Project design document form for small-scale CDM project activities

(Version 05.0)

PROJECT DESIGN DOCUMENT (PDD)	
Title of the project activity	Biogas recovery from wastewater treatment in PT. Umbul Mas Wisesa Palm Oil Mill
Version number of the PDD	Version 08
Completion date of the PDD	27/03/2015
Project participant(s)	PT Umbul Mas Wisesa
Host Party	Indonesia
Sectoral scope and selected methodology(ies), and where applicable, selected standardized baseline(s)	Sectoral scope 13 Baseline and monitoring methodology applied: AMS-III.H “Methane recovery in wastewater treatment” (version 16)
Estimated amount of annual average GHG emission reductions	57,640 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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The proposed small-scale project activity is the implementation of a sequential stage of anaerobic wastewater treatment system with biogas recovery in a palm oil mill. Both, the palm oil mill as well as the wastewater treatment system with biogas recovery is Greenfield projects. The palm oil mill will be set up by PT. Umbul Mas Wisesa ("UMW") at South Labuhan Batu, North Sumatra, Indonesia. The mill will be fully operational by the end of 2014 for producing crude palm oil ("CPO") while discharging the raw palm oil mill effluent ("POME"). The designed production capacity of the mill will be 65 tonnes/hr of fresh fruit bunch ("FFB"). The discharged POME will be rich in organic content with Chemical Oxygen Demand (COD) value approximately 65,000 mg/l. The average daily discharge of POME from the palm oil mill is expected to be 780m^3/day.

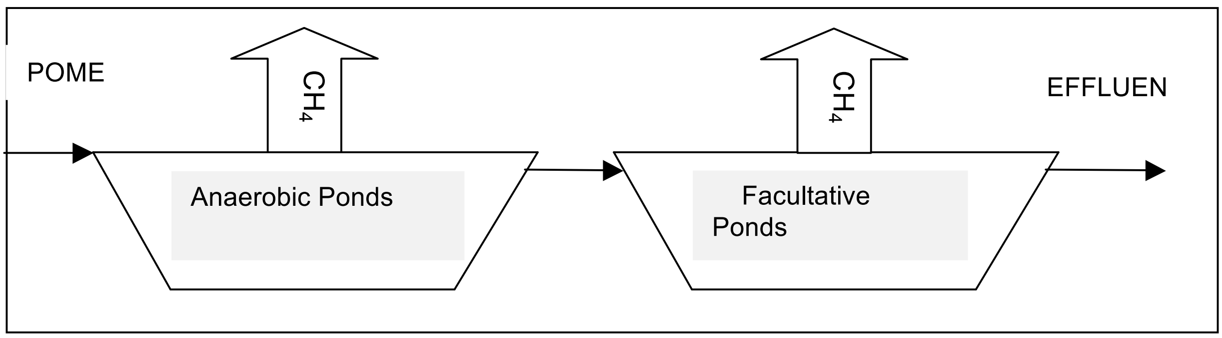
Purpose of the proposed project activity

Degradation of organic content in the POME results in the generation of biogas (i.e. methane) which will be emitted into the atmosphere if not recovered. The purpose of the proposed project activity is to treat the discharged POME in an anaerobic digester and to recover the biogas which would have otherwise been emitted to the atmosphere. The recovered biogas will be combusted together with biomass in a boiler in the palm oil mill and in emergency situation excess biogas will be flared. The end use of biogas will lead to saving of biomass, which would have been used in boiler by the project activity, resulting the saved biomass available to be used by other project activity for steam/power generation displacing fossil fuel, however, the emission reduction due to end use of biogas will not be considered under the proposed project activity.

The estimated annual average and the total CO_2e emission reduction by the project activity over the fix crediting period of 10 years are expected to be 57,640 tCO_2e and **576,400**tCO_2e respectively.

As established in section B.4 of the PDD, treatment of discharged POME in open anaerobic lagoons without biogas recovery is the most plausible baseline scenario for the proposed project activity. Therefore in the absence of the project, the methane gas from anaerobic open lagoons would have been emitted into the atmosphere resulting in GHG emissions.

The baseline and project situation is compared as below-



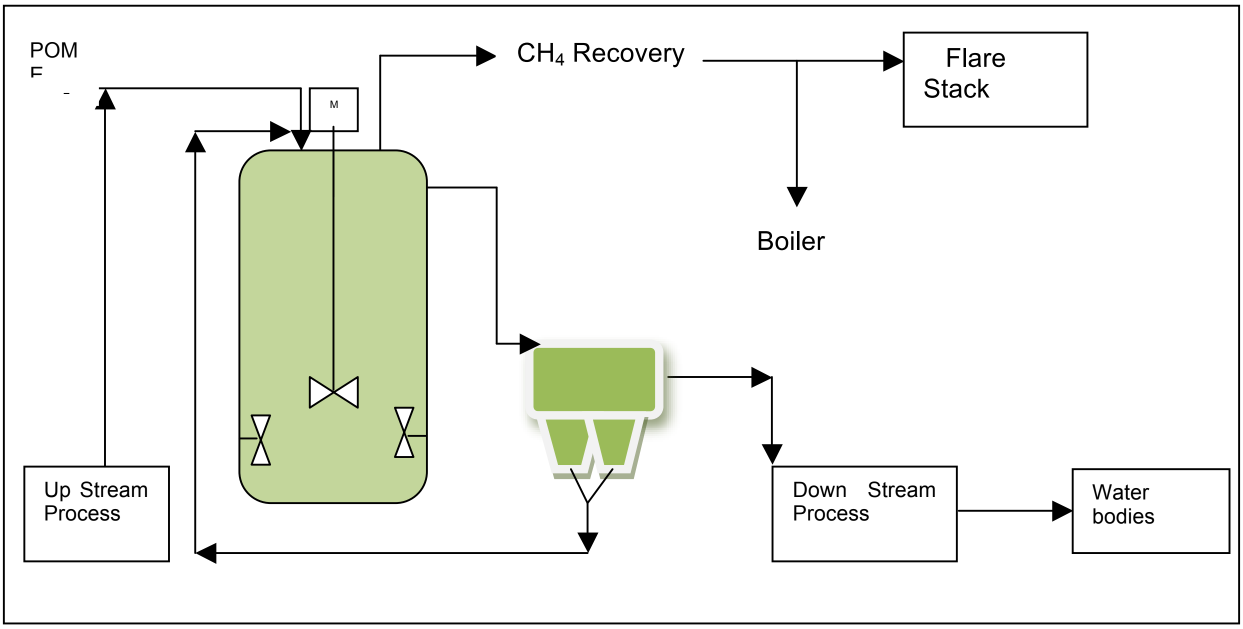


Figure 1: Comparison of baseline and project situation

Contribution to sustainable development

Environmental Sustainability:

1. The project activity provides a higher efficiency alternative for the treatment of wastewater for the Agro-industry.

2. Higher performance wastewater treatment systems enable better compliance with the final discharge limit that reduces the risk of water contamination.

3. Capture of biogas from wastewater systems reduces odor and possible health hazards which would have been generated using the open lagoon treatment system, thus minimizing pollution to the environment.

4. The reduction of GHG emissions from methane destruction will improve the quality of the air resulting in the preservation of the environment.

5. The project promotes and supports Indonesia's renewable energy programme with biogas utilization.

Economic Sustainability:

1. Provides job opportunities especially for the community near the processing facilities.

2. In addition to providing job opportunities, the project will also catalyze development of the nearby area, especially with processing facilities, which are normally located in rural areas.

3. The project activity will improve the local economy by increasing business opportunities for local suppliers in transportation, maintenance and repair, supply of equipment and parts, food and other services.

4. Training will be provided to the local staff to execute and manage the projects in Indonesia, thus increasing the country's qualified manpower and knowledge.

5. The project will lead to an increase of the Gross Domestic Product (GDP) and will have a positive impact on the Indonesian annual GDP growth rate.

Social Sustainability:

1. Improve the agro-industry companies' way of doing business in a sustainable manner.

2. Provide knowledge and awareness to the residents, especially in the local community, with respect to environment, climate change and renewable energy.

3. Improve the quality of life and environmental condition of the local community leading to a healthier population.

4. The increased job opportunity will reduce social disparity in the community thereby contributing to peace in the society.

Technology Transfer:

1. The technology used in the project activity is a well-proven technology for POME treatment, where key features are based on worldwide experience and advancement in the technology and principles.

2. Workers will be trained by the technology supplier of this advanced technology, as well as the know-how of the process. The results of this capacity building will contribute towards the development of biogas as a significant renewable energy source in Indonesia.

The Project will assist Indonesia and the agro-industry and local community in achieving sustainable development.

A.2. Location of project activity

A.2.1. Host Party

>>
Republic of Indonesia

A.2.2. Region/State/Province etc.

>>
North Sumatra Province, Sumatra Island

A.2.3. City/Town/Community etc.

>>
Kampung Rakyat sub-district

A.2.4. Physical/Geographical location

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The Project Activity site bears the official address of South Labuhan Batu Regency. The

GPS coordinates of the project activity is as follows –

Latitude: 2°12’ 50.55”N
Longitude: 100°16’ 15.14” E

The location is graphically shown below:

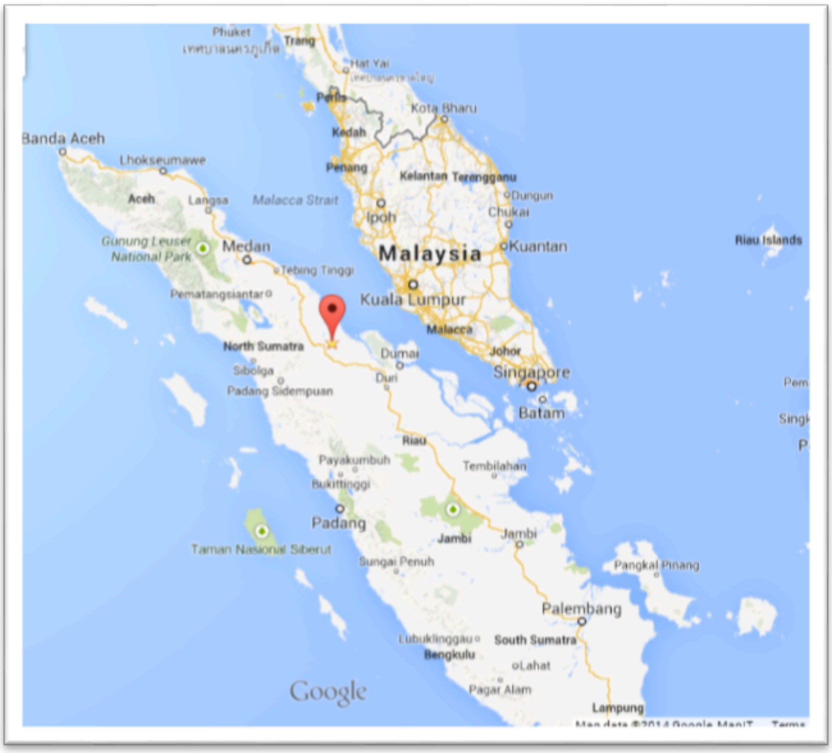

Figure 2: Location of the project activity

A.3. Technologies and/or measures

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In accordance with Appendix B of the simplified modalities and procedures for small-scale CDM project activities (SSC M&P), the proposed project activity falls under the following category[1]:
Type III: Other project activity
Category M: Methane recovery
Baseline and monitoring methodology applied: AMS-III.H “Methane recovery in wastewater treatment” (version 16)

Technological Description

The technology applied for the project activity is an anaerobic digester system with methane recovery for treatment of POME generated from the palm oil milling operations. The project technology is environmentally safe and sound.

Steps required for the complete process are as follows –

Up Stream Pre Treatment Systems

[1] http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html

The raw wastewater from the process shall be taken to the effluent treatment plant by suitably designed channel or closed pipe depending upon the topography of the site. Effluent shall enter into the screen chamber for the removal of floating matter and shall then enter into the Oil &Grease trap.

Equalization Tank:
The effluent from oil & grease trap enters into the equalization tank for equalization and surge control. Mixer shall be provided to equalize the effluent. Effluent from the equalization tank shall be then pumped into buffer tank through Plate Heat Exchanger (PHE).

The Specification for the Equalization Tank:

Description	Unit	Specification
Volume	m3	390
Residence Time	Day	0.5
Size	M	11.4 x 11.4x 3.0 SWD
Number	Set	1
Motor capacity	KW	7.5

Plate Heat Exchanger (PHE):
The raw wastewater from Equalization Tank (EQT) shall then pump to plate heat exchanger to reduce the temperature.

Dissolve Air Floatation System (DAF)
Effluent from the Plate Heat Exchanger shall be then enters in to the Dissolved Air Flotation system. This system is used to remove residual emulsified oil and suspended solids from the effluent to the maximum extent. This DAF is provided as a backup. It will be used only when COD of inlet POME is above designed value.

The Specification for the DAF System:

Description	Unit	Specification
Volume	m3	50
Residence Time	Day	0.06
Size	M	4.5 Dia x 3.3 SWD
Number	Set	1
Motor Capacity	KW	0.37

Primary Clarifier:
The effluent from Dissolved Air Flotation then enters into the primary clarifier. The clarifier is a hopper bottom circular tank with centrally driven clarifier mechanism to remove excess solids. It will be used mainly during trouble shooting of process.

The Specification for the Primary Clarifier:

Description	Unit	Specification
Volume	m3	115
Residence Time	Day	0.14

Size	M	7.0 Dia x 3.0 SWD
Number	Set	1
Motor Capacity	KW	1.5

Buffer Tank
In buffer tank the complex organics in the wastewater is subjected to hydrolysis. The hydrolyzed effluent shall be pumped from the buffer tank for anaerobic treatment in the reactor.

The Specification for the Buffer Tank

Description	Unit	Specification
Volume	m3	260
Residence Time	Day	0.3
Size	M	11.4 x 8.5 2.7 SWD
Number	Set	1
Motor capacity	KW	9.5

ANAEROBIC CSTR REACTOR
It is non-media, Continuously Stirrer Tank Reactor. It is mesophillic reactor i.e. it operates best in temp range of 36 – 39 ^{O}C. Reactor will be fabricated at site using **Special grade steel plates with specific chemical and mechanical properties** and structural members confirming to relevant grades as per internationally accepted codes.

In reactor the raw waste is introduced from top of the reactor. The recycled sludge is also introduced from the top of the reactor. This mixed liquor travels downward through the central shaft. In this central shaft, agitator provides adequate mixing of raw waste and recycled sludge. From central shaft liquor enters reactor near bottom of tank.

The solids are separated from the outlet of reactor in Lamella Clarifier and returned to the system by recirculation pumps. This recirculation of settled solids helps to maintain adequate population of active bacteria inside reactor.

The biogas produced by anaerobic digestion inside the reactor is collected from reactor roof. Biogas is then transferred to floating type gas holder. Biogas is then conveyed to blower for further utilization in boiler or biogas engines.

