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

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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 5.5.0

Completion Date: 16/07/2008

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 (effluent) generated by its industrial activity ("Project"). PAA is an integrated palm oil processing facility consisting of palm oil mill, kernel crushing plant, and under-construction palm oil refinery and bio-diesel plant to be completed in 2008. 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

The major contributors of effluent at PAA are the palm oil mill and the empty fruit bunch treatment system. The palm oil mill utilizes large amount of steam to pressure cook the fresh fruit bunches prior to extraction, resulting in large amount of condensate. The empty fruit bunch treatment system presses the remaining water in EFB prior to combustion in biomass boilers. Due to direct contact with organic substances, the generated effluent from both processes contains high amount of organic material. Other processing facilities in PAA: the kernel crushing plant, refinery, and bio-diesel plant are expected to generate less significant amount of waste water with lower COD characteristics.

At the time of PDD writing, only the palm oil mill and kernel crushing plant in PAA complex have commenced operation with limited load. It was planned that all effluents from all facilities within the complex were to be collected and treated in a series of anaerobic lagoons. The lagoons was constructed in 2005 with holding capacity of 122,000m^3 consisting of 5 sequential ponds with depth between 4-6m. These lagoons was designed to process waste water to meet the regulatory standards for disposal into river system which mandates COD content to be below 350mg/L. PAA internal test and reports submitted to the environmental agency[1] suggests that the lagoons are able to reduce waste water quality below the required 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. The extracted biogas will be utilized primarily to generate high pressure steam for the refinery. Any excess biogas will be

[1] Riau Province Agency for Environmental Management (BAPEDAL)

combusted in PAA's primary power and heat generation system, or the flare system. Consequently, in addition to the installation of anaerobic digester reactors and flare, the scope of the Project is extended to modification of the refinery HT-500 Boiler from its original design and the cogeneration system main boiler.

No sludge treatment exists in both pre-Project and Project situations as the effluent contains minimum organic sludge digestible by microbes in both 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 decomposition of organic material is minimized.

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

- **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
Japan	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:

Sebangor Hamlet, Mandau District, Regency 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 geographical location is shown in Figure 1 below.

Figure 1 - PAA Geographical Location

PAA is located on KM No. 26 (*Simpang Bangko*) of the main road connecting the City of Duri and and City of Dumai (*Lintas Duri Dumai*), at 1°25’41.75’’N and 101°11’21.29”E.

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 Project Activities, Category H: Methane recovery in wastewater 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. This corresponds to measure (vi) in methodology III-H.

- **Type I: Renewable Energy Project, Category C: Thermal energy for the user with or without electricity**
  The Project generates heat from industrial waste water, and thus considered as renewable sources.

Project Technology
The project installation is a licensed waste water treatment technology by Keck Seng Bhd, and is 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 illustrated in **Figure 2** (p.8) .

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 digesters. In these ponds, pH and temperature are adjusted, and impurities are removed using screening method to prevent clogging. The treatments adjust the waste water conditions to meet the ideal environment suitable for anaerobic digestion. The digesters consists of four interconnected continuous stirred tanks and a sedimentation tank, equipped with sludge return system to maintain appropriate sludge level for effective digestion. The project installation 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 (HT-500) boiler located in the new refinery**. This boiler is a new fuel-oil boiler supplied as part of standard equipment to the under-construction refinery. This boiler was manufactured by GekaKonus GmbH with capacity to supply maximum of 2,325kW or 6,090kg of steam per hour at 95bar. In the refinery this boiler is needed to heat the bleached palm oil entering the deodorizer unit. Under normal operating condition, the boiler is expected to supply about 5,000kg of steam per hour at 60bar.

The supplied boiler has standard diesel-fired burner. As part of the Project, a new burner will be installed for HT-500 to allow combustion of biogas. The diesel-oil burner itself remains as secondary system to provide supplementary heat if the biogas production is down or insufficient.

It is likely, however, with price of residual fuel more economical than diesel fuel, there is possibility that the diesel burner will be displaced with residual fuel oil burner. The operation of the biogas burner hence directly displace the consumption of fuel-oil: either diesel oil or residual fuel oil.

The construction of the refinery is expected to be completed by end of November 2007 and commenced commercial production by January 2008.

(B) **Biomass power and heat generation systems**. The primary power and heat provision system in PAA consists of 3 biomass cogeneration plants providing medium and low pressure steam and all of electricity for the complex[2]. The system burns mostly biomass from the palm mill operations and generate waste water from the pressing of empty fruit bunches prior to combustion.

There is an immediate plan to combust excess biogas not consumed in system (A) in this system. The biogas pipeline to this site and its associated gas burner is expected to commence work only after commissioning of the entire complex and expected to have only a minor impact to PAA biomass consumption. Nevertheless, when implemented, this practise will reduce energy which otherwise unrecovered in flare unit.

As this system is exclusively biomass, the combustion of biogas directly displaces the consumption of biomass. The impact of this displacement is discussed under leakage analysis.

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

Project Technology & Safety The Anaerobic Digester (AD) system is not a new technology and proven in the waste water treatment industry. However, without incentives – this technology hardly penetrates developing country like Indonesia. The installation will be equipped with safety equipment for protection towards explosion and fire.

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 processed water requirement through recycling of the generated waste water.

[2] High pressure steam is only needed in the deodorizer unit and exclusively supplied by system (A)

