Goal** of reducing GHG emissions in Thailand. Importantly, it will also contribute to the **Goal of Thailand's GEF strategy**, which is to mobilize GEF resources in support of the implementation of Sufficiency Economy principles, as enshrined in the 10th National Economic and Social Development Plan.

In the descriptions of Outcomes and Outputs, below, indicative activities are noted. During the project Inception Workshop, and subsequently during annual planning workshops activities will be further refined.

Outcome 1: Strengthened institutional, organizational and social capacity results in planning, management and implementation of integrated RE programmes in MHS, Chiang Rai, Chiang Mai and Tak

Some of the major barriers to the development of sustainable RE systems in Thailand relate to institutional and organizational shortcomings. For example, the failure of energy planning to be reflected in current provincial planning in Mae Hong Son is due in part to the fact that the Ministry of Energy does not have a local office in the province. Instead, energy planning is conducted from Chiang Mai and as a result the PAO and Ministry of Energy do not coordinate and integrate their planning processes.

Equally, although DEDE and others have undertaken numerous initiatives to promote renewable energy systems, especially micro-hydro, many of these systems have failed, in large part because there is insufficient knowledge and experience, from the village level to regional levels, on project implementation, operation and repair. Another problem is that due to cumbersome ownership arrangements, as assets built with government funds cannot be transferred directly to non-government ownership, communities often do not feel that they have clear ownership of the units. Government regulations limiting the transfer of assets developed with government funds to non-governmental agencies such as community groups is a major barrier to more widespread development of RE systems.

Consequently, Outputs contributing to this Outcome will address these institutional and organizational barriers so as to build the social capital to allow development and sustainable management of RE systems in MHS.

Output 1.1 Integrated provincial RE plans prepared

Although the project seeks to mobilize communities and enterprises to develop locally appropriate and financial viable RE systems, the current system of development planning in Thailand, which involves both top-down and bottom-up planning, means that the promotion of RETs needs to be integrated into provincial planning. The PAO's Local Development Officer needs to be exposed to the concepts and practicalities of RETs in order to assist in sensitizing TAOs to the potential for RETs to offer financial benefits to communities and to local enterprises. All levels of PAO and the local Ministry of Energy office need to work together to ensure integration of energy planning into provincial development planning. In stakeholder consultations during the PPG, both parties committed to achieving these results. Activities leading to this Output include:

- Organization and conduct of workshops for provincial and local governmental staff, community leaders and local entrepreneurs on RETs in general, benefits, costs and practical constraints
- Organization and conduct of workshops for relevant stakeholders (incl. provincial and local governmental staff, community leaders and representatives of local entrepreneurs) to formulate

integrated provincial RE plans (the results of the resource assessment studies under output 2.5 will form an input, amongst other things, to this activity)
- Establishment of a local Ministry of Energy office to facilitate cooperation between the Ministry of Energy with other provincial and local governmental institutions.

Output 1.2 Strengthened mobilization and co-ordination mechanisms

During the PPG, a multi-stakeholder provincial working group in MHS was established to guide the project design. This working group proved effective in bringing together stakeholders who had previously had relatively little contact. During the project this mechanism will be formalized and initiated in other provinces. In particular, similar working groups will be developed at the tambon level to assist in identification of RE options and to promote effective coordination of the top-down and bottom-up planning processes. Activities leading to this Output include:

- Establishing of formal agreements on administration and activities of provincial working groups
- Organization of regular meetings of the working group to support new policies and approaches
- Developing tambon working groups in at least 20 tambons in the province
- Developing village-level groups to promote local energy planning

Output 1.3 Institutional arrangements for cooperatively-owned and PPP renewable energy systems

The lack of institutional arrangements to promote community owned RE systems is a major barrier to wider application of RETs. Virtually the only management model applied in Thailand to date is Government BOO (Build, Own, and Operate), apart from private sector participation in the SPP and VSPP schemes, of which none is happening in MHS. So far about sixty village-micro-hydro systems have been built as DEDE-village joint ventures. The DEDE supplies expertise and capital equipment such as turbine, pipe, generator, transformers, and wires. Villagers supply labor and local materials such as rock, sand, and trees. These systems have been built as “stand-alone” in off-grid locations typically at least 5 km from existing PEA lines. They are typically 15 to 30 kW. Over time, PEA’s grid expands into villages that have micro-hydro systems. In most cases the micro-hydro systems are abandoned when the PEA expands into the area.

Some villages are interested in keeping their system running and selling electricity back to PEA under the VSPP program. Technical challenges are relatively minor: installing appropriate relays to safely allow synchronization is a standard procedure and equipment is readily available. The bureaucratic challenges have been more significant: the DEDE cannot transfer ownership to the village cooperative because of laws that restrict the transfer of government assets to collections of individuals. A solution is to transfer ownership to the Tambon government, and work out a revenue-sharing agreement between the Tambon and the cooperative. This is underway in one village, Mae Kam Pong, in Chiang Mai province but the process has taken several years, and no other villages have dared to try it.

Transferring ownership from DEDE is important because DEDE hydropower plants sell electricity at only 1.1 baht/kWh due to a long-standing agreement between DEDE and PEA. Villagers would rather see the project transferred to the village cooperative, and have electricity sold under the VSPP laws and subsidy adder, which provides revenues in excess of 3 baht/kWh on average.

Appropriate ownership and management models might vary by technology. For example, an appropriate ownership model for SHS might be household private ownership. For micro-hydro systems, a community-based ownership model might be appropriate, whereas for biomass systems, community-business joint ownerships models might apply. Therefore, activities required to achieve this Output include:

- Analysis of current ownership and management models of RE applications in Thailand

- Development of proposals and guidance for different types of (technology-specific) new ownership and management models
- Preparing guidelines and draft legal agreements concerning operation and management of different RE systems under different ownership models
- Development of agreements between specific partners to develop RE applications under new ownership models
- Development of financing arrangements (loans, equity) for initial capital costs.

Output 1.4 Local entities with strong leadership to plan, develop and manage RE systems

A lesson learnt from existing RE systems in various parts of Thailand is that the systems are much more sustainable if led by strong local leaders supported by strong community organizations. Therefore, in identifying potential ownership models under Output 1.3, one of the criteria to be applied in identifying community partners will be the quality of leadership and existence of strong community organizations. However, as it is unlikely that sufficiently strong leadership will exist in every case, activities leading to this Output will focus on developing and strengthening local leadership. Thus, activities include:

- Sharing of lessons learned and past experiences in Thailand regarding RET applications
- Study tour for identified and selected officials, community leaders and local entrepreneurs to learn from best practices and past experiences in other parts of Thailand
- Development of local energy plans, as a component of local development planning

Outcome 2: **Financially sustainable RE systems operational in MHS, Chiang Mai, Chiang Rai and Tak**

The social capital built through improved institutional and organizational capacity developed under Outcome 1 will permit the renovation of existing RE systems in MHS, Chiang Mai, Chiang Rai and Tak as well as the development and application of new RETs' addressing both on-grid and off-gird electricity technologies and non-electrical technologies. GEF funding will be used only for the support to the development of on-grid systems, with co-financing supporting the other technologies. Among the barriers to sustainable RE systems are access to knowledge and financing, including concessional loans. These barriers will be addressed through Outputs resulting in this Outcome.

Output 2.1 Awareness of all stakeholders involved in RE project regarding social, economic and environmental costs and benefits of RE systems enhanced

The first step in establishing sustainable RE systems is to ensure that all stakeholders involve in a RE investment are aware of the social, economic and environmental costs and benefits of the RE systems. Local leadership and organizations will have been developed through Outcome 1, but sustainability depends on equitability, so there is a need to ensure that all shareholders in whatever ownerships models are pursued have a thorough understanding of the issues associated with RE technologies. Consequently, activities leading to this Output include:

- For identified potential RE project investments sites: conduct of awareness raising sessions within communities about RET applications and the potential project
- Dissemination of information on RET applications, benefits and access to technical support and financial resources (e.g. via roving units)

Output 2.2 Operational guidance on SPP (RE)/VSPP and other schemes disseminated among stakeholders

Thailand's SPP and VSPP schemes offer attractive opportunities for income generation through the development of grid-linked RE systems. However, limited uptake of these opportunities is related to

an information gap on how to take advantage of the opportunities offered by the schemes. The project will rectify this situation for communities located on or close to the grid where sale of surplus electricity production is feasible. Activities leading to this Output include:

- Preparation of recommendations for improvements to current policies/incentives and suggestions for new policies/incentives promoting RE application, including financial and fiscal incentives
- Preparation of socially appropriate informational materials to supplement the official sources of information on the schemes which are not easily understood by most potential participants
- Conduct of training courses on the SPP and VSPP schemes and the implications of participation

Output 2.3 RE systems installed under previous initiatives rehabilitated

Previous initiatives in MHS have mostly focused on off-grid systems, particularly the large number of solar units distributed by the Ministry of the Interior. The high failure rate of these units is partly due to the use of failure-prone equipment that was not adequately field-tested in village conditions. One aspect of rehabilitation involves retrofitting failure-prone equipment with robust alternatives. Another cause of high system failure rates is due to the failure of the programme to train participants in their maintenance, the failure to provide for repairs and service, and ambiguities over ownership of the equipment. Rather than simply repairing broken units, which would only return the situation to the time of original installation without fixing these basic problems, the project will built the capacities to repair existing units. Activities include:

- Identification, testing, and providing information on robust alternatives to failure-prone equipment.
- Conduct of training courses in repairs and maintenance of RE systems, to stimulate local people to maintain systems and establish repair services (links with vocational institutes will be established, see also output 3.3.)
- Negotiation and finalization of clear ownership arrangements for the systems
- Provision of trainings on loan management
- Provision of loans to optimize performance of the units within each community

Output 2.4 Off-grid renewable energy electrical systems to local communities established

DEDE has already identified at least 12 potential sites for off-grid micro-hydro developments. The project will assist DEDE in learning lessons from past experiences which suffered high failure rates to ensure that new off-grid units are sustainable. For example, identifying and employing robust varieties of equipment, tariff arrangements (marginal-pricing or peak-load based) that address village-mini grid constraints while preserving goals of equitable service for all the new forms of ownership models developed through Output 1.3 will be used, and greater attention paid to local capacity and the development of strong community organizations to manage the installed systems. Feasibility studies will also address not only technical but also social and financial issues.

The majority of activities under this Output will be funded through co-financing, but where feasible, activities will be combined with those relevant to Output 2.5 (see below). For example, activities to build strong community organizations will be similar whether dealing with on-grid or off-grid communities. Thus, activities leading to this Output include:

- Preparation of resource assessment studies
- Preparation of comprehensive (technical, social, environmental and financial) feasibility studies for off-grid RE systems
- Design and conduct of training courses in community organization and the technical and financial skills required to manage the off-grid RE electrical systems

- Provision of support to/advice on planning, design, construction/installation and commissioning of equipment, where feasibility studies and community development indicates high probability of success
- Provision of technical support/advice to participating communities/local businesses in operation and maintenance of the systems

Output 2.5 Grid-linked RE electrical systems established consistent with integrated provincial development plans

Various types of grid-linked RE systems will be supported by the project. The first type will be hydro systems, including community-based systems. The second type will be biomass based systems owned and operated by local businesses such as hotels, rice and wood mills and other agricultural processing facilities, possibly in partnership with local farmers or municipalities. In both cases, the activities will be similar as in output 2.4 i.e. resource assessment studies, the preparation of comprehensive feasibility studies, governmental officials and community capacity building activities, support to installation of systems and technical support for operation and maintenance. Thus, the activities leading to this Output will largely mirror those for Output 2.4.

Output 2.6 Non-electrical renewable energy systems (e.g. charcoal kilns, biodiesel) promoted

The project strategy is to promote a comprehensive and integrated approach to promoting renewable energy. This approach is based on lessons from experiences in other parts of Thailand, which indicated that compartmentalization of electricity generation from broader issues of community development will result in failure (a lesson reinforced by stakeholder consultations during the PPG). This means that, in addition to the provision of on-grid electricity from RE sources (Output 2.5) and off-grid electricity generation (Output 2.4), the project will also promote non-electrical renewable energy applications. Analyses of energy use show that generation of e.g. heat in traditional ways (e.g. biomass burning) or charcoal making generates significant GHG emissions.

The project will apply methodologies developed in other parts of Thailand, for example, through the PRO-SE programme, to support Local Energy Planning and the introduction of RE energy sources. For example, modern charcoal production techniques can result in much higher quality charcoal, which generates less CO_2 and the strong greenhouse gas CH4, both in production and in use. Similarly, there are various opportunities for production of biodiesel where feedstock is cultivated in a sustainable way, and experiences in other parts of Thailand demonstrate that local people can benefit from substantial incomes by specializing in biodiesel production. Activities leading to this Output include:

- Development of Local Energy Plans (which include the promotion of non-electrical and electrical RE applications) that are integrated with local development plans
- Provision of technical support to the introduction of non-electrical renewable energy technologies in communities
- Sharing of lessons learned of the application of non-electrical renewable energy systems among participating communities

Output 2.7 Access to concessional loans facilitated

Another significant barrier to the use of RETs is access to funding. This is particularly important because equipment required for RETs is usually not cheap. The project will seek to create conditions such that stakeholders, such as communities and businesses have access to cheap loans that can be used to develop RE systems. This output will be achieved with support from BAAC. Activities required under this Output include:

- Preparation of analysis of current RE loan management practices and policies in Thailand

- Preparation of guidance and development of new approaches for loans to local businesses and communities
- Preparation of institutional arrangements for small loans to stakeholders such as communities and businesses
- Conduct of awareness raising campaigns and training in loan management
- Dissemination of information on the loan programme
- Provision of support/advice on the administration and management of the loans
- Management of loan portfolio
- Trainings on credit management

Outcome 3: Technical support is available locally for the development, management and maintenance of RE applications in MHS, Chiang Rai, Chiang Mai and Tak

Through Outcome 2, electrical (on- and off-grid) and non-electrical RETs will be introduced to MHS, Chiang Mai, Chiang Rai and Tak and the project will provide technical support/advice to the management of these systems. However, in order to ensure sustainability, and to overcome a number of identified barriers, Outputs under Outcome 3 will build the technical capacity to produce, distribute, manage, maintain RE systems.

Output 3.1: RE curricula for vocational training institutes targeting private service providers and others developed and officially approved

Throughout Thailand there is an extensive network of vocational training institutes, providing practical skills training to local people at minimal cost. However, in the Northern provinces of Thailand, none of these institutions offer training in construction, maintenance and repair of equipment used in RE systems. The project will therefore work with local and national vocational institutions to introduce such courses and develop officially approved curricula. The course will be particularly targeted at catalyzing the formation of local businesses undertaking such activities, which will be able to provide service to owners of RE systems much more promptly and at much lower cost than is currently the case – another identified barrier to sustainable RE systems. This output will be achieved with support from EGAT.

Activities leading to this Output include:

- Preparation of analysis of current curricula in vocational institutes
- Development/improvement of RE curricula in partnership with local vocational institutes (focusing on design, engineering, manufacturing, installation, repair and maintenance of RE systems)
- Dissemination of information about the availability of RE courses
- Mobilization of technical expertise to support initial courses and to develop local teaching skills

Output 3.2 Completed training in business, financial and resource management of RE systems

Sustainable operation of RE systems, and the development of local businesses to support such systems, requires training not only in business and financial management, but also in resource management. This is particularly clear in the case of biomass systems, where ideally a constant supply of raw materials, often from diverse sources, needs to be developed and managed. Therefore the project will provide training in business, financial and resource management. Also information on examples of successful RE applications in Thailand and other countries will be disseminated. Activities include:

- Provision of trainings in business, financial and resource management of RE systems to managers of RE applications

- Integration of business, financial and resource management courses in existing and new RE curricula
- Provision of support to stakeholders facing challenges in business, finance and resource management of RE systems
- Preparation of information materials (AV materials) to provide examples of successful examples of RE applications

Output 3.3 Completed training in maintenance and repair of RE systems

There is a clear need to train operators, technicians and entrepreneurs in maintenance and repair of RE systems. This output will be achieved with support from EGAT.
Activities under this output include:

- Conduct of technical training courses in repairs and maintenance of RE systems (including SHS, hydro and biomass based systems); to stimulate stakeholders to maintain systems properly and establish repair services. (links with vocational institutes will be established)
- Providing advice to stakeholders facing challenges in technical maintenance, repair and operations of RE systems
- On the job training and training in repair and maintenance in RE power facilities of EGAT
- Design of sustainable technical training programs that can be implemented after the project.

Output 3.4 Disseminated RE Technology/ information

While major repairs of RE equipment may require trained specialists, much of the on-going maintenance can be carried out by the owners/operators themselves. The project will therefore prepare and disseminate information on the different RE technologies and requirements for maintenance and repair. Activities leading to this Output include:

- Preparation of appropriate information materials
- Dissemination of materials (e.g. via technical roving unit)

Output 3.5 Technically capable and skilled local RE technology equipment manufacturers increased

One of the identified barriers to wider adoption of RE technologies is that very little of the equipment is manufactured in Thailand. Not only does this add to the cost, but it also means that expertise in maintenance and repairs is not locally available. The main company involved in micro-hydro equipment manufacture is a small workshop, the "Rong Klung Muang Rae Lae Usahagam" in Chiang Mai. This company has essentially one client: the DEDE. The equipment produced seems to work fairly well (but could do better – systems often can only function at a fraction of their rated capacity). Furthermore, the Rong Klung has capacity to build only a few units per year, and the technologies they use have changed little over the past 20 years. Prices would be lower and quality higher if there was competition. Under the VSPP program, Thailand could support hundreds of installations per year. Consequently the project will:

- Provision of support to domestic manufacturing of RE equipment, such as solar panels and solar water heaters
- Creating and establishment of a RE manufacturers association
- Provision of trainings on establishing and operating SME (RE technology manufacturers)

Outcome 4: **Policies facilitate up-scaling and replication of RE systems in rural Thailand**

New concepts and approaches will be developed under Outcomes 1-3. Mae Hong Son was selected by the government of Thailand to pilot many of the interventions because it is a poor province that is

particularly suited to the development of RE systems. It has also been identified as a province where the principles of the Sufficiency Economy will be piloted. Activities under component 1 to 3 will also be implemented in Chiang Rai, Chiang Mai and Tak. The Objective of the project is "To overcome barriers to the provision of Renewable Energy (RE) services in integrated provincial renewable energy programmes in Thailand". This requires replication and scale-up of activities piloted in Mae Hong Son and other Northern provinces to the rest of the country. Outputs under Outcome 4 will focus more on the replication to the rest of the country. It is envisaged that the experiences gained and new concepts and approaches developed will be endorsed by the government (e.g. in policies) and applied elsewhere in Thailand.