The Specification for the Anaerobic Tank:

Description	Unit	Specification
Volume	m3	8495
Residence Time	Day	10.89
Size	M	26m Dia x 16.0 m SWD
Number	Set	1
Top Motor Capacity	KW	7.5
Side Entry motor s	KW	5.5

Down Stream Treatment systems

Conventional Aeration Tank:
The overflow from lamella clarifier enters into conventional aeration tank. In Conventional Aeration Tank microorganisms degrade soluble organics aerobically.

The Specification for the Conventional Aeration Tank:

Description	Unit	Specification
Volume	m3	2235
Residence Time	Day	2.85
Size	M	27.3 x 27.3 x 3.0 SWD
Number	Set	1
Motor Capacity	KW	18.5

Secondary Clarifier-A:
The mixed liquor from Conventional Aeration Tank enters the central well of clarifier–A for separation of sludge and liquid. The clarifier is a hopper bottom circular tank with centrally driven clarifier mechanism.

The Specification for the Clarifier A:

Description	Unit	Specification
Volume	m3	156
Residence Time	Day	0.19
Size	M	8.1 m Dia x 3.0 SWD
Number	Set	1
Motor Capacity	KW	1.5

Extended Aeration Tank:
The overflow of clarifier-A enters into Extended Aeration Tank. In Extended Aeration Tank microorganisms degrade soluble organics aerobically.

The Specification for the Extended Aeration Tank:

Description	Unit	Specification
Volume	m3	780
Residence Time	Day	1
Size	M	22.8 x 11.4x 3.0 SWD
Number	Set	1
Motor Capacity	KW	9.5

Secondary Clarifier-B:

The mixed liquor from Extended Aeration Tank enters the central well of clarifier-B for separation of sludge and liquid. The clarifier is a hopper bottom circular tank with centrally driven clarifier mechanism.

The Specification for the Clarifier B:

Description	Unit	Specification
Volume	m3	195
Residence Time	Day	0.25
Size	M	9.1 m Dia x 3.0 SWD
Number	Set	1
Motor Capacity	KW	1.5

Chlorine Contact Tank
The treated effluent will further be subjected to chlorination for disinfection.

De-Chlorine Tank (DCT)
The treated wastewater will further be subjected to de-chlorination. Sodium Meta Bi Sulphite solution will be added to treated wastewater.

Multi Grade Filter (MGF)
De-chlorinated effluent will then be pumped to Multi Grade Filter for removal of suspended solids.

Activated Carbon Filter (ACF)
Effluent will then be pumped from Multi Grade Filter to activated carbon filter for removal of suspended solids, color, odor etc.

The clarified overflow POME from the clarifier will be further treated in the downstream activities. The final treated POME will be discharged to nearby river.

The specification of the anaerobic digester to be used in the project activity is as follows:

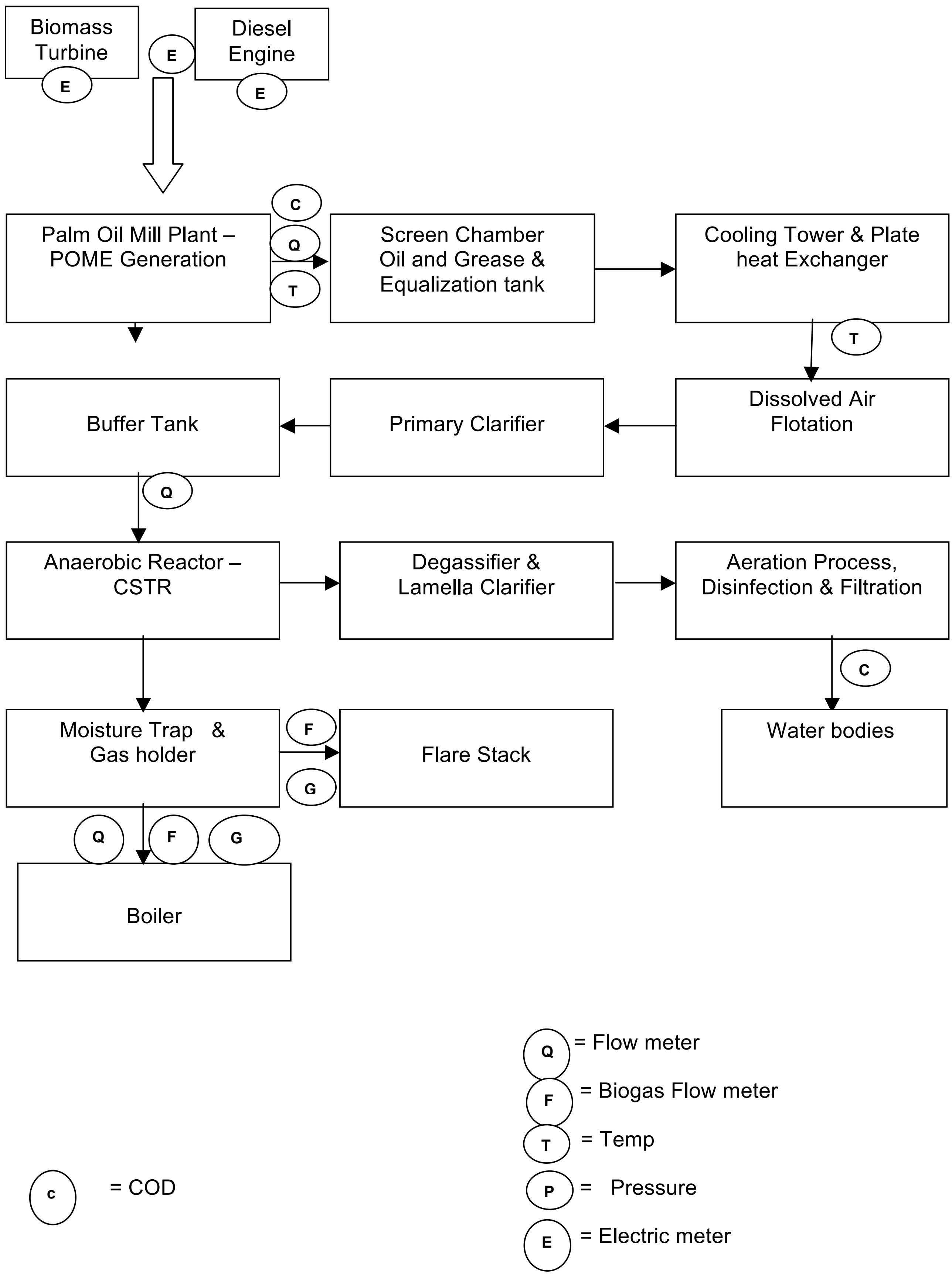
Model	: LESAR reactor
Digester type	: Continuously Stirrer Tank Reactor
Volume	: 8,495 m^3
Hydraulic retention time	: 11 days (=8,495m^3 / 780 m^3/day)
Operating temperature	: 36-39°C
Treated BOD	: <100 mg/L
Treated TSS	: <100 mg/L
Treated O & G	: <50 mg/L
Volume of biogas	: 0.5 ± 5% m^3/kg COD removed
Expected biogas CH_4 composition	: 60% methane
Design COD removal efficiency	: 85 %
Operational lifetime	: 20 years

The recovered biogas from the project activity will be combusted together with biomass in a boiler. In case there is any excess of biogas, it will be flared in an open flare system. The use of biogas is not covered within the project activity. The boiler is expected to have the following specifications:

Guaranteed steam output : 35,000 kg/h (35 MT/h)
Operating pressure : 30 barg
Steam temperature : 280°C

The overall process flow diagram applied in the proposed project are shown in the figure below –

Figure 3: Process Flow Diagram



A.4. Parties and project participants

Party involved (host) indicates host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of Indonesia (host)	Private entity- PT Umbul Mas Wisesa	No

A.5. Public funding of project activity

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No public funding is involved for this project activity.

A.6. Debundling for project activity

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As per clause 2 of the Appendix C of the Simplified Modalities and Procedure for Small-Scale CDM project activities (consolidated in Guidelines on assessment of de-bundling for SSC project activities, Version 03.1, EB54, Annex 13), a small-scale project activity shall be deemed to be a de-bundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:

- With the same project participants
- In the same project category and technology/measure
- Registered within the previous 2 years
- Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

The project participant has no other project activity registered within previous 2 years, whose project boundary falls within 1 km of the project boundary of the proposed project activity within same project category and technology/measure. Hence, the project activity is not a de-bundled component of a large-scale project activity.

SECTION B. Application of selected approved baseline and monitoring methodology and standardized baseline

B.1. Reference of methodology and standardized baseline

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The baseline and monitoring of this project activity is based on the following approved methodology, guidelines and tools:
AMS-III.H (version 16): "Methane recovery in wastewater treatment"
Tools:

- General guidelines for SSC CDM methodologies (Version 20.0);
- Clean development mechanism project standard (Version 07.0);
- Guidelines on the Demonstration of Additionality of Small-Scale Project Activities (Version 09.0);
- Guidelines for completing the project design document form for small-scale CDM project activities (Version 01.1);
- Project emissions from flaring (Version 02.0.0);
- Sampling and surveys for CDM project activities and programme of activities (Version 04.1);

- Tool to calculate baseline, project and-or leakage emissions from electricity consumption (Version 01);
- Tool to determine the mass flow of a greenhouse gas in a gaseous stream (Version 02.0.0).

B.2. Project activity eligibility

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The approved small-scale methodology AMS-III.H (version 16) is applicable to the project due to the following reasons as presented in the table below.

Table 1: Justification of the choice of the project category AMS-III.H (version 16)

Para. No.	AMS-III.H Applicability Requirements	Project activity
1	This methodology comprises measures that recover biogas from biogenic organic matter in wastewater by means of one, or a combination, of the following options: a. Substitution of aerobic wastewater or sludge treatment systems with anaerobic systems with biogas recovery and combustion; b. Introduction of anaerobic sludge treatment system with biogas recovery and combustion to a wastewater treatment plant without sludge treatment; c. Introduction of biogas recovery and combustion to a sludge treatment system; d. Introduction of biogas recovery and combustion to an anaerobic wastewater treatment system such as anaerobic reactor, lagoon, septic tank or an on-site industrial plant e. Introduction of anaerobic wastewater treatment with biogas recovery and combustion, with or without anaerobic sludge treatment, to an untreated wastewater stream; f. Introduction of a sequential stage of wastewater treatment with biogas recovery and combustion, with or without sludge treatment, to an anaerobic wastewater treatment system without biogas recovery (e.g. introduction of treatment in an anaerobic reactor with biogas recovery as a sequential treatment step for the wastewater that is presently being treated in an anaerobic lagoon without methane recovery).	The wastewater treatment system will be installed in parallel with the Greenfield palm oil mill (i.e. there is no existing wastewater treatment system). As per Section B.4, the most plausible baseline scenario for the project activity is treatment of wastewater in open anaerobic lagoons without biogas recovery. The project activity involves implementation of sequential stage wastewater treatment plant i.e. anaerobic digester system for wastewater treatment with biogas recovery and combustion. Thus, option 1(f) is applicable to the project activity i.e. introduction of a sequential stage of wastewater treatment with biogas recovery and combustion, to an anaerobic wastewater treatment system without biogas recovery.
2	In cases where baseline system is anaerobic	As this is a Greenfield project, the

Para. No.	AMS-III.H Applicability Requirements	Project activity
	lagoon the methodology is applicable if: a. The lagoons are ponds with a depth greater than two meters, without aeration. b. Ambient temperature above 15°C, at least during part of the year, on a monthly average basis; c. The minimum interval between two consecutive sludge removal events shall be 30 days.	characteristic of the most plausible baseline treatment system (i.e. open anaerobic lagoons without methane recovery) will be based on available information from existing anaerobic lagoons at similar industrial facilities in Indonesia. The information referred is from selected three (3) CDM projects, which are registered, that have implemented biogas recovery measure to their existing POME treatment system (i.e. open anaerobic lagoons without methane recovery) in the projects. In absence of the project activity, the wastewater would have been treated in series of anaerobic lagoons without methane recovery. The average depth of three (3) above-identified registered CDM projects (i.e. with open anaerobic lagoons as baseline units), from which the baseline COD removal efficiency for this project activity is referred (i.e. 85%), is 6 meters[2]. The ambient temperature in South Labuhan Batu is estimated using the average temperature of the nearest major city (i.e. Medan). The average annual temperature in this area is 26.2°C[3]. Taking into the consideration of the required manpower to conduct de-sludging, the typical interval between two consecutive sludge removal events would be more than 30 days. Further, as per the publication "Pipeline[4]" the lagoons are able to properly function without sludge removal for up to 5 to 10 years.
3	The recovered biogas from the above measures may also be utilized for the following applications instead of combustion/flaring:	The recovered biogas will be combusted in a boiler for energy generation and any excess biogas will be flared using open flaring system.

[2] The list of projects from which this value was taken is provided in Appendix 4 of this PDD.

[3] http://www.climatetemp.info/indonesia/medan-sumatra.html

[4] National Small Flows Claringhouse (1997). *Lagoons Need Proper Operation, Maintenance.* PIPELINE – Spring 1997; Vol. 8, No. 2. http://www.nesc.wvu.edu/pdf/WW/publications/pipline/PL_SP97.pdf

Para. No.	AMS-III.H Applicability Requirements	Project activity
	a. Thermal or mechanical, electrical energy generation directly; b. Thermal or mechanical, electrical energy generation after bottling of upgraded biogas; or c. Thermal or mechanical, electrical energy generation after upgrading and distribution, in this case additional guidance provided in Annex 1 shall be followed: i. Upgrading and injection of biogas into a natural gas distribution grid with no significant transmission constraints; ii. Upgrading and transportation of biogas via a dedicated piped network to a group of end users; or iii. Upgrading and transportation of biogas (e.g. by trucks) to distribution points for end users. d. Hydrogen production. e. Use as fuel in transportation applications after upgrading.	
4	If the recovered biogas is used for project activities covered under paragraph 3(a), that component of the project activity can use a corresponding methodology under type I	Even though the generated biogas from the project activity will be used for energy generation, PP will not claim any emission reductions associated with such energy generation.
Paragraphs 5 – 11 are not applicable.		
12	New facilities (Greenfield projects) and project activities involving a change of equipment resulting in a capacity addition of the wastewater or sludge treatment system compared to the designed capacity of the baseline treatment system are only eligible to apply this methodology if they comply with the relevant requirements in the "General guidelines to SSC CDM methodologies". In addition the requirements for demonstrating the remaining lifetime of the equipment replaced, as described in the general guidelines shall be followed.	This project activity is a Greenfield project which complies with the "General guidelines for SSC CDM methodologies". The determination of plausible baseline scenario is presented in section B.4. There will be no equipment replaced; therefore, provisions pertaining to remaining lifetime of the equipment are not relevant to the project activity.
13	The location of the wastewater treatment plant as well as the source generating the wastewater shall be uniquely defined and described in the PDD.	The location of the wastewater treatment plant will be adjacent to the source of wastewater generation (i.e. the palm oil mill). The location is

Para. No.	AMS-III.H Applicability Requirements	Project activity
		defined under section A.2 of the PDD
14	Measures are limited to those that result in aggregate emissions reductions of less than or equal to 60,000 tCO_2e annually from all Type III components of the project activity.	The project activity is expected to generate annual average emission reductions of 57,640 tCO_2e during the crediting period.