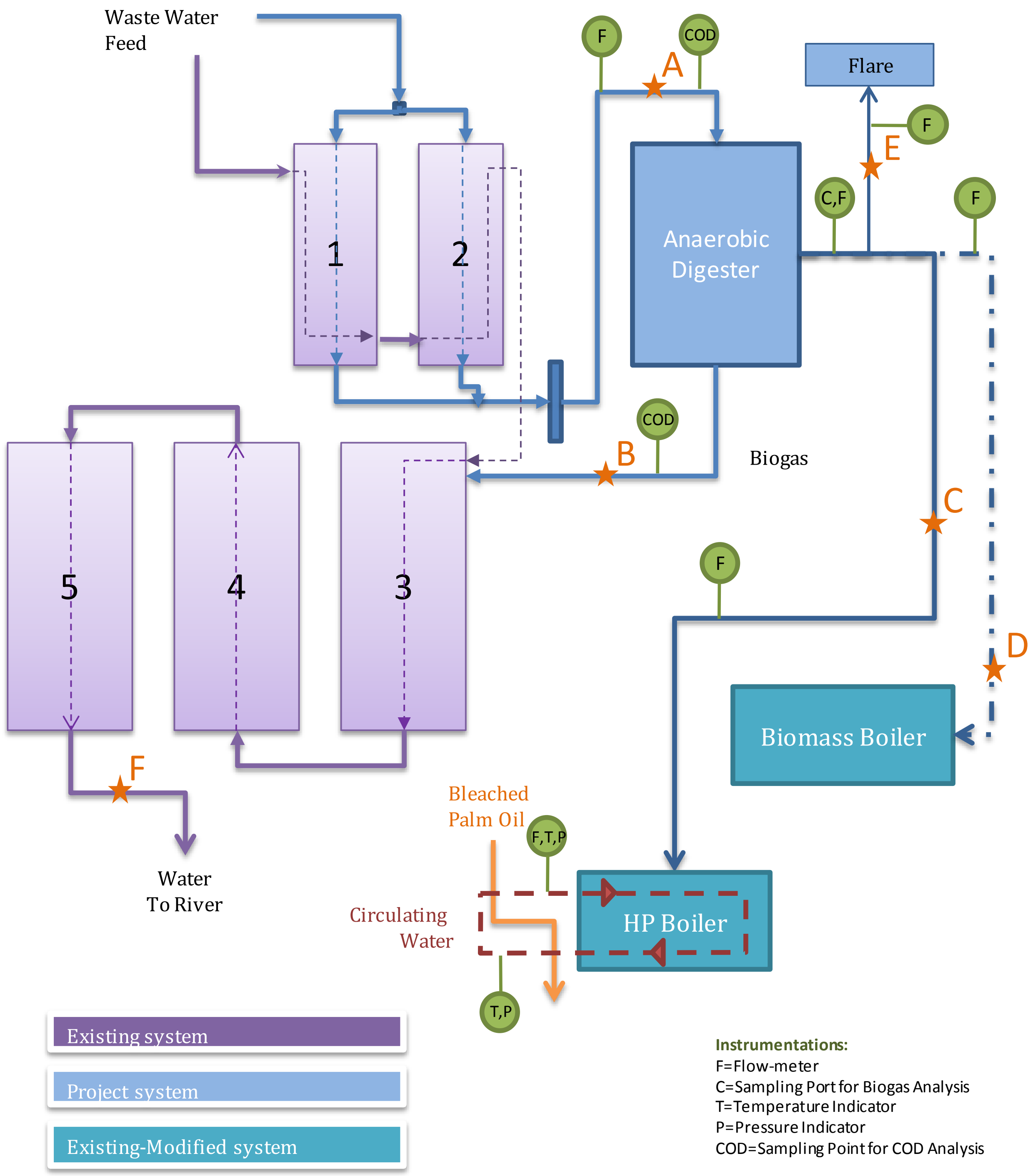

Figure 2 - Simplified Flow Diagram of Project & Existing Installations

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

Year	Estimation of annual emission reductions In tonnes of CO_2e per year
1	42,301
2	42,301
3	42,301
4	42,301
5	42,301
6	42,301
7	42,301
Total estimated emission reduction	296,107
Total number of crediting years	7
Annual average of the estimated reduction over the crediting period (t-CO_2e/yr)	42,301

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 its 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 wastewater treatment"
AMS-I.C Version 12 "Thermal energy for the user with or without electricity'

The emission from flare is calculated in accordance with the methodological "*Tool to determine project emissions from flaring gases containing methane*" as approved in EB28.

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

Type III: Other Project Activities, Category H: Methane recovery in wastewater treatment

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 with or without electricity

Large proportion of methane from waste water will be combusted to generate steam in the modified High Pressure boiler in the refinery (HT-500), 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/electrical generation activity. For heat generation activity, sub-type I.C is deemed suitable.

The boiler is expected to deliver 5tonnes per hour of superheated steam at 50-60bar, pre- and post Project implementation. With approximated enthalpy of 2,926MJ/t, this is equivalent to 4.06MW_{th}[3], much less than the 45MWth limit as stipulated in paragraph 4 of methodology I-C. The additional burner does not add steam generation capacity of the HT-500 Boiler.

With consideration of PAA existing biomass cogeneration plant, this additional biogas burner adds a new renewable energy unit to the existing renewable energy systems at PAA. This existing renewable energy facility, however, is physically distinct system from the HT-500 Boiler located in the refinery and uses completely different types of renewable fuel.

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 boilers where the biogas is combusted for heat generation and includes all equipments described in Figure 2.

[3] Without consideration of enthalpy from returning condensate

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.

For *ex-ante* purpose, the baseline emission is calculated using method prescribed in paragraph 7(d) which is based on waste water flowrate, COD loading of raw waste water and methane generation potential. For *ex-post* calculation, paragraph 10 stipulates that emission reduction is to be calculated based on monitored methane recovered and fuelled or flared minus project and leakage emission.

In this Project, the amount of methane fuelled and flared is equivalent to the amount of methane recovered in the Project installation. Thus, amount of methane recovered is calculated as the sum of all biogas delivered to various points in the project activity as shown in Figure 2 of this PDD.

$$V_{TR,y} = V_{C,y} + V_{D,y} + V_{E,y}$$

Equation 1

Parameter	Description	Unit
$V_{TR,y}$	Total volumetric amount of biogas recovered from the Project	Nm^3/yr
$V_{C,y}$	Volumetric amount of biogas used in the HT-500 boiler or point C of Figure 2.	Nm^3/yr
$V_{D,y}$	Volumetric amount of biogas used in the biomass boiler(s) or point D of Figure 2.	Nm^3/yr
$V_{E,y}$	Volumetric amount of biogas flared or point E of Figure 2.	Nm^3/yr

The parameter $V_{E,y}$ is relevant if the methane destroyed in the flare unit is to be accounted as a source of emission reduction, otherwise, this parameter is set to zero in both the baseline and project emissions calculations.

The volume of methane in the biogas is calculated by identifying the volumetric proportion of methane in biogas through periodic sampling. In order to report the methane recovered in mass unit, the volumetric amount are converted into mass unit using ideal gas equation.

Thus baseline emission from methane recovery is calculated as follow:

$$BE_{y,CH4} = X_{CH4,y} \cdot \frac{P_N * V_{TR,y}}{R * T_N} \cdot \frac{MW_{CH4}}{X_1} \cdot GWP_{CH4}$$

Equation 2

Parameter	Description	Unit
$X_{CH4,y}$	Proportion of methane in biogas in volume/volume basis	Nm^3 /Nm^3
P_N	Reference pressure at normal condition in Pascal	Pa
V_{TR}	Volumetric amount of biogas recovered	Nm^3/yr
R	Ideal gas constant, 8.314	m^3.Pa/mol.K
T_N	Reference temperature at normal condition in Kelvin	K
MW_{CH4}	Molecular weight of methane	gram/mol
X_1	Conversion factor 10^6 grams/tones	gram/ton

GWP_{CH4}	Global warming potential of methane	tCO_2/tCH_4

Emissions from sludge both in the baseline and project situation are excluded as there are no sludge treatment involved in both situations.

Heat recovery from biogas
The combustion of biogas directly displaces fuel oil as main energy source in the HT-500 Boiler which is designed to supply steam at 50bar to 60 bar (or 5,000 – 6,000kPa) 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 30bar (or 3,000kPa) and thus unable to service this requirement.

Paragraph 6 of methodology I-C prescribes that for *renewable energy technology displacing fossil fuel*, the simplified baseline is the fuel consumption of the technologies that would have been used in the absence of the project activity. Therefore, the suitable baseline is consumption of fuel oil in the HT-500 Boiler if operated without biogas, times an emission coefficient of the fossil fuel type displaced. Paragraph 10 further states that the baseline emission is to be calculated based on boiler thermal output, displaced fuel emission factor, and the original boiler efficiency.

Presently, HT-500 boiler is designed to consume diesel oil. As stated in earlier Section A.4.2, there is likelihood that the fuel-oil furnace be modified to consume residual fuel oil. In such case, the relevant fuel emission factor should be applied for the relevant heat output generated using a particular fuel oil.

$$BE_{y,CO2,FO} = \sum_{f} \frac{HG_{HP,y,f}}{\eta_{HP}} \times EF_{f,y}$$

Equation 3

Parameter	Description	Unit
$HG_{HP,y,f}$	Net quantity of heat supplied by HT-500 Boiler using fuel type *f* in year *y*	TJ/yr
η_{HP}	HT-500 Boiler efficiency if fired using fuel oil	Unitless
$EF_{f,y}$	Emission factor of fuel oil type f in year *y*	$t\text{-}CO_2$ /TJ

Paragraph 14 prescribes that efficiency of baseline boiler should adopt either one of the followings: (a) the highest measured efficiency of a unit with similar specifications, (b) the 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.

