Project design document form
(Version 10.1)

Complete this form in accordance with the instructions attached at the end of this form.

BASIC INFORMATION	
Title of the project activity	Chumporn applied biogas technology for advanced waste water management.
Scale of the project activity	☒ Large-scale ☐ Small-scale
Version number of the PDD	12
Completion date of the PDD	30/11//2017
Project participants	Private entity: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Eschborn, Germany Private entity: Chumporn Palm Oil Public Company Limited, Bangkok, Thailand
Host Party	Thailand
Applied methodologies and standardized baselines	AM0013: Avoided methane emissions from organic waste-water treatment --- Version 4.0
Sectoral scopes linked to the applied methodologies	Sectoral Scope: 13. Waste handling and disposal
Estimated amount of annual average GHG emission reductions	28,133 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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1) Purpose of the project activity, reduction of greenhouse gases

The purpose of the *Chumporn applied biogas technology for advanced waste water management* is to treat the wastewater generated in the production of palm oil and to use the organic matter removed from the wastewater to produce heat from clean, renewable energy (biogas). The planned project activity consists of a wastewater treatment facility, i.e. a combination of anaerobic tank digesters, as well as a combustion system to generate heat from the produced biogas. Biogas is produced by the anaerobic digestion of organic matter in the tank reactors. The project activity involves the design, construction, installation, start-up and operation of the wastewater treatment and heat generation facilities.

Hence, the project will lead to a shift from traditional waste water treatment in open, anaerobic ponds with uncontrolled release of methane to the atmosphere to a closed tank digester system with biogas capture and utilization. The ultimate purpose of the project activity is to reduce greenhouse gas emissions to the atmosphere and contribute to an environmentally and socially sustainable development of palm oil production at Chumporn Palm Oil Industry (CPI).

2) The view of the project participants of the contribution of the project activity to sustainable development

The proposed project activity is expected to foster sustainable development on the local, regional and national scale in several regards:

Impacts on the local and regional level

- As a result of reduced methane emissions, offensive smells from the operation of the palm oil mill will be minimized. In recent years, the approx. 200 farmers and villagers in the vicinity of the mill had raised complains with regard to bad odors being released from the plant. The project activity will thus improve living and working standards of the local community.
- Produced biogas can be used to substitute at least 374,200 liters/year of heavy oil and 5,397.5 tons/year of palm shells that would otherwise have been utilized[1]. Substitution of fossil fuels by biogas will lower the emission of local air pollutants.
- The operation of the factory is expected to become more efficient. Additional fossil fuel consumption can be avoided, and the chemical oxygen demand (COD) of effluents will be reduced by approximately 80%[2].
- The significant reduction of COD of discharged water contributes to the protection of natural water resources, which improves the quality of the water supplied to the local community.
- Sludge and treated effluent can be used for fertilizing farm land without negatively

[1] These figures are based on the assumption that 15% of produced biogas will be utilised in substitution for heavy oil and 85% to substitute palm shells. This assumed share of fuels is conservative in terms of baseline emissions. The utilisation of 100% palm shells is not feasible in technical terms due to the relatively low calorific value that does not meet the requirements of the boilers. Hence, co-utilization of at least 15% heavy oil is necessary.

[2] Investigations, lab test and conventional batch test on the biodegradability of organics in waste water and corresponding COD reduction have been carried out at Chiang Mai University in cooperation with Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) in 2004/2005 within the programme "Regional Information and Advisory Service for Appropriate Technology" and the German Appropriate Technology and Eco-efficiency Programme. Results have been proved within several implementations of the technology at pig farms. Measurements at a waste to energy project at a starch factory in Korat, Thailand proved similar results by measurements (please refer to the envisaged CDM project "Korat Waste to Energy Project").

impacting ground water quality (otherwise, there would be the danger of pollution e.g. through high COD).

- The construction, operation and maintenance of the anaerobic waste water and biogas system will create additional employment opportunities. Four new jobs will be created (2 technicians, 2 laborers).

Impacts on the national level

- The project activity helps to reduce the dependency on fossil fuels by implementing a modern technology that produces biogas (autonomous renewable energy).
- The project activity will constitute a positive example for other palm oil plants in Thailand. Applied on a large scale, the project type may have macroeconomic benefits by reducing the need for fossil fuel imports. Additionally, such decentralized types of power generation help to minimize governmental expenses for power production infrastructure.
- The project activity serves the industrial pollution prevention scheme of the government according to the 9th National Economic and Social Development Plan (NESDP) 2002 - 2006[3]. The NESDP focuses, amongst others, on the promotion on renewable energy, improving energy conservation and the eco-efficiency of the agro-industry of Thailand.

On the global level, the project activity reduces emissions of greenhouse gases, primarily of methane.

3) Host country eligibility criteria

The eligibility criteria for CDM projects of the Thai DNA are fulfilled by the planned project activity. National requirements are summarized in the table below:

Table 1: Host country eligibility criteria

Eligibility criterion as defined by Thai DNA[4]	Criterion met by project activity
Project category: Renewable Energy, Energy Efficiency, or Energy Reduction and GHGs	YES
Project operation consistent with Thai National Development Strategy	YES
Voluntary participation, agreement of all parties involved	YES
Contribution to capacity building, technology transfer and know-how	YES
Consistency with Thai legislation and regulations	YES
There shall be Environment and Technical Assessment of the project as it should involve public participation	YES

4) Sustainable development screen

In addition to the views of the project participants of the project's contribution to sustainable development as described above, a comprehensive sustainable development screen has been conducted based on an initial stakeholder consultation.

Table 2 summarizes the results of the sustainable development screen. The total indicator score

[3] The National Economic and Social Development Plan (NESDP) 2002 - 2006, National Economic and Social Development Board (NESDB), Office of the Prime Minister, Bangkok 2002

[4] Mrs. Aree Wattana Tummakird, presentation "CDM in Thailand", CDM Cooperation Center, MONRE/ONEP, handed over by the Thai DNA and confirmed by Dr. Sirintornthep Towpryoon (Advisor to Thai DNA, Assoc. Professor of the Joint Graduate School for Energy and Environment, King Mongkut's University of Technology, Thonburi, Thailand); and Mr. Arrie Setiwan (Pelangi) – 22nd August 2006.

of +6 reflects the positive anticipations of involved stakeholders. More comprehensive information on the results of the sustainable development screen, as well as the stakeholder consultations can be found in Annexes 6-8 of this document.

Table 2: Evaluation of the project activity based on sustainable development indicators

Component Indicators	**Score –2 to +2**
Local/regional/global environment	
➢ Water quality and quantity (as per technical description of the project, calculated basis)	+ 1
➢ Air quality (reduction of fugitive CH_4)	+ 1
➢ Other pollutants (no toxic, radioactive, POPs, or stratospheric ozone layer depleting gases, other than methane are relevant)	not applicable
➢ Soil condition (quality and quantity)	0
➢ Biodiversity (species and habitat conservation)	0
Sub total	**+ 2**
Social sustainability and development	
➢ Employment (including job quality, fulfillment of labor standards)	+ 1
➢ Livelihood of the poor (including poverty alleviation, distributional equity, and access to essential services)	0
➢ Access to energy services	not applicable
➢ Human and institutional capacity (including empowerment, education, involvement, gender)	0
Sub total	**+ 1**
Economic and technological development	
➢ Employment (numbers)	+ 1
➢ Balance of payments (sustainability)	+ 1
➢ Technological self reliance (including project replicability, hard currency liability, skills development, institutional capacity, technology transfer)	+ 1
Sub total	**+ 3**
TOTAL	**+ 6**

Remarks on Table 2***:*** The following scoring system applies:

-2: Major negative impacts, i.e. where there is significant damage to ecological, social and/or economic systems that cannot be mitigated through preventive (not remedial) measures.
-1: Very minor negative impacts, i.e. where there is a measurable impact but not one that is considered by stakeholders to mitigate against the implementation of the project activity or cause significant damage to ecological, social and/or economic systems.
0: No, or negligible impacts, i.e. there is no impact or the impact is considered insignificant by stakeholders.
+1: Minor positive impacts
+2: Major positive impacts

A.2. Location of project activity

A.2.1. Host Party

Thailand

A.2.2. Region/State/Province etc.

South East, Chumporn Province

A.2.3. City/Town/Community etc.

296, Moo 2 Phetchkasem Road, Tambol Salui, Ampur Tasae, Chumporn

A.2.4. Physical/Geographical location

CPI is located in Chumporn province in the uppermost part of the Southern region. The Gulf of Thailand is in the east, while the Union of Myanmar is in the west. The location is approximately 463 km south-south-west from Bangkok, close to the Tha Sae intersection about 15 km north of Chumporn City. The project activity is located within the existing site of the Chumporn Palm Oil Industry Complex, therefore no additional area is required.

Figure 1 visualizes the physical location of the project activity in Thailand.

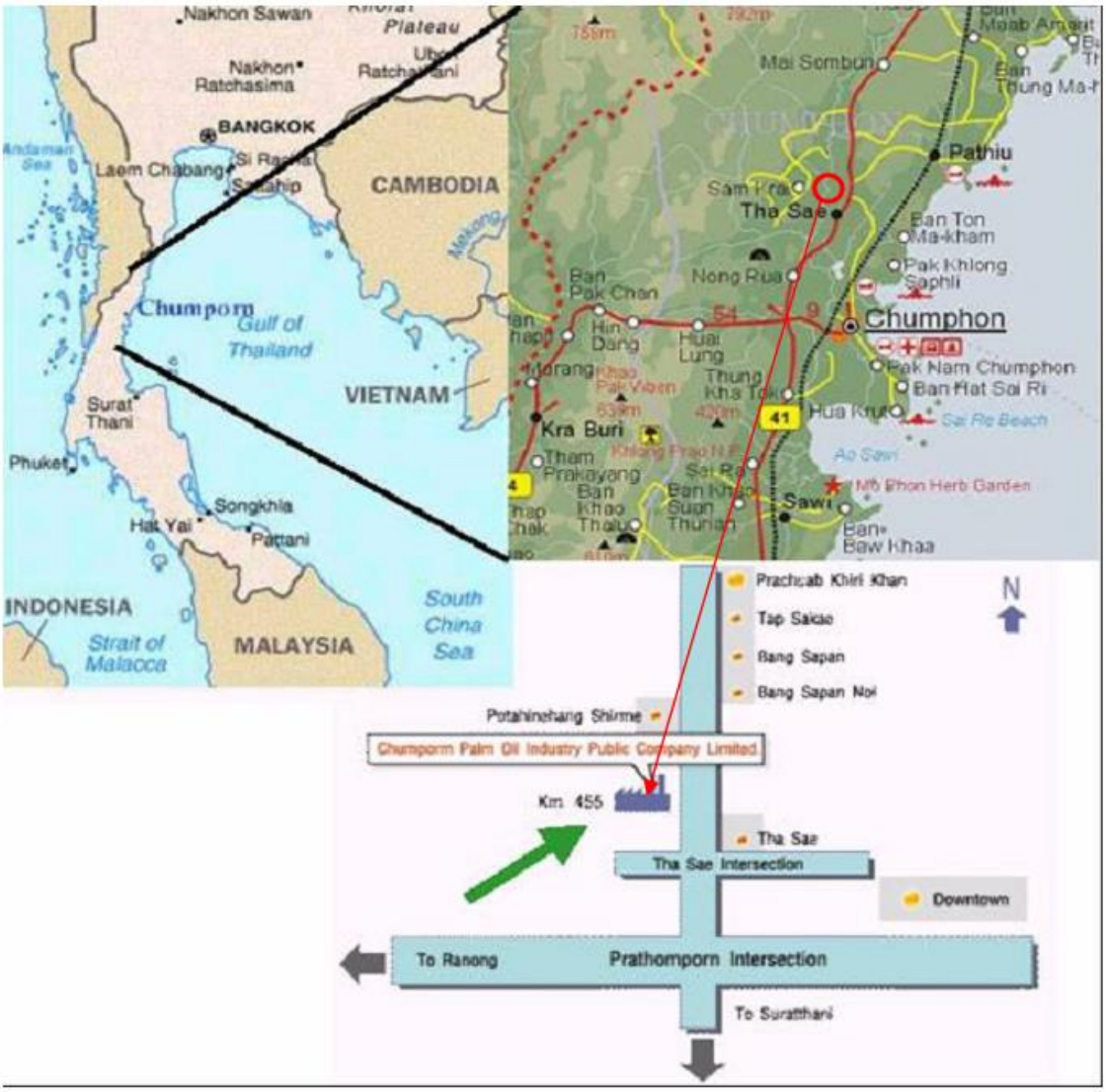

Figure 1: Location of the project activity in Thailand.

Chumporn Palm Oil Industry PCL (CPI) has been registered in Thailand in 1979. CPI had 748 employees in 2003 and 755 in 2004 (CPI Annual Report, 2004).

A.3. Technologies/measures

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A modern waste water treatment technology will be implemented at CPI. Waste water generated through palm oil processing averages 0.5 m^3/ton of fresh fruit bunches (FFB). The palm oil mill

processes about 260,000 – 320,000 t FFB and thus 130,000 – 160,000 m^3 wastewater per year, with an average of approximately 145,000m^3/year. The existing simple wastewater treatment system in open, anaerobic lagoons will be replaced by a closed tank digester system to recover methane and produce biogas. The latter will be utilized in the production process at CPI to generate heat.

The discharge of the plant is characterized by a high chemical oxygen demand (COD) stemming from organic fractions of the palm oil production process, primarily FFB. Laboratory tests showed that discharged effluent has a COD of approximately 70-100 g/liter of which about 70%-80% is biodegradable. The building and operation of a **completely stirred tank reactor (CSTR)** is the central part of the project activity. A combined system of each CSTR and two UASB-reactors has been chosen as it is best suited for the underlying situation. Since the waste water is characterized not only by a high COD, but also by a high load of suspended solids (SS) with low separation ability, an adoption of traditional tank reactors to the specific site characteristics is necessary. Thus, an ***Appropriate Complete Stirred Tank Reactor*** **(A-CSTR)** will be established, which has been developed in co-operation between Thai experts and the University of Wageningen, Netherlands; the equipment itself will be delivered by a Thai company[5]. The design engineering of the A-CSTR optimizes the contact rate of bacteria with effluent while minimizing energy needed for mixing purposes. Two tank reactors with a utilizable volume of 6,000m^3 are to be established and operated. This will allow a maximum daily load of approx. 800m^3 waste water. The recent output of the plant has typically been 475 - 650 m^3/day. Based on this, the system is expected produce approximately 12,700 m^3 of biogas per day, which will substitute the utilization of heavy oil and of palm shells for heat generation.

The two CSTR-tank reactors will be composed of reinforced concrete in a half capsule channel shape that is partly underground. An outlet pipe will be installed at the bottom of hopper shapes in the tank to drain digested sludge to the sludge treatment system. An overflow system allows the discharge of digested effluent with low COD and SS content. COD content in the effluent will be reduced by about 80% and enter UASB reactors, before being released to the conventional open-pond post treatment process. Thus, the project activity will not only reduce GHG emissions, but also enhance the quality of effluent from the palm oil plant through a significant reduction of COD. The digested effluent will be used for irrigation purposes at surrounding palm plantations.

The A-CSTR system ensures a continuous high contact rate of bacteria in the reactor. Produced biogas gas will be re-circulated into the digester for mixing purposes. The top of the digester is equipped with a plastic sheet system to collect all the generated biogas to be stored and utilized as a renewable energy source.

Besides the tank reactor, being the central element of the improved treatment process, the following components will be installed:

- **Collection and equalization tank**
  The tank allows temperature adjustment of waste water leaving the production process as well as a first sedimentation of solid components

- **Screening and sand trap**
  The effluent from the collection/equalization tank will be pumped to a screening device for removing large particles and sand from the wastewater before entering A-CSTR.

- **Distribution Tank**
  The distribution tank continuously pumps screened effluent to A-CSTR.

- **Sludge Treatment system**

[5] Natural Power Co. Ltd. 191/15-16 Tambon Mae Hia, Amphoe Muang, Chiang Mai 50200, Thailand

Separation of solid and liquid parts of digested sludge from the bottom of the digester. The treatment system will consist of sand bed filters or other technical solution (e.g. belt press), either way with the intention to produce sludge dry enough for the transportation and land application.

- **Post Treatment and storage pond**
  Overflow effluent of the A-CSTR and UASB digesters and effluent from the sand bed filter will be further treated in the existing open pond system.

- **Biogas Filter**
  Retained gas stored will first be channeled through a biogas filter in order to remove hydrogen sulfide (H_2S).

- **Combustion system**
  The cleaned biogas will be utilized in the steam boilers to generate heat. Two boilers are operated: a mid/high pressure boiler (60-90 bar, boiler type NUK-HP 930, dual-fuel burner type RGMS7/1-D ZMD, DN50) and a low pressure boiler (30 bar, AWG Series II dual-fuel burner from Hamworthy (AWG 15)). Post-registration, after proven reliable operation of the biogas system, it has been decided to divert a part of the biogas to be used in 2 high pressure boilers in CPI's palm oil refinery.

Plant operation will be monitored continuously. An open flare system will come into operation to deal with oversupply of methane or irregularities in the operation of the boilers. In such cases, the surplus of methane will be flared until the system operates regularly again.

The flow diagram in **Figure 2** summarizes the described process.

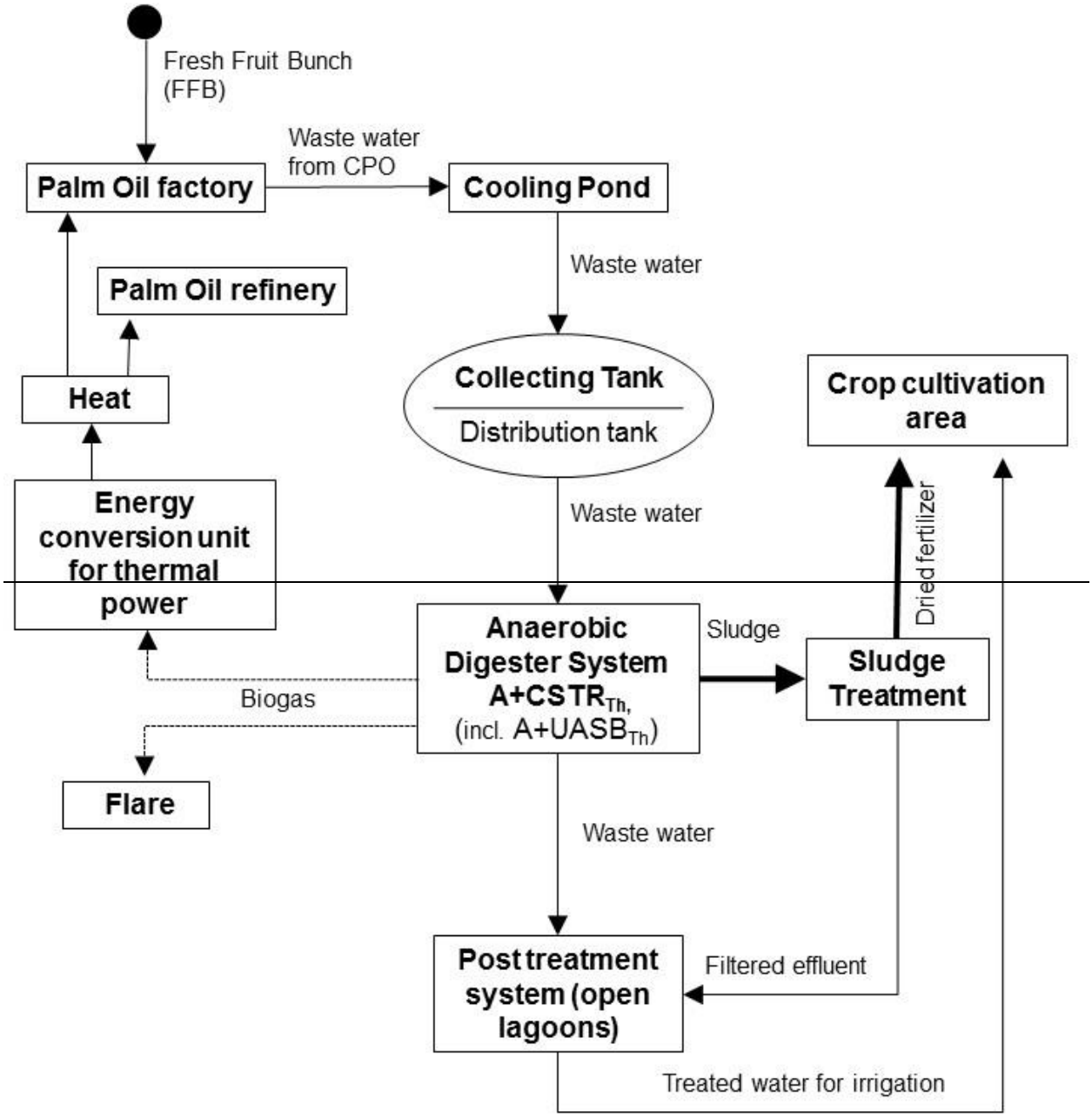

Figure 2: Flow diagram of improved waste water management system after project implementation

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)

Thailand (host)	Private entity: Chumporn Palm Oil Public Company Limited, Bangkok, Thailand	No
Germany	Private entity: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Eschborn, Germany	No

A.5. Public funding of project activity

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Neither public funding nor official development assistance are used in the project activity. No loans from international financial institutions (IFIs) are included. The financing will be realized by CPI with own capital, a bank loan, and the sale of generated CERs to private investors.

A.6. History of project activity

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It is herewith confirmed that

a) the proposed CDM project activity is neither registered as a CDM project activity nor included as a component project activity (CPA) in a registered CDM programme of activities (PoA); and
b) that the proposed CDM project activity is not a project activity that has been deregistered.

It is herewith declared that

a) the proposed CDM activity is not a CPA that has been excluded from a registered CDM PoA; and
b) the is no registered CDM project activity or a CPA under a registered CDM PoA whose crediting period has or has not expired (hereinafter referred to as former project) exists in the same geographical location as the proposed CDM project activity.

A.7. Debundling

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Not applicable.

SECTION B. Application of selected methodologies and standardized baselines

B.1. Reference to methodologies and standardized baselines

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Approved Methodology AM0013 “Avoided methane emissions from organic waste-water treatment”, version 4, as of 22/12/2006 is applied. This methodology is based on the baseline approach from paragraph 48 of the CDM modalities and procedures “Existing actual or historical emissions as applicable”.

The calculation of the Thai grid emissions factor is based on the Approved Consolidated Methodology ACM002, version 6, as of 19/05/2006 is applied.

The methodology also refers to the “Tool to determine project emissions from flaring gases containing Methane” (version as of December 2006) is applied. In addition, the “Tool for the demonstration and assessment of additionality” (version 03) is applied.

B.2. Applicability of methodologies and standardized baselines

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The methodology AM0013 is applicable, because the underlying project activity fulfils all of the defined applicability criteria:

Applicability criterion as defined in AM0013	Criterion met by project activity
Methane recovery project activity involving an organic wastewater treatment plant	YES
Existing waste water treatment system is an open lagoon system, with 'active' anaerobic conditions, which is characterized as follows:	YES
○ Depth of the open lagoon system is at least 1 m[6]	YES
○ Temperature of the anaerobic lagoon is higher than 10°C[7]	YES
○ Residence time of the organic matter should be at least 30 days[8]	YES
Sludge produced during project activity is not be stored onsite before land application to avoid any possible methane emissions from anaerobic degradation	YES

The project activity involves the avoidance of methane emissions from open lagoons through installation of an anaerobic digester with biogas extraction capacity at an existing organic wastewater treatment plant to treat the majority of the degradable organic content in the wastewater. Hence, there is a process change from open lagoon to accelerated CH_4 generation in a closed tank digester.

B.3. Project boundary, sources and greenhouse gases (GHGs)

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The project boundary includes existing wastewater treatment plant, where sludge is degraded in open sludge lagoons under mainly anaerobic conditions. Figure 3 visualises the project boundaries:

[6] The average depth of the open ponds is above 5 meters.

[7] The temperature of the lagoons is always significantly higher than 10°C, because the wastewater leaves the production process with about 40°C and the average air temperature is 27.3 °C, with the minimum regional temperatures above 25 °C in December/January (source: Thai National Weather Service, Meteorological station of Chumporn).

[8] There are 7 open ponds plus an open reservoir with a total volume of approx. 345,000 m^3, which is sufficient to store the generated waste water significantly longer than one year.

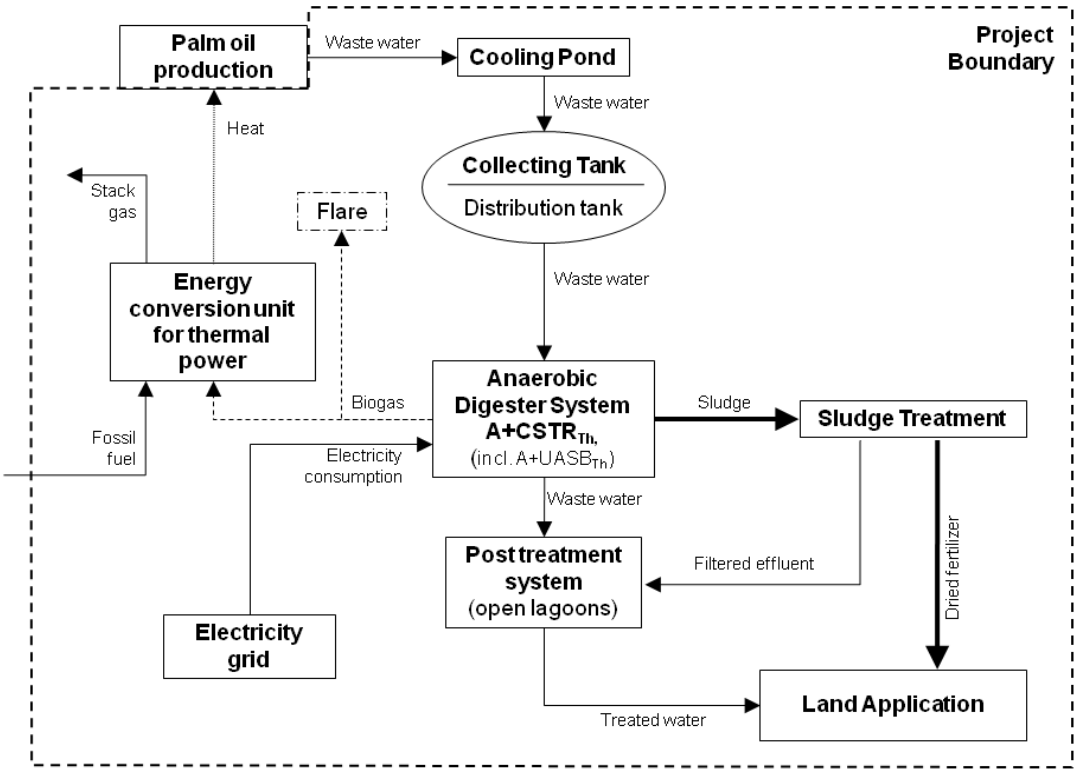

Figure 3: Project boundary

In line with AM0013, the following sources and gases are included in the project boundary:

	Source	GHG	Included?	Justification/Explanation
Baseline	Direct emissions from the waste treatment processes.	CO_2	Excluded	CO_2 emissions from the decomposition of organic waste are not accounted.
		CH_4	Included	The major source of emissions in the baseline
		N_2O	Excluded	Excluded for simplification. This is conservative.
	Emissions from electricity consumption	CO_2	Included	However, quantitatively not relevant as the project activity does not effect baseline emissions from electricity consumption.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
	Emissions from thermal energy generation	CO_2	Included	Thermal energy generation is included in the project activity.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
Project activity	On-site fossil fuel consumption due to the project activity	CO_2	Included	May be an important emission source
		CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small.
	Emissions from on-site electricity use	CO_2	Included	Additional electricity will be consumed from the grid due to the project activity.
		CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small.
	Direct emissions from the waste treatment processes.	CO_2	Excluded	CO_2 emissions from the decomposition of organic waste are not accounted.
		CH_4	Included	The emission from uncombusted methane and also leakage in case of anaerobic digesters. In case of dewatering and land application, conservative estimates of methane are included.
		N_2O	Excluded	Excluded for simplification. Not and important emission source.

B.4. Establishment and description of baseline scenario

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The identification of the most plausible baseline scenario is conducted in a step-wise approach:

- In step one, realistic and credible alternatives for the treatment of the sludge are identified
- In a second step, the alternatives that are not complying with applicable laws and regulations are eliminated
- In a third step, the alternatives that face prohibitive barriers are eliminated
- In a further step, the economic attractiveness of the remaining alternatives is compared
- Finally, baseline emissions of the most plausible baseline scenario are determined in line with AM0013.

STEP 1: Identification of possible realistic and credible alternatives for the treatment of the sludge

The following alternatives have been identified as plausible baseline scenarios:

1) Business as usual scenario: continuation of wastewater treatment in open anaerobic lagoons
2) Replacing the existing anaerobic ponds by managed aerobic or alternating ponds;
3) Methane recovery and flaring;
4) Methane recovery and utilization for electricity or heat generation; and
5) Land application of the sludge.

The other alternatives as listed in AM0013 - landfilling, aerobic composting, mineralization, and composting – cannot be considered realistic alternatives due to the characteristics of the sludge from CPI. The sludge is to be categorised as a fluid, and hence the above named options are technically not feasible.

STEP 2: Eliminate alternatives that are not complying with applicable laws and regulations

Alternative 5 -Land application of untreated sludge - would constitute a danger of contamination for ground and surface water and is not complying with applicable laws. Hence, this alternative is excluded from further consideration.

STEP 3: Eliminate alternatives that face prohibitive barriers

Alternative 2 (Replacing the existing anaerobic ponds by managed aerobic or alternating ponds), alternative 3 (Methane recovery and flaring) and alternative 4 (Methane recovery and utilization for electricity or heat generation) face prohibitive financial barriers:

- Alternative 2 might be chosen if the primary objective of the plant operator was the reduction of COD at point of discharge. Adapting the existing open anaerobic pond system to make it (partially) aerobic would lead to a digestion of COD by aerobic bacteria coupled with the production of CO_2 instead of CH_4. Alternating aerobic and anaerobic waste water treatment leads to a higher reduction of COD in the waste water. – However, such adaptation of the system would require the installment of aeration and mixing devices in the existing ponds. This implies significant investment and operational costs; e.g. relating to the conversion of existing ponds and electricity consumption by mixing devices and air infiltration. No additional income would be generated in this alternative. Since there is neither a legal requirement to implement such a system, nor any economic benefit, this alternative is not realistic in practical terms – it is less attractive than the continuation of the current situation.
- Alternative 3 faces a similar barrier: the installation of equipment to collect and flare the biogas/methane requires financial investment. Operation costs also occur. However, no income is generated through this option and hence there is no economic reason
- The implementation of alternative 4 faces both financial and technological barriers. As shown in detail in section B.5 of this document, the implementation of this alternative requires a significant investment (> 40,000,000 BHT) while there is no direct income and

the investment is not economically attractive. In addition, closed anaerobic tank digesters are more complicated to construct and to operate than the well-known open lagoon systems; and the technological approach of collecting and utilising biogas from wastewater treatment is hardly known in Thai Palm Oil industry. 23 out of 25 Thai palm oil mills use open lagoon systems (for details see section B.5).

STEP 4: Compare the economic attractiveness of remaining alternatives

No comparison of economic attractiveness is possible because all other treatment methods, except alternative 1 – continuation of the BAU-scenario - have been eliminated in STEP 2 and STEP 3.

Hence, the continuation of current practice is identified as the most plausible baseline scenario.

B.5. Demonstration of additionality

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In the following it is demonstrated by applying the "Tool for the demonstration and assessment of additionality" that the proposed project activity would not have happened in the absence of the CDM and thus effectively reduces anthropogenic emissions of greenhouse gases.

0. Preliminary screening based on the starting date of the project activity

The project participants do not wish to have the crediting period starting prior to the registration of the project activity. - It may be noted, however that the CDM has been considered a mechanism to support project implementation since early 2004, i.e. 2 years before the construction of the new system was decided and started in 2006. In 2004, CPI participated in a project tender for greenhouse gas reduction projects conducted by the Hamburg Institute of International Economics (HWWA). This process and the dialogue on the economic chances of the CDM made CPI to go ahead with the project activity.

1. Identification of alternatives to the project activity

Sub-step 1a – Definition of alternatives to the project activity

As has been discussed extensively in section B.4 of this document, the only realistic alternative to the planned CDM project activity is the continuation of the status quo, i.e. the operation of an open anaerobic waste water treatment system and the utilization of fuels (both fossil and renewable) to meet the energy demands of the palm oil mill.

Sub-step 1b – Consistency with mandatory laws and regulations

Both alternatives listed in sub-step 1 are complying with applicable legislation and regulations:

There are no national or regional legal provisions that enforce anaerobic waste water treatment with coupled collection and utilization of biogas[9]. In Thailand, palm oil mills adhere to the general

[9] Thailand's National Communication to the UNFCCC states that "For wastewater treatment facilities, basically two options are available - aerobic and anaerobic treatment systems. The choice as to which system to develop depends on a number of factors, including wastewater characteristics and properties, water volume, organic loading, budget, etc. If the anaerobic system is chosen, it should be equipped with energy recovery devices for heat or electricity generation. As with solid wastes, however, the viability of the project depends on the size of the methane recovery site" (Thailand's Initial National Communication under the UNFCCC, p. 60).

waste water regulations for industry. The discharge limit for COD is 120 mg/liter, if waste water is discharged to public water systems or rivers[10]. However, no discharge limits are defined if treated waste water is recycled, e.g. for irrigation purposes. Waste water from Chumporn Palm Oil Mill has been used for irrigation of surrounding palm plantations. This practice has been approved by the licensing authority at the Ministry of Industry at the yearly license procedure of the factory since 20 years. The planned CDM project activity will not change this situation[11]. Hence, it is in line with national legislation.

2. Investment analysis to determine that the proposed project activity is not the most economically or financially attractive

In line with the Tool for demonstration of additionality, the benchmark analysis option (Option 3 of the Additionality Tool) is applied, because the planned CDM project activity creates financial/economic benefits through reducing the consumption of fossil fuels.

The applicable financial indicator shall be equity IRR, since the proposed project activity is an upgrade of an existing process. According to the Additionality Tool, the benchmark is to represent standard returns in the market, considering the specific risk of the project type, but not linked to the subjective profitability expectation or risk profile of a particular project developer.

The most suitable approach to determine standard returns in the market would be to analyze IRR-expectations of the Thai Palm Oil Industry. As no publically available literature exists on this matter, experts of the Thai Palm Oil Industry have been interviewed in late 2005. They consistently pointed out that the typical maximum payback period in that sector is 3.5 – 6 years[12]. This corresponds to an IRR_{equity} range of 17.4 – 26.6%[13]. However, the interviewed experts have been reluctant to confirm their estimate in writing. Hence, this approach only delivers a general impression, but no sufficient basis for an IRR-benchmark.

For this project, the applicable IRR-benchmark is defined as the average required IRR according to option (a) "*analyzing governmental bond rates, increased by a suitable risk premium to reflect private investment and/or the project type, as substantiated by an independent (financial) expert"* and option (b) "*estimating the cost of financing and required return on capital …,, based on bankers views and private equity investors/funds' required return on comparable projects"* of the additionality tool.

1) Required IRR as per option (a) of the additionality tool:

- Long term government bond auctions resulted in rates of 5.55% in the second half of 2005[14], i.e. the period in which the investment decision was made.

[10] Notification of Ministry of Science, Technology and Environment No.3, B.E. 2539 (1996), dated January 3, B.E. 2539 (1996), published in the Royal Government Gazette, Vol.113, Part 13 D, dated February 13, B.E.2539 (1996).

[11] The Managing Director of CPI, Mr. Chusak Prachayangprecha confirmed in writing that this practice will not be changed by CPI at least for the next 10 years.

[12] E.g. interview with Mr. Vazan, (COGEN-Programme at Asian Institute of Technology (AIT) Thailand, and Thailand Biomass-Based Power Generation and Cogeneration within Small Rural Industries, National Energy Policy Office (NEPO) and Black&Veatch, Bangkok, Thailand), held in November 2005.

[13] This view has recently been confirmed by Mr. Thierry Lefevre of the Centre for Energy Environment Resources Development, Bangkok/Thailand[13]. Mr. Lefevre pointed out that Palm Oil millers in Thailand are "reluctant to invest in anything longer than 3 years". This would correspond to an IRR_{equity} of > 30% (Email as of 20 April, 2008).

[14] Bank of Thailand (2005): Thai Government Bond Tender – Historical Data (http://www.bot.or.th/BOTHomepage/BankAtWork/Bond/Data/BondAuction/BondResult/BondResultHistoricalPage1_E.htm), accessed 21/04/2008).

- To define a suitable risk premium for Thailand, the approach of A. Damodaran of the New York University, Stern School of Business (USA) is applied. In this approach, the total risk premium is calculated as the sum of the long term country risk premium for the country under consideration and the risk premium for a mature equity market. The long term country risk premium is based on the country's rating according to Moody's [www.moodys.com] and the spread of bond rates compared to the US Treasury bond rate due to that rating. This becomes a measure of the country-specific risk premium for that country, to which a risk premium for a mature equity market is added. The latter has been derived from US historical data, as this is a mature economy with a long period of equity market history (data availability back to the year 1928). More details of this approach can be found in A. Damodaran (2005)[15]. For the year 2005, A. Damodaran calculated the risk premium for a mature equity market with 4.8%; the country risk premium of Thailand is 1.65%. This results in a total risk premium of 6.45%.
- Hence, according to this approach the applicable benchmark for IRR_{equity} calculates as 5.55 % + 6.45% = 12.0%.

2) Required IRR as per option (b) of the additionality tool:

IbbotsonAssociates (http://www.ibbotson.com), a leading provider of independent investment research in major international markets, annually determine the required return of capital for investments in 173 countries from the perspectives of foreign investors. The statistics represent the IRR-return that an investor would expect to receive if investing in a particular country. The work also contains a sensitivity analysis by applying different calculation methods and assuming different investors' backgrounds. In total, 12 IRR-values are provided for each country under consideration.

For Thailand and the year 2005, the analysis shows a range of required IRR of 14.8 - 19.5%, with an average of 17.9% (IbbotsonAssociates, 2005[16]). The average IRR of 17.9% is chosen for the next step of IRR-determination.

Benchmark determination

Finally, the benchmark for the underlying project activity is calculated as the average of the two above IRR-values:

$\mathbf{IRR_{equity,\ BM}} = (IRR_{Option\ (a)} + IRR_{Option\ (b)}) / 2$

→ $\mathbf{IRR_{equity,\ BM}} = (12.0 + 17.9)/2 = \mathbf{14.95\%}$.

Underlying assumptions and parameters

The calculations of the IRR_{equity} are based on investment costs as estimated in the project's feasibility study, which has been conducted by the local biogas consultancy Natural Power Co., Ltd. (NPC). Fuel prices (heavy oil and palm shells) have been chosen as the average prices from January 2003 to October 2005 as provided by CPI, also seeTable 3.

[15] Aswath Damodaran, 2005: Equity Risk Premiums, Stern School of Business, http://pages.stern.nyu.edu/~adamodar/pdfiles/papers/riskprem.pdf

[16] IbbotsonAssociates, 2005: International Cost of Capital Perspectives Report 2005. The report has been submitted to the DOE but cannot be published on the UNFCCC website due to copyright constraints.

Table 3: Average fuel prices from 2003-2005, Source CPI

Fuel prices	2003	2004	2005	Average 2003-2005*
Heavy oil [THB/litre]	9.16	9.48	12.62	9.468
Palm shells [THB/kg]	0.6	0.75	0.85	0.64

** until October 8th 2005*

An annual increase of energy prices by 3% has been assumed in line with the inflation rate. The quantity of substituted heavy oil and palm shells has been calculated on the basis of heating values for those fuels as depicted inTable 11. The interest rate of the loan used to finance the project calculated with 8%.. Although the project activity will produce compost and liquid fertilizer, income from selling these products cannot be viewed as additional revenues, because the currently existing open-pond system delivers about the same quantity of compost and fertilizer. Sludge from the open pond treatment is currently used as fertilizer on surrounding plantations, and will also be utilized as such after the project's implementation. Consequently, the planned project activity does not change the income situation in this regard.

Other income

Thailand has implemented some supporting schemes for renewable energies, namely the small power producers (SPP) programme that subsidizes combined heat and power installations (CHP) from 1992, and the very small renewable power producers programme (VSREPP) for electricity producers from 2002. However, since the planned project activity does neither include the operation of a CHP-plant, nor the export of electricity to a grid, it is not eligible for those subsidies.

Results of the analysis

The results of the investment analysis are summarized in Table 4 below. A comprehensive analysis has been made available to the DOE and is available separately to the PDD (Summary of Excel-Spreadsheet). As the calculations show, the project's payback period is 9.2 years, the IRR 6.1%.

Table 4: Overview of the project's economics

Investments and incomes	Baht
1. Initial investment(Baht)	
1.1 Consultancy (technical design of system)	5,800,000
1.2 Construction, installation and energy utilization	35,000,000
2. Average annual expenditure (Baht)	
2.1 Operation & Maintainance	150,000
2.2 Personnel (2 technicians + 2 laborers)	390,000
2.3 External monitoring costs	300,000
2.4 External CDM-costs (verification; only in CDM-scenario)	1,000,000
2.5 Average loan interest[1]	1,492,114
3. Annual income (Baht)	
3.1 Heavy fuel oil (15% of biogas produced)[2]	3,509,996
3.2 Palm shell (85% of biogas produced)[3]	3,454,400
4. Payback period	9.2 years
5. Cash return (IRR_{Equity})	6.1%

Remarks

All costs - except 2.5 - in 2005 prices

1. Interest rate of loan at 8% per year (with 20% equity)

2. Payback of loan = 7 years

3. Heavy oil price of 9.47 Baht/liter

4. Palm shell price of 0.64 Baht/kg

Scenario for adjustment of project activity – HP boilers at the refinery:

1) The calculations of the IRR_{equity} were based on investment costs as initially estimated in the project's feasibility study, which had been conducted by the local biogas consultancy Natural Power Co., Ltd. (see initial investment of total 40,800,000 Baht in Table 4).
After completed construction and project start-up it became clear that the initial project cost have been largely underestimated; the actual investment cost (1.2 Construction, installation and energy utilization) amounted to 76,556,047 THB (see Table 5).

Table 5: Actual Initial Investment cost

Investments	**Baht (THB)**
1. Actual Initial Investments	
1.1 Consultancy (technical design of the system)	5,800,000

1.2. Construction, installation and energy utilisation	76,556,047

Recalculation of the IRR shows that the project with this investment cost would result in an IRR of -5.8% without CDM and 1.2% with CDM.

Table 6: IRR calculation; comparison of original IRRs with IRRs according to actual initial investment cost

IRR calculation	without CDM	with CDM	Case in Calculation Sheet
original PDD	6.1 %	17.0%	1a) + 1b)
actual investment cost	-5.8 %	1.2%	2a) + 2b)

2) The project feasibility under these circumstances is much less attractive than estimated. As a result of the project owners considerations on how to improve the project activity to make it financially more feasible, the solution was found in change of biogas utilization. CPI runs, together with the palm oil mill, a refinery at the factory site in Chumporn (wastewater from the refinery was originally included in the project activity). The refinery is in need of steam, which was generated by HP boilers using bunker fuel. The idea was that by adjusting and changing the existing system, parts of the biogas could be utilised to replace bunker fuel at the refinery. During the post-registration period, the project participant (PP) has adjusted the existing system as described in section A.3 “Technologies and/or measures” (above) and appendix 6 (“Appendix 6: Summary of post registration changes”). Thus, after proven reliable operation of the biogas system, it has been decided to divert some parts of the biogas to be used in 2 high pressure boilers in CPI’s palm oil refinery.-
This solution needed additional investments (burner, new boiler, etc.) but does in return achieve savings on fuel expenses.
Additional investment cost for the adjustments needed to utilise biogas in the refinery amounted to 6,304,197 THB. After installation of the high pressure boilers it is possible to utilise approximately 15 % of the generated biogas to replace bunker oil at the refinery. This is creating saving of expensed for bunker oil at the refinery, but at the same time 15 % less savings than originally planned are achieved at the CPO mill accordingly. Nevertheless this shift in utilization of biogas has an overall positive impact on the cost, as the savings that can be achieved in the refinery boilers are higher than in the CPO mill. This adjustment is leading to improved IRRs of -0.9% without and 5.0% with CDM revenues (see Table 7 below).

Table 7: IRR calculation; comparison of original IRRs with IRRs according to actual investment cost and inclusion of HP boilers at the refinery

IRR calculation	without CDM	with CDM	Case in Calculation Sheet
original PDD	6.1 %	17.0%	1a) + 1b)
actual investment cost	-5.8 %	1.2%	2a) + 2b)
actual investment cost and inclusion of HP boilers at the refinery	-0.9%	5.0%	3a) + 3b)

actual investment cost and inclusion of the HP boilers at the refinery + increased biogas production	6.5 %	11.8%	4a) + 4b)

The change in project activity from complete utilization of biogas in the biomass boiler at the CPO mill to partly utilization of biogas in the adjusted steam system of the refinery (HP boilers) has considerably increase the feasibility of the project again, yet in total numbers, the IRR stays well below the benchmark even with CDM.

3) As an additional scenario the situation with actual investment cost, inclusion of the HP boilers plus an increase of biogas production was added to the IRR calculation. This scenario takes into account the information available at the time of post-registration change of this PDD. After the first years of monitoring it has become apparent that more biogas than originally estimated is being produced at the project site. This is due to the increase of production of the CPO and the correspondingly higher amount of waste water. While the original estimated amount of biogas was at 12,700 m3/day, the actual biogas production was slowly increasing and reached and average 17,880 m3/day over the last full year of the 1st monitoring period (Sept.2009 to Aug.2010). The calculation shows that the increase biogas helps to lift the IRR from -0.9% to 6.5 % without CDM benefits, and to 11.8% with consideration of additional income from CERs.

IRR benchmark for the CPI project for re-assessing additionality under the adjusted project scenario (utilization of biogas for HP-boilers):

The original investment decision to implement the CPI biogas project was taken in the year 2005. The decision to extend the utilization of biogas to the palm oil refinery, i.e. to divert parts of the biogas to the HP boilers in the refinery was taken in the end of 2008. The IRR benchmark of 14.95 % used for the investment analysis during the registration of the project was determined specifically for the investment environment of 2005.
For the re-assessment of the project under the new scenario, for reasons of transparency and conservativeness, the IRR benchmark has been adjusted according to the guidelines on the assessment of investment analysis (version 05, EB 62, annex5, Appendix). For the project, the expected return of equity investment in the first group (para. 8, table of country specific default values) for Thailand is applied as default benchmark value: 11.2 %.

Sensitivity Analysis for the investment analysis after inclusion of HP boilers in the project activity

In accordance with benchmark analysis, if the financial indicators of the proposed project, such as the project IRR, are lower than the benchmark, the proposed project is not considered to be financially attractive.

In order to obtain reliable conclusion, the sensitivity analysis is performed to assess the variations of the financial parameters when the project IRR reaches the benchmark, For the proposed project, four parameters were selected as sensitive factors to check the financial attractiveness. In accordance with paragraph 21 of EB 62 Annex 5 (Guidelines on the assessment of investment analysis, version 05) a variations in the sensitivity analysis of +10% and -10% has been chosen, which covers a reasonable range:

1. Total investment
2. Biogas production

3. Total energy savings by biogas utilisation (based on change in price of biomass and fossil fuels)
4. Total payment cost (running costs, incl. O&M, other cost)

Table 8; Sensitivity analysis of the project situation (scenario 3); variations of relevant financial parameter and resulting IRR (%)

Changes to the assumptions made in the PDD (in percent)	Total investment	Biogas production	Total energy saving by Biogas utilization	Total payment cost (incl. O&M, other cost)
10%	5.1%	8.7%	8.7%	5.8%
5%	5.8%	7.6%	7.6%	6.1%
0%	6.5%	6.5%	6.5%	6.5%
-5%	7.3%	5.3%	5.3%	6.9%
-10%	8.2%	4.1%	4.1%	7.3%

The standard IRR for the project including the HP boilers (scenario 4) is 6.5 %, which is most positively influenced by variations in the production rate of biogas and the total energy cost savings. If one of these factors increases by 10%, the IRR would reach 8.7 % which is still far below the benchmark IRR.

The sensitivity analysis confirms that, by applying a realistic variation of ± 10 % to the selected parameters the proposed project is still proven to be economical unattractive, the calculated IRR does not reach the benchmark in any scenario.

Conclusion Step 2

The determined indicator IRR_{equity} does not reach the benchmark value under all project scenarios without CDM benefits. Since the project activity encounters numerous economic and technical risks - such as uncertainties regarding a stable production of biogas, the heating value of biogas, and lack of experience with this technology in the host country - and the return on investment is not significantly higher than the cost of procuring a loan, the project activity cannot be considered attractive to CPI without the additional income through the CDM.

In line with the provisions of the Tool for the demonstration and assessment of additionality, the discussion continues with the common practice analysis.