B.3. Project boundary

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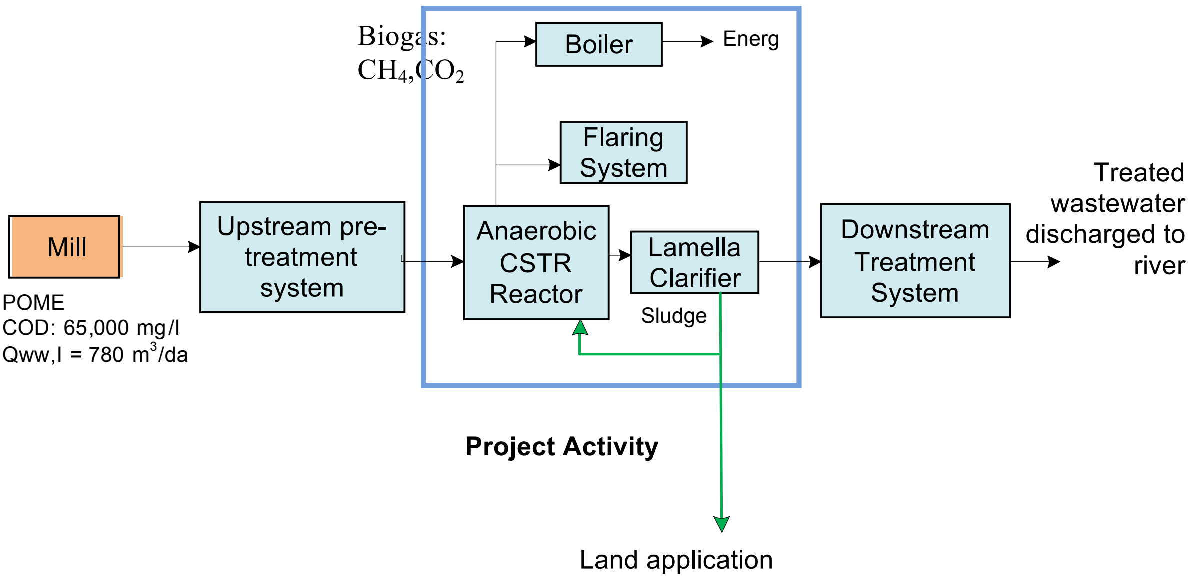
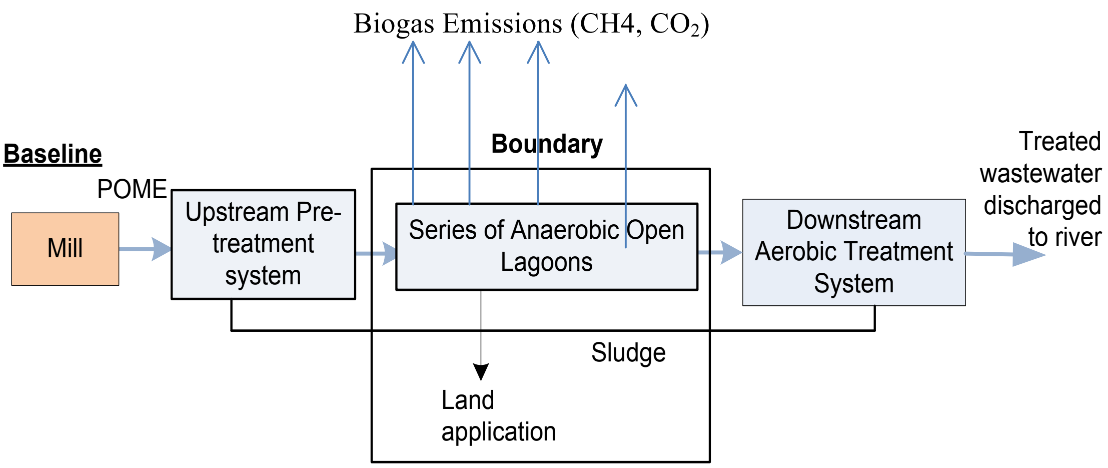
The project boundary is delineated in Figure 4.



Baseline Scenario



Baseline	Emissions from the baseline wastewater treatment system.	CO_2	No	CO_2 emission is not accounted because this is generated from the decomposition of organic matter.
		CH_4	Yes	CH_4 is the major component in the biogas produced during anaerobic wastewater treatment
		N_2O	No	Excluded for simplification.
	Emissions from the baseline sludge treatment system.	CO_2	No	There is no baseline sludge treatment system which will be affected by the project activity.
		CH_4	No	
		N_2O	No	
	Emissions on account of electricity or fossil fuel used	CO_2	No	Baseline emissions from electricity consumption will not be accounted for because there would have been negligible electricity consumption in the baseline scenario.
		CH_4	No	
		N_2O	No	
	Emissions from the discharge of the effluent into river/lake/sea	CO_2	No	Excluded for simplification
		CH_4	No	The treated water would have been discharged to the river (MCF=0.1). However, baseline emissions from discharge of wastewater are excluded since they are negligible. This is conservative.
		N_2O	No	Excluded for simplification

Project activity	Emissions from electricity or fuel consumption in the project activity	CO_2	Yes	The electricity source is from biomass and biogas based captive power plant in the palm oil mill. For *ex-ante* estimation, this emission is assumed zero. However, for *ex-post* estimation, this emission will be included in the case when electricity generated by diesel back-up generators is used.
		CH_4	No	Excluded for simplification.
		N_2O	No	Excluded for simplification.
	Emissions from wastewater treatment system affected by the project activity and not equipped with biogas recovery	CO_2	No	There is no component of the wastewater treatment system affected by the project activity which is not equipped with biogas recovery system.
		CH_4	No	
		N_2O	No	
	Emissions from sludge treatment system affected by the project activity and not equipped with biogas recovery	CO_2	No	There is no provision for sludge treatment system in the project activity.
		CH_4	No	
		N_2O	No	
	Emissions from the discharge of the effluent into river/lake/sea	CO_2	No	Excluded for simplification
		CH_4	Yes	The treated water will be discharged to the river.
		N_2O	No	Excluded for simplification
	Emissions from biogas release in capture system	CO_2	No	CO_2 emission from biogas release is not accounted.
		CH_4	Yes	CH_4 is the major component in any fugitive biogas not captured by the capture system.
		N_2O	No	Excluded for simplification.
	Emissions due to incomplete flaring of biogas	CO_2	No	It is assumed that CO_2 emissions from recovered biogas do not lead to changes of carbon pools in the LULUCF sector.
		CH_4	Yes	Emission source due to incomplete flaring of biogas. For *ex-ante*

				estimation, this emission is assumed zero since flaring system will operate only in emergency (i.e. during maintenance or shutdown of the boiler). However, for *ex-post* estimation, this emission will be accounted whenever flaring system is used.
		N_2O	No	Excluded for simplification.
	Emissions from biomass stored under anaerobic conditions	CO_2	No	No biomass will be stored under anaerobic conditions in the project activity.

B.4. Establishment and description of baseline scenario

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In accordance with "General Guidelines for SSC CDM methodologies (Version 20.0)", the PP has used the following steps for identifying the most plausible baseline scenario for the proposed Greenfield project activity.

Step 1: Identification of alternative scenarios

In this step, various alternatives available to the PP that deliver comparable level of service including the proposed project activity undertaken without being registered as a CDM project activity are identified. The comparable level of service here is defined as 85% COD removal efficiency as per specification of the technology (i.e. anaerobic digester in the CDM project activity).

Table 3: Alternative Scenarios for Baseline Identification

No	Alternative	Comparability Check
Alternative 1	Use of open anaerobic lagoons for wastewater treatment without methane recovery	The use of anaerobic lagoons for treating POME has been adopted in most of the palm oil mills and can generally achieve COD removal efficiency of more than 85%.
Alternative 2	Use of anaerobic lagoons with sealed covers for wastewater treatment	The use of anaerobic lagoons with sealed covers has been implemented previously in the region and, similar to Alternative 1, can achieve COD removal efficiency of more than 85%.
Alternative 3	Use of series of aerobic lagoons for wastewater treatment	This option is not a feasible alternative because POME's organic-loading is too high for direct aerobic treatment[5].
Alternative 4	Use of aerobic wastewater treatment using activated sludge	Under optimal controlled conditions, the activated sludge system is able to achieve COD removal efficiency of 89%[6].
Alternative 5	Anaerobic digester without methane recovery	The anaerobic digester tanks can generally achieve COD removal efficiency of 83-95%[7].
Alternative 6	Anaerobic digester with methane recovery but not registered as CDM project	Similar to Alternative 5, the anaerobic digester tanks can generally achieve COD removal efficiency of 83-95%.

Through evaluation of the possible alternatives in this step, it is shown that the use of aerobic treatment alone (i.e. series of aerobic ponds) is not feasible due to high organic load content of POME. Therefore, Alternative 3 is eliminated. Alternatives 1, 2, 4, 5 and 6 are further analyzed in Step 2.

Step 2: Elimination of alternatives which are non-compliant to applicable laws and regulations

Alternatives 1, 2, 4, 5 and 6 are in compliance with current laws and regulations in Indonesia. The discharge of industrial wastewater in Indonesia is regulated by the Ministry of Environment under MenLH Decree 51/1995, Attachment B.IV (Palm Oil Industry)[8]. According to this regulation, the COD of wastewater shall not exceed 350 mg/l and the 5-day BOD (BOD_5) shall not exceed 100 mg/l (refer to Table 4). There is no other regulatory requirement for the implementation of a specific

[5] Schuchardt F. *et al*. (2007). *Effect of new palm oil processes on the EFB and POME utilisation.* Proceedings of Chemistry and Technology Conference PIPOC, pg 44-57. http://www.utec-bremen.com/userfiles/file/pdf/paper_C2_Schuchardt_PIPOC_2007.pdf

[6] Wu T.Y., Mohammad A.W. (2010) Pollution control technologies for the treatment of palm oil mill effluent (POME) through end-of-pipe processes, Journal of Environment Management, Table 6, pg 1472.

[7] Wu T.Y., Mohammad A.W. (2010) Pollution control technologies for the treatment of palm oil mill effluent (POME) through end-of-pipe processes, Journal of Environment Management, Table 7, pg 1474.

[8] MenLH Decree 51/1995, Attachment B.IV (Palm Oil Industry), http://www.cets-uii.org/BML/Air/BMLC/kepmen5195/

wastewater treatment technology, such as an anaerobic digester or aerobic treatment system, at palm oil mills.

Table 4: Effluent Discharge Standard for Palm Oil Industry[9]

Parameter	Maximum Permitted Level (mg/l)
BOD^5	100
COD	350
TSS	250
Oil and Fat	25
Ph	6.0 – 9.0

The remaining alternatives, with alternative 1, 2, 4, 5, and 6 coupled with the downstream aerobic treatment system, are able to meet the regulated standard and hence are not excluded in this step.

Step 3: Elimination of alternatives that face prohibitive barriers
In this step, all the remaining alternatives will be assessed against one or more of the following barriers: investment barrier, technological barrier, and other barrier. A summary of the barrier analysis using investment, technological and other barrier is presented in Table 5 below.

Barrier	Alternative 1 - Installation of open anaerobic lagoons for wastewater treatment without methane recovery	Alternative 2 - Installation of anaerobic lagoons with sealed covers for wastewater treatment	Alternative 4- Use of aerobic wastewater treatment using activated sludge	Alternative 5 - Anaerobic digester without methane recovery	Alternative 6 - Anaerobic digester with methane recovery but not registered as CDM project
Investment Barrier	Construction of anaerobic open lagoons requires low capital cost. Likewise, the operation and maintenance cost are low as the energy required for operation is minimal[10]. Anaerobic treatment in open	Additional cost needs to be incurred by the project owner to cover the lagoons. The operational cost of operating covered lagoons will be much higher compared to operating open lagoons.	Operation of aerobic digester (i.e. activated sludge system) will not generate any revenues for the PP. It involves higher capital and operational	Operation of anaerobic digester will not generate any revenues for the PP. It involves higher capital and operational cost compared to the conventional anaerobic	The investment barriers applicable to Alternative 5 (i.e. anaerobic digester without methane recovery) will be also applicable here[18].

[9] MenLH Decree 51/1995, Attachment B.IV (Palm Oil Industry), http://www.cets-uii.org/BML/Air/BMLC/kepmen5195/

[10] Wu T.Y., Mohammad A.W. (2010) *Pollution control technologies for the treatment of palm oil mill effluent (POME) through end of pipe process,* Journal of Environmental Management, No 91, pg 1483.

Barrier	Alternative 1 - Installation of open anaerobic lagoons for wastewater treatment without methane recovery	Alternative 2 - Installation of anaerobic lagoons with sealed covers for wastewater treatment	Alternative 4- Use of aerobic wastewater treatment using activated sludge	Alternative 5 - Anaerobic digester without methane recovery	Alternative 6 - Anaerobic digester with methane recovery but not registered as CDM project
	lagoons will be regarded as the most financially viable option.	In addition, several projects in relation to methane recovery from covered lagoons have been registered as CDM projects in the country (e.g. Ref No. 4394[11], 4480[12], 2664[13], 2663[14], 2662[15], 2643[16]) thus	cost compared to the conventional anaerobic lagoon system. The aeration system in the aerobic digestion is very energy intensive. Lack of incentive together with	lagoon system[17]. Lack of incentive together with the financial costs incurred is a prohibitive barrier for this alternative. Therefore, it will be unlikely for the project	In addition, installation of methane recovery will further increase the cost. Due to high initial cash outlay, it is unlikely that the project owner will select this

[18] Agricultural Anaerobic Digestion Fundamentals for Undestanding, Evaluating and Applying, Colorado Department of Public Health and Environment, Colorado Governor's Office of Energy Management and Conservation, http://files.harc.edu/Sites/GulfCoastCHP/ProjectDevelopment/AgriculturalAnaerobicDigestion.pdf

[11] "Harapan Biogas Project", PDD Version 3.11, 13/01/2011. http://cdm.unfccc.int/filestorage/S/Z/W/SZWD914CIVJ5AFPO3E2LGUKYX0QMBH/4394%20PDD.pdf?t=NkJ8bWVmeWJ5fDDj9fH-cQeeWG8kIuU6Itk2

[12] " Methane Recovery and Utilization at PT. Musim Mas Palm Oil Mill In Pangkalan Lesung, Riau, Indonesia", PDD Version 8, 08/08/2011. http://cdm.unfccc.int/filestorage/e/j/KIYD9BN23QXZRVESGP6U40OA8HTCJ1.pdf/3702_Pinago_Biogas_PDD_v09%2027062012%20clean.pdf?t=UUx8bWVmeWI3fDBfySgwkfjfRWZ4oYAlPkPG

[13] "ID08-WWP-14, Methane Recovery in Wastewater Treatment, Riau Province, Indonesia", PDD Version 11, 07/10/2009. http://cdm.unfccc.int/filestorage/9/P/U/9PUEKW0ODRFC6735JZT2YBXNQIMAHG/2664%20PDD%20corrected%20clean.pdf?t=UjJ8bWVmemVmfDCZfu-8VLrJBnBPpVvLI9jx

[14] "ID08-WWP-09, Methane Recovery in Wastewater Treatment, Aceh, Indonesia", PDD Version 13, 07/10/2009. http://cdm.unfccc.int/filestorage/L/K/A/LKA6NJVEBX9U1437R2ZDFPI5CQOGY8/2663_PDD%20clean.pdf?t=clR8bWVmejFifDAPktRjjglH1i_TkhDedhBG

[15] "ID08-WWP-11, Methane Recovery in Wastewater Treatment, Jambi, Indonesia", PDD Version 12, 19/10/2009. http://cdm.unfccc.int/filestorage/V/A/P/VAPCFLDR1ENQUMHXYI5ZJ60GBK4382/2662_PDD_clean.pdf?t=UDN8bWVmeXVmfDBLpgRiC45H4L1VVIO02eRn

[16] "ID08-WWP-10, Methane Recovery in Wastewater Treatment, West Sumatera, Indonesia", PDD Version 9, 11/11/2009. http://cdm.unfccc.int/filestorage/E/6/Q/E6QI0WD43SVR7FLKZ1BXUJOA985THC/PDD.pdf?t=U218bWVmeXlzfDDmtsTuRAb6XaJcIQ39Est2

[17] Agricultural Anaerobic Digestion Fundamentals for Undestanding, Evaluating and Applying, Colorado Department of Public Health and Environment, Colorado Governor's Office of Energy Management and Conservation, http://files.harc.edu/Sites/GulfCoastCHP/ProjectDevelopment/AgriculturalAnaerobicDigestion.pdf

Barrier	Alternative 1 - Installation of open anaerobic lagoons for wastewater treatment without methane recovery	Alternative 2 - Installation of anaerobic lagoons with sealed covers for wastewater treatment	Alternative 4- Use of aerobic wastewater treatment using activated sludge	Alternative 5 - Anaerobic digester without methane recovery	Alternative 6 - Anaerobic digester with methane recovery but not registered as CDM project
		demonstrating that this alternative already faces significant barriers compared to the most prevalent practice of treating wastewater in anaerobic open lagoons.	the financial costs incurred is a prohibitive barrier for this option. Therefore, it will be unlikely for the project owner to select this alternative.	owner to select this alternative.	option.
Technological Barrier	The ponding system technology is reliable and stable19. Therefore, it is easier to manage and involves lower risks compared to the project activity. It does not face prohibitive technical barriers. It is observed that this technological option has the capacity to tolerate wider range of Organic Loading Rate (OLR)20.	The installation of cover on anaerobic lagoons will carry potential technological difficulties. The PP runs the risk whether the cover has been implemented effectively and whether any potential biogas leakages are occurring. Cover of the lagoon is exposed to UV light and weather daily and subject to wear and tear. The PP has to select among	Many problems can develop in activated sludge operation that adversely affects the effluent quality with origins in engineering, hydraulic and microbiological components of the process. The various microbiological problems that can occur in activated sludge operation include non-settle able growth, pin floc problem, zoogloeal	The organic content of POME will be digested anaerobically by the microorganisms inside the digester. The process is a series of complex biological process such as hydrolysis, acidogenesis, acetogenesis, and methanogenesis, producing biogas by the end of the process24. Each step involves a	All the discussions on technological barriers under Alternative 5 (i.e. anaerobic digester without methane recovery) will be as well applicable here. Addition of methane recovery will increase the need of operation and maintenance procedures for the plant. There will be additional manpower

[19] Wu T.Y., Mohammad A.W. (2010) *Pollution control technologies for the treatment of palm oil mill effluent (POME) through end of pipe process,* Journal of Environmental Management, No 91, pg 1483.

[20] Poh P.E., Chong M.F. (2009) *Development of anaerobic digestion methods for palm oil mill effluent (POME) treatment*, Bioresource Technology 100, pg 6.

Barrier	Alternative 1 - Installation of open anaerobic lagoons for wastewater treatment without methane recovery	Alternative 2 - Installation of anaerobic lagoons with sealed covers for wastewater treatment	Alternative 4- Use of aerobic wastewater treatment using activated sludge	Alternative 5 - Anaerobic digester without methane recovery	Alternative 6 - Anaerobic digester with methane recovery but not registered as CDM project
		the available materials which is UV resistant, hydrophobic, tear and puncture resistant, non-toxic to bacteria and has a bulk density near that of water21. Regular visual inspections for rainfall accumulation, tearing, and wear are required to ensure no leakage. With relatively high rainfall22, the maintenance will need to be more frequent. In addition, there is a need for regular maintenance to ensure that no large bubbles accumulated below the cover system during the operation.	bulking and foaming, polysaccharide bulking and foaming23. In addition, in order to operate under optimum condition, the dissolved oxygen (DO) level in the aerobic activated sludge system has to be maintained continuously. Therefore higher level of expertise will be called upon by the project owner to operate these systems in an efficient manner.	specific type of bacteria, of which growth and activity are affected by different variables (e.g. temperature, pH, retention time, etc). Particularly, the growth and activity of bacteria involved in methanogenesis process is affected by the organic loading rate and hydraulic retention time which varies daily subject to the chemical properties of POME and the volume discharged to the treatment system25. Due to the complex association of different types of bacteria, digesters have a higher risk of breakdown and	required to operate and maintain the system as compared to the anaerobic lagoons. This team will need to be equipped with the necessary skills and expertise to ensure smooth operation. In addition, there will be also a need for precautionary measures for handling biogas (i.e. methane). The biogas is highly explosive and flammable, therefore, gas storage and piping system must be constructed in strict accordance to best engineering

[24]Information Sheet on Anaerobic Digestion, pg 4

[21] Detailed Description of the Three Main Dairy Digester Technolgies (Appendix B), http://www.rcminternationalllc.com/RCM_Forms/RCM_Digester_Types.pdf

[22]Annual precipitation is 2,125mm, http://www.climatetemp.info/indonesia/medan-sumatra.html

[23] Activated Sludge Microbiology Problems and Their Control, page 2.

[25] Yacob S. *et al.* (2006). *Baseline study of methane emissions from anaerobic ponds of palm oil mill treatment,* Science of the Total Environment, No. 366, pg 187 – 196

Barrier	Alternative 1 - Installation of open anaerobic lagoons for wastewater treatment without methane recovery	Alternative 2 - Installation of anaerobic lagoons with sealed covers for wastewater treatment	Alternative 4- Use of aerobic wastewater treatment using activated sludge	Alternative 5 - Anaerobic digester without methane recovery	Alternative 6 - Anaerobic digester with methane recovery but not registered as CDM project
				may be difficult to control26. Often, problems are difficult to diagnose as there are several parameters involved. Readjusting the equilibrium of these parameters could take significant time. Thus, it requires a high level of expertise to operate the digester effectively and also constant monitoring will be required to ensure the balance of the system.	practice in order to avoid leakages. Hydrogen sulphide (H2S) gas which is present in the biogas imposes some risks as this H2S gas could accumulate in bottom tanks and is harmful in high concentration 27.
Barrier Due to prevailing practices:	Prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions. The open anaerobic ponds system is an effective and low-tech solution that can easily meet the water discharge limits applicable to the agro-industry. The existing system which consists of anaerobic/facultative/aerobic lagoons/ponds has been able to meet the current permitted discharge level of biochemical oxygen demand (BOD) set by the Department of Environment Indonesia. Only a few mills or factories have reported the use and operation of a closed-tank anaerobic bioreactor equipped with a biogas recovery system because it is relatively new in Indonesia and not readily acceptable in the agro-industry in Indonesia.				
Other barrier	In Indonesia, the quality of the wastewater discharged from palm oil mill is regulated by the Decree of Ministry of Environment 51/1995[28]. This regulates the maximum allowable concentration of COD and BOD in the discharged effluent. However, there is no regulation				

[26]Information Sheet on Anaerobic Digestion, pg 4

[27] *Section Safety* – Anaerobic Digesters, http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex10945

[28] MenLH Decree 51/1995, http://www.cets-uii.org/BML/Air/BMLC/kepmen5195/

Barrier	Alternative 1 - Installation of open anaerobic lagoons for wastewater treatment without methane recovery	Alternative 2 - Installation of anaerobic lagoons with sealed covers for wastewater treatment	Alternative 4- Use of aerobic wastewater treatment using activated sludge	Alternative 5 - Anaerobic digester without methane recovery	Alternative 6 - Anaerobic digester with methane recovery but not registered as CDM project
	on how to treat the effluent. There is lack of prevailing regulatory requirement in the country. Therefore, it is most unlikely that the project owner will invest in technologies which entail higher investments and/or technical barriers. The technology which has been predominantly used in the region (i.e. Indonesia) is Alternative 1, i.e. installation of anaerobic lagoons for wastewater treatment[29].				
Summary of barrier analysis	This alternative is the most plausible baseline scenario as the investment and technological barriers faced are minimal.	The capital cost and the operational cost incurred for implementing and operating covered lagoons is higher compared to open lagoons. The technical risk associated with this option is also higher compared to open lagoons operations. This scenario is not a plausible scenario for the PP.	Lack of incentive with high capital cost and high level of anticipated technological risks prohibit project owner to select this alternative. This scenario is not a plausible scenario for the PP.	Lack of incentive with high capital cost and high level of anticipated technological risks prohibit project owner to select this alternative. This scenario is not a plausible scenario for the PP.	This scenario is not a plausible scenario for the PP due to lack of incentive and high level of anticipated technological risks. In addition, the absence of policy encouraging methane recovery technology will prevent project owner from selecting this alternative.

B.5. Demonstration of additionality

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Date	Activities
9 February 2011	The Board of Directors decided to install anaerobic digester with biogas recovery after due consideration of CDM revenue potentials from the project activity.
10 February 2011	Signing of the main equipment/contractor contract to implement the project activity.

[29] The list of registered project activities in the region with the information of their baseline POME treatment technology is provided in Annex 3 of this PDD.

21 February 2011	"Prior consideration" submitted to the UNFCCC and the host country DNA.
5 May 2011	Conducting local stakeholders meeting.

Demonstration of additionality
The additionality of this project activity is demonstrated through the following barrier analyses.

Investment barrier
As demonstrated in Section B.4 of the PDD, the most plausible baseline scenario in the absence of the project activity would have been the implementation of series of open anaerobic lagoons without methane recovery. Operation of open lagoons is the most economical option as it requires minimum human intervention and energy consumption[30]. Therefore, series of open anaerobic lagoons is regarded to be the most plausible investment option facing minimum barriers to implementation.

On the other hand, in the project scenario, substantial capital investment will be incurred in the construction of new anaerobic digester (i.e. project activity) system with biogas recovery.

Both the baseline scenario (i.e. open anaerobic lagoons without methane recovery) and project activity (i.e. anaerobic digester system with biogas recovery) do not generate any revenues to meet operational expenses. However, the baseline scenario is a low cost option compared to the project activity. Hence, compared to the baseline scenario, the project activity faces significantly large financial barrier as it involves higher capital and operational costs.

Without CERs revenues, in the absence of the CDM project activity, there is no incentive for the PP to invest in such capital intensive project. The PP would have implemented the most financially viable technology, which is the series of open anaerobic lagoons without methane recovery. The registration of the project activity as a CDM project will provide the PP with additional revenue from sales of CERs which will alleviate the financial burden of the project and therefore, the PP will be more willing to invest in such project.

Technological barrier
It is expected that the PP will also face several technological barriers in the implementation and operation of the proposed digester system.

i. **Performance risk**
Operation of anaerobic reactor requires high level of maintenance and its performance carries some risks. The performance of anaerobic digester is sensitive as it is a complex biological process involving different types of bacteria[31]. The growth and activity of these bacteria are affected by different variables (e.g. temperature, pH-value, retention time, COD load of wastewater etc). Based on the study "*Baseline study of methane emissions from anaerobic ponds of palm oil mill treatment*"[32] it is shown that daily variation in chemical properties and discharged volume of POME will affect the methanogenesis process. Several control loops are required to keep the digester parameters within appropriate levels. All the parameters have to be balanced to provide best conditions for the bacteria. Improper operation of the digester or incorrect application of chemical substances would harm the

[30] Wu T.Y., Mohammad A.W. (2010) *Pollution control technologies for the treatment of palm oil mill effluent (POME) through end-of-pipe processes*, Journal of Environment Management, Table 6, pg 1472.

[31] Information Sheet on Anaerobic Digestion

[32] Yacob, S. *et al.* (2006). *Baseline study of methane emissions from anaerobic ponds of palm oil mill treatment,* Science of the Total Environment, No. 366, pg 187 – 196

microorganisms and lead to the collapse of the reactor system. Poor performance of the digester adversely affects the quantity and the methane content of the biogas which may eventually impact the quantity of emission reductions that may be generated from the project.

In addition, there will be also a need for precautionary measures for handling biogas (i.e. methane) which is highly explosive and flammable. Gas storage and piping system must be constructed in accordance with standard engineering practice in order to avoid leakages. There is also a risk from hydrogen sulphide (H_2S) gas which is present in the biogas. This H_2S gas could accumulate in bottom tanks and is harmful in high concentration[33]. In order to ensure smooth operation while preventing undue safety hazards, well trained and technically skilled manpower is required.

In contrast, the risks associated in the open lagoons are considered very low due to simplicity and robustness of their operation principles. Operation and maintenance required is minimal given that the system is not automated.

ii. Need for more manpower

Unlike the anaerobic lagoons, the project system (i.e. anaerobic digester with methane recovery) requires higher level of maintenance in the operation of the reactor. There will be a need for more technicians in the operation of proposed project activity (as compared to the most plausible baseline scenario (i.e. anaerobic lagoons).

Furthermore, the staffs have to be trained to be qualified to ensure appropriate handling of the anaerobic treatment system to manage the complicated biological, hydraulic processes and the precautionary measures for handling biogas. This team of staff need to be able to provide timely assistance in the case of breakdown/unstable operations etc.

Since the proposed reactor is not the most prevalent wastewater treatment technology in the region and the local operators are more used to the operation of conventional anaerobic open ponds system, the PP will face barriers in the implementation of the project activity.

Barrier due to prevailing Practice

Prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions. The open anaerobic ponds system is an effective and low-tech solution that can easily meet the water discharge limits applicable to the agro-industry. The existing system which consists of anaerobic/facultative/aerobic lagoons/ponds has been able to meet the current permitted discharge level of biochemical oxygen demand (BOD) set by the Department of Environment Indonesia.
Only a few mills or factories have reported the use and operation of a closed-tank anaerobic bioreactor equipped with a biogas recovery system because it is relatively new in Indonesia and not readily acceptable in the agro-industry in Indonesia.

Other barrier

In Indonesia, the quality of POME discharged from palm oil mill is regulated by the Decree of Ministry of Environment 51/1995[34]. It regulates the allowable concentration of pollutants both organic and non-organic in the discharged wastewater from palm oil industry.

