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

CONTENTS

Revision history of this document

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

SECTION A. General description of small-scale project activity

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

Title: Biogas recovery from wastewater treatment in PT. Umbul Mas Wisesa Palm Oil Mill

Version: 01
Date: 11/08/2011

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

Introduction
The proposed 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 are Greenfield projects. The palm oil mill will be set up by PT. Umbul Mas Wisesa ("UMW") at Labuhan Batu, North Sumatra, Indonesia. The mill is expected to be fully operational in March 2012 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 either by use in a boiler in the palm oil mill or by flaring or by a combination of both. The use of the biogas is not part of the CDM project activity. Treatment of discharged POME in anaerobic open lagoons without biogas recovery is the most plausible baseline scenario for the proposed project activity. This will be demonstrated under section B.4 of the PDD. 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.

Proposed technology for the project activity
The technology used in the project activity comprises of pre-treatment, anaerobic digester and downstream aerobic treatment system. The POME will be stabilized and cooled down. The suspended solids and emulsified oil will be removed from the POME. The pre-treated POME will then be passed on to the anaerobic digester where the COD content will be reduced. The digester will be equipped with biogas recovery system to recover the generated biogas. The sludge generated from the digestion process will be dried and used for land application under aerobic condition.

The clarified POME will be treated in the downstream activities which include aerobic treatment systems. The final treated POME from the treatment plant will be of re-usable quality and will be used for land application under aerobic condition.

The project activity will therefore reduce greenhouse gases (GHG) emissions through recovery of methane in the anaerobic digesters.

Contribution to Sustainable Development
The project activity contributes to the sustainable development in four principal aspects:

Environmental Sustainability

1. The project activity involves the use of anaerobic digesters with methane recovery. It thus avoids the emission of methane into the atmosphere and therefore contributes to the reduction of GHG emissions.The project activity may further utilize the recovered biogas for energy generation for captive consumption; this would reduce the emissions associated with the fossil fuel use. It will also conserve the use of natural resources used as fuel.
2. The treated wastewater discharged from the project activity will meet the standards set for the industrial wastewater, particularly for palm oil industry[1].
3. The project activity introduces water re-use which reduces on-site water consumption, and thus contributes to conservation of natural resources (i.e. water).
4. The project activity will not cause any disturbance to the biodiversity and the natural habitats in the surrounding area of the project.
5. The PP will ensure all requirements pertaining to this land use, i.e. permissions and approvals from the relevant agencies, will be complied with.
6. The project activity will implement best practices in issues related to health and safety, and thus it will not impose health risk for the employees or for the local community. Further, the avoidance of methane emission will reduce the unpleasant odour associated with the POME treatment in the most plausible baseline system.
7. The PP will ensure that the project activity will comply with the work safety regulations. There will be staffs transferred from the group company, who are ISO 14001, RSPO and ISCC certified. These employees are used to work in accordance with the Health and Safety Regulations at workplace. The PP will form a specific committee for health and safety issues at workplace.
8. All procedures related to efforts in preventing accidents in the project site and the actions to be taken if accidents happen are documented in a company's reference called "Kebijakan Keselamatan dan Kesehatan Kerja".

Economic Sustainability

1. The project activity will not reduce the income of local community. In fact, as it requires more skilful manpower in operation from diverse backgrounds (i.e. engineering, science and finance), the implementation of this project will potentially increase employment opportunities in the region.
2. Further, the PP will ensure that there are no layoff issues, to the extent possible, which will arise due to the project activity. For any such occurance, a discussