CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

Title : Clean Energy One Biomass Power Plant Project
Version: 04
Date: 06/08/2010

A.2. Description of the small-scale project activity:

Purpose of the project activity

The proposed project entails the installation of a 9.4 MW power plant, which uses coconut residues as the primary fuel for power generation. The project is located in Prachuap Khirikhan Province, in southern Thailand.

Clean Energy Thapsakae Limited[1] was founded for the purpose of electricity production from biomass and electricity supply to the national grid. The project is a Greenfield project. As discussed in Section B.4, the most conservative and plausible baseline scenario corresponds to the situation in which the power would have been generated in the grid. The main biomass fuels for the project are coconut residue and coconut frond. The coconut residue is a by-product from the coconut fiber production. Coconut residue is easy to obtain in the plant area and surroundings as the main agricultural activity in Prachuap Khirikhan, Chumporn, Surat Thani and Samut Sakhon is based on coconut plantations. The biomass residues used in the project activity would have been dumped in open in the absence of the project activity.

The electricity generated will be sold to the Provincial Electricity Authority (PEA). The main channel for PEA purchases of renewable energy is the Very Small Power Producer scheme. Standardized power purchase agreements (PPAs) with EGAT (Electricity Generating Authority of Thailand) under the VSPP (Very Small Power Producers) program run for one year and are renewed annually.

The use of biomass residue as a fuel for power generation displaces an equivalent amount of grid power, which would otherwise be produced by grid connected power plants. In Thailand, grid power is comprised of a large share of fossil fuel based generation systems. The project will thus achieve GHG (greenhouse gas) emission reductions by displacing fossil-fuel electricity from the grid.

Contribution to the Sustainable Development of the Host Country

1. **Social well being:**

- The project activity results in social and economic benefits by generating employment, in a deprived segment of society, at the rural level for collecting, processing and supplying the biomass. Opportunities are being generated for the people to collect and transport the biomass. Additional jobs are created for operation and maintenance of the biomass power plant.

2. **Economic well being:**

[1] Earlier known as - TP Reanchai Industry Company Limited

- The project reduces fossil fuel requirements through the use of biomass. Therefore, fossil fuel import requirements for the country are reduced;
- Through the use of agricultural residues, the project offers monetary benefits to the farmers that sell these residues, thus making rural areas more self sustainable.

3. Environmental well being:

- As compared to the standard practices of burning biomass residues in the fields, or leaving them to decay which might generate odour, the project activity utilizes the biomass for power generation and therefore improves local air quality;
- Apart from the reduction of GHG emissions, the project significantly reduces SO_x and NO_x emissions. This is due the fact that biomass contains lower amount of Sulphur and Nitrogen in comparison to fossil fuels[2]
- Since, the project uses only biomass materials for power generation it reduces the demand for energy generation through fossil fuels such as coal, lignite, gas and oil.

4. Technological well being

- The project showcases an innovative way to use low-density crop residues, combining power generation from renewable resources and sustainable development in rural areas. The combustion chamber of the boiler has been imported from Germany and the turbine generator has been imported from Malaysia.
- The project presents technological innovations in the boiler design and special Operation and Maintenance Protocols in order to avoid corrosion problems caused by the fuel properties of low-density crop residues.

In light of the information above, the project activity strongly contributes to sustainable development. Biomass fuels represent abundant and unexploited energy resources for Thailand. Renewable energy sources currently account for a very small proportion of Thailand's electricity generation, which is dominated by natural gas, lignite and imported fuel oil. The project, by producing electricity from biomass residues, will directly complement the Thai government's effort to reduce the country's dependency on imported fossil fuels. The project will also play an important role for the country in meeting electricity demand while using less fossil fuel.

The proposed project activity is implemented purely on a voluntary basis. There is no regulation that requires implementing such a project.

A.3. Project participants:

Name of Party involved (*) (host) indicate a host party	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Thailand (host country)	Clean Energy Thapsakae Limited	No

[2] http://www.docstoc.com/docs/26052572/A-Summary-of-NOx-Emissions-Reduction-from-Biomass-Cofiring/

http://www.eusustel.be/public/documents_publ/WP/WP3/Biomass%20Applications%20Report%20Final%20ICEPT.pdf

	(private entity)	
Switzerland	Swiss Carbon Assets Ltd (private entity)	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party (ies) involved is required.		

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

A.4.1.1. Host Party(ies):

Thailand (the "Host Country")

A.4.1.2. Region/State/Province etc.:

Prachuapkhirikhan Province

A.4.1.3. City/Town/Community etc:

Tubsakae District

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity :

The project activity is situated in Tubsakae district, Prachuapkhirikhan Province.
The address of the site is:
137 Moo3 Petchakasem Road,
Tumbon HuayYang Ampur Tabsakae,
Prachuapkhirikhan Province,
Thailand

The coordinates of the project are::

- Latitude : 11°36'17"N
- Longitude : 99°38'59"E

Figure 1. The location map of Prachuap Khiri Khan

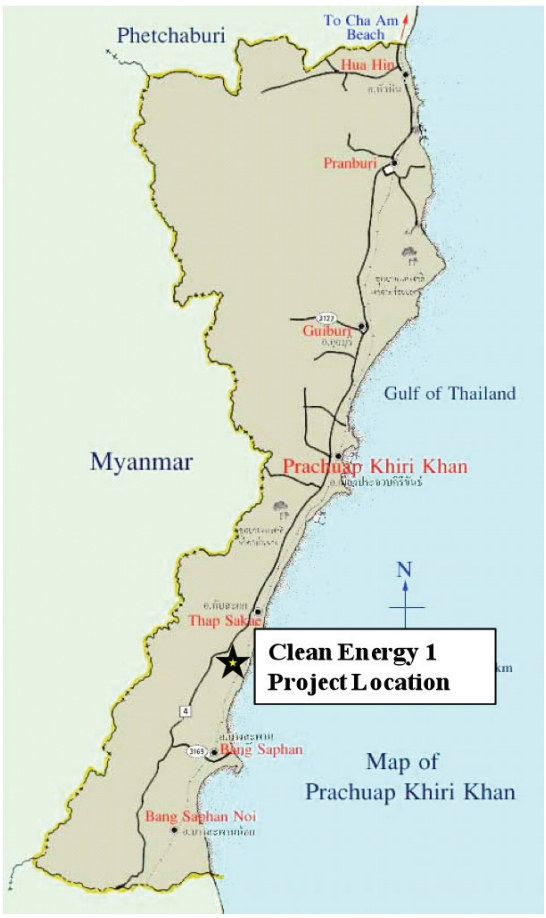


Figure 2. Map showing the location of the project activity in Thap Sakae

A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

Project type Type I – Renewable energy project

Category D – Electricity generation for a system[3]

The total installed capacity of the generator does not exceed the threshold of 15 MW for electricity generation projects under type I.

Technology of project activity

The project activity is situated in Tubsakae district, Prachuapkhirikhan Province, which is the region where coconut trees are most abundant in Thailand. The technology used, based on coconut residues combustion, is environmentally safe and sound. Compared to conventional fuels, coconut energy source has a lower impact on the environment.

[3] Page 52 - Appendix B - http://cdm.unfccc.int/Reference/COPMOP/08a01.pdf#page=43

The biomass residue is delivered to the power plant predominantly from the coconut processing factories, which have produced coconut fiber for more than 30 years and from the surrounding community in the form of other coconut residue (such as coconut frond).

Coconut residue is used as fuel in boiler. The boiler produces steam to drive the 9.4 MW turbine and is expected to produce 66,488 MWh of electricity per year. The electricity will be sold to the Provincial Electricity Authority (PEA) for use on the national grid.

Following are the technical parameters for the boiler and the turbine.

Boiler	Unit	Value
Rated capacity	TPH	45
Outlet pressure	Bar	43
Outlet temperature	Deg C	450
Type		Moving step grate
Efficiency	%	86.66%
Manufacturer		LAWI Engineering

Turbine	Unit	Value
Rated capacity	MW	9.4
Inlet pressure	Bar	41
Inlet temperature	Deg C	420
Type		Condensing
Manufacturer		Jebsen & Jensen

The project employs a Stepping Grate Stoker, which is a moving grate system. The technology is developed by LAWI Engineering GMbH, Germany. LAWI 's system is a system whereby 60% of the combustion is in the air while 40% is on the grate[4].

The operational lifetime of the project is 20 years.

Picture 1: Project site

[4] Technical description from the Feasibility report

Picture 2: Project site

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

A renewable crediting period of 7 years has been chosen. The estimated emission reductions are as follows:

Years	Estimation of annual emission reductions in tonnes of CO_2e
2011	38,098
2012	38,098
2013	38,098
2014	38,098
2015	38,098
2016	38,098
2017	38,098
Total estimate reductions (Tonnes of CO2e)	266,685
Total number of crediting period	7
Annual average over the crediting yeas of estimated reductions (tonnes of CO2e)	38,098

A.4.4. Public funding of the small-scale project activity:

The project has not received any public funding from Annex I countries.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

With reference to "Appendix C to the simplified modalities and procedures for the small scale CDM project activities", 'Debundling' is defined as the fragmentation of a large project activity and is not eligible to use the simplified modalities & procedures for small-scale CDM project activities. In view of Para 2 of Appendix C ,the proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or a request for registration by another small-scale project activity:

- With the same project participants;
- In the same project category and technology/measure;
- Registered within the previous two years; and
- Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

The proposed project activity is not a debundled component of large scale project as there is no other small-scale project activity that fulfils the above mentioned criteria.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the small-scale project activity:

The approved baseline and monitoring methodology applied to the project activity is:

AMS.I.D-Grid connected renewable electricity generation
Reference Version 15, scope 1, approved at EB 50, valid from 30th Oct 2009[5]

AMS.I.D refers to:
"Tool to calculate the emission factor for an electricity system" version 02,

B.2 Justification of the choice of the project category:

The table below is used to justify the choice of the project type and category of the project activity, by highlighting the eligibility of the project activity as per applicability criteria defined in AMS I.D.

No.	Reference to AMS I.D	Relevance of the project activity
1	This category comprises renewable energy generation units, such as photovoltaics, hydro, tidal/wave, wind, geothermal and renewable biomass, that supply electricity to and/or displace electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit.	The project activity uses biomass residues a renewable source of energy, which supplies electricity to the national grid thereby displacing electricity generated from the fossil fuels.
2	Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology: ▪ The project activity is implemented in an existing reservoir with no change in the volume of reservoir;	The project activity is not a hydro power plant and therefore this condition is not relevant.

[5] http://cdm.unfccc.int/methodologies/DB/UX8NR66U85988BFYZJ70BIIZNUHC9H/view.html

	▪ The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the Project Emissions section, is greater than 4 W/m2; ▪ The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the Project Emissions section, is greater than 4 W/m2.	
3	If the unit added has both renewable and non-renewable components (e.g. a wind/diesel unit), the eligibility limit of 15 MW for a small-scale CDM project activity applies only to the renewable component. If the unit added co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15 MW.	The project activity has only renewable component as it utilises biomass in the power plant to generate electricity using boiler and turbine. The rated capacity of the turbine is 9.4 MW which is less than the eligibility of 15MW. The project activity does not co-fire fossil fuels.
4	Combined heat and power (co-generation) system are not eligible under this category.	The project activity is not a cogeneration system.
5	In the case of project activities that involve the addition of renewable energy generation units at an existing renewable power generation facility, the added by the project should be lower than 15 MW and should be physically distinct from the existing units.	The project activity is implemented in a new location and is therefore not addition at an existing facility. This condition therefore is not relevant.
6	Project activities that seek to retrofit or modify an existing facility for renewable energy generation are included in this category. To qualify as a small-scale project, the total output of the modified or retrofitted unit shall not exceed the limit of 15 MW.	As explained in point 5 above, the project activity is implemented in a new location and is not a retrofit or modification of an existing facility. This condition is therefore not relevant.

As discussed above, the project activity meets all the relevant applicability conditions of AMS ID.

B.3. Description of the project boundary:

According to paragraph 7 of the methodology, the project boundary has been defined as:

> *"The physical, geographical site of the renewable generation source delineates the project boundary."*

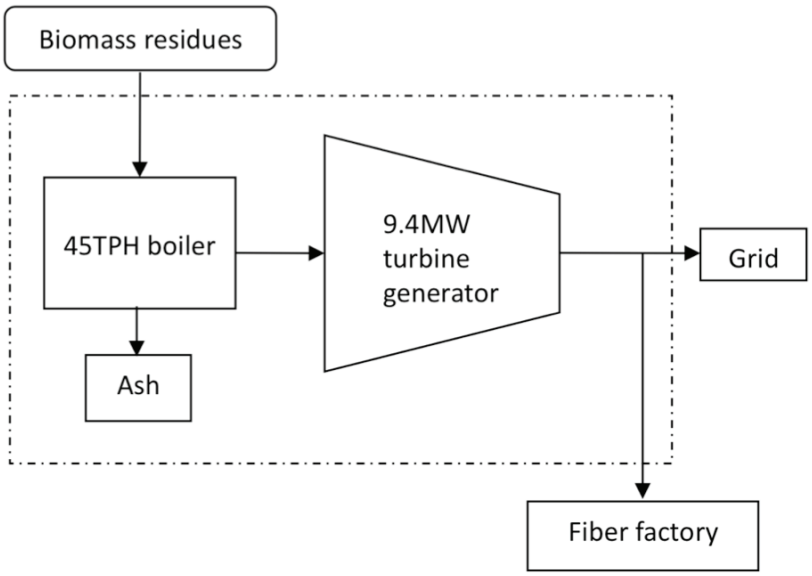


Fig: **Project Boundary**

B.4. Description of baseline and its development:

The baseline emissions should be calculated according to paragraph 10 of the methodology as:

> *"For all other systems, the baseline emissions are the product of electrical energy baseline expressed in kWh of electricity produced by the renewable generating unit multiplied by an emission factor"*

The proposed project activity is a renewable fuel based electricity generation, which will export electricity to the grid. This electricity exported will displace electricity generated from fossil fuels in the grid. The emission factor has been calculated following the approach given in paragraph 11 (a) of the methodology.

> "11 *(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the 'Tool to calculate the emission factor for an electricity system"*

A detailed analysis on combined margin (CM) can be found in Annex 3.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

In line with the Attachment A to Appendix B of the simplified modalities and procedures for small-scale CDM project activities, project participants shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers:

a) Investment barrier
b) Technological barrier
c) Barrier due to prevailing practices

d) Other barriers

Investment barrier

The additionality has been demonstrated using the benchmark analysis as the project activity generates revenues from selling of power in addition to the CDM related income. The financial indicator chosen is the project IRR.

The project activity entails an investment of 639.6 million THB. The investment analysis has been done over a period of 20 years consistent with the project's operational lifetime. The input values have been sourced from the project's feasibility study[6] and all the supportive documents will be provided to the DOE for validation.

The following table outlines the key input parameters used in the investment analysis:

Cost	Unit	in millions
Total investment	THB	639.626
Debt	%	62.54%
Equity	%	37.46%
Labor cost	THB	12
Administrative expenses	THB	5
O&M *-Regular*	THB	4
-Major (every 6 years)	THB	6
Escalation	%	5%
AES O&M Cost	% of revenues	0.02
Energy fund	THB/kWh	0.01
Depreciation (straight line)		
Building and construction (20 years)	THB/yr	3
Machinery & others (10 years)	THB/yr	51.79
Tax		
Year 01 – Year 08		0%
Year 09 onwards		30%

The project activity has an installed capacity of 9400 kW, of which 8000 kW will be used to export electricity to the national grid and 500kW to the neighbouring fiber plant. The revenues from export are as per the tariff mentioned below:

Tariff	Unit	Rate	Escalation	
Peak	THB/kWh	2.9278	5%	Every 6 years
Off-peak	THB/kWh	1.1154	5%	Every 6 years
FT	THB/kWh	0.6865	3%	per annum
Adder	THB/kWh	0.3		
PEA Operating cost	of kWh dispatched	2%		Deduction
Fiber plant	THB/kWh	2.4	3%	per annum

[6] Data from the feasibility report: Biomass power plant, Location Prachuap Khirikhan, Fuel – Coconut residues, Date: 16/06/2008.