Even though the quality of discharged wastewater from palm oil mill is regulated, there is no specific regulation on the technology to be used for wastewater treatment and for recovery of methane from the wastewater system. There is lack of prevailing regulatory requirement.

[33] *Section Safety* – Anaerobic Digesters, http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex10945

[34] MenLH Decree 51/1995, http://www.cets-uii.org/BML/Air/BMLC/kepmen5195/

Therefore, it is most unlikely that the palm oil mill owners in the region will make large investments to implement technologies with methane recovery. Instead, using open lagoons with no methane recovery serves as an easier and lower cost option for them[35]. However, such an alternative will result in higher GHG emissions into the environment.

How CDM revenue alleviate the barriers to the project implementation
The approval and registration of the project activity will alleviate the above three identified barriers and enable the project activity to be undertaken and contribute to emission reductions. CER revenues will provide the necessary financial incentive to the PP to implement such high-investment project activity and move away from the easier alternatives such as open lagoons system. The CDM revenue will provide a source of income for the project owner which will contribute towards the capital cost for the project technology as well as the operation and maintenance cost.

The expected additional CERs revenue will also mitigate the risk associated with the technological difficulties in the implementation of the project activity. Furthermore, the CERs revenue will help the PP in seeking and training the required manpower

B.6. Emission reductions

B.6.1. Explanation of methodological choices

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Baseline emission
As explained in Section B.4, the most plausible baseline scenario for the project is anaerobic lagoons without methane recovery. As per Paragraph 18 of AMS-III.H (Version 16), baseline emissions are calculated as follows:

$$BE_y = \{BE_{power,y} + BE_{ww,treatment,y} + BE_{s,treatment,y} + BE_{ww,discharge,y} + BE_{s,final,y}\}$$

[35] Expanded Market Study for Indonesia Sustainable Energy Finance, Renewable Energy Opportunities in Palm Oil Mills in Kalimantan and Sumatra, IFC.

Table 7: Summary of Baseline Emissions

No.	Emissions	Description	Remarks
1	$BE_{power,y}$	Emissions on account of electricity or fossil fuel used	Not applicable. Baseline emissions from electricity consumption will not be accounted because there is negligible electricity consumption in the baseline scenario.
2	$BE_{ww,treatment,y}$	Methane emissions from baseline wastewater treatment systems	Applicable. Methane is the major component in the biogas produced during anaerobic wastewater treatment.
3	$BE_{s,treatment,y}$	Methane emissions from baseline sludge treatment system.	Not applicable. There is no baseline sludge treatment systems affected by the project activity.
4	$BE_{ww,discharge,y}$	Methane emissions on account of inefficiencies in the baseline wastewater treatment systems and presence of biodegradable organic carbon in untreated wastewater discharged to sea / river / lake	Not applicable. Baseline emissions on account of final discharge of wastewater into the river are not accounted as they are negligible. This is conservative.
5	$BE_{s,final,y}$	Methane emissions from the decay of the final sludge generated by baseline treatment system	Not applicable. Under the most plausible baseline scenario, sludge is used for land application under aerobic condition.

Therefore, the baseline emission is simplified as follow:

$BE_y = BE_{ww,treatment,y}$

<u>Baseline emissions from wastewater treatment system</u>

$$BE_{ww,treatment,y} = \sum (Q_{ww,i,y} * COD_{untreated,i,y} * \eta_{COD,BL,i} * MCF_{ww,treatment,BL,i}) * B_{o,ww} * UF_{BL} * GWP_{CH4}$$

Where:

$Q_{ww,i,y}$	Volume of wastewater treated in baseline wastewater treatment system *i* in year *y* which is affected by the project activity (m^3/year)
$COD_{untreated,i,y}$	Chemical Oxygen Demand of the wastewater inflow to the baseline treatment system *i* in year *y* (tonnes/m^3)
$\eta_{COD,BL,i}$	COD removal efficiency of the baseline treatment system *i*, determined as per the paragraphs 26, 27 or 28 of AMS-III.H version 16
$MCF_{ww,treatment,BL,i}$	Methane correction factor for the baseline wastewater treatment system *i* (MCF value is obtained from Table III.H.1 in AMS-III.H version 16)
$B_{o,ww}$	Methane producing capacity of the wastewater (kg CH_4/kg COD)
UF_{BL}	Model correction factor to account for model uncertainties
GWP_{CH4}	Global warming potential for methane

The COD removal efficiency is determined as per paragraph 28 of AMS-III.H (version 16).

Project emission
As per paragraph 29 of AMS-III.H (version 16), the project activity emissions from the systems affected by the project activity is calculated as follows:

$$PE_y = PE_{power,y} + PE_{ww,treatment,y} + PE_{s,treatment,y} + PE_{ww,discharge,y} + PE_{s,final,y} + PE_{fugitive,y} + PE_{biomass,y} + PE_{flaring,y}$$

Table 8: Summary of project activity emission

No.	Project emissions	Descriptions	Remarks
1	$PE_{power,y}$	Emissions from electricity or fuel consumption in the year *y*	Applicable. The electricity source is from biomass and biogas based captive power plant in the palm oil mill. For ex-ante estimation, this emission is electricity generated by diesel based back-up generator. Diesel-based backup generator will be used when the captive power plant is not in operation due to maintenance or emergency.
2	$PE_{ww,treatment,y}$	Methane emissions from wastewater treatment systems affected by the project activity, and not equipped with biogas recovery, in year *y*	Not applicable. The project activity is a Greenfield project, there is no component of the wastewater treatment system which is affected by the project activity and not equipped with biogas recovery.
3	$PE_{s,treatment,y}$	Methane emissions from sludge treatment systems affected by the project activity, and not equipped with biogas recovery, in year *y*	Not applicable. Project activity does not involve sludge treatment.
4	$PE_{ww,discharge,y}$	Methane emissions from degradable organic in treated wastewater in year *y*	Applicable. The treated effluent will be discharged under aerobic conditions to the nearest river.
5	$PE_{s,final,y}$	Methane emissions from anaerobic decay of the final sludge produced in year *y*	Not applicable. The sludge will be used for land application. As per the monitoring requirements applicable to “Amount of dry matter in the sludge” (provided on page 19 of AMS-III.H (version 16), the end use of the final sludge will be monitored during the crediting period.
6	$PE_{fugitive,y}$	Methane emissions from biogas release in capture systems in year *y*	Applicable. The emission due to inefficiency of capture system in anaerobic digesters will contribute to methane emissions to atmosphere.

No.	Project emissions	Descriptions	Remarks
7	$PE_{flaring,y}$	Methane emissions due to incomplete flaring in year *y*	Applicable. The emission due to inefficiency of the flaring system will contribute to methane emission to atmosphere. For ex-post estimation, in the case when flaring system is activated, such emissions will be accounted accordingly. The flaring system will be activated in the event of the maintenance of the captive power plant or in an emergency.
8	$PE_{biomass,y}$	Methane emissions from biomass storage under anaerobic conditions	Not applicable. This project activity does not involve biomass storage under anaerobic condition.

Therefore, *ex-ante* calculation the project activity emissions (PE_y) are simplified as follow:

$PE_y = PE_{power,y} + PE_{ww,treatment,y} + PE_{s,treatment,y} + PE_{ww,discharge,y} + PE_{s,final,y} + PE_{fugitive,y} + PE_{biomass,y} + PE_{flaring,y}$

$PE_y = PE_{power,y} + 0 + 0 + PE_{ww,discharge,y} + 0 + PE_{fugitive,y} + 0 + PE_{flaring,y}$

$PE_y = PE_{power,y} + PE_{ww,discharge,y} + PE_{fugitive,y} + PE_{flaring,y}$

Ex-post project emissions calculations due to electricity consumption

Project emissions on account of electricity consumption in the project activity will be calculated as per "Tool to calculate baseline, project and/or leakage emission from electricity consumption" (the "Tool"). The project activity shall fall under Scenario-B of the Tool, i.e. Electricity consumption from an off-grid fossil fuel fired captive power plant.

The electricity for the project activity will be generally supplied from the renewable energy based steam boilers, howsoever, when the steam boilers are not operating, the electricity will be supplied by diesel based back-up generator. The electricity supply from the diesel back-up generator has a separate line and is metered separately.

Project emissions from electricity consumption to be calculated as follows:

$$PE_{EC,y} = EC_{PJ,j,y} * EF_{EL,j,y} * (1 + TDL_{j,y})$$

where:

$PE_{EC,y}$: Project emissions due to electricity consumption in year *y* (tCO_2)
$EC_{PJ,j,y}$: Quantity of electricity consumed by the project activity which is supplied by the back-up diesel generators in the year *y* (MWh)
$EF_{EL,j,y}$: Emission factor for electricity generation from source *j* in year *y* (tCO_2/MWh)
$TDL_{j,y}$: Average technical transmission and distribution losses for providing electricity to source j in year y

A default value of 1.3 tCO_2/MWh will be used for $EF_{EL,j,y}$. This is in line with option B2 under the Tool. The Tool allows the use of default emission factor for Scenario-B projects provided the electricity consumption source is the project activity.

Project emissions from the treated wastewater discharged

$$PE_{ww,discharge,y} = Q_{ww,y} * GWP_{CH4} * B_{o,ww} * UF_{PJ} * COD_{ww,discharge,PJ,y} * MCF_{ww,PJ,discharge}$$

$Q_{ww,y}$	Volume of treated wastewater discharged in year *y* (m^3)
GWP_{CH4}	Global warming potential for methane (value of 25)
$B_{o,ww}$	Methane producing capacity of the wastewater (IPCC default value of 0.25 kg CH_4/kg COD)
UF_{PJ}	Model correction factor to account for model uncertainties
$COD_{ww,discharge,PJ,y}$	Chemical oxygen demand of the treated wastewater discharged into sea, river or lake in the project situation in the year *y* (t/m^3).
$MCF_{ww,PJ,discharge}$	Methane correction factor based on the discharge pathway in the project scenario (e.g. into sea, river or lake) of the wastewater (MCF values as per Table III.H.1 of AMS-III.H version 16)

Project emissions from biogas release in capture system

$PE_{fugitive,y} = PE_{fugitive,ww,y} + PE_{fugitive,s,y}$

$PE_{fugitive,ww,y}$	Fugitive emissions through capture inefficiencies in the anaerobic wastewater treatment systems in the year *y* (tCO_2e)
$PE_{fugitive,s,y}$	Fugitive emissions through capture inefficiencies in the anaerobic sludge treatment systems in the year *y* (tCO_2e)

$PE_{fugitive,ww,y} = (1 - CFE_{ww}) * MEP_{ww,treatment,y} * \mathrm{GWP}_{CH4}$

CFE_{ww}	Capture efficiency of the biogas recovery equipment in the wastewater treatment systems (a value of 0.9 is used, as per AMS-III.H version 16)
$MEP_{ww,treatment,y}$	Methane emission potential of wastewater treatment systems equipped with biogas recovery system in year *y* (tonne)

$$MEP_{ww,treatment,y} = Q_{ww,\,i,,y,} * B_{o,ww} * UF_{PJ} * \sum_k COD_{removed,PJ,k,y} * MCF_{ww,treatment,PJ,k}$$

$Q_{ww,i,y,}$	Amount of wastewater to be treated in the wastewater treatment system equipped with biogas recovery (m^3/year)
$COD_{removed,PJ,k,y}$	The Chemical Oxygen Demand removed by the treatment system *k* of the project activity equipped with biogas recovery in the year *y* (t/m^3)
$MCF_{ww,treatment,PJ,k}$	Methane correction factor for the project wastewater treatment system *k* equipped with biogas recovery equipment
UF_{PJ}	Model correction factor to account for model uncertainties

Fugitive emission due to inefficiency in capture system in sludge treatment system ($PE_{fugitive,s,y}$) is zero (not accounted) as there will be no sludge treatment in the project activity (i.e. anaerobic digesters system). Therefore the fugitive emission is simplified as:

$PE_{fugitive,y} = PE_{fugitive,ww,y}$

Methane emissions due to incomplete flaring in year *y (*$PE_{flaring,\,y}$)

Methane emissions that occur due to incomplete flaring will be calculated ex post as per the "Project emissions from flaring (Version 2)".
This tool is applicable to the flaring of flammable greenhouse gases where:

- Methane is the component with the highest concentration in the flammable residual gas;
- The source of the residual gas is coal mine methane or a gas from a biogenic source (e.g. biogas, landfill gas or wastewater treatment gas).

The tool is not applicable to the use of auxiliary fuels and therefore the residual gas must have sufficient flammable gas present to sustain combustion. For the case of an enclosed flare, there shall be operating specifications provided by the manufacturer of the flare. For the proposed project, the source of gas is wastewater treatment gas and methane is the component with the

highest concentration in the flammable residual gas. The gas is not used as auxiliary fuel and the flaring is open flaring. Thus, the "Project emissions from flaring (Version 2)" can be applied to the proposed project.

Step 1. Determination of the methane mass flow in the residual gas

In the "Project emissions from flaring (Version 2)", the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream (Version 2)” shall be used to determine $F_{CH4,m}$ which is used to determine the mass of methane in kilograms fed to the flare in minute m ($F_{CH4,RG,m}$). $F_{CH4,m}$ shall be determined on a dry basis.

The following requirements apply to use the tool:

- The gaseous stream tool shall be applied to the residual gas;
- In the proposed project, the flaring gas is residual gas.
- The flow of the gaseous stream shall be measured continuously;
- In the proposed project, the flow of the gaseous stream shall be measured continuously.
- CH_4 is the greenhouse gas i for which the mass flow should be determined;
- In the proposed project, CH_4 is the greenhouse gas i for which the mass flow is determined.
- The simplification offered for calculating the molecular mass of the gaseous stream is valid; and
- In the proposed project, the simplification offered for calculating the molecular mass of the gaseous stream is valid
- The time interval t for which mass flow should be calculated is every minute m.
- In the proposed project, the time interval t for which mass flow should be calculated is every minute m

According to the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream (Version 2)”,
there are six options shown in the below table.

OPTIONS	FLOW OF GASEOUS STREAM	VOLUMATRIC FRACTION
OPTION A	Volume flow - dry basis	Measured on dry basis ($v_{i,t,db}$)
OPTION B	Volume flow - wet basis	Measured on dry basis ($v_{i,t,db}$)
OPTION C	Volume flow - wet basis	Measured on wet basis ($v_{i,t,wb}$)
OPTION D	Mass flow - dry basis	Measured on dry basis ($v_{i,t,db}$)
OPTION E	Mass flow - wet basis	Measured on dry basis ($v_{i,t,db}$)
OPTION F	Mass flow - wet basis	easured on wet basis ($v_{i,t,wb}$)

Project participant chooses Option A.

Option A

Flow measurement on a dry basis is not doable for a wet gaseous stream. Therefore, it is necessary to demonstrate that the gaseous stream is dry to use this option. There are two ways to do this:

a) Measure the moisture content of the gaseous stream ($C_{H2O,t,db,n}$) and demonstrate that this is less or equal to 0.05 kg H_2O/m^3 dry gas; or
b) Demonstrate that the temperature of the gaseous stream (T_t) is less than 60ºC (333.15 K) at the flow measurement point.

Project participant will measure temperature of the biogas (T_t) at the flow measurement point and demonstrate that (T_t) is less than 60ºC (333.15 K) at the flow measurement point.

If it cannot be demonstrated that the gaseous stream is dry, then the flow measurement should be assumed to be on a wet basis and the corresponding option from the above Table should be applied instead.

The mass flow of methane is determined as follows:
$F_{i,t} = V_{t,db} * v_{i,t,db} * \rho_{i,t}$

Where:
$F_{i,t}$ = Mass flow of greenhouse gas i in the gaseous stream in time interval t (kg gas/h)
$V_{t,db}$ = Volumetric flow of the gaseous stream in time interval t on a dry basis (m³ dry gas/h)
$v_{i,t,db}$ = Volumetric fraction of greenhouse gas i in the gaseous stream in a time interval t on a dry basis (m³ gas i/m³ dry gas)
$\rho_{i,t}$ = Density of greenhouse gas i in the gaseous stream in time interval t (kg gas i/m³ gas i)

$$\rho_{i,t} = \frac{P_t * MM_i}{R_u * T_t}$$

P_t = Absolute pressure of the gaseous stream in time interval *t* (Pa)
MM_i = Molecular mass of greenhouse gas *i* (kg/kmol)
R_u= Universal ideal gases constant (Pa.m^3/kmol.K)
T_t = Temperature of the gaseous stream in time interval *t* (K)

Step2. Determination of flare efficiency

The proposed project uses open flares. Thus, according to the "Project emissions from flaring (Version
2)", the flare efficiency in the minute m ($n_{flare,m}$) is 50% when the flame is detected in the minute m ($Flame_m$), otherwise $n_{flare,m}$ is 0%.

Step3. Calculation of project emissions from flaring

$$PE_{flare,y} = \sum_{m=1}^{OM} F_{CH4,RG,m} \times \left(1 - \eta_{flare,m}\right) \times 10^{-3} \times GWP_{CH4}$$

Where:
$PE_{flare,y}$ = Project emissions from flaring of the residual gas in year y (tCO_2e)
GWP_{CH4} = Global warming potential of methane valid for the commitment period (tCO_2e/tCH_4)
$F_{CH4,RG,m}$ = Mass flow of methane in the residual gas in the minute m (kg)
$\eta_{flare,m}$ = Flare efficiency in minute m
OM_y = Operating minutes in year y

$F_{CH4,RG,m} = F_{i,t} / 60 * OM_y$

Where:
$F_{CH4,RG,m}$ = Mass flow of methane in the residual gas in the minute m (kg)
$F_{i,t}$ = Mass flow of greenhouse gas i in the gaseous stream in time interval t (kg gas/h)
OM_y = Operating minutes in year y

However, for ex ante estimation, in accordance with AMS-III.H version 16 equation 8, baseline emission calculation for wastewater treatment (i.e. equation 2 of AMS-III.H) can be used but without the consideration of GWP for CH_4 according to AMS-III.H. Thus, ex ante methane emissions due to incomplete flaring in year y is calculated as follows:

$$PE_{flaring,y} = \sum (Q_{ww,i,y} \times COD_{inflow,i,y} \times n_{COD,PJ} \times MCF_{ww,treatment,PJ,i}) \times B_{o,ww} \times UF_{PJ}$$

Where:
$Q_{ww,i,y}$ =Volume of wastewater treated in baseline wastewater treatment system *i* in year *y* (m^3).
$COD_{inflow,i,y}$ = Chemical oxygen demand of the wastewater inflow to the baseline treatment system i in year *y* (t/m^3)
$\eta_{COD,PJ,i}$ =COD removal efficiency of the baseline treatment system *i*
$MCF_{ww\ treatment,PJ,i}$`= Methane correction factor for baseline wastewater treatment systems *i* (*MCF* values as per Table III.H.1)
i= Index for baseline wastewater treatment system
$B_{o,ww}$ =Methane producing capacity of the wastewater (IPCC value of 0.25 kg CH_4/kg COD)
UF_{PJ}= Model correction factor to account for model uncertainties (0.89)

Leakages
Leakages are not applicable because there is no transfer of technology from another project activity.

Emission Reduction
As per paragraph 32 of AMS-III.H (version 16), the emission reductions are calculated as per following equation:

$$ER_{y\ ex\ ante} = BE_{y\ ex\ ante} - (PE_{y\ ex\ ante} + LE_{y,\ ex\ ante})$$

Where:

$ER_{y,ex\ ante}$	*Ex ante* emission reduction in year *y* (tCO_2e)
$LE_{y\ ex\ ante}$	*Ex ante* leakage emissions in year *y* (tCO_2e)
$PE_{y,\ ex\ ante}$	*Ex ante* project emissions in year *y* (tCO_2e)
$BE_{y,\ ex\ ante}$	*Ex ante* baseline emissions in year *y* (tCO_2e)

B.6.2. Data and parameters fixed ex ante

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

Data / Parameter	$MCF_{ww,treatment,BL,i}$
Unit	Fraction
Description	Methane correction factor for baseline wastewater treatment system
Source of data	Table III.H.1 in AMS-III.H (version 16)
Value(s) applied	0.80
Choice of data or Measurement methods and procedures	The default value for anaerobic deep lagoons with depth of more than 2 m is specified in AMS-III.H
Purpose of data	Calculation of baseline emission
Additional comment	None

Data / Parameter	$B_{o,ww}$
Unit	kg CH_4/kgCOD
Description	Methane producing capacity of the wastewater
Source of data	Paragraph 20 of AMS-III.H (version 16)
Value(s) applied	0.25

Choice of data or Measurement methods and procedures	IPCC value, as per AMS-III.H (version 16) paragraph 20
Purpose of data	Calculations of baseline and project emissions
Additional comment	None

Data / Parameter	$\mathbf{UF_{BL}}$
Unit	Fraction
Description	Model correction uncertainty factor to account for model uncertainties
Source of data	Paragraph 22 of AMS-III.H (version 16)
Value(s) applied	0.89
Choice of data or Measurement methods and procedures	As per paragraph 22 of AMS-III.H (version 16)
Purpose of data	Calculations of baseline emissions
Additional comment	None

Data / Parameter	$\mathbf{GWP_{CH4}}$
Unit	-------
Description	Global warming potential of methane
Source of data	IPCC value as per paragraph 20 of AMS-III.H (version 16)
Value(s) applied	25
Choice of data or Measurement methods and procedures	IPCC default for second commitment period
Purpose of data	Calculations of baseline and project emissions
Additional comment	None

Data / Parameter	$\eta_{COD,BL,i}$
Unit	%
Description	COD removal efficiency of the baseline treatment system i
Source of data	The value as per manufacturer specification
Value(s) applied	85
Choice of data or Measurement methods and procedures	The data has been determined (please refer to Appendix-4) in line with the requirements of paragraph 28 (2) (b) of the baseline and monitoring methodology AMS-III.H (version 16).
Purpose of data	Calculations of baseline emissions
Additional comment	None

Data / Parameter	$\mathbf{MCF_{ww,treatment\ PJ,k}}$
Unit	Fraction
Description	Methane correction factor for project wastewater treatment system k
Source of data	Table III.H.1 in AMS-III.H (version 16)
Value(s) applied	0.8
Choice of data or Measurement methods and procedures	The project activity wastewater treatment system is an anaerobic digester
Purpose of data	Calculations of project emissions

Additional comment	None

Data / Parameter	UF_{PJ}
Unit	Fraction
Description	Model correction to account for model uncertainties
Source of data	Paragraph 30(a) Eq 11 of AMS-III.H (version 16)
Value(s) applied	1.12
Choice of data or Measurement methods and procedures	As per paragraph 30 of AMS-III.H (version 16)
Purpose of data	Calculations of project emissions
Additional comment	None

Data / Parameter	$\eta_{COD,PJ,j}$
Unit	%
Description	COD removal efficiency of the project treatment system j.
Source of data	The COD removal efficiency is obtained from the supplier of the anaerobic digester.
Value(s) applied	85%
Choice of data or Measurement methods and procedures	The value is used from manufacturer specification.
Purpose of data	Calculations of Project emissions
Additional comment	None

Data / Parameter	CFE_{ww}
Unit	-
Description	Capture efficiency of the biogas recovery equipment in the wastewater treatment systems
Source of data	Default value as per paragraph 30(a) Eq 10 of AMS-III.H version 16
Value(s) applied	0.9
Choice of data or Measurement methods and procedures	In line with AMS-III.H version 16 Para 30(a)
Purpose of data	Calculations of Project emissions
Additional comment	None

Data / Parameter	MCFww,PJ,discharge
Unit	-
Description	Methane correction factor based on the discharge pathway of the wastewater in the project scenario (e.g. into sea, river or lake)
Source of data	Table III.H.1 in AMS-III.H (version 16)
Value(s) applied	0.1

Choice of data or Measurement methods and procedures	The treated wastewater in the project scenario will be discharged to nearby river.
Purpose of data	Calculations of baseline emissions
Additional comment	None

Data / Parameter	$EF_{EL,j,y}$
Unit	tCO2/MWh
Description	Emission factor for electricity generation for source j in year y, where j is the source of electricity consumption in the project
Source of data	Default value under option B2 of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (EB 39, Annex 7)
Value(s) applied	1.3
Choice of data or Measurement methods and procedures	In line with AMS-III.H version 16 Para 29
Purpose of data	Calculations of Project emissions
Additional comment	None

Data / Parameter	Hflare
Unit	-
Description	Flare efficiency
Source of data	Default value for open flaring as per "Project emissions from flaring"
Value(s) applied	0.5, if flare is detected in a minute. 0, otherwise
Choice of data or Measurement methods and procedures	The flaring system used in the project activity is open flaring. Default value of 50% flare efficiency can be used if the flare is detected in a minute . Otherwise, the default efficiency to be considered as 0%.
Purpose of data	Calculation of project emissions
Additional comment	None

Data / Parameter	Ru
Unit	(Pa.m3/kmol.K)
Description	Universal ideal gases constant
Source of data	Tools to determine the mass flow of a greenhouse gas in a gaseous stream
Value(s) applied	8,314
Choice of data Or Measurement methods and procedures	Default value
Purpose of data	Calculation of project emissions
Additional comment	None

Data / Parameter	Mmi
Unit	kg/kmol
Description	Molecular mass of greenhouse gas i

Source of data	Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 02.0.0)
Value(s) applied	Compound Structure: Methane CH_4; Molecular mass (kg / kmol): 16.04
Choice of data or Measurement methods and procedures	The default value from Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 02.0.0).
Purpose of data	Calculation of project emission
Additional comment	None

B.6.3. Ex ante calculation of emission reductions

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Baseline emissions

As mentioned in section B.6.1, the baseline emissions are calculated as follow:

$BE_y = BE_{ww,treatment,y}$

Baseline emissions from wastewater treatment system

$BE_{ww,treatment,y} = \Sigma(Q_{ww,i,y} * COD_{untreated,i,y} * \eta_{COD,BL,i} * MCF_{ww,treatment,BL,i}) * B_{o,ww} * UF_{BL} * GWP_{CH4}$

Table 9: Value of parameters used in baseline emissions calculations

Parameters	Value	Source
$B_{o,ww}$	0.25 kg CH_4/kgCOD	Value as per AMS-III.H (version 16) paragraph 20.
$COD_{untreated,i,y}$	0.0650 tCOD/m^3	Design value from third-party consultant (Global Palm Consultancy SDN BHD) for the palm oil mill. This parameter will be monitored in the ex-post scenario.
$\eta_{COD,BL,i}$	85 %	Designed value as per manufacturer specification established in line with paragraph 28 (2) (b) of AMS-III.H version 16. Please refer Appendix-4 for details.
$Q_{ww,i,y}$	284,700 m^3/year	For *ex-ante* estimation in the PDD, design wastewater generation volume of the project activity is used. However, for ex-post estimation of emission reductions, $Q_{ww,i,y}$ will be monitored in line with the requirements of the methodology.
$MCF_{ww,treatment,BL,i}$	0.8	IPCC value as per Table III.H.1 in AMS-III.H version 16. The plausible baseline scenario is the anaerobic lagoons with depth of more than 2m, therefore value of 0.8 is applied which is in line with the requirements of the methodology.
UF_{BL}	0.89[36]	Value as per AMS-III.H (version 16) paragraph 20.

[36] Reference: FCCC/SBSTA/2003/10/Add.2, page 25

Parameters	Value	Source
GWP_{CH4}	25	IPCC default value

$BE_{ww,treatment,y}$ = 284,700 m^3 * (0.065 tonnes COD/m^3 * 85% * 0.8) * 0.25 tonnes CH_4/tonnes COD * 0.89 * 25
= 69,997 tCO_2e

$BE_y = BE_{ww,treatment,y}$
= 69,997 tCO_2e

Project emissions
As explained in section B.6.1, the emission from project activity is as follow:
$PE_y = PE_{power,y} + PE_{ww,discharge,y} + PE_{fugitive,y} + PE_{flaring,y}$

Project emissions calculations due to electricity consumption ($PE_{EC,y} = PE_{power,y}$)
$PE_{EC,y} = EC_{PJ,j,y} * EF_{EL,j,y} * (1 + TDL_{j,y})$
$PE_{EC,y}$ = 521 * 1.3 * 1
$PE_{EC,y}$ = 678 tCO_2e

Project emissions from the treated wastewater discharged

$PE_{ww,discharge,y} = Q_{ww,y} * GWP_{CH4} * B_{o,ww} * UF_{PJ} * COD_{ww,discharge,PJ,y} * MCF_{ww,PJ,discharge}$
= 284,700 m^3 * 25 tonnes CO_2/tonnes CH_4 * 0.25 tonnes CH_4/tonnes COD * 1.12 * 0.00035 tonnes COD/m^3 * 0.1
= 70 tCO_2e

Project emissions from biogas release in capture system

$MEP_{ww,treatment,y} = Q_{ww,i,y} * B_{o,ww} * UF_{PJ} * COD_{removed,PJ,k,y} * MCF_{ww,treatment,PJ,k}$
= 284,700 m^3 * 0.25 tonnes CH_4/tonnes COD * 1.12 * 0.05525 tonnes COD/m^3 * 0.8
= 3,523 tonnes CH_4

$PE_{fugitive,ww,y} = (1 - CFE_{ww}) * MEP_{ww,treatment,y} * GWP_{CH4}$
= (1 - 0.9) * 3,523 * 25 = 8,809 tCO_2e

$PE_{fugitive,y} = PE_{fugitive,ww,y}$ = 8,809 tCO_2e

Methane emissions due to incomplete flaring

$$PE_{flaring,y} = \sum (Q_{ww,i,y} \times COD_{inflow,i,y} \times n_{COD,PJ} \times MCF_{ww,treatment,PJ,i}) \times B_{o,ww} \times UF_{PJ}$$

= 284,700 m^3 * (0.065 tonnes COD/m^3 * 85% * 0.8) * 0.25 tonnes CH_4/tonnes COD * 0.89
= 2800 tCO_2e