Output 4.1 Centre of Learning in MHS promoting RE as part of the Sufficiency Economy established

As noted previously, Mae Hong Son has been identified as a province where the principles of the Sufficiency Economy will be piloted, and this is partly in response to enthusiastic support from local authorities – the governor and PAO – for the Sufficiency Economy. The project will support the development of a Centre of Learning in MHS with a focus on the role of RE in the Sufficiency Economy.

Activities leading to this Output include:

- Identification, selection of location and establishment of Centre of Learning
- Negotiations with project owners of RE systems to allow access for learning purposes (to pay visits to the sites)
- Design of RE exhibits and information
- Organization of study tours of identified key stakeholders in Thailand to MHS (e.g. provincial governors and heads of PAOs)
- Provision of support to the establishment of a database with information collected during the project (e.g. local manufactures of RE applications, resource assessments, stakeholders, etc.)
- Preparation of a manual/handbook on RE applications
- Preparation of official publication to showcase good examples and lessons learned from the project

Output 4.2 RE applications included prominently in government energy programmes

Government agencies often produce conflicting messages regarding RE. For example, while policy targets have been clearly stated, there are also major initiatives to build new fossil-fuel fired power stations and build new pipelines and other infrastructure for importation of fossil fuels for electricity generation. The project will work with all major government stakeholders to ensure that policy and programmes are consistent, and to promote RE as a major solution to Thailand's growing energy needs. Activities include:

- Establishment of an inter-Ministerial Committee on RE
- Analysis of all current government programmes, concerning promotion of renewable energy applications and potential for substitution of fossil-fuels by RE sources
- Preparation of recommendations for improvements to current policies/schemes and for new policies/schemes, based on the experienced gained in MHS and other provinces, will be put forward
- Establishment of a regular reporting system (combined with Output 4.4)
- Encouragement of adoption of planning practices that incorporate fair consideration of externality costs of various technologies, and consider renewable energy and energy conservation on a level-playing field with conventional fossil fuel approaches

Output 4.3 Flexible subsidies / tax incentives revised and promoted

Analyses of the current tariff and subsidy systems in the SPP and VSPP schemes suggest that they are not adequate to provide a real financial incentive to potential participants. The Ministry of Energy is scheduled to review the tariff and subsidy system. Consequently the project will work with the Ministry to ensure that the revised tariff and subsidy system makes the installation and operation of RE systems more, rather than less financially attractive. Required activities include:

- SWOT Analysis of current system
- Stakeholder consultations with current and potential participants
- Identification of improvements to current scheme and economic and financial analyses of options
- Design of a revised tariff and subsidy system
- Provision of trainings on policies/incentive schemes for RE systems
- Provision of assistance in government in endorsement of the new system

Output 4.4 Transparent system of government accountability on RE promotion established

Some of the barriers to sustainable RE systems relate to processes that are not transparent. For example, there is a high import tax of 30% on RE equipment. Although this tax is theoretically refundable, it is based on a "pay upfront and reclaim later" system, but the "reclaiming later" element is uncertain and difficult. Also, although government policy on RE is clear, actual progress towards targets is unclear.

Thailand has a strong NGO sector. Historically there has tended to be a hostile relationship between government agencies and NGOs, who are often viewed as interfering. In many countries this "traditional" attitude has changed dramatically in recent decades as it has been recognized that NGOs can play a very positive role, and in fact can be strong allies of government agencies that may face an "uphill battle" to defend budgets and secure adequate resources in the face of countless competing claims. While this more enlightened relationship between NGOs and government agencies is still relatively under-developed in Thailand, attitudes are moving in that direction. The project will therefore build on such initial momentum as exists to introduce a system of public sector monitoring that will clarify processes relating to, for example, refund of tax payments, and track progress towards stated targets. Activities leading to this Output include:

- Development of a cooperative government-NGO partnership form monitoring RE development
- Establishment of an information dissemination process – e.g. publications
- Agreement on a work plan
- Regular assessment and reporting on implementation of incentive (schemes) for RE initiatives

Output 4.5 Policy makers that support RE development and application programs

Naturally, there is broad awareness within the Ministry of Energy about the opportunities and benefits of RE. However, other policy makers, who may be in a position to counteract measures to promote RE, may not be as aware of the potential environmental, societal and economic benefits. Furthermore, most provincial governors also do not have high levels of awareness of these issues and are therefore not always supportive to the development of RE systems. The project will therefore support the establishment of awareness-raising campaigns by the government, targeting provincial and central policy makers. Activities include:

- Assessment of awareness-raising needs
- Provision of support to the design of awareness-raising programmes
- Assessment of impact of awareness raising programmes and recommendations for adjustments of programmes (if required).

Output 4.6 a "VSPP association" consisting of VSPP practitioners, academics, NGOs and government agencies established

Past and current RE initiatives in Thailand have been fragmented and uncoordinated. As a result, lessons have not been effectively learnt; there has been wastage of resources and duplication of efforts. The current project represents the single largest coordinated effort to promote RE in an integrated fashion in Thailand. It is therefore very important that lessons are effectively learnt. The VSPP scheme is a very important financial scheme to promote small RE applications and an opportunity for many project developers. The project will therefore promote exchange of information through the establishment of a "VSPP Association", consisting not only of VSPP practitioners, but also of academics and NGOs. Activities include:

- Initiation of the Association – development of rules of membership and of procedures, etc.
- Formation of the Association
- Holding of regular meetings
- Processing and dissemination to a broader audience of findings and lessons derived through the activities of the Association

c) Project Indicators, Risks and Assumptions

At the level of the **Project Goal and Objective**, impact indicators are:

- % increase of in RE-based power generation capacity in MHS by EOP
  Justification: This is a direct impact indicator of change in the energy generation pattern in Mae Hong Son achieved by the project.
- GHG emissions reduction in MHS by EOP
  Justification: This is a measure of total GHG emissions savings that will be achieved in the country as a whole as a result of the project and its replication and scale-up strategy

At the level of Outcomes, performance indicators are:

Outcome 1:

- Acceptance of an alternative RE management model
  Justification: The project strategy is to overcome barriers, including capacity barriers that have restricted alternative models of RE management. It is recognized that a single model will not suffice for all situations. This indicator measures success in terms of the diversity of situations through which RE systems can be established.
- Number of communities/businesses planning or operating RE systems (in cooperation with utilities/government institutions) by EOP
  Justification: The project seeks to mobilize local commitment to RE technologies appropriate to local environment and socio-economic conditions. This indicator measures the level of commitment in Mae Hong Son.

Outcome 2:

- Increase in invested amount for RE in MHS (all sectors)
  Justification: A significant barrier is the amount of, and access to financial resources for establishing RE systems.
- Amounts available in the form of micro-credit for communities/businesses wishing to establish RE systems
  Justification: Micro-credit is a proven instrument in catalyzing community/local business development in numerous areas, including energy planning.
- Village/community/local business revenues from grid-connected RE systems

Justification: Lessons from previous initiatives have demonstrated that sustainable financial benefits to local communities/businesses/villages are a major factor in maintaining commitment to RE technologies.

Outcome 3

- Improved RE 'customer' satisfaction rate
  Justification: Key barriers to sustainable RE systems have been lack of understanding of maintenance procedures and lack of access to service, such that break-downs occur much more frequently than they should and repairs are very difficult to achieve. This indicator measures changes in attitude among rural communities, local businesses, utilities in response to improved maintenance and service.
- Reduced failure rate of installed equipment
  Justification: This indicator is a direct measure of improvements resulting from training in maintenance of equipment.
- Service response time for RE equipment repair
  Justification: This indicator is a direct measure of improved performance of RE service suppliers, which is important for maintaining commitment to the RE technologies.

Outcome 4:

- Adoption of project methodology in other provinces
  Justification: This is a direct measure of the success of the replication and scale-up strategy supported by this Outcome
- Support for RE among the general public
  Justification: Increased support among the general public will promote sustainability and encourage additional government support to RE.

Risks and Mitigation

Based on the pre-feasibility assessment during the project preparation, the overall project risk is low. The project is designed to facilitate close coordination and consultation of the relevant stakeholders in each of the proposed activities. Government agencies (particularly those with the mandate to promote renewable energy) have committed to financially support the project and use part of their budget in the next 5 years to co-finance this project. At the inception stage, the project risks and assumptions will be reviewed; also, a detailed risk management strategy for project implementation will be prepared. During project implementation, risks escalation will be monitored and reported to the project board

Table 16: Summary of Risk Assessment and Mitigation measures for *Promoting Renewable Energy in Mae Hong Son* Project

Risk	Level of Risk	Mitigating Actions
Political instability and institutional uncertainty - this risk is associated with the recent creation of new government agencies, the possibility of future re-structuring, and the conflicting and overlapping mandates of government agencies that can result from such a process. This might create a situation in which government agencies do not work effectively together when such	Low Moderate	• The project applies the country's decentralization strategy in demonstrating the pioneer RE province at the local level which is more stabilized and averting impact from government reshuffling. • As to guarantee government and national policy support to the project, co-financing letters have been obtained by the departments under the Ministry of Energy including the national power generation authorities.

Risk	Level of Risk	Mitigating Actions
cooperation is needed in order to attain the project objective.		
The NGO-led project may jeopardize government's role in incorporating policy implication of the project	Low	• TEI is a long-established and well- respected national NGO which has a history of building effective cooperation among diverse government agencies. • The project's NGO execution modality allows flexibility and efficiency in coordinating multi-stakeholder across agencies and help proving the effectiveness of government policy implementation on the ground. • The project design process explicitly addresses this risk by building a multi-sector consortium of project partners, including Government, NGOs and CBOs to help avoid any likelihood of direct government agency non-cooperation.
Ineffective multi-stakeholders coordination – the project involves various stakeholders and requires intensive coordination both between the central and local government agencies; and among stakeholders at the local level.	Low	• A multi-stakeholder provincial working group was established during the project preparation period to guide the project design. This mechanism will be formalized during the project implementation to ensure effective coordination among local stakeholders. • The project board comprising beneficiaries, key drivers and project assurance of the project provide consultative ground, including check and balance mechanism to ensure good coordination and result-based management •
Lack of local ownership and insufficient community participation several lessons learnt from past attempts points out that the failure in promoting renewable energy use at the local level is due largely to the lack of ownership and community participation. This is one of the major barriers the project aims to overcome, and the one that largely determines the success of the project. It needs to be handle carefully to integrate community participation into the planning, developing, and managing the RE system.	Low	• The inception workshops and selection process of project demonstration sites will be designed to ensure public participation from the planning process. • During the project inception period, all project partners at the national and local level will identify roles and responsibility at project implementation level which include need analysis and contribution (in kind and in cash) to project activities within a definite timeframe. • Multi-stakeholder working groups will be established at the Tambon level in each demonstration site. • The gender-mainstreaming plan is prepared to make sure that women also are one of the major stakeholders.
Lack of financial incentives – the project intervention to overcome the financial barriers is relatively new and poses a challenge to the success of the project.	Low	• The project intervention to overcome the financial barrier is designed with a comprehensive approach at policy level to provide various options to make the use of renewable energy financially viable or even profitable. Among these measures are access to concessional loans, support on off-grid

Risk	Level of Risk	Mitigating Actions
		renewable energy supply, and incentives for rehabilitation of RE systems installed under previous initiatives. • Bank of Agriculture and Cooperatives, one of the project's key partners officially confirmed that the project is in line with the bank's policy in promoting RE. The bank has a concrete action plan and budget to provide loans to local governments and community groups.

Risk	Level of Risk	Mitigating Actions
Limitations on up-scaling and replication: one of the major concerns with regard to a demonstration project at the local level is the limited policy impacts, to upscale what has been achieved in Mae Hong Son to other provinces, and integrating it to national policy.	Low	• A province is the miniature of central government administration comprising line agencies led by the governor and with policy and action plan to be implemented. Provincial administration is therefore, the crucial entry point of the central government in transforming policy into action. Achieving the target of Mae Hong Son as the first RE province will enabling the replication of good practices in other provinces. • The project management set-up is designed to have a National Steering Committee (NSC) above the Project Board level to ensure linkages of the project outcomes and policy implication. NSC will be chaired by the permanent secretary of the Ministry of Energy. • As a long-established national NGO, TEI has developed strong connections with policy makers, through its council of trustees as well as the collaborative relationship the institute has with relevant agencies.
A limitation on project monitoring and evaluation –It is possible that there will be constraints both in technical and administrative skill in meeting all monitoring and reporting requirement by GEF.	Low	• The project management set-up designated that TEI assign or recruit a staff to be a project manager. This include both technical and administrative team whose TOR will be to closely monitor and report the project progress. Risks and issues log are required as regular reporting to the Project board. • UNDP has been rigorous in its role of project assurance and has been working closely and on good terms with TEI to ensure the on-track and on-target delivery during the project preparation period. The practice will be continued in the project implementation phase. UNDP as the project assurance will advise directly to the project board.
OVERALL	**Low**	

Expected global, national and local benefits

Expected benefits at each level and target group,

- Global/ International level: reduced greenhouse gas emissions;
- National level: more sustainable energy supply and lowered reliance on external sources;
- Provincial level: enhancement of development initiatives leading to poverty reduction and other social and environmental objectives;
- Local level: energy provision to target communities; community infrastructure improvement (social/ economic/ environmental);
- Individual level: income generation; quality of life improvement through economic benefits and increased health due to reduction in smoke inhalation (from household wood fires);
- Special needs groups and minority groups: inclusion within government programmes related to energy provision; access to new and affordable energy sources leading to increased economic and social opportunities;

See the Incremental Cost Analysis in Section II for more detail.

d) Mainstreaming Gender and Energy

During the inception stage, the concepts of gender analysis and the gender disaggregation of project activities will be introduced to all stakeholders. This will be achieved by mobilizing a gender analysis specialist, who will organize workshops, meetings and other fora to sensitize project partners to the issue and raise awareness of the potential for gender-specific interventions. A session of the Inception Workshop will focus on gender issues.

During project implementation, gender-specific issues will be addressed through institutional strengthening, technology options, technical and management training, and advocacy and replication. The Table below shows the specific project Outputs where gender will be mainstreamed in project implementation.

The project monitoring and evaluation process will mainstream gender issues by mobilizing gender experts. In particular, the mid-term evaluation team will include a gender expert. In addition, monitoring outputs such as reports and data tables will be regularly reviewed by a gender expert who will provide advice to the project team on modifications to project interventions required to mainstream gender issues more effectively.

Table 17: Mainstreaming Gender in Renewable Energy Practice

Project Output	Process	Activities	Support needed	Timeframe
Institutional Strengthening				
Output 1.1 Integrated provincial RE plans prepared	- Gender disaggregated data - GM in focused groups' energy plan	- Data collection on current / future energy needs and gender goals	- Gender disaggregated expert	Months 4 - 12
Output 1.2 Strengthened mobilization and co-ordination mechanisms	- Planning and budgeting	- Series of workshops among groups and sub-groups	- Gender disaggregated expert	Months 4-18
Output 1.3 Institutional arrangements for cooperatively-owned and PPP renewable energy	- Gender disaggregated data - Planning and budgeting	- Series of workshops among groups and sub-groups	- Gender disaggregated expert	Months 4-12

systems				
Output 1.4 Local entities with strong leadership to plan, develop and manage RE systems	- Identification of female candidates			Months 18 onwards
Technology options: Women only in particular groups and sub-groups				
Output 2.4 Off-grid renewable energy electrical systems to remote communities established	Encourage engagement of females in selected groups/ sub-groups (+, -)	- Selected female groups to implement - Apply incentives to motivate female involvement on energy technology	- Energy Gender mainstreaming expert	Months 10-40
Output 2.6 Non-electrical renewable energy systems (e.g. charcoal kilns, biodiesel) promoted	Encourage engagement of females in selected groups/ sub-groups (+, -)	- Selected female groups to implement - Apply incentives to motivate female involvement on energy technology	- Energy Gender mainstreaming expert	Months 10-40
Output 2.7 access to concessional loans facilitated	- Female financial managers	- Selected female groups to implement	- Energy Gender mainstreaming expert	Months 10-40
Technical and management training				
Output 3.2 Completed training in business, financial and resource management of RE systems	-female with more confidence - gender role changed	- Training according to needs (financing/ product)	- Gender mainstreaming trainer	Months 10-40
Output 3.3 Completed training in maintenance and repair of RE systems	-female with more confidence - gender role changed	- Training according to needs (financing/ product)	- Gender mainstreaming trainer	Months 10-40
Advocacy and Replication				
Output 4.1 Centre of learning in MHS promoting RE as part of the Sufficiency Economy established	- Increased number of sub-groups participation - Specific gender issues addressed through Learning Centre	Recruitment of women to staff Learning Centre	- Gender mainstreaming trainer	Months 24 onwards
Output 4.6 a "VSPP association" consisting of VSPP practitioners, academics, NGOs and government agencies established	- Increased number of sub-groups participation	- Sharing experience among groups/ sub-groups	- provincial officers - UNDP	Throughout project

e) Country Ownership: Country Eligibility and Country Drivenness

Thailand ratified the UNFCCC on 28th December 1994, and is eligible for technical assistance from UNDP (see Section IV for the endorsement letter of the national operational focal point).