As elaborated in Section A.4.2, the modification of HT-500 Boiler with biogas burner and does not eliminate possibility of fuel oil combustion. Thus, fuel oil consumption in the HT-500 Boiler should be monitored and discounted from the baseline emissions as project emission in compliance with paragraph 20 of the methodology.

Baseline emission from combustion of biogas in biomass boiler
Combustion of the biogas in the retrofitted biomass boiler (System B described in Section A.4.2) will not lead to any emission reduction as it displaces biomass fuel. The primary purpose of this system is to reduce unrecovered biogas in the event of excess.

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 analysis in Section B.6.1-C.

Applicable baseline data are shown in Table 1.

Table 1 - Baseline Parameters

Related Methodology	Baseline Parameter	Description	Value and Unit
AMS.III-H	GWP_{CH4}	Global warming potential of methane	21 tCO_2/tCH_4
	MW_{CH4}	Molecular weight of methane	16g/mol
	P_N	Reference pressure at normal condition	10^5Pa
	T_N	Reference temperature at normal condition	273.15K
	R	Ideal gas constant	8.314m3.Pa.$mol^{-1}.K^{-1}$
	X_1	Conversion factor from gram/ton	10^6gram/ton
AMS.I-C	η_{HP}	HT-500 Boiler efficiency when fired using fuel oil	100%

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 mandatory requirement to capture methane from industrial waste water. Without incentives from CDM, these factors continue to create barrier for PAA and other industry players. This Project is PHG's first endeavour in biogas technology from all of its facility.

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 Budi Acid Jaya 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, a minimum benchmark of 18% must be achieved before the company proceed with this investment.

Assumptions taken for financial analysis

- The Project is estimated to cost around USD2.1million with revenue derived solely from fuel savings accrued from elimination of diesel oil. It is estimated that the biogas will displace about 46.75TJ of energy per year or equivalent to 1.23ML/yr of diesel oil[4] at a rate of IDR5,270 per year. The diesel oil rate used is based on the diesel oil price for industrial users as published by PERTAMINA for October 2006.

- 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 or 792,000kWh/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.

- In order to cover maintenance of biogas pipeline/pumps networks and the Project installation, a 10% of total asset value is budgeted for the maintenance and spare-parts, including insurance, leakage detection activity, and system calibration, worker costs, etc. A further 1% is budgeted for management and operatorship of the Project or totalled to USD230Kper 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 14.05%. This is lower than the minimum expected return, and therefore not a financially attractive investment.

This IRR calculation is conservative as it assumes elimination of diesel oil as revenue. In practice, all of diesel oil boilers in PHG's facility has been converted to consume cheaper residual fuel oil. Thus, the savings are considerably less.

Sensitivity Analysis
A series of sensitivity analysis is performed on some critical assumptions of the financial analysis. The results are summarized in Table 2 below.

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

Table 2 – Results of Sensitivity Analysis

No.	Sensitivity Scenario	From	To	Resulting IRR
1	Escalation rate for fixed costs and operational costs are reduced	3%	0%	15.27%
2	Diesel oil price is increased	IDR5,270	IDR5,534	15.73%
3	Capital outlay is reduced	USD2,091,175	USD1,916,910	17.19%
4	Tax rate is reduced	30%	25%	15.03%
5	Maintenance costs is reduced	10%	8%	16.01%
6	Costs of electricity is reduced	USD0.046	USD0.023	14.90%

In the sensitivity case number 3, the budgeted capital outlay is reduced to USD1.9million. This value represents total cost that has been committed by up to October 2007 (USD1.9 out of USD2.1million or 95%). Thus, it is not possible for the IRR to be further increased due to lower realization of capital spending.

In all cases, the results of sensitivity analysis shows that the resulting IRR is still within the benchmark of 18% within variation of critical assumption and thus it can be concluded that the financial model is robust.

Impact of CDM

It is clear from the above financial analysis that without CDM, waste-water project such as this - is not a financially attractive undertaking. The above financial analysis also demonstrate the significance of carbon-credit revenue to the Project's implementation. 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 14.05% to 26% well above the accepted minimum benchmark. It is clear from this analysis that CDM significantly improves the Project financial attractiveness.

Consideration of CDM prior to Project Implementation

With awareness of the importance of CDM revenue to the Project, PAA management decided to proceed with the Project while pursuing CDM registration. Such consideration is evident in the contract and proposal signed by PAA and its process licensor which explicitly states potential income from emission credits under Kyoto Protocol arrangement and has been provided to the validator during. Relevant excerpts of this document is published with this PDD[5].

[5] The contract between the process licensor and the project propont was prepared on 15th of October 2006, and was signed by the project proponent on November 15th 2006. Thus, November 15th 2006 is adopted as the start date of the Project.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

A. BASELINE EMISSIONS

A.1 Avoided methane emission from the anaerobic lagoon due to project activity, $BE_{y,CH4}$
As elaborated in Section B.4, the baseline emission for a project with baseline activity corresponds with scenario described in paragraph 6(vi) (of AMS-III.H) is the emission from existing anaerobic waste water treatment system which is captured/recovered by the project activity.

Upon project implementation, the baseline emission is calculated based on the monitored volume of biogas combusted in HT-500 Boiler (V_C), volume of biogas combusted in biomass boiler (V_D) , and volume of biogas flared (V_F). The total recovered biogas and its associated baseline emission is calculated using the following Equation 1and Equation 2.

$$V_{TR,y} = V_{C,y} + V_{D,y} + V_{E,y}$$

Equation 1

Parameter	Description	Unit
$V_{TR,y}$	Volumetric amount of biogas recovered from the Project	Nm^3/yr
$V_{C,y}$	Volumetric amount of biogas used in the HT-500 Boiler or point C of Figure 2.	Nm^3/yr
$V_{D,y}$	Volumetric amount of biogas used in the biomass boiler(s) or point D of Figure 2.	Nm^3/yr
$V_{E,y}$	Volumetric amount of biogas flared or point E of Figure 2.This parameter must be monitored if methane destruction in the flare unit is to be accounted as an emission reduction source.	Nm^3/yr

$$BE_{y,CH4} = X_{CH4,y} \cdot \frac{P_N * V_{TR,y}}{R * T_N} \cdot \frac{MW_{CH4}}{X_1} \cdot GWP_{CH4}$$

Equation 2

Parameter	Description	Unit
$X_{CH4,y}$	Proportion of methane in biogas in volumetric basis	Nm^3 /Nm^3
P_N	Reference pressure for normal condition	Pa
V_{TR}	Volumetric amount of biogas recovered	Nm^3/yr
R	Ideal gas constant, 8.314	m^3.Pa/mol.K
T_N	Reference temperature for normal condition	K
MW_{CH4}	Molecular weight of methane	gram/mol
X_1	Conversion factor 10^6grams/tones	gram/ton
GWP_{CH4}	Global warming potential of methane	tCO_2/tCH_4

A.2 Baseline CO_2 emission from thermal energy generation in HT-500 Boiler, $BE_{y,CO2,FO}$
In compliance with paragraph 6, and 10 of AMS-I.C and elaborated under Section B4, the baseline CO_2 emissions associated with the displacement of fuel oil with renewable biogas in the HT-500 Boiler is calculated as function of boiler output, efficiency of boiler and the emission factor of fossil fuel displaced:

$$BE_{y,CO2,FO} = \sum_{f} \frac{HG_{HP,y,f}}{\eta_{HP}} \times EF_{f,y}$$

Equation 3

Parameter	Description	Unit
$HG_{HP,y,f}$	Net quantity of steam supplied by HT-500 Boiler using fuel oil type *f* in year *y*	TJ/yr
η_{HP}	HT-500 Boiler efficiency if fired using fuel oil	unitless
$EF_{f,y}$	Emission factor of fuel oil type *f* used in year *y*	t-CO_2 /TJ

B. PROJECT EMISSIONS

As stated earlier in Section B.4, there are no sludge treatment in both pre-Project and Project situation. Thus, project emission involving sludge are excluded for further consideration.

