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

CONTENTS

Annexes

Revision history of this document

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

SECTION A. General description of small-scale project activity

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

Title: "PAA Biogas Extraction Project for Heat Generation"

Version: Version 1.1.0

Completion Date: 16/08/2007

This document is written following Guidelines for Completing Simplified Project Design Document (CDM-SSC-PDD) Version 04.

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

PT Pelita Agung Agrindustri (PAA) plans to implement a biogas extraction facility to treat waste water generated by its industrial activity ("Project"). PAA is an integrated palm oil processing facility consisting of a palm oil mill, a kernel crushing plant, and currently developing a palm oil refinery and a bio-diesel plant. The complex is wholly owned by PT Permata Hijau Group (PHG) who owns and operates palm plantations and a number of palm oil processing plants in Sumatra.

Current Situation
Under the original plan, effluent generated by PAA activities will be collected and treated in a series of anaerobic lagoons. The effluent is largely generated by PAA palm oil mill from its FFB cooking activity and effluent collected from EFB (as liquor). Other processing facilities, the kernel crushing plant, refinery, and bio-diesel plant are expected to generate not significant amount of waste water with lower COD characteristics.

In 2005, PAA constructed anaerobic lagoons with holding capacity of 122,000m^3 to treat the effluent. The system consists of 5 lagoons with depth between 4-6m and was designed to process waste water to comply with local standard.

Project Installation and Purpose
With incentive from CDM, PAA plans to install a new methane extraction facility to extract biogas from the waste water. The selected system is anaerobic reactors with total hold-up capacity of 14,000m^3 equipped with combination of fixed and floating roof. Water from lagoon number 1 and 2 will be routed to these reactors, and returned to the next lagoons with a much lower COD concentration. It is expected that the technology will improve the quality of waste water discharged significantly.

The new technology extracts methane rich biogas from the effluent which will be utilized primarily to generate high pressure steam for the refinery – any excess biogas will be combusted in PAA's primary power and heat generation system. Consequently, in addition to the installation of anaerobic digester reactors, the scope of the Project is extended to modification of the refinery HP boiler from the original design and the cogeneration system main boiler.

The effluent contains minimum organic sludge digestible by microbes in both the existing and the Project system. There are no sludge treatment in both pre-Project and Project situations.

Contribution to Sustainable Development:

- **Zero Waste Activities**. The Project represents an innovative and energy efficient way to power a palm oil processing complex. With the project implementation, PAA converts all of its generated wastes into energy complimenting its previously implemented biomass initiatives.

- **Better air quality**. In addition to green house gas mitigation, the project activity also improves air quality by eliminating the pungent smell released from the anaerobic lagoons. The proposed reactor system is a closed system, and the treated effluent is returned to the lagoons with much lower organic content and thus release of odorous gases associated with organic material decomposition is minimized.

- **Improvement in water discharge quality.** The additional facility increases the COD removal productivity of waste water and consequently the final discharged waste water from the combined treatments (reactor and lagoons) is expected to be of better standard than that mandated by national regulation. Additionally, the reactor close system eliminates possibility of accidental release of untreated waste water from lagoon overflowing that sometimes occurs due to higher-than-normal rainfall.

  Upon successful completion of the Project, PHG is committed to seek ways to reduce environmental water discharge by recycling the treated water for further industrial usages.

- **Renewable energy generation**. With the Project implementation, PAA and PHG will realize its vision of being truly independent from fossil fuel utilization. This pioneering achievement will set a new industry standard for other palm oil players in the region.

A.3. Project participants:

Name of Party Involved	Private and/or public entity(ies) project participant	Kindly indicate if the Party involved wishes to be considered as Project Participant (Yes/No)
Indonesia (host)	PT Pelita Agung Agrindustri (Private Entity)	No
Indonesia (host)	PT Permata Hijau Group (Private Entity)	No
Japan	Clean Energy Finance Committee Mitsubishi UFJ Securities Co. Ltd. (Private Entity)	No

PT Pelita Agung Agrindustri (PAA) is wholly owned by PT Permata Hijau Group (PHG) based in Medan, North Sumatra, Indonesia.

The group operates palm plantations, palm oil mills & refineries, bulk storage terminal, and recently entering bio-fuel industry with the inception of PT Pelita Agung Agrindustri. PAA is a pioneer in integrated palm oil processing complex in Indonesia adopting upstream-downstream processing strategy which preserves energy through:

- elimination of intermediate products transportation;
- efficient distribution of waste-derived energy not only for the waste generation source facility (palm oil mill) but also the downstream facilities (kernel crushing plant, refinery, etc);

The Clean Energy Finance Committee of the Mitsubishi UFJ Securities Co. Ltd., is the CDM consultant for this Project.

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

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

A.4.1.1. Host Party(ies):

Indonesia

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

The Province of Riau

A.4.1.3. City/Town/Community etc:

Sebangar Hamlet, Mandau District, Town of Bengkalis

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

The Project is located within PAA palm processing complex. The Project lay out will be provided as an attachment to this PDD. The Project geographical location is shown in Figure 1 below.

Figure 1 - PAA Geographical Location

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

Project Type & Category:
In accordance with Appendix B of the simplified modalities and procedures for small-scale CDM project activities ("SSC M&P"), the proposed Project falls under the following categories:

- **Type III: Other Activities, Category H: Methane recovery in waste water treatment**
  The Project recovers methane from biogenic organic matter through introduction of a new methane-extraction step with energy recovery to the existing anaerobic lagoon or measure (vi) in methodology III-H.

- **Type I: Renewable Energy Project, Category C: Thermal energy for the user.**
  The Project generates heat from industrial waste water which is derived from renewable sources.

Project Technology
The project installation is a licensed waste water treatment technology by Keck Seng Bhd, and will be implemented jointly by PAA and Aquarius System (Malaysia) Sdn. Bhd.

As elaborated under Section A.2, the Project introduces a new step to the existing waste water treatment through installation of Anaerobic Digestion (AD) reactors. The simplified flow diagram of the existing system and the proposed system is shown in **Figure 2** overleaf.

Under the current system, the effluent is treated sequentially from ponds 1 to 5 before it is released to the environment. The Project intercepts the waste water flow between pond number 2 and 3 and therefore is an additional step to the existing lagoon system.

Under the Project, treatment ponds 1 and 2 acts as pre-conditioning ponds to the anaerobic reactors. In these ponds, pH and temperature is adjusted, and impurities are removed using screening method to prevent reactor clogging. The treatments adjust the waste water condition to meet the ideal condition for anaerobic digestion feeding. The reactors are interconnected continuous stirred tanks with sedimentation tanks and sludge return system to maintain appropriate sludge level for effective digestion. The reactors are also equipped with necessary safety equipment to prevent leaks and protection from fire.

Effluent treated by the AD system will be returned to pond number 3 which overflows in the same direction as per existing system.

The biogas produced by the AD process will be piped to 3 locations with the following merit order:
(A) High pressure (HP) diesel boiler located in the new refinery. This boiler generates 50bar steam from combustion of diesel fuel. This boiler is a turn-key equipment in the refinery design.

(B) Biomass power and heat generation systems. The system is PAA primary energy provision plant consisting of 3 biomass cogeneration plants generating steam and electricity for the complex. Excess biogas will be burn in this system and therefore reducing PAA biomass intake and minimizes energy unused for flaring.

(C) Flare unit. An open flare will be installed although unlikely to be operated under normal condition considering the multiple measures (A) and (B).