The 10th National Economic and Social Development Plan (2007-2011) has re-applied the Sufficiency Economy Philosophy as its guiding principles for Thailand's development and administration to ensure its observation of the middle path and a more balanced development manner.

"The Sufficiency Economy is a philosophy directed by His Majesty the King as a guideline for the livelihood and practice for the people of all levels, be they the family, community and state levels all of which should follow the middle path, especially in terms of the economic development to ensure that Thailand can keep pace with the globalized world. The sufficiency can be compiled and filtered as adequacy, reasonability and good immunity, as well as self- preparedness to accept adverse impacts resulting from internal and external changes." (Source: National Economic and Social Development Board)

The 10th National Plan has defined the development guidelines under which studies, research and development of alternative and renewable energies are encouraged, and necessary campaigns and public relations for households, businesses and state's active participation are promoted. This is due to the fact that Thailand has encountered environmental changes such as droughts, floods and disruption of the ecosystem's balance. It is thus necessary to increase the efficiency in energy utilization and the promotion of alternative energies.

At the same time, the report on Thailand's Initial National Communication (INC) to the UNFCCC outlines several mitigation options, including promoting RE sources, where possible, such as hydropower, solar, biomass, etc., and supporting incentives and removal of financial barriers to promote the use of environment-friendly machines, equipments, and materials.

UNDP and the RTG have developed a partnership programme, entitled UTEP (UNDP-Thailand Environment Partnership), which is anchored to MDG #7 – ensure environmental sustainability, target 9, which aims at integrating the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources. Two of the three objectives of UTEP are:

- To increase application of renewable energy generated from local resources with efficient management and sustainable use
- To promote community-based initiatives on natural resources management and sustainable energy development aiming to further poverty reduction

In relation to the UNPAF, the project falls primarily in the Environment focus area, as it will contribute to the following three goals:

- Support Thailand's effort in achieving compliance to the various Multilateral Environmental Agreements by encouraging ratification and effective implementation of these agreements
- Support environmental governance through capacity building and public participation
- Support pro-poor and environmentally sound development policies and programmes

However, the project will also contribute to a secondary focus area, namely Governance, where it will support two of the goals:

- Support Thailand in promoting transparency and accountability in the implementation of public policy
- Support and promote decentralization and strengthen local governance

f) Sustainability and Replicability

The project is expected to be financially and institutionally sustainable. Project activities are linked to long-term national programs on energy efficiency and renewable energy utilization and to the intention of the Royal Thai Government to diversify fuel utilization and to protect the environment.

To ensure sustainability beyond the implementation period, the project would:

- Apply lessons from previous initiatives that have high-lighted both the need for an optimal approaches to the establishment of sustainable civil society institutions to support sustainable energy planning. The project therefore places great emphasis on the design and implementation of sustainable community ownership structures – see Outputs 1.2, 1.3, and 1.4;
- Address another major short-coming with previous initiatives, access to technical support and funding to pay for maintenance and repair of RE units. The project will undertake numerous activities to ensure ready access to technical support – see, for example, Outputs 3.1 – 3.4;
- Influence the regulatory framework to ensure adequate financial incentives to promote the adoption of RE systems by communities and enterprises – see Output 4.3;
- Build capacity of the central/local authorities and local communities through adequate training and technical advice (Outputs 3.1 – 3.4 and 4.1, 4.4); and
- Strengthen the awareness and understanding of the benefits of renewable energy utilization by the local population, general public and key stakeholders, and their involvement in the above mentioned activities (Outputs 2.1 and 4.5).

The Program's replicability is ensured by its robust focus on removing barriers to the development of renewable energies in rural areas of Thailand and the development and application of new concepts, endorsed by the government in policies, which will finally lead to a change in the current unfavorable investment and incentive structure and create an effective enabling environment.

Once the financial, information, institutional, ownership and implementation capacity barriers are removed and new policies/approaches endorsed by the government facilitating the uptake of RE, renewable energy development will become competitive and attract private financing to suitable resource bases throughout the country. Several Outputs will support the establishment of RE systems in other areas of the country, especially by the government endorsed new approaches (e.g. new ownership models, tariff system) and e.g. 4.1 (the establishment of RE learning centre) and 4.6 (networking among VSPP practitioners)

PART III: Management Arrangements

National Steering Committee - A National Steering Committee (NSC) will be set up to provide overall guidance, supervise, monitor and evaluate the project performance. The NSC will be chaired by the Permanent Secretary of the Ministry of Energy. NSC will comprise representatives from relevant central agencies, namely Energy Policy and Planning Office (EPPO), Department of Alternative Energy Development and Efficiency (DEDE), MONRE Office of International Environment Cooperation (MONRE-OIC), Department of National Parks, Department of Environmental Quality Promotion, Office of Natural resources and Environmental Policy and planning (ONEP), Director of Mae Hong Son Policy and Planning office, Provincial Electricity Authority (PEA), Electricity Generation Authority of Thailand (EGAT), Bank of Agriculture and Agricultural Cooperatives (BAAC), and UNDP. The NSC will meet twice a year, or as often as necessary.

The Project Board - At a more operational level, a Project Board (PB) will be set up to supervise and monitor the project delivery according to the annual work plan. The PB will comprise of:

1. Executive: Chair of the Board (Governor of Mae Hong Son)
2. Senior Supplier: will provide guidance regarding the technical and overall feasibility of the project (TEI, UNDP, and the Project Manager)
3. Senior Beneficiary: ensure the project benefits reach the intended beneficiaries (Provincial Working Groups and local government, CBOs).

The PB is responsible for making executive management decisions for the project when guidance is required by the project manager, including approval of project revisions. The PB will also provide guidance regarding the technical feasibility of the project, and ensure the realization of project benefits to the project beneficiaries. TEI will provide secretarial support to the PB.

The PB will be chaired by the governor of Mae Hong Son. Members of PB include representatives from Mae Hong Son Provincial Working Group appointed by the governor, Local Governments (PAOs, TAOs and Municipalities), Thailand Environment Institute (TEI) and UNDP. The Mae Hong Son Working Group comprises representatives from provincial line ministries, Mae Hong Son Provincial Policy and Planning division, Public Relation Office, and representatives from NGOs and CBOs in the province. Relevant UN agencies will be invited to join the Project Board Meeting. Board meetings shall be held quarterly or subject to necessity.

Project Manager - TEI, as the Project Implementing Partner, will contract a project management team led by a project manager. The Project Manager has the authority to run the project on a day-to-day basis on behalf of the Project Board within the constraints laid down by the Project Board and is responsible for day-to-day management and decision making for the project. The project manager's prime responsibility is to ensure that the project produces the results specified in the project document, to the required standard of quality and within the specified constraints of time and cost.

Responsibilities include the preparation of progress reports which are to be submitted to the members of the Project Board. The project manager will also coordinate directly with UNDP Environment Unit manager who will subsequently report to the Regional Coordination Unit of UNDP-GEF office. A monthly meeting between UNDP and the project management team will be held to regularly monitor the planned activities and their corresponding budgets in the project's Annual Work Plan (AWP).

Ad-hoc Advisory Group - This group might be established to provide technical guidance and advice on specific issues.

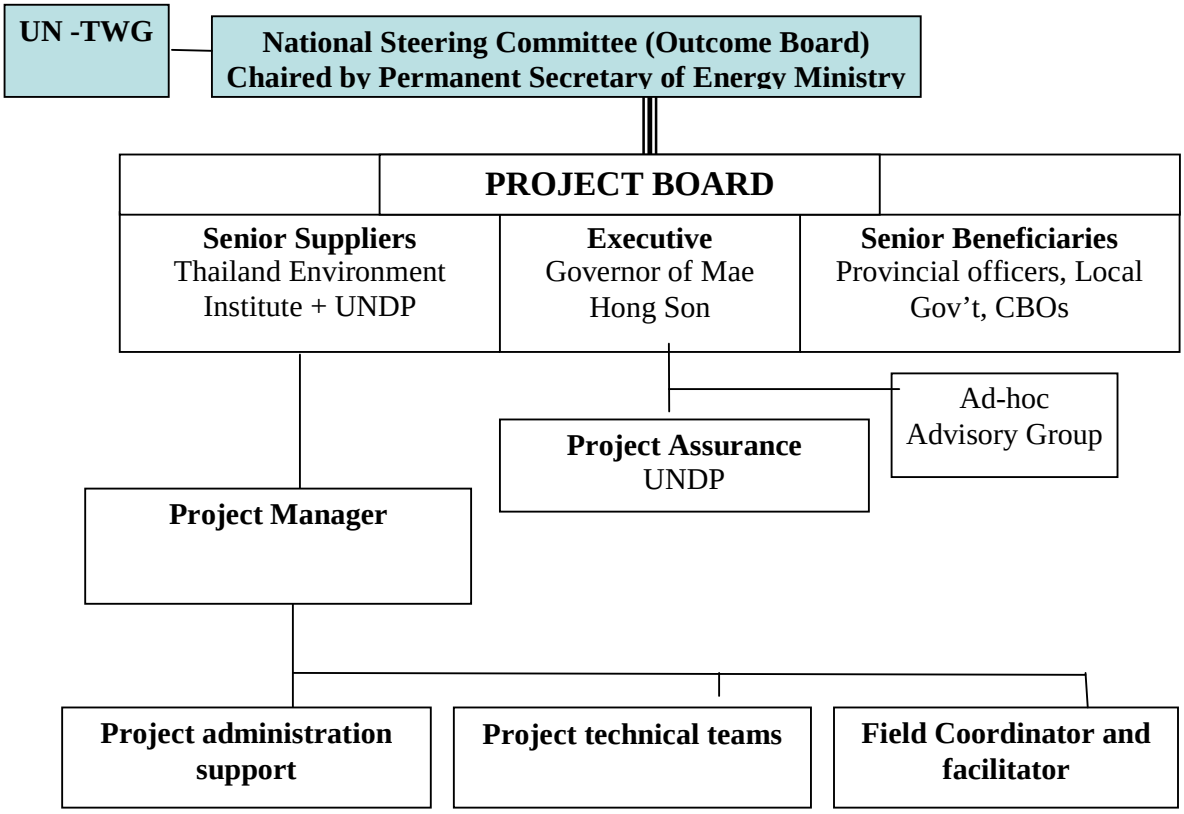
The Project Assurance - The Project Assurance function will be performed by UNDP to support the Project Board. This ensures that appropriate project management milestones are met and that the project is well managed.

In order to accord proper acknowledgement to GEF for providing funding, a GEF logo should appear on all relevant GEF project publications. Any citation on publications regarding projects funded by GEF should also accord proper acknowledgment to GEF. The UNDP logo should be more prominent -- and separated from the GEF logo if possible, as UN visibility is important for security purposes.

In line with the United Nations reform principles, especially simplification and harmonization, the AWP will be operated with the harmonized common country programming instruments and tools, i.e. the UNPAF results matrix, M&E and the Harmonized Approach to Cash Transfer (HACT).

At the day-to-day operational level, ATLAS will be used for keeping track of timely and efficient delivery of the activities and for effective financial monitoring under the AWP.

The overall programme management of the project is shown below:



PART IV: Monitoring and Evaluation Plan and Budget

Project monitoring and evaluation will be conducted in accordance with established UNDP and GEF procedures and will be provided by the project team and the UNDP Country Office (UNDP-CO) with support from UNDP/GEF. The Logical Framework Matrix in Section II, Part 2 provides *performance* and *impact* indicators for project implementation along with their corresponding *means of verification*. These will form the basis on which the project's Monitoring and Evaluation system will be built.

Monitoring and Reporting

Project Inception Phase

A Project Inception Workshop will be conducted with the full project team, relevant government counterparts, co-financing partners, the UNDP-CO and representation from the UNDP-GEF Regional Coordinating Unit, as well as UNDP-GEF (HQs) as appropriate.

A fundamental objective of this Inception Workshop will be to assist the project team to understand and take ownership of the project's goals and objectives, as well as finalize preparation of the project's first annual work plan on the basis of the project's log frame matrix. This will include reviewing the log frame (indicators, means of verification, assumptions), imparting additional detail as needed, and on the basis of this exercise finalize the Annual Work Plan (AWP) with precise and measurable performance indicators, and in a manner consistent with the expected outcomes for the project.

Additionally, the purpose and objective of the Inception Workshop (IW) will be to: (i) introduce project staff with the UNDP-GEF *expanded team* which will support the project during its

implementation, namely the CO and responsible Regional Coordinating Unit staff; (ii) detail the roles, support services and complementary responsibilities of UNDP-CO and RCU staff vis-à-vis the project team; (iii) provide a detailed overview of UNDP-GEF reporting and monitoring and evaluation (M&E) requirements, with particular emphasis on the Annual Project Implementation Reviews (PIRs) and related documentation, the Annual Project Report (APR), Tripartite Review Meetings, as well as mid-term and final evaluations. Equally, the IW will provide an opportunity to inform the project team on UNDP project related budgetary planning, budget reviews, and mandatory budget re-phasing.

The IW will also provide an opportunity for all parties to understand their roles, functions, and responsibilities within the project's decision-making structures, including reporting and communication lines, and conflict resolution mechanisms. The Terms of Reference for project staff and decision-making structures will be discussed again, as needed; in order to clarify for all, each party's responsibilities during the project's implementation phase.

Day to day monitoring of implementation progress will be the responsibility of the Project Manager, with support of project management team comprising technical experts, project coordinator and facilitator, based on the project's Annual Work Plan and its indicators. The Project manager will inform the UNDP-CO of any delays or difficulties faced during implementation so that the appropriate support or corrective measures can be adopted in a timely and remedial fashion.

The Project Manager and the Project GEF Technical Advisor will fine-tune the progress and performance/impact indicators of the project in consultation with the full project team at the Inception Workshop with support from UNDP-CO and assisted by the UNDP-GEF Regional Coordinating Unit. Specific targets for the first year implementation progress indicators together with their means of verification will be developed at this Workshop. These will be used to assess whether implementation is proceeding at the intended pace and in the right direction and will form part of the Annual Work Plan. The local implementing agencies will also take part in the Inception Workshop in which a common vision of overall project goals will be established. Targets and indicators for subsequent years would be defined annually as part of the internal evaluation and planning processes undertaken by the project team.

Measurement of impact indicators related to global benefits will occur according to the schedules defined in the Inception Workshop. The measurement, of these will be undertaken through subcontracts or retainers with relevant institutions (e.g. vegetation cover via analysis of satellite imagery, or populations of key species through inventories) or through specific studies that are to form part of the projects activities (e.g. measurement carbon benefits from improved efficiency of ovens or through surveys for capacity building efforts) or periodic sampling such as with sedimentation.

Periodic monitoring of implementation progress will be undertaken by the UNDP-CO through quarterly meetings with the project proponent, or more frequently as deemed necessary. This will allow parties to take stock and to troubleshoot any problems pertaining to the project in a timely fashion to ensure smooth implementation of project activities.

UNDP Country Offices and UNDP-GEF RCUs as appropriate, will conduct yearly visits to projects that have field sites, or more often based on an agreed upon scheduled to be detailed in the project's Inception Report / Annual Work Plan to assess first hand project progress. Any other member of the Steering Committee can also accompany, as decided by the SC. A Field Visit Report will be prepared by the CO and circulated no less than one month after the visit to the project team, all SC members, and UNDP-GEF.

Annual Monitoring will occur through the ***Tripartite Review (TPR).*** This is the highest policy-level meeting of the parties directly involved in the implementation of a project. The project will be subject to Tripartite Review (TPR) at least once every year. The first such meeting will be held within the first twelve months of the start of full implementation. The project proponent will prepare an Annual

Project Report (APR) and submit it to UNDP-CO and the UNDP-GEF regional office at least two weeks prior to the TPR for review and comments.

The APR will be used as one of the basic documents for discussions in the TPR meeting. The project proponent will present the APR to the TPR, highlighting policy issues and recommendations for the decision of the TPR participants. The project proponent also informs the participants of any agreement reached by stakeholders during the APR preparation on how to resolve operational issues. Separate reviews of each project component may also be conducted if necessary.

Terminal Tripartite Review (TTR)

The terminal tripartite review is held in the last month of project operations. The project proponent is responsible for preparing the Terminal Report and submitting it to UNDP-CO and RBAP-GEF's Regional Coordinating Unit. It shall be prepared in draft at least two months in advance of the TTR in order to allow review, and will serve as the basis for discussions in the TTR. The terminal tripartite review considers the implementation of the project as a whole, paying particular attention to whether the project has achieved its stated objectives and contributed to the broader environmental objective. It decides whether any actions are still necessary, particularly in relation to sustainability of project results, and acts as a vehicle through which lessons learnt can be captured to feed into other projects under implementation of formulation.

The TPR has the authority to suspend disbursement if project performance benchmarks are not met. Benchmarks will be developed at the Inception Workshop, based on delivery rates, and qualitative assessments of achievements of outputs.

Project Monitoring Reporting

The Project Manager in conjunction with the UNDP-GEF extended team will be responsible for the preparation and submission of the following reports that form part of the monitoring process. Items (a) through (f) are mandatory and strictly related to monitoring, while (g) through (h) have a broader function and the frequency and nature is project specific to be defined throughout implementation.

Inception Report (IR)

A Project Inception Report will be prepared immediately following the Inception Workshop. It will include a detailed Firs Year/ Annual Work Plan divided in quarterly time-frames detailing the activities and progress indicators that will guide implementation during the first year of the project. This Work Plan would include the dates of specific field visits, support missions from the UNDP-CO or the Regional Coordinating Unit (RCU) or consultants, as well as time-frames for meetings of the project's decision making structures. The Report will also include the detailed project budget for the first full year of implementation, prepared on the basis of the Annual Work Plan, and including any monitoring and evaluation requirements to effectively measure project performance during the targeted 12 months time-frame.