Relevant project emission sources for this activity are summarized in Table 3.

Table 3 – Project activity emission sources

Ref.	Meth.	Parameter	Description
B.1	III-H	$PE_{y,power}$	CO_2 emission from the combustion of fossil fuel to generate power required to run the project activity
B.2	III-H	$PE_{y,ww,treated}$	CH_4 emission from organic matter untreated by the Project and decomposes in lagoons 3-5.
B.3	III-H	$PE_{y,fugitive}$	Fugitive CH_4 emission escaping from Project installations
B.4	III-H	$PE_{y,dissolved}$	CH_4 emission from waste water released to the river
B.5	I-C	$PE_{y,fueloil}$	Project emission from combustion of fuel oil in HT-500 Boiler

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

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 with capacity of larger than 200kW.

Paragraph 5(i) of AMS-I.D requires that the emission factor is to be determined in compliance with rules prescribed in AMS-ID which sets emission factor of 0.8t-CO_2/MWh for power generator greater than 200kW.

$$PE_{y,power} = EG_{y,DG} \times EF_{DG}$$

Equation 4

Parameter	Description	Unit
$EG_{y,DG}$	The amount of electricity used to run the Project generated using the stand-by diesel generator in year *y*. This excludes the amount of electricity from the biomass cogeneration system	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 decomposes in the anaerobic lagoons, $PE_{y,ww,treated}$

A small portion of organic matter remains in the waste water after treatment in the anaerobic digester and will be returned for further treatment in the anaerobic lagoons. It is conservatively assumed that the flow-rate of waste-water returned to anaerobic lagoon (point B of Figure 2) remains the same as that entering the anaerobic digester (point A of Figure 2).

$$Q_{y,ww} = Q_{y,ww,A} = Q_{y,ww,B}$$

Methane emission from the decomposition of the remaining organic matter in the lagoons is accounted as project emission and is calculated as follow:

$$PE_{y,ww,treated} = Q_{y,ww} \times COD_B \times B_{o,ww} \times MCF_{AL,H} \times GWP_{CH4}$$

Equation 5

Parameter	Description	Unit
$Q_{y,ww}$	Total volumetric flow-rate of effluent entering Anaerobic Digester or total waste water flow-rate at point A in **Figure 2**	m^3/yr
COD_B	Chemical Oxygen Demand (COD) concentration of the effluent entering pond number 3 after treatment in Anaerobic Digester. Note: This parameter is equivalent to $\mathbf{COD_{y,ww,treated}}$ in AMS III-H and adapted for specific location relevant to this Project (point B of Figure 2).	t-COD /m^3
$B_{o,ww}$	Methane generation potential of waste water	t-CH_4 /t-COD
$MCF_{AL,H}$	Upper limit of methane correction factor applicable to anaerobic lagoon (AL) with depth greater than 2m (Table III-H.1, AMS) Note: This parameter is equivalent to $MCF_{ww,final}$ in AMS III-H which is the methane correction factor based on the type of treatment or discharge pathway of waste water. In this Project, although the final disposal of pathway is the river system, the waste water must first past anaerobic lagoons 3-5. The lagoons, which are not the final pathway, is the more relevant system for project emission calculation. In order to avoid ambiguity, $MCF_{ww,final}$ is re-termed to $MCF_{AL,H}$, where '**AL**' refers to Anaerobic Lagoon and '**H**' refers to the higher value in Table III-H.1 of AMS III-H.	Unitless
GWP_{CH4}	Global warming potential of methane gas.	t-CO_2 /t-CH_4

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

The fugitive methane emissions from the Project's installations are calculated as a portion of total methane generation potential from untreated waste water (MEP). The proportion of escaping gas,

(CFE_P) is determined based on capture efficiency of the installations established from combination leakage test results and constants.

$$PE_{y,fugitive} = (1 - CFE_P) \times MEP_{y,ww,treatment} \times GWP_{CH4}$$

Equation 6

Parameter	Description	Unit
$MEP_{y,ww,treatment}$	Methane emission potential from untreated waste water calculated under Equation 7.	t-CH_4 /yr
CFE_P	Capture efficiency of the Project's installation as established in the following Equation 8, based on periodic leak measurement test and default flare efficiency. If no leakage equipment test is performed within a period of maintenance, default value of 0.9 must be used.	Unitless
GWP_{CH4}	Global warming potential of methane gas	t-CO_2/t-CH_4

Methane emission potential from untreated waste water

$$MEP = Q_{y,ww} \times COD_A \times B_{o.ww} \times MCF_{AL.H}$$

Equation 7

Parameter	Description	Unit
$Q_{y,ww}$	Total volumetric flow-rate of effluent entering Anaerobic Digester or total waste water 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
$MCF_{AL,H}$	Upper limit of methane correction factor applicable to anaerobic lagoon (AL) with depth greater than 2m (Table III-H.1, AMS) Note: This parameter is equivalent to $MCF_{ww,treatment}$ in AMS-III.H, which is the methane correction factor of *waste water treatment system that will be equipped with methane recovery and combustion* or the anaerobic lagoon.	Unitless

Capture and flare efficiency of Project Installations 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, equipped with pumping equipments to deliver the biogas to HT-500 Boiler, biomass power plants and flare unit.

The anaerobic digester system consists of fully-sealed stainless steel tanks with interconnecting steam pipeline. Prior to commissioning, these equipments undergo leakage test, and thus, leakage is expected to be very small. If leakage occurs in the digester system and its subsequent pipeline network, it will be reflected in the baseline calculation as it is

based on actual biogas consumption at end-users (Equation 1). Consequently, the only source of leakage is the biogas not combusted in the open flare.

Proportion of biogas loss in flare
This calculation is relevant only if methane destroyed in flare is considered as a source of emission reduction. Otherwise, proportion biogas loss in flare unit, $L_{flare,y}$ is excluded as project emission source, therefore set to zero.

The calculation of biogas leakage from flare unit follows the guideline provided by '*Tool to determine project emissions from flaring gases containing methane*' (or subsequently referred as 'Tool') using equation analogous to Equation 15 of Step 7 of the Tool. The equation calculates project emissions from biogas un-combusted in flare being proportional to 1(one) minus the flare efficiency, η_{FLARE}.

As not all biogas generated by the anaerobic digester are flared, the **proportion** of leakage of biogas from flare is calculated by adjusting the efficiency value with *the ratio of biogas flared relative to total biogas generated by the anaerobic digester*.

$$L_{flare,y} = \frac{V_{E,y}}{V_{TR,y}} \times (1 - \eta_{FLARE,y})$$

In order to determine suitable η_{FLARE}, Step 6 of the 'Tool' mandated continuous monitoring of the flare operation to determine the hourly efficiency value ($\eta_{FLARE,h}$). The Tool prescribed that if flame is not detected for more than 20minutes during hour *h*, then $\eta_{FLARE,h}$ is 0, otherwise $\eta_{FLARE,h}$ is 50%.