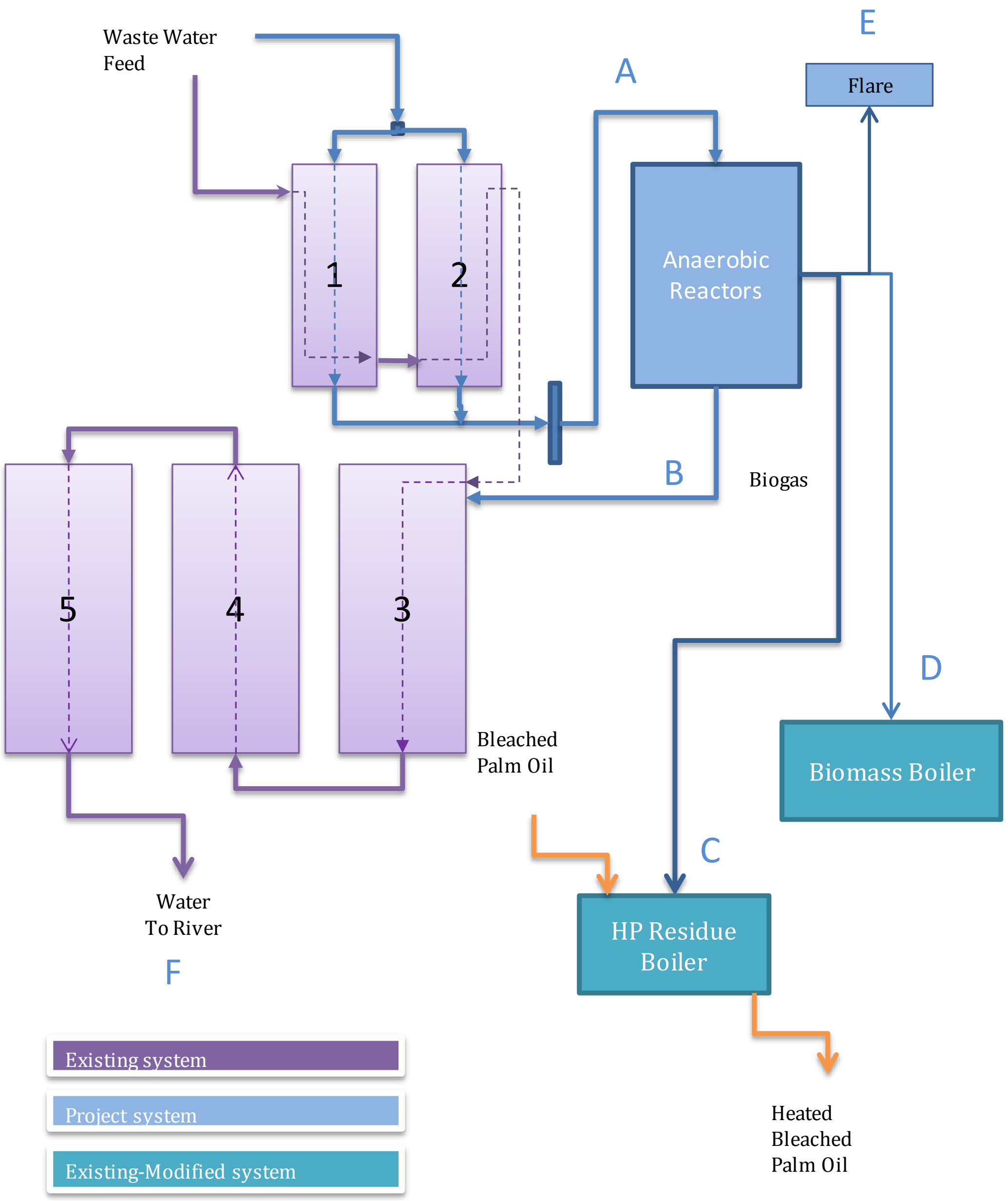

Figure 2 - Simplified Flow Diagram of Project & Existing Installations

As part of the Project, both boilers (A & B) will be modified into dual fuel systems equipped with sophisticated control instrumentations to anticipate fluctuation in biogas calorific value. For the HP boiler this fluctuation will be compensated with heat from the combustion of diesel fuel.

The AD system is not a new technology in the waste water treatment industry. However, without incentives – this technology hardly penetrates developing country like Indonesia. The existing lagoon system in PAA was built in 2005, and is capable to meet PAA requirement. The additional step, however, will significantly improve the efficiency of the existing system, and can possibly support PAA process water requirement through recycling of the generated waste water.

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

Table 1 - Estimated Emission Reduction

Year	Estimation of annual emission reductions In tonnes of CO2e per year
1	40,040
2	40,040
3	40,040
4	40,040
5	40,040
6	40,040
7	40,040
Total estimated emission reductions	280,280
Total number of crediting years	7
Annual average of the estimated reductions over the crediting period (t-CO2e/yr)	40,040

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

The Project does not involve any public funding from Annex I countries.

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

As defined in Appendix C of the *simplified modalities and procedures for small scale project activities*, this Project is not a debundled component of any larger project activity as the Project Proponent does not own or operate any other CDM registered project of similar nature and technology within 1km of the project boundary.

The biomass cogeneration systems at PAA are implemented with CDM assistance. However, this activity is different in nature and technology.

SECTION B. Application of a baseline and monitoring methodology

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

AMS-III.H Version 6 “Methane recovery in waste water treatment”
AMS-I.C Version 12 “Thermal energy for the user with or without electricity’

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

Type III: Other Project Activities, Category H: Methane recovery in waste water

The Project comprises measure to recover methane from biogenic organic matter from effluent currently treated in existing anaerobic lagoons. The treated effluent will be returned to the existing lagoon system in a sequential manner and therefore corresponds with activity (vi) under paragraph 1 of AMS-III.H: “Introduction of a sequential stage of waste water treatment with methane recovery and combustion to an existing waste water treatment system without methane recovery”

The resulting emission reduction from this activity is estimated to be well below the 60,000t-CO_2 annually and therefore meets the applicability condition in the methodology.

Type I: Renewable Energy Projects, Category C: Thermal energy for the user

Large proportion of methane from waste water will be combusted to generate steam in the modified High Pressure (HP) boiler in the refinery, any excess will be combusted in the biomass boiler. Paragraph 2 of AMS III-H prescribes the use of Type I methodology for activity involving the use of recovered methane for heat generation activity.

The modification of HP boiler from diesel to biogas adds a new renewable energy unit to the existing renewable energy systems at PAA which consists of biomass co-generation plants. This existing renewable energy facility is physically distinct system from the HP boiler located in the refinery and uses completely different types of renewable fuel.

The HP boiler is expected to deliver 5tonnes per hour of superheated steam with enthalpy of 2,926MJ/t at 50 bar. This is equivalent to 84TJ per year of energy or about 4.06MWth. This addition represents less than the 45MWth limit as stipulated in paragraph 4 of methodology I-C.

No emission reduction will be claimed for the use of biogas in the biomass boiler.

B.3. Description of the project boundary:

As stated in both SSC Methodologies, the project boundary is *the physical and geographical site where the waste water and sludge treatment takes place*. In this case, the project boundary is extended to the location of boiler where the biogas is combusted for heat generation.

B.4. Description of baseline and its development:

Methane recovery from waste water

As stated under point 6(vi) of methodology III.H, in the case of introduction of a sequential anaerobic waste water treatment system, the applicable baseline is the existing anaerobic waste water treatment system without methane recovery and combustion

Consequently, the baseline is the methane emission that would have escaped from waste water entering lagoon number 3 if the Project does not exists. Paragraph 7(d) of AMS-IIIH further specified that this methane emission is calculated based on the measured volume and COD of waste water, methane generation potential of waste water type, and methane correction factor of the existing waste water lagoons in accordance to Equation 1 (p.13) of this PDD.

The methane generation capacity of waste water set for baseline calculation is 0.21kgCH_4/kgCOD. This is consistent with the methane generation capacity prescribed by the methodology. With consideration that the existing lagoons have depths between 4m to 6m, methane correction factor of 0.8 is deemed appropriate. This factor is the MCF lower value contained in Table III.H.1 for anaerobic lagoons with depth greater than 2 m.

Heat recovery from biogas

The biogas will displace diesel oil as main energy source in the HP boiler which is designed to supply steam at 50bar for the purpose of heating bleached palm oil during the refining process. This steam quality is much higher than those generated by the main co-generation system – which is operated at maximum pressure of 15bar and thus unable to service this requirement.