The Inception Report will include a more detailed narrative on the institutional roles, responsibilities, coordinating actions and feedback mechanisms of project related partners. In addition, a section will be included on progress to date on project establishment and start-up activities and an update of any changed external conditions that may affect project implementation.

When finalized the report will be circulated to project counterparts who will be given a period of one calendar month in which to respond with comments or queries. Prior to this circulation of the IR, the UNDP Country Office and UNDP-GEF’s Regional Coordinating Unit will review the document.

Annual Project Report (APR)

The APR is a UNDP requirement and part of UNDP's Country Office central oversight, monitoring and project management. It is a self -assessment report by project management to the CO and provides input to the country office reporting process and the ROAR, as well as forming a key input to the Tripartite Project Review. An APR will be prepared on an annual basis prior to the Tripartite Project Review, to reflect progress achieved in meeting the project's Annual Work Plan and assess performance of the project in contributing to intended outcomes through outputs and partnership work.

The format of the APR is flexible but should include the following:

- An analysis of project performance over the reporting period, including outputs produced and, where possible, information on the status of the outcome
- The constraints experienced in the progress towards results and the reasons for these
- The three (at most) major constraints to achievement of results
- AWP, CAE and other expenditure reports (ERP generated)
- Lessons learned
- Clear recommendations for future orientation in addressing key problems in lack of progress

Project Implementation Review (PIR)

The PIR is an annual monitoring process mandated by the GEF. It has become an essential management and monitoring tool for project manager and offers the main vehicle for extracting lessons from ongoing projects. Once the project has been under implementation for a year, a Project Implementation Report must be completed by the CO together with the project. The PIR can be prepared any time during the year (July-June) and ideally prior to the TPR. The PIR should then be discussed in the TPR so that the result would be a PIR that has been agreed upon by the project, the executing agency, UNDP CO and the concerned RC.

The individual PIRs are collected, reviewed and analyzed by the RCs prior to sending them to the focal area clusters at the UNDP/GEF headquarters. The focal area clusters supported by the UNDP/GEF M&E Unit analyze the PIRs by focal area, theme and region for common issues/results and lessons. The TAs and PTAs play a key role in this consolidating analysis.

The focal area PIRs are then discussed in the GEF Interagency Focal Area Task Forces in or around November each year and consolidated reports by focal area are collated by the GEF Independent M&E Unit based on the Task Force findings.

The GEF M&E Unit provides the scope and content of the PIR. In light of the similarities of both APR and PIR, UNDP/GEF has prepared a harmonized format for reference.

Quarterly Progress Reports

Short reports outlining main updates in project progress will be provided quarterly to the local UNDP Country Office and the UNDP-GEF regional office by the project team. See format attached.

Project Terminal Report

During the last three months of the project the project team will prepare the Project Terminal Report. This comprehensive report will summarize all activities, achievements and outputs of the Project, lessons learnt, objectives met, or not achieved structures and systems implemented, etc. and will be the definitive statement of the Project's activities during its lifetime. It will also lay out recommendations for any further steps that may need to be taken to ensure sustainability and replicability of the Project's activities.

Independent Evaluation

The project will be subjected to at least two independent external evaluations as follows:-

Mid-term Evaluation

An independent Mid-Term Evaluation will be undertaken at the end of the second year of implementation. The Mid-Term Evaluation will determine progress being made towards the achievement of outcomes and will identify course correction if needed. It will focus on the effectiveness, efficiency and timeliness of project implementation; will highlight issues requiring decisions and actions; and will present initial lessons learned about project design, implementation and management. Findings of this review will be incorporated as recommendations for enhanced implementation during the final half of the project's term. The organization, terms of reference and timing of the mid-term evaluation will be decided after consultation between the parties to the project document. The Terms of Reference for this Mid-term evaluation will be prepared by the UNDP CO based on guidance from+ the Regional Coordinating Unit and UNDP-GEF.

Final Evaluation

An independent Final Evaluation will take place three months prior to the terminal tripartite review meeting, and will focus on the same issues as the mid-term evaluation. The final evaluation will also look at impact and sustainability of results, including the contribution to capacity development and the achievement of global environmental goals. The Final Evaluation should also provide recommendations for follow-up activities. The Terms of Reference for this evaluation will be prepared by the UNDP CO based on guidance from the Regional Coordinating Unit and UNDP-GEF.

Audit Clause

The implementing partner (TEI) will provide the Resident Representative with certified periodic financial statements, and with an annual audit of the financial statements relating to the status of UNDP (including GEF) funds according to the established procedures set out in the Programming and Finance manuals. The Audit will be conducted by a legally recognized auditor of the Government, or by a commercial auditor engaged by the Government.

Learning and Knowledge Sharing

Results from the project will be disseminated within and beyond the project intervention zone through a number of existing information sharing networks and forums. In addition:

- The project will participate, as relevant and appropriate, in UNDP/GEF sponsored networks, organized for Senior Personnel working on projects that share common characteristics. UNDP/GEF shall establish a number of networks, such as Integrated Ecosystem Management, eco-tourism, co-management, etc, that will largely function on the basis of an electronic platform.
- The project will identify and participate, as relevant and appropriate, in scientific, policy-based and/or any other networks, which may be of benefit to project implementation though lessons learned.

The project will identify, analyze, and share lessons learned that might be beneficial in the design and implementation of similar future projects. Identify and analyzing lessons learned is an on- going process, and the need to communicate such lessons as one of the project's central contributions is a requirement to be delivered not less frequently than once every 12 months. UNDP/GEF shall provide a format and assist the project team in categorizing, documenting and reporting on lessons learned. To this end a percentage of project resources will need to be allocated for these activities.

Table 18: Indicative Monitoring and Evaluation Work plan and corresponding Budget

Type of M&E activity	Responsible Parties	Budget US$ *Excluding project team Staff time*	Time frame
Inception Workshop	▪ Project Coordinator ▪ UNDP CO ▪ UNDP GEF		Within first two months of project start up
Inception Report	▪ Project Team ▪ UNDP CO	None	Immediately following IW
Measurement of Means of Verification for Project Purpose Indicators	▪ Project Coordinator will oversee the hiring of specific studies and institutions, and delegate responsibilities to relevant team members	To be finalized in Inception Phase and Workshop. Indicative cost $10,000	Start, mid and end of project
Measurement of Means of Verification for Project Progress and Performance (measured on an annual basis)	▪ Oversight by Project GEF Technical Advisor and Project Coordinator ▪ Measurements by regional field officers and local IAs	To be determined as part of the Annual Work Plan's preparation. Indicative cost $15,000	Annually prior to APR/PIR and to the definition of annual work plans
APR and PIR	▪ Project Team ▪ UNDP-CO ▪ UNDP-GEF	None	Annually
TPR and TPR report	▪ Government Counterparts ▪ UNDP CO ▪ Project team ▪ UNDP-GEF Regional Coordinating Unit	None	Every year, upon receipt of APR
Steering Committee Meetings	▪ Project Coordinator ▪ UNDP CO	None	Following Project IW and subsequently at least once a year
Periodic status reports	▪ Project team	$3,000	To be determined by Project team and UNDP CO
Technical reports	▪ Project team ▪ Hired consultants as needed	$12,000	To be determined by Project Team and UNDP-CO
Mid-term External Evaluation	▪ Project team ▪ UNDP- CO ▪ UNDP-GEF Regional Coordinating Unit ▪ External Consultants (i.e. evaluation team)	$15,000	At the mid-point of project implementation.
Final External Evaluation	▪ Project team, ▪ UNDP-CO ▪ UNDP-GEF Regional Coordinating Unit ▪ External Consultants (i.e. evaluation team)	$20,000	At the end of project implementation
Terminal Report	▪ Project team ▪ UNDP-CO ▪ External Consultant	None	At least one month before the end of the project
Lessons learned	▪ Project team ▪ UNDP-GEF Regional Coordinating Unit (suggested formats for documenting best practices, etc)	$15,000 (average 3,000 per year)	Yearly
Audit	▪ UNDP-CO ▪ Project team	$5,000 (average $1000 per year)	Yearly
Visits to field sites	▪ UNDP Country Office	$15,000 (average one visit	Yearly

(UNDP staff travel costs to be charged to IA fees)	▪ UNDP-GEF Regional Coordinating Unit (as appropriate) ▪ Government representatives	per year)	
TOTAL INDICATIVE COST *Excluding project team staff time and UNDP staff and travel expenses*		US$ 110,000	

PART V: Legal Context

Pending the finalization of the Standard Basic Assistance Agreement (SBAA) between UNDP and the Royal Thai Government, the Agreement between the United Nations Special Fund, signed between the Royal Thai Government and the United Nations Special Fund on 4 June 1960, will govern the technical assistance provided by UNDP Thailand under the Country Programme Action Plan (CPAP). The project document, which forms part of the CPAP, constitutes together a project document as referred to in the Agreement between the United Nations Special Fund and the Royal Thai Government.

This document together with the CPAP signed by the Government and UNDP which is incorporated by reference constitute together the instrument envisaged in the Supplemental Provisions to the Project Document, attached hereto.

Consistent with the above Supplemental Provisions, the responsibility for the safety and security of the implementing partner and its personnel and property, and of UNDP's property in the implementing partner's custody, rests with the implementing partner.

The implementing partner shall:
a) Put in place an appropriate security plan and maintain the security plan, taking into account the security situation in the country where the project is being carried;
b) Assume all risks and liabilities related to the implementing partner's security, and the full implementation of the security plan.

UNDP reserves the right to verify whether such a plan is in place, and to suggest modifications to the plan when necessary. Failure to maintain and implement an appropriate security plan as required hereunder shall be deemed a breach of this agreement.

The implementing partner agrees to undertake all reasonable efforts to ensure that none of the UNDP funds received pursuant to the Project Document are used to provide support to individuals or entities associated with terrorism and that the recipients of any amounts provided by UNDP hereunder do not appear on the list maintained by the Security Council Committee established pursuant to resolution 1267 (1999). The list can be accessed via http://www.un.org/Docs/sc/committees/1267/1267ListEng.htm.

This provision must be included in all sub-contracts or sub-agreements entered into under this Project Document.

SECTION II: STRATEGIC RESULTS FRAMEWORK AND GEF INCREMENT

PART I: Incremental Cost Analysis

A. PROJECT BACKGROUND

Despite the government's commitment to RE, there have been constraints to the wider and more sustained application of Renewable Energy Technologies (RETs) in Thailand. For example, the Department of Alternative Energy Development and Efficiency (DEDE) has established 59 micro-hydro projects with a total capacity of 2 MW in Northern Thailand since 1979, but by the end of 2003, only 25 sites are still operational. The failures are due to the lack of involvement of the communities, and improper maintenance of the systems. In particular, investments in small-scale RE systems made with government financing are considered government assets which cannot easily be transferred to private or communal ownership. Therefore, communities have not been able to benefit financially from such systems by selling power to the national grid. Another example out of around 300,000 solar home systems for rural electrification which have been installed in Thailand, approximately only 20% are still operating. This project will overcome barriers that currently prevent widespread and sustainable utilization of renewable energy technologies for the provision of rural energy services in rural areas of Thailand. The project will focus on Mae Hong Son province, which the Ministry of Energy has identified as its target to be the first energy self-sufficient province in Thailand, in conformity with the king's sufficiency economy concept. Activities will also be implemented in Chiang Rai, Chiang Mai and Tak, provinces with similar economic and geographic situation and RE potential. Provisionally identified market barriers include those that are related to institutional and technical capacity, policy, and economic incentives.

B. INCREMENTAL COST ASSESSMENT

Baseline - National

If the present trends continue and policy changes are not specifically adopted to encourage CO_2 reduction, emissions would increase fourfold by 2020. In order to be consistent with the National Economic and Social Development Board (NESDB) evaluation on development progress during the 9th National Plan (2002-2006), it is thus of necessity to increase the efficiency of energy use and to promote alternative energy. The national target for RE as a percentage of total energy supply is set at 8% by 2011, the current achievement is only about 4%.

Thailand has introduced two innovative schemes to promote increased use of renewable energy. Thailand's Small Power Producer (SPP) laws were passed in 1992, allowing grid-interconnection and sale of electricity by private sector renewable energy or clean combined heat and power (CHP) installations of up to 90 MW per facility. In May 2002, Thailand was the first developing country to adopt net metering regulations (known in Thailand as the Very Small Power Producer (VSPP) program) that facilitate interconnection of renewable energy generators under 1MW in size. Under these regulations, generators can offset their own consumption at retail rates. If net surplus of electricity is generated, the VSPP regulations stipulate that Thai distribution utilities – Metropolitan Electricity Authority (MEA) in Bangkok and Provincial Electricity Authority (PEA) in the rest of the country – must purchase this electricity at the same tariff as they purchase electricity from the utility, EGAT.

Baseline – Provincial

Power supply in Mae Hong Son comes from grid connected power plants (hydro, solar and diesel plants) owned by the government and/or utilities, and from imports from the neighboring province (Chiang Mai) as well as from a large number of independent units using diesel, hydro and solar power. During the wet season, excess electricity production in MHS will be exported through the grid to Chiang Mai, while this same grid line serves as back-up in the dry season.

The net import of electricity by MHS was approximately 1,067 toe in 2007 (=12,386 MWh, applying the national energy mix ratios). Based on calculations using the national energy mix[7], MHS emits about 83 million tons of CO_2. Under the BAU scenario emissions will increase to 90 million tons by 2012.

During the dry season (March-May) when the hydro power plants operate with reduced capacity, diesel generators of the Electricity Generation Authority of Thailand (EGAT) are being used as backups. Demand has outgrown the capacity of the existing 22kV line, resulting brownouts (low voltage) or blackouts 2-3 times/day. These are power quality problems are especially frequent at night, and worst during periods when many people are using electricity concurrently.

Sustainable deployment of renewable energy in Mae Hong Song is constrained by a variety of factors which can be grouped into five categories: (1) Capacity (2) Policy/regulatory/legal (3) Organizational (4) Economic and financial, and (5) Technical/environmental. These barriers are common to other remote rural regions of Thailand.

The business as usual scenario for Mae Hong Son is that energy consumption will continue to grow at the predicted rate from 36,000 toe in 2007 to 40,600 toe in 2012. However, by 2010 MHS will start to import more and more electricity since the growing energy demand eventually outgrows constant energy generation.

Emission reduction calculations

Project Duration: 5 years

*The **Project Objective*** is to overcome barriers to the provision of Renewable Energy (RE) services in integrated provincial renewable energy programmes in Thailand. This will contribute to the broader Goal of reducing GHG emissions in Thailand.

Project Components:

Component 1: Strengthened institutional, organizational and social capacity results in planning, management and implementation of integrated RE programmes in MHS, Chiang Rai, Chiang Mai and Tak;

Some of the major barriers to the development of sustainable RE systems in Thailand relate to institutional and organizational shortcomings.

Component 2: Financially sustainable RE systems operational in MHS, Chiang Mai, Chiang Rai and Tak

The social capital built through improved institutional and organizational capacity developed under Outcome 1 will permit the renovation of existing RE systems in MHS as well as the development and application of new RETs' addressing both on-grid and off-gird electricity technologies and non-electrical technologies. GEF funding will be used only for the support to the development of on-grid systems, with co-financing supporting the other technologies. Among the barriers to sustainable RE systems are access to knowledge and financing, including concessional loans.

Component 3: Technical support is available locally for the development, management and maintenance of RE applications in MHS, Chiang Rai, Chiang Mai and Tak;

[7] National grid supply comprises 10% lignite, 60% natural gas, and 30% hydropower, which is partly imported from neighboring countries

Through Outcome 2, electrical (on- and off-grid) and non-electrical RETs will be introduced to MHS, Chiang Rai, Chiang Mai and Tak and the project will provide technical support to the installation and management of these systems. However, in order to ensure sustainability, and to overcome a number of identified barriers, Outputs under Outcome 3 will build the technical capacity to produce, distribute, maintain and repair equipment needed in RE systems.

Component 4: Policies facilitate up-scaling and replication of RE systems in rural Thailand;
The activities under Outcomes 1-3 deal with the promotion of renewable energy in mainly Mae Hong Son, but also Chiang Mai, Chiang Rai and Tak. Mae Hong Son was selected to pilot many of the interventions because it is a poor province that is particularly suited to the development of RE systems. It has also been identified as a province where the principles of the Sufficiency Economy will be piloted. However, the Objective of the project is "To overcome barriers to the provision of Renewable Energy (RE) services in integrated provincial renewable energy programmes in Thailand". This requires replication and scale-up of activities piloted in Mae Hong Son, Chiang Rai, Chiang Mai and Tak to the rest of the country. New policies, models and approaches developed and tried out in MHS will be promoted to be endorsed by the government.

Step 1: Determination of baseline
Given the existing institutional, organizational, financial, and technical constraints facing renewable energy development in the country, it is highly likely that market development will not occur in the short term without donor-based and long-term assistance.

The business as usual scenario for Mae Hong Son is that energy consumption will continue to grow at the predicted rate from 36,000 toe in 2007 to 40,600 toe in 2012. By 2010 MHS will start to import more and more electricity from other provinces since the growing energy demand eventually outgrows constant energy generation in Mae Hong Son. The marginal technology in the country is coal (14%) and gas-fired (71%) electricity generation.

Step 2: Determination of the GEF Alternative
With the support of the GEF project, institutional, organizational, financial, and technical barriers will be addressed, allowing the gradual scale-up of RE technologies. The activities and investments below are included in the log frame and will be monitored.

a) Over the five-year project, up to 11.8 MW of RE capacity will be supported in mainly MHS but also, Chiang Mai and Tak through capacity building that would not have occurred without the project (output 2.5). This, along with the development of new policies/approaches, will foster the beginnings of the transformation of the energy market toward one that is more conducive to renewable energy. Direct emission reductions will result from these activities. During the 5-year project, the following investment projects in renewable energy-based power generation will be implemented as demo/pilot projects showcasing the process by which the RE resource in these provinces can be effectively and in a sustainable manner, be utilized for power generation to support the livelihood and welfare of the residents of these provinces, as well as support the provinces' socio-economic development.