In line with the guidance available in "Guideline on the assessment of investment analysis" (Annex 58, EB51), depreciation has been added back to the net profits. The result of this analysis is a post tax project IRR 11.08% which is not attractive enough to be viable under the business-as-usual scenario. The benchmark is referred from the two indicative rates associated with power generation in Thailand. The study by NEPO (The National Energy Policy Office) of Thailand and Black & Veatch[7] outlines the acceptable IRR hurdle rate as 23% and projects with IRRs below this rate are not deemed as financially viability and attractive. This study however dates back to 2001 and therefore we also refer to a more recent rate sourced from "IPP Bidding" by Ayudhya Securities Public Company Limited, which cites the benchmark of 15% for an Independent Power Producer (IPP)[8]. The 15% benchmark is chosen as bother realistic and conservative. In the light of the above, the project activity (project IRR – 11.08%) is clearly not financially attractive compared to the benchmark (15%).

The robustness check of the analysis has been carried out by a sensitivity analysis of the parameters subjected to reasonable variation (±10%).

Variable	-10%	-5%	0%	5%	10%
Total cost	12.95%	11.98%	11.08%	10.26%	9.50%
O&M cost	11.18%	11.13%	11.08%	11.03%	10.99%
Power output	7.29%	9.27%	11.08%	12.78%	14.39%

The reduction in Total cost and O & M cost by 10% and an increase in power output by 10% does not result in a project IRR which crosses the benchmark. Therefore, this further strengthens the assumptions made above and clearly demonstrates that the project activity is not viable under business-as-usual.

Barrier due to prevailing practice

Moreover, there are currently several biomasses fired power plants in Thailand in operation; however, none of them use coconut residue as a primary source of fuel. The following table illustrates the proportion of renewable energy used for VSPP or "Very Small Power Producer" scheme in Thailand.

Thailand Renewable Energy as of September 2009

[7] Biomass based power generation and cogeneration within small rural industries of Thailand - http://www.nrbp.org/papers/037.pdf

[8] http://www.ays.co.th/Uploadeds/Research/eng/Energy_071119_U.pdf

	Type of fuel/Technology	Amount of electricity sell to system		
		Amount	Install capacity(MW)	Amount of electricity sell to the grid (MW)
Renewable Energy				
1	Solar Panel	46	6.685	6.575
2	Biogas	27	30.242	23.083
3	Biomass	50	691.201	263.835
	Palmoil residue	1	12.000	8.500
	Jatropha residue	0	-	-
	bagass	28	521.800	156.300
	bagass+rice husk	1	39.400	8.000
	rice husk	11	61.425	51.400
	rice husk + woodchip	2	17.300	14.500
	rice husk+ corn husk	0	-	-
	sawdust	1	0.600	0.600
	coconut residue	0	-	-
	corn residue	1	0.160	0.135
	corn residue+rice husk	0	-	-
	EFB	4	26.516	18.200
	bark	0	-	-
	hay	0	-	-
	tapioca	0	-	-
	woodchip	1	12.000	6.200
4	waste	4	5.620	5.100
5	hydropower	3	0.560	0.540
6	wind	2	0.330	0.330
7	used vegetable oil	0	-	-
Total		132	734.638	299.463

*Coconut residue

Source: www.eppo.go.th/power/data/status-VSPP-sep-2009.xls

As can be seen from the table above, Thailand now has a total of 734.638 MW of installed capacity through renewable energy and 299.463 MW of this has been fed to the national grid system from solar, biogas, biomass, landfill, hydro, wind and cooked oil. However, from this capacity no power has been generated from coconut residues. The implementation of proposed project activity will increasethe technology and knowledge awareness of coconut residue based power generation systems. It will further help in utilisation of the coconut residues in energy generation which would have been left to decay in the absence of the project activity.

Since the project is the first of a kind for coconut residue power plant, the operation and maintenance requires skilled boiler operators. These operational difficulties are considerable deterrents to project activity. Project proponents shall cover these extra costs and efforts by utilizing the CER income.

Local staff will have to undergo extensive training to ensure adequate combustion temperature. Training must also be extended to cover ash disposal and other matters relating to the proper operation of the power plant, notably water treatment. The careful control and monitoring of the water quality needed for a high-

pressure boiler system to prevent problems with the boiler and with the turbine blades requires training for a skilled technician. The proper maintenance is essential especially because, should the power plant be damaged, there will not be spare parts immediately available in Prachuab Kririkhan province. The application of the new technology will be too risky to implement without financial assistance through obtaining CERs

Demonstration and assessment of Prior Consideration of the CDM
The following table gives an overview of the timeline of key milestones in the project implementation clearly showing CDM consideration.

Date	Event
17/6/2008	Project feasibility study including CDM consideration
29/8/2008	Announcement of the project with CDM acknowledged content[9]
7/10/2008	Communication from SCB Quant Asset Management Co Ltd[10] with South Pole Carbon Asset Management
20/12/2008	Civil engineering work start = Project start date
1/12/2008	MoUwith South Pole Carbon Asset Management
27/01/2009	Submission of the Letter of Intent to Thai DNA
18/03/2009	Financial closure of the project (Paid up capital)
02/04/2009	Submission of the Letter of Intent to the UNFCCC
10/04/2009	ERPA signed between project owner and Swiss Carbon Assets Ltd
25/08/2009	Stakeholder consultation meeting
08/01 – 06/02' 2010	PDD webhosted on the UNFCCC website

Conclusion
It is clear that the carbon credits revenues play a significant role in the financial viability of the projectand that the project owner would not have invested in such a project without the consideration of carbon credits revenues. The above timeline shows that CDM has been considered since the early stages of project implementation and has played an important role in the decision making to go ahead with the project. Furthermore, the project activity contributes in the mitigation of Global Warming by using a renewable biomass. The additional revenues from CDM will therefore help in rapid propagation of such projects which otherwise would not happen.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

Baseline Emissions BEy
The project activity comprises measures which generate emission reductions from by using biomass residues for power generation (AMS ID).

The baseline emissions (BE_y) can be given as follows:

[9] http://www.asia-rising.com/News_Detail.asp?id=6

[10] Now "Asia Rising Advisory Limited"

$$BE_y = EG_y \cdot EF_{grid,y}$$

Where:

BE_y	Baseline emissions due to electricity generation during the year y, tCO_2
EG_y	Net electricity exported by the project activity during the year y, MWh
$EF_{grid,y}$	Emission factor of the Thai national grid, tCO2/MWh (fixed ex-ante)

Project emissions
As per paragraph 14 in AMS ID, the project activity utilizes biomass residues as a source of energy therefore, the project emissions are not considered.

Leakage
There are two potential sources of leakage in the project activity:

Transfer of equipment
As per paragraph 15 in AMS ID, leakage would occur in the case where **"**the energy generating equipment is transferred from another activity". The project activity does not result in any transfer of equipment from another activity, leakage from this source is not considered.

Competing use of Biomass
According to the paragraph 18 of Attachment C to Appendix B[11] - General Guidance on leakage in biomass project activities -

> *"The project participant shall evaluate **ex ante** if there is a surplus of the biomass in the region of the project activity, which is not utilised. If it is demonstrated (e.g., using published literature, official reports, surveys etc.) at the beginning of each crediting period that the quantity of available biomass in the region (e.g., 50 km radius), is at least 25% larger than the quantity of biomass that is utilised including the project activity, then this source of leakage can be neglected otherwise this leakage shall be estimated and deducted from the emission reductions."*

The assessment uses the latest publicly available data from official sources to demonstrate that the project does not results in leakage from competing use of biomass.

Availability of Biomass residues

Type	Provinces	Tonnes/Year[12]
Fiber	Prachuap Kririkhan	547,488
Frond	Prachuap Kririkhan	293,304

Consumption of biomass residues
According to the publicly available information of coconut residue usage

Type	User	Tonnes/Year

[11] http://cdm.unfccc.int/Reference/Guidclarif/ssc/methSSC_guid04.pdf

[12] Department of Agriculture Extension, Prachuap Kririkhan

Fiber	Project activity	50,250
	Fertilizer*	108
	Others**	273,744
Frond	Project activity	43,550
	Others**	146,652

Note:
* Cooperative of Prachuap Kririkhan province,
**Due to the lack of publicly available information from the government source, the project assumes that coconut may be bought, transferred and processed outside the province where the project located. Hence, the project deducted the total amount by 50% for the conservativeness assumption.

Surplus
The following table illustrates that for each type of biomass used, the surplus available is more than 25%. Therefore, no leakage is to be considered from competing use of the biomass residues.