Paragraph 6 of methodology I-C prescribes that for such activity the simplified baseline is the fuel consumption of the technologies that would have been used in the absence of the project activity – in this case consumption of diesel oil in the HP Boiler, times an emission coefficient of the fossil fuel

displaced. Paragraph 10 further stipulates that the baseline emission is to be calculated based on boiler thermal output, displaced fuel emission factor, and the original boiler efficiency.
Paragraph 14 prescribes that efficiency of baseline boiler should adopt (a) highest measured efficiency of a unit with similar specifications, (b) highest of efficiency values provided by two manufacturers or more for units with similar specifications or (c) maximum efficiency of 100%. The project developer chose to use option (c) or 100% efficiency for simplification.

It is pertinent to note that the modification of HP boiler does not eliminate possibility of diesel fuel combustion in the HP boiler to maintain operational reliability. Consequently, diesel fuel combustion in the HP boiler should be discounted from the baseline emissions in accordance to paragraph 20 of the methodology.

$$BE_{CO2,DO} = \left[\frac{Q_{B,OUT}}{\eta_B} - m_{DO} \times NCV_{DO}\right] \times EF_{DO}$$

Where;

Parameter	Description	Unit
$Q_{B,OUT}$	Total heat output of HP boiler	TJ/yr
η_B	HP Boiler efficiency fired using diesel oil	unitless
m_{DO}	Amount of diesel oil co-fired in HP boiler	t/yr
NCV_{DO}	Net calorific value of diesel boiler	TJ/t
EF_{DO}	Emission factor of diesel oil	t-CO2 /TJ

Baseline emission from retrofitting existing biomass boiler
Combustion of the Project generated biogas in the retrofitted biomass boiler will not lead to any emission reduction its purpose is merely to reduce unrecovered biogas in the event of excess. This activity further minimizes the amount of biogas that would have been flared. Consequently, biogas thermal energy generation in this boiler will not be included in the baseline emission calculation.

It is however noted that reduction of biomass intake to the boiler may lead to methane emission leakage from decaying unused biomass, particularly if the unused biomass is EFB. This emission effect is negligible but nevertheless will be evaluated under leakage emission.

Applicable baseline data are shown in Table 2.

Table 2 - Baseline Parameters

Related Methodology	Baseline Parameter	Description	Value and Unit
AMS.III-H	$B_{o,ww}$	Methane generation potential per COD	0.21t-CH4/t-COD
	$MCF_{AL,L}$	Methane correction factor for the existing waste water treatment system to which the Project is being introduced, thus the anaerobic lagoons (AL) with depths between 4m to 6m	0.8 (unitless) Lower value of Table III.H.1
	GWP_{CH4}	Global warming potential of methane gas	21t-CH4/tCO2
AMS.I-C	NCV_{DO}	Net calorific value of diesel oil	0.043TJ/t or 43TJ/Gg Table 1.2 – Default NCV Values, 2006 IPCC
	η_B	HP Boiler efficiency	100%

	EF_{DO}	Emission factor of diesel fuel oil used in the HP boiler prior to modification	74.1t-CO2/TJ Default value of Table 2.2 (*Emission Factor for Stationary Combustion for Energy Industry*), 2006 IPCC Guideline

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

In accordance with Attachment B of Appendix B of the *simplified modalities and procedures for small scale CDM project activity*, the Project Participant shall demonstrate that the Project would not have occurred without CDM as it faces at least one of the barrier specified in Appendix A: financial barrier, technological barrier, barrier due to prevailing practise, and other barrier.

Barrier due to prevailing practise of lagoon system
Anaerobic lagoon system is the prevalent technology to treat waste water in both Sumatra and Indonesia due to combination of low capital and no regulation to capture of methane from industrial waste water at local or national level. Without incentives from CDM, these factors continue to create barrier for PAA and other industry players to capture methane from its industrial waste water. This Project is PHG's first endeavour in biogas technology.

Indonesia has for quite sometimes conduct experiments in small scale biogas projects to meet household energy requirement in places with limited energy resources. However, successful commercial biogas project are predominantly been implemented as CDM endeavours. At the time of writing, this includes the registered Lampung Bekri Biogas Project and under validation Sungai Budi project. There is no known biogas project has been successfully implemented in palm oil mill in the host country.

PAA is in unique position because it is the first integrated upstream-downstream palm oil processing complex. Traditional operator runs palm oil mill to process FFB to CPO. Some operators integrate kernel crushing plant to the mill operation. But there are no other player that integrates palm oil mill, kernel crushing plant, refinery and biodiesel facility in a single location like PAA. In addition to the reduction of energy usage, the holistic energy management approach taken by PAA creates a unique opportunity for PAA to be fully energy sustainable through utilization of waste generated upstream (palm oil mill) for downstream processing energy provision (refinery). PAA successful implementation will set a welcome precedent amongst Indonesia palm oil industry players.

Investment barrier
The Project is initiated at a time when PAA cash flow is needed to finance the construction of the refinery and biodiesel plants. It must compete with PAA's other needs for core activities. During financial feasibility analysis in October 2006, it was evaluated that the return of this Project does not meet the standard required by a typical investor in developing country. This is demonstrated by the following investment analysis.

Benchmark
The minimum expectation for a Project to proceed is that it must at least return the cost of borrowing and covers its implementation risks. The standard investment loan in 2006 published by Bank of Indonesia is 15%, and considering that this first biogas installation by the company, the implementation risk is set at 3%. Therefore the minimum benchmark of at least 18% must be achieved before the company proceed with the investment.

Assumptions taken for financial analysis

- The Project is estimated to cost around USD2.3million with revenue derived solely from fuel savings accrued from elimination of diesel oil. It is estimated that the biogas will displace about 51TJ of energy per year or equivalent to 1,347,907L/yr of diesel oil[1] at a rate of IDR5,270 per year.

- The operational cost associated with the Project is incurred due to electricity needed to run pumps and other auxiliary equipments which is expected to be 120kW for 7,200hours of operation or 864,000kWh/yr. Since PAA generates its own electricity using biomass, the costs of electricity generation is approximated to about 80% of the costs from grid electricity or USD0.046 per kWh.

- It is approximated that the spare-parts, maintenance and operatorship will cost about 10% of the total capital installation or USD230,416 per year.

- An escalation rate of 3% for all revenues and expenses are built in the financial model to anticipate country inflation, which stands at 5% per annum in 2006.

Calculated IRR
Based on the above assumptions, it is estimated that the Project without additional revenue from CDM can achieve IRR of 14.72%. This is lower than the minimum expected return, and therefore not a financially attractive investment.

Sensitivity Analysis
A series of sensitivity analysis is performed on some critical assumptions of the financial analysis. The results are summarized in Table 3 below.

Table 3 – Results of Sensitivity Analysis

Sensitivity Scenario	From	To	Resulting IRR
Escalation rate for fixed costs and operational costs are reduced	3%	0%	15.82%
Based diesel price is increased	IDR5,270	IDR5,534	16.36%
Capital outlay is reduced	USD2,304,159	USD2,188,951	16.36%
Tax rate is reduced	30%	25%	15.74%
Maintenance costs is reduced	10%	8%	16.65%
Costs of electricity is reduced	USD0.046	USD0.043	14.80%

The above sensitivity analysis demonstrates that the Project IRR is still within the minimum benchmark with variations of critical assumptions. Therefore the financial model is robust.