4. Common practice analysis

Anaerobic closed tank reactors are not common practice in Thai palm oil industry; open lagoons constitute the standard. According to Chavalparit (2006, p. 7), 93% of the 25 Thai palm oil mills use open lagoon systems (either anaerobic and facultative ponds in series, or anaerobic and aerobic lagoons in series). Only 7% - or two installations - use an anaerobic digestion tank and facultative ponds in series.[17]. Interviews with experts on the Thai palm oil industry[18] underline this; they

[17] Orathai Chavalparit: Clean Technology for the Crude Palm Oil Industry in Thailand, PhD Thesis Wageningen University, September 2006, http://library.wur.nl/wda/dissertations/dis4003.pdf, accessed July 28, 2007

[18] Interview with Werner Kossmann, GTZ-advisor to Chiang Mai University in the field of appropriate technology, Thailand, June 5th 2005

indicate that two tank reactor systems have recently been established or are in the conception phase, but they apply different technological approaches (e.g. different tank reactor systems). One is a project implemented at Asian Palm Oil mills in Krabi with support from the Office of Energy Policy and Planning (EPPO) and Thammasat University since 2001. Hence, this is clearly a pilot project with an important research component[19]. The other project intends to apply for registration as a CDM project activity as well; it is being developed under the Danish CDM programme[20].

To conclude, the closed tank reactor projects currently undertaken in Thailand are having special characteristics (highly government-supported pilot project / CDM project) which show that they are not common practice. Neither there are long-term experiences with the operation of such systems. The planned project activity helps introducing a new technological approach in this industrial sector.

5. Impact of registration of the proposed project activity as a CDM project activity.

The range of expectation of annual additional income generated by selling CERs is 3,033,938 – 9,101,815 Baht[21] annually. These figures are based on CER prices of 3.0, 5.0 and 9.0 EUR/CER.

Table 9: Impact of registration of the proposed project activity as a CDM project (EUR/yr; Baht/yr)

Incomce through CER-sales		
EUR/CER	EUR (total)	Baht (total)
3.0	70,344	3,033,938
5.0	117,240	5,056,564
9.0	211,032	9,101,815

With regard to the benchmark analysis conducted for alternative 3 in step 2 of the additionality test, referring to the standard scenario (Table 6), and assuming a CER-price of 5.0 EUR, additional revenues from CER-sales increase the IRR from 6.1% to 17.0% and reduce the payback period to 4.8 years under the original scenario. This clearly shows that the defined benchmark value could only be met with the additional income through the CDM. Under scenario 3 (*inclusion of HP boilers in the project activity*), the impact of including CDM income in the investment analysis lifts the project IRR from -0.9 to 5.0 % (Table 7). This shows that having implemented the project under the CDM has ensured a positive project IRR, which is not the case without CER income.

[19] See Asia-Pacific Environmental Innovation Strategies (APEIS) Research on Innovative and Strategic Policy Options (RISPO) Good Practices Inventory: Waste-to-Energy Project by a Palm Oil Manufacturer, http://www.iges.or.jp/APEIS/RISPO/inventory/db/pdf/0073.pdf, accessed 28 July 2007. For a description of this project and the common practice of wastewater treatment in Thai palm oil industry see also Arul Rajoo: Thailand's Energy And Money From Waste Water, Malaysian National News Agency (Bernama), June 27, 2007, http://www.bernama.com.my/bernama/v3/news.php?id=269835, accessed July 28, 2007.

[20] See http://www.ambbangkok.um.dk/en/menu/DevelopmentCooperation/ProgrammeComponents/CleanDevelopmentMechanism/DanishCDMProjects/BiogasinPalmOilIndustry/. The other project at Thachana Palm Oil Company has been submitted for validation to JQA and is available at http://www.jqa.jp/service_list/environment/file/thachana_070604.pdf.

[21] 43.13 Baht/EUR – European reference rate, 30.3.2007

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

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Emission reductions are calculated as the difference between baseline emissions and project emissions strictly in line with the provisions and formulas defined in AM0013.

Baseline emissions include:

- Lagoon baseline emissions
- Electricity/heat baseline emissions

Lagoon baseline emissions are calculated based on the chemical oxygen demand (COD) of the effluent that would enter the lagoon in the absence of the project activity, the maximum methane producing capacity (Bo) and a methane conversion factor (MCF) that expresses what proportion of the effluent would be anaerobically digested in the open lagoons:

$$\underset{(kg/yr)}{CH_4 \text{ emissions}} = \underset{\substack{COD_{available,m} \\ (kg\ COD/month)}}{Total} \times \underset{(kg\ CH_4/kg\ COD)}{B_o} \times MCF_{baseline}$$

where:

$COD_{available,m}$	Is the monthly Chemical Oxygen Demand available for conversion which is equal to the monthly COD entering the digester or directed to land application $COD_{baseline,m}$ plus COD carried on from the previous month.
$COD_{baseline,m}$	Is the monthly Chemical Oxygen Demand of effluent entering lagoons or directed to land application (measured)
B_o	Is the maximum methane producing capacity
$MCF_{baseline}$	Is the monthly methane conversion factor (fraction)

As there is effluent from the lagoons in the baseline, $COD_{baseline}$ is multiplied by the factor AD:

$$AD = 1 - \left(\frac{COD_{a,out}}{COD_{a,in}} \right)$$

where:

$COD_{a,out}$	is the COD that leaves the lagoon with the effluent
$COD_{a,in}$	is the COD that enters the lagoon

In line with AM0013, the total baseline CH_4 emissions are translated into CO_2 equivalent emissions by multiplying by its global warming potential (GWP) of 21.

Electricity baseline emissions are not relevant for the underlying project, as it does not involve generation of electricity.

Heat baseline emissions are calculated as:
$BE_{heat} = HG_{Bl,y} * CEF_{Bl,therm,y}$

where $HG_{Bl,y}$ is the quantity of thermal energy that would be consumed in year y at the project site in the absence of the project activity (MJ) using fossil fuel.
$CEF_{Bl,\,therm}$ is the CO_2 emissions intensity for thermal energy generation (tCO_2e/MJ)

Project emissions include:

- Methane emissions from lagoons
- Physical Leakage from biodigesters (standard value of AM0013, 15% of the total biogas production, is applied)
- Stack emissions from the flare or energy generation (standard flare efficiency of 50% is applied in line with the "Tool to determine project emissions from flaring gases containing Methane")
- Emissions from heat use and electricity use due to the project activity ($PE_{elec/heat}$)
- Emissions from land application of sludge
- Emissions from wastewater removed in the dewatering process

No leakage is associated with the project activity.

Formula for the calculation of project methane emissions from lagoons as in AM0013:

CH_4 emissions from the lagoons (kg/yr)	=	COD_{dig_out} (kg COD/yr)	X	B_o (kg CH_4/kg COD)	x	MCF_{dig_out}

Where:

COD_{dig_out}	Is Chemical Oxygen Demand of effluent entering lagoons (measured)
B_o	Is maximum methane producing capacity
MCF_{dig_out}	Is methane conversion factor (fraction) estimated as described in the baseline section above

Formula for the calculation of project emissions from electricity use:

$$PE_{elec/heat} = EL_y * CEF_d + HG_{Pr,y} * CEF_{Pr,therm,y}$$

where,

$EL_{P,y}$	is the amount of electricity in the year y that is consumed at the project site for the project activity (MWh).
$CEFd$	is the CO_2 emissions factor for electricity consumed at the project site during the project activity (tCO_2/MWh), estimated as described below. Factor is zero if biogas is used to produce electricity.
$HG_{Pr,y}$	is the quantity of thermal energy consumed in year y at the project site due to the project activity (MJ).
$CEF_{Pr,therm,y}$	is the CO_2 emissions intensity for thermal energy generation (tCO2e/MJ), estimated as per method described for baseline thermal energy use. Factor is zero if biogas is used for generating thermal energy.

CEF_d is calculated in line with ACM002. PE_{heat} is not relevant for the underlying project, as no additional heat is consumed due to the project activity.

Formula for the calculation of emissions from land application of sludge:

CH_4 emissions (kg/yr)	=	Total COD_{la} (kg COD/yr)	x	B_o (kg CH_4/kg COD)	x	MCF_{la}

Where:

COD_{la}	Is Chemical Oxygen Demand of the sludge used for land application after dewatering (measured)
B_o	Is maximum methane producing capacity
MCF_{la}	Is methane conversion factor (fraction) assumed to be equal to 0.05

And

N_2O emissions (kg/yr)	=	S_a (kg sludge/yr)	x	NC (kg N/kg sludge)	x	EF_{N2O}

Where:

S_a Is the amount of sludge applied to land in kg per year

NC Is the nitrogen content in the sludge in (Kg N/Kg sludge)

EF_{N2O} Is the emission factor of nitrogen from sludge applied to land to be assumed 0.016 kg N_2O/ Kg N

Emissions from wastewater removed in the dewatering process:

The wastewater removed from the dewatering process may contain some organic matter that has not been degraded/removed. Emissions from such wastewater should be estimated from the following equation:

CH_4 emissions (kg/yr)	=	Total COD_{dw} (kg COD/yr)	x	B_o (kg CH_4/kg COD)	x	MCF_{dw}

Where:

COD_{dw} Is Chemical Oxygen Demand in the wastewater from the dewatering process (measured)

Bo Is maximum methane producing capacity

MCF_{dw} Is methane conversion factor (fraction) estimated as described in the baseline section above

Emissions of wastewater removed in the dewatering process may be relevant to the project activity at times when sludge treatment and dewatering takes place. At times when no sludge treatment and dewatering is taking place, solid residues from the biogas digester system will be discharged in open ponds and project emissions of methane from lagoons will be accounted for instead.

The calculation of ex-ante Emission Reductions is based on the formula:

Baseline emissions (tCO_2/yr)	=	Baseline emissions from open lagoons (t CO_2e/yr)	+	Baseline emissions from grid electricity generation (tCO_2/yr)	+	Baseline emissions from the portion of fossil fuel displaced by biogas used in heating equipment (tCO_2/yr)

Emission reductions (tCO_2/yr)	=	Baseline emissions (tCO_2e/yr)	-	Leakage (t CO_2e/yr)	-	Project emissions (t CO_2e/yr)

While the calculation of emission reductions in this PDD are based on ex-ante estimation, for the purpose of claiming emissions reductions the lower of the two will be assumed as the baseline emissions:

(i) baseline methane emissions less the physical leakage

(ii) the actual methane captured and flared/used for energy generation.

If (ii) above is the baseline emissions then physical leakage from anaerobic digester for estimating emissions reduction shall be taken as zero.

Additional explanations regarding the calculation of baseline emissions:

For ex-ante baseline calculations, values from 2006 are taken for F_{dig}, COD_{in}, and COD_{out}. All data are based on measurements; COD-data is calculated on the basis of measured BOD-data. Table 10 summarises the monthly values for 2006.

Table 10: Results of wastewater analysis 2006

WASTE WATER Analysis Results 2006

WASTE WATER	DETAIL	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
Process CPO	COD [mg/l]	73,750	0	92,248	96,250	97,845	84,583	21,555	68,333	0	70,417	64,750	70,833
Process Refinery 1		1,103	0	0	1,952	128	792	832	233	11,915	875	2,358	3,208
Process Refinery 2	Caculate	1,192	1,417	0	1,317	6,218	800	960	85	3,782	88	688	367
Last pond		542	650	1,153	783	237	667	337	822	262	1,458	172	942
F_dig (CPO)	m3/month	4,551	8,856	16,026	17,098	16,593	13,992	10,155	8,717	9,717	11,561	11,296	9,368
F_dig (Refinery)	m3/month	6,556	6,306	8,100	6,475	7,913	7,869	5,700	8,050	7,594	8,756	8,413	8,113
COD_in (CPO)	COD [kg/month]	335,625	0	1,478,409	1,645,683	1,623,581	1,183,528	218,894	595,692	0	814,098	731,422	663,574
COD_in (Refinery)	COD [kg/month]	7,523	8,934	0	10,581	25,109	6,262	5,106	1,281	59,598	4,218	12,815	14,501
COD_out (Last pond)	COD [kg/month]	6,016	9,856	27,826	18,466	5,800	14,574	5,338	13,777	4,530	29,630	3,383	16,461

The methane conversion factor (MCF) is calculated on a monthly basis in line with AM0013.
The project activity does not produce electricity. Hence, only heat baseline emissions are considered ($CEF_{Bl,therm}$). $HG_{Bl,y}$ is calculated on the basis of heat contents of produced biogas [MJ] in order to separate the project activities' effects from energy consumption at the palm oil mill.

Additional explanations regarding the calculation of project emissions:

- The formula on page 11 of AM0013 is applied to calculate methane emissions from lagoons. For ex-ante calculations it is assumed that an 80% reduction of COD is achieved in the tank digester. This assumption is based on field tests and expert judgment.
- Physical leakage from biodigesters: in line with AM0013, a leakage rate of 15% is assumed.
- Stack emissions from the flare or energy generation: a flare operating time of 16 h/year is assumed for ex-ante calculations. As an open flare system is applied, a flare efficiency of 0.5 is assumed in line with "Tool to determine project emissions from flaring gases containing Methane".
- Emissions from heat use and electricity use due to the project activity (PEelec/heat): emissions from heat use are zero (no additional heat use); emissions from electricity use are calculated as $PE = EL * CEF$. Details of CEF-calculation are provided in Annex 3.
- Emissions from land application of sludge: the expected COD of sludge after treatment is 50 g/kg; the expected N-content of sludge is 0.00159 kg N_3/kg sludge, the expected amount of sludge applied to land is 4.5 million kg/yr.

B.6.2. Data and parameters fixed ex ante

(Copy this table for each piece of data or parameter.)

Data/Parameter	Bo
Data unit	%
Description	Biogas producing capacity
Source of data	Default value as specified in AM0013, based on IPCC default values
Value(s) applied	0.21 kg CH4/kg COD
Choice of data or measurement methods and procedures	n.a.
Purpose of data	Calculation of baseline and project emissions
Additional comment	

Data/Parameter	Hu_PS
Data unit	
Description	Calorific value of palm shells
Source of data	Desk Study on Palm Oil Industry in Thailand
Value(s) applied	13.8 MJ/kg
Choice of data or measurement methods and procedures	Value is based on detailed analysis by Thai-German Program for Enterprise Competitiveness E3AGRO-Project, Desk Study on Palm Oil Industry, Prawat Leetanakul, Bangkok, Thailand, November 2004.
Purpose of data	Calculation of baseline emissions
Additional comment	

Data/Parameter	Hu_HeavyOil
Data unit	MJ/litre
Description	Calorific value of heavy oil
Source of data	Standard default value: IPCC (1996), Module 1, Table 1-3.
Value(s) applied	35.1 MJ/litre (40.19 MJ/t @ 0.86 t/litre)
Choice of data or measurement methods and procedures	
Purpose of data	Calculation of baseline emissions
Additional comment	

Data/Parameter	GWP_CH_4
Data unit	Number
Description	Global warming potential of CH_4
Source of data	UNFCCC
Value(s) applied	21
Choice of data or measurement methods and procedures	
Purpose of data	Calculation of baseline and project emissions
Additional comment	

Data/Parameter	$CEF_{BI, elec,y}$

Data unit	t CO_2/MWh
Description	CO_2 emission factor for electricity consumed at the project site in the absence of the project activity
Source of data	Electricity Generation Authority of Thailand (EGAT), own calculations based on ACM0002 (simple operating margin, see Annex 3)
Value(s) applied	0.523
Choice of data or measurement methods and procedures	See Annex 3 to this document.
Purpose of data	Calculation of baseline and project emissions
Additional comment	

Data/Parameter	**D_{lng}**
Data unit	M
Description	Depth of lagoon
Source of data	Measurement at CPI
Value(s) applied	> 5
Choice of data or measurement methods and procedures	Standard depth meter; metering randomly selected and varying places of the lagoons.
Purpose of data	Calculation of baseline and project emissions
Additional comment	

Data/Parameter	**F_d**
Data unit	%
Description	Fraction of anaerobic degradation due to depth as per table 1 of AM0013
Source of data	AM0013
Value(s) applied	70%
Choice of data or measurement methods and procedures	Standard value as defined in AM0013
Purpose of data	Calculation of baseline and project emissions
Additional comment	

Data/Parameter	**E**
Data unit	Cal/mol
Description	Activation energy constant
Source of data	AM0013
Value(s) applied	5.175
Choice of data or measurement methods and procedures	Standard value as defined in AM0013
Purpose of data	Calculation of baseline and project emissions
Additional comment	

Data/Parameter	**$COD_{a,in}$**
Data unit	kg COD/yr

Description	COD that enters the lagoon
Source of data	Laboratory tests at CPI (Method AWWA 5220B.,P5-14,1998)
Value(s) applied	Monthly values, see Table 10
Choice of data or measurement methods and procedures	See description at $COD_{c, baseline.}$
Purpose of data	Calculation of baseline and project emissions
Additional comment	

Data/Parameter	**$COD_{a,out}$**
Data unit	kg COD/yr
Description	COD that leaves lagoon with the effluent
Source of data	Laboratory tests at CPI
Value(s) applied	Monthly values, see Table 10
Choice of data or measurement methods and procedures	See description at $COD_{c, baseline.}$
Purpose of data	Calculation of baseline and project emissions
Additional comment	

Data/Parameter	**$COD_{available}$**
Data unit	kg COD
Description	Monthly COD available for conversion which is equal to the monthly COD entering the digester or directed to land application $COD_{baseline,m\ plus}$ COD carried on from the previous month
Source of data	Calculated in line with AM0013
Value(s) applied	Monthly values, see Annex 3 of this document.
Choice of data or measurement methods and procedures	Application of AM0013
Purpose of data	Calculation of baseline and project emissions
Additional comment	

Data/Parameter	**Uncertainty conservativeness factor**
Data unit	
Description	Uncertainty conservativeness factor
Source of data	AM0013
Value(s) applied	0.89
Choice of data or measurement methods and procedures	Standard value as defined in AM0013
Purpose of data	Calculation of baseline and project emissions
Additional comment	

Data/Parameter	**T1**
Data unit	Kelvin
Description	Temperature

Source of data	AM0013
Value(s) applied	303.16
Choice of data or measurement methods and procedures	Standard value as defined in AM0013
Purpose of data	Calculation of baseline and project emissions
Additional comment	

Data/Parameter	**R**
Data unit	Cal/K mol
Description	Ideal gas constant
Source of data	AM0013
Value(s) applied	1.987
Choice of data or measurement methods and procedures	Standard value as defined in AM0013
Purpose of data	Calculation of baseline and project emissions
Additional comment	

Data/Parameter	**EGy**
Data unit	MWh
Description	Electricity consumption of existing waste water treatment system
Source of data	CPI
Value(s) applied	0
Choice of data or measurement methods and procedures	Historical value (measurement with standard electric meter)
Purpose of data	Calculation of baseline emissions
Additional comment	

Data/Parameter	**$CEF_{Bl,therm}$**
Data unit	CO_2 e/TJ
Description	CO_2 emissions intensity for thermal energy generation
Source of data	IPCC 1996 Guidelines – Residual Fuel Oil, Table 1-1
Value(s) applied	77.37
Choice of data or measurement methods and procedures	IPCC standard value for this fuel type
Purpose of data	Calculation of baseline emissions
Additional comment	

Data/Parameter	**HG_{Bl}**
Data unit	MJ
Description	Quantity of [additional] thermal energy that would be consumed in year y at the project site in the absence of the project activity using fossil fuel
Source of data	Information provided by CPI, calculation on the basis of energy content of the produced biogas.

Value(s) applied	11,172,825
Choice of data or measurement methods and procedures	Only the additional thermal energy that would be consumed in year y at the project site in the absence of the project activity using fossil fuels is relevant for the calculation of emission reductions. HG_{BI} is calculated on the basis of annual biogas production (3,238,500 m3/yr), the calorific value of biogas (0.000023 TJ/Nm^3), and the expectation that 15% of the generated biogas will be used to replace fossil fuel (oil).
Purpose of data	Calculation of baseline emissions
Additional comment	

Data/Parameter	**HGp,y**
Data unit	MJ
Description	Quantity of thermal energy that is consumed in year y at the project site due to the project activity using fossil fuel
Source of data	Planning data of installation
Value(s) applied	0
Choice of data or measurement methods and procedures	The new waste water treatment system will not lead to a consumption of thermal energy.
Purpose of data	Calculation of project emissions
Additional comment	

Data/Parameter	**$CEF_{Pr,therm,y}$**
Data unit	tCO_2 e/TJ
Description	CO_2 emissions intensity for thermal energy generation
Source of data	AM0013
Value(s) applied	0
Choice of data or measurement methods and procedures	Biogas is used for generating thermal energy (used at palm oil production, not for waste water treatment system itself)
Purpose of data	Calculation of baseline and project emissions
Additional comment	

Data/Parameter	**EF_{N2O}**
Data unit	Kg N_2O/ Kg N
Description	Emission factor of nitrogen from sludge applied to land
Source of data	AM0013
Value(s) applied	0.016
Choice of data or measurement methods and procedures	Application of AM0013
Purpose of data	Calculation of project emissions
Additional comment	

Data/Parameter	**COD_{dw}**
Data unit	kg COD/yr
Description	Chemical Oxygen Demand in the wastewater from the dewatering process
Source of data	Installation design

Value(s) applied	0 (Not applicable for ex-ante)
Choice of data or measurement methods and procedures	Is applicable at times when sludge treatment and dewatering takes place.
Purpose of data	Calculation of project emissions
Additional comment	

B.6.3. Ex ante calculation of emission reductions

>>

Emission reductions are calculated as the difference between baseline emissions and project emissions in line with the provisions in AM0013. In order to determine baseline emissions, the following data, variables, and parameters will be used for ex-ante calculations:

Underlying data for ex-ante calculations

Table 11: Data for ex-ante calculation

Parameter	Data source (ex-ante figures)	Value used for ex-ante baseline calculation
Production capacity palm oil plant	Plant operator	950 tonnes/day
Production days	Plant operator	300 days/year
Effluent generated by production process (low rate at digester inlet)	Measurement (2006 data)	See Table 10
COD concentration of effluent (at digester inlet)	Measurement (2006 data)	See Table 10
Reduction of COD in tank digester	Field test and expert judgment (Natural Power Co., Ltd.)	80%
Biogas production (net)	Field test and expert judgment (Natural Power Co., Ltd.)	12,700m^3/day
Calorific value biogas	Feasibility study	23.0 MJ/m^3
Electricity supplied to grid	Technical specifications, installation planning	0
Technical lifetime	Technology provider	10 - 15 years
Regulations and incentives relevant to effluent	Literature review, study of relevant regulations	No applicable regulations/incentives

Calculation of baseline emissions

The baseline methodology as elaborated in AM0013 is applied to the underlying project activity without changes. Baseline emissions are the CH_4 emissions from open lagoon wastewater treatment systems, and the CO_2 emissions associated with fossil fuel combustion in the industrial process heating equipment that is displaced due to the project activity. Since the project activity does not include the generation of electricity, no emission reductions are generated by such.

1. Lagoon baseline emissions have been calculated as 38,531 t $CO_{2\text{-eq}}$/yr. Details are provided in emission reduction calculation (ER) spreadsheet.

2. Electricity baseline emissions (heat generation) have been calculated as 854 t CO_2/yr. Details are provided in ER calculation spreadsheet.

3. Other greenhouse gas emissions

   The planned project activity reduces greenhouse gas emissions outside the project boundary as defined in AM0013 and this PDD. The reduction in GHG-emissions is achieved through reduction in road transport, i.e. the transportation of palm shells and heavy oil to the plant in absence of the project. In 2004 alone, 16,750 t of palm shells have been transported by 12 t-trucks (300 days per year). The palm shells have been brought from Krabi and Surathani Provinces. The average transportation distance was 300 km one way. As indicated above, the utilization of about 7,650 additional t palm shells can be avoided through the project activity. This leads to a significant reduction of transport-related CO_2-emissions. - For conservativeness reasons, however, those emission reductions shall not be accounted for.

   Indirect emissions outside the project boundary from decay of stored palm shells that will not be utilized by CPI in the future are not to be expected. This is due to the fact that there is a functioning market for palm shells in Thailand (price level 0.77 baht/kg) so that these palm shells will be utilized somewhere else.

4. Total baseline emissions

   In total, baseline emissions amount to **39,385 t $CO_{2\text{-}eq}$/year**.

Calculation of project emissions

In accordance with AM0013, project emissions consist of methane emissions from the lagoons, physical leakage from the digester system, emissions related with the consumption of electricity/heat in the digester auxiliary equipment, stack emissions from the flare, emissions from land application of sludge, emissions from wastewater removed in the dewatering process.

1. Methane emissions from post-treatment lagoons have been calculated as 5,111 t $CO_{2\text{-}eq}$/yr. Details are provided in ER calculation spreadsheet. The project emission from post-treatment are calculated based on the amount of wastewater that is treated in and leaving the anaerobic digester system. This amount is determined using the approach $F_{Dig} = F_{Dig,out}$.

2. Methane emissions from the digester system

   Applying the default value of AM0013 (15%) leakage, the annual leakage is calculated as 5,606 t $CO_{2\text{-}eq}$/yr. Details are provided in ER calculation spreadsheet.

3. Emissions from the consumption of electricity and heat have been calculated as 324 t $CO_{2\text{-}eq}$/yr. The operation of the digester (e.g. electrical gas pump) will lead to an additional electricity consumption of approx.526 MWh/yr; electricity consumption due to water pumping from the plant to the waste water treatment system is not expected to change compared to the current situation (78,222.5 kWh/yr). Given limited data availability, the Thai grid emissions factor has been calculated as a Simple OM (operating margin) according to ACM0002. The analysis determines the Thai grid emissions factor as 0.523 kg CO_2/kWh. Underlying data and details of calculation can be found in ER calculation spreadsheet.

4. Stack emissions from the flare have been calculated as 125 t $CO_{2\text{-}eq}$/yr. Details are provided in ER calculation spreadsheet.

5. Emissions from land application of sludge have been calculated as 86 t $CO_{2\text{-}eq}$/yr. Details are provided in ER calculation spreadsheet.

6. Emissions from wastewater removed in the dewatering process are likely to be not applicable.

7. Total project emissions

In total, project emissions amount to **11,252 t CO_{2-eq}/year**.

Calculation of leakage

According to AM0013, leakage is not applicable for the underlying project.

B.6.4. Summary of ex ante estimates of emission reductions

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)[1]	Leakage (t CO_2e)	Emission reductions (t CO_2e)
1	39,385	11,252	0	28,133
2	39,385	11,252	0	28,133
3	39,385	11,252	0	28,133
4	39,385	11,252	0	28,133
5	39,385	11,252	0	28,133
6	39,385	11,252	0	28,133
7	39,385	11,252	0	28,133
8	39,385	11,252	0	28,133
9	39,385	11,252	0	28,133
10	39,385	11,252	0	28,133
Total	**393,850**	**112,520**	0	**281,330**
Total number of crediting years	**10**			
Annual average over the crediting period	**39,385**	**11,252**	0	**28,133**

[1] includes leakage (15%) from bio-digestors

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

(Copy this table for each piece of data or parameter.)

Data/Parameter	T2
Data unit	K
Description	Ambient temperature (Kelvin) for the climate
Source of data	Weather station Chumporn Information received upon request to the service of Thai Meteorological Department, Ministry of Information and Communication Technology of Thailand (info_service@tmd.go.th)
Value(s) applied	Monthly Averages (2005): Jan.: 299.1 - Feb: 300.7 - Mar.: 301.2 - Apr: 302.8 - May: 301.7 Jun.: 300.7 - Jul.: 300.3 - Aug.: 301 - Sep.: 300.4 - Oct.: 299.9 Nov.: 299.6 - Dec.: 298.3
Measurement methods and procedures	n.a.
Monitoring frequency	Monthly averages are obtained from the weather station at least annually.
QA/QC procedures	Internal double-check of using the correct values.
Purpose of data	Calculation of baseline and project emissions
Additional comment	According to the monitoring methodology in AM0013 vers.04, the temperature of the lagoon is monitored to calculate the proportion of organic matter that are biologically available for conversion to methane based upon the temperature of the system. The assumed temperature is equal to the ambient temperature.

Data/Parameter	**$F_{Dig,}$**
Data unit	m^3 / yr
Description	Flow rate of organic wastewater into the digester
Source of data	Measurement
Value(s) applied	See Table 10
Measurement methods and procedures	Flow rates will be continuously recorded with Magnetic Flow Meter or similar, installed at least 5 diameters of discharge pipe up- and downstream away from any flow disturbance (e.g. sample points, valves, etc.). An isolating valve will be installed upstream of the meter for maintenance purposes. Accuracy < ± 1 % of actual flow at the lowest typical flow. Continuously values will be transferred online and recorded.
Monitoring frequency	Continuously
QA/QC procedures	Calibration: flow meter will be calibrated by manufacturer or approved company at the time of installation. Frequency of subsequent calibration will be appropriate to the application, but not less than half-yearly re-calibration to ensure accuracy of < ± 1% at lowest plant specific flow rate. Each time the meter is calibrated, an On-Site-Calibration-Report will be submitted to CPI. Inspection and Maintenance: Meters will be installed such to enable easy inspection at least half-yearly and are not to be installed where they will or may be submerged. Installation will also facilitate separation valves for meter removal and repair and recalibration. For this purpose, a spare meter will be held on stock, to avoid long time loss of data record. O&M staff of the digester will be trained to maintain the meters in accordance with the manufacturer's requirements. Meters will be daily inspected by CPI staff and repaired as necessary by a service provider approved by the manufacturer. Laboratory and QA/QC staff will train O&M staff for data reading in parallel to online data transfer. Data storage: Online transfer to computer. Monthly data backup to external data storage. Data Preparation and reporting: Counter control routine between digester inlet and outlet. Aggregation to 24 hrs average, weekly, monthly and quarterly rates by routines. Monthly aggregated reports will be printed and filed at factory and headquarters respectively.
Purpose of data	Calculation of baseline and project emissions
Additional comment	-

Data/Parameter	**F_{Dig_out}**
Data unit	m^3 / yr
Description	Flow rate of organic wastewater out of the digester
Source of data	Measurement
Value(s) applied	See Table 10
Measurement methods and procedures	The following determination of project emissions shall be used: $F_{Dig,out} = F_{Dig}$
Monitoring frequency	Continuously

QA/QC procedures	Calibration: flow meter will be calibrated by manufacturer or approved company at the time of installation. Frequency of subsequent calibration will be appropriate to the application, but not less than half-yearly re-calibration to ensure accuracy of < ± 1% at lowest plant specific flow rate. Each time the meter is calibrated, an On-Site-Calibration-Report will be submitted to CPI. Inspection and Maintenance: Meters will be installed such to enable easy inspection at least half-yearly and are not to be installed where they will or may be submerged. Installation will also facilitate separation valves for meter removal and repair and recalibration. For this purpose, a spare meter will be held on stock, to avoid long time loss of data record. O&M staff of the digester will be trained to maintain the meters in accordance with the manufacturer's requirements. Meters will be daily inspected by CPI staff and repaired as necessary by a service provider approved by the manufacturer. Laboratory and QA/QC staff will train O&M staff for data reading in parallel to online data transfer. Data storage: Online transfer to computer. Monthly data backup to external data storage. Data Preparation and reporting: Counter control routine between digester inlet and outlet. Aggregation to 24 hrs average, weekly, monthly and quarterly rates by routines. Monthly aggregated reports will be printed and filed at factory and headquarters respectively.
Purpose of data	Calculation of project emissions
Additional comment	

Data/Parameter	**$COD_{c,baseline}$**
Data unit	kg COD/m^3
Description	COD - concentration of organic wastewater into the digester
Source of data	Laboratory tests at CPI (monthly) – Method: APHA 5220 D
Value(s) applied	See Table 10
Measurement methods and procedures	Sample points at digester inlets. Method: APHA 5220 D **Laboratory tests at CPI laboratory** Measure COD of WasteWater Sample by using Close Reflux Method.
Monitoring frequency	Weekly (same day, same times) , 4 samples per hour, total 12 samples per day (weekly same day, same times)

QA/QC procedures	• Sampling will be carried out adhering to internationally recognized procedures. *Alternative 1:* Manual sample and laboratory analysis. CPI runs its own laboratory with appropriate sampling and analysis equipment. CPI and its laboratory are certified ISO 9001:2008. CPI will elaborate standard operation procedures (SOP) and QC/QA instructions according to ISO9001:2008 for sampling taking and laboratory practice. Equipment supplier and internal laboratory staff and QA staff will train O&M staff to take samples according international standard requirements. Sample and analyzing accuracy will be < ± 3 %. • *Alternative 2*: Automatic continuous measurement. Method: Electrochemical oxidation. Sample Preparation: Maintenance free particle separator. Calibration: Regular calibration by manufacturer or approved company (half-yearly) – calibration report to CPI. Cross-Checks: If automatic monitoring will be installed, additional quarterly sample will be taken and potassium dichromate digestion analysis carried out. The results will be stored in computer and comparison routines will check these data with quarterly average data from continuous monitoring system. Data capture/storage: Data capture at the laboratory/IT-center resp. online transfer, if continuous monitoring system will be used. Monthly data backup on external data storage of CDM specific data will be carried out by data management (MIS) staff. Data will be stored for 10 years of CDM project duration and 2 years afterwards. Data backup procedure valid for the overall monitoring. Data Preparation and reporting: Data plausibility routines will check data reliability and data comparison automatically. Aggregation to 24 hrs average, weekly, monthly and quarterly rates by routines. Monthly aggregated reports will be printed – two copies will be filed at factory and headquarters respectively. Half-yearly control sampling and analysis by accredited laboratory.
Purpose of data	Calculation of baseline emissions
Additional comment	Due to a misunderstanding of the monitoring requirements the project proponent had adopted a different monitoring frequency during the first monitoring period but has then adjusted the sampling procedure to the description above. Two samples per time mixed together and 2 times a week were collected for COD measurement by internal laboratory. Additionally, samples were taken and sent for analysis to an external laboratory monthly. For conservativeness the lower monthly data are used for emission reduction calculation.

Data/Parameter	**$COD_{a,in}$**
Data unit	kg COD/yr
Description	COD that enters the lagoon
Source of data	Laboratory tests at CPI, Method: APHA 5220 D
Value(s) applied	See Table 10
Measurement methods and procedures	See description at $COD_{c,baseline}$.
Monitoring frequency	Weekly (same day, same times) , 4 samples per hour, total 12 samples per day (weekly same day, same times)
QA/QC procedures	See description at $COD_{c,baseline}$.
Purpose of data	Calculation of baseline emissions
Additional comment	See description at $COD_{c,baseline}$.

Data/Parameter	**$COD_{a,out}$**
Data unit	kg COD/yr
Description	COD that leaves the lagoon
Source of data	Laboratory tests at CPI, Method: APHA 5220 D
Value(s) applied	See Table 10
Measurement methods and procedures	See description at CODc, baseline.

Monitoring frequency	Weekly (same day, same times) , 4 samples per hour, total 12 samples per day (weekly same day, same times)
QA/QC procedures	See description at CODc, baseline.
Purpose of data	Calculation of project emissions
Additional comment	See description at $COD_{c,baseline}$.

Data/Parameter	**T_{lng}**
Data unit	K
Description	Temperature of the lagoon
Source of data	Measurements by CPI
Value(s) applied	
Measurement methods and procedures	Standard industrial temperature meter
Monitoring frequency	Daily measurements; calculation of monthly average.
QA/QC procedures	Internal double-check of using the correct values.
Purpose of data	Calculation of project emissions (for plausibility check against ambient temperature data.
Additional comment	That ambient temperature obtained from weather station will be used for the calculation.

Data/Parameter	**D_{lng}**
Data unit	M
Description	Depth of the lagoons
Source of data	Measurements by CPI
Value(s) applied	
Measurement methods and procedures	Standard depth meter.
Monitoring frequency	daily measurements; calculation of monthly average.
QA/QC procedures	This is done by a mechanical measuring tape, which does not need recalibration. The accuracy is in the range of the scale: ± 1 cm.
Purpose of data	Calculation of project emissions
Additional comment	According to the approved monitoring plan, the depth of the lagoon needs to be measured daily to calculate a monthly average. Over the monitoring period covered by this report, the depth of the lagoon was only measured monthly during the first monitoring period. For the calculation of emission reduction for the lagoon, the highest default values of fraction due to depth (fd) = 0.7 (for lagoons deeper than 5 m) is applied. This is most conservative.

Data/Parameter	**HG_{Bl}**
Data unit	MJ
Description	Quantity of [additional] thermal energy that would be consumed in year y at the project site in the absence of the project activity (MJ) using fossil fuel
Source of data	Calculation based on calorific values and quantity of biogas as well as standard calorific values of fossil fuels (heavy oil).
Value(s) applied	11,172,825
Measurement methods and procedures	Only the additional thermal energy that would be consumed in year y at the project site in the absence of the project activity using fossil fuels is relevant for the calculation of emission reductions. HGBl is calculated on the basis of annual biogas production (3,238,500 m3/yr), the calorific value of biogas (0.000023 TJ/Nm3), and the expectation that 15% of the generated biogas will be used to replace fossil fuel (oil).
Monitoring frequency	-
QA/QC procedures	QS/QA procedures according to ISO 9000:2000 scheme set up by CPI.

Purpose of data	Calculation of baseline emissions
Additional comment	Also see monitoring procedure for biogas flow rates and methane content.

Data/Parameter	**COD_{c,dig_out}**
Data unit	kg COD/m^3
Description	COD-concentration in discharged effluent from digester
Source of data	Measurements by CPI (monthly)
Value(s) applied	See Table 10
Measurement methods and procedures	See description at $COD_{c,baseline}$.
Monitoring frequency	See description at $COD_{c,baseline}$.
QA/QC procedures	See description at $COD_{c,baseline}$.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**$EL_{P,y}$**
Data unit	MWh/yr
Description	Amount of electricity in the year y that is consumed at the project site for the project activity
Source of data	Measurements at CPI
Value(s) applied	Estimate by technology provider, see Appendix 4, Project emissions
Measurement methods and procedures	Standard electricity meter (separate meter for waste water plant); A separate and officially calibrated electric meter will be connected to the main electricity supply of the overall biogas plant.
Monitoring frequency	Continuously
QA/QC procedures	Yearly calibration by official organization or authorized company. No further steps are applicable due to external quality control (electricity provider). The instrument has the measurement accuracy of ±1%.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**F_{la}**
Data unit	kg/yr
Description	Quantity of sludge used for land application after dewatering
Source of data	Measurements by CPI
Value(s) applied	4,500,000
Measurement methods and procedures	Weighing of trucks with standard industrial weighbridge.
Monitoring frequency	Continuously
QA/QC procedures	QS/QA procedures according to ISO 9000:2008 scheme set up by CPI. The calibration frequency of the instrument is biannually (every 2 years). The accuracy is ±10 kg.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**COD_{la}**
Data unit	kg COD/m^3
Description	COD of the sludge used for land application after dewatering
Source of data	Measurements by CPI (laboratory), Method: APHA 5220 D
Value(s) applied	50 g COD/kg

Measurement methods and procedures	See description at $COD_{c,baseline}$.
Monitoring frequency	Monthly (if applicable)
QA/QC procedures	see description at $COD_{c,baseline}$.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**$Fc_{,dw}$**
Data unit	m^3/yr
Description	Flow rate of organic wastewater from the dewatering process
Source of data	Measurement by CPI (reading of flow meter and recording)
Value(s) applied	Is applicable at times when sludge treatment and dewatering takes place.
Measurement methods and procedures	Flow rates will be continuously recorded with Magnetic Flow Meter or similar.
Monitoring frequency	Continuously
QA/QC procedures	See description under F_{Dig}
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**$COD_{c,dw}$**
Data unit	kg COD/yr
Description	COD of the wastewater from the dewatering process
Source of data	Measurements by CPI (laboratory), Method: APHA 5220 D
Value(s) applied	Is applicable at times when sludge treatment and dewatering takes place.
Measurement methods and procedures	See description at $COD_{c,baseline}$.
Monitoring frequency	Monthly (if applicable)
QA/QC procedures	See description at $COD_{c,baseline}$.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**FR_{Bio}**
Data unit	m^3/yr
Description	Biogas flow rate at digester outlet (two lines are considered)
Source of data	Measurements
Value(s) applied	3,238,500 (300 day x 12,700 m3 = 3,810,000 m3; minus 15 % physical leakage)
Measurement methods and procedures	Application of ThermalMass Flow Meter or similar (measurement range 0-5,000 Nm3/hr Measurement at the outlet of the biogas system, after the biogas cleaner, before utilization of the gas. Accuracy ± 1% of reading, ± 0.2 % of full scale Continuously values will be transferred online and recorded.
Monitoring frequency	continuously

QA/QC procedures	Regular Calibration of Thermal Mass flow meter or similar by manufacturer or approved company (half-yearly) – calibration report to CPI. QC staff of CPI will be trained on calibration control and on malfunction recognition. Subsequent calibration control every month will be appropriate to the application to assure accuracy of ± 2%. Each time the meter is calibrated by approved companies, an On-Site-Calibration-Report will be supplied to CPI. Calibration control and adjustments by CPI-QC staff will be recorded. QC of meter function: One flow meter for each outlet 1 and 2 will be installed. Data of the meter will be sent to a computer. Computer program will cross-check total digester outlet with Sum of flow to flare and energy conversion units. Flow meter malfunction or leakages can thus be detected. Daily flow meter function inspection. Cross-check accuracy set to ± 2 %. A spare flow meter will be held on stock for immediate change if needed at any place of gas pipes. Separation valves will allow deviation of gas flow through second line during exchange of meter. Range of meter will allow to measure full flow. Data recording and storage: Online transfer to computer. Monthly data backup to external data storage. Data preparation and reporting: Aggregation to 24 hrs average, weekly, monthly and quarterly rates by routines. Monthly aggregated reports will be printed and filed at factory
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**$P_{CH4,bio}$**
Data unit	ppm
Description	Biogas CH_4 content at digester outlet
Source of data	Measurement (quarterly)
Value(s) applied	65
Measurement methods and procedures	CH_4 content will be determined through electronic probe and analysis: Non-Dispersion Infrared method (NDIR). Preferably application of portable analyzer (range 0 -100vol%). The average of 12 months will be calculated and transformed in [%] of biogas.
Monitoring frequency	Measurements at 1 hr frequency (portable analyzer). Continuous measurement with at least hourly recording or periodical measurement at 95% confidence level using portable analyser.
QA/QC procedures	Accuracy of equipment < ± 1 % at full scale. Accuracy of Method (portable analyzer): < ± 2 % due to relatively stable production process and low variation of CH_4 production. Regular calibration by manufacturer or by approved company (half-yearly or before each measurement period, if portable equipment are used) – calibration report to CPI. QC staff of CPI will be trained on calibration control and on malfunction recognition. Data recording/storage: Data logger reading or online transfer to computer. Monthly data backup to external data storage.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**$FR_{f,inlet}$**
Data unit	m^3/hr
Description	Biogas flow rate at flare inlet
Source of data	Measurement / calculation
Value(s) applied	Assumption of flare operation time: 16 hrs/yr (conservative estimate) Assumption of flow rate: 12,700 m3/day Resulting assumption of quantity of flared biogas: 25,400 m^3/yr

Measurement methods and procedures	Thermal Mass Flow Meter Accuracy ± 1% of reading, ± 0.2 % of full scale
Monitoring frequency	Continuously
QA/QC procedures	See description at $FR_{Bio..}$ The minimum re-calibration interval is 2 years.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**$T_{comb,f}$**
Data unit	hrs/yr
Description	Fraction of time gas is combusted in the flare
Source of data	Measurement
Value(s) applied	16
Measurement methods and procedures	The gas flow to the flare is controlled by a pressure control system: If gas flows to the boiler stops, pressure in biogas storage bag will raise. If this pressure exceeds a certain level, a signal will be send to gas blower which will switch on pump. This starts gas pumping to the flare. The ignition of the flare is being controlled by pressure. If pressure increases, a signal will be send to switch to ignite the flame. Thermal Mass Flow Meter Accuracy ± 1% of reading, ± 0.2 % of full scale.
Monitoring frequency	Continuously
QA/QC procedures	QS/QA procedures according to ISO 9000:2000 scheme set up by CPI. The minimum re-calibration interval of the gas flow meter is 2 years.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**$PE_{flare, y}$**
Data unit	t CO_{2e}
Description	Project emissions from flaring of the residual gas stream in year y
Source of data	Calculation based on $FR_{f,inlet,,}PCH_{4,f,s,}$ and $T_{comb,f}$

Value(s) applied	125 t CO_{2e}
Measurement methods and procedures	$PE_{flare, y}$ will be calculated as the annual amount of CH_4 being utilized in the flare [t/yr] times the standard flare efficiency of 0.5 times the GWP of CH_4 (21): $PE_{flare, y} = (M_{CH4, flare} * 0.5 * 21)/1000$ in [t/yr] The annual amount of CH_4 being utilized in the flare ($M_{CH4, flare}$) will be calculated as: $M_{CH4, flare} = V_{Bio, flare} * \rho_{Bio, flare} * P_{CH4,bio}$ in [kg/yr] Where $V_{Bio, flare}$ = Annual volumetric flow of biogas at norm conditions = ($FR_{f,inlet}$ * $T_{comb,f}$) * (1+27.3°C[22] / 273.15°C) $\rho_{Bio, flare}$ = Density of biogas at norm conditions = $P_{CH4,bio}$ * 0.717 kg/m³ + (1-$P_{CH4,bio}$) * 1.251 kg/ m³ Remarks: ▪ The calculation of the density of the biogas is based on the simplified assumption that the biogas consists of CH_4 and N_2 only. This is in line with the TME, page 5. ▪ 0.717 kg/m³ is the density of CH_4 at norm conditions, 1.251 kg/ m³ is the density of N_2 at norm conditions (http://www.biologie.de/biowiki/Liste_der_Dichte_gasf%C3%B6rmiger_Stoffe)
Monitoring frequency	-
QA/QC procedures	See $T_{comb,f}$ and $FR_{f,inlet.}$
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**$FR_{e,inlet}$**
Data unit	m³/yr
Description	Flow rate of the biogas entering the heat generation equipment
Source of data	Measurement
Value(s) applied	3,213,100 (15% leakage assumed and 25,400 m3 to the flare)
Measurement methods and procedures	The valve at the biogas burner is controlled by UV detector (flame control) and/or pressure drop at gas storage. Thermal mass flow meter is installed at biogas utilisation unit. Accuracy ± 1% of reading, ± 0.2 % of full scale.
Monitoring frequency	Continuously
QA/QC procedures	See description at $FR_{Bio.}$. The minimum re-calibration interval is 2 years.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**$FR_{e,s}$**
Data unit	m³/yr
Description	Flow rate of the heat generation equipment stack gases
Source of data	Measurement
Value(s) applied	n.a.
Measurement methods and procedures	The stack gas emission flow rates (m3/s) are measured for the environmental monitoring for Industrial department half yearly under normal operating conditions of the boilers (full load). Based on the measured flow rate and the operation time of the boiler (which is continuously logged), the yearly flow of stack gas (m3/yr) will be calculated.
Monitoring frequency	Half yearly.

[22] 27.3 °C is the average annual temperature at the project site.

QA/QC procedures	See description at $FR_{Bio.}$
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**$P_{CH4,e,s}$**
Data unit	Ppm
Description	Methane content in stack gas of heat generation stack gases.
Source of data	Measurement (half yearly)
Value(s) applied	n.a.
Measurement methods and procedures	CH_4 content will be determined through Measurement for the environmental monitoring for Industrial department half yearly.
Monitoring frequency	Half yearly
QA/QC procedures	See description at $P_{CH4,bio.}$
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**$T_{comb,e}$**
Data unit	hrs/yr
Description	Fraction of time gas is combusted in the heat generation equipment.
Source of data	Measurement
Value(s) applied	n.a.
Measurement methods and procedures	The valve at the biogas burner is controlled by UV detector (flame control) and/or pressure drop at gas storage. Thermal mass flow meter is installed.
Monitoring frequency	Continuously
QA/QC procedures	QS/QA procedures according to ISO 9000:2000 scheme set up by CPI.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**Sa**
Data unit	kg/yr
Description	Amount of sludge applied to land
Source of data	Measurement
Value(s) applied	4,500,000
Measurement methods and procedures	Weighing of trucks with standard industrial weight truck.
Monitoring frequency	Continuously
QA/QC procedures	QS/QA procedures according to ISO 9000:2000 scheme set up by CPI.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**NC**
Data unit	kg N/kg sludge
Description	Nitrogen content in the sludge
Source of data	Monthly measurements
Value(s) applied	50 g COD/kg
Measurement methods and procedures	Laboratory tests at CPI laboratory – Kjeidahl Method (Total Kjeldahl Nitrogen 3094 mg/L as N)
Monitoring frequency	Monthly measurements
QA/QC procedures	QS/QA procedures according to ISO 9000:2000 scheme set up by CPI.

Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**EGy**
Data unit	MWh
Description	Amount of electricity in the year y that would be consumed at the project site in the absence of the project activity
Source of data	Historical data provided by CPI
Value(s) applied	0 (zero); (the historic consumption is 78.2225 MWh, but no emission reduction are claimed for this)
Measurement methods and procedures	Standard industrial electrical metering meters (accuracies: Power ± 0.5%, Current± 0.3, %Energy ± 1%, Power factor± 0.5%,Frequency± 0.1%)
Monitoring frequency	
QA/QC procedures	External control by electricity provider.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**NCV_BG**
Data unit	MJ/m^3
Description	Net calorific value of biogas (dry)
Source of data	Measurement by PTT chemical public company limited
Value(s) applied	23 MJ/m^3
Measurement methods and procedures	Laboratory tests at PTT chemical public company limited Methane Method ASTM D 1945-91 Total Hydrocarbons(C2-C5) Method ASTM D 2712-91
Monitoring frequency	-
QA/QC procedures	n.a.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**T_{FI}**
Data unit	K
Description	Temperature of Flare
Source of data	Automatic measurement
Value(s) applied	n.a.
Measurement methods and procedures	Measurement temperature by Thermocouple transmitter type S . Accuracy ± 0.3% of FS.
Monitoring frequency	Continuously
QA/QC procedures	
Purpose of data	Calculation of project emissions
Additional comment	-

All data will be kept for at least two years following the end of the crediting period or the last issuance of CERs (whatever is the later). For all monitoring supervision, maintenance, data storage, data handling and plausibility check measures, standard operation procedures (SOP) will be elaborated. These SOPs will be integrated into the existing ISO 9001:2008 System.

Reconstruction/calculation of data in case of instrument failure

Missing monitoring data derived from instrument failure and during replacement of broken instruments will be reconstructed from former and subsequent series of measurement. Within the first month of monitoring, missing data will not be reconstructed and losses accepted accordingly.

After one month of monitoring and one month data record respectively, missing data will be reconstructed from the average of the lowest measured values of the previous and the following month, if the monitoring interruption is longer than one week (5 working days).

This method is appropriate and conservative, since the flow rates of waste water and biogas as well as the COD content in the waste water and CH_4 content in the biogas are not subject to huge variations in such production processes. To avoid suspicion referring bridging of complete production interruptions, corresponding data from parallel instruments and proved production data from the same period of the instrument failure will be recorded and documented in order to prove the continuity of the production process. Reconstructed values will be marked in the record and monitoring reports accordingly.

Data Storage

The planned control room for the biogas digester, adjacent to the Biogas plant will be used for monitoring data record and processing facilities. The room will be ventilated through AC system and will provide shelter for the computer equipment and peripheral equipment (printer, modem).

B.7.2. Sampling plan

>>
The section is left blank intentionally

B.7.3. Other elements of monitoring plan

>>
The monitoring methodology AM0013 will be applied. This includes monitoring of a set of 33 parameters to determine baseline and project emissions. Since the project activity does not involve generation of electricity, the parameters 24 - 28 as listed in the monitoring methodology cannot be monitored. Figure 4 summarizes the major monitoring points and data ID-numbers. Details for each ID-number are provided in Appendix 5.

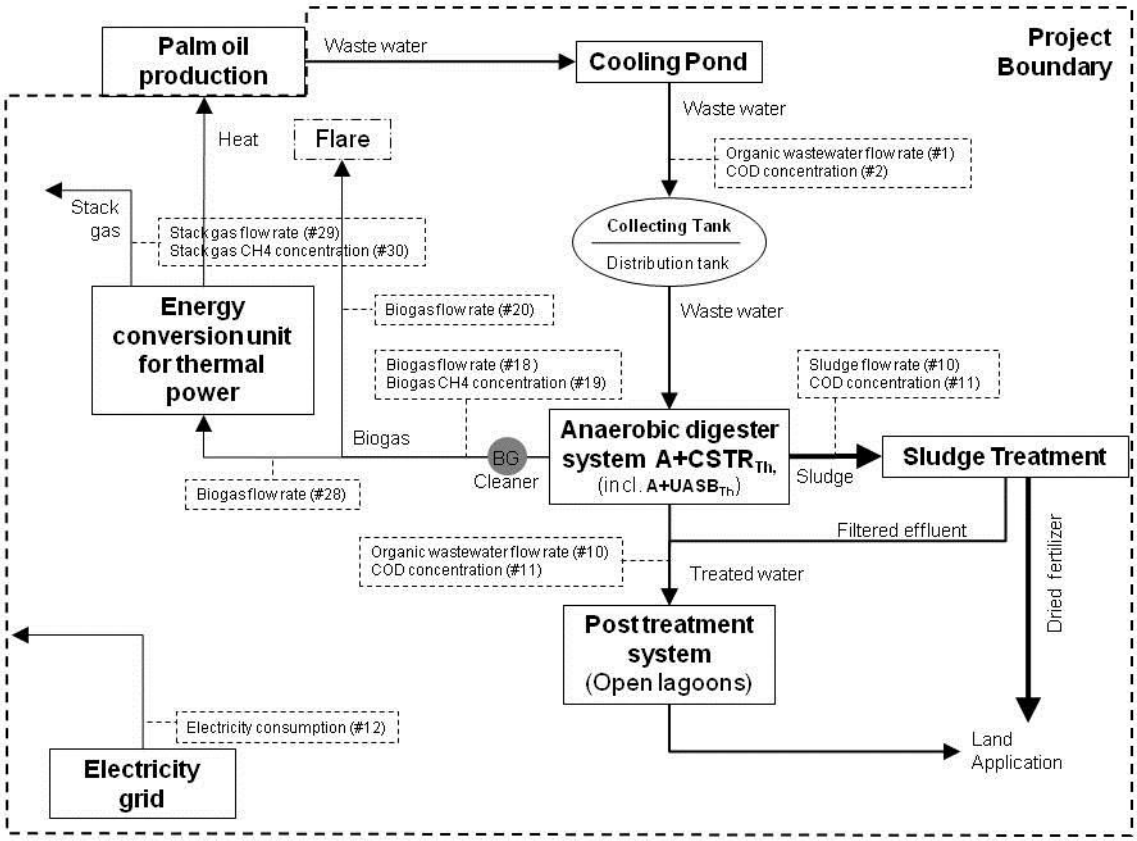


Figure 4: Monitoring plan – overview of measurement points

Organizational and management structures

The management structure as well as implementation and operation management of the efficient monitoring system will be as follows:

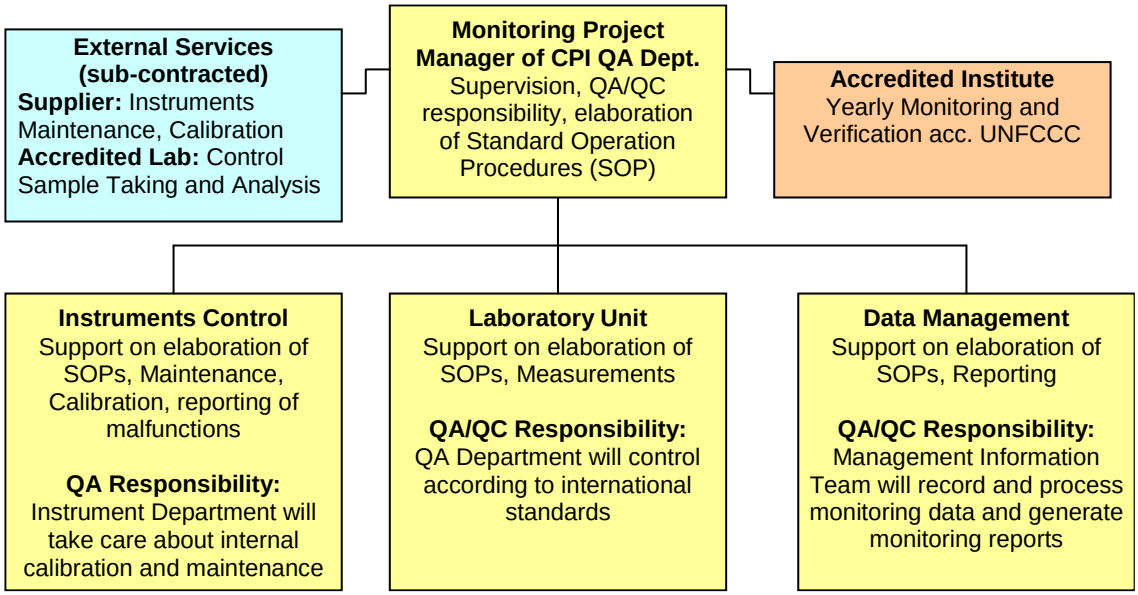


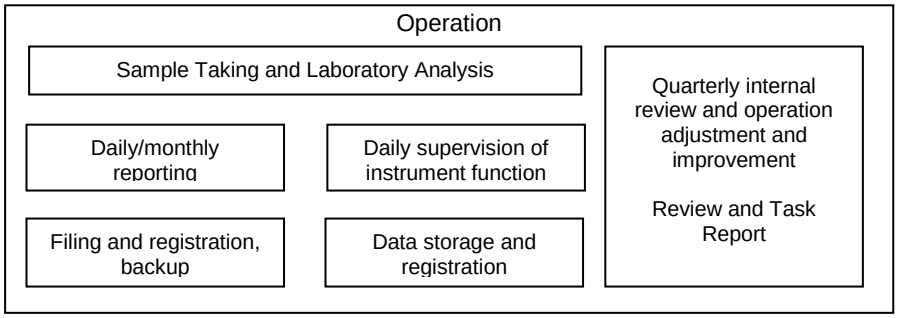
Figure 5: Management Structure of Monitoring System

Monitoring implementation and operation management and procedure

In order to implement, operate, maintain and control the monitoring system appropriately, the following operation procedure will be implemented:

Figure 6: Monitoring Operation Procedure

Responsibility of Installation and Operation	*Monitoring Implementation and Operation*	*Training*	*Responsibility of Training*
Supplier	Installation of Monitoring Equipment	Instruction on equipment (operation, maintenance, emergency/failure response)	Supplier CPI
		Determination of responsibilities	CPI
Supplier CPI	Design and implementation of data system, e.g. transfer, storage, processing, reporting, and backup	Instructions on data handling system	Supplier
		Determination of responsibilities	CPI
CPI	Implementation of control measurement procedures	Instructions on sample taking, handling and analysis	Official laboratory/ institute
		Determination of responsibilities	CPI
CPI	Elaboration of Standard Operation Procedures (SOP) for sample taking, analysis, instrument control, maintenance, emergency/failure response, data processing, report generation		
Supplier CPI	Start up Operation	Instructions on Monitoring Reporting	CPI



Training

To assure the correct handling of the equipment, correct monitoring, a comprehensive training of local stuff will be organized. 16 staff members, which will be responsible for operating and managing the system, will be trained. Out of these 16 staff members, 8 staffs are from the operational level, 4 staffs (engineers) from the mid-management level and 4 staffs from the supervisory level. The training focuses on:

- general knowledge about the applied equipment at the digesters and biogas utilization units;
- reading, recording and processing data and elaboration of monitoring reports;
- inspection and maintenance of equipment
- calibration methodology;
- emergency situation (complete exchange of equipment).

A first training phase already took place from February to May 2007 – focus: principals of anaerobic digestion and design parameters. A second training phase followed from May to July 2007, with a focus on start-up and operating procedure including gas utilization. A third phase currently takes place and will last until one year after the finalisation of construction – it focuses on the M&E concept and procedure.

The main course of the training will be carried out by staff of the monitoring equipment supplier. CPI staff will attend the installation of the equipment, calibration and start up operation.

Guidebooks for the monitoring system and a handbook of the digester operation are provided in local or English language by the suppliers. The operator and the monitoring management team can find information about:

- operation and maintenance of the monitoring instruments
- operation manual of the digester;
- design parameters of the biogas composition, temperature, pressure, flow rate, etc..
- drawings;
- inspection, maintenance and simple emergency repair instructions;
- description of parts of the equipment;

The training will be in accordance with the already implemented ISO9001:2000 procedures at CPI and will consider the above presented Monitoring Management Organization and staff assigned to the positions within this organization structure.

Monitoring of sustainable development benefits

Please see Appendix 5 to this document.

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

>>
February 2006 (start of construction work)
Commissioning and testing: March 2007
Start-up: May 2007
Full operation: since July 2007

C.2. Expected operational lifetime of project activity

>>

Technical lifetime: 12 years, 0 months[23]

C.3. Crediting period of project activity

C.3.1. Type of crediting period

>>
10 years fixed crediting period

C.3.2. Start date of crediting period

>>
15/10/2008 or upon date of registration, if this is later

C.3.3. Duration of crediting period

>>
10 years

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>

According to the regulations of the Kingdom of Thailand, a comprehensive environmental impact assessment (EIA) is not required for the underlying project activity[24].

However, the Thai DNA requires an Initial Environmental Evaluation (IEE) for potential CDM project activities. Since the Thai DNA has adopted the standards and requirements on sustainable development and environmental impact screening from the Gold Standard Scheme, the IEE has been conducted closely following the Gold Standard procedures.

Potential environmental impacts of the project activity have been assessed by means of stakeholder consultations, the EIA-activities as described in section A2, and by applying the Gold Standard pre-screen checklist. The latter, including the results of the assessment are summarized in Figure 7.

1. Will there be a large change in environmental conditions?	No	
2. Will new features be out-of-scale with the existing environment?	No	
3. Will the effect be unusual in the area or particularly complex?	No	
4. Will the effect extend over a large area?		No
5. Will there be any potential for transfrontier impact?	No	
6. Will many people be affected?		No
7. Will many receptors of other types (fauna and flora, businesses, facilities) be affected?	No	
8. Will valuable or scarce features or resources be affected?		No
9. Is there a risk that environmental standards will be breached?	No	
10. Is there a risk that protected sites, areas, features will be affected?		No
11. Is there a high probability of the effect occurring?		No
12.Will the effect continue for a long time?		No
13.Will the effect be permanent rather than temporary?	No	
14.Will the impact be continuous rather than intermittent?	No	
15. If it is intermittent will it be frequent rather than rare?	No	
16.Will the impact be irreversible?		No severe impacts
17.Will it be difficult to avoid, or reduce or repair or compensate for the effect?	No severe impacts	

[23] Realistic expectation based on the technology provider's lifetime expectation of 10 – 15 years.

[24] Legal requirements for conducting EIAs are defined under the "Enhancement and Conservation of the Natural Environmental Quality Act of 1992", Part 4, Section 46-51. This Act lists project types that require an EIA. The adoption of a different technology for an existing waste water treatment plant is not subject of this law.

Figure 7: Application of the Gold Standard pre-screen checklist to the underlying project activity

Despite this summary of the positive results of the EIA pre-screen (comprehensive table please see Annex 6), an IEE according to Thai DNA requirements has been carried out in co-operation with experts from the Thai Environment Institute (TEI) and local stakeholders. The results are summarized in the following paragraphs, and – in a more detailed form – in Annex 6. No significant environmental and social impacts through the project activities have been identified.

Major findings are:

- The project has the potential to play an important role with regard to the establishment of efficient and environmentally friendly self-supply of thermal power in the agro-industry in Thailand.
- The project activity helps to decrease the level of air-borne particles deriving from the utilization of fossil fuels.
- The new waste water treatment system is more effective in terms of COD-reduction and thus improves the quality of discharged water.
- The project activity will take place on the existing site of the facility. Hence, no additional land use occurs, which potentially would impact surrounding ecosystems.
- Regarding the utilization of methane gas, no harmful pollutants or smoke/soot will be emitted. Also, fugitive methane emissions from the existing open-pond system will be eliminated.
- The project activity will not significantly produce noise. At a distance of 20 m or more, no noise or vibration will be noticeable.

D.2. Environmental impact assessment

>>
The results of the IEE, site assessments and the stakeholder consultations came to the conclusion that no significant environmental impacts are to be expected.
An English summary of the IEE is attached in Attachment 1.

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

>>

Scope of the local stakeholder consultations

The stakeholder and public consultations have been carried out in four steps: the initial stakeholder consultations, the publications of a non-technical PDD and draft-PDD, the interim stakeholder consultation, and a final stakeholder meeting. Although there is formally no legal requirement for public participation, it is common practice of the governmental agencies responsible for licensing factories or large projects to call for such. With the initial stakeholder consultations, these requirements, as well as the UNFCCC's requirement for public participation for CDM-projects, are met. The additional steps of local stakeholder consultation have been conducted to meet the requirements of the Gold Standard.

A more detailed description of the individual steps is provided below.

Step 1: Initial stakeholder consultations

- The initial local stakeholder consultations were conducted in August and September 2005

- The consultations covered the information of and consultation with people living within 2 kilometres from the production site (Moo 2-4, 7 and 8; Salui sub-district; Tasae District; Chumporn Province).
- Involved stakeholders include different groups of people. A total of 41 persons - governmental officers, school teachers and school children, monks, officers of the Tambon Authority Office (TAO), community's leaders, factory's workers, general villagers, agriculturists, and merchants – were included.
- Stakeholders have been briefed on the project purpose and interviewed concerning their perception of the impacts of the palm oil factory on the environment, social systems and general economics. Their opinions on future impacts through the planned project activity and operation of the plant have been gathered and evaluated. The results have been summarized in Annex 6.
- The initial stakeholder consultation process was finalized by September 27th 2005. The summary report has been made available on September 31st (English version) and the Thai translation was available by October 3rd, 2005.

Step 2: Publication of a non-technical PDD and draft PDD on the web sites of CPI and TEI

- Public access to all documents at Chumporn Local Authority, CPI Factory Chumporn, CPI Offices in Bangkok, TEI Offices in Bangkok, ENVIMA Office in Bangkok.
- Announcement of the project and access to all documents through press publications at Bangkok Post Nov. 3, 2005 and Nov. 17, 2005, including invitations for comments to the project.

Step 3: Interim Stakeholder Consultation as part of the validation audit

- Comprising of the Validator, PDD developer, Project Developer, CPI staff, and seven main stakeholders of the Chumporn local authorities (Administration, environmental department, Public Health Department, etc.). More detailed information is provided in Annex 8.

Step 4: Final Stakeholder Meeting in Chumporn

- Conducted on November 15, 2005 - 8 weeks after the first publication of the project documents. More detailed information is provided in Annex 8.

E.2. Summary of comments received

>>

No comments have been submitted based on the public accessibility of the project documents.

Comments have been given by the stakeholders at the official stakeholder meetings. These comments have been discussed with CPI and the NPC. During the stakeholder meetings, no concerns about severe environmental impacts of the project activity were raised. For more details, please refer to Attachment 3.

E.3. Consideration of comments received

>>

As pointed out above, no concerns of severe environmental impacts through the project have been expressed. There was a broad understanding of the applied technology and its improvements compared to the current environmental impacts. For more details, please refer to Attachment 3.

SECTION F. Approval and authorization

>>

The section is left blank intentionally

Appendix 1. Contact information of project participants

Organization name	Deutsche Gesellschaft für Internationale Zusammenarbeit (GTZ) GmbH
Country	Germany
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Telephone	+49 (0)6196 / 79 0
Fax	+49 (0)6196 / 79 1115
E-mail	Info@giz.de
Website	www.giz.de
Contact person	Mrs. Anja Wucke Department of environment and Infrastructure +49 (0)6196 / 79 80 1376 +49 (0)6196 / 79 1376 Anja.Wucke@giz.de

Organization name	Chumporn Palm Oil Industry Public Company Limited
Country	Thailand
Address	1168/65, Rama IV Rd., Sathorn Lumpini Tower Building, 23rd Fl., Unit A 10120 Bangkok
Telephone	+66 2 679 9166
Fax	+66 2 285 6369
E-mail	info@cpi-th.com
Website	www.cpi-th.com
Contact person	Mr. Suriya Ayachanun Environment and Infrastructure Department +66 1 860 2907 sa@cpi-th.com

Appendix 2. Affirmation regarding public funding

No public funding is involved in the project activity.

Appendix 3. Applicability of methodologies and standardized baselines

The section is Left blank intentionally.

Appendix 4. Further background information on ex ante calculation of emission reductions

BASELINE INFORMATION

The baseline methodology as elaborated in AM0013 has been applied to the underlying project activity without changes. The following Excel spread-sheets summarize the results of calculations for the relevant categories of baseline emission, project emissions and emission reductions. For verbal explanations please see section B.6.
Further details on the ex ante calculation of emission reductions can be found in the “Emission reduction calculation sheet” as an annex to this PDD.

CALCULATION OF THAI GRID EMISSIONS FACTOR

The Thai grid emissions factor needs to be determined to calculate project-related CO2-emissions (electricity consumption by digester auxiliaries. This is done according to ACM0002 vs. 06 using the tool to calculate the emission factor for an electricity system.

The calculation considers the years 2004-2006 as no comprehensive data is available for 2007 yet. Data is taken from the annual reports of the Electricity Generation Authority of Thailand (EGAT), Energy Policy and Planning Office (EPPO) and the Department of Alternative Energy Development and Efficiency, Thailand (DEDE). However, there is a significant lack of data. Neither the above institutions nor any other sources publish the complete plant-specific data required for the calculation of operating margin (OM) using the simple adjusted OM approach or Dispatch Data Analysis OM approach and build margin (BM). Especially, plantwise fuel consumption needed for the BM calculation is missing.

Also, the specifications of the Thai grid - energy supply by public (EGAT), independent (IPP) and small (SPP) power producers - increase the complexity of the calculation.

Therefore, the calculations are based on an aggregated approach which is in line with the ACM0002 vs. 06 and are based on the “Study on Electricity Sector Baselines in Thailand” of the ECON Centre for Economic Analysis of December 2005.

According to these calculations, the grid emissions factor of Thailand is = 0.523 kg CO2/kWh.

Calculation of fossil fuel-based generation weighted-average CO_2 emission factor

Tool to calculate the emisson factor for an electricity system Vs. 01

Baseline Emission Factor THAILAND		
Year 2004 (y1)		
EF_{OM} (tCO_2/MWh)	0,5930	
Annual generation[1] (MWh)	117.127.444	
Year 2005 (y2)		
EF_{OM} (tCO_2/MWh)	0,5877	
Annual generation[1] (MWh)	128.784.794	
Year 2006 (y3)		
EF_{OM} (tCO_2/MWh)	0,6135	
EF_{BM} (tCO_2/MWh)	0,4485	
Annual generation[1] (MWh)	132.812.942	
Generation weighted $EF_{OM,y1-y3}$	0,598	(tCO_2/MWh)
$EF_{CM} = 0.5*EF_{OM,y1-y3} + 0.5*EF_{BM,y3}$ =	**0,523**	**(tCO_2/MWh)**

Method used to calculate OM: Simple OM (ex ante)

1. For ex-ante calculation of simple OM generation weighted average considering total generation **excluding** LC/MR and **including** approved CDM projects if applicable and **including** imports

2. Calculations based on:
New methodological tool to calculate the EF for an electricity system (based on EB35, Annex 12);
Sources: EGAT, DEDE, EPPO (see data sheet for sources)
own calculations,
IPCC (2006)

Low Cost / Must Run Technologies	2002	2003	2004	2005	2006	average
Total Generation (GWh)	111.254	118.408	125.339	136.887	143.403	
Total LC / MR Technologies (GWh)	7.369	7.210	8.212	8.102	10.590	
% LC/MR Technologies	6,62%	6,09%	6,55%	5,92%	7,38%	6,51%

(Low cost / must run constitute less than 50% of total grid generation in average 2002-2006, therefore Simple OM method is applicable)

Appendix 5. Further background information on monitoring plan

ID Number(s)	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Proportion of data to be monitored	How will data be archived? (electronic/ paper)	Comment
1, 10.	F_{Dig} = Flow rate of organic wastewater into the digester (F_{dig}); FDig,out determined as FDig,out = FDig	m^3 / yr	M	continuously	100%	Electronic, paper	Hourly values will be recorded. Use of flow meter
2	$COD_{c,\ baseline}$ = COD - concentration of organic wastewater into the digester	kg COD/m^3	M	monthly	100%	electronic	Laboratory tests at CPI, Method APHA 5220 D
3	$COD_{a,out}$ = COD that leaves lagoon with the effluent	kg COD/yr	M	Historical 1 year data	100%	electronic	Laboratory tests at CPI, Method APHA 5220 D
	B_o = maximum methane generating capacity	%	C	Ex-ante	100%		Ex-ante determination
4	$COD_{a,in}$ = COD that enters the lagoon	kg COD/yr	M	Historical 1 year data	100%	electronic	Laboratory tests at CPI, Method APHA 5220 D
5.	T_{lng} = Temperature of the lagoon	K	M	Daily (between 6:00 and 9:00 a.m.)	100%	Electronic, paper	Daily average is monitored but monthly average is used in the calculations.
6.	D_{lng} = Depth of lagoon	m	M	daily	100%	Electronic, paper	
7.	EG_y = amount of electricity that would be consumed in absence of project activity	MWh/yr	E	Ex-ante	100%		Conservatively assumed 0 (zero) MWh.
8	$CEF_{Blelec,y}$ = CO_2 emission factor for electricity consumed at the project site in the absence of the project activity	Kg CO_2/kWh	C	Ex-ante	100%	Electronic, paper	
9	$EG_{d,y}$ = amount of electricity	kWh	M	n.a.	100%	Electronic	Not applicable because the