Type	Generation (Tonnes/Yr)	Consumption (Tonnes/Yr)	Surplus (%)
Fiber	547,488	324,102	68.92%
Frond	293,304	190,202	54.21%

Emission reductions
As discussed above, the project activity does not lead to project or leakage emissions. Therefore, the emission reductions are given as:

$$ER_y = BE_y$$

Where:
ER_y Emission reductions during the year y, tCO2
BE_y Emission reductions due to electricity generation during the year y, tCO_2

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	**$EF_{grid,y}$**
Data unit:	tCO_2/MWh
Description:	Emission factor of the Thai national grid
Source of data used:	EGAT, EPPO, DEDE
Value applied:	0.573 tCO_2/MWh
Justification of the choice of data or description of measurement methods and procedures actually applied :	The calculation is done as per the "Tool to calculate the emission factor for an electricity system", version 02. The data is from publicly available authentic sources like EGAT, EPPO, DEDE and IPCC.
Any comment:	Fixed ex-ante

Data / Parameter:	**$EF_{OM,y}$**
Data unit:	tCO_2/MWh
Description:	CO_2 Operation margin emission factor of the Thai national grid.
Source of data used:	EGAT, EPPO, DEDE
Value applied:	0.547
Justification of the	The calculation is done as per the "Tool to calculate the emission factor for an

choice of data or description of measurement methods and procedures actually applied :	electricity system". The data is from publicly available authentic sources like EGAT, EPPO, DEDE and IPCC.
Any comment:	Fixed ex-ante

Data / Parameter:	**$E_{BM,y}$**
Data unit:	tCO_2/Mwh
Description:	CO_2 Build margin emission factor of the Thai national grid
Source of data used:	EGAT, EPPO, DEDE
Value applied:	0.600
Justification of the choice of data or description of measurement methods and procedures actually applied :	The calculation is done as per the "Tool to calculate the emission factor for an electricity system". The data is from publicly available authentic sources like EGAT, EPPO, DEDE and IPCC.
Any comment:	Fixed ex-ante

Data / Parameter:	**SFC_k**
Data unit:	kg/kWh
Description:	Specific fuel consumption of the biomass residues of type k
Source of data used:	Heat balance calculation by the technology supplier
Value applied	Specific fuel consumption - Coconut fibre: 1.501 Specific fuel consumption - Coconut frond: 1.664
Justification of the choice of data or description of measurement methods and procedures actually applied :	The source of data for the calculation of specific fuel consumption is the Heat balance analysis done by the Technology provider (Sabang Corportation Ltd).
Any comment:	The specific fuel consumption data is not used in the calculation of emission reductions. As per the paragraph 20 and 21 of the methodology AMS 1D version 15, this data is used only in the case fossil fuel is also used in the project activity. The project activity however does not plan to use any fossil fuels.

B.6.3 Ex-ante calculation of emission reductions:

Baseline Emissions BE_y

The project activity comprises measures which generate emission reductions from by using biomass residues for power generation (AMS ID).

The baseline emissions (BE_y) can be given as follows:

$$BE_y = EG_y \cdot EF_{grid,y}$$

Where:

$BE_{elec,y}$ Baseline emissions due to electricity generation during the year y, tCO_2
EG_y Net electricity exported by the project activity during the year y, MWh
$EF_{grid,y}$ Emission factor of the Thai national grid, tCO2/MWh (fixed ex-ante)

The expected electricity export has been estimated based on the following assumptions.

Operating hours		**Peak**	**Off-peak**	
Day		**Mon-Fri**	**Mon-Fri**	**Sat/Sun/holidays**
Time		**9:00 - 22:00**	**22:00-9:00**	**Full day**
EGAT dispatch order	kW	8,000	8,000	8,000
Hours to grid	hours	13	11	24
kWh to grid (per day)	kWh	104,000	88,000	192,000
Days in year		247	247	118
Total hours to grid (per year)	92%	2,954	2,500	2,605
kWh to grid per year	**kWh**	**23,632,960**	**19,997,120**	**20,843,520**
Sale to fiber plant	kW	500	500	500
Hours to fiber plant (per day)		6	6	12
Days in year		247	247	118
Total hours to fiber plant per year	92%	1,363	1,363	1,303
kWh to fiber plant (per year)	**kWh**	**681,720**	**681,720**	**651,360**

The EG_y is given as the sum of export to the grid and to the fiber plant.

= , **+** ,

Therefore, from above table,

$EG_{grid,y}$ = (23,632,960+19,997,120+20,843,520)/1000
= 64,473.6 MWh
and,

$EG_{fiberplant,y}$ = (681,720+681,720+651,360)/1000
= 2,014.8 MWh

Therefore, EG_y = 66,488.4MWh / year

Using the values, EG_y = 66,488.4 MWh and $EF_{grid,y}$ = 0.573 tCO2/MWh, the annual baseline emissions are given as:

BE_y = 38,098 tCO_2e / year.

As discussed in section B.6.1, there are no project or leakage emissions from the project activity. Therefore, the emission reductions are given as:

$$ER_y = BE_y$$

Where:

ER_y Emission reductions during the year y, tCO_2

BE_y Baseline emissions due to electricity generation during the year y, tCO_2e / year

From above, ER_y = 38,098 tCO_2e / year.

B.6.4 Summary of the ex-ante estimation of emission reductions:

Year	Estimation of project activity emissions tCO2e	Estimation of baseline emissions tCO2e	Estimation of leakage tCO2e	Estimation of overall emission reductions tCO2e
2011	0	38,098	0	38,098
2012	0	38,098	0	38,098
2013	0	38,098	0	38,098
2014	0	38,098	0	38,098
2015	0	38,098	0	38,098
2016	0	38,098	0	38,098
2017	0	38,098	0	38,098
Total (tonnes of CO_2 e)	**0**	266,685	**0**	266,685

B.7 Application of a monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	**$BF_{k,y}$**
Data unit:	Tonnes
Description:	Quantity of biomass residue of type k combusted in the project activity during the year
Source of data to be used:	Plant records
Value of data	Coconut residues – 50,250 tonnes, Coconut frond – 43,550 tonnes
Description of measurement methods and procedures to be applied:	The parameter by type of biomass will be measured continuously using the weighbridge installed at the project activity. The amount of biomass combusted will be given by the difference between the amount of biomass received and the amount left in the storage yard. The data will be monitored continuously. The data will be collected continuously and reported in the monthly report. The monthly report will be the basis for obtaining this data.
QA/QC procedures to be applied:	The weighbridge will be calibrated as per the manufacturer's specification. The calibration will be done at least once a year.
Any comment:	The data will be kept in the plant for the crediting period + 2 years after it. The data will be maintained in both soft copy and hard copy format. If more types of fuel are used in the project activity, each type of fuel will be monitored separately.

Data / Parameter:	**$EG_{grid,y}$**
Data unit:	MWh

Description:	Net electricity exported by the project activity during the year y
Source of data to be used:	Electricity sale invoices
Value of data applied for the purpose of calculating expected emission reductions in section B.5	64,473.6 MWh
Description of measurement methods and procedures to be applied:	The parameter will be measured continuously using the energy meters. The energy meters are under the ownership of the PEA. Data will be recorded on monthly basis and signed by the PEA and the operation team from the plant. The electricity export figures in the monthly invoices will be the basis of the data for the calculation of the emission reductions..
QA/QC procedures to be applied:	The data can be cross-checked with the plant internal data on power generation and auxiliary consumption. The meters will be calibrated by PEA at regular intervals. The project owner does not have any control on the export energy meter.
Any comment:	The data will be kept in the plant for the crediting period + 2 years after it. The data will be maintained in both soft copy and hard copy format.

Data / Parameter:	**$EG_{fiberplant,y}$**
Data unit:	MWh
Description:	Net electricity exported by the project activity to the fiber plant during the year y
Source of data to be used:	Electricity sale invoices
Value of data applied for the purpose of calculating expected emission reductions in section B.5	2,014.8 MWh
Description of measurement methods and procedures to be applied:	The parameter will be measured continuously using the energy meters. The data will be monitored daily and consolidated monthly. The electricity export figures in the monthly invoices will be the basis of the data for the calculation of the emission reductions.
QA/QC procedures to be applied:	The data can be cross-checked with the plant internal data on power generation and auxiliary consumption and power exported to the grid. The meters will be calibrated annually.
Any comment:	The data will be kept in the plant for the crediting period + 2 years after it. The data will be maintained in both soft copy and hard copy format.