Impact of CDM
The revenue from the sales of CER is expected to be more than 25% of total Project revenue. This additional revenue will alleviate the Project IRR from 14.7% to 25% well above the accepted minimum benchmark. It is clear from this analysis that CDM significantly improves the Project financial attractiveness. With awareness of the importance of CDM revenue to the Project, PAA management decided to proceed with the Project while pursuing CDM registration.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

A. BASELINE EMISSIONS

[1] Based on NCV of 43TJ/kt (2006 IPCC) and specific gravity of 0.88kg/L for Industrial Diesel Oil (IDO) published in PERTAMINA website

A.1 Avoided methane emission from the anaerobic lagoon due to project activity, $BE_{CH\,4,AL}$

For case involving the introduction of a sequential anaerobic waste water treatment to an existing anaerobic lagoon, paragraph 7 (d) of AMS.III-H prescribes that the baseline is the methane that would have been generated by the pre-Project anaerobic lagoon.

$$\mathbf{BE_{CH4,AL} = V_A \times COD_A \times B_{o.ww} \times MCF_{AL,L} \times GWP_{CH4}}$$

Equation 1

Parameter	Description	Unit
V_A	Volumetric flow rate of effluent entering pond number 3 or volumetric flow rate at point A in **Figure 2**	m^3/yr
COD_A	Chemical Oxygen Demand (COD) concentration of the effluent entering pond number 3 or total COD concentration at point A in **Figure 2**	t-COD /m^3
$B_{o.ww}$	Methane generation potential of waste water	t-CH_4 /t-COD
$MCF_{AL,L}$	Methane correction factor applicable for deep anaerobic lagoon. The depth of lagoon 3 to 5 is between 4-6m	Unitless
$GWP_{CH\,4}$	Global warming potential of methane gas.	t-CO_2 /t-CH_4

A.2 Avoided CO_2 emission from combustion of diesel fuel oil displaced by biogas, $BE_{CO\,2,DO}$

In compliance with paragraph 6, 10 and 20 of AMS-I.C and elaborated under Section B4, the baseline CO_2 emissions associated with the displacement of diesel oil with renewable energy in the HP boiler is calculated using the following formula:

$$\mathbf{BE_{CO2,DO}} = \left[\frac{\mathbf{HG_{HP,y}}}{\eta_\mathbf{B}} - \mathbf{m_{DO} \times NCV_{DO}}\right] \times \mathbf{EF_{DO}}$$

Equation 2

Parameter	Description	Unit
$HG_{HP,y}$	Total heat output of HP boiler This is calculated by monitoring the circulating steam / condensate conditions from the HP boiler	TJ/yr
η_B	Boiler nameplate efficiency	unitless
m_{DO}	Amount of diesel oil co-fired in HP boiler	t/yr
NCV_{DO}	Net calorific value of diesel boiler co-fired in HP Boiler	TJ/t
EF_{DO}	Emission factor of diesel oil	t-CO_2 /TJ

B. PROJECT EMISSIONS

The following areas in Table 4 are considered as project activity emission sources.

Table 4 – Project activity emission sources

Ref.	Meth.	Parameter	Description
B.1	III-H	PE_{POWER}	CO_2 emission from the combustion of fossil fuel to generate power required to run the project activity
B.2	III-H	$PE_{CH\,4,AL}$	CH_4 emission from organic matter untreated by the Project and treated in the existing lagoons.
B.3	III-H	$PE_{CH\,4,FUG}$	Fugitive CH_4 emission from Project installations
B.4	III-H	$PE_{CH\,4,W}$	CH_4 emission from waste water released to environment

B.1 CO_2 emission from the combustion of fossil fuel to generate power required to run the project equipment, PE_{POWER}

The PAA complex generates its own electricity using biomass powered CHP technology and does not use electricity from external sources (grid). In the event of power failure, the electricity will be supplied by the stand-by diesel generators.

The stand-by diesel generators at PAA has capacity of more than 200kW. Table 1.D-1 of AMS-ID prescribes that emission factor from such equipment is 0.8t-CO_2/MWh.

$$PE_{POWER} = EG_{DG} \times EF_{DG}$$

Equation 3

Parameter	Description	Unit
EG_{DG}	The amount of electricity generated used by the project generated using the stand-by diesel generator	MWh/yr
EF_{DG}	Emission factor of diesel generator with capacity greater than 200kW	0.8tCO_2/MWh

B.2 CH_4 emission from organic matter untreated by the Project and returned to anaerobic lagoon, $PE_{CH4,AL}$

A small portion of organic matter remains in the waste water after treatment in the project installation and will be treated in the anaerobic lagoons. Methane emission from the decomposition of the remaining organic matter in the lagoons is accounted as project emission and is calculated as follow:

$$\mathbf{PE_{CH4,AL} = V_B \times COD_B \times B_{o.ww} \times MCF_{AL,H} \times GWP_{CH4}}$$

Equation 4

Parameter	Description	Unit
V_B	Total volumetric flow-rate of effluent entering pond number 3 after treatment in the Project's reactors or total flow-rate at point B in **Figure 2**	m^3/yr
COD_B	Chemical Oxygen Demand (COD) concentration of the effluent entering pond number 3 after treatment in the Project's reactors or total COD concentration at point B in **Figure 2**	t-COD /m^3
$B_{o.ww}$	Methane generation potential of waste water	t-CH_4 /t-COD
$MCF_{AL,H}$	Methane correction factor applicable to anaerobic lagoon with depth greater than 2m	Unitless
GWP_{CH4}	Global warming potential of methane gas.	t-CO_2 /t-CH4

B.3 Fugitive CH_4 emission from Project's installations $PE_{CH4,FUG}$

The fugitive methane emissions from the Project's installations are calculated as a portion of total methane generation potential from the waste water (MEP). The proportion (CFE_P) is determined based on capture efficiency of the installations established from combination leakage test results and constants.

$$PE_{CH4,FUG} = (1 - CFE_P) \times MEP \times GWP_{CH4}$$

Equation 5

Parameter	Description	Unit
MEP	Methane emission potential from untreated waste water calculated under Equation 6	t-CH_4 /yr
$\mathrm{CFE_P}$	Capture efficiency of the Project's installation as established in Equation 7	unitless
$\mathrm{GWP_{CH\,4}}$	Global warming potential of methane gas	t-CO_2/t-CH_4

Methane emission potential from untreated waste water

$$\mathrm{MEP} = \mathrm{V_A} \times \mathrm{COD_A} \times \mathrm{B_{o.ww}} \times \mathrm{MCF_{AL.H}}$$

Equation 6

Parameter	Description	Unit
$\mathrm{V_A}$	Total volumetric flow-rate of effluent entering pond number 3 or total flow-rate of effluent in point A of **Figure 2**	m^3/yr
$\mathrm{COD_A}$	Chemical Oxygen Demand (COD) concentration of the effluent entering pond number 3 or total COD concentration at point A in **Figure 2**	t-COD /m^3
$\mathrm{B_{o.ww}}$	Methane generation potential of waste water	t-CH_4 /t-COD
$\mathrm{MCF_{AL,H}}$	Methane correction factor applicable to anaerobic lagoon	Unitless

Capture and flare efficiency of Project Installations $\mathrm{CFE_P}$

The project installations consists of a series of fully-sealed stainless steel tanks with combination of fixed and floating roof and pipe networks to deliver the biogas to HP Boiler, biomass power plants and flare unit.

Anaerobic digester tanks & pipe networks capture efficiency, $\mathrm{CE_{AD}}$

The rate of fugitive methane emissions is established during leakage test by blowing air into to the system and measure the ratio of total outgoing and incoming flow-rate at the end of maintenance shut-down. If any leak is detected, the maintenance procedure will seal all of the leak sources until the capture efficiency is 1.

By design, the capture efficiency is at its highest level at system start-up and decline to its lowest level at shut-down. Consequently, for accounting purpose, it is conservative to use the capture efficiency measured at the end of periodic shut-down as a CDM monitored parameter.

Efficiency of flare system, $\mathrm{E_{FLARE}}$

The flare type installed with the Project installations are of open flare type. However, its utilization is expected to be small as excess gas (if any) will be channelled to the biomass boilers in the same complex. The flare will be used only when both the refinery and biomass boilers are not in operation.

For open flare, paragraph 12 of AMS.III-H prescribed the use of efficiency of default value of 50%.