Table 19: List of demo investment projects on RE-based power generation

District	Sub district	Project name	RE Resource	Planned Installed capacity (MW)	Expected load factor (%)	Project Host/Owner	Investment budget (Million Baht)	Expected start of construction
Mae Hong Son Province								
Mueang	Moak Jam Pae	Huay Pong Aon	Hydro	0.11	60	DEDE	15.5	start year of operation 2011
Mueang	Moak	Mae Sa	Hydro	5.2	60	DEDE	180	start year of

District	Sub district	Project name	RE Resource	Planned Installed capacity (MW)	Expected load factor (%)	Project Host/Owner	Investment budget (Million Baht)	Expected start of construction
	Jam Pae	Nga						operation 2011
Mae Sa Rieng	Mae Sa Rieng	Mae Ka Nite	Hydro	0.89	60	DEDE	232.2	start year of operation 2011
Mae Sa Rieng	Mae Hoa	Huay Mae Sa Wan	Hydro	0.136	60	PEA	8.1	2011
Khun Yuam	Mae Yuam Noi	Mae Ko Pe	Hydro	0.03	60	DEDE	7.1	Start year of operation 2011
Pai	Pai	Huay Mee	Hydro	0.53	60	DEDE	51	2015
Pang Ma Pha	Na Poo Pom	Nam Mae Nuang	Hydro	0.04	60	PEA	6.5	2013
Khun Yuam	Mae Kee	Huay San	Hydro	0.03	60	PEA	6.5	2013
Mai On	On Nuang	Mai On	Hydro	0.07	60	PEA	7.3	2012
Hod	Boo Sa Lee	Mae Lid	Hydro	0.15	60	PEA	12.2	2012
Mae Jam	Gong Kak	Mae Kong Ka	Hydro	0.07	60	PEA	8.65	2012
Wang	Mae Win	Mae Wang	Hydro	0.015	60	PEA	11.98	2012
Mae Sod	Pra Tad Pa Dang	Huay Mae Tao Ae Sai	Hydro	0.16	60	PEA	12.4	2012
Pob Pra	Chong Kab	Huay Ban Chong Kab	Hydro	0.13	60	PEA	10.56	2012
Mae Sarieng	Pa Pae	Salween Forest Industry Plantation	Biomass residues: wood chips	1	70	PEA and Forest Industry Organization	40	2012
Mae Taeng	NA	Ban Gid Chang	Hydro	0.045	60	DEDE	11.6	2010
Mae Taeng	NA	Mon-Ngo	Hydro	0.045	60	DEDE	17.7	2010
Nam Mae Ngao	NA	Om Koy	Hydro	1.417	60	DEDE	388.3	2015
Chiang Mai Province								
Chiang Dao	NA	Khun Mae Mae	Hydro	0.320	60	DEDE	23.2	2010
Samoeng	NA	Nam Mae Joom	Hydro	0.110	60	DEDE	11	2010
Tak Province								
Tha Song Yang	NA	Hauy Mae Usu	Hydro	1.306	60	DEDE	198	2011
Total Installed Capacity				**11.804 MW**				

b) In addition, the following micro-hydropower generation plant and a community solar home system project that are currently non-operational, and are planned for rehabilitation, are also identified as potential demo/pilot projects to be showcased under the MHS Project.

Table 20: Hydropower plants and solar home systems that are planned for rehabilitation in MHS in 2010 – 2015

District	Sub district	Project Name	Source	Installed capacity	Expected load	Project Owner	Expected year of Rehabilitation

				(kW)	factor (%)		
Pa Pae	Mae Sa Rieng	Pa Pae	Hydro	10	60	DEDE	2011
Mae Hong Son	-	Rehabilitation of solar home systems	Solar	1,234*	6 hours sun per day	PEA	2010

It is estimated that currently around 80% of the 14,800 systems distributed are non-functional. The project aims to rehabilitate these and after the project the failure rate of the rehabilitated systems should be below 10%. For the emission reduction calculations, an emission factor of 1.4 tCO2e/MWh and a production/consumption ratio of 80% have been assumed. [8],[9]

D) The project aims to promote the use of non-electrical renewable energies like biodiesel and improved charcoal kilns in all communities. The emission reductions could be significant, especially in the case of improved charcoal kilns and the resulting reductions in methane emissions (GWP of 21). Methane emissions occur when charcoal is produced under sub-optimal temperature as the release of methane is directly proportional to the charcoaling temperature. The temperature and oxygen supply during charcoaling is difficult to control in traditional open-ended charcoaling kilns. In improved kilns, the conditions can be much better controlled. However, due to lack of data it is hard to come up with a reasonable estimate of the emission reductions resulting from these activities under this project. For conservativeness reasons these emission reductions are not included in the estimation below.

Step 3: Direct Emissions Reductions

Direct emission reductions are calculated by assessing the emission savings attributable to the investments made during the project's supervised implementation period.

In accordance with the guidance in the GEF GHG emissions manual, direct emission reductions can be calculated by multiplying the displaced demand for thermally produced energy (measured in kWh or MWh) by the corresponding emissions factor of the marginal technology that would supply the on-grid electricity in lieu of the project.

$CO2\ direct = E * C$ (1)

Where;

E = cumulative energy saved or substituted
C = CO2 intensity of the marginal technology or electricity saved

First, the amount of energy generated by investments made during the project must be calculated. In this project, energy generated is reported in the form of MWh. Installing grid-connected RE power provides a substitute for electricity supplied from other sources to the national grid, currently comprised predominantly of gas- and coal-fired power generation.

As a result of the project, (10.8 MW * 8760 h * 0.6 + 1 MW *8760 h * 0.7 + 10 kW * 8760 h* 0.6 + 1,234 kW * 6 h * 365 days * 0.8 = 56,764 MWh + 6,132 MWh + 53 MWh + 2,162 MWh =) 65,111 MWh of renewable energy will be produced per year.

[8] As per UNFCCC CDM EB approved CDM project activity 0182 : "Photovoltaic kits to light up rural households in Morocco", a consumption/production ratio of 80% has been assumed.
[9] In accordance with CDM modalities and procedures for Small Scale CDM project activities, approved methodology AMS I.D "Grid connected renewable electricity generation", table 1.D.1, an emission factor of 1.4 tCO2e/MWh has been selected, which is applicable to mini grids below 15 kW using diesel gen. sets with temporary service (typically 4 to 6 hours per day – 50 % load factor), which would be the most likely alternative/baseline electricity source for households in the rural areas where the solar panels are being installed.

To obtain the direct CO2 emission reductions, the cumulative thermal grid-supplied electricity saved due to the installation of RE generation capacity, and the CO2 intensity of the grid supplied electricity, are multiplied together. The grid emission factor in Thailand is 0.51 tonnes of CO2 per MWh. For the solar panels an emission factor of 1.4 tCO2e/MWh has been assumed.

This means that given the quantity of RE electricity produced, and the carbon intensity of the electricity supplied on the national grid, the total direct CO2 emission reductions occurring through the five-year project lifetime can be clearly determined. The simplifying assumption is made that all investments will have an operational lifetime of 20 years. The total direct CO2 emissions are equal to the annual emission reductions stemming from the renewable energy produced, multiplied by 20 years.

CO2 direct = E * C = 62,949 MWh * 0.51 tCO2e / MWh * 20 years = 642,080 tCO2e (2)

2,162 * 1.4 tCO2e / MWh * 20 years = 60,536 tCO2e (3)

Total: 642,080 + 60,536 = 702,616 tCO2e (4)

Step 4: Direct Post-project Emission Reductions
For conservativeness reasons, the project is not claiming direct post-project emission reductions although under output 2.7 the project will facilitate concessional loans.

Step 5: Indirect Emissions Reductions
Indirect emission reductions are long-term GHG savings achieved after the GEF project's completion. The project includes up-scaling of the activities implemented in Mae Hong Son to at least 3 other provinces. As per the GEF guidelines on GHG emission reductions, the emission reductions resulting from these activities should be counted as direct emission reductions as the activities will be implemented during the project and will be monitored in accordance with the log frame. It is very hard to estimate emission reductions due to the activities under outcome 4. As a conservative approach these emission reductions are being calculated as indirect emission reductions in the bottom-up approach. By doing so, the emission reductions are underestimated, as the indirect effects of the activities in the 3 additional provinces as well as Mae Hong Son (i.e. long term impacts on the energy sector in Thailand) are being ignored.

Approach 1: Bottom-up
The bottom-up approach aims to calculate how many times the investments made during the project might be replicated and can be calculated using the following formula:

CO2 indirect BU = CO2 direct * RF; (5)

Where;

CO2 indirect BU = emission reductions following the project close, calculated using the bottom-up methodology
CO2 direct = estimate for total direct (including post-project) emission reductions
RF = replication factor

A suitable replication factor must be determined. The results of the project will be disseminated in Thailand and up-scaling will take place in 3 other provinces (outcome 4) in Thailand. The default "influence period" of 10 years and the default replication factor for a demonstration project with capacity building is assumed; i.e. 3. This is a very conservative estimate, as indirect emission reductions are meant for emission reductions occurring after close of the project, while in this case scaling up is part of the project.

The above assumptions mean, during the implementation of outcome 4
- 35.4 MW more RE power will be installed
- 30 kW more hydropower capacity will be rehabilitation from abandoned sites
- Around 30,000 more solar power systems will be rehabilitated.

CO2 indirect BU = CO2 direct * RF = 702,616 * 3 = 2,107,848 tCO2e (6)

Approach 2: Top-down information, bottom-up methodology

The indirect impact of the project is calculated based on the market size in the country. This information is obtained through the project preparation process. Once the total market potential for renewable energy is determined it is then corrected downward to determine the top-down estimate for CO2 emission reductions caused by the GEF project.

CO2 indirect TD = CO2 TM * CF; (7)

Where;

CO2 indirect TD = emission reductions following the project close, calculated using the top-down methodology
CO2 TM = total market potential for CO2 emission reductions
CF = causality factor

The total technological and economic potential for hydro and biomass based power generation in Thailand is approx. 5,400 MW (see chapter 1.3.2 section 1, part I, A).

Table 22: Calculation of Top-Down Indirect Emissions

market potential (MW installed capacity)	**Emission factor grid (tCO2/MWh)**	**Load Factor (%)**	**Causality factor**	**Overall indirect emission reductions over 20-year lifetime of investments (t C02e)**
5,400	0.51	0.6	40%	5,790,009

In determining the GEF causality factor (i.e., the percentage of CO2 emission reductions that can be attributed to the long-term effect of the project through overcoming market barriers) we must examine other likely influences on the market. In the case of Thailand, there are planned and ongoing projects that will impact the market for RE technologies. Therefore a conservative causality factor of level 2 "modest and substantial," GEF causality = 40 percent has been assumed.

Direct Emissions Reductions

Part of the outputs of the project will be the following investments:

- By the end of the project, at least 11.8 MW additional RE generation capacity (hydro and biomass) installed;
- By the end of the project 1 hydropower installation (10 kW), which currently is abandoned, have been rehabilitated;
- By the end of the project 70% of the solar panels distributed by the Interior Ministry via PEA, of which currently around 80% are non-operational, have been rehabilitated.

These activities will result in direct greenhouse gas emission reductions during the project's implementation phase. As a result of these activities during the project implementation period of five years, direct greenhouse gas emission reductions totaling 702,616 tonnes of CO2 equivalent will be achieved over the lifetime of the investments of 20 years. In the non-GEF case, these energy needs

would be satisfied by mainly coal- and gas-fired power generation comparable to the current national power generation portfolio, with an emission factor of 0.51 t CO2e / MWh.

Emission reductions due to promotion of more efficient charcoal kilns and use of biodiesel have not been accounted for.

The project is not claiming direct post-project emission reductions although under output 2.7 the project will facilitate concessional loans.

Indirect Emission Reductions

Using the GEF bottom-up methodology, indirect emission reductions attributable to the project are 2,107,848 tonnes of CO2 equivalent. This figure assumes a replication factor of 3.
It should be noted that the emission reductions resulting from the activities under outcome 4 have conservatively been considered as indirect emission reductions and not, as per GEF guidelines, as direct emission reductions.

Using the GEF top-down methodology, indirect emission reductions attributable to the project are 5,790,009 tonnes of CO2 equivalent. This figure assumes that the total technological and economic potential for hydro and biomass based power generation in Thailand is approx 5,400 MW over 10 years, and a conservative project causality factor of 40 percent (level 2).

Alternative

The project will adopt an approach of integrated sustainable energy planning at the provincial and local levels in Mae Hong Son. This approach will examine all aspects of energy use within the context of socio-economic development planning. Thus, the approach will address electricity and non-electricity energy needs. Electricity needs will include on-grid and off-grid applications, as locally relevant. GEF funding will be used to support the installation and sustainable management of grid-connected RE systems by overcoming barriers that currently constrain the development of such systems, and co-financing will be used to address off-grid electrical and non-electrical sustainable energy needs.

The **Project Objective** is "To overcome barriers to the provision of Renewable Energy (RE) services in integrated provincial renewable energy programmes in Thailand". This will contribute to the broader **Goal** of reducing GHG emissions in Thailand. The project will achieve its Objective through four Outcomes:

Outcome 1: Strengthened institutional, organizational and social capacity results in planning, management and implementation of integrated RE programmes in MHS, Chiang Rai, Chiang Mai and Tak;

Some of the major barriers to the development of sustainable RE systems in Thailand relate to institutional and organizational shortcomings. For example, the failure of energy planning to be reflected in current provincial planning in Mae Hong Son is due in part to the fact that the Ministry of Energy does not have a local office in the province. Instead, energy planning is conducted from Chiang Mai and as a result the PAO and Ministry of Energy do not coordinate and integrate their planning processes.

Equally, although DEDE and others have undertaken numerous initiatives to promote renewable energy systems, especially micro-hydro, many of these systems have failed, in large part because there is insufficient knowledge and experience, from the village level to regional levels, on project implementation, operation and repair. Another problem is that due to cumbersome ownership arrangements, as assets built with government funds cannot be transferred directly to non-government ownership, communities often do not feel that they have clear ownership of the units. Government

regulations limiting the transfer of assets developed with government funds to non-governmental agencies such as community groups is a major barrier to more widespread development of RE systems.

Outcome 2: **Financially sustainable RE systems operational in MHS, Chiang Mai, Chiang Rai and Tak**;

The social capital built through improved institutional and organizational capacity developed under Outcome 1 will permit the renovation of existing RE systems in MHS, Chiang Mai, Chiang Rai and Tak as well as the development and application of new RETs' addressing both on-grid and off-gird electricity technologies and non-electrical technologies. GEF funding will be used only for the support to the development of on-grid systems, with co-financing supporting the other technologies. Among the barriers to sustainable RE systems are access to knowledge and financing, including concessional loans.

Outcome 3: Technical support is available locally for the development, management and maintenance of RE applications in MHS, Chiang Rai, Chiang Mai and Tak;

Through Outcome 2, electrical (on- and off-grid) and non-electrical RETs will be introduced to MHS, Chiang Rai, Chiang Mai and Tak and the project will provide technical support/advice to the installation and management of these systems. However, in order to ensure sustainability, and to overcome a number of identified barriers, Outputs under Outcome 3 will build the technical capacity to produce, distribute, maintain and repair equipment needed in RE systems.

Outcome 4: **Policies facilitate up-scaling and replication of RE systems in rural Thailand**;

Almost all activities under Outcomes 1-3 deal with the promotion of renewable energy in Mae Hong Son. Mae Hong Son was selected to pilot many of the interventions because it is a poor province that is particularly suited to the development of RE systems. It has also been identified as a province where the principles of the Sufficiency Economy will be piloted. However, the Objective of the project is "To overcome barriers to the provision of Renewable Energy (RE) services in integrated provincial renewable energy programmes in Thailand". This requires replication and scale-up of activities piloted in Mae Hong Son to the rest of the country.

Systems Boundary
The temporal systems boundary for the project itself is defined by the time period over which it will be implemented (5 years), although the full domestic and global benefits will accrue over a longer time period of approximately 20 years.