ID Number(s)	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Proportion of data to be monitored	How will data be archived? (electronic/ paper)	Comment
	generated utilizing the biogas.						project activity does not involve electricity generation.
10	$HG_{Bl,y}$ = quantity of thermal energy that would be consumed in year y at the project site in the absence of the project activity using fossil fuel	MJ	m, c	Continuously	100%	Electronic, paper	Thermal energy consumed is determined from quantity of biogas consumed in the heat generation equipment and its calorific value: $HG_{Bl} = T_{comb,e} * FR_{e,inlet} * NCV_{BG}$
11	$F_{Dig,out}$ = Flow rate of organic wastewater out of the digester; determined as $F_{Dig,out} = F_{Dig}$	m^3 / yr	M	continuously	100%	Electronic, paper	Hourly values will be recorded. Use of flow meter (using data determined for parameter #1 F_{Dig})
12	$CEF_{Bl,\ therm}$ = CO_2 emissions intensity for thermal energy generation		C	Ex-ante		Electronic, paper	Using standard emission factors
13	COD_{c,dig_out} = COD-concentration in discharged effluent from digester	Kg/m^3	M	Monthly	100%	Electronic, paper	Data used to estimate CH_4 emissions in the project case
14	$EL_{P,y}$ = amount of electricity in the year y that is consumed at the project site for the project activity	MWh/yr	M	Continuously	100%	Electronic, paper	
15	HGPr,y = quantity of thermal energy consumed from fossil fuels in year y at the project site due to the project activity	MJ, litres heavy oil	n.a.	n.a.	100%	Electronic, paper	Not applicable (no additional thermal energy consumption due to project activity)
	$CEF_{Pr,\ therm,y}$ = CO_2 emissions intensity for thermal energy generation	Kg CO_2/MJ	n.a.	n.a.	100%	Electronic, paper	Not applicable (no additional thermal energy consumption due to project activity)
16	F_{la} = Quantity of sludge used for land	m^3/yr	M	Continuously	100%	Electronic, paper	Parameter monitored continuously but

ID Number(s)	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Proportion of data to be monitored	How will data be archived? (electronic/ paper)	Comment
	application after dewatering						aggregated annually for calculations.
7.	$COD_{c,la}$ of the sludge used for land application after dewatering	kg COD/m^3	M	monthly	100%	Electronic, paper	
18.	Fc,dw = flow rate of organic wastewater from the dewatering process	m^3/yr	M	continuously	100%	Electronic, paper	
19.	$COD_{c,dw}$ of the wastewater from the dewatering process	kg COD/m^3	M	monthly (if applicable)	100%	Electronic, paper	At times when dewatering is taking place
20	FR_{Bio} = biogas flow rate at digester outlet (two lines are considered)	m^3/yr	M	continuously	100%	electronic	Measure points (flow meters) at each digester line outlet. Hourly values will be recorded and aggregated annually.
21	$P_{CH4,bio}$ = biogas CH_4 content at digester outlet (measurements at each digester line)	ppm	M, c	monthly	-	electronic	Average of 12 months will be recorded. CH_4 content will be determined through electronic probe and chemical analysis
22	$FR_{f,inlet}$ = biogas flow rate at flare inlet	m^3/yr	M	continuously	100%	electronic	Application of flow meters. Hourly values will be recorded and aggregated annually.
23	$FR_{f,s}$ = flow rate of the flare stack gases	m^3/yr	M	n.a.	100%	electronic	
24	$P_{CH4,f,s}$ = Methane content in stack gas of flare	ppm	M	n.a.	100%	electronic	
25	$T_{comb,f}$ = fraction of time gas is	%	M	continuously	100%	electronic	Measured using a run time meter connected to a flame continuous

ID Number(s)	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Proportion of data to be monitored	How will data be archived? (electronic/ paper)	Comment
	combusted in the flare						temperature controller (Thermocouple transmitter 4-20mA). Signals of the transmitter are recorded and show run time of flare.
26	$FR_{e,inlet}$ = Flow rate of the biogas entering the electricity generation equipment	m^3/hr	M	n.a.	100%	electronic	Note: no electricity generation is involved. Instead, the flow rate of the biogas entering the heat generation equipment is monitored.
27	$FR_{e,}$ = Flow rate of the electricity generation equipment.			n.a.			Not applicable (see data # 24)
28	$P_{CH4,e,s}$ = methane content in stack gas of electricity generation stack gases.			n.a.			Not applicable (see data # 24)
29	$T_{comb,e}$ = fraction of time gas is combusted in the electricity generation equipment.	Hrs/yr	m	n.a.	100%	electronic	Not applicable (see data # 24)
30	$FR_{e,inlet}$ = Flow rate of biogas entering the heat generation equipment.	m^3/yr	m	continuously	100%	electronic	Hourly values will be recorded and aggregated annually.
31	$FR_{e,s}$ = Flow rate of biogas of the heat generation equipment stack gases.	m^3/yr	m, c	half-yearly	100%	electronic	Stake gas flow rate (m3/s) will be measured half-yearly and the yearly flow rate (Nm3/yr) calculated, using the yearly boiler operation time.
32	$P_{CH4,e,s}$ = Methane content in stack gas of heat generation stack gases.	ppm	m	half yearly	100%	electronic	

ID Number(s)	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Proportion of data to be monitored	How will data be archived? (electronic/ paper)	Comment
33	$T_{comb,e}$ = Fraction of time gas is combusted in the heat generation equipment.	hrs/yr	m	Continuously	100%	electronic	Measured using a run time meter connected to a flame detector or a flame continuous temperature controller.
34	Sa = Amount of sludge applied to land	Kg/yr	m	Monthly	100%	Electronic, paper	
35	NC = Nitrogen content in the sludge	kg N/kg sludge	m	monthly	100%	electronic	Laboratory tests at CPI laboratory (Total Kjeldahl Nitrogen 3094 mg/L as N)
36	NCV_{BG} = Net calorific value biogas	TJ/m^3	m	weekly		Electronic	Laboratory tests at PTT Chemical Company Ltd. - Methane Method ASTM D 1945-91: analysis of total Hydrocarbons(C2-C5) – method ASTM D 2712-91

Monitoring of sustainable development benefits

In addition to monitoring baseline and project emissions, the actual project performance in terms of sustainable development benefits will be assessed on an annual basis. Based on the results of the first stakeholder consultation and the resulting evaluation on social, environmental and technical sustainability in 2005, the most sensitive sustainable development indicators have been determined. These indicators, also summarized in Table 12, will be monitored on a yearly basis. It should be noted that none of the stakeholders have anticipated any severe impacts deriving from the project (see sustainability screen in section A.2. as well as Annexes 7-8. People from surrounding communities will be informed periodically by CPI on the monitoring results.

CPI already practices periodic stakeholder meetings. On average, 2 – 3 stakeholder meetings per year are conducted. CPI will use these traditional stakeholder meetings to inform about the sustainability performance of the project activity.

	Sustainable Development Indicator	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)
1	**Water quality**	As per monitoring Section D, No. 1	COD	kg COD/m^3	M
2	**Air quality (Emission)**	Odor	qualitative	Record of complaints	E
3	**Employment (fulfillment of labor standards)**	Monthly salary	Average salary of new employed staff	THB/year	M
4	**Employment (numbers)**	Monthly number of staff	Number of new employed staff for project activity (employment contract)	Number	M
5	**Balance of payment (yearly savings of fossil fuel)**	Monthly savings	Saved fossil fuel Saved costs on fossil fuels and palm shells	Liter/year THB/year	c c
6	**Project replicability (technical sustainability)**	Yearly replications	Number of applied similar technology at other palm oil industries[1]	Number per year	M

Table 12: Data to be collected in order to monitor the project's performance on the most sensitive sustainable development indicators

[1] These data and information shall be obtained at the Ministry of Energy and the Ministry of Industry

Referring to the items in Table 12, the following monitoring system will be introduced by CPI:

1. Monitoring of the COD of the effluent at the digester outlet

2. Based on the existing complaints-system of the Ministry of Natural Resources and Environment, complaints with regard to offensive smells will be recorded. CPI will regularly collect the information and will add them to the overall monitoring report.

3. + 4. CPI will keep record of project-related employment and will add respective information to the overall monitoring report.

5. Based on production statistics and records on fuel consumption, CPI monitors the reduction of fossil fuel and related savings.

6. CPI will request for information from the Ministry of Industry and Ministry of Energy on applications of similar projects on a yearly basis.

Appendix 6. Summary report of comments received from local stakeholders

Refer section E.2 on summary of comments received and E.3 consideration of comments received. Further details refer to attachment 3.

Appendix 7. Summary of post-registration changes

Changes in 2014 (PRC-2148-001)

	Changes compared to registered PDD	Comment / Explanation
1)	**Change in PP name**	The name of the project participant has changed from GTZ (Gesellschaft fuer Technische Zusammenarbeit) to GIZ (Gesellschaft fuer Internationale Zusammenarbeit). A revised MoC has been submitted accordingly.
2)	**Additionality**	
	IRR calculation and Sensitivity analysis	The changes to the project compared to the registered PDD may have affected the additionality of the project, therefore a revised IRR calculation and sensitivity analysis have been included in the revised PDD. The installation of high pressure boiler and technical adjustments at the palm oil refinery allows the utilization of biogas in replacement of bunker oil, which has an impact on the financial feasibility of the project. The IRR calculation and sensitivity analysis demonstrated that the additionality of the project has at all time (for all steps of project implementation and adjustment) remained valid.
3)	***Baseline***	
	Old: Waste water from refinery and CPO. New: Waste water from CPO only (not from refinery)	It was planned and had been implemented as such that refinery waste water was supposed to be treated in the new biogas system. During the early stage of biogas system operation it became clear that the treatment of refinery waste water was difficult due to strong fluctuation in waste water composition, e.g. quickly changing COD and pH values. It was thereafter decided to abandon the treatment of refinery waste water and treat only CPO process waste water. The COD amount from refinery waste water makes up only 1.6% of the total estimated COD load to the new biogas system, or the baseline system respectable (please compare Table 10). The resulting changes in the potential emission reduction are almost negligible and the essential project activity is not affected. Only small changes in the PDD are necessary, as the refinery waste water was not directly mentioned in the registered PDD, except in Tab.8 were it serves as an example for historic data about the baseline situation. Refinery wastewater is further only mentioned in the Appendix 1 (ER calculation spread sheet) which is completely revised and Annex 3 (Baseline Information) where it is now deleted.
	old: utilisation of biogas in biomass	Besides the biomass in the boilers of the CPO, bunker fuel in the HP boilers of the refinery has become another baseline

	Changes compared to registered PDD	Comment / Explanation
	boiler in the CPO new: utilisation of biogas in biomass boiler in the CPO and HP boilers in the palm oil refinery	under the adjusted project activity. The HP boilers have been included under technology description in section A.4.3 (Combustion systems). The baseline information have been adjusted in section B.4. Further information on the impact on project additionality (IRR calculation) are given in section B.5. For conservative reasons emission reductions for fossil fuel replacement from HP boilers have not been included in the project activity.
4)	***Technology design***	
	a) System design The registered PDD mentioned two anaerobic tank digesters; the PDD has been revised to describe more generally "a combination of anaerobic tank digesters"	The 2 CSTR digesters are the main biogas generation process reactors, whereas the following 2 UASB digesters have a post-treatment function of the low strength treated wastewater leaving the CSTRs. Contribution of the UASB digesters to the total biogas generation is low and had been included in the original biogas generation prediction of the technology provider. While the 2 CSTR digesters were originally seen as the main components of the biogas system, the whole system is now explicitly described as a combination of (different) anaerobic digesters
	b) Gas utilization (use in refinery burner) p.9 (of the registered PDD): The cleaned biogas will be utilized in the steam boilers to generate heat. Two boilers are operated: a mid/high pressure boiler (60-90 bar, boiler type NUK-HP 930, dual-fuel burner type RGMS7/1-D ZMD, DN50) and a low pressure boiler (30 bar, AWG Series II dual-fuel burner from Hamworthy (AWG 15)).	added: Post-registration, after proven reliable operation of the biogas system, some parts of the biogas will be diverted to be used in 2 high pressure boilers in CPI's palm oil refinery. Further information above "Baseline"
	c) Effluent/sludge handling: Sand Bed Filter Separation of solid and liquid parts of digested sludge from the bottom of the digester.	New: Sludge Treatment system "Separation of solid and liquid parts of digested sludge from the bottom of the digester. The treatment system will consist of sand bed filters or other technical solution (e.g. belt press), either way with the intention to produce sludge dry enough for transportation and land application." This paragraph has been added to the revised PDD as a result of difficulties with the original treatment system, implemented as per registered PDD. Since the sand bed filter so far did not deliver the expected dry sludge, to be used for land application,

	Changes compared to registered PDD	Comment / Explanation
		the addition simply reflects the intention to introduce a new technical solution for the treatment of sludge if needed and should therefore give the project owner some flexibility in sludge treatment, without other changes to the project activity.
5)	***Explanation of methodological choices***	
	a) Emissions from wastewater removed in the dewatering process are not relevant to the project activity, as no dewatering process takes place.	A provision to calculate and account for project emissions from the wastewater removed in the dewatering process has been included for times when dewatering of sludge is actually taking place. Due to the technical difficulties, but still following the original intention of the project activity to produce dry sludge, this is again kind of a flexibility mechanism for the project owner. The idea is to treat sludge, either with the original sand bed filter, or with other technical solutions, In the case the treatment is operating and working, emissions from removed wastewater will be monitored; the monitoring system (e.g. flow meter and COD measurement) have been included in the project from the beginning but were wrongly not included in the PDD, which has now been corrected. The project owner should still have the flexibility not to treat the sludge from the digester, e.g. when the system is not working or for other reasons, in which case the sludge would be treated the same way as wastewater effluent in open ponds, by monitoring flow and COD (sludge still has a very high water content) and account for project emissions accordingly.
6)	***Monitoring***	
	F_{Dig}, F_{Dig_out} **Vortex Flow Meter**	Instead of the vortex flow meter and hourly records, a magnetic flow meter with continuous measurements has been installed. The magnetic flow meter is the most common choice of flow meter for biogas systems and biogas project monitoring in Thailand. The vortex flow meter had been chosen in the early project design stage, not knowing of the limitations in availability and other difficulties. The magnetic flow had been installed from the beginning and deliver similarly accurate and reliable measurements as the vortex flow meter. For practical reasons to keep the monitoring efforts for this small project (despite being large scale would easily fall under the small scale project threshold), the data back-up is being done on a monthly basis. Under normal operating conditions, this does not influence the accuracy and reliability of the data.
	COD-measurements old: Laboratory tests at CPI (monthly) – Method: AWWA 5220B.,P5-14,1998	new: Laboratory tests at CPI (monthly) – Method: APHA 5220 D This change is reflecting the change of laboratory equipment and method as compared to the original PDD. The COD analyser is a very common choice of test equipment in biogas project monitoring in Thailand. The original method had been chosen in the early project design stage, but did not reflect the common practice at the project owner's laboratory. The Close Reflux Method has been used from the beginning and delivers similarly accurate and reliable COD values.

	Changes compared to registered PDD	Comment / Explanation
	p.42 (of the registered PDD): $Fc_{,dw}$ and $COD_{c,dw}$ Not applicable, because the project activity does not include a dewatering process.	Is now applicable at times when sludge treatment and dewatering takes place.
	FR_{Bio} / $FR_{f,inlet}$ and $P_{CH4,bio}$ Biogas flow rate at digester outlet (two lines are considered) old: Application of Coriolis Mass Flow Meter or similar (measurement range 100 –500 kg/hr at 0.717 kg/m3). Measure points at each digester line outlet. Accuracy <± 1 % at 2 - 100 % of 8 kg/min. Hourly values will be transferred online and recorded.	Editorial change. All biogas flow from the digesters are combined in one pipe, passing the monitoring equipment. Instead of the Coriolis mass flow meter a thermal mass flow meter has been installed. The thermal mass flow meter is the most common choice of flow meter for biogas systems and biogas project monitoring in Thailand. The Coriolis mass flow meter had been chosen by the first project CDM consultant in the early project design stage, not knowing of the limitations in availability (pressure of biogas in the pipes) and other difficulties. The thermal mass flow had been installed from the beginning and deliver similarly accurate and reliable measurements as the Coriolis mass flow meter.
	$FR_{e,s}$ Application of Coriolis Mass Flow Meter or similar (measurement range 3000 m3/min. at 290 C). Measure points at stack of boiler. Accuracy <± 2 % at flow rate. Hourly values will be transferred online and recorded. and $P_{CH4,e,s}$ CH4 content will be determined through electronic probe and analysis: Non-Dispersion Infrared method (NDIR). Preferably application of portable analyzer. Accuracy of Method (portable analyzer): < ± 2 % due to relatively	new: The stack gas emissions are measured for the environmental monitoring for Industrial department half yearly. The continuous measurement of stack gas emissions is not possible due to the huge financial effort of the installation of flow meter with the radius of the stacks of the boilers. For practical reasons to keep the monitoring efforts for this small project (despite being large scale would easily fall under the small scale project threshold), the gas emissions measurements required by law shall be applied. While the measurements from the HP boilers, using only biogas are really related to project emissions, the measurements in the biomass boiler where biogas co-combusted with EFB does not reflect real project emissions anyway, because it cannot be differentiated between methane from incomplete combustion of biogas and EFB (which would solely be burned in the baseline scenario). Installing very expensive monitoring equipment for the measurement would only appear to produce more accurate data. One has to keep in mind that the project owner would in any case be trying to optimize the combustion to operate most economic.

	Changes compared to registered PDD	Comment / Explanation
	stable production process and low variation of CH4 production. The average of 12 months will be calculated and transformed in [% of biogas].-	
	Addition of accuracy and frequency of monitoring	Due to the use of a new PDD template and additional requirements information about accuracy and frequency of monitoring has been added to the monitoring parameter tables
7)	**Change in baseline and project emissions**	The estimated emission reduction based on ex ante parameters have changed from **23,448 to 28,133 tCO2 annually**. Main reasons for this change: **Baseline emission:** 40,080 down to 39,385 tCO2 annually. The decrease in baseline emission from the lagoon is caused by the exclusion of refinery waste water to the new waste water treatment plant. This refiner waste water has a small impact on lagoon baseline emissions due to the low COD load of this discharge. Furthermore the power/heat baseline emissions are slightly reduced due to a correction: the PDD states that the electricity consumption of existing waste water treatment system EGy = 0 MWh/yr, but in the old calculations still a value of 78.2 MWh/yr was applied. This is now removed. **Project emissions**: 16,632.49 down to 11,252 tCO2 annually. According to the applied methodology AM0013ver04 and the registered PDD, the lagoon project emissions are calculated as per equation: CH_4 emissions from the lagoons (kg/yr) = COD_{dig_out} (kg COD/yr) X B_o (kg CH_4/kg COD) x MCF_{dig_out} Where: COD_{dig_out} Is Chemical Oxygen Demand of effluent entering lagoons (measured) Other then for the baseline emission the methodology does not mention that carry over of COD in the lagoon has to be taken into account in this calculation. The carry over in the original calculation was therefore wrongly applied and has been removed (PE_{lagoon} 7,836.50 down to 5,111 tCO2 annually). Furthermore, with regard to physical leakage from biogas digesters, The calculation in the registered PDD had been based on the biogas production of 13.370 kg/day. This is not explained and not in line with all other calculations based on an output of 12,700 m3/day (see table 12 in the revised PDD and parameter table **FR_{Bio}** at 300 days production per year). Since the proportion of methane in biogas is being expressed in ppm in the PDD, the calculation in the original ER calculation sheet, which is based on 65% of the 13.370 kg biogas/day is not correct. The new corrected calculation is based on volume percent ($PE_{leakage}$ 8,212.5 down to 5,606 tCO2 annually).

Changes in 2017 (PRC-2148-002)

	Changes compared to registered PDD	Comment / Explanation
1)	Re-include the original determination of F_{Dig} = $F_{Dig,out}$ as alternative for monitoring $F_{Dig,out}$	Due to problems with the measurements of $F_{Dig,out}$ in the second monitoring period (after the installation of the additional meter), the determination of the parameter $F_{Dig,out}$, by again using the original approach of the approved monitoring period AM0013, $F_{Dig,out}$, = F_{Dig} for this and following monitoring periods. Applying the assumption F_{Dig} = $F_{Dig,out,}$ is the most conservative assumption, because the maximum amount of wastewater entering the biogas system is assumed to leave the treatment system.

Attachment. 1. Detailed Results of the EIA Pre-Screen and summary of the Initial Environmental Evaluation (IEE)

1.1 Detailed Results of the EIA Pre-Screen

The following results of the EIA Pre-Screen are based on the results of the first stakeholder contacts and discussions, the stakeholder's anticipation of the existing situation referring to environmental impacts from the oil plant and site investigations by experts from Thailand Environment Institute. Results from the first stakeholder contacts and site investigation can be found in Annex 8.

Environmental and Social Impacts Checklist

Environmental Impacts	Yes / No / ? . Briefly describe	Is this likely to result in a significant effect? Yes/No/? – Why?
1. Will construction, operation or decommissioning of the Project use or affect natural resources or ecosystems such as land, water, forests, habitats, materials or, especially any resources which are non-renewable or in short supply?	Yes. The project location is on the properties of the plant (industrial area). Land use is already for industrial purposes.	No. The land provided for the project is part of the operation license of the factory and therefore already approved to not significantly effect the environment. The project will provide renewable energy resources through methane capturing, thus avoid the use of fossil resources and reducing fugitive methane emission. 5 of the 7 ponds will not be used after project implementation. They will be re-naturalized.
2. Will the Project involve use, storage, transport, handling, production or release of substances or materials (including solid waste) which could be harmful to the environment?	Yes. The project will handle and use existing methane gas and organic laden waste water.	No. The operation of the waste water treatment plant will be altered to capture and utilize the existing fugitive methane gas. The waste water treatment will be improved, resulting in less contaminating characteristics of the effluents. There will be no other changes of the operation, input and output parameters remain the same.
3. Will the Project release pollutants or any hazardous, toxic or noxious substances to air?	No. The project boundaries are focused on the capture of methane gas. Future utilization of the methane gas are not part of the project.	No. Through the capture of climate impacting methane gas, fugitive emission of climate harmful pollutants deriving from the emission will be avoided. The occurrence of emission through future burning methane gas for heat and electricity generation in comparison to the existing fugitive methane emission is negligible.

Environmental Impacts	Yes / No / ? . Briefly describe	Is this likely to result in a significant effect? Yes/No/? – Why?
4. Will the Project cause noise and vibration or release of light, heat energy or electromagnetic radiation?	No. The planned biogas reactor will operate without noises. There will be no additional impacts.	No. The noises from the biogas reactor are deriving from a little pump and thus no impact would occur.
5. Will the Project lead to risks of contamination of land or water from releases of pollutants onto the ground or into surface waters, groundwater, coastal wasters or the sea?	No. Sludge and effluent from the waste water treatment will be used as fertilizer	No. The operation of the new waste water treatment plant will not change the handling of the effluents, which in the future as well will be used as fertilizer. An improvement of the treated waste water quality can be expected.
6. Are there any areas on or around the location which are protected under international or national or local legislation for their ecological value, which could be affected by the project?	No. The area is approved industrial and agricultural area; the project location is on the factory's own property.	No. The factory's area and the surroundings are proved by Thai planning and legislation for agro-industrial and intensive agricultural land use.
7. Are there any other areas on or around the location, which are important or sensitive for reasons of their ecology, e.g. wetlands, watercourses or other water bodies, the coastal zone, mountains, forests or woodlands, which could be affected by the project?	Yes. A small river is in the vicinity of the plant and already used by the factory and the surrounding communities as a water resource.	No. The conditions of the river will not be affected through the project. Treated water will be used as liquid fertilizer as the factory is already doing it under the licensed operation since 20 years. It is expected that the project will be bringing along a reduction of the number of open lagoons and a general improvement of the two remaining lagoons, thus securing the waste water treatment plant against leakages.
8. Are there any areas on or around the location which are used by protected, important or sensitive species of fauna or flora e.g. for breeding, nesting, foraging, resting, over-wintering, migration, which could be affected by the project?	There are no specific investigation on the appearance of protected, important or sensitive species in this area is available.	No. But the construction and operation of the new waste water treatment component will improve the quality of the post treated waste water in the existing open lagoons, thus improving the conditions of the surrounding of the location through reducing odor, fugitive methane emission and improving the water quality in the remaining open lagoons.
9. Are there any inland, coastal, marine or underground waters on or around the location which could be affected by the project?	Yes. Ground water under the factory's area and an adjacent river exists.	No. No negative change of the effluent quality will be expected. The project activities will not harm the groundwater. Improvements of the existing lagoons will be expected, thus eliminating leakages. The river will not be affected, since the waste water will be used for irrigation purposes.