Capture and Flare Efficiency of the project installation $\mathrm{CFE_P}$

Based on the above information, the capture and flare efficiency of the project can be approximated based on the amount of biogas in the system:

$$\mathbf{CFE_P = CE_{AD} - \frac{V_{B,FLARED}}{V_B} \times E_{FLARE}}$$

Equation 7

Parameter	Description	Unit
$\mathrm{CE_{AD}}$	AD and pipe networks capture efficiency as measured during leak test at the end of every maintenance period.	Unitless

$\frac{V_{B,FLARED}}{V_B}$	Fraction of biogas flared calculated as the volume of gas flared divided by total volume of biogas generated by the anaerobic digester	m^3/m^3
E_{FLARE}	Flare efficiency (use default 50%)	Unitless

B.4 CH4 emission from final treated waste water disposed to river system, $PE_{CH4,W}$
The final effluent which will be released to environment has some methane dissolved in it and may be released at later stage. The associated emission from this final effluent is calculated as follow:

$$PE_{CH4,W} = V_A \times CH4_{D,F} \times GWP_{CH4}$$

Equation 8

Table 5

Parameter	Description	Unit
V_A	Total effluent flow rate at point A	m^3/yr
$CH4_{D,F}$	Dissolved methane concentration measured at point F (Figure 2) or use default value of 10^{-4} t-CH_4/m^3	t-CH_4 /m^3
GWP_{CH4}	Global warming potential of methane gas	t-CO_2/t-CH_4

C. LEAKAGE EMISSIONS

Leakage from equipment movement
Both methodology IC and III-H stipulates that leakage effect is to be considered if:
a. The Project technology is equipment transferred from another activity; or
b. The existing technology is transferred to another activity.

In the case of the Project, the Project equipments are new equipments and the anaerobic lagoon will not be used by other activity other than PAA's activity. The HP boiler is a new boiler that will be modified as part of the project activity and will remain in service in its original designation.

Leakage analysis from unused biomass
As stated in Section B.4, excess biogas will be combusted into the biomass boiler to minimize flaring. The use of biogas in the biomass boiler may lead to leakage due to unused biomass. The following paragraph demonstrates that the leakage from this source is negligible.

The biomass at PAA consumes three types of biomass: fibre, EFB, and shell. All three types of biomass are produced by the palm oil mill within PAA complex with complimentary shell is imported whenever required.

The merit order of biomass dispatch in PAA is as follow:
1. EFB will be used first due to the limited storage ability of the material and no economic value;
2. Fibre will be used next as it has no market value but longer storage ability than EFB;
3. Shell will be disposed last as this material has the highest calorific content, transportable, and has market value. Shell made up as the largest portion of biomass used in PAA boiler both in terms of quantity and energy, half is generated internally and the remains are purchased from surrounding mills.

Without the biogas, PAA boilers are estimated to consume about 2,881TJ/yr of shell and fibre. This magnitude of energy consumption is 28 times larger than the total methane generation potential of biogas from waste water which is 2,555t-CH4/yr or equivalent to 101.5TJ/yr of energy input. Consequently, excess biogas combusted in the biomass boiler reduces only a small fraction of the total heat requirement in the biomass boiler and leads to reduction of the last biomass in the merit order, which is off-site shell. Thus, effectively the use of native biogas leads to positive emission reduction due to elimination of biomass transportation. It is therefore conservative not to count this emission source in the emission reduction.

D. EMISSION REDUCTION

All parameters are reported in t-CO_2/yr

Total baseline emissions, BE_y

$$\mathbf{BE_y = BE_{CH4,AL} + BE_{CO2,DO}}$$

Equation **9**

Table 6

Parameter	Description
$BE_{CH\,4,AL}$	Avoided methane emission from the anaerobic lagoon due to project activity
$BE_{CO\,2,DO}$	Avoided CO_2 emission from combustion of diesel fuel oil displaced by biogas

Total project emissions, PE_y

$$PE_y = PE_{POWER} + PE_{CH\,4,AL} + PE_{CH\,4,FUG} + PE_{CH\,4,W}$$

Equation 10

Table 7

Parameter	Description
PE_{POWER}	CO_2 emission from the combustion of fossil fuel for power required to run the project activity
$PE_{CH\,4,AL}$	CH_4 emission from the waste water untreated by the Project returning to anaerobic lagoon
$PE_{CH\,4,FUG}$	Fugitive CH_4 emission from the inefficiency of the AD and flare system
$PE_{CH\,4,W}$	CH_4 emission from final treated waste water disposed to river system

Total emission reduction,ER_y

$$ER_y = BE_y - PE_y$$

Table 8

Parameter	Description
BE_y	Total baseline emissions in year y
PE_y	Total project emissions in year y

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

Data / Parameter:	$B_{o,ww}$
Data unit:	t-CH4 /t-COD
Description:	Methane generation potential of waste water
Source of data used:	Methodology default value
Value applied:	0.21 t-CH4/t-COD
Justification of the choice of data or description of measurement methods and procedures actually applied:	
Any comment:	

Data / Parameter:	$MCF_{AL,L}$ and $MCF_{AL,H}$
Data unit:	Unitless

Description:	Methane correction factor applicable to anaerobic lagoon
Source of data used:	Lower value (L) or High value (H) of Table III.H-1 for deep anaerobic lagoon
Value applied:	Lower value 0.8 High value 1.0
Justification of the choice of data or description of measurement methods and procedures actually applied:	The existing lagoons 1 and 2 have depth of 4m; lagoons 3 to 5 have depths of 6m.
Any comment:	

Data / Parameter:	GWP_{CH4}
Data unit:	$t\text{-}CO_2$ /$t\text{-}CH_4$
Description:	Global warming potential of methane
Source of data used:	IPCC Data
Value applied:	21 $t\text{-}CO_2$/$t\text{-}CH_4$
Justification of the choice of data or description of measurement methods and procedures actually applied:	
Any comment:	

Data / Parameter:	η_B
Data unit:	Unitless
Description:	Boiler efficiency
Source of data used:	Methodology default value
Value applied:	100%
Justification of the choice of data or description of measurement methods and procedures actually applied:	Conservative
Any comment:	

Data / Parameter:	NCV_{DO}
Data unit:	TJ/t
Description:	Net calorific value of diesel boiler
Source of data used:	Table 1.2 Default NCV, 2006 IPCC Report
Value applied:	0.043TJ/t
Justification of the choice of data or description of measurement methods and procedures actually applied:	
Any comment:	

Data / Parameter:	EF_{DO}
Data unit:	$t\text{-}CO_2$ /TJ
Description:	Emission factor of diesel oil
Source of data used:	Table 2.2 Emission Factor for Stationary Combustion for Energy Industry, 2006 IPCC Report
Value applied:	74.1$t\text{-}CO_2$/TJ
Justification of the choice of data or description of measurement methods and procedures actually applied:	
Any comment:	

Data / Parameter:	E_{FLARE}
Data unit:	Unitless
Description:	Flare efficiency

Source of data used:	Paragraph 12 of AMS.III-H
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied:	
Any comment:	

Data / Parameter:	$CH4_{D,F}$
Data unit:	t-CH4 /m^3
Description:	Dissolved methane at final effluent
Source of data used:	Methodology default value
Value applied:	10^{-4}
Justification of the choice of data or description of measurement methods and procedures actually applied:	
Any comment:	

Data / Parameter:	$EF_{D,G}$
Data unit:	t-CO_2 /MWh
Description:	Emission factor of the stand-by diesel generator unit
Source of data used:	Table I-D.1 AMS ID
Value applied:	0.8
Justification of the choice of data or description of measurement methods and procedures actually applied:	
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

A. **BASELINE EMISSIONS**

A.1 Avoided CH_4 emission from the anaerobic lagoon due to project activity, $BE_{CH4,AL}$
PAA generates on average 234,000m^3 per year of waste water with COD of 52,000mg/L from its milling activity. Without the Project, this effluent is treated in a series of anaerobic lagoon with depth of 4m or more. Table III-H.1 prescribes that the appropriate methane correction factor for a lagoon system with depth greater than 2 m is 0.8.

Using methane generation potential of 0.21 t-CH_4/t-COD and global warming potential of 21t-CO_2/t-CH_4, methane emission avoided as a result of project activity is approximated to be 42,928tCO_2/yr.

$$BE_{CH4,AL} = 234{,}000\,\frac{m3}{yr} \times 0.052\,\frac{t-COD}{m3} \times 0.21\,\frac{t-CH4}{t-COD} \times 0.8 \times 21\,\frac{t-CO2}{t-CH4} = 42{,}928\,\frac{t-CO2}{yr}$$

A.2 Avoided CO_2 emission from combustion of diesel fuel oil displaced by biogas, $BE_{CO2,DO}$
The HP Boiler is intended to supply 28,800t/yr of steam at 50 bar, 300℃ with heat content of 2,926MJ/t. Assuming that condensate are returned to boiler with enthalpy of 1,155MJ/t, the boiler output is approximated to be 51TJ/yr

$$HG_{HP} = \left[2{,}926\,\frac{MJ}{t} - 1{,}155\,\frac{MJ}{t}\right] \times 28{,}800\,\frac{t}{yr} \times \frac{TJ}{10^6 MJ} \sim 51\,\frac{TJ}{yr}$$

The biogas generated by the anaerobic digester will be used directly for combustion without purification. With consideration that (a) the presence of CO_2 limits the combustion process and (b) no better information is available, the energy recovery efficiency is assumed to be 50%. This is conservative for purpose of this calculation. With this efficiency the energy required to generate steam is expected to be 102 TJ per year.

The Project installation is expected to be able to supply about 1,744tCH_4/yr equivalent to 97.07TJ per year of energy based on methane heat of combustion of 55,648kJ/kg-CH_4. Thus the remaining 4.94TJ/yr must be supplied by operating the diesel boiler. This amount of energy is equivalent to 96.62t/yr of diesel oil, based on calorific value of 0.043TJ/t.

Based on the above assumptions, the emission reduction resulting from the avoidance of diesel oil is calculated to be 3,414t-CO_2 per year.

$$\mathrm{BE_{CO\,2,DO}} = \left[\frac{51\frac{\mathrm{TJ}}{\mathrm{yr}}}{100\%} - 96.62\frac{\mathrm{t}}{\mathrm{yr}} \times 0.043\frac{\mathrm{TJ}}{\mathrm{t}}\right] \times 74.10\frac{\mathrm{tCO_2}}{\mathrm{TJ}} \sim 3{,}414\frac{\mathrm{tCO_2}}{\mathrm{yr}}$$

B. **PROJECT EMISSIONS**

B.1 CO_2 emission from the combustion of fossil fuel for power used to run the project equipment, $\mathrm{PE_{POWER}}$

The Project requires 120kW or 864MWh per year to operate its pumps and instrumentations. This electricity will be primarily supplied by the biomass co-generation plants within PAA. In the event of this plant is shut-down, the electricity for the Project will be generated using the stand-by diesel generator.

This event is very rare considering that the primary energy provider consists of three individual cogeneration systems designed with high reliability to avoid down-time. In the case of failure in one of the cogeneration systems, the Project will be amongst the first activity to be shut-down due to its relative importance in the overall process operation. In such situation, limited electricity production from all diesel generators will be dedicated to critical processes and not to the project, while heat that is normally supplied by biogas will be switched to diesel fuel in HP boiler.

It is therefore projected that only less than 1% of electricity or 8.64MWh will be provided using diesel generators.

$$\mathrm{PE_{POWER}} = 8.64\mathrm{MWh} \times \frac{0.8\mathrm{tCO_2}}{\mathrm{yr}} \sim 7\mathrm{tCO_2/yr}$$

B.2 CH_4 emission from the organic matter untreated by the Project and returned to anaerobic lagoon, $\mathrm{PE_{CH\,4,AL}}$

Some organic matter remains in the effluent after treatment in the Project installation, and releases methane during decomposition in the subsequent anaerobic ponds.

The Project installation is expected to reduce the COD to concentration of 3000mg/L. With assumption that effluent flow-rate remains the same before and after treatment, ie 234,000m^3/yr and methane generation potential of 0.21t-CH_4/t-CO_2, the project emission from this source is approximated to be 3,095tCO_2/yr

$$\mathbf{PE_{CH4,AL}} = \mathbf{234,000\frac{m3}{yr} \times 0.003\frac{t-COD}{m3} \times 0.21\frac{t-CH4}{t-CPD} \times 1 \times 21\frac{t-CO2}{t-CH4} = 3,095\frac{t-CO2}{yr}}$$

B.3 Fugitive CH4 emission from the inefficiency of the AD and flare system, $\mathrm{PE_{CH\,4,FUG}}$

Methane emission potential from untreated waste water

Using similar assumptions as per Section B.6.2-A1, the methane emission potential of the untreated waste water is calculated to be 2,555t-CH_4/yr

$$\mathrm{MEP} = 234{,}000\,\frac{\mathrm{m3}}{\mathrm{yr}} \times 0.052\,\frac{\mathrm{t{-}COD}}{\mathrm{m3}} \times 0.21\,\frac{\mathrm{t{-}CH4}}{\mathrm{t{-}CPD}} \times 1 = 2{,}555\,\frac{\mathrm{t{-}CH4}}{\mathrm{yr}}$$

Capture and flare efficiency of project installation, $\mathrm{CFE_P}$

It is expected that leakage from project installations will be no more than 5% at any given period, and therefore the capture efficiency or $\mathrm{CE_{AD}}$ is 95%. Considering that most excess biogas would have been combusted in biomass boiler, the amount of biogas flared would be less than 0.1% of the total biogas generated by the AD system. Based on these assumptions, the capture and flare efficiency of the project is approximated to be above 0.9495.

$$\mathbf{CFE_P = 0.95 + 0.001 \times 0.5 = 0.9495}$$

Using the above calculated MEP and $\mathrm{CFE_P}$ the fugitive emissions are calculated to be 2,709t-CO2/yr.

$$\mathrm{PE_{CH4,FUG}} = (1 - 0.9495) \times 2{,}555\,\frac{\mathrm{t{-}CH4}}{\mathrm{yr}} \times 21\,\frac{\mathrm{t{-}CO2}}{\mathrm{t{-}CH4}} = 2{,}709\,\frac{\mathrm{t{-}CO2}}{\mathrm{yr}}$$

B.4 CH_4 emission from final treated waste water disposed to river system, $\mathrm{PE_{CH4,W}}$

It is expected that some methane is dissolved in the treated effluent that will eventually joins the river system. Emissions from this sourced is accounted as fugitive emission and estimated to be 491tCO_2/yr based on default methane

Based on ex-ante data from Table 5, the amount of methane dissolved in the remaining waste water is calculated as follow:

$$\mathrm{PE_{CH4,W}} = 234{,}000\,\frac{\mathrm{m3}}{\mathrm{yr}} \times 10^{-4}\,\frac{\mathrm{t{-}CH4}}{\mathrm{m3}} \times 21\,\frac{\mathrm{t{-}CO2}}{\mathrm{t{-}CH4}} = 491\,\frac{\mathrm{t{-}CO2}}{\mathrm{yr}}$$

C. **EMISSION REDUCTION**

Baseline Emission		
Parameter	Description	Ex-ante estimation
$\mathrm{BE_{CH4,AL}}$	Avoided methane emission from the anaerobic lagoon due to project activity	$42{,}928\,\frac{\mathrm{t{-}CO2}}{\mathrm{yr}}$
$\mathrm{BE_{CO2,DO}}$	Avoided CO2 emission from combustion of diesel fuel oil displaced by biogas	$3{,}414\,\frac{\mathrm{t{-}CO2}}{\mathrm{yr}}$
Total baseline emissions, $\mathrm{BE_y}$		$46{,}342\,\frac{\mathrm{t{-}CO2}}{\mathrm{yr}}$

Project Emissions		
Parameter	Description	Ex-ante estimation
$\mathrm{PE_{POWER}}$	CO2 emission from the combustion of fossil fuel for power used to run the project activity	$7\,\frac{\mathrm{t{-}CO2}}{\mathrm{yr}}$
$\mathrm{PE_{CH4,AL}}$	CH4 emission from the waste water untreated by the Project returning to anaerobic lagoon	$3{,}095\,\frac{\mathrm{t{-}CO2}}{\mathrm{yr}}$
$\mathrm{PE_{CH4,FUG}}$	Fugitive CH4 emission from the inefficiency of the AD and flare system	$2{,}709\,\frac{\mathrm{t{-}CO2}}{\mathrm{yr}}$
$\mathrm{PE_{CH4,W}}$	CH4 emission from final treated waste water disposed to river system	$491\,\frac{\mathrm{t{-}CO2}}{\mathrm{yr}}$
Total project emissions, $\mathrm{PE_y}$		$6{,}302\,\frac{\mathrm{t{-}CO2}}{\mathrm{yr}}$

Emission Reductions	
Parameter	Ex-ante estimation
Total baseline emissions, BE_y	$46{,}342\,\frac{t-CO2}{yr}$
Total project emissions, PE_y	$6{,}302\,\frac{t-CO2}{yr}$
Total emission reduction, ER_y	$40{,}040\,\frac{t-CO2}{yr}$

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

Table 9 – Summary of emissions and emission reduction from category III.H

Year	Estimation of project activity emissions (t-CO2/yr) (A)	Estimation of baseline emissions (t-CO2/yr) (B)	Estimation of leakage emissions (t-CO2/yr) (C)	Estimation of overall emission reduction (t-CO2/yr) (B)-(A)-(C)
1	6,302	42,928	0	36,626
2	6,302	42,928	0	36,626
3	6,302	42,928	0	36,626
4	6,302	42,928	0	36,626
5	6,302	42,928	0	36,626
6	6,302	42,928	0	36,626
7	6,302	42,928	0	36,626
Total (t-CO2/yr)	44,114	300,496	0	256,382

Table 10 – Summary of emissions and emission reduction from category I.C

Year	Estimation of project activity emissions (t-CO2/yr) (A)	Estimation of baseline emissions (t-CO2/yr) (B)	Estimation of leakage emissions (t-CO2/yr) (C)	Estimation of overall emission reduction (t-CO2/yr) (B)-(A)-(C)
1	0	3,414	0	3,414
2	0	3,414	0	3,414
3	0	3,414	0	3,414
4	0	3,414	0	3,414
5	0	3,414	0	3,414
6	0	3,414	0	3,414
7	0	3,414	0	3,414
Total (t-CO2/yr)	0	23,898	0	23,898

Table 11 – Summary of total emissions from all category

Year	Estimation of project activity emissions (t-CO2/yr) (A)	Estimation of baseline emissions (t-CO2/yr) (B)	Estimation of leakage emissions (t-CO2/yr) (C)	Estimation of overall emission reduction (t-CO2/yr) (B)-(A)-(C)
1	6,302	46,342	0	40,040
2	6,302	46,342	0	40,040
3	6,302	46,342	0	40,040
4	6,302	46,342	0	40,040
5	6,302	46,342	0	40,040
6	6,302	46,342	0	40,040
7	6,302	46,342	0	40,040
Total (t-CO2/yr)	44,114	324,394	0	280,280

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

B.7.1 Data and parameters monitored:

Data / Parameter:	V_A
Data unit:	m^3/yr
Description:	The volumetric flowrate of effluent entering the anaerobic digesters.
Source of data to be used:	Volumetric flowrate meter at the digester feed
Value of data	234,000m^3/yr
Description of measurement methods and procedures to be applied:	Data will be recorded using flow monitoring instrument and logged manually on daily basis
QA/QC procedures to be applied:	*Uncertainty level of data*: Error level of maximum 4% *QA/QC Procedure to be applied*: Volumetric flow rate instrument must be calibrated using standard laboratory equipment for at least every maintenance shut-down.
Any comment:	Maintenance shut-down is typically once per year

Data / Parameter:	V_B
Data unit:	m^3/yr
Description:	The volumetric flow rate of effluent leaving anaerobic digesters
Source of data to be used:	Volumetric flow rate meter at the digester outlet entering pond number 3.
Value of data	234,000m^3/yr
Description of measurement methods and procedures to be applied:	Data will be recorded using flow monitoring instrument and logged manually on daily basis
QA/QC procedures to be applied:	*Uncertainty level of data*: Error level of maximum 4% *QA/QC Procedure to be applied*: Volumetric flow rate instrument must be calibrated using standard laboratory equipment at least once a year.
Any comment:	Maintenance shut-down is typically once per year

Data / Parameter:	COD_A
Data unit:	t-COD/yr
Description:	COD concentration at point A of Figure 2
Source of data to be used:	Measurement from sampling port
Value of data	52,000mg/L or 0.052t-COD/m^3
Description of measurement methods and procedures to be applied:	Waste water is sampled on daily basis using portable COD testing device
QA/QC procedures to be applied:	*Uncertainty level of data:* Medium, sampling will be performed to 95% confidence level. *QA/QC Procedure to be applied* The portable COD testing device must be calibrated annually to standard (certified) laboratory equipment

Any comment:	

Data / Parameter:	COD_B
Data unit:	t-COD/yr
Description:	COD concentration at point B of Figure 2
Source of data to be used:	Measurement from sampling port
Value of data	3,000mg/L or 0.003t-COD/m3
Description of measurement methods and procedures to be applied:	Waste water is sampled on daily basis using portable COD testing device
QA/QC procedures to be applied:	*Uncertainty level of data:* Medium, sampling will be performed to 95% confidence level. *QA/QC Procedure to be applied* The portable COD testing device must be calibrated annually to standard (certified) laboratory equipment
Any comment:	

Data / Parameter:	$HG_{HP,y}$
Data unit:	TJ/yr
Description:	Heat output of HP Boiler
Source of data to be used:	Heat metering device at both the outlet (steam) and inlet (condensate return) of the boiler.
Value of data	51TJ/yr
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	*Uncertainty level of data:* Error level of maximum 4% *QA/QC Procedure to be applied* Heat metering device is to be calibrated to error level of 4% minimum once a year.
Any comment:	

Data / Parameter:	m_{DO}
Data unit:	t-diesel/yr
Description:	Amount of diesel oil co-fired in the HP boiler
Source of data to be used:	Flow-meter from diesel storage tanks dispatch to HP Boiler
Value of data	114.8t/yr
Description of measurement methods and procedures to be applied:	Based on flow-meter logged during dispatch from diesel storage tanks, adjusted to mass basis using specific gravity of diesel fuel from official sources (if necessary).
QA/QC procedures to be applied:	*Uncertainty level of data:* Error level of maximum 4%
Any comment:	

Data / Parameter:	EG_{DG}
Data unit:	MWh
Description:	Electricity used by the Project sourced from the stand-by diesel generator
Source of data to be used:	Electricity meter from the Project from diesel generator

Value of data	8.64
Description of measurement methods and procedures to be applied:	Data is logged on monthly basis
QA/QC procedures to be applied:	*Uncertainty level of data:* Error level of maximum 4% *QA/QC Procedure to be applied* Electricity meter is to be calibrated in accordance to manufacturer recommendation.
Any comment:	The Project emission associated with this source is expected to be very small, as primary supply is from the biomass co-generation plant.