Table 10: Value of parameters used in project emissions calculation

Parameter	Value	Source
$Q_{ww,i,y}$	2,84,700 m^3/year	For *ex-ante* estimation in the PDD, design wastewater generation volume value is used. However, for *ex-post* estimation of emission reductions, $Q_{ww,i,y}$ will be monitored in line with the requirements of the methodology.
$COD_{inflow,i,y}$	0.0650 tCOD/m^3	Design value from third-party consultant (Global Palm Consultancy SDN BHD) for the palm oil mill. This

Parameter	Value	Source
		parameter will be monitored in the ex-post scenario.
$\eta_{COD,PJ}$	85 %	Designed value from manufacturer specification
$B_{o,ww}$	0.25 kg CH_4/kg COD	Value as per AMS-III.H (version 16) paragraph 20.
UF_{PJ}	0.89	Value as per AMS-III.H (version 16) paragraph 29.
$MCF_{ww,treatment,PJ,k}$	0.80	IPCC value as per Table 6.8 Volume 5 Chapter 6 of IPCC 2006 Guideline for anaerobic reactor

$PE_y = PE_{power,y} + PE_{fugitive,y} + PE_{flaring,y} + PE_{ww,discharge,y}$
$PE_y = 678 + 8,809 + 2800 + 70$
$PE_y = 12,357 tCO_2e$

Leakage
The project activity does not involve equipment transfer from another activity thus there are no leakages to be accounted for this project activity.
$LE_y = 0$

Emission reduction
Emission reduction (ER) from the project activity follows the following equation:

$ER_{y\ ex\ ante} = BE_{y\ ex\ ante} – (PE_{y\ ex\ ante} + LE_{y,\ ex\ ante})$
= 69,997 tCO_2e – (12,357 tCO_2e + 0 tCO_2e)
= 57,640 tCO_2e

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

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
2014-15	69997	12357	0	57640
2015-16	69997	12357	0	57640
2016-17	69997	12357	0	57640
2017-18	69997	12357	0	57640
2018-19	69997	12357	0	57640
2019-20	69997	12357	0	57640
2020-21	69997	12357	0	57640
2021-22	69997	12357	0	57640
2022-23	69997	12357	0	57640
2023-24	69997	12357	0	57640
Total	**699970**	**123570**	**0**	**576400**
Total number of crediting years	10			
Annual average over the crediting period	**69997**	**12357**	**0**	**57640**

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data / Parameter	$Q_{ww,i,y}$
Unit	m^3/month
Description	Monthly volume of untreated wastewater entering (inflow) the anaerobic digester in project activity
Source of data	Measurements will be undertaken using flow meter.
Value(s) applied	23,725
Measurement methods and procedures	Measurements are undertaken by using flow meter at inlet of the anaerobic digester. The accuracy class of the meter will be as per applicable industry standard.
Monitoring frequency	Monitored continuously
QA/QC procedures	The measurements will be monitored continuously (at least hourly measurements will be undertaken, if less than confidence/ precession level of 90/10 is attained). Calibration of the flow meters will be conducted as specified by manufacturer or once every 3 years, whichever is less.
Purpose of data	Calculations of baseline and project emissions
Additional comment	Data will be archived for 2 years from the end of the crediting period or the last request for issuance whichever is later.

Data / Parameter	$COD_{untreated,i,y}$ or $COD_{inflow,i,y}$
Unit	$tCOD/m^3$
Description	Chemical Oxygen Demand of the wastewater entering the Anaerobic Digester
Source of data	Representative Sampling by PP
Value(s) applied	0.065
Measurement methods and procedures	The measurement of COD will be according to national or international standards by internal team from PP. The COD will be measured through representative sampling. The values will be cross-checked periodically through an accredited laboratory.
Monitoring frequency	Periodically
QA/QC procedures	Average value will be used through sampling with 90/10 confidence/precision level.
Purpose of data	Calculations of baseline and project emissions
Additional comment	Data will be archived for 2 years from the end of the crediting period or the last request for issuance whichever is later

Data / Parameter	$COD_{ww,treated,y}$
Unit	$tCOD/m^3$
Description	Chemical oxygen demand of the treated wastewater leaving the anaerobic digester
Source of data	Representative Sampling by PP
Value(s) applied	0.00975
Measurement methods and procedures	The measurement of COD will be according to national or international standards by internal team from PP. The COD will be measured through representative sampling. The values will be cross-checked periodically through an accredited laboratory.
Monitoring frequency	Periodically.
QA/QC procedures	Average value will be used through sampling with 90/10 confidence/precision level.
Purpose of data	Calculations of project emissions
Additional comment	Data will be archived for 2 years from the end of the crediting period or the last request for issuance whichever is later.

Data / Parameter	$COD_{ww,discharge,pj,y}$
Unit	$tCOD/m^3$
Description	Chemical oxygen demand of the treated wastewater discharged into sea river or lake
Source of data	Representative Sampling by PP
Value(s) applied	0.00035
Measurement methods and procedures	The measurement of COD will be according to national or international standards by internal team from PP. The COD will be measured through representative sampling. The values will be cross-checked periodically through an accredited laboratory.
Monitoring frequency	Periodically.
QA/QC procedures	Average value will be used through sampling with 90/10 confidence/precision level.
Purpose of data	Calculations of project emissions
Additional comment	Data will be archived for 2 years from the end of the crediting period or the last request for issuance whichever is later.

Data / Parameter	**vi,t,db**
Unit	m^3 gas i/m^3 dry gas
Description	Volumetric fraction of greenhouse gas i in a time interval t on a dry basis
Source of data	Measured on site.
Value(s) applied	Not applicable for ex-ante calculation
Measurement methods and procedures	Continuous gas analyser operating in dry-basis. Volumetric flow measurement refer to the actual pressure and temperature
Monitoring frequency	Continuous

QA/QC procedures	Calibration includes zero verification with an inert gas (e.g. N2) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases will have a certificate provided by the manufacturer and under their validity period.
Purpose of data	Calculation of project emissions
Additional comment	Data will be archived for 2 years from the end of the crediting period or the last request for issuance whichever is later.

Data / Parameter	**Vt,db**
Unit	m^3 dry gas/h
Description	Volumetric flow rate of the gaseous stream in time interval t on a dry basis
Source of data	Measured on site.
Value(s) applied	Not applicable for ex-ante calculation
Measurement methods and procedures	Volumetric flow measurement refers to the actual pressure and temperature. Calculated based on the wet basis flow measurement plus water concentration measurement
Monitoring frequency	Continuous
QA/QC procedures	Periodic calibration against a primary device provided by an independent accredited laboratory. Calibration and frequency of calibration is according to manufacturer's specifications.
Purpose of data	Calculations of project emissions
Additional comment	Data will be archived for 2 years from the end of the crediting period or the last request for issuance whichever is later.

Data / Parameter	**Flame,m**
Unit	Flame on or Flame off
Description	Flame detection of flare in the minute m
Source of data	Flare detection system
Value(s) applied	None
Measurement methods and procedures	Measure using a fixed installation optical flame detector: Ultra Violet detector or Infra Red or both
Monitoring frequency	Once per minute. Detection of flame recorded as a minute that the flame was on, otherwise recorded as a minute that the flame was off
QA/QC procedures	This will be monitored on a continuous basis. Calibration of the detector will be done periodically according to the manufacturer's specification or once every 3 years, whichever is lesser.
Purpose of data	Calculations of project emissions
Additional comment	Applicable because open flaring is used. Data will be archived for 2 years from the end of the crediting period or the last request for issuance whichever is later. Monitoring will be on continuous basis.

Data / Parameter	**ECPJ,j,y**
Unit	MWh/yr

Description	Quantity of electricity consumed by the project electricity consumption source j in year y
Source of data	Electricity meters
Value(s) applied	521
Measurement methods and procedures	Continuously, aggregated at least monthly. The accuracy class of the meter will be as per applicable industry standard.
Monitoring frequency	Monthly
QA/QC procedures	Calibration of the meter will be done periodically according to the manufacturer's specification or once every 3 years, whichever is lesser
Purpose of data	Calculations of project emissions.
Additional comment	This parameter is only measured when back-up generator is used. Data will be archived for 2 years from the end of the crediting period or the last request for issuance whichever is later. Monitoring will be on continuous basis.

Data / Parameter	**Tt**
Unit	K
Description	Temperature of the gaseous stream in time interval t (K)
Source of data	Temperature meter (if applicable)
Value(s) applied	Not applicable for ex-ante calculation
Measurement methods and procedures	Instruments with recordable electronic signal (analogical or digital) are required. Examples include thermocouples, thermo resistance, etc
Monitoring frequency	Continuous unless differently specified in the underlying methodology
QA/QC procedures	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. Calibration and frequency of calibration is according to manufacturer's specifications
Purpose of data	Calculations of project emissions
Additional comment	Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture content determination and therefore it should be metered only when performing such measurements (with same frequency). However, if the applicability condition related to the gaseous stream flow temperature being below 60"C is adopted, this parameter must be monitored continuously to assure the applicability condition is met. The data will be archived electronically and kept for minimum of two years after the end of the crediting period or the last issuance of CERs for the project activity, whichever occurs later.

Data / Parameter	**Pt**
Unit	Pa
Description	Pressure of the gaseous stream in time interval t
Source of data	Absolute pressure transmitter (if applicable)

Value(s) applied	Not applicable for ex-ante calculation
Measurement methods and procedures	Instruments with recordable electronic signal (analogical or digital) are required. Examples include pressure transducers, etc.
Monitoring frequency	Continuous unless differently specified in the underlying methodology
QA/QC procedures	Periodic calibration against a primary device must be performed periodically and records of calibration procedures must be kept available as well as the primary device and its calibration certificate. Pressure transducers (either capacitive or resistive) must be calibrated monthly
Purpose of data	Calculations of project emissions
Additional comment	Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture content determination and therefore it should be metered only when performing such measurements (with same frequency) The data will be archived electronically and kept for minimum of two years after the end of the crediting period or the last issuance of CERs for the project activity, whichever occurs later.

Data / Parameter	**TDLi,y**
Unit	
Description	Average technical transmission and distribution losses for providing electricity to source j in year y
Source of data	Tool to calculate baseline, project and/or leakage emissions from electricity consumption
Value(s) applied	0
Choice of data or Measurement methods and procedures	Measurement is not required as default value of 0 is used for scenario B according to the Tool to calculate baseline, project and/or leakage emissions from electricity consumption.
Purpose of data	To calculate project emission
Additional comment	The data will be archived electronically and kept for minimum of two years after the end of the crediting period or the last issuance of CERs for the project activity, whichever occurs later.

Data / Parameter	$\mathbf{BG_{burnt,y}}$
Unit	m3
Description	Biogas volume in year y
Source of data	Flow Meter
Value(s) applied	Monitored continuously (at least hourly measurements are undertaken, if less, confidence/precision level of 90/10 shall be attained)

Choice of data or Measurement methods and procedures	In all cases, the amount of biogas recovered, fuelled, flared or otherwise utilized (e.g. injected into a natural gas distribution grid or distributed via a dedicated piped network) shall be monitored ex post, using continuous flow meters. If the biogas streams flared and fuelled (or utilized) are monitored separately, the two fractions can be added together to determine the total biogas recovered, without the need to monitor the recovered biogas before the separation. The methane content measurement shall be carried out close to a location in the system where a biogas flow measurement takes place
Purpose of data	Baseline and project emission
Additional comment	The data will be archived electronically and kept for minimum of two years after the end of the crediting period or the last issuance of CERs for the project activity, whichever occurs later.

Data / Parameter	$\eta_{flare,h}$
Unit	Percentage
Description	Flare efficiency in hour h based on measurements or default values.
Source of data	Based on default value
Value(s) applied	Measurements by project participants
Choice of data or Measurement methods and procedures	This should include all data and parameters that are required to monitor whether the flare operates within the range of operating conditions according to the manufacturerís specifications including a flame detector in case of open flares.
Purpose of data	Project emission
Additional comment	The data will be archived electronically and kept for minimum of two years after the end of the crediting period or the last issuance of CERs for the project activity, whichever occurs later.

Data / Parameter	$S_{final,PJ,final}$
Unit	Tonnes
Description	Amount of dry matter in final sludge
Source of data	Onsite measurement
Value(s) applied	0
Choice of data Or Measurement methods and procedures	Measure the total quantity of sludge on a wet basis. The volume (m3) and density or direct weighing may be used to determine the sludge amount (wet basis). Representative samples are taken to determine the moisture content to calculate the total sludge amount on dry basis. If the methane emissions from anaerobic decay of the final sludge are to be neglected because the sludge is controlled combusted, disposed of in a landfill with methane recovery, or used for soil application, then the end-use of the final sludge will be monitored during the crediting period.
Monitoring frequency	Average value will be used through sampling with 90/10 confidence/precision level. Calibration of the equipment used will also be conducted as per manufacturer specifications. Cross-check will be performed at least every six months by accredited lab. In case accredited lab is used, the acredition certificate will act as the proof of correct calibration and application of standard by the respective lab.
QA/QC procedures	Average value will be used through sampling with 90/10 confidence/precision level.
Purpose of data	Data is used to estimate project emission
Additional comment	The data will be archived electronically and kept for minimum of two years after the end of the crediting period or the last issuance of CERs for the project activity, whichever occurs later.

Data / Parameter	$w_{CH4,y}$
Unit	%
Description	Methane content in the biogas in year y.
Source of data	Onsite measurement using gas analyser.
Value(s) applied	60
Measurement methods and procedures	The fraction of methane in the gas will be measured with a continuous analyser or, alternatively, with periodical measurements at a 90/10 confidence/precision level by appointed staff of the project owner. It will be measured using equipment that can directly measure methane content in the biogas - the estimation of methane content of biogas based on measurement of other constituents of biogas such as CO2 is not permitted. The methane content measurement shall be carried out close to a location in the system where a biogas flow measurement takes place.
Monitoring frequency	The fraction of methane in the gas should be measured with a continuous analyser or, alternatively, with periodical measurements at a 90/10 confidence/precision level.
QA/QC procedures	The measurement will be monitored regularly and the analyser used will be calibrated periodically as per vendor's specifications.
Purpose of data	Data is used for calculation of Project Emission
Additional comment	The data will be archived and kept for minimum of two years after the end of the crediting period or the last issuance of CERs for the project

	activity, whichever occurs later.

B.7.2. Sampling plan

>>
During monitoring period, the COD level will be determined through sampling. Representative sample size will be taken to ensure the 90/10 confidence/precision level requirement. COD levels will be monitored based on the table below.

Table 11: Determination of representative sample size

Parameters for monitoring	Minimum sample size required for 90/10 confidence/precision level[37]	Actual sample size
COD of untreated, treated, and discharged wastewater	30 (based on a population of 52 samples)	52 (once every week)

B.7.3. Other elements of monitoring plan

>>
The PP is well aware of the importance of having a good operational and management team in order to execute a well-defined monitoring plan for the project activity. From this perspective, PP's operational team for the palm oil mill will have the responsibility of data monitoring, archiving and analyzing and will report to the plant's management team.