Environmental Impacts	Yes / No / ? . Briefly describe	Is this likely to result in a significant effect? Yes/No/? – Why?
10. Is the project location susceptible to earthquakes, subsidence, landslides, erosion, flooding or extreme or adverse climatic conditions e.g. temperature inversions, fogs, severe winds, which could cause the project to present environmental problems?	No. Normal geological and climate conditions	No. The weather and earthquake statistics and the landscape conditions are not proving any endangering incidents in this area.
Socioeconomic and Health Impacts		
11. Will the Project involve use, storage, transport, handling, production or release of substances or materials (including solid waste) which could be harmful to human health or raise concerns about actual or perceived risks to human health?	Yes. The project plans to handle and use methane gas.	No. The existing fugitive methane gas will be captured and utilized as a renewable fuel resource, thus reducing impacts on human health through avoiding the utilization of fossil fuels and palm shells. There will be no other changes of the operation. Input and output parameters remain the same.
12. Will the Project releases pollutants or any hazardous, toxic or noxious substances to air that could adversely affect human health?	Yes. Through the utilization of the methane gas as a renewable fuel for operating steam boilers, emission from the burning of methane gas will occur.	No. Through the utilization of climate impacting methane gas, emission of harmful pollutants deriving from the use of fossil fuels and fugitive emission of methane will be avoided. The occurrence of emission through burning methane gas in comparison to the existing fugitive methane emission will be negligible.
13. Will the Project cause noise and vibration or release of light, heat energy or electromagnetic radiation that could adversely affect human health?	No. The planned biogas reactor will operate without noises. There will be no additional impacts.	No. The noises from the biogas reactor are deriving from a little pump and thus no impact would occur.
14. Will the Project lead to risks of contamination of land or water from releases of pollutants onto the ground or into surface waters, groundwater, coastal wasters or the sea that could adversely affect human health?	No. Sludge and effluent from the waste water treatment will be used as fertilizer	No. The operation of the new waste water treatment plant will not change the handling of the effluents, which in the future as well will be used as fertilizer. Improvements of the existing open pond system as a post-treatment facility can be expected, reducing risk of leakages. The fertilizer and thus remaining organics will be absorbed by the plantations.

Environmental Impacts	Yes / No / ? . Briefly describe	Is this likely to result in a significant effect? Yes/No/? – Why?
15. Will there be any risk of accidents during construction or operation of the Project which could affect human health?	No. The methane gas capturing during operation is based on low pressure technology.	No. The low pressure technology will keep the gas storage, which is 25 % of the daily production, under 3 millibar. The storage is completely oxygen evacuated. Damages of the storage covering foil will cause very low outflow of the gas, which will immediately spread out while the concentration will decrease below explosive concentrations.
16. Will the Project result in social changes, for example, in demography, traditional lifestyles, employment?	No. There will be no adverse affect on demography, lifestyle or employment due to its small scale industrial internal characteristics.	No. The project purpose is the change of waste water treatment technology in small scale on the factory's terrain. In contrary, additional 4 jobs will be created. Recently one staff is responsible for the existing open pond system.
17. Are there any areas on or around the location, protected or not under international or national or local legislation, which are important for their landscape, historic, cultural or other value, which could be affected by the project?	No. There are no protected and important areas, which could be affected by the project.	No. The waste water treatment and gas capture will not have direct effects beyond the factory's boundaries. The plant is completely located on factory terrain.
18. Are there any transport routes or facilities on or around the location which are used by the public for access to recreation or other facilities and/or are susceptible to congestion, which could be affected by the project?	No. The project will not have any affect on transport. The road is not susceptible to congestion.	No. The project will not cause additional traffic load. In contrary the project will avoid additional transports of oil, coal and/or palm shells, which would be the alternative fuels in absence of this project.
19. Is the project in a location where it is likely to be highly visible to many people?	No. There are only about 200 villagers and farmers around the factory. The technical installations and buildings associated with the project activity will be lower than the surrounding factory buildings.	No. The waste water treatment and gas capturing will not be visible from villages or the surrounding streets and roads. The gas storage will not be higher than 3 m. Vegetation on the factory's ground and around the factory (Plantations) avoids visibility of the plant.

Environmental Impacts	Yes / No / ? . Briefly describe	Is this likely to result in a significant effect? Yes/No/? – Why?
20. Are there existing or planned land uses on or around the location e.g. homes, gardens, other private property, industry, commerce, recreation, public open space, community facilities, agriculture, forestry, tourism, mining or quarrying which could be affected by the project?	Yes. The surrounding is characterized by agricultural land, little villages with not more than 200 people, schools and temples within a radius of 2 km.	No. The next village is in approx. 300 m distance from the factory site. Villages, schools and temples within a radius of 2 km will not be affected negatively. The project's side effects are reduction of water contamination, fugitive methane emission reduction and reduction of odor.
21. Are there any areas on or around the location which are densely populated or built-up, or occupied by sensitive uses e.g. hospitals, schools, places of worship, community facilities, which could be affected by the project?	No. There is a very low population density within a radius of 2 km. Within this radius there are no sensitive uses.	No. The average population density in the area is approx. 72 people per square kilometers. The area around the factory is mainly agricultural land with scattered settlements.
22. Are there any areas on or around the location which contain important, high quality or scarce resources e.g. groundwater, surface waters, forestry, agriculture, fisheries, tourism and minerals, which could be affected by the project?	Yes. Adjacent to the factory and crossing the overall surrounding is a small river, providing water resources to the villagers and farmers and to the factory. The area around the factory is characterized by typical agricultural use, such as fruits, coconut and palm oil.	No. The project will not affect the quality or quantity of the existing water resources. The project purpose is the waste water treatment plant with methane capturing. Improvement of the waste water quality can be expected. Existing and potential future air emission will be reduced.
23. Is the project location susceptible to earthquakes, subsidence, landslides, erosion, flooding or extreme or adverse climatic conditions e.g. temperature inversions, fogs, severe winds, which could cause the project to present socioeconomic problems?	No, normal geological and climate conditions	No. The weather and earthquake statistics and the landscape conditions are not proving any endangering incidents in this area.

(Adapted from: CEC, 1993, Environmental Manual, Annex 1)

1.2 Summary of the Initial Environmental Evaluation (IEE)

This report presents the initial environmental evaluation of "*Chumporn Applied Biogas Technology for Advanced Wastewater Management*" of Chumporn Palm Oil Industry PCL.

The purpose of the project is to shift from traditional wastewater treatment in open, anaerobic ponds with uncontrolled release of methane to the atmosphere to a close tank digester system with biogas capture and utilization. This initial environmental evaluation is mainly focused on the impacts caused by the activity of applying biogas technology for advanced wastewater in the location of plant and surrounding areas. Primary data was collected through the stakeholder meetings and opinion survey of people living in nearby area. Further, secondary data such as map and basic information of the study area was also collected.

The surrounding area of the plant's location comprises of agricultural areas for oil palm trees, existing wastewater treatment, Klong Tasae, community, school and temples within 2 kilometers. At the present, there are approximately 200 people live in the area which is less density.

According to the evaluating study, it was found that the negative impacts of the applying biogas technology are rarely found both during construction and operation. With regard to explosion risks in case of biogas leakages (→ explosive methane-air mixture), the applied low pressure technology can be considered as quite

safe. Due to small pressure differences, damages of the covering foil would lead only to low gas outflows. Immediate dispersion of little amounts of gas and dilution with prevents the development of explosive gas-air mixtures.

Moreover, it was found that the biogas technology would render positive impacts. For example, the biogas system will reduce methane emissions and thus decrease the impact of bad odor caused by the existing wastewater treatment system. The quality of natural water resources supplying the community will be improved, because the COD-load of the discharged effluent is reduced. The water can then be used for agricultural purpose without harming the groundwater. Furthermore, substitution of fossil fuels by biogas will reduce air pollution caused by the combustion process. Besides this, sludge and treated effluent can be used for fertilizing farm land without polluting groundwater. To sum it up, water and air quality as well as human health will be improved.

Attachment 2:

Public announcements of the accessibility of the CDM Project Documents
Stakeholder Comments
Non-Technical PDD (English translation)

Bangkok Post, Nov. 3, 2005

CPI บริษัท ชุมพรอุตสาหกรรมน้ำมันปาล์ม จำกัด (มหาชน)
CHUMPORN PALM OIL INDUSTRY PUBLIC COMPANY LIMITED

Chumporn Palm Oil Industry launches Biomass project in line with the Cleaner Development Mechanism (CDM)

Chumporn Palm Oil Industry PCL. (CPI), in recognition of the huge potential for developing alternative sources of energy, has decided to install appropriate complete stirred anaerobic wastewater treatment technology at the company's plant. Chumporn Palm Oil is Thailand's leading user of palm oil refinery technology and one of the country's biggest palm oil manufacturers. The technology, designed by Natural Power Co., Ltd. (NPC), will make use of the biogas (methane) from wastewater as its power resource and as a substitute for fossil fuels in CPI's production processes.

This investment in biomass is also consistent with the company's plan to increase production capacity from 300 t/d to 600 t/d by the fourth quarter of 2005, which will result in a higher demand for energy. To avoid additional environmental impacts through the burning fossil of fuel for power generation, CPI will utilize its own renewable energy source produced from wastewater from its production processes. Once installed, CPI will be the first Thai cooking oil manufacturer to utilize such a technology.

According to Khun Suriya Ayachanan, Assistant Managing Director of Chumporn Palm Oil Industry Public Co., Ltd, the company sees continually increasing growth of the domestic and foreign palm oil markets of no less than 8-9% per year. Particularly in Europe, demand for palm oil is growing by more than 13% per year. CPI's investment in its renewable energy projects will be of great benefit to the industry, the country's environment and to CPI in reducing energy cost.

In Thailand, several projects have already been developed utilizing potential sources of biomass and biogas within the agro-industry. Many of these projects have been in addition, been developed to allow for applications for Certified Emission Reductions under the Clean Development Mechanism (CDM) of the Kyoto Protocol. CPI, however, is the first company in Thailand to have applied for a Certified Emission Reduction (CERs) within a CDM Project under the Gold Standard. The Gold Standard is an international agreed standard to assure the highest quality in the application process and application documents are met, with a special focus on sustainable development criteria covering the environment, social and employment matters and technology.

ENVIMA (Thailand) Co., Ltd. is carrying out the overall elaboration of the Project Design Document (PDD) and is advising CPI on the application process. The Thailand Environment Institute (TEI), subcontracted by ENVIMA is responsible for environmental matters and public participation in the project. TEI has already contacted more than 40 local stakeholders from the local authority, communities, temples and schools in Chumporn province around the factory site during an initial stakeholder consultation.

The further process of the stakeholder consultation will include giving public access to all project related documents from 01.10.2005 to 30.10.2005 for all parties concerned and those interested in the project and possibly affected by the project in order to give the opportunity to comment the project within the given period. The documents can be read

- at the Chumporn local authority offices
- at the Chumporn Palm Oil Factory, 296 Moo 2 Salui Amphur Tasae, Chumporn 86140
- in the offices of CPI, 1168/91 Lumpini Tower 30th Floor, Rama IV Rd., Sathorn, Bangkok 10120, Tel: +66 2 679 9166 and on CPI webpage www.cpi-th.com
- in the offices of Thailand Environment Institute, 16/151 Muang Thong Thani, Bond Street, Bangpood, Nonthaburi 11120 Thailand, Tel: +66 2 503 3333 and on TEI webpage www.tei.or.th
- in the offices of ENVIMA (Thailand) Co., Ltd., 1023 TPS Building, Pattanakarn Road, Suan Luang, Bangkok 10250, Tel: +66 2 717 8114.

After the period of public access of the documents, CPI will invite those interested in participating to a final stakeholder meeting. In this meeting, the overall project, project progress and the evaluation of received comments and their consideration in the future planning will be addressed. The meeting will as well give room for further discussion and inquiries.

CPI is the only integrated palm oil manufacturer and palm oil product distributor in Thailand. The company offers palm oil under the "Leela" brand packaged in PET bottle, tin and pouch for market nationwide.

Bangkok Post, November 17, 2005 (Correction note and extension of public availability of the documents due to delayed publication of the first announcement, caused by Bangkok Post)

CPI บริษัท ชุมพรอุตสาหกรรมน้ำมันปาล์ม จำกัด (มหาชน)
CHUMPORN PALM OIL INDUSTRY PUBLIC COMPANY LIMITED

With regard to the public announcement made in the Bangkok Post on 3 November 2005 regarding the Chumporn Palm Oil Industry PCL (CPI) Cleaner Development Mechanism Project. This notice is to reconfirm that the closing date for public access to the project documents and to make comments is until 30 November 2005. CPI would like to encourage all interested members of the public to access these documents, which are available at the following venues:

- Chumporn local authority offices
- Chumporn Palm Oil Factory, 296 Moo 2 Salui Amphur Tasae, Chumporn 86140
- CPI, 1168/91 Lumpini Tower 30th Floor, Rama IV Road, Sathorn, Bangkok 10120, Tel: +66 2 679 9166 and on the CPI web site www.cpi-th.com
- The Thailand Environment Institute, 16/151 Muang Thong Thani, Bond Street, Bangpood, Nonthaburi 11120 Thailand, Tel: +66 2 503 3333 and on the TEI web site www.tei.or.th
- ENVIMA (Thailand) Co., Ltd., 1023 TPS Building, Pattanakarn Road, Suan Luang, Bangkok 10250, Tel: +66 2 717 8114

All relevant documents have also been available on the UNFCCC web sites and at CPI web site www.cpi-th.com since 15 September 2005.

2.1 Stakeholder comments to published project information

No comments to the public available documents of the CDM project have been issued.

2.2 Non-Technical PDD (English translation)

The non-technical PDD has been developed and published prior to the validation. In line with the results of the validation, some technical data have been changed in the PDD. At subsequent stakeholder consultations, these changes have been communicated to the stakeholders respectively.

Non-Technical Project Design Document

September 2005

Submitted by

ENVIMA (Thailand) Co., Ltd.

on behalf of

Chumporn Palm Oil Industry PCL

PROJECT NAME

ANAEROBIC WASTE-WATER MANAGEMENT SYSTEM for Chumporn Palm Oil Factory

TYPE OF PROJECT

Methane capture from waste-water management system and biogas utilization in palm oil factory.

PROJECT DEVELOPER

Natural Power Co., Ltd. (NP)

Natural Power Co., Ltd. is a private consultancy firm with experienced staff and expertise to facilitate the application of biogas technology for waste-water treatment and energy utilization. While the consultancy firm was established in 2004 as a spin-off of Biogas Advisory Union Foundation (2003) and the Biogas activities of Chiang Mai University, most of the personnel have over ten years of experience in the field of biogas technology and were involved in the installation of 32 large scale biogas plants.

PROJECT OWNER

Chumporn Palm Oil Industry PCL (CPI)

The Chumporn Palm Oil Industry PCL (CPI) registered to become a Company Limited in 1979 Rung Ruang Palm Oil Co., Ltd. and Pathiu Plantation Co. Ltd., which are palm plantation companies, each holds shares in the CPI PCLand both are having a plantation land space of more than 20,000 rais (8,000 acres).

CPI also buys fresh palm fruits from farmers in Chumporn to process as crude palm oil. In 1993, the company built a distill factory for palm oil production. This made the company the first Thai company for producing a full cycled palm oil industry from oil palm plantation, a Crushing Mill for crude palm oil production, a Refinery Plant for refined palm oil including a continuous production of other standard palm oil products to the industry's and consumer market.

CPI is proving quality assurance and environmental performance as follows

April 2000	Was the first palm oil production company of Thailand to be awarded the ISO 9001:2000 certificate.
March 2001	Entered the GMP system (Good Manufacturing Practice) and the HACCP system (Hazard Analysis and Critical Control Point) in the Food Industry Factory under the Plan for Improvement of Industrial Structure.
September 2003	Was granted the ISO 9001 2000 Quality Assurance Certificate.
November 2004	Received certificates for Good Manufacturing Practice (GMP) and Hazard Analysis and Critical Control Point(HACCP) after being assessed and certified.

PROJECT IMPLEMENTATION PERIOD

Total project implementation period is expected to last 2 years (24 months) starting from the project signing date.

PROJECT OBJECTIVE

To apply anaerobic digestion (biogas technology) to manage wastewater from the palm oil industry and produce biogas as renewable energy

PROJECT IN BRIEF

Palm oil production is an agro-industry that generates many by-products and wastes from its manufacturing process, e.g. fresh fruit bunches, palm fiber, palm shells, and wastewater.

A pre-survey and study was conducted of the palm oil process: its wastewater type and characteristics, its energy consumption and management, and the company's understanding of environmental management. Based on the results of this study, it was agreed that the overall conditions are favorable for **the development of** the palm oil anaerobic wastewater treatment system.

Up to now, most palm mills use an open anaerobic pond system for wastewater treatment. This system has reasonable investment and operational costs. As it covers a large land area, however, the system has low efficiency and stability and releases bad odors and attracts flies. This is intensified by high atmospheric pressure during the rainy season. Furthermore, biogas generated from the treatment pond is released into the atmosphere, hence contributing to increased methane levels and thus to global warming.

At present, the Chumporn Palm Oil mill uses open anaerobic ponds, facultative ponds and polishing ponds connected in series for wastewater treatment. Post-treatment effluent is used as fertilizer for palm plantations surrounding the mill. Sludge is removed from the anaerobic ponds and dried each year to be sold as dry fertilizer. Solid wastes such as empty fruit bunches and palm fiber are used as alternative fuel for boilers to produce steam and electricity for mill use. However, apart from the energy gained from such alternative fuel, the mill still needs additional energy for its newly constructed refinery plant. The mill previously planned to buy bunker oil for such purpose.

The application of biogas technology, i.e. treating and managing wastewater from palm oil mills, is an appropriate means to reduce water pollution. The organic matter in wastewater will be digested anaerobically and transformed into methane gas (CH_4) with a 60–70% composition yield. The biogas can then be used as fuel to produce heat and/or electricity. Both heat and electricity can be used in the palm oil manufacturing process and/or fed into the main public grid of the Provincial Electricity Authority of Thailand. This compliments the national policy of energy conservation and reduction of fuel import and contributes to the environment through improved water treatment, reduction of odor and reduction of emission from fossil fuel.

A feasibility study revealed that the palm oil mill has a production capacity of 45 – 60 tons/hr or 1,000 – 1,500 tons/day of Fresh Fruit Bunch (FFB). The production process will discharge approximately 600 – 700 m^3 of effluent/day. The discharged effluent has a chemical oxygen demand (COD) of approximately 80,000 – 100,000 mg/liter of which 70% is biodegradable. Because of the high concentration of COD and suspended solids (SS), and because of low separation ability of the substrate, the most suitable digestion system is the installation of an appropriate and completely stirred tank reactor ($A+CSTR_{TH}$) system.

The system is expected to produce 18,000 m^3 of biogas/day which will replace 1,400 liters/day of heavy oil (bunker oil) and 21.4 tons/day of palm shells. The biogas system can deliver additionally approximately 25 tons/day of dry compost and 600 m^3/day of liquid fertilizer to be utilized in nearby palm orchards. Additionally, the system reduces bad odor/air pollution and improves sanitation.

PROJECT LOCATION

Region/State/Province

ASIA/THAILAND/CHUMPORN

Chumporn province is located in the most upper part of the Southern region. Following the Highway No.4, it is approximately 463 kilometers south of Bangkok. The total area of Chumporn is about 6,009 square kilometers, the fourth largest province of the South.

City/Town/Community etc:

Chumporn Palm Oil Industry Public Company Limited

Factory : 296, Moo 2 Phetchkasem Road, Tambol Salui, Ampur Tasae, Chumporn, Thailand 86140
Tel. (66 77) 599 267 **Fax.** (66 77) 502 367 **E-mail :** info@cpi-th.com

ENVIRONMENTAL BENEFITS

Energy Conservation

- The planned project will contribute to energy conservation during the entire life span of the system which is estimated to be up to 15 years
- The mill can produce up to 5 million m^3/year of biogas thus replacing approximately 420,000 liters/year of bunker oil and additionally, the biogas can replace 6,420 tons/year of palm shell.

Impact on climate and sanitation:

- Reduction of methane gas emission of 2.6 million kg/year,
- Reduction of 1.8 million kg/year of COD in the wastewater.

Impact on soil and agricultural production:

- Production of approximately 8.0 million kg/year of dry organic fertilizer will improve soil fertility
- Production of approximately 180,000 m^3/year of liquid fertilizer will substitute chemical fertilizer.

IMPACT FROM THE INSTALLATION

Impact in absence of the proposed biogas technology

Without the installation of the biogas system as specified in item 3, the wastewater from the palm oil mill will be treated in the anaerobic, facultative and open pond system which may render negative impacts as follows:

Direct impacts of the mill

- The treatment system will release bad odors and become a nuisance especially in the rainy season.
- The current treatment system may work at low efficiency and stability, hence leading to effluent quality problems that tend to intensify during the rainy season.
- The mill will have to utilize coal or bunker oil, missing the opportunity to make use of alternative energy generated from the organic matter in the wastewater and reduce potential emission from fossil fuel.
- Additional methane gas, a major component found in released biogas, will contribute to global warming.

Possible impact after installation of the proposed biogas system

The proposed biogas system upon installation will render positive impact as follows:

Positive impacts of the mill

- 5.4 million m^3/year of biogas produced can be used to substitute 420,000 liters/year of heavy oil and to replace 6,420 tons/year of palm shells.

- Other by-products yielded from the system can be utilized, e.g. dry sludge from the sand bed filter can be used as soil conditioner or sold as fertilizer. Treated effluent can be used for irrigation on nearby farm land.
- The wastewater treatment system will work more efficiently and be more stable.
- An efficient and stable wastewater treatment system that can help conserve energy and protect the environment is a major component to be considered in the certification of ISO 14001.
- The use of biogas as renewable energy will reduce emission and overall production costs and therefore improve the mill's environmental performance and competitiveness both in the local and overseas markets.

Impacts on the surrounding community

- The problem of bad odors and insects caused by the wastewater treatment system will be reduced and hence the overall surrounding environment of the mill will improve.
- The treated effluent from the wastewater treatment system can be used for agricultural purposes and does not harm the groundwater. Subsequently, the natural water resource supplying the community will be less polluted.
- Employment opportunities will increase, especially during the construction and installation of the system, and also for the long term maintenance of the biogas technology and related systems.

Impacts on the overall environment

- The biogas system in the mill will reduce methane emission and thus decrease the mill's impact on the global warming. (CO_2 emission reductions from reduced methane emission are expected amount to an equivalent of 53.000 tons CO_2 per year).
- Reduced use of fossil fuels will indirectly reduce air pollution caused by the combustion process.
- Water and air quality as well as human health will improve.

Benefits for the country

- The project will demonstrate energy conservation and environmental protection through the use of biogas as a renewable energy source. The economic return is reflected by the reduction of imported oil and fuel.
- The project will be cited as a success case of sustainable consumption and effective utilization of waste as a resource.
- The project will reduce the government's burden in power production and supply.
- The project serves the industrial pollution prevention scheme of the government. The mill will also have a driving force to manage the wastewater in such a way that the mill gains benefit continuously and regularly.

Attachment 3:

Results of the Stakeholder Meetings (including lists of participants)

Summary of the results from the Initial Stakeholder Consultation (Aug. – Sept. 2005) Conclusion of Opinion of People and Institutions living in the area affected by Chumporn Palm Oil Factory

Table 2 of this PDD summarizes the results of the sustainable development screen based on consultations with local stakeholders. As pointed out above, the overall anticipation on the project activities' effects are positive; the total project scoring is +6. In the following, some background information on the stakeholder's concerns is provided.

- Local stakeholders expressed their concerns about the recent state of the environment due to impacts of the palm oil factory, mainly referring to air quality through high soot and particle content in the air[25], odor deriving from the open pond waste water treatment system, water scarcity - especially in the dry season - in rivers due to high water consumption of the factory[26], and water pollution (oil and grease film on the rivers water, which is not proved to be caused by the factory).
- All stakeholders expect improvements through the planned project. They understood that the extension of the plant will reduce some environmental impacts due to the utilization of biogas. They expect a mitigation of the odor problem, no additional air pollution through particles, better water management and reduction of the water pollution in the rivers. All stakeholders understood clearly that the project activity helps solving the offensive smell problem.
- Approximately 90% of the villagers living in a 2 km-distance to the plant are employees of the factory. Additional farmers benefit from the factory in economic terms as they receive support for establishing and operating plantations to deliver palm oil fruits. The factory provides fresh water to the villagers, schools and temples in the dry season.
- The villagers expect additional positive economic effects through the construction and operation of the plant, more specifically opportunities of contracting, delivery of materials, and employment due to the expansion of the plant. Higher officials of the local authority welcome the introduction of the technology, which might induce emulation effects at the many other palm oil factories in the southern part of Thailand.