Data / Parameter:	CE_{AD}
Data unit:	Unitless
Description:	Capture efficiency of the Project equipment
Source of data to be used:	Air test at manual shut-down before maintenance is performed
Value of data	0.95
Description of measurement methods and procedures to be applied:	At every maintenance shut-down air is blown into the project equipment, inlet and outlet flow is recorded. CE_{AD} is the ratio of outlet flow to inlet flow.
QA/QC procedures to be applied:	*Uncertainty level of data:* Low, this is conservative assumptions. *QA/QC Procedure to be applied* Air test must be carried out by qualified engineer using equipment that has been calibrated within at least 1 year.
Any comment:	

Data / Parameter:	$\frac{V_{B,FLARED}}{V_B}$
Data unit:	Unitless
Description:	Fraction of biogas flared to total biogas generated by AD system
Source of data to be used:	Flow-meter observation
Value of data	0.001
Description of measurement methods and procedures to be applied:	1. Daily log of biogas to boiler from flow-meter 2. Daily log of total biogas produced from flow meter; 3. Total biogas flared = (2)-(1) 4. $\frac{V_{B,FLARED}}{V_B}$=(3)/(2)
QA/QC procedures to be applied:	*Uncertainty level of data:* All flow-meter would have a maximum error level of 4%. *QA/QC Procedure to be applied* All biogas flow rate equipment must be calibrated at least annually.
Any comment:	

B.7.2 Description of the monitoring plan:

Management Structure of CDM in PAA

In order to meet the CDM monitoring and reporting requirements as outlined above, PAA will appoint the Plant Manager as the CDM Coordinator reporting directly to a member of the Board of Director at the PAA' parent company Permata Hijau Group. The CDM Coordinator will supervise the following activities:

- Data collection and instrument calibration by the PAA's technical department;
- Consolidation of results from various departments on a monthly basis; and
- Issuance of emission reduction and monitoring reports for the purpose of verification.

The CDM Coordinator will also be responsible to ensure that data has been collected as per the requirements of this PDD and contain no errors.

Monitoring equipment & Calibration Procedure
All monitoring equipment is installed by experts using standard methods. Once installed, this equipment will be calibrated to the highest standards and regularly maintained by the project operator. Any irregularities or problems with the equipment will be reported to the management and rectified as soon as possible. A thorough instrument calibration will be conducted at the start of the crediting period.

A calibration report status is maintained for CDM purpose. The report identifies all instrumentations mandatory for calibration, its historical maintenance and calibration report. Calibration is performed minimum annually timed during Plant maintenance shut-down or if any irregularities are identified. The calibration status report will be checked for validity and compliance during audits prior to the release of six-monthly Emission Reduction Delivery Report (ERDP).

PHG will train the power plant personnel to operate the equipment and to record all the data necessary for monitoring the Project activity as specified in the monitoring plan. This data will be directly used for calculation of project emissions. Fuel purchase records, measurement records and other records will be used to ensure consistency.

Archiving, Reporting, and Auditing Procedure
All data required to be logged on hourly basis will be recorded in the Operator Log Sheet system. At the end of the week, the operator log sheet will be transferred to a CDM Weekly Report covering all CDM-related instrumentation record. This weekly report covers periodic data of:
(a) Volumetric flow-rate of effluent in and out of the digesters;
(b) Electricity generated by the diesel generators used by Project installations;
(c) Sampling results of COD in waste water in and out of digesters;
(d) Heat output of HP Boiler
(e) Amount of diesel oil used in the HP Boiler
(f) Proportion of biogas flared

The monitoring of data which is less regular, such as the calculation of captured efficiency will be integrated into the maintenance protocol of PAA.

The hard copy of the weekly report will be stored locally at PAA' site and an electronic copy is sent to PHG's headquarter in Medan on weekly basis to prevent data loss. Both electronic and hard copy will be archived for at least 2 years after the end of the last crediting period.

On six-monthly basis, the Technical Department at PHG will issue an Emission Reduction Delivery Report (ERDP) covering a review of leakage issue and quality control, a consolidated CDM daily Report, delivered emission reduction, calibration status report and an audit report verifying the accuracy of the CDM Daily Report. The ERDP is signed and approved by PHG's Technical Director and will make part of the monitoring report for annual verification.

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

Date of completion: 16/08/2007

Name of responsible entity: Clean Energy Finance Committee
Mitsubishi UFJ Securities Co. Ltd.
Marunouchi Building, 26th Floor
2-4-1 Marunochi, Chiyoda-ku
100-6317 Tokyo, Japan
Email: hatano-junji@sc.mufj.jp

Mitsubishi UFJ Securities Co. Ltd is the CDM Consultant for this Project and is also a project participant.

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

15/10/2006

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

21 year and 00 month

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

C.2.1. Renewable crediting period

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

30/01/2008 or immediately after registration, whichever the later

C.2.1.2. Length of the first crediting period:

7 years 00 month

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

N/A

C.2.2.2. Length:

N/A

SECTION D. Environmental impacts

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

As the Project is located within Pelita Agung Agrindustri complex, its environmental documentations must follow the framework sets for PAA. Approval has been granted by the local environmental agency for the Project Proponent to carry out extensions of this facility.

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

No significant environmental impacts is expected from this activity.

SECTION E. Stakeholders' comments

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

The Project proponents host a stakeholder meeting on June 18th 2007 at PT Pelita Agung Agrindustri office in Simpang Bangko which is also the Project location. Invitations were distributed to local government via community leaders and residents surrounding the Project site.

The meeting was attended by 23 people excluding representatives from the Project developer. Opening statement was given by the General Affair Manager of PHG, Mr Asep Dadang, and presenting the meeting material was Mr. Dodik Suyanto, the technical director of PHG. The meeting mentioned briefly about the impact of global warming and explained in depth about possible outcome of the Project toward the surrounding area.

A section of question and answer were held at the end of the meeting to accommodate comments and questions raised during the presentation, which are elaborated in the following section E.2.

E.2. Summary of the comments received:

Mr. Amrizal, the vice village head inquires on the hazards of utilizing industrial waste water to extract gas. PAA explained that any undertakings will expose operator to risks. However after several assessments, PAA concluded that the risk from this activity is small if proper measures are taken. PAA has located the Project installations including biogas storage tank as far as possible from major installations and away from residential areas. In addition to this, PAA will install necessary precaution such as gas detectors and alarm which will automatically shut-down biogas production if leak is detected. Under normal circumstances, biogas will be burned in boilers and flare, converting the gas to harmless carbon neutral carbon dioxide.

Mr. Katik Wahidin, a member of community enquires about the involvement of the government and the private sector in mitigating global warming in Indonesia. To this enquiry, PHG responded that Indonesia's government through the Ministry of Environment and Non-Governmental Organization has stepped up efforts to promote global warming awareness. The government has ratified Kyoto Protocol and implement Designated National Authority to facilitate Clean Development Mechanism or CDM. Through this awareness programme, private entity like PHG was encouraged to initiate projects that contribute to mitigation of global warming.

Mr. Mariono, a community member from Duri village raised two questions: (a) the impact of global warming to farmers and (b) information of efforts taken by PAA to minimize the waste from its activity and therefore avoids peril to the residents in the vicinity of PAA complex.

PAA explained that global warming tipped the balance of the climate system and therefore disrupt harvesting activities by exposing farmers to longer drought, heavy precipitation in shorter period causing flooding. This disruption in climate can potentially disrupt planting and harvesting cycle to rice farmers, and reduces the maturing of fruits of palm trees and therefore causing severe damages to farmer income.

In addressing the 2nd question, PAA explained that the company has taken necessary measures in its facility to contribute to mitigation of climate change. PAA has taken efforts to minimize its waste through a zero-waste policy programme, where solid and liquid waste is recycled for energy generations. In addition to this biogas

Project, PAA is also implementing biomass initiatives to convert all generated waste into electricity and steam for its own operation. By taking these steps, PAA no longer produce any residues from its activity and eliminate the need to burn fossil fuel for its operation.

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

The Project and explanations from PAA were well accepted by the representative from local government and community members. Community members appreciated the efforts taken by PAA to provide communication of its activity. There is no due account from the comments and enquiry received during the stakeholder meeting.

Annex 1

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Annex 3

BASELINE INFORMATION

Annex 4

MONITORING INFORMATION

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