There will be an operational and management team formed, which will be responsible to operate and maintain the wastewater treatment system and implement the monitoring plan.

The team will be responsible for daily monitoring of the processes in accordance to the quality assurance and control of each parameter as per the monitoring plan. In addition, a technician will be responsible in recording the monitored data and report any abnormalities to plant manager on daily basis. The aggregated monitored and recorded data will be stored electronically and in hard copy format up to 2 years after the end of crediting period or the last issuance of CERs, whichever is later. The monitored and recorded data will be used and presented to DOE during CERs verification. The plant manager will be responsible to review the work performed by the technician and making final reporting to the management of the PP.

The roles and responsibilities performed by the team members are as below:

Role	Responsibility description
Technician	• *Data collection* o Collect the data on the various monitoring parameters as per the monitoring plan. o Report to the plant manager if there any abnormalities • *Data archiving* o Well-defined protocols and routine procedures, with good, professional data entry, extraction and reporting will be encouraged to maximize transparency of data archiving • *Data aggregation and emission reduction calculations* o Data for various parameters will be aggregated and used in

[37] "Easy Sample"- a sampling software used for determining sample size.

Role	Responsibility description
	emission reduction calculations. • *Verification* ○ Coordinate with the DOE during verification.
Plant Manager	• Review and confirm the raw data collected, aggregated and emission reduction calculations done by the technician. • Assist the technician during verification. • Responsible for reporting the following to the management: • Estimated emission reductions during the monitoring period • Outcome of the verification and status of issuance of CERs

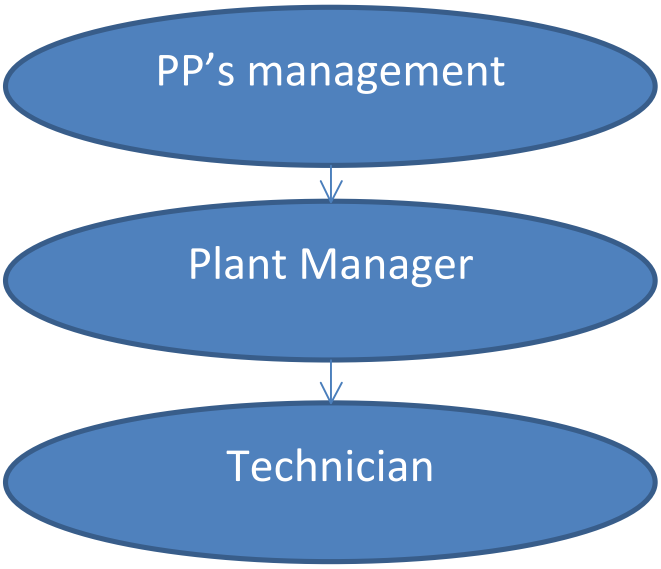

Figure 6: Organizational Structure

Quality assurance and quality control
Calibration will be carried out in accordance with the equipment manufacturer's recommendation as may be applicable depending upon the nature of the measurement equipment. There may exist certain measurement equipments which need not be recalibrated during their entire life span. PP will take responsibility for the quality assurance and quality control for recording, maintaining and archiving all the data by appointing consultants and/or technical support team to carry out the system analysis, equipment calibration and overall maintenance on a regular basis throughout the crediting period. PP will impart necessary training on data monitoring and recording to all the staff personnel involved in the monitoring process, in order to improve the efficiency of their work.

Emergency procedure
PP will implement an Emergency Procedure in the plant, for which a detailed manual will be developed. The manual will contain instructions on how to handle an emergency situation in the plant, and measures to be taken to ensure that there is no unintended methane leakage from the system. All the plant operators will be familiarized on the procedure.

B.7.4. Date of completion of application of methodology and standardized baseline and contact information of responsible persons/ entities

>>
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Director

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SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

>>
10/02/2011
(Date of execution of the contract to implement the project activity)

C.1.2. Expected operational lifetime of project activity

>>
20 years

C.2. Crediting period of project activity

C.2.1. Type of crediting period

>>
Fixed crediting period

C.2.2. Start date of crediting period

>>
06/01/2015 (start date of crediting period shall be the date of registration or the commencement of operation of the project activity whichever is later)

C.2.3. Length of crediting period

>>
10 years 00 months

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>
The environmental approval for the project activity along with that of the palm oil mill and plantations was obtained as a common and combined approval on 31/12/2008. An environmental impact assessment has been documented; identifying environmental impact areas include the following:

Air quality
The project activity will generate dust and particulate matter due to exhaust from vehicles related to the construction of the project activity. Post-construction, during operation, the air pollutant emitted by the palm oil mill are nitrogen dioxide (NO_2), sulphur dioxide (SO_2), Lead (Pb) and particulate matters.

Water quality
There may be impact on the water quality due to increased sedimentation from civil works during the construction. Similarly, during the operation of the palm oil mill, the physical and chemical characteristics of the water of the nearby river may be affected.

Noise level
There will be increased noise level due to manpower mobility and logistics transportation during the construction of the project activity. Throughout the operation of the palm oil mill, there will be increased vehicles activity for regular transportation passing through the villages.

Soil Fertility
Drainage during the construction will significantly improve the fertility of the soil. During the operation of the palm oil mill the sludge generated will be used for land application and hence affect the soil fertility.

Biodiversity
As a consequence of the impact on water quality and accumulation of organic matter, there may be impacts towards the biodiversity in the nearby river during the operation of the palm oil mill.

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

>>
The local stakeholder meeting of this proposed project activity was held on 5th May 2011 from 10.30 am – 12.00 pm at PT. Umbul Mas Wisesa, Desa Tanjung Mulia, Kecamatan Kampung Rakyat, Kabupaten South Labuhan Batu, North Sumatra, Indonesia with Knowledge Integration Service (Singapore) Pte. Ltd. (KIS Group).

The meeting was attended by 40 people, among them: Ministry of Environment Jakarta, Board of Environment South Labuhan Batu, local government and local community.

The agenda of the meeting was as follows:

1. Explanation of Clean Development Mechanism (CDM) project.
2. Explanation on the technology used in the project.
3. Project’s contribution to sustainable development.
4. Clean Development Mechanism (CDM) in Kyoto Protocol.

Question and answer (Q&A) session

E.2. Summary of comments received

>>
There were three queries from the participants at the end of the presentation from the PP.

Query 1: What is company’s contribution with the implementation of the CDM project?

Response from PP: This project contributes to give opportunity for technology transfer in the use of anaerobic reactor for palm oil mill effluent treatment in Indonesia.

Query 2: In the existence of CDM, will the company accept more local manpower to work?

Response from PP: The operation and maintenance of the anaerobic reactor system require high level of skill. Recruitment of manpower will be in accordance with the required skills.

Query 3: How does methane capture work?

Response from PP: Methane gas is captured by treating the POME in an anaerobic reactor made of light steel sheets with total capacity of around 8,495 m^3 and residence time of 11 days and equipped with biogas recovery system.

The reactor will be equipped with agitator which will maintain the bacteria to work. The type of reactor is Continuous Stirred Tank Reactor (CSTR) and expected to generate 28 m^3 biogas per m^3 of treated POME. The generated biogas will then be collected and stored in a floating type biogas tank.

Sludge from the POME will be separated and some of them re-circulated to the reactor to maintain appropriate microorganism population in the reactor

E.3. Report on consideration of comments received

>>
The local stakeholders did not raise any objections or concerns about the proposed project.

SECTION F. Approval and authorization

>>
The letter of approval (LoA) for the project activity was provided by the Indonesian Designated National Authority (DNA) on 06/03/2012.

Appendix 1. Contact information of project participants and responsible persons/ entities

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	PT Umbul Mas Wisesa
Street/P.O. Box	Jl. Imam Bonjol no 18
Building	Gedung Bank Sumut, 7th Floor
City	Medan
State/Region	North Sumatra
Postcode	20152
Country	Indonesia
Telephone	+6261-4152043
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E-mail	marketing@tolantiga.co.id
Website	http://www.tolantiga.co.id
Contact person	Mr. Achuthan Govindan
Title	Director of Engineering
Salutation	Mr.
Last name	Govindan
Middle name	--
First name	Achuthan
Department	--
Mobile	--
Direct fax	--
Direct tel.	--
Personal e-mail	achuthan@tolantiga.co.id

Appendix 2. Affirmation regarding public funding

There is no public funding available for this project activity.

Appendix 3. Applicability of methodology and standardized baseline

There is no further background information on the applicability of this methodology

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

As per paragraph 28 of AMS-III.H (version 16), there are two options, i.e. (2) (a) and (2) (b), to determine baseline emissions in the Greenfield projects. PP has selected option (2) (b) which takes value provided by the manufacturer/designer of a Greenfield wastewater treatment plant using the same technology demonstrated to be conservative, e.g. average values from the top 20 percent plants with lowest emission rate per ton COD removed among the plants installed in the last five years designed for the same country/region to treat the same type of wastewaters at the project activity.

In the proposed project activity, COD removal efficiency of the baseline system ($\eta_{COD,BL,i}$) is obtained from the average values of the top 20% wastewater treatment plants from registered CDM projects with the lowest emission per ton COD removed among the plants installed in the last 5 years designed for same country/region to treat the same type of wastewater as the project activity. This is in line with para 28(2b) of AMS-III.H version 16.

Table 12: COD removal efficiency of the baseline system ($\eta_{COD,BL,i}$)

S.No.	UN Ref. No.	Historical Data Availability For At Least One Year	Baseline Cod Removal Efficiency	Emission Per Ton Of COD Removed (CO_2e/tCOD)	Registration Date With UNFCCC	COD (mg/l)	Selected
1	4480	YES	0.865	3.74	Oct-11	108723	No
2	3702	YES	0.979	2.95	Nov-10	65360	Yes
3	2664	YES	0.922	3.53	Nov-09	47825	No
4	2662	YES	0.922	3.81	Feb-10	47720	No
5	2621	YES	0.905	3.76	Nov-09	76950	Yes
6	2633	YES	0.837	3.45	Nov-09	32704	No
7	2421	YES	0.9423	3.53	Jun-09	52000	Yes
8	2634	YES	0.92	3.30	Nov-09	34902	No
9	1899	YES	0.98	3.60	Dec-08	52650	Yes
10	2130	YES	0.89	3.96	Jan-09	85767	No
11	Project activity	NO	0.85	NA	NA	65000	

PP has analyzed the registered CDM projects for the last 5 years and selected the project activities with COD values ranging between ± 20% of the COD value of the project activity i.e. between 52,000 mg/l to 78,000 mg/l. Based on above analysis, 4 projects were found under the given criterion, out of which lowest emission per ton COD removed for the project (UNFCCC Ref. No.

3702) is selected as baseline. Below is the list of similar projects identified from the CDM projects registered with UNFCCC in last five year prior to publishing of the proposed project activity for global stakeholder consultation at UNFCCC website i.e. 07/12/2011.

S.No.	UN Ref. No.	Historical Data Availability For At Least One Year	Baseline Cod Removal Efficiency	Emission Per Ton Of COD Removed ($CO_2e/tCOD$)	Registration Date With UNFCCC	COD (mg/l)	Sele
1	3702	YES	0.979	2.95	Nov-10	65360	Y
2	2421	YES	0.9423	3.53	Jun-09	52000	Y
3	1899	YES	0.98	3.60	Dec-08	52650	Y
4	2621	YES	0.905	3.76	Nov-09	76950	Y
5	Project activity	NO	0.85	NA	NA	65000	

The lowest emission per ton COD removed from the table above is 2.95 (UNFCCC Ref. No. 3702) for which the baseline COD removal efficiency of 97.9%. Considering uncertainty factor of 0.89, the COD removal efficiency for the selected project comes out to be 87.13%.

As per manufacturer specification, the COD removal efficiency of the for baseline scenario i.e. 85% is lower than 87.13% and hence is conservative.

Appendix 5. Further background information on monitoring Sampling Plan

Determination of representative sampling data

During monitoring period, COD levels which will be determined through sampling. Representative sample size will be taken to ensure at least 90/10 confidence/precision level requirement. Each CPA will follow the “Best Practice Examples Focusing on Sample Size and Reliability Calculations” (Annex-6, EB (hereinafter referred to as “Best Practice Examples”) for determining the number of COD samples to be taken in order to ensure 90/10 confidence precision level. The CPA will follow the relevant guidance applicable to “Measurement in Biogas Projects” from clause 96 through clause 112 of the best practice examples.

Random COD samples will be taken over a campaign period of 10 days at the start of any monitoring period for obtaining the COD values. These monitored results will be used to calculate the mean and standard deviation for COD results as input parameters in equation 39 (page 20, Annex 6, EB 67 Report) for determining the actual/required sample size for COD measurements over the entire monitoring period.

The output of the above will be compared with proposed schedule as per clause 109 (page 21, Annex 6, EB 67 Report), to select the exact COD monitoring schedule for the relevant monitoring period.

No.	Parameter	Unit	Source of Data

1.	$Q_{ww,i}$	m³/month	The monthly flow of untreated wastewater entering the anaerobic digester
2.	$COD_{untreated,i, y\ or}$ $COD_{inflow,i, y}$	tCOD/m³	Chemical Oxygen Demand of the wastewater entering the anaerobic digester
3.	$COD_{ww,treated,y}$	tCOD/m³	Chemical Oxygen Demand of the treated wastewater leaving the anaerobic digester
4.	$COD_{ww,discharge,y}$	tCOD/m³	Chemical Oxygen Demand of the treated wastewater discharged into sea river or lake
5.	$v_{i,t,db}$	m³ gas i/m^3 dry gas	Volumetric fraction of greenhouse gas i in a time interval t on a dry basis
6.	$V_{t,db}$	m³ dry gas/h	Volumetric flow rate of the gaseous stream in time interval t on a dry basis
7.	$Flame_m$	Flame on or Flame off	Flame detection of flare in the minute m
8.	$EC_{PJ,j,y}$	MWh/yr	Quantity of electricity consumed by the project electricity consumption source j in year y
9.	T_t	K	Temperature of the gaseous stream in time interval *t* (K)
10.	P_t	Pa	Pressure of the gaseous stream in time interval t

Appendix 6. Summary of post registration changes

Not applicable

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Document information

Version	*Date*	*Description*
05.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the project design document form for small-scale CDM project activities (these instructions supersede the "Guidelines for completing the project design document form for small-scale CDM project activities" (Version 01.1)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and **Error! Reference source not found.**; • Change the reference number from *F-CDM-SSC-PDD* to *CDM-PDD-SSC-FORM*; • Editorial improvement.
04.1	11 April 2012	Editorial revision to change history box by adding EB meeting and annex numbers in the Date column.
04.0	13 March 2012	EB 66, Annex 9 Revision required to ensure consistency with the "Guidelines for completing the project design document form for small-scale CDM project activities"
03.0	15 December 2006	EB 28, Annex 34 • 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.
02.0	08 July 2005	EB 20, Annex 14 • 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>.
01.0	21 January 2003	EB 07, Annex 05 Initial adoption.

Decision Class: Regulatory
Document Type: Form
Business Function: Registration
Keywords: project design document, SSC project activities