***Note*:** The results of the environmental screen, the evaluation of the first stakeholder consultation and the final sustainable development screen have been included into the Non-Technical PDD in Thai language and into the draft PDD as of 11.10.2005. Both documents (earlier versions) have been published on the web pages of CPI in early September 2005 already. The revised versions as of 11.10.2005 have been published at CPI Palm Oil factory, Chumporn Provincial Authority and at several locations in Bangkok (Office of CPI, Office of Thailand Environment Institute, Office of ENVIMA (Thailand) Co., Ltd. in October and November 2005 and replaced the earlier version at the web site of CPI. A final public hearing (Stakeholder Consultation Meeting) has been conducted in Chumporn Province on November 15, 2005, which is 30 days after open access to the documents had been ensured.

List of contacted stakeholders (first stakeholder contact and discussions)

[25] This is not targeted by the project activity

[26] This is not targeted by the project activity

Name	Position	Address	Phone#
Mr. Preeda Himthong	Salui TAO* President	5/1 Moo 6 Thasae Distric, Chumporn	06-2823132
Mr. Sukkhanan Kueanoon	Salui TAO Council Chairman	Salui TAO Office	01-8955232
Mr. Chawana Chuaychunoo	Salui TAO Permanent Secretariat	Salui TAO Office	077-520041
Mr.Sayun Maneevihok	Salui TAO Deputy President	Salui TAO Office	09-1962338
Miss Pornthip Thongkum	Salui TAO Deputy President	Salui TAO Office	09-7240395
Mr. Jaruek Pinthong	Salui TAO Council Deputy President	Salui TAO Office	06-1733057
Mr. Soonthorn Klubprayoon	Kamnun	Moo 2 Thasae Distric, Chumporn	077-610440
Mrs.Wassana Saowakon	Village Administrator	Moo 3 Thasae Distric, Chumporn	09-9283624
Mr. Panya Maneevihok	Village Administrator	Moo 4 Thasae Distric, Chumporn	01-8937215
Mr. Karun Chansaeng	Village Administrator	Moo 7 Thasae Distric, Chumporn	
Mrs. Nida Nawasutthi	Village Administrator	Moo 8 Thasae Distric, Chumporn	077-611045
Mr.Somchai Pueakniern	TAO member	Moo 2 Thasae Distric, Chumporn	01-2701791
Mr. Pukdee Kongnoi	TAO member	Moo 2 Thasae Distric, Chumporn	09-5895286
Mr. Pramin Pongsai	TAO member	Moo 3 Thasae Distric, Chumporn	01-0781190
Mr. Preecha Bumrungphole	TAO member	Moo 3 Thasae Distric, Chumporn	06-5572943
Mr. Vitthaya Ngamrabum	TAO member	Moo 4 Thasae Distric, Chumporn	
Mr. Norm Mongkolpetch	TAO member	Moo 4 Thasae Distric, Chumporn	01-0892756
Mr. Pongsak Mekmok	TAO member	Moo 7 Thasae Distric, Chumporn	01-0830167
Mr. Nikom Youngsrinak	TAO member	Moo 8 Thasae Distric, Chumporn	01-0781702
Mr. Kitti Siangyai	TAO member	Moo 8 Thasae Distric, Chumporn	01-9581041
Mr.Suthee Mungnong	President of Health Volunteer	Moo 2 Thasae Distric, Chumporn	
Miss Sumpao Silsorn	President of Health Volunteer.	Moo 3 Thasae Distric, Chumporn	
Mr. Pinitch Prabphon	President of Health Volunteer	Moo 4 Thasae Distric, Chumporn	
Mr. Mungkorn Kumdum	President of Health Volunteer	Moo 7 Thasae Distric, Chumporn	
Miss Phannee Sapprakorb	President of Health Volunteer	Moo 8 Thasae Distric, Chumporn	
Mr.Sophon Charoenphole	Radio Amateur Group President	Moo 2 Thasae Distric, Chumporn	01-8800104
Miss Sunee Pumluemkid	Chair Person of Ladies Community Women's Club	Moo 2 Thasae Distric, Chumporn	09-7453109
Mr. U-Thai Uainang	Community Waterworks President	Moo 2 Thasae Distric, Chumporn	

Phra Sujin	Portahinchang Temple	Moo 2 Thasae Distric, Chumporn	
Mr.Summano Jinathit	School Director of Baan Mai Somboon School	Moo 2 Thasae Distric, Chumporn	
Miss Chandra Poonikom	Salui Sudistrict Health Manager	Moo 5 Thasae Distric, Chumporn	077-520243
Miss Prapaporn Kianhoon	Prutakian Sudistrict Health Manager	Moo 8 Thasae Distric, Chumporn	01-7372474
	Head of Tha Sae Forest Industry Organization	Moo 2 Tha sae Distric, Chumporn	
Mr. Amnuay Buakiew	President of Chumporn Administrative Organization	Chumporn Administrative Organization Office, Moo 5 Ranong-chumporn road	077-506090
Mr. Anusith Methawararuk	Chief of Provincial Natural Resources and Environment Office	16 Porraminmakka Road	077-503019
Mr.Suvit Payappanon	Chief of Provincial Industrial office	200 Moo Khao Kaew Government Centre	077-511601
Mr.Pongsachote Saingarm	Chief of Provincial Labour office	3rd floor, City Hall, Arphakorn Road	077-051168 ,077-503381
Mr.Tossaphole Kritwongwimarn	Provincial Labour Protection and Welfare.	88 Moo 1 Chumporn Government Centre	077-599013
Mr. Tawatchai Disyanand	Nai Amphur Tha Sae	Tha Sae District office 1 Moo 6	077-599013
Mr. Preecha Somnium	Public Health officer	Tha Sae Public Health office, Tha Sae-Saplee road	077-599016
Mr. Virun Chooklang	Member of Provincial Administration Organization, Tha Sae district		06-0839635

* TAO = Tambon Administration Organization (District Office)

STAKEHOLDER INVOLVEMENT

- Village residents located within a distance of 2 kilometers to the palm oil plant were informed and interviewed. More specific, the following areas were covered: Moo 2-4, 7 and 8, Salui Sub-district, Tasae District, Chumporn Province. In total 41 persons were interviewed.
- Different groups of people - governmental officers, school teachers and school children, monks, TAO's officers, community's leaders, factory's workers, general villagers, agriculturists, and merchants, etc. – were involved. They were selected randomly.
- All consultations were done in the period from August to November 2005 - being organized, managed, recorded, evaluated and translated by Thailand Environment Institute (TEI)

Results of the Environmental and Social Impact Assessment with Stakeholder Participation

1. Impacts on sustainability of natural resources and environmental aspects

1.1 Quality and quantity of water

- *Utilization of Natural Water Resources by Community and Factory*

  It was found that people from the community normally use tap water supplied by Por Ta Hin Chang Water Supply Branch for consumption and general utilization. Therefore, they were not intensively affected on water issues. However, farmers from southern area of the palm oil plant expressed that they historically were affected by water shortages during the dry season. The reason hereof is a partial retention of water for utilization in the Palm Oil Factory. However, temples and schools located in adjacent area are permanently supplied with drinking water by the factory every week. The project does not cause any change on water utilization.

- *Quality of wastewater discharged by the factory to public water resources*

  It was found out that the wastewater problem is more severe in the rainy season. Grease films, originating from waste water leakages of the existing open pond system of CPI, float in water resources resulting on suffocation of fishes and other aquatic lives. Apart from that, grease films also cause death of natural aquatic plants. The project will contribute to avoid such problems.

1.2 Air Quality and air pollution

Air pollution has become a severe problem in the area. Adjacent villages are affected by wastewater‘s strong odor, smoke, ash and dust particles emitted from factory‘s burning process. On humid days, the odor from the open pond waste water treatment system spreads to the adjacent area, molesting the population close to the factory. Through the methane capturing planned by the project, odor problems will be eliminated.

1.3 Other environmental concerns

Some people expressed their concern that the utilization of fossil fuels in the palm oil plant possibly causes people‘s health problems. It has been explained to the stakeholders that the planned utilization of methane gas instead of fossil fuels and palm shells will result in not increasing dust or harmful air pollution.

1.4 Effects on soil conditions and soil quality

This aspect mainly considered the effect on soil issue such as soil degradation, soil erosion and changing of land use pattern. The research revealed that the plant operation has little to no effects on soils.

1.5 Protection of local bio-diversity

CPI supports agriculturists with good palm oil trees, knowledge on good-practice fertilization and sustainable operation of plantations. Those measures help to minimize environmental impacts, also with regard to local bio-diversity. However, the water quality of Tasae canal, being the major water resources in the area, has been impacted by the oil plants operations. Sometimes, it has strong odor and grease, which leads to an affection of water fauna. It has been explained to and understood by the stakeholders that the new water treatment system will not have leakages and thus is not contributing to deterioration of the water fauna. The proposed project activity therefore is expected to improve the environmental situation.

The majority of stakeholders expressed that the problems 1.1 and 1.2 are the most severe ones. However, they have no idea that who or which organization will be responsible for solving these

problems. Nonetheless, they know that the factory is preparing to solve the problem. They expressed their understanding that the project will not cause any severe impact and that recent problems (odor, waste water leakages) will be mitigated or eliminated by the project.

2. Sustainable social and economic development aspects

2.1 Quality of employment in the factory

It can be figured out that 90 % of temporary employees on daily basis are local people. Their wage is approximately 139 Baht per day. Higher-educated temporary employees are paid due to their competence, capability and responsibility. The distinguished temporary employees will be employed as permanent staff. The executive staffs are mainly come from central region or other areas.

2.2 Status of living expense of local people

- *Poverty reduction for people in the community*

It was found that CPI hires many local people. Before the establishment of the factory, this group of people was very poor. For qualified employees, the company provides bonus as an incentive. Apart from that, agriculturists in the area can sell their products (palm oil fruits) to the factory at a reasonable price with less transportation cost.

- *Access to basic services of employees*

It was found that the factory provides accommodations for their permanent employees. Moreover, the factory provides social insurance and cooperative store where employee can buy products at reasonable prices on a loan basis; expenses will be deducted from employees' wages by the end of the month. In addition, the factory provides drinking water and scholarships for their employees.

- *Access to clean energy services*

There is no support from the factory on this issue.

2.3 Participation in Social and Economic Development Activities

Advantages were limited within factory workers group. Significant community development activities supported by the factory are the provision of drinking water for schools and temples, the construction of community's sport fields, and the support of religious activities (i.e. donations and building Buddha's images, etc.).

3. Technology and Economic Development Aspects

The research revealed that the interviewees could not give the data with regard to employment efficiency, development of mechanisms to introduce clean technologies for energy saving or of technological skills for self-reliance. However, from discussion with chief level staffs of the factory, it was found that CPI at present is trying to improve its production system aiming at higher production, reduction of environmental impacts, and reduction of imported energy. The factory employed strategy such as using residues from the production process, skins and fibers of palm oil fruits, as fuel as a substitute for heavy oil. Apart from that, the factory is trying to conduct research on production of bio-gas from wastewater as alternative energy resources.

Conclusions

The major concern is air pollution caused by pollutants emitted in form of dust particles, ashes and smoke and strong odor from wastewater. In addition, the factory shall improve the quality of wastewater discharging it to natural water sources.

In terms of sustainable social development aspects, the majority of community people are satisfied with having the factory in the area because it is an employment source. Moreover, they can sell their products to the factory. Hence, if the factory can solve all environmental problems occurred in the area, this area can be considered as one of a livable community.

Minutes of Meeting and Discussion of the Group of main stakeholders Involved with the Implementation of CDM Project in CPI Factory
October 6, 2005
Meeting Room of Chumporn Palm Oil Industry Co. Ltd.

Note: The minutes of meeting have been recorded and translated by TEI. This stakeholder meeting has been observed by the DOE.

Meeting Participants

1. Mr. Weerapan Kratpakedee, Managing Director, Natural Power Co., Ltd.
2. Mr.Cristian Delamarian, Industry Division Manager, TUEV SUED Philippines. Inc.
3. Mr. Magnus A. Staudte, GTZ
4. Mr.Rudolf Rauch, GTZ
5. Mr. Chatree Daengkaew, Project Consultant, TEI
6. Mr. Suriya Ayachanan, Assistant Managing Director, CPI
7. Mr.Nithad Rungnapanate, CPI Logistic Manager
8. Mr.Tosaporn Aroonsak, CPI Office Manager
9. Mr.Pirom Intapirak ,CPI Rae Material Researching Manager
10. Mr.Anorn Pittan , CPI Production Manager
11. Mr.Poanee Jittawarajinda ,CPI QC Manager
12. Mr.Anorn Rittan, CPI Production Manager
13. Mr.Yosmrorn Arronsak , CPI Office Manager
14. Mr. Preeda Himthong, President, Salui TAO
15. Mr. Sayant Maneevihok, Vice President, Salui TAO
16. Mrs. Vassana Saowakont, Village Chief, Moo 3
17. Mr. Panya Maneevihok, Village Chief, Moo 4
18. Mr. Karant Chantsaeng, Village Chief, Moo 7
19. Mrs. Nida Navasut, Village Chief, Moo8
20. Mr Suvakon Pokbeesana, a school teacher, representing School Director of Baan Mai Somboon School
21. Mr. Kiattiyot Boonyor, a community health officer, representing Health Chief of Baan Pru Takian Health Station

Minutes of the meeting

1. Mr. Suriya Ayachanant, Assistant Managing Director, stated the objectives of the meeting invitation of the leaders of stakeholders which were:
   1.1 To inform all key stakeholders that to date Thailand has received a partnership from the Thai-German Cooperation Agency. It is for the provision of a production system development project that is based on clean technologies meant for industrial factories that want to address environmental problems capable of impacting on their surroundings and, for the purpose, this CPI will serve as a pilot factory,
   1.2 To request for opinions from community leaders of sub-district, village and agency levels which are currently affectedly the environmental issues resulting from CPI and to jointly find solutions for these problems in due course,

2. Mr. Veerapant Kiatpakdee, Managing Director of Palang Thammachat Co. Ltd., introduced the CDM Project to the meeting participants, saying that GTZ and CPI have jointly formulated the CDM Project of which Palang Thammachat Co. will be in charge of the technical and design aspects. This project will only focus on addressing waste water and on identifying alternative energies that CPI can make available for the present and the future needs. In so doing, waste water currently produced and to be produced from the production system will first be put into the fermenting system in order to obtain gas that will serve as an energy source for the CPI's production system process. Residual water from this fermentation will then become cleaner and will be less or not harmful to the surrounding by not less than 85% after it is discharged

from the fermentation pond. It is expected that this project will be approved by mid-2006 and authorized to start at the beginning of 2007.

3. Mr. Chatree Daengkaew, Project Consultant, TEI, said that at the project's start TEI would be responsible for conducting surveys, collecting, studying and analyzing primary data related to environmental, economic, social conditions of the involved communities, as well as other surrounding areas of CPI. As a matter of facts, TEI has already started to do something, especially in terms of the promotion of, through forums and meetings, exchanges of opinions and experience in having jointly addressed similar problems by factories, communities and other related local agencies.

4. The meeting was also opened to a Q & A session.
   - Mr. Preeda Himthong, president of Salui TAO, was the first to start. He said he was glad to have been invited for this meeting. In the past when problems arose in this factory or when there was something about this factory, community leaders and communities were not informed at all. Thus far there was no flow of information in between and that was something nobody wanted. In his opinion, he wanted the factory to hold meetings with community leaders and other related agencies often or every month.
   - Other key questions raised by community leaders and government officers participating in this meeting were:

   Today's smoke: how will the factory address it?

   A representative from the factory said that the factory was improving its production system on a continual and regular basis. To date smokes and dust are getting less and less. Shortly the factory will start to operate a new machine with a daily production capacity of 400 tons per day. This machine will help save fuel, water and resources needed for the production. And this will also help reduce smoke, dust and waste water.

   Waste water and its odor: how will the factory solve the problem?

   An explanation was that to date waste water to be treated was sent through a pipe system to 8 open waste water system ponds located in a plot of 7 rai. Actually this has already been done for 5 years. In this process waste water will slowly flow and settle by the time it reaches the last pond. It then will be discharged as bio fertilizers into the factory's oil palm plantations of 100 rai. This is a way to dispose of its waste water which will further flow down to naturally treated waste water ponds in a plot of about 30 rai.

   As for the offensive smells, they would come with the wind in intervals. If the needed waste water system can really be developed, there will be no more stink. And the gas to be obtained from the fermentation would be the substitute for other energies currently consumed by the factory. The stilt accumulated would simply become for manures. And the residual waters could be for feeding the oil palm plantations or just be discharged away.

   Community leaders were of opinions that it would be good if the factory could resort to these fermenting technologies in treating waste water. However, such action would only benefit the factory. This is because, if such can be implemented and, at the same time, can benefit the various communities, such a technology will be most welcomed. This is due to the fact that most communities are producing dried bananas. Not less than 200 families are making a living on this. However, each day not less than 3 – 4 tons of bananas have to be discharged as they cannot be sufficiently treated. Every day each family will have to consume at least a tank of 15 kilograms. If this project can support them with bodies of knowledge and necessary working capitals, such actions will greatly benefit these families. Mr. Weerapan said that the project might provide some assistance to big schools that could serve as models. However, details of these should further be elaborated if budgetary allocations could be made.

   In order to create a good coordination and relationship system between the factory and schools, the following steps should be observed:

- A factory-community coordinating committee should be set up and should regularly hold meetings.
- The factory should participate more in communities' public activities.
- The factory should regularly disseminate information and data that are, in one way or another, related to the various communities. Such can be done through the factory's personnel or by mails.

The factory management accepted to propose these three recommendations to the factory board's meeting before giving any exact answers.

The Final Meeting within CDM Gold Standard Project
Applied Biogas Technology for Advanced Waste Water Management.
Chumporn Palm Oil Industry
November 15, 2005, Kang Phuka Resort Chumporn

Note: The minutes of the meeting have been taken by Thailand Environment Institute (TEI). The stakeholder meeting has been observed by WWF Thailand. The translation of the minutes of the stakeholder meeting has been done by TEI.

PARTICIPANTS

Name	Title	Phone Number
1. Mr. Preeda Himthong	Salui TAO President	06-282 3132
2. Mr. Suranant Kuanoon	Salui TAO Council Chairman	01-895 5232
3. Mr. Sayant Manivihok	Salui TAO Vice President	09-196 2338
4. Miss Pornthip Thongkham	Salui TAO Vice President	09-724 0395
5. Mr. Jaruk Pinthong	Salui TAO Council Vice Chairman	06-173 3057
6. Mr. Soonthorn Klabprayoon	Salui Sub-district Kamnan	09-868 0094
7. Mr. Nida A-na-va-sut	Moo 8 Village Head	01-979 3739
8. Mr. Somchai Phuaknian	Moo 2 TAO Member	01-270 1791
9. Mrs. Wassana Saovakont	Moo 3 Village Head	09-908 3624
10. Mr. Panya Manivihok	Moo 4 Village Head	01- 893 7215
11. Mr. Phakdi Kongnoi	Moo 2 TAO Member	09-589 5286
12. Mr. Phiha Ngarmra-bam	Moo 4 TAO Member	
13. Mr. Nop Mongkolphet	Moo 4 TAO Member	01-089 2756
14. Mr. Pongsak Mekmok	Moo 7 TAO Member	01-083 0169
15. Mr. Kitti Siangyai	Moo 8 TAO Member	01-958 1041
16. Mr. Phinit Prabpal	Moo 4 Health Volunteer President	
17. Mr. Mangkorn Khamdam	Moo 7 Health Volunteer President	04-842 9526
18. Mr. Sophon Charoenphol	Patiew-Thasae Radio Amateur Group President	
19. Mr. Uthai Ui-nang	Moo 2 Community Waterworks President	
20. Mr. Sumno Jinathit	Director, Ban Mai Somboon School	
21. Mrs. Jintana Phunikom	Salui Sub-district Health Center Chief	
22. Miss Praphaporn Kianboon	Ban Phu Takian Health Center Chief	
23. Mr. Veeraphant Kiatphakdee	Managing Director, Palang Thammachat Co. Ltd.	
24. Mr. Magnus Staudte	Managing Director, ENVIMA (Thailand) Co. Ltd.	
25. Mr. Suriya Ayanant	Assistant MD, CPI Co. Ltd.	01-860 2907
26. Mr. Chatree Daengkaeo	TEI Project Advisor	01-995 9393
27. Miss Wanun Permpiboon	WWF Thailand	
28. Mr. Phumsak Palaplivant	Information Analysis Assistant, WWF Thailand	
29. Mr. Karant Chantsaeng	Moo 7 Village Head	01-088 1367

Summary of the meeting

After self-introduction of all meeting participants, Mr. Suriya presented the background of CPI which started to operate in 1982. In the first years of operations, water pollution was very critical as it was very odorous. However, the factory has tried its best to solve the problem continuously. In 2005, the factory management decided to apply CDM to solve its environmental problems in its factory and nearby areas. This is to treat waste water in closed pond-systems with bacteria. From this system there will emerge a by-product which is gas which can be used as substitute energy in the factory. And the residual water from the fermentation will be turned into manure for oil palm trees in its plantations. This project will be constructed at the end of 2005 and should be completed by the end of 2006.

Mr. Veeraphan informed about biogas technological application in CDM which is using the decomposing technology in the anaerobic condition in which gas is generated. A major part of it will be methane gas. This methane gas will be used as a kind of substitute energy. Mr. Veeraphan then explained in details all the steps of operations of the project so that all participants understood well the project's operations, as well as the benefits the various communities would receive directly and indirectly from the project and the factory. Details are in the papers distributed by Mr. Veeraphan to Mr. Magnus.

Miss Wanun (WWF) explained about the CDM Gold Standard Project or mechanisms for clean water development in accordance with the gold standard. She mentioned about the impact on the earth's climatic changes due to the increase of CO_2 and methane gas in the earth's stratosphere because of the current industrial development. These are related to human life. Man will have to try to solve the problem together. During the meeting, the following questions were posted by the participants.

When are operations going to start?
Answer: At present the design study has already been completed and the construction will start as soon as the approval will arrive from the national DNA and the UNFCCC EB.

After burning the biogas, will there be any smell?
Answer: There will be no odor.

How to deal with hydrogen sulphide generated from fermentation? This is because if it leaks into the atmosphere there will be acid rains.
Answer: In the fermentation, each kind of gas will be separated from one another. Hydrogen sulphide will then be stimulated with O_2. Then the gas will change into sulphur and turn into powder which can be used for general purpose.

Will the energy generated from the gas be a substitute for energy obtained from the burning of palm oil residues? Will the biomass be sufficient for common use? In what percentage will this account for?
Answer: At this moment, no estimation can be made because the production volume still keeps increasing. However, it can be said all this will never be sufficient for all the need. And the project wants to transfer all this gas production knowledge to the nearby communities through the curriculum in the schooling system.

Up to now, it can be said some polluted water still keeps flowing down into the public stream, especially in the rainy season when water will turn into black and fish will die. Oil traces appear everywhere.
Answer: It might be true as mentioned. However, the factory will improve the situation through the new waste water treatment and will avoid any leakages.

In the future will the factory allow the community to see how the factory solve the wastewater problem inside the factory? And does the Department for Pollution Control come to inspect the wastewater treatment regularly?

Answer: The community can come inside to inspect the wastewater treatment system. Soon there will be a meeting of the Community-Factory Coordination Committee. The committee members are eligible to inspect the condition. As for the investigation of the industrial impact, the Department for Pollution Control has authorized the Provincial Pollution Control Office to act on its behalf.

It should be noted that it is good that the CDM system is now applied. However, it should always be kept in mind that wastewater can also seep underground and the methane gas can always leak.
The wastewater treatment tank will be steel-reinforced concrete. And the ponds are closed so as to keep water leakages and methane gas well under control.

Please clarify if the factory is using fuel oil or coal?
Answer: Fuel oil is used in the oil refinery at the rate of 2 m^3 for each hour. Coal is used temporarily when biomass is insufficient and when oil palm residues or fibers are rain-wet. However, the factory has been trying to reduce these two energy sources as much as it can. Further increase of fossil fuel resources can be reduced through the project by using methane gas instead.

The atmosphere in the meeting room was very friendly and it was highly possible that other related organizations would soon step in to provide necessary assistance. The community requested that problems should squarely be solved so as to reduce all the adverse impacts.

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Document information

Version	*Date*	*Description*
10.1	28 June 2017	Revision to make editorial improvement.
10.0	7 June 2017	Revision to: • Improve consistency with the “CDM project standard for project activities” and with the PoA-DD and CPA-DD forms; • Make editorial improvement.
09.0	24 May 2017	Revision to: • Ensure consistency with the “CDM project standard for project activities” (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the “Project design document form for small-scale CDM project activities” (CDM-SSC-PDD-FORM); • Make editorial improvement.
08.0	22 July 2016	EB 90, Annex 1 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the “Standard: Applicability of sectoral scopes” (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revision to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Make editorial improvement.
05.0	25 June 2014	Revision to: • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from F-CDM-PDD to CDM-PDD-FORM; • Make editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
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