As there are only 2 types of hourly efficiency values (50% maximum value or 0% minimum value), the periodic efficiency, $\eta_{FLARE,y}$, can be estimated by adjusting the maximum efficiency with the fraction of time of which the condition for maximum value is met, ie. flare is detected for more than 20 minutes, $F_{T,y}$.

$$F_{T,y} = \frac{\text{no. of hours in year y, which flare is detected for more than 20 mins in an hour}}{\text{no. of hours per year}} = \frac{F_{T20,y}}{8{,}760}$$

$$\eta_{FLARE,y} = F_{T,y} * 50\%$$

Capture and Flare Efficiency of the project installation CFE_P
Based on the above information, the capture and flare efficiency of the project can be approximated as follow:

$$\mathbf{CFE_P = 1 - L_{flare,y}}$$

Equation 8

Parameter	Description	Unit
$L_{flare,y}$	% Biogas loss due to flaring inefficiency	%
$V_{E,y}$	Volume of biogas flared	Nm^3
$V_{TR,y}$	Total volume of biogas recovered as calculated in Equation 1 of this PDD	Nm^3
$\eta_{FLARE,y}$	Efficiency of flaring process	Unitless

$F_{T,y}$	The fraction of time of which the biogas is flared	%

If no measurement is performed to establish the leakage rate as defined above, capture efficiency rate of 90% must be used as prescribed in paragraph 5(iv) of AMS-III-H.

B.4 CH4 emission from final treated waste water disposed to river system, $PE_{y,disolved}$

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:

$$PE_{y,dissolved} = Q_{y,ww} \times [CH4]_{y,ww,F} \times GWP_{CH4}$$

Equation 9

Parameter	Description	Unit
$Q_{y,ww}$	Total volumetric flow-rate of effluent entering Anaerobic Digester or total waste water flow-rate at point A in **Figure 2**	m^3/yr
$[CH4]_{y,ww,F}$	Concentration of methane dissolved in waste water disposed to the river measured at point F (Figure 2). If no measurement results available default value of 10^{-4} t-CH_4/m^3 can be used.	t-CH_4 /m^3
GWP_{CH4}	Global warming potential of methane gas	t-CO_2/t-CH_4

B.5 Project emission from combustion of fuel oil in HT-500 Boiler, $PE_{y,FO}$

Paragraph 20 of AMS-IC requires emission from combustion of fuel-oil in HT-500 Boiler are calculated based on specific fuel consumption and the quantity of fossil fuel consumed. However, since the boiler has never been operated, no historical data is available to establish specific fuel consumption. Thus, to calculate project emission from combustion of fossil fuel, the project proponent chose to apply methodological tool: "*Tool to calculate project or leakage CO2 emissions from fossil fuel combustion*", Version 01.

The tool prescribes the use of fuel consumption and CO_2 emission coefficient to calculate project emission using the following relationship:

$$PE_{y,FO} = \sum_{f} FC_{f,y} \cdot COEF_{f,y}$$

Equation 10

Parameter	Description	Unit
$FC_{f,y}$	Fuel consumption of fossil fuel type *f* in year *y*.	t-CO_2/yr
$COEF_{f,y}$	CO_2 emission coefficient of fossil fuel type *f* in year *y*	t-CO_2/t-fuel

The "Tool" allows the application of two options to calculate CO_2 emission coefficient of fuel: Option A which is based on chemical content of fuel and Option B which is based on net calorific value and emission factors.

As fuel oil of any type is a complex mixture which is typically defined by assay rather than chemical composition. Thus, Option A is not applicable and only Option B can be used.

$$COEF_{i,y} = NCV_{f,y} \cdot EF_{f,y}$$

Equation 11

Parameter	Description	Unit
NCV_f	Net calorific value of fossil fuel type *f* used in year *y*	TJ/t-fuel
$EF_{f,y}$	Emission factor of fossil fuel type *f* used in year *y*	tCO2/TJ

C. LEAKAGE EMISSIONS

Leakage from equipment movement

The adopted 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 as it is located inside PAA. The HT-500 Boiler is a new boiler that will be modified as part of the project activity and will remain in service in its original designation for back-up purpose. Thus, from equipment movement point of view, there is no leakage source to be monitored.

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 boilers 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 (50%) and energy (64%). At maximum operation capacity, only half of the amount of shell used is generated internally by PAA and the remains are purchased from surrounding mills.

Without the biogas, PAA boilers are estimated to consume about 2,746TJ/yr of shell and fibre. This magnitude of energy consumption is much larger than the total methane generation potential from waste water which is 2,555t-CH_4/yr or maximum 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.

Effectively the use of native biogas leads to further emission reduction or negative leakage due to elimination of biomass transportation. It is therefore considered conservative not to count this emission source in the emission reduction.

D. EMISSION REDUCTION

All parameters are reported in t-CO_2/yr

Total emission reduction,ER_y

$$ER_y = BE_y - PE_y$$

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

Total baseline emissions, BE_y

$$\mathbf{BE_y = BE_{y,CH4} + BE_{y,CO2,FO}}$$

Equation 12

Parameter	Description
$BE_{y,CH4}$	Avoided methane emission from the anaerobic lagoon due to project activity
$BE_{y,CO2,FO}$	Avoided CO_2 emission from combustion of fuel oil that are displaced by biogas

Total project emissions, PE_y

$$PE_y = PE_{y,power} + PE_{y,ww,treated} + PE_{y,fugitive} + PE_{y,dissolved} + PE_{y,fueloil}$$

Equation 13

Parameter	Description
$PE_{y,power}$	CO_2 emission from the combustion of fossil fuel for power required to run the project activity
$PE_{y,ww,treated}$	CH_4 emission from the organic matter untreated by the Anaerobic digester and decomposes in the anaerobic lagoon
$PE_{y,fugitive}$	Fugitive CH_4 emission from the inefficiency of the AD and flare system
$PE_{y,dissolved}$	CH_4 emission from final treated waste water disposed to river system
$PE_{y,fueloil}$	CO_2 emission from combustion of fuel oil

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

Data / Parameter:	P_N and T_N
Data unit:	Pressure in Pascal (Pa) Temperature in Kelvin (K)
Description:	Reference pressure (P) and temperature (T) at normal (N) condition as adopted by the volume measurement device.
Source of data used:	IUPAC (present) definition or other internationally accepted definition.
Value applied:	IUPAC (present) definition: ▪ Normal Pressure 100kPa or 10^5Pa ▪ Normal Temperature 0℃ or 273.15°K IUPAC (past) definition: ▪ Normal Pressure 101.325kPa or 1.01325×10^5Pa ▪ Normal Temperature 0℃ or 273.15°K
Justification of the choice of data or description of measurement methods and procedures actually applied:	N/A
Any comment:	

Data / Parameter:	R
Data unit:	‘$m^3.Pa.mol^{-1}.K^{-1}$
Description:	Ideal gas constant in SI Unit
Source of data used:	Standard engineering book
Value applied:	8.314
Justification of the choice of data or description of measurement methods and procedures actually applied:	N/A
Any comment:	

Data / Parameter:	MW_{CH4}
Data unit:	gram/mol
Description:	Molecular weight of methane
Source of data used:	Standard chemistry book
Value applied:	16g/mol
Justification of the choice of data or description of measurement methods and procedures actually applied:	N/A
Any comment:	

Data / Parameter:	η_{HP}
Data unit:	Unitless
Description:	HT-500 Boiler efficiency if fired using fuel-oil
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:	EF_{DG}
Data unit:	t-CO_2 /MWh
Description:	Emission factor of the stand-by diesel generator unit, with capacity greater than 200kW
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:	N/A
Any comment:	

Data / Parameter:	$B_{o,ww}$
Data unit:	t-CH_4 /t-COD
Description:	Methane generation potential of waste water
Source of data used:	Methodology default value
Value applied:	0.21 t-CH_4/t-COD
Justification of the choice of data or description of measurement methods and procedures actually applied:	N/A
Any comment:	

Data / Parameter:	$MCF_{AL,H}$
Data unit:	Unitless
Description:	Higher value methane correction factor applicable to anaerobic lagoon with depth greater than 2m.
Source of data used:	Table III.H-1
Value applied:	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:	This parameter is equivalent to both $MCF_{ww,final}$ and $MCF_{ww,treatment}$ in AMS-III.H

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:	N/A
Any comment:	

Data / Parameter:	$[CH4]_{y,ww,F}$
Data unit:	t-CH4 /m^3
Description:	Dissolved methane of final effluent discharged to river
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:	N/A
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

A. **BASELINE EMISSIONS**

Generation assumptions taken for ex-ante calculation
As the palm oil mill generates the highest proportion of waste water in PAA, the operating hour of the project is defined by the operation hour of the palm oil mill. For purpose of *ex-ante* estimation, it is estimated to be 6,600hr/year which is based on 22hours per day for 300days per year.