B.7.2 Description of the monitoring plan:

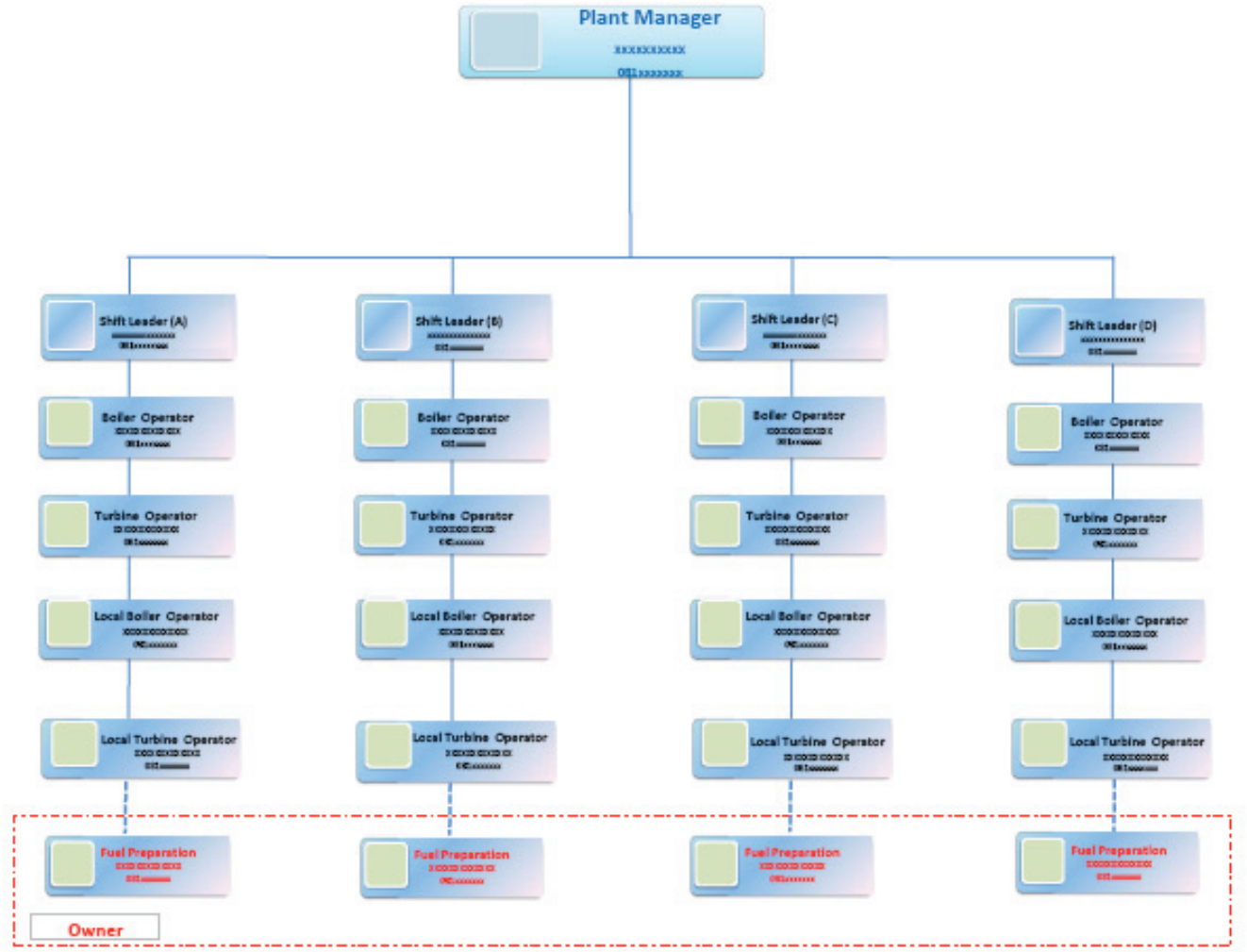
The operation and maintenance for the project activity has been contracted to Siam Operation Services Co., Ltd (SOS). The team from SOS will ensure adequate monitoring of all the important plant parameters including those required in the calculation of the emission reductions. The team will be provided necessary training by the technology providers and equipment suppliers.

The necessary monitoring devices like energy meters and weighbridge will be installed as per the recommendation of the technology provider to monitor the power generation and biomass consumption data within the plant. The data will be recorded online using SCADA but manual records will also be maintained. The export energy meters will be under the control of the PEA. The data will be recorded continuously in the log books and in the online monitoring system.

All the meters will be calibrated at regular intervals as per manufacturer's recommendations. The calibration responsibility of the energy meters for export will be under the PEA.

The project owner will work closely with the team from South Pole in monitoring the data as per CDM requirement. South Pole will make necessary recommendations as well as do regular data checks to make sure that there are no data discrepancies. In case any discrepancy or change in the intended design is found out, it will be promptly reported. This will also form a part of the necessary QA/QC on the data monitored.

The organization chart for the O&M team from SOS is as follows:



The specific responsibilities are described as below:

Position	Manpower	Description
Plant manager	1	Directing and Managing overall Operation & Maintenance include manpower , cost and budget control , shutdown planning, preventive maintenance planning .
Shift Leader	4	Monitors by checking and analysing report , log sheet, laboratory result , problem solving and report to Plant Manager by Daily report form.
Boiler operator	4	Control Process of Power Plant , Boiler System , Combustion , Fuel from the SCADA for normal operating condition and good efficiency after that record and report to Shift Leader by Log sheet form.
Turbine operator	4	Control Process of Power Plant , Turbine & Generator System , Water System, Cooling Tower from the SCADA for normal operating condition and good efficiency after that record and report to Shift Leader by Log sheet

		form.
Local boiler operator	4	Inspecting and checking the machine and equipment , Boiler System , Combustion , Fuel for normal operating condition and good efficiency (local record) after that record and report to Boiler Operator , Shift Leader by Log sheet form.
Local turbine operator	4	Inspecting and checking the machine and equipment , Turbine & Generator System , Water System, Cooling Tower for normal operating condition and good efficiency (local record) after that record and report to Turbine Operator , Shift Leader by Log sheet Form.

B.8 Date of completion of the application of the baseline and monitoring methodology and the name of the responsible person(s)/entity(ies)

Name of persons determining the baseline and monitoring methodology:

Patrick Burgi, South Pole Carbon Asset Management Ltd.

Date of completion of baseline study and monitoring plan: 05/12/2009

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

20/12/2008[13]

C.1.2. Expected operational lifetime of the project activity:

20 years 00 months

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

01/08/2010 or the date of registration whichever is later

C.2.1.2. Length of the first crediting period:

7 years 00 month

[13] Construction start date

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable

C.2.2.2. Length:

Not applicable

SECTION D. Environmental impacts

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

In accordance with the Thai environmental regulations, projects with a power plant capacity below 10MW are not required to carry out an Environmental Impact Assessment (EIA)[14]. However, an Initial Environmental Evaluation (IEE) has been done as part of the requirement of the Thai DNA[15]. The IEE report must be approved in relation to Thai sustainable development criteria for CDM. This process ensures that a project with a negative impact to the environment is considered in parallel with GHG reductions of the project.

The completed IEE report can be provided to the Designated Operation Entity (DOE) on request. The IEE report concluded that the project will create no negative impact on the local environment. In the event of a negative impact, mitigation measures need to be implemented. The main conclusions of the IEE report are:

Noise: During operation, the noise level (Leq-24) at the nearest community, 400 m. away is expected to be 58.9 dB (A). In the absent of project activity, the existing noise level is 58.8 dB(A). The evaluation found out that the impact on the local community is negligible. In addition, the evaluation report showed that the noise level generated by project activity is lower than the standard as following;

Parameters	National standard[16]
Lmax	< 115 dB(A)
Leq 24 hr	< 70 dB(A)
Annoyance Noise	< 10 dB(A)

Air quality: The sources of air emission are the biomass storage; ash handling and boiler stack from the operation of the project activity. The biomass storage and ash handling process will result in dust emission

[14] Notification of Natural Resources and Environment Ministry, Re: The regulation of types and specifications of projects or business that require an environment impact assessment (EIA) including the principles, procedures, practices and guidelines for making an EIA report, under the "Enhancement and Conservation of Natural Environmental Quality Act of 1992", Part 4, Section 46-51.