Table 19: Incremental Cost Matrix

Cost/Benefit	Baseline (B)	Alternative (A)	Increment (A-B)
Domestic Benefits	Economic development proceeds at an accelerating pace in MHS, but associated with rising electricity and fuel prices, which compromises economic benefits	Economic development proceeds as under the Business-a-usual scenario, but with increased economic benefits due to reduced electricity and fuel prices, increased incomes for participating communities, and increased reliability of electrical supplies Diversified livelihoods through training in RE systems management and maintenance Empowerment of local communities and women	
Global Benefits	Global environment continues to degrade due to the adverse impacts caused by high GHG emissions	Domestic benefits sustained due to improved global environment resulting from avoided emissions of at least 702,616 tonnes of CO2e (direct) and between 2,107,848 and 5,790,009 tCO2e (indirect)	
Costs **Outcome 1** Strengthened institutional, organizational and social capacity results in planning, management and implementation of integrated RE programmes	Little investment in energy planning or strengthened institutional and social capacity; RE systems installed on an ad hoc basis and prove to be unsustainable in many instances; Total estimated costs during life of the project: $400,000	By the end of the project at least 15 community or local business/entrepreneur-managed RE systems are operating; By the end of the project, at least 10 communities/local businesses are planning to develop and install RE systems (in addition to those directly supported by the project); Total estimated costs: $1,570,000	$1,170,000 of which: GEF: $370,000 PEA: $800,000
Outcome 2 Financially sustainable RE systems operational in MHS	Installed on-grid and off-grid system continue to fail at a paid rate; most systems not financially sustainable, so contribution of RE to on-grid electricity supply in MHS remains very small and below government-mandated target; Total estimated costs during life of the project: $1,200,000	By the end of the project at least 800 million baht has been invested in RE systems in MHS; Funding is available in the form of micro-credit to villages for installation of RE systems; Village-level revenues from sale of electricity in grid-connected systems promote replication; Total estimated costs: $8,400,000	$7,200,000 of which: GEF: $1,000,000 BAAC: $5,900,000 PEA: $300,000
Outcome 3 Technical support is available locally for the development, management and maintenance of RE applications	Little or no technical support to manage and maintain RE systems, so that failure rate is high; Total estimated costs during life of the project: $100,000	Active and efficient technical service providers; Diversified livelihoods; Failure rate of solar home systems distributed via PEA is below 10% and the failure rate of newly installed micro-hydro and biomass units is 0% Total estimated costs: $1,732,000	$1,632,000 of which: GEF: $562,000 EGAT: $870,000 PEA: $200,000
Outcome 4 Policies facilitate up-scaling and	Policies favouring RE remain incompletely implemented so progress towards	At least 3 provinces initiate plans to promote RE based on lessons learned through the project and undertaken feasibility studies for RE investments;	$1,124,200 of which:

Cost/Benefit	Baseline (B)	Alternative (A)	Increment (A-B)
replication of RE systems in rural Thailand	government RE target remains behind schedule; Opportunities for learning through networking are largely absent; Total estimated costs during life of the project: $600,000	Support among public = 50% increase over baseline; Total estimated costs: $1,724,200	GEF: $424,200 PEA: $700,000
Project Management and Monitoring and Evaluation	Total estimated costs: $0	Total estimated costs: $906,500	$906,500 Of which: GEF: 356,500 TEI: 550,000
Cost Totals	$2,300,000	$14,332,700	$12,032,700 of which: GEF: $2,712,700 EGAT: $870,000 BAAC: $5,900,000 PEA: $2,000,000 TEI: $550,000

PART II: Logical Framework Analysis

Result	Indicators	Baseline value	Target and benchmarks	MOV and frequency	Assumptions
Overall Goal: The reduction of GHG emissions in Thailand					
Project Objective: To overcome barriers to the provision of Renewable Energy (RE) services in integrated provincial renewable energy programmes in Thailand	**Increase of power generation capacity and usage from RE systems in MHS** **Percentage of power generation capacity nationally from RE systems**	**RE power generation capacity in MHS amounts to 17.0 MW (on grid) and 2.4 MW (off-grid)** **1.45% grid power generation and 5.37% grid + off-grid power generation is by RE**	**By the end of the project RE power generation capacity in MHS amounts to 27.06 MW (on grid) and more than 2.4 MW (off-grid). This is equivalent to an increase of at least 55,000 MWh/year)** **By the end of the project the proportion of power generation from installed or planned RE systems nationally is 6% (grid) and 8% (grid + off-grid)**	**DEDE statistics;**	**National support for implementation of RE technologies remains part of the national development agenda**
Outcome 1: Strengthened institutional, organizational and social capacity results in planning, management and implementation of integrated RE programmes in MHS, Chiang Rai, Chiang Mai and Tak	**Acceptance of an alternative RE management model besides government BOO model[10]** **Number of communities/local businesses planning or operating RE systems**	**Only RE management model is government BOO** **None**	**By the end of the project another RE management model besides government BOO model is being operated by at least 15 communities or entrepreneurs/local businesses** **By the end of the project, at least another 10 communities/local businesses are planning to develop and install RE systems (in addition to those directly supported by**	**Project reports; surveys; Development Plans of Provincial Organization and provincial agencies (MOE; MONRE; etc.);**	**Decentralization process continues and sub-national levels of government continue to have sufficient autonomy to formulate and adopt such plans Provincial stakeholders encourage a multi-sectoral approach in participation**

[10] Management models will include the design, building, ownership and operation of RE systems (e.g. PPP)

Result	Indicators	Baseline value	Target and benchmarks	MOV and frequency	Assumptions
			the project)		
Output 1.1 Integrated provincial RE plans prepared	Integrated provincial development plan includes RE needs as umbrella for sub-provincial levels	No such integration exists	By the end of 2014, integrated provincial development plans addressing RE needs are endorsed by the provincial administrations	Provincial Organization resolution Development Plans of Provincial Organization and provincial agencies (MOE; MONRE; etc.)	Stakeholders, particularly provincial organizations, are sufficiently motivated to develop and implement plans
Output 1.2 Strengthened mobilization and co-ordination mechanisms	Provincial and sub-provincial working groups Village groups focused on RE	A provincial working group was formulated in MHS only for assistance in project formulation No village groups address RE	By the end of the project, provincial working groups have facilitated the provincial RE plans and investments By the end of the project at least 40% of village groups focus on RE	Minutes of group meetings; Survey	New institutional arrangements are accepted by all stakeholders
Output 1.3 Institutional arrangements for cooperatively-owned and PPP renewable energy systems	Existence of guidelines for institutional arrangements	No examples of cooperatively-owned and PPP systems	By the end of 2015, guidelines have been produced and endorsed by Ministry of Energy outlining procedures for installation and management of cooperatively-owned and PPP RE systems	Project reports	Legal framework is sufficiently flexible to allow development of viable institutional arrangements
Output 1.4 Local entities with strong leadership to plan, develop and manage RE systems	Number of trained local leaders that initiate formulation of an RE action plan in their locality Number of entities	No local leader promoting RE No cooperatives (for RE) exist	By the end of the project at least 10 villages/communities/local businesses have plans for RE systems based on encouragement from local leaders By the end of 2012 at least	Surveys/interviews; Provincial statistics office records; DEDE statistics Signed agreements Project reports; field surveys and interviews	Correct local champions are identified and are sufficiently motivated Institutional arrangements and

Result	Indicators	Baseline value	Target and benchmarks	MOV and frequency	Assumptions
			3 village cooperatives have been established and these remain operational at the end of the project		incentives encourage cooperative formation
Outcome 2: Financially sustainable RE systems operational in MHS, Chiang Mai, Chiang Rai and Tak	**Increase in invested amount for RE in MHS (all sectors)** **Amounts available in the form of micro-credit for communities wishing to establish RE systems** **Village revenues from grid-connected RE systems**	**Investment in 2007 = 486 million baht (figure for MHS province)** **No micro-credit available** **No income**	**By the end of the project at least an additional 800 million baht[11] is invested in RE systems in MHS compared to the baseline** **By the end of 2015 at least 10 million baht is available in the form of micro-credit to individual villages for installation of RE systems** **By the end of the project village-level revenues from sale of electricity in grid-connected systems amounts to at least 15 million baht per year[12]**	**DEDE/ EPPO statistics (regarding deployed units)**	**RE technology is actively demonstrated as a financially viable energy source at all levels;**

[11] The 800 million baht investments are calculated based on table 19 "List of demo investment projects on RE-based power generation".

[12] It is assumed that the 10 village hydropower systems of 40 kW and the 8 gasifiers of 100 kW mentioned in table 19 "Set of technologies to be installed during the project" will generate electricity which will partly be exported to the grid, generating revenues for local villages. Based on an average electricity tariff of 1.8 B/kWh (corrected for off-peak and peak) + FT tariff of 0.9 B/kWh + currently applicable adder for the technology concerned see table 2 "Subsidy Addition for Renewable VSPP", the load factors mentioned in table 19 and the assumption that around 30% of the time that the plants operate they produce electricity for own consumption, the yearly revenues for villages will be around 15 million baht. These revenues contribute to the sustainability of the investments and will encourage villagers to maintain and operate these installations. The payback time of this type of investments is around 6 to 7 years, as can be derived from table 13: "Comparison of Financial Returns, Emissions and Local Employment between Selected and reviewed Technologies".

Result	Indicators	Baseline value	Target and benchmarks	MOV and frequency	Assumptions
Output 2.1 Awareness raised of all stakeholders involved in RE projects regarding social, economic and environmental costs and benefits of RE systems	Level of awareness among villagers	Awareness levels close to zero	By the end of 2015, villagers in at least 10 communities are able to describe social, economic and environmental costs and benefits of RE systems	Survey	Awareness raising activities are able to access all target villages
Output 2.2 Operational guidance on SPP (RE)/VSPP and other schemes disseminated among stakeholders	Increase in demand for RE services	No guidance exists and no current demand for SPP/VSPP schemes	By the end of 2015 guidance disseminated to all tambons/villages By the end of the project at least 15 SPP/VSPP proposals have been prepared based on guidance	Project reports; interviews Project reports; interviews	Guidelines designed and disseminated in a way that is culturally acceptable for use by local communities
Output 2.3 RE systems installed under previous initiatives rehabilitated	Number of operational solar and micro-hydro electric units	Number of installed solar electric units in MHS is 14,800 (of which 80% estimated are non-functional); 4 micro-hydro units non-functional	By the end of the project the percentage of non-operational solar electric units is less than 10% and one micro-hydro units which was abandoned is functioning again	Project reports; surveys	Past experience of failure has not prejudiced communities against RE, especially solar systems
Output 2.4 Off-grid renewable energy electrical systems to local communities established	Completion of feasibility studies Percentage of off-grid households with access to RE electrical energy	No feasibility studies undertaken Percentage of off-grid households with access to RE electrical energy = ~85%	By the end of 2014 at least 14 feasibility studies have been completed By the end of the project, at least 95% of all off-grid households have access to RE electrical energy	Project reports Project reports, surveys	No legal or institutional barriers affect feasibility (e.g. access to water resources)

Result	Indicators	Baseline value	Target and benchmarks	MOV and frequency	Assumptions
Output 2.5 Grid-linked RE systems established consistent with integrated provincial development plans	Number of applications installed and operating	No units in operation	By the end of the project, at least 11,800 kW of additional RE generation capacity installed in MHS, Chiang Mai and Tak (hydro and biomass)	Project reports; survey	Communities and entrepreneurs are sufficiently motivated Feasibility studies (Output 2.3) identify viable options
Output 2.6 Non-electrical renewable energy (e.g. charcoal kilns, biodiesel) promoted	Proportion of community non-electrical energy from RE	Proportion of community non-electrical energy = 25%	By the end of the project, at least 40% of community non-electrical energy provided from RE sources	Project reports, surveys	
Output 2.7 access to concessional loans facilitated	Volume of loan funding	Essentially no loan funding available	By the end of the project, at least $5 M is available to promote RE through concessional loans	Project reports, surveys	
Outcome 3: Technical support is available locally for the development, management and maintenance of RE applications in MHS, Chiang Rai, Chiang Mai and Tak	**Improved RE 'customer' satisfaction rate** **Reduced failure rate of installed equipment** **Service response time for RE equipment repair**	**No knowledge or expertise centre easily available;** **Failure rate of solar home systems: 80%** **No service provided**	**By the end of the project at least 75% of RE systems managers report satisfaction with service provision** **By the end of the project the failure rate of rehabilitated solar home systems is below 10%. Failure rate of newly installed micro-hydro and biomass units are all 0%.** **At the end of the project the service time for RE system problems is less than 7 days**	**Survey**	**That vocational/ technical colleges are interested and willing to integrate RE technology services material within their programmes;**
Output 3.1: RE curricula for vocational training institutes targeting private service providers and others developed and officially approved	Curriculum integrated into training programme	No curriculum exists	By the end of 2015 RE curricula are integrated into training programmes in 6 vocational training institutes in MHS, Chiang Mai,	Project reports; surveys of vocational training institutes Training reports	Training institutes are committed to providing training in RE Service providers see

Result	Indicators	Baseline value	Target and benchmarks	MOV and frequency	Assumptions
	Number of technicians graduating from vocational training institute courses	No training in RE systems	Chiang Rai and Tak By the end of the project at least 250 local government technicians have passed training courses		sufficient potential business to motivate them to be trained
Output 3.2 Completed training in business, finance and resource management of RE systems	Number of individuals trained	No training	By the end of the project, at least one person from at least 25 communities has passed training courses in business, finance and resource management	Training reports	Trained individual apply newly-acquired knowledge effectively
Output 3.3 Completed trainings in maintenance and repair of RE systems	Number of community persons graduating from the course	No training	By the end of the project, at least one person from at least 40 communities has passed training courses in maintenance of RE systems	Training reports	Correct community representatives selected for training Financial incentives to maintain and manage RE systems adequate
Output 3.4 Disseminated technology/ information	Number of end-users and potential producers reached	No information available for end-users	By the end of 2015, information booklets on RE management and maintenance have been disseminated to at least 80% of all tambons and villages	Project reports; surveys	Information booklets designed in such a way as to be attractive to community representatives
Output 3.5 Technically capable and skilled local RE technology equipment manufacturers increased	Number of local manufacturers increased	No Market competition	By the end of the project there are at least 12 more local manufacturers	Project reports; interviews	Sufficient members exist to enable more competition.
Outcome 4: Policies facilitate up-scaling and replication of RE systems in Thailand	**Adoption of project methodology in other provinces**	**No replication**	**At least 3 provinces have initiated plans to promote RE based on lessons learned through the project and undertaken feasibility studies for RE investments**	**Project reports; interviews with provincial leaders**	**Tariff rates and other mechanisms are negotiable and the national government and state enterprises support the use of small-scale RE technology within the national energy programme**
Output 4.1 Centre of learning in MHS	Existence of centre of	No Centre of	By the end of 2015 a Centre	Project reports; reports	Centre enjoys strong

Result	Indicators	Baseline value	Target and benchmarks	MOV and frequency	Assumptions
promoting RE as part of the Sufficiency Economy established	learning Number of visitors	learning	of Learning is established in MHS By the end of the project the Centre receives at least 5000 visitors per year, including 80% from other provinces	of Centre operation; surveys	political support in MHS and is publicized throughout the country
Output 4.2 RE applications prominent in government energy programmes	Government budget allocations to implement RE policy	Government budget allocations in 2007 = 900 million baht	Government budget allocations in 2010 = 1100 million baht and in 2015 = 1400 million baht	Government budget figures	Political stability allows development and implementation of stable policies and programmes
Output 4.3 Flexible subsidies / tax incentives revised and promoted	Guidelines available	Production subsidy 8 baht/ kWh for solar; 0.4 to 0.8 baht/ kWh for micro-hydro; 0.3 baht/ kWh for biomass; No support for solar thermal	Removal of MW cap on SPP subsidy		Government agencies are willing to negotiate modifications to subsidy schemes to favor community generation of grid-linked RE
Output 4.4 Transparent system of government accountability established	Existence of public accountability monitoring system	No accountability system	By the end of 2015 a participatory monitoring system, endorsed by the Ministry of Energy, has been established Each year after 2015 RE accountability reports are publicly released	Project reports; monitoring reports from established mechanism	Government agencies willing to accept oversight structures including NGOs and CBOs
Output 4.5 Policy makers that support RE development and application programs	Number of (positive) policy changes (a policy change is a	0	By the end of the project the number of policy changes = 5[13]	Government publications	Better awareness among policy makers translates into better policies!

Examples of envisaged policy changes include:

1) Setting standards for renewable energy technologies and renewable energy manufactures;
2) Adding and improving RE curricula for (vocational) schools;
3) Providing financial support and low interest rate loans to RE investments by local businesses/communities (new approach to loan management supported by government);
4) By government endorsed new ownership models for RE applications

Result	Indicators	Baseline value	Target and benchmarks	MOV and frequency	Assumptions
	distinct change to regulations, tariff structures, eligibility rules, or laws which favor the introduction or replication of RETs)				
Output 4.6 a "VSPP association" consisting of VSPP practitioners, academics, NGOs and government agencies established	Existence and size of a VSPP association	No VSPP association exists	By the end of 2013 a VSPP association has been created; by the end of the project there are at least 50 members of the association	Project reports; interviews	Sufficient VSPP practitioners share sufficient conditions in common to make exchange of lessons
	Number of lessons exchanged	No lessons exchanged	By the end of the project, village heads are able to describe at least 3 lessons learned from other initiatives	Interviews	Other initiatives generate lessons of relevance to MHS and other provinces

5) Setting up or reforming laws and regulations to encourage RE investments; e.g. by import tax exception or reduction on RETs, revised VSPP regulation endorsed by government.
6) Up-scaling renewable energy policy to national agenda

SECTION III: Total Budget and Work Plan

Award ID:	48912
Award Title:	Thailand: Promoting Renewable Energy in Mae Hong Son Province
Business Unit:	THA10
Project Title:	Thailand: Promoting Renewable Energy in Mae Hong Son Province
Project ID:	00059287 (PIMS: 3908)
Implementing Partner (Executing Agency)	Thailand Environment Institute