A.1 Avoided CH_4 emission from the anaerobic lagoon due to project activity, $BE_{y,CH4}$
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 $t\text{-}CH_4$/t-COD and global warming potential of 21$t\text{-}CO_2/t\text{-}CH_4$, methane emission avoided as a result of project activity is approximated to be 42,928tCO_2/yr.

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

It is pertinent to note that that the actual baseline will be calculated based on the *ex-post* monitoring of biogas combusted and flared.

A.2 Baseline CO_2 emission from thermal energy generation, $BE_{y,CO2,FO}$

The HT-500 Boiler is intended to supply 26,400t/yr of steam at 50bar, 300℃ with approximate 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 46.75TJ/yr

$$HG_{HP,y} = \left[2{,}926\frac{MJ}{t} - 1{,}155\frac{MJ}{t}\right] \times 26{,}400\frac{t}{yr} \times \frac{TJ}{10^6 MJ} \sim 46.75\frac{TJ}{yr}$$

With baseline boiler efficiency of 1 and emission factor of diesel fuel adopted from the lower limit emission factor prescribed in Table 1.4 2006 IPCC guideline, the baseline CO_2 emission from displacement of fuel oil is calculated below:

$$BE_{y,CO2,FO} = \frac{46.75\frac{TJ}{yr}}{100\%} \times 72.60\frac{tCO_2}{TJ} \sim 3{,}394\frac{tCO_2}{yr}$$

B. PROJECT EMISSIONS

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

The Project requires 120kW or 792MWh 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 HT-500 Boiler.

It is therefore projected that only less than 1% of electricity or 7.92MWh will be provided using diesel generators.

$$PE_{y,power} = 7.92\text{MWh} \times \frac{0.8tCO_2}{yr} \sim 6.34tCO_2/yr$$

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

Some organic matter remains in the effluent after treatment in the anaerobic digester, and releases methane during decomposition in the subsequent anaerobic ponds. The anaerobic digester is designed to reduce the COD loading to concentration below 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

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

B.3 Fugitive CH4 emission from the inefficiency of the AD and flare system, $PE_{y,fugitive}$

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

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

Capture and flare efficiency, CFE_P
It is expected that only less than 1% of biogas is flared. Based on assumptions that the flare is not operated at most time, the appropriate efficiency is thus 0%. The leakage rate of biogas in the flare unit is estimated to be 0.001.

As there are no available data, it is assumed that flame is detected on the flare unit for more than 20 minutes in one hour for half of the total biogas plant operating hour or 3,300hours per year. Thus, the proportion of time of which the flare is in operation is 38% as calculated below.

$$F_{T,y} = \frac{F_{T20}}{8{,}760} = \frac{3{,}300}{8{,}760} = 38\%$$

The associated flare efficiency for F_{T20} is 50%, and thus the total annual flare efficiency is 19%.

$$\eta_{FLARE,y} = 50\% * 38\% = 19\%$$

The proportion of biogas escaped un-burnt from the flare unit is therefore 0.008

$L_{flare,y} = 0.01 * (1 - 19\%) = 0.008$ or 0.8%

The capture efficiency is thus estimated to be 0.992.

$\mathbf{CFE_P = 1 - (0.008) = 0.992}$ or 99.2%

Fugitive emission
Using the above calculated MEP and CFE_P the fugitive emissions are calculated to be 429t-CO_2/yr.

$$PE_{y,fugitive} = (1 - 0.992) \times 2{,}555\frac{t-CH4}{yr} \times 21\frac{t-CO2}{t-CH4} = 429\frac{t-CO2}{yr}$$

B.4 CH_4 emission from final treated waste water disposed to river system, $PE_{y,dissolved}$
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 concentration.

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

B.5 CO_2 emission from combustion of fuel oil in HT-500 Boiler, $PE_{y,fueloil}$
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%. Using this assumed efficiency, the energy required to generate steam is estimated to be 93.5 TJ per year.

The Project installation is expected to be able to supply about 1,744tCH_4/yr[6] equivalent to 97.07TJ per year of energy based on methane heat of combustion of 55,648kJ/kg-CH_4. Thus, if the boiler maintains high efficiency, 3.56TJ/yr is available for combustion in biomass boiler or flare unit and no fuel-oil is needed in the HT-500 Boiler.

$$PE_{y,fueloil} = 0$$

C. EMISSION REDUCTION

Baseline Emission		
Parameter	Description	*Ex-ante* estimation
$BE_{y,CH4}$	Avoided methane emission from the anaerobic lagoon due to project activity	$42,928 \frac{t-CO2}{yr}$
$BE_{y,CO2,FO}$	Baseline CO_2 emission from thermal energy generation in the HT-500 Boiler	$3,394 \frac{t-CO2}{yr}$
Total baseline emissions, BE_y		$46,322 \frac{t-CO2}{yr}$

Project Emissions		
Parameter	Description	*Ex-ante* estimation
$PE_{y,power}$	CO_2 emission from the combustion of fossil fuel for power generation needed to run the project activity	$6 \frac{t-CO2}{yr}$
$PE_{y,ww,treated}$	CH_4 emission from the organic content untreated by the AD and decomposes in the anaerobic lagoon	$3,095 \frac{t-CO2}{yr}$
$PE_{y,fugitive}$	Fugitive CH_4 emission from the inefficiency of the AD and flare system	$429 \frac{t-CO2}{yr}$
$PE_{y,dissolved}$	CH_4 emission from final treated waste water disposed to river system	$491 \frac{t-CO2}{yr}$
$PE_{y,FO}$	CO_2 emission from the use of fuel oil in HT-500 Boiler	$0 \frac{t-CO2}{yr}$
Total project emissions, PE_y		$4,021 \frac{t-CO2}{yr}$

Emission Reductions	
Parameter	*Ex-ante* estimation
Total baseline emissions, BE_y	$46,322 \frac{t-CO2}{yr}$
Total project emissions, PE_y	$4,021 \frac{t-CO2}{yr}$
Total emission reduction, ER_y	$42,301 \frac{t-CO2}{yr}$

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

Table 4 – Summary of emissions and emission reduction from category III.H

Year	Estimation of project activity emissions	Estimation of baseline emissions (t-CO2/yr)	Estimation of leakage emissions (t-CO2/yr)	Estimation of overall emission reduction

[6] Calculated as methane in the baseline minus sum of: methane decomposes in anaerobic lagoons subsequent to the Project, methane escaped from project installation, and methane dissolved in final waste water determined during project emission calculation.