[15] Outline of CDM project approval process. Thailand Greenhouse Gas Management Oranization (Public Organization). Source: http://www.tgo.or.th/english/index.php?option=com_content&task=view&id=60&Itemid=52

[16] Notification of the Ministry of Industry on Specification of Annoyance Noise and Noise Level from the Factory. B.E. 2548 (2005)

but this will have a very low impact to the environment. The main emission due to the operation of the project activity (Total Suspended Particles (TSP), SO_2 and NO_2) is under the air quality standard of national regulation. Where:

Parameters	National standard[17] @24 hr.
TSP	< 330 µg/m^3
SO_2	< 300 µg/m^3
NO_2	< 320 µg/m^3

Effluent quality: Waste water of the project activity are from the use of employee's daily activity, cooling water blow down, boiler blow down, and demineralise process. The effluent will be treated and reused within the process. Therefore there is no impact on water quality due to the project activity.

Ash Handling: Combustion residues from the process are well handled in the plant area and will be processed and/or transported in accordance with the ministry of industry's regulation[18]. Collected ash would be utilized for soil conditioning purpose.

The IEE report also recommended some preventive measures for the construction phase, as a means to manage on-site solid and liquid wastes, reduce noise, and recommend Occupational Health and Safety (OHS) measures. The IEE report also recommended monitoring measures of pollutants other than the greenhouse gases covered under the Kyoto Protocol (CO, NO_2, PM, etc). All the recommendations from the IEE report will be adopted by the project developer.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

According to the IEE report, there is no significant environmental impact likely to occur due to the project activity. Moreover, according to the regulation, all significant pollutants other than greenhouse gases will be monitored and controlled.

SECTION E. Stakeholders' comments

E.1. Brief description how comments by local stakeholders have been invited and compiled:

A workshop was organized on 25th of August 2009 at Huay Yang, local authority office meeting room to conduct the stakeholder's consultation. It assembled representative from the project developer, the IEE consultants, the CDM staff and local stakeholders as well as the local press. During this meeting about 160 people attended the discussion. An invitation was made almost one month prior to the meeting date.

[17] Ambient Air Standards. Notification of National Environmental Board No. 24, B.E. 2547 (2004) and No. 33 B.E. (2552) under the Enhancement and Conservation of National Environmental Quality Act B.E.2535 (1992).

[18] Notification of the Ministry of Industry on Eradicating Garbage or Waste Matters B.E. 2548

Stakeholders who attended the consultation were invited in person and by public announcement. The agenda of the meeting was as follows:

Time	Agenda
8.30 – 9.00	Registration
9.00 – 9.15	Project introduction
9.15 – 9.30	History of the project
9.30 – 10.00	Break
10.00 – 10.30	Project detail/information
10.30 – 11.00	Environmental impact measure
11.00 – 12.00	Q/A

A second follow discussion round was held between 4-5th Oct 2009, which was attended by about 350 people. The people who attended the meeting represented the organizations given below:

Entity/Organization
Governmental authority
Department of Industrial Work, Prachub Kririkhan Office of Natural Resources and Environmental Policy and Planning, Prachub Kririkhan Department of Public health, Prachub Kririkhan Governmental authority of Prachub Kririkhan province Local authority of Tub Sakae Local authority of Huay yang Local authority of Sang Aroon
Non government organization
Tub Sakae hospital Huay Yang medical centre Nuan Din Dang medical centre Hin Turn medical centre
Educational institution
Huay Yang Wittaya school Arron Wittaya school Prachapitak school Baan Rainai school Baan Tung Yao school Baan Bang Kum school
Local community
Baan Huay Yang sub-district Baan Bon sub-district Baan Tung Yao sub-district Baan Huay Maprang sub-district Baan Tung Kwang sub-district Baan Kogma sub-district BaanNong Pub sub-district Baan Num Tok Sai 1 sub-district Baan Sae Jan sub-district Baan Rai Nai sub-district Baan Sang Tong sub-district

Baan Hub wai sub-district Baan Seng Arron sub-district
Project developer
Asia Rising Advisory Limited TP Reanchai Industry Co.,Ltd Consultant Of Technology Co.,ltd

E.2. Summary of the comments received:

The commentsfrom the stakeholders who attended the meeting were as follows:

No	Comments
1	What was the initial idea to develop the project?
2	Who will benefit from this project?
3	How does the project ensure that there is enough biomass for the power plant? If this is not the case, will the project use coal as a fuel instead?
4	How does local community monitor that there is no coal used in the project?
5	How does the project reduce the global warming problem?

E.3. Report on how due account was taken of any comments received:

The project developer and consultant's responses to the enquiries received from the stakeholder were as follows:

No	Response
1	The project developer is also in the coconut business and it has been observed that there is an opportunity to create value from coconut residue which is largely left unused in the region. Therefore, the implementation of the project activity will create a local market for the biomass residues thereby improving the local economy at the same time contribute in reductions of GHG emissions to the environment.
2	The project activity will create a stable demand for the coconut residues in the local market. The local farmers can therefore collect and sell biomass to the project activity. This will directly create economic incentives to the local population. The project will export electricity to the grid which will directly increase the electricity available in the region. Therefore, the local consumers will have a reliable electricity supply due to the implementation of the project activity.
3	The biomass availability assessment has been carefully conducted in order to ensure sufficientbiomass supply for the power plant. Prachub Kririkhan has the largest area under coconut plantation in Thailand which more than 480,732 Rai. Information from the provincial agricultural department shows that more than 547,488 tons a year of coconut residue is produced while the project needs only around 60,000 tons of coconut residues per year. The boiler in the project activity is designed to use only biomass. Therefore, given the surplus availability of biomass and technical modifications which will be required to use coal, the project activity is not expected to use coal.
4	The government representative will visit the plant at regular intervals for observation. The

	representative will not only check the fuel used in the power plant but also the combustion residue. This will ensure that the project complies with the regulation standard. The project proponent is also open to visits from the local communityto ensure that the project is complying with the design.
5	The project activity will be generating electricity from biomass which is carbon neutral. The electricity generated will replace the electricity generated in the grid from fossil fuels. Therefore, the project activity will reduce the GHG emissions from power generation from fossil fuels and hence contribute to reductions in global warming.

Example of the stakeholder consultation's invitation letter

บริษัท คอนซัลแทนท์ ออฟ เทคโนโลยี จำกัด
CONSULTANTS OF TECHNOLOGY CO., LTD.
39 LADPRAO 124 RD., WANGTHONGLANG, BANGKOK 10310
☎ (66 2) 9043239-47 Fax : (66 2) 9043248 E-mail : cot@cot.co.th www.cot.co.th

สมาชิกของสมาคม วิศวกรที่ปรึกษาแห่งประเทศไทย
MEMBER OF THE CONSULTING ENGINEERING ASSOCIATION OF THAILAND

Our Ref.EIA 090711/405230

20 กรกฎาคม 2552

เรื่อง ขออนุเคราะห์เข้าพบชี้แจงรายละเอียดโครงการ
โครงการผลิตไฟฟ้าจากพลังงานชีวมวล ของบริษัท ที.พี.อุตสาหกรรม เหรียญชัย จำกัด

เรียน ผู้ว่าราชการจังหวัดประจวบคีรีขันธ์

ตามที่บริษัท คอนซัลแทนท์ ออฟ เทคโนโลยี จำกัด ได้รับมอบหมายจากบริษัท ที.พี.อุตสาหกรรม เหรียญชัย จำกัด ในการจัดทำรายงานการวิเคราะห์ผลกระทบสิ่งแวดล้อม เบื้องต้น (IEE) "โครงการผลิตไฟฟ้าจากพลังงานชีวมวล" ซึ่งตั้งอยู่ที่ 137หมู่ 3 ถนนเพรชเกษม ต.ห้วยยาง อ.ทับสะแก จ.ประจวบคีรีขันธ์ ในการจัดทำรายงานฯ ดังกล่าวจะมีการดำเนินงานในด้านการมีส่วนร่วมของประชาชน ซึ่งจะมีงานในส่วนของการประชาสัมพันธ์/ชี้แจงรายละเอียดโครงการให้กับหน่วยงานราชการในพื้นที่ เพื่อรวบรวมความคิดเห็นและข้อเสนอแนะต่างๆ มากำหนดเป็นมาตรการป้องกันและลดผลกระทบสิ่งแวดล้อมในรายงานฯ ต่อไป โดยมอบหมายให้ คุณรอมือละ คอมอ เป็นผู้เข้ามาประชาสัมพันธ์และชี้แจงรายละเอียดโครงการให้กับให้กับหน่วยงานราชการในพื้นที่