GEF Outcome/Atlas Activity	Responsible Party/ Implementing Agent	Fund ID	Donor Name	Atlas Account Code	ATLAS Budget Description	Amount Year 1 (USD)	Amount Year 2 (USD)	Amount Year 3 (USD)	Amount Year 4 (USD)	Amount Year 5 (USD)	Total (USD)	See Budget Note:
OUTCOME 1: Strengthened institutional, organizational and social capacity results in planning, management and implementation of integrated RE programmes	**TEI**	**62000**	**GEF**	71200	International Consultants	34,170	21,356	17,085	8,543	4,271	**85,425**	**a**
				71300	Local Consultants	50,048	31,280	25,024	12,512	6,256	**125,120**	**a**
				72100	Contractual services - companies	40,000	60,000	0	0	0	**100,000**	**b**
				71600	Travel	10,000	10,000	10,000	5,000	5,000	**40,000**	**c**
				74500	Miscellaneous	5,000	5,000	4,455	3,000	2,000	**19,455**	**d**
					Total Outcome 1	**139,218**	**127,636**	**56,564**	**29,055**	**17,527**	**370,000**	
OUTCOME 2. Financially sustainable RE systems operational in MHS	**TEI**	**62000**	**GEF**	71200	International Consultants	61,455	107,546	61,455	46,091	30,728	**307,275**	**e**
				71300	Local Consultants	83,232	145,656	83,232	62,424	41,616	**416,160**	**e**
				72100	Contractual services - companies	17,000	95,000	65,000	25,000	5,000	**207,000**	
				7450	Miscellaneous	3,000	5,000	5,000	3,565	3,000	**19,565**	
				71600	Travel	10,000	15,000	10,000	10,000	5,000	**50,000**	
					Total Outcome 2	**174,687**	**368,202**	**224,687**	**147,080**	**85,344**	**1,000,000**	
OUTCOME 3: Technical support is available locally for the development, management and	**TEI**	**62000**	**GEF**	71200	International Consultants	20,655	41,310	41,310	20,655	13,770	**137,700**	**f**
				71300	Local Consultants	36,720	73,440	73,440	36,720	24,480	**244,800**	**f**
				71600	Travel	10,000	15,000	15,000	15,000	10,000	**65,000**	
				72100	Contractual Services - companies	10,600	48,950	16,050	15,450	5,000	**96,050**	

maintenance of RE applications				74500	Miscellaneous	3,000	4,000	4,000	4,000	3,450	**18,450**	
					Total Outcome 3	**80,975**	**182,700**	**149,800**	**91,825**	**56,700**	**562,000**	
OUTCOME 4: Policies facilitate up-scaling and replication of RE systems in rural Thailand	**TEI**	**62000**	**GEF**	71200	International Consultants	3,570	7,140	17,850	21,420	21,420	**71,400**	**g**
				71300	Local Consultants	6,596	13,192	32,980	39,576	39,576	**131,920**	**g**
				71600	Travel	5,000	5,000	10,000	15,000	12,000	**47,000**	
				72100	Contractual Services-companies	10,000	33,000	20,000	21,000	66,000	**150,000**	
				74500	Miscellaneous	3,880	5,000	5,000	5,000	5,000	**23,880**	
					Total Outcome 4	**29,046**	**63,332**	**85,830**	**101,996**	**143,996**	**424,200**	
MONITORING &EVALUATION	**TEI**	**62000**	**GEF**	71200	International Consultants	10,000	3,000	10,000	3,000	13,000	39,000	**h**
				71300	Local Consultants	10,000	3,000	13,000	3,000	8,000	37,000	**i**
				71600	Travel	2,000	4,000	6,000	4,000	8,000	24,000	
				74100	Professional Services	1,000	1,000	1,000	1,000	1,000	5,000	**j**
				74500	Miscellaneous	1,000	1,000	1000	1,000	1,000	5,000	
					Total M&E	**24,000**	**12,000**	**31,000**	**12,000**	**31,000**	**110,000**	
PROJECT MANAGEMENT	**TEI**	**62000**	**GEF**	71300	Local consultants	42,000	42,000	42,000	42,000	42,000	210,000	**k**
				71600	Travel	4,500	5,000	5,000	5,000	5,000	24,500	**l**
				72500	Office Supplies	8,000	1,000	1,000	1,000	1,000	12,000	**m**
					Total Management	**54,500**	**48,000**	**48,000**	**48,000**	**48,000**	**246,500**	
				PROJECT TOTAL		***502,426***	***801,871***	***595,881***	***429,956***	***382,567***	***2,712,700***	

Summary of Funds: [14]

	Year 1	Year 2	Year 3	Year 4	Year 5	**Total**
GEF	502,426	801,871	595,881	429,956	382,567	**2,712,700**
In-kind **EGAT**	150,000	300,000	250,000	120,000	50,000	**870,000**
Cash (soft loans) **BAAC**	300,000	1,400,000	1,400,000	1,400,000	1,400,000	**5,900,000**
Cash (Investments) **PEA**	300,000	500,000	400,000	400,000	400,000	**2,000,000**
In kind **TEI**	150,000	100,000	100,000	100,000	100,000	**550,000**
TOTAL	1,402,426	3,101,871	2,745,881	2,449,956	2,332,567	12,032,700

[14] Summary table should include all financing of all kinds: GEF financing, co-financing, cash, in-kind, etc.

Budget Notes:

A) For further details of consultants (costs per week and activities), see table below. Local (10 weeks) and international (3 weeks) awareness and outreach experts; Local (32 weeks) and international (12 weeks) RE management models experts; Local (16 weeks) and international (5 weeks) RE resource assessment experts; Local (14 weeks) and international (6 weeks) RE feasibility studies experts and Local (20 weeks) and international (7.5 weeks) RE poly experts.

B) Contractual services companies for organizing provincial consultative workshops, stakeholders meetings, and trainings. This budget note applies to this budget line item across all outcomes. For more details see table below.

C) Travel to and from the countries of origins for international consultants; travel within the country and to the project sites for international, and local consultants, and study tours. This budget note applies to this budget line item in all outcomes.

D) Miscellaneous is for insurance, bank charges (incl. interest earned in a savings account), claims and adjustments, storage, sundry. Given the technical and logistical complexity of the project a slightly higher amount has been budgeted under the miscellaneous head as a contingency fund to deal with unexpected situations and costs that may arise during the life of the project that could not be anticipated in advance as well as to contend with fluctuating exchange rates and inflation.

E) Local (10 weeks) and international (3 weeks) awareness and outreach experts; Local (48 weeks) and international (15 weeks) RE loan experts; Local (24 weeks) and international (9 weeks) RE management models experts; Local (15 weeks) and international (5 weeks) maintenance and operations experts of hydro power systems (engineers); Local (15 weeks) and international (5 weeks) maintenance and operations experts of solar systems (engineers); Local (10 weeks) and international (3.5 weeks) maintenance and operations experts of biomass based RE systems (engineers); Local (64 weeks) and international (20 weeks) RE resource assessment experts; Local (56 weeks) and international (24 weeks) RE feasibility studies experts; Local (32 weeks) and international (12 weeks) RE poly experts; Local (25 weeks) and international (20 weeks) hydropower engineer; Local (7 weeks) and international (4 weeks) tariff experts

F) Local (10 weeks) and international (3 weeks) awareness and outreach experts; Local (24 weeks) and international (7.5 weeks) RE loan experts; Local (16 weeks) and international (6 weeks) RE management models experts; Local (40 weeks) Curriculum and Education consultants; Local (20 weeks) and international (10 weeks) RE business and financial management experts; Local (15 weeks) and international (5 weeks) maintenance and operations experts of hydro power systems (engineers); Local (15 weeks) and international (5 weeks) maintenance and operations experts of solar systems (engineers); Local (10 weeks) and international (3.5 weeks) maintenance and operations experts of biomass based RE systems (engineers); Local (8 weeks) and international (3 weeks) RE poly experts; Local (15 weeks) and international (7 weeks) SME business development experts; Local (7 weeks) and international (4 weeks) tariff experts

G) Local (10 weeks) and international (3 weeks) awareness and outreach experts; Local (8 weeks) and international (2.5 weeks) RE loan experts; Local (8 weeks) and international (3 weeks) RE management models experts; Local (20 weeks) and international (7.5 weeks) RE poly experts; Local (10 weeks) Information Technology and Database experts; Local (10 weeks) Learning Centre experts; Local (10 weeks) technical editors for official publications; Local (21 weeks) and international (12 weeks) tariff experts.

H) International consultants will work as the project GEF technical advisor and M&E specialists on monitoring and evaluation in accordance with the established UNDP and GEF procedures and requirements, including independent external evaluations

I) Local consultants for independent external evaluations.

J) Professional services for audit fees and Harmonized Approach to Cash Transfers (HACT) assessment fees

K) Long term consultants for project management unit, including Project Manager and Project Administration Support.

L) Travel for the project management unit.

M) Office supplies: costs of stationery and office supplies, communications, printing and publication have been budgeted to cover the numerous policy and legal reviews, associated consultations as well as monitoring and evaluation activities envisaged under this Outcome, along with the development of a variety of training materials.

Experts and consultants to be hired under the project from resources provided by GEF

Type of Experts	Rate (US$) per week	Weeks	Tasks to be Done
Local Experts			
Awareness and Outreach Expert	1360	40	-Design of overall awareness, capacity building and outreach framework
			-Design of capacity building programme for governmental institutions (local, provincial and national level), community leaders and entrepreneurs
			-Design of awareness raising campaign on village and community level
			-Support to set up/design of various capacity building, awareness raising and training events
			- Advice/support on the preparation of socially appropriate informational materials (brochures, guidelines, presentations, videos, etc.)
RE Loan Expert	1360	80	-Analysis of current RE loan management practices/policies in Thailand
			-recommendations for improvements to existing policies/incentives/concepts related to loans for RE applications and proposals for new policies/incentives
			-Preparation of guidance on loans management for RE applications
			-Preparation of awareness raising and training materials on RE loan management
			-Technical resource person for trainings on loan management
			-Preparation of draft institutional arrangements for small loans to communities and local businesses (private sector)
			-Support on the management of loans by local businesses and local communities
			-Support to/advice on administration and management of loans by (local) banks
RE Management Models Expert (including legal aspects)	1360	80	-Analysis of current ownership and management models of RE applications in Thailand
			-Formulation of guidelines for alternative ownership and management models for RE applications adopted to the situation in Thailand
			-Formulation of recommendations for new policies/incentives facilitating the uptake of new ownership models

Type of Experts	Rate (US$) per week	Weeks	Tasks to be Done
			-Developing materials for trainings on various ownership models for RE systems
			-Technical resource person for trainings
			-Preparation of guidelines and legal agreements for the management of RE systems under different ownership models
			-Advice to/support to stakeholders entering into agreements regarding RE applications applying new ownership and management models
Curriculum and Education Consultant	1360	40	-Analysis of current curricula of vocational institutes and universities related to RE applications
			-Improvement to existing curricula/development of new curricula on RE in partnership with local and national vocational institutes and universities
			-Setting up system for continuous improvement of local teaching skills (Training of trainers)
			-Identification and mobilization of technical expertise to support initial courses and to develop local teaching skills
RE Business and Finance and Resource Management Expert	1360	20	-Developing training materials for trainings in business, finance and resource management of RE systems
			-Technical resource person for trainings
			-Providing advice/Support to stakeholders facing challenges in business, finance and resource management of RE systems
Maintenance and Operations Expert of hydro power systems (engineer)	1360	30	-Developing training materials for trainings on technical maintenance, repair and operations of hydro power systems
			-Providing Technical training for maintenance, repair and operations of hydro power systems
			-Providing advice/Support to stakeholders facing challenges in technical maintenance, repair and operations of hydropower systems

Type of Experts	Rate (US$) per week	Weeks	Tasks to be Done
Maintenance and Operations Expert of SHS systems (engineer)	1360	30	-Developing training materials for trainings on maintenance, repair and operations of SHS systems
			-providing technical training for repair, maintenance and operations of SHS systems to stimulate local people to establish repair services.
			-Providing advice/support to stakeholders facing challenges in maintenance, repair and operation of solar power systems
Maintenance and Operations Expert of biomass based RE systems (engineer)	1360	20	-Developing training materials for technical trainings on maintenance, repair and operations of biomass based RE systems
			-Providing Technical training for maintenance, repair and operations of biomass based RE systems
			-Providing advice/support to stakeholders facing challenges in technical maintenance, repair and operation of biomass power systems
RE Resource Assessment Experts	1360	80	-Carrying out in depth surveys of RE sources to be used for provincial & local RE planning by government institutions and private sector/entrepreneurs:
			*Biomass Energy Resource Assessment - identification, verification and quantification of the available biomass energy resources and identification of potential biomass energy applications
			* Hydro Energy Resource Assessment - identification, verification and quantification of the available hydro resources and identification of potential hydro energy applications
			* Wind Energy Resource Assessment - identification, verification and quantification of the available wind resources and identification of potential wind energy applications
			*Solar Energy Resource Assessment - identification, verification and quantification of the solar energy resources (thermal and power) and identification of most feasible sites for utilizing solar energy

Type of Experts	Rate (US$) per week	Weeks	Tasks to be Done
			*Geothermal Energy Resource Assessment - identification, verification and quantification of the geothermal energy resources and identification of most feasible sites for utilizing geothermal energy
RE feasibility studies expert	1360	70	-Preparation of detailed and comprehensive (technical, social, environmental, economic and financial) feasibility studies for new RE applications for selected sites identified during the mapping exercises of RE sources
RE policy expert	1360	80	-Compilation and analysis of all existing government policies/interventions/incentives aiming to promote RE applications/RE resources (also to be used by other consultants as background materials, like loan expert and tariff expert)
			-Preparation of recommendations for improvements to current policies/incentives and suggestions for new policies/incentives promoting RE application, including financial and fiscal incentives (in close cooperation with tariff expert)
			-Developing materials for trainings on policies/incentives (including financial and fiscal schemes which are not being promoted currently) for RE systems
			-Technical resource person for trainings
			-Assistance in preparing transparent governmental accountability system
			-Analysis of current practices in Thailand in preparing provincial and local RE plans (incl. analysis on best ways of cooperation between all government institutions involved)
			-Sharing of good examples/establishing guidance on best practices in preparing provincial and local RE plans
			-Support to RE village cooperatives
			-support to the process of preparing integrated RE plans, including workshops and provincial working groups

Type of Experts	Rate (US$) per week	Weeks	Tasks to be Done
SME business development expert/RE market development expert	1360	15	-assistance in setting up/advice to local RE manufacturers businesses
Information Technology And Database Expert	1360	10	-Consolidation of all information on RE applications, RE resources, curricula in vocational institutes, etc. available locally, in the region, and worldwide to facilitate information exchange among the stakeholders and ensure coherent sector wide information and education campaign.
Leaning Centre expert	1360	10	-Design and assistance in setting up of learning centre, sharing of lessons learned and best practices of the successful clearing house mechanism in Thailand on biomass
Technical editor	1360	10	-Compiling technical inputs from various experts, drafting and editing of 2 official publications: 1) manual on RE applications and 2) lessons learned from the project
Hydropower Engineer	1360	25	-assistance and advice in the design, planning, construction, commissioning phase for hydropower plants
Tariff Expert	1360	35	-Analysis of current VSPP and SPP scheme, including SWOT analysis
			-Stakeholder consultations with current and potential participants
			-Identification of improvements to current system and economic/financial evaluation/analyses of the identified options
			-Design of a draft revised tariff and subsidy system including guidance
			-Assistance in setting up of a VSPP association
			-Developing materials for trainings on VSPP and SPP schemes
			-Technical resource person for trainings
International Experts			
Awareness and	2550	12	-Design of overall awareness, capacity building and outreach framework

Type of Experts	Rate (US$) per week	Weeks	Tasks to be Done
Outreach Expert			-Design of capacity building programme for governmental institutions (local, provincial and national level), community leaders and entrepreneurs
			-Design of awareness raising campaign on village and community level
			-Support to set up/design of various capacity building, awareness raising and training events
			- Advice/support on the preparation of socially appropriate informational materials (brochures, guidelines, presentations, videos, etc.)
RE Loan Expert	2550	25	-Analysis of current RE loan management practices/policies in Thailand
			-recommendations for improvements to existing policies/incentives/concepts related to loans for RE applications and proposals for new policies/incentives
			-Preparation of guidance on loans management for RE applications
			-Preparation of awareness raising and training materials on RE loan management
			-Technical resource person for trainings on loan management
			-Preparation of draft institutional arrangements for small loans to communities and local businesses (private sector)
			-Support on the management of loans by local businesses and local communities
			-Support to/advice on administration and management of loans by (local) banks
RE Management Models Expert	2550	30	-Analysis of current ownership and management models of RE applications in Thailand
			-Formulation of guidelines for alternative ownership and management models for RE applications adopted to the situation in Thailand
			-Formulation of recommendations for new policies/incentives facilitating the uptake of new ownership models
			-Developing materials for trainings on various ownership models for RE systems
			-Technical resource person for trainings

Type of Experts	Rate (US$) per week	Weeks	Tasks to be Done
			-Preparation of guidelines and legal agreements for the management of RE systems under different ownership models
			-Advice to/support to stakeholders entering into agreements regarding RE applications applying new ownership and management models
RE Business, Finance and resource Management Consultant	2550	10	-Developing training materials for trainings in business, finance and resource management of RE systems
			-Technical resource person for trainings
			-Providing advice/Support to stakeholders facing challenges in business, finance and resource management of RE systems
Maintenance and Operations Expert of hydro power systems	2550	10	-Developing training materials for trainings on technical maintenance, repair and operations of hydro power systems
			-Providing Technical training for maintenance, repair and operations of hydro power systems
			-Providing advice/Support to stakeholders facing challenges in technical maintenance, repair and operations of hydropower systems
Maintenance and Operations Expert of SHS systems	2550	10	-Developing training materials for trainings on maintenance, repair and operations of SHS systems
			-providing technical training for repair, maintenance and operations of SHS systems to stimulate local people to establish repair services.
			-Providing advice/support to stakeholders facing challenges in maintenance, repair and operation of solar power systems
Maintenance and Operations Expert of biomass based RE systems	2550	7	-Developing training materials for technical trainings on maintenance, repair and operations of biomass based RE systems
			-Providing Technical training for maintenance, repair and operations of biomass based RE systems
			-Providing advice/support to stakeholders facing challenges in technical maintenance, repair and operation of biomass power systems