	(t-CO2/yr) (A)	(B)	(C)	(t-CO2/yr) (B)-(A)-(C)
1	4,021	42,928	0	38,907
2	4,021	42,928	0	38,907
3	4,021	42,928	0	38,907
4	4,021	42,928	0	38,907
5	4,021	42,928	0	38,907
6	4,021	42,928	0	38,907
7	4,021	42,928	0	38,907
Total (t-CO2/yr)	28,147	300,496	0	272,349

Table 5 – 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	3,394	0	3,394
2	0	3,394	0	3,394
3	0	3,394	0	3,394
4	0	3,394	0	3,394
5	0	3,394	0	3,394
6	0	3,394	0	3,394
7	0	3,394	0	3,394
Total (t-CO2/yr)	0	23,758	0	23,758

Table 6 – 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	4,021	46,322	0	42,301
2	4,021	46,322	0	42,301
3	4,021	46,322	0	42,301
4	4,021	46,322	0	42,301
5	4,021	46,322	0	42,301
6	4,021	46,322	0	42,301
7	4,021	46,322	0	42,301
Total (t-CO2/yr)	28,147	324,254	0	296,107

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

B.7.1 Data and parameters monitored:

Data / Parameter:	$V_{C,y}$
Data unit:	Nm^3/yr
Description:	Volumetric flow-rate of biogas combusted in the HT-500 Boiler in year *y*
Source of data to be used:	Gas flow-meter at equipment inlet
Value of data	N/A
Description of measurement methods and procedures to be	Data will be recorded using flow monitoring instrument and logged manually on hourly basis

applied:	
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 will calibrated by a third party certified laboratory using internationally accepted calibration method *Frequency of calibration* At least every maintenance shut-down or minimum once per year
Any comment:	Paragraph 11 of AMS IIIH requires the monitoring of temperature and pressure of the biogas to calculate the density of methane combusted. This density is presumably required to convert the actual flowrate to its equivalent flowrate at normal condition (Normal flowrate). However, since the biogas flowrate is already reported in normal conditions, the monitoring of temperature and pressure are automatically monitored by the monitoring instrument. Furthermore, the calibration of this instrument also covers the calibration of the temperature and pressure sensors.

Data / Parameter:	$V_{D,y}$
Data unit:	Nm^3/yr
Description:	Volumetric flow-rate of biogas combusted in the biomass boilers in year *y*
Source of data to be used:	Gas flow-meter at equipment inlet
Value of data	N/A
Description of measurement methods and procedures to be applied:	Data will be recorded using flow monitoring instrument and logged manually on hourly 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 will calibrated by a third party certified laboratory using internationally accepted calibration method *Frequency of calibration* As per manufacturer recommendation or minimum once every two years
Any comment:	Paragraph 11 of AMS IIIH requires the monitoring of temperature and pressure of the biogas to calculate the density of methane combusted. This density is presumably required to convert the actual flowrate to its equivalent flowrate at normal condition (Normal flowrate). However, since the biogas flowrate is already reported in normal conditions, the monitoring of temperature and pressure

	are automatically monitored by the monitoring instrument. Furthermore, the calibration of this instrument also covers the calibration of the temperature and pressure sensors.

Data / Parameter:	$V_{E,y}$
Data unit:	Nm^3/yr
Description:	Volumetric flow-rate of biogas flared in year *y*
Source of data to be used:	Gas flow-meter at equipment inlet
Value of data	N/A
Description of measurement methods and procedures to be applied:	Data will be recorded using flow monitoring instrument and logged manually on hourly 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 will calibrated by a third party certified laboratory using internationally accepted calibration method *Frequency of calibration* As per manufacturer recommendation or minimum once every two years
Any comment:	This parameter is to be included in baseline emission calculation if methane destroyed in the flare unit is to be included as a source of project emission. Paragraph 11 of AMS IIIH requires the monitoring of temperature and pressure of the biogas to calculate the density of methane combusted. This density is presumably required to convert the actual flowrate to its equivalent flowrate at normal condition (Normal flowrate). However, since the biogas flowrate is already reported in normal conditions, the monitoring of temperature and pressure are automatically monitored by the monitoring instrument. Furthermore, the calibration of this instrument also covers the calibration of the temperature and pressure sensors.

Data / Parameter:	X_{CH4}
Data unit:	Nm^3/Nm^3 or mol/mol
Description:	Concentration of methane in biogas on volume/volume basis
Source of data to be used:	Gas analysis device
Value of data	N/A
Description of measurement methods and procedures to be applied:	Either one of the followings: (a) Continuous gas analysis; or (b) Daily gas sampling performed to meet 95% confidence level
QA/QC procedures to be applied:	*Uncertainty level of data*: Error level of maximum 5% *QA/QC Procedure to be applied*:

	Gas analysis equipment will be calibrated by a third party certified laboratory using internationally accepted calibration method. *Frequency of calibration* As per manufacturer recommendation or minimum once a year
Any comment:	

Data / Parameter:	$HG_{y,HP,f}$
Data unit:	TJ/yr
Description:	Heat output of HT-500 Boiler in year *y* generated using fossil fuel type *f*
Source of data to be used:	Combination of the following meters: (a) Temperature indicators of feed-water and steam outlet. (b) Pressure measurements of feed-water and steam outlet (c) Flow measurement device of inlet water (d) Hourly observation of fuel typed used.
Value of data	Estimated at 46.8TJ/yr
Description of measurement methods and procedures to be applied:	Data from all monitoring devices are to be logged on hourly basis to calculate average daily temperature and average daily pressure and establish specific enthalpy of feed-water ($\dot{H_W}$) and steam output ($\dot{H_S}$). Using the cumulative daily feed-water flowrate ($F_{d,W}$), the daily heat output are calculated using the following relationship: $HG_{d,HP} = F_{d,W} * (\dot{H_S} - \dot{H_W})$
QA/QC procedures to be applied:	*Uncertainty level of data*: Error level of maximum 4% from individual measurement device. *QA/QC Procedure to be applied*: All monitoring devices are to be calibrated by a third party certified laboratory using internationally accepted method. *Frequency of calibration* As per manufacturer recommendation or minimum once a year
Any comment:	N/A

Data / Parameter:	$FC_{f,y}$
Data unit:	t-fuel/yr
Description:	Quantity of fuel type *f* used for thermal generation in HT-500 Boiler in year *y*
Source of data to be used:	Metering device. If volume meter is used, value must converted into mass unit using the density of the fuel as reported/published by fuel supplier.
Value of data	0
Description of measurement	Data will be logged hourly to calculate daily consumption

methods and procedures to be applied:	
QA/QC procedures to be applied:	*Uncertainly level of data* Error level of maximum 4% *QA/QC Procedure to be applied:* 1. Metering device (mass/volume) are to be calibrated by a third party certified laboratory using internationally accepted method. 2. Consolidated monthly results should be cross checked against the fuel dispatch records in PAA's fuel inventory system. *Frequency of calibration* As per manufacturer specification or minimum once every two years.
Any comment:	N/A

Data / Parameter:	$NCV_{f,y}$
Data unit:	TJ/t-fuel
Description:	Net calorific value of fuel type *f* used in year *y*
Source of data to be used:	IPCC default values at the upper limit of the uncertainty at 95% confidence interval as provided in Table 1.2 of Chapter 1, Vol.2, 2006 IPCC Guidelines on National GHG Inventories
Value of data	0.0433 TJ/t for diesel oil ("*minyak diesel*") 0.0417 TJ/t for residual fuel oil ("*minyak bakar*")
Description of measurement methods and procedures to be applied:	Future revision of IPCC guideline should be taken into consideration
QA/QC procedures to be applied:	N/A
Any comment:	N/A