จึงเรียนมาเพื่อขอความอนุเคราะห์ และขอขอบพระคุณมา ณ โอกาส นี้

ขอแสดงความนับถือ

(นายเอกรัช อุงน้อย)
ผู้ประสานงานโครงการ
บริษัท คอนซัลแทนท์ ออฟ เทคโนโลยี จำกัด

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Host country project participant:

Organization:	Clean Energy Thapsakae Limited
Street/P.O.Box:	137 Moo 3 Petchkasem Rd
Building:	
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State/Region:	Prachuapkhirikan Province
Postfix/ZIP:	
Country:	Thailand
Telephone:	+662 686 2000
FAX:	
E-Mail:	
URL:	
Represented by:	
Title:	Managing Director
Salutation:	Mr
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Middle Name:	
First Name:	Chaiyut
Department:	
Mobile:	
Direct FAX:	
Direct tel:	
Personal E-Mail:	

Annex I country project participants:

Organization:	Swiss Carbon Asset Ltd.
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Building:	
City:	Zurich
State/Region:	
Postfix/ZIP:	8005
Country:	Switzerland
Telephone:	
FAX:	
E-Mail:	p.buergi@southpolecarbon.com
URL:	www.southpolecarbon.com
Represented by:	
Title:	Managing Partner
Salutation:	Mr
Last Name:	Bürgi
Middle Name:	
First Name:	Patrick
Department:	
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Direct FAX:	
Direct tel:	+ 66 2 678 8979
Personal E-Mail:	

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funds are utilised in the project activity.

Annex 3

BASELINE INFORMATION

Detail of calculation for grid emission factor

The study of the estimation of grid emission factor is carried out in accordance with the tool **"Tool to calculate the emission factor for an electricity system**", version 02, approved by the CDM Executive Board (CDM EB) at EB50. The data employed in this study was based on the most recent data available at the time of submission of the CDM PDD to the DOE for validation. The data is sourced from DEDE annual report "Electricity Power in Thailand 2008"[19]. The value applied is 0.573 tCO_2e/MWh. The details of the grid emission factor calculation are shown below.

"***Tool to calculate the emission factor for an electricity system"*** states procedures to determine the following parameters to estimate baseline grid emission factor:

Parameter	Unit	Description
$EF_{grid,CM,y}$	tCO_2/MWh	Combined margin CO_2 emission factor for the project electricity system in year *y*
$EF_{grid,BM,y}$	tCO_2/MWh	Build margin CO_2 emission factor for the project electricity system in year *y*
$EF_{grid,OM,y}$	tCO_2/MWh	Operating margin CO_2 emission factor for the project electricity system in year *y*

Baseline Methodology Procedure:
As per the "***Tool to calculate the emission factor for an electricity system"*** project participants shall apply the following six steps:

STEP 1. Identify the relevant electric power system.
STEP 2.Choose whether to include off-grid power plants in the project electricity system (optional)
STEP 3. Select a method to determine the operating margin (OM).
STEP 4. Calculate the operating margin emission factor according to the selected method.
STEP 5. Identify the group of power units to be included in the build margin (BM).
STEP 6. Calculate the build margin emission factor.
STEP 7. Calculate the combined margin (CM) emissions factor.

Step 1: Identifying the relevant electric power system

The tool defines the *project electricity system* as the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity and that can be dispatched without significant transmission constraints.

The national grid is identified as the project electricity system. Electric power transmitted by the national grid includes electricity generated annually by the Electricity Generating Authority of Thailand (EGAT),

[19] http://www.dede.go.th/dede/fileadmin/usr/wpd/static/2008/EleThai2008.pdf

Independent Power Producers (IPPs), Small Power Producers (SPPs), Very Small Power Producers (VSPPs) and imported electricity from neighbouring countries.

Step 2: Choose whether to include off-grid power plants in the project electricity system (optional)

Project participants choses "**Option I**: Only grid power plants are included in the calculation", to calculate the operating margin and build margin emission factor.

Step 3: Selecting a method to determine the operating margin (OM)

The calculation of the Operating Margin, $EF_{grid,OM,y}$, is based on one of the following methods according to the 'Tool to calculate the emission factor for an electricity system':

(a) Simple OM,
(b) Simple Adjusted OM,
(c) Dispatch Data Analysis OM, or
(d) Average OM.

For this proposed project activity, (a) the Simple OM is applied.

According to the 'Tool to calculate the emission factor for an electricity system', version 02, the simple OM method can only be used if the low –cost/ must-run resources constitute less than 50% of total grid generation in 1) average of the 5 most recent years, or 2) based on long-term averages for hydroelectricity production.

Low –cost/ must-run resources (LCMR) are defined as power plants with low marginal generation costs or power plants that are dispatched independently of the daily or seasonal load of the grid. They typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation.

EGAT is in charge of the national electricity grid for supply in Thailand. In addition to the power plants owned by EGAT, there are three types of private power companies:

- Independent Power Producers (IPPs),
- Small Power Producers (SPPs),
- Very Small Power Producers (VSPPs).

Some of SPPs and VSPPs power plants use both renewable and conventional energy. Therefore, the calculation of Low –cost/ must-run in this study includes also electricity generated from SPP and VSPP power plants. Based on the data from "Electricity Power in Thailand 2008", the average Low –cost/ must-run of the five most recent years is determined to be 15.33% as shown in Table 1. Consequently, the *Simple OM* is deployed for calculation of the OM emission factor in this study.

Table 1. National grid generation in Thailand, 2004-2008

Year	Total[20]	Hydro (LCMR)	Other[21] (LCMR)	SPP&VSPP (LCMR)	Total LCMR

[20] National grid generation.

[21] Including geothermal, solar cell, and wind turbine

	GWh	GWh	GWh	GWh	GWh	%
2004	125,727	6,040	2	13,514	19,556	15.6%
2005	132,197	5,798	2	13,702	19,502	14.8%
2006	138,742	8,125	3	13,731	21,859	15.8%
2007	143,378	8,114	3	14,559	22,676	15.8%
2008	147,427	7,113	5	14,646	21,764	14.8%
Average over last five years						**15.33%**

Source: Electricity Power in Thailand 2008, Department of Alternative Energy Development and Efficiency, Ministry of Energy (DEDE)- http://www.dede.go.th/dede/fileadmin/usr/wpd/static/2008/EleThai2008.pdf
Table 16-17, page 20-21.

For the simple OM, the emission factor has been calculated ex-ante.

Ex-ante option: *"The emission factor is determined once at validation stage, thus no monitoring and recalculation of emission factor during the crediting period is required. For grid power plants, a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation. "*

The data vintage is well documented in this section and shall not be changed during the crediting period.

Step 4: Calculate the operating margin emission factor according to the selected method

The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost / must-run power plants / units.

Since the data of fuel consumption and electricity generation for each power unit is not available, option B of the tool is used and the simple OM emission factor is thus calculated based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system, as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_i \left(FC_{i,y} \times NCV_{i,y} \times EF_{co2,i,y}\right)}{EG_y}$$

Where:

$EF_{grid,OM,simple,y}$ =Simple operating margin CO_2 emission factor in year y ($t CO_2/MWh$)
$FC_{i,y}$ = Amount of fossil fuel type *i* consumed in the project electricity system in year *y*, (mass or volume unit)
$NCV_{i,y}$ = Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ/mass or volume unit)
$EF_{CO2,i,y}$ = CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/GJ)
EG_y = Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/must-run power plants/units in year *y* (MWh)
y = The relevant year as per the data vintage chosen in step 3

Option B can be used since the necessary data for Option A is not available; nuclear and renewable power generation are considered as low-cost/must-run power sources and the quantity of electricity supplied to the grid by these sources is known; and off-grid power plants are not included in the calculation.

Data used and calculations

Amount of fuel *i* consumed by the project electricity system, $FC_{i,y}$

Fossil fuel consumption in the National grid.