Type of Experts	Rate (US$) per week	Weeks	Tasks to be Done
RE Resource Assessment Experts	2550	25	-Carrying out in depth surveys of RE sources to be used for provincial & local RE planning by government institutions and private sector/entrepreneurs:
			*Biomass Energy Resource Assessment - identification, verification and quantification of the available biomass energy resources and identification of potential biomass energy applications
			* Hydro Energy Resource Assessment - identification, verification and quantification of the available hydro resources and identification of potential hydro energy applications
			* Wind Energy Resource Assessment - identification, verification and quantification of the available wind resources and identification of potential wind energy applications
			*Solar Energy Resource Assessment - identification, verification and quantification of the solar energy resources (thermal and power) and identification of most feasible sites for utilizing solar energy
			*Geothermal Energy Resource Assessment - identification, verification and quantification of the geothermal energy resources and identification of most feasible sites for utilizing geothermal energy
RE feasibility studies expert	2550	30	-Preparation of detailed and comprehensive (technical, social, environmental, economic and financial) feasibility studies for new RE applications for selected sites identified during the mapping exercises of RE sources
RE policy expert	2550	30	-Compilation and analysis of all existing government policies/interventions/incentives aiming to promote RE applications/RE resources (also to be used by other consultants as background materials, like loan expert and tariff expert)
			-Preparation of recommendations for improvements to current policies/incentives and suggestions for new policies/incentives promoting RE application, including financial and fiscal incentives (in close cooperation with tariff expert)
			-Developing materials for trainings on policies/incentives (including financial and fiscal schemes) for RE systems

Type of Experts	Rate (US$) per week	Weeks	Tasks to be Done
			-Technical resource person for trainings
			-Assistance in preparing transparent governmental accountability system
			-Analysis of current practices in Thailand in preparing provincial and local RE plans (incl. analysis on best ways of cooperation between all government institutions involved)
			-Sharing of good examples/establishing guidance on best practices in preparing provincial and local RE plans
			- Support to RE village cooperatives
			-support to the process of preparing integrated RE plans, including workshops and provincial working groups
Hydropower Engineer	2550	20	-assistance and advice in the design, planning, construction, commissioning phase for hydropower plants
SME business development expert/RE market development expert	2550	7	-assistance in setting up local RE manufacturers businesses
Tariff Expert	2550	20	-Analysis of current VSPP and SPP scheme, including SWOT analysis
			-Stakeholder consultations with current and potential participants
			-Identification of improvements to current system and economic/financial evaluation/analyses of the identified options
			-Design of a draft revised tariff and subsidy system including guidance
			-Assistance in setting up of a VSPP association
			-Developing materials for trainings on VSPP and SPP schemes
			-Technical resource person for trainings

Experts and consultants to be hired under the project for project management and M&E

Position Titles	*$/ person week*	*Estimated person weeks*	*Tasks to be performed*
For Project Management			
Local			
Project Manager	985	124.6	The project manager would be responsible to lead and guide the project team; contract out and supervise all technical consultancies; perform administrative and financial management, and liaison with the UNDP office
Project Assistant (co-financed)	700	124.6	The project assistant would be responsible for all administrative and financial tasks related to the management of the project.
International	-	-	-
For Monitoring and Evaluation			
Local			
Monitoring and Evaluation experts	1480	25	Preparation of the mix-term external evaluation and final external evaluation, Consultants to assist in Measurement of Means of Verification for project purpose indicators, consultants for technical reports.
International			
Monitoring and Evaluation experts	2600	15	Preparation of the mix-term external evaluation and final external evaluation Consultant to assist in Measurement of Means of Verification for project purpose indicators, consultants for technical reports (if required).

Details contractual services carried out with financial resources provided by GEF

Outcomes	Activities	Total	Year 1	Year 2	Year 3	Year 4	Year 5
Component 1: Strengthened institutional, organizational and social capacity results in planning, management and implementation of integrated RE programmes	Workshops for preparing integrated provincial renewable energy plans. A) One-day workshop in each (4) province to provincial and local governmental staff, community leaders and local entrepreneurs about RET applications in general, the benefits and costs and practical constraints. B) One-day workshop in each (4) province for the formulation of integrated provincial energy plans + local energy plans (100 participants each workshop).	80000	40000	40000	0	0	0
	Study tour for identified and selected officials, community leaders and local entrepreneurs to learn from best practices and past experiences in other parts of Thailand (20 people). Selected people will be key stakeholders related to investments implemented under component 2.	20000	0	20000	0	0	0
	Total component 1	**100000**	**40000**	**60000**	**0**	**0**	**0**
Component 2: Financially sustainable RE systems operational in MHS	For identified RE project investments sites: awareness raising sessions within communities (around 20 sessions)	20000	10000	10000	0	0	0
	In-depth trainings on preparing and implementing RE investment plans, managing and operating RE systems. Including dissemination of information on a) new and existing approaches for loan management, b) existing and new incentive schemes like VSPP scheme, c) new and existing ownership models, d) existing fiscal incentives (which are not being promoted). Target group: identified and selected private businesses, governmental officials, participating communities and other stakeholders (2 trainings of 2 days in each province, 100 participants per training)	160000	0	80000	60000	20000	0
	Setting up of a roving unit within vocational training institute(s) to create awareness/built capacities of stakeholders involved (local businesses, communities, government institutions, etc.) regarding RE, to address questions on RE while developing & implementing RE investment plans, as a follow up on the general awareness raising workshops and the in-depth technical trainings. Information is coming to the stakeholders and continued support is being provided.	27000	7000	5000	5000	5000	5000
	Total component 2	**207000**	**17000**	**95000**	**65000**	**25000**	**5000**
Component 3: Technical support is available locally for the development,	Technical trainings on the repair and maintenance of RE systems. One training for biomass applications, one training for solar systems, one training for hydropower systems (100 participants each, participants from various provinces are brought together).	30000	0	10000	10000	10000	0

management and maintenance of RE applications							
	Printing costs/training materials for all workshops and trainings (150 US per one day training * 27 training/workshop days)	4050	600	1950	1050	450	0
	Development and production of audio visual learning tools:						0
	* video for general awareness raising on RE applications (1 audio-video production)	10000	10000	0	0	0	0
	* videos showing examples of successful RE applications, ownership models, management and critical success factors (1 audio-video production with examples for biomass applications, 1 audio-video production with examples for hydropower systems and 1 audio-video production for solar applications)	30000	0	30000	0	0	0
	Setting up of a technical roving unit within vocational training institute(s) to provide advice and assistance in maintenance and repair of RE applications to local businesses, communities, government institutions, etc.), as a follow up on the technical trainings on repair and maintenance. Also support in setting up of local repair businesses. Information/support is coming to the stakeholders and continued support is being provided (training on the job).	22000	0	7000	5000	5000	5000
	Total Component 3	**96050**	**10600**	**48950**	**16050**	**15450**	**5000**
Component 4: Policies facilitate up-scaling and replication of RE systems in rural Thailand	Establishment of a RE Learning Centre to share lessons learned from the project and disseminate to stakeholders and other provinces. Including development of display materials.	20000	0	3000	5000	6000	6000
	Official publications and various smaller publications (leaflets, brochures, etc.). Two official publications: 1) manual/handbook on RE applications, 2) lessons learned from the project, 3,000 copies each a 40,000 US. Various smaller publications total 20,000 US.	100000	10000	30000	15000	15000	30000
	Study tour for identified and selected government officials, and other key stakeholders to the learning centre to learn from the experiences gained during the project (30 people) (e.g. governors of other provinces)	30000	0	0	0	0	30000
	Total component 4	**150000**	**10000**	**33000**	**20000**	**21000**	**66000**

PART I: Related Documents

Operational Focal Point endorsement letter (Annex 7)
Co-financing letters (Annex 8)

PART II: Stakeholder Involvement Plan

Output		Key Stakeholders
Outcome 1	**Strengthened institutional, organizational and social capacity results in planning, management and implementation of integrated RE programmes**	
Output 1.1	Integrated provincial RE plans	- ***MHS Provincial Office*** - MHS Provincial Authority Office - MHS Provincial Energy Office - Policy and Strategy Co-ordination Office, MOEN
Output 1.2	Strengthened mobilization and co-ordination mechanisms	- ***MHS Provincial Energy Office*** - MHS Provincial Office
Output 1.3	Institutional arrangements for cooperatively-owned and PPP renewable energy systems	- ***Network to Strengthen MHS CBOs*** - MHS Provincial Authority Office
Output 1.4	Local entities with strong leadership to plan, develop and manage RE systems	- ***Network to Strengthen MHS CBOs***
Outcome 2:	**Financially sustainable RE systems operational in MHS**	
Output 2.1	Communities in MHS are aware of social, economic and environmental costs and benefits of RE systems	- ***TRF, MHS Office*** - Network to Strengthen MHS CBOs - DEQP
Output 2.2	Operational guidance on SPP (RE)/VSPP and other schemes disseminated among communities	- ***EPPO*** - Network to Strengthen MHS CBOs
Output 2.3	Incentives for rehabilitation of RE systems installed under previous initiatives	- ***MHS Provincial Authority Office*** - Network to Strengthen MHS CBOs
Output 2.4	Off-grid renewable energy electrical systems supply needs to remote communities	- ***PEA*** - DNP
Output 2.5	Grid-linked RE systems in communities not only communities in Mae Hong Son consistent with integrated provincial development plan	- ***PEA*** - DNP
Output 2.6	Non-electrical renewable energy (e.g. charcoal kilns, biodiesel) used in all communities	- ***Network to Strengthen MHS CBOs*** - MHS Provincial Energy Office

Output 3.2 Training in business and resource management	- ***MHS Provincial Energy Office*** - EGAT - DEDE
Output 3.3 Trained entities providing capacity for RE development, management and maintenance	
Output 3.4 Technology/ information disseminated	- ***DEDE*** - DEQP
Output 3.5 Increased number of local RE technologies manufactures	- ***DEDE*** - ***MHS Provincial Energy Office***
Outcome 4: Policies facilitate up-scaling and replication of RE systems in rural Thailand	
Output 4.1 Centre of learning in MHS promoting RE as part of the Sufficiency Economy	- ***TRF, MHS Office*** - MHS PAO - DEQP
Output 4.2 RE applications prominent in government energy programmes	- ***DEDE***
Output 4.3 Flexible subsidies / tax incentives promoting willingness to pay	- ***EPPO***
Output 4.4 Transparent system of government accountability	- ***EPPO*** - DLA
Output 4.5 Policy makers aware of benefits of RE applications	- ***EPPO***
Output 4.6 Networking and exchange of lessons with other RE initiatives through a "VSPP association" for VSPP practitioners, academics, NGOs and government agencies	- ***Policy and Strategy Co-ordination Office, MOEN*** - Network to Strengthen MHS CBOs

Agency	Plan and Activity
National level	
MOEN EPPO	EPPO is to submit and propose national energy policies and plans, preparing for eventual energy self-reliance through energy saving and efficiency through development of RE from domestic sources. They promote competition and increased roles on the part of the private sector in terms of power purchasing mechanisms from SPP and VSPP. Apart from this, policy is being implemented to provide support for SPPs that are making use of renewable energy from the energy conservation fund currently under the EPPO administration. EPPO is to make available the budgetary allocation framework to promote energy conservation, to coordinate for more collaboration for this purpose and to act as the national energy-related information center. Part of its current activities includes RE promotion and demonstration in the various areas countrywide. It also promotes public relations activities and campaigns in all forms for the general public, including Mae Hong Son – however, no related action is currently being implemented.
DEDE	An action plan is set whereby community-based hydro power generation will be encouraged in any location with potential, including new ones or those in dilapidated condition with possibilities for restoration. These will ultimately be transferred to either LGOs or community cooperatives while the DEDE will provide necessary advice and monitoring support. The locations for new implementation are still under consideration together with assessing potential and needs, as well as readiness of communities involved. However, one point being kept in mind is that, if possible, operations in the protected areas be avoided. DEDE is planning to promote and demonstrate various forms of RE utilization for interested agencies and households all over the country. These include transforming waste into energy, community biodiesel promotion, and economical and efficient energy consumption/ utilization.
PSCO	PSCO is implementing a Project "Local Energy Planning through joint actions" with related LGOs and communities. Replication will be carried out by expanding from the 24 prototype models in 2006 to 80 in 2007. One has been constructed in Pang Moo Sub-district of Muang (city) District of Mae Hong Son. Monitoring and evaluation are being conducted along with the community-level development of leaders and volunteers to ensure sustainability and replicability to other locations. In the near future, it is expected that some 126 target locations will be identified nationwide in 2007 of which two or three new sites will be in Mae Hong Son.
MONRE DNP	DNP is in charge of natural resources in protected areas of the country. Related to the project, 80% of Mae Hong Son is classified as protected area. DNP is thus significant in developing new initiatives in this province, especially tourism promotion in national parks. Water power utilization has been demonstrated for the benefits of the participating communities and for improving quality of life in remote communities.
DEQP	DEQP acts as a center for data and information, as well as campaigns on national environment, focusing increasingly on climate change. It is also conducting R&D on RET and is commissioned to transfer environmentally friendly technologies. It has been attempting to establish networks of community-based natural environment volunteers in Mae Hong Son and elsewhere in the country with no specific action scheduled for Mae Hong Son yet.
State Enterprises	EGAT generates power in Mae Hong Son either through mini-hydro or diesel

Agency	Plan and Activity
EGAT	fuel facilities. There is a solar cell power production unit at Pha Bong in Mae Hong Son with a capacity of 300 KW which has objectives to demonstrate and conduct research on power generation rather that power production for sale as such. EGAT is planning to expand its power generation to meet current and future demand in Mae Hong Son Province. A preliminary study has already been conducted with the EGAT action plan likely affecting Mae Hong Son's new initiative on the RE-based power promotion. EGAT already has undertaken studies and research on RETs, and owing to this, it can also provide necessary support to the project of which it is interested to take part in its investment with any interested LGO.
PEA	PEA provides users with services and manages distribution channels of various types. Power production in Mae Hong Son is insufficient when water supply is scarce (dry season) or during peak demand. For that period PEA will supplement the needed power with either hydro power or diesel fuel, or both. PEA used to be the agency taking part in installing the SHS for some 15,000 households in Mae Hong Son and, at present, it is still in charge of their maintenance PEA is planning to construct some 25 hydro power plants nationwide in remote areas for their SCR task.
Local level	
MHS Provincial Office	The MHS PO is in charge of coordinating various agencies in determining the provincial development strategies focusing on natural resource management and sustainable tourism. MHS PO is to locally coordinate initiation of this project and to act as the secretariat of the provincial working group. It is expected that the provincial energy plan to be formulated will be integrated into the provincial development strategy plan to ensure the implementation in compliance with standard bureaucratic procedures.
MHS PAO	MHS PAO is to implement the provincial development strategy plans by translating them into practice consistent with local people's needs and local conditions, as well as to provide assistance to LGOs and various agencies in the province. To date the MHS PAO has provided budgetary support to a school for micro-hydro to use a waterfall behind the school's building. The MHS PAO has a significant role in developing the province's tourism which can connect RE with the tourism industry. Moreover, the MHS PAO has development plans in place for new investment initiatives and support for RE-based operations highlighting creating understanding for local leaders and good system administration and management to ensure sustainability and benefits for underprivileged communities.
MHS Provincial Energy Office	Since 2006 the MHS PEO through the Region 10 Energy Office, has formulated a provincial energy development strategy plan for MHS. Such a plan will be implemented by the recently instituted provincial energy office. The MHS PEO's energy strategy development plan highlights balanced energy and environmental development to ensure self-reliance for all based on the sufficiency economy philosophy. Its short-term plan focuses on biodiesel production based on vegetable oil plants; its intermediary plan focuses on feasibility studies of various forms of available RE; its long-term plan seeks to increase hydro power production. To date the MHS PEO is not ready in terms of personnel and facilities needed for the implementation of this action plan. Owing to this, it is only providing cooperation with various agencies that are ready to drive initiatives in meeting these challenges.

Agency	Plan and Activity
Strengthened MHS CBOs Network	With its long and outstanding role and experience in working with communities and civil society in MHS, this network has been recognized by various communities and state agencies. Coupled with the present RE condition, this network will be useful in coordination and cooperation for this project. In spite of its interest in the RE, it does not have any specific RE-related activity yet. However, its capability and experience, as well as performance in the natural resource management, local wisdom utilization and driving roles at the grassroots level within this province, will serve well as a replication platform to assist this project to continue its action for RE-related benefits of this province.

PART III: List of Annexes referred to in the text

Annex 1: Detailed information on the socio-economic context in Mae Hong Son

Annex 2: Energy Scenarios for MHS

Annex 3: Details of the MHS Energy Strategy report by Regional Energy Office 10

Annex 4: Detailed description of barriers by technology.

Annex 5: Summary of stakeholder consultation events

Annex 6: The "long list" of stakeholders consulted

Annex 7: Operational Focal Point endorsement letter

Annex 8: Co-financing letters

SIGNATURE PAGE

Country: THAILAND

UNPAF Outcome(s)/Indicator(s):	Improved sustainable utilizations and management of natural resources and the environment at national and community levels
Expected Outcome(s)/Indicator (s):	Increased capacity of national focal points in addressing policy removal of barriers in pursuing local sustainable management of natural resources and environment in selected ecosystems and promotion of area-based renewable energy application.
Expected Output(s)/Annual Targets:	Demonstration of sustainable management of viable renewable energy consumption and production in Mae Hong Son Province; model dissemination and policy advocacy to promote the utilization of renewable energy nationwide
Implementing partner:	Thailand Environment Institute (TEI)
Responsible parties:	Mae Hong Son provincial and local authorities Ministry of Energy (DEDE, PSCO) Electricity Generating Authority (EGAT) Provincial Electricity Authority (PEA) Bank of Agriculture and Cooperatives (BAAC)

Programme Period: 2010-2015
Programme Component: Energy and Environment
Project Title: Promoting Renewable Energy in Mae Hong Son Provinces
Proposal/project ID: 00048912/00059287
Project Duration: 5 years
Management Arrangement: NGO Impl. Partner

Total budget: USD 12,032,700
Allocated resources:
- Regular
- Other:
  - GEF USD 2,712,700
- Government (Cash + in kind) USD 8,770,000
- In-kind Contribution NGO
  - TEI USD 550,000

Agreed by (Mae Hong Son Provincial Government):

_____ _____
Mr. Thongchai Wongrianthong Date
Governor, Mae Hong Son Province

Agreed by (UNDP):

_____ _____
Ms. Gwi-Yeop Son Date
UN Resident Coordinator and UNDP Resident Representative