Data / Parameter:	$EF_{f,y}$		
Data unit:	tCO_2/TJ		
Description:	CO_2 emission factor of fossil fuel type *f* used in year *y*		
Source of data to be used:	IPCC default at 95% confidence interval, Table 1.4 of Chapter 1 of Vol. 2 of 2006 IPCC Guidelines on National GHG Inventories. ▪ For baseline calculation used Lower Limit ▪ For project calculation ($COEF$) used Upper Limit		
Value of data	Fuel type	Lower Limit	Upper Limit
	Diesel oil	72,600	74,800
	Residual fuel oil	75,500	78,800
Description of measurement methods and procedures to be applied:	Future revision of IPCC guideline should be taken into consideration		
QA/QC procedures to be applied:	N/A		
Any comment:	N/A		

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

Description:	Amount of electricity used by the Project sourced from the stand-by diesel generator(s)
Source of data to be used:	Electricity meter consumed by the Project from diesel generator
Value of data	7.92
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 by a third party certified laboratory using internationally accepted method. *Calibration Frequency* In accordance with recommendation from manufacturer or recommended calibration date in the calibration certificate.
Any comment:	At present, the Project installation only withdraws electricity from the biomass cogenerations with no electricity back-up available to the Project. Thus, this parameter is relevant only when the Project has been connected to electricity back-up system. This status must be updated and verified annually.

Data / Parameter:	$Q_{y,ww}$
Data unit:	m^3/yr
Description:	Volumetric flow-rate of effluent entering anaerobic digester
Source of data to be used:	Flowrate meter of waste water pumped into the feeding tank
Value of data	$195{,}000m^3/yr$
Description of measurement methods and procedures to be applied:	Data will be logged hourly to calculate daily flow-rate
QA/QC procedures to be applied:	*Uncertainty level of data* Error level of maximum 4% *QA/QC Procedure to be applied:* Flowmeter is to be calibrated by a third party certified laboratory using internationally accepted method. *Calibration Frequency* As per manufacturer recommendation or minimum once per year
Any comment:	N/A

Data / Parameter:	COD_B
Data unit:	t-COD/yr
Description:	COD concentration of the effluent after treatment in anaerobic digester and entering pond number 3
Source of data to be used:	Analysis using COD meter from daily effluent sampling
Value of data	3,000mg/L or $0.003t\text{-}COD/m^3$

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* COD testing device will be calibrated by a third party certified laboratory using internationally accepted method. *Frequency of calibration* As per manufacturer recommendation or minimum once per year.
Any comment:	3,000mg/L is the design parameter of the upper limit of the COD exiting digester.

Data / Parameter:	COD_A
Data unit:	t-COD/yr
Description:	COD concentration of the effluent before treatment in anaerobic digester
Source of data to be used:	Analysis using COD meter from daily effluent sampling
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* COD testing device will be calibrated by a third party certified laboratory using internationally accepted method. *Frequency of calibration* As per manufacturer recommendation or minimum once per year.
Any comment:	52,000mg/L is based on the design parameter. In practise the COD load fluctuates between 40,000mg/L to 60,000mg/L based on the level of industrial activity at PAA.

Data / Parameter:	$F_{T20,y}$
Data unit:	-
Description:	The number of hours in year y, of which the flame is detected for more than 20 minutes in an hour *h*.
Source of data to be used:	Flame detection system
Value of data	3,300 hours
Description of measurement methods and procedures to be applied:	Continuous observation via flame detection system
QA/QC procedures to be applied:	*Uncertainty level of data:* Low *QA/QC Procedure to be applied*

	Flame detection instrument is checked and tested at least once per year
Any comment:	This parameter is only relevant if methane destruction in the flare unit is considered as an emission reduction source.

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) Methane captured based on monitoring of volumetric flow-rate of biogas combusted and flared, and percentage of methane at the digester outlet;
(b) Thermal output of HT-500 Boiler based on monitored temperature, pressure and flow-rate of steam and condensate;
(c) Fuel consumption in the HT-500 Boiler;
(d) Electrical consumption of project installation sourced from diesel generator;
(e) COD processed in anaerobic lagoons (3-5) based on monitored volumetric flow-rate of effluent and outlet COD from digester;
(f) COD processed in anaerobic digester based on monitored volumetric flow-rate of effluent and inlet COD to the digester;

The update of data which is less regular, e.g. the calculation of captured efficiency, properties of fuels, etc., will be integrated into the implementation 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 CDM implementation containing: a consolidated delivered emission reduction, calibration status report and an audit report verifying that implementation has been implemented in accordance with standard pre-set in the protocol. 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: 16/07/2008

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:

15/11/2006, as the date of signing of agreement with Novaviro

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:

25/08/2008 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. In accordance with regulation issued by Environmental Ministry No. 11/2006, PAA does not need to submit Environmental Impact Statement, but mandated to provide "Efforts for Environmental Management and Monitoring".

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:

The project activity has two direct environmental impacts: impact to waste-water disposed to the river and impact to air quality due to replacement of fuel oil with biogas.

Impact to waste water The Project is expected to improve the water disposal quality from existing level. This is because the COD entry into the lagoons are lower than that prior to the Project. Nevertheless, PAA still needs to meet the regulatory quality and reporting requirements.

The Project (and the existing anaerobic lagoon) disposes water into the river system, and thus under applicable regulation is mandated to report the quality of water disposal on periodically to local regulatory body. The analysis intends to control the quality of water disposed into the river system below a set benchmark set by government regulation No. 51/10/1995 Attachment IVB (palm industry) covering a number of parameters including solid suspension (max. 250mg/L), pH (6-9), ammonia concentration (max.50mg/L), BOD (max.100mg/L), COD (max.350mg/L) and grease and oil content (max. 25mg/L).

Impact to Air Quality The combustion of biogas in boilers and flare are also not expected to lead to any worse environmental impact than the business-as-usual practise. Nevertheless, PAA operation (including the Project) must meet the government set regulation that mandates the control of ambient air quality and emission from stack gas.

No other significant environmental impacts is expected from this project 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

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organisation:	PT Pelita Agung Agrindustri
Street/P.O.Box:	Jl. Iskandar Muda No. 107
Building:	PHG Building
City:	Medan
State/Region:	North Sumatra
Postal code:	20154
Country:	Indonesia
Phone:	+62 61 457 7777
Fax:	+62 61 456 9755
E-mail:	jhonny@permatagroup.com
URL:	N/A
Represented by:	N/A
Title:	Managing Director
Salutation:	N/A
Last name:	Virgo
Middle name:	N/A
First name:	Jhonny
Department:	N/A
Phone (direct):	N/A
Fax (direct):	N/A
Mobile:	N/A
Personal e-mail:	jhonny@permatagroup.com

Organization:	Mitsubishi UFJ Securities Co., Ltd.
Street/P.O.Box:	2-5-2 Marunouchi, Chiyoda-ku
Building:	2F, Mitsubishi Building
City:	Tokyo
State/Region:	N/A
Postfix/ZIP:	100-0005
Country:	Japan
Telephone:	N/A
FAX:	N/A
E-Mail:	N/A
URL:	www.sc.mufg.jp
Represented by:	N/A
Title:	Chairman, Clean Energy Finance Committee
Salutation:	Mr.
Last Name:	Hatano
Middle Name:	N/A
First Name:	Junji
Department:	Clean Energy Finance Committee
Mobile:	N/A
Direct FAX:	+81 3 6213 6331
Direct tel:	+81 3 6213 6175
Personal E-Mail:	hatano-junji@sc.mufg.jp

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Please refer to Section A.4.4

Annex 3

BASELINE INFORMATION

Please refer to Section B.4

Annex 4

MONITORING INFORMATION

Please refer to Section B.7

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