Year	Fuel Oil*	Diesel Oil*	Coal & Lignite*	Natural Gas*
	Million litres	Million litres	Thousand tonnes	(MMscf)
2006	2,022	40	16,250	764,215
2007	936	23	19,650	783,137
2008	350	44	20,465	812,620

Source: Table 19, Page 23
Electricity Power in Thailand 2008, Department of Alternative Energy Development and Efficiency, Ministry of Energy (DEDE)- http://www.dede.go.th/dede/fileadmin/usr/wpd/static/2008/EleThai2008.pdf
Note: excluding fuel consumption from SPP and VSPP

Fossil fuel consumption in SPP and VSPP

Year	Fuel Oil	Diesel Oil	Coal & Lignite	Natural Gas
	Million litres	Million litres	Thousand tonnes	(MMscf)
2006*	8.17	0.44	915.93	92,888
2007**	6.98	1.25	898.83	94,725
2008**	7.55	1.45	969.82	94,707

Source:
*Table 20 - http://www.dede.go.th/dede/fileadmin/usr/wpd/static/thail_ele_2006/34T20.pdf
** Table 20 - http://www.dede.go.th/dede/fileadmin/upload/cc/EleThai110951.pdf
*** Table 20 - http://www.dede.go.th/dede/fileadmin/usr/wpd/static/2008/EleThai2008.pdf

From above tables, total fuel consumption ($FC_{i,y}$)is:

Year	Fuel Oil	Diesel Oil	Coal & Lignite	Natural Gas
	kl	kl	tonnes	(MMscf)
2006	2,030,175	40,436	17,165,933	857,103
2007	942,975	24,249	20,548,833	877,862
2008	357,548	45,450	21,434,819	907,327

Factors:

Fuel	NCV (Source: DEDE Thailand)*		EF (Source:IPCC)**	
	Value	Unit	Value	Unit
Diesel	36.4	MJ/lt	74,100	kg/TJ
Fuel Oil	39.77	MJ/lt	77,400	kg/TJ
Natural gas	1.04	MJ/scf	56,100	kg/TJ
Coal	10.47	MJ/kg	101,000	kg/TJ

*DEDE: http://www.dede.go.th/dede/fileadmin/usr/wpd/static/2008/OilandThailand2008.pdf
Page 42, section on conversion factors.
** IPCC 2006

From above data, CO2 emissions are calculated as follows:

Year	$FC_{i,y}*NCV_{i,y}*EF_{Co2,i,y}$ (tCO2)			
	Fuel Oil	**Diesel Oil**	**Coal & Lignite**	**Natural Gas**
2006	6,249,279	109,127	18,152,459	50,006,817
2007	2,902,664	65,441	21,729,774	51,217,981
2008	1,100,603	122,656	22,666,678	52,937,086

Simple OM emission factor ($EF_{grid,OM,simple,y}$)

Year	EG_y	$FC_{i,y}*NCV_{i,y}*EF_{Co2,i,y}$	$EF_{grid,OMsimple,y}$
	GWh	(tCO2)	tCO2/MWh
2006	135,023	74,517,682	0.552
2007	138,826	75,915,859	0.547
2008	141,914	76,827,024	0.541
			0.547

Step 5: Identifying the group of power units to be included in the build margin

According to the 'Tool to calculate the emission factor for an electricity system', version 02, the sample group of power units *m* used to calculate the build margin consists of either:

(a) The set of five power units that have been built most recently, or
(b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

The following table shows the list of most recently built larger annual generation five power plants which also comprise more than 20% (at 21.9 %) of the system generation (in KWh). Besides, all these five power plants are not registered as CDM project activity and not built more than 10 years ago from the date that the proposed project started to supply electricity to the grid.

Plant name (sample group m)	**Commercial Operation Date** COD	**Plant Capacity** (MW)	**Generation in 2008** (GWh)
Chana	July 2008	710.0	3,754
GPG	Mar 2008	1,468.0	9,195
RGCO POWER	Mar 2008	1,400.0	5,812
EPEC	Mar 2003	350.0	2,670
BLCP	Aug 2006	1,346.6	10,801
Total			**32,232**
Total grid generation			147,427
Generation of group m is part of total grid generation			**21.9%**

Source: Electric Power in Thailand 2008 Report, DEDE, Table 8, page 10 and Table 18 page 22 and EPPO website http://www.dede.go.th/dede/fileadmin/usr/wpd/static/2008/EleThai2008.pdf
COD: Status of IPP on May 2008 http://www.eppo.go.th/power/data/index.html
http://pr.egat.co.th/AnnualReport/annual2008/annual08_eng/annual2008en_p74.pdf

In term of vintage data, **Option 1**: the build margin emission factor is calculated *ex ante* based on the most recent information available on unites already built at the time of CDM-PDD submission to the DOE for validation is chosen, hence, monitoring the emission factor is not required during the crediting period. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Step 6: Calculating the build margin emission factor

The Build Margin emission factor is calculated as the generation-weighted average emission factor of all power units m during the most recent year y for which power generation, as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

Where:

$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y*
$EF_{EL,m,y}$ = CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
m = Power unit included in the build margin
y = Most recent historical year for which power generation data is available

The CO_2 emission factor of each power plant unit m ($EF_{EL,m,y}$) should be determined as per the simple OM.

Option A2. is used to calculate it, as there is data on electricity generation, fuel types and the efficiency of the group of power unit to be included in the build margin:

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \cdot 3.6}{\eta_{m,y}}$$

Where:

$EF_{EL,m,y}$ = CO2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
$EF_{CO2,,mi,y}$ = Average CO2 emission factor of fossil fuel type *i* in power unit *m* in year *y* (tCO_2/GJ)
$\eta_{m,y}$ = Average net energy conversion efficiency of power unit *m* in year *y* (ration)
m = All power units serving the grid in year *y* except low-cost/must-run power units
y = The relevant year as per the data vintage chosen in Step 3

Plant name (sample group m)	Commercial Operation Date COD	Plant Capacity (MW)	Generation in 2008 (GWh)	Type of Fuel	efficiency %	EF EL,m tCO2/MWh	Emissions (tCO2)	EF BM,y (tCO2/MWh)
Chana	July 2008	710.0	3,754	Natural Gas	48%	0.42	1,573,197	
GPG	Mar 2008	1,468.0	9,195	Natural Gas	49%	0.41	3,781,547	
RGCO POWER	Mar 2008	1,400.0	5,812	Natural Gas	48%	0.42	2,424,986	
EPEC	Mar 2003	350.0	2,670	Natural Gas	50%	0.40	1,076,106	
BLCP	Aug 2006	1,346.6	10,801	Coal	38%	0.97	10,471,210	
Total			**32,232**				**19,327,047**	**0.60**
Total grid generation			147,427					
Generation of group m is part of total grid generatio			**21.9%**					

From the table, $EF_{grid,BM,,y}$ = **0.600 tCO_2/MWh**

Step 7: Calculating the combined margin emission factor

The combined margin emissions factor is calculated as fellows:

$EF_{grid,CM,y} = EF_{gird,OM,Y} * w_{OM} + EF_{grid,BM,Y} * w_{BM}$

Where:
$EF_{BM,Y}$ = Build margin CO_2 emission factor in year *y* (tCO2/MWh)
$EF_{OM,Y}$ = operation margin CO_2 emission factor in year *y* (tCO2/MWh)
w_{OM} = Weight of operating margin emission factor (%)
w_{BM} = Weight of build margin emission factor (%)

The following default value should be used for w_{OM} and w_{BM}:

- Wind and solar power generation project activities: w_{OM} = 0.75 and w_{BM} = 0.25 (owing to their intermittent and non-dispatchable nature) for the first crediting period and for subsequent crediting periods.
- All other project: w_{OM} = 0.5 and w_{BM} = 0.5 for the first crediting period, and w_{OM} = 0.25 and w_{BM} = 0.75 for the second and third crediting period, unless otherwise specified in the approved methodology which refer to this tool.

For this project activity, which is not a wind or solar power generation project activity, the following weights are chosen: w_{OM} = 0.5 and w_{BM} = 0.5.

Operating Margin EF	tCO2/MWh	0.547
Build Margin EF	tCO2/MWh	0.600
Weight age for OM (W_{OM})	%	0.500
Weight age for BM (W_{BM})	%	0.500
Combined Margin EF ($EF_{CM,y}$)	tCO2/MWh	**0.573**

Therefore, the baseline emission factor **EF_y = 0.573 tCO2/MWh.**

Annex 4

MONITORING INFORMATION

Please refer to section B.7.1 and B.7.2

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Annex 5

PDD revision history

Date	Version	Details
15/12/2009	01	Webhosted PDD
20/04/2010	02	Revision after first set of DOE comments
21/06/2010	03	Revision after second set of DOE comments
06/08/2010	04	Revision after third set of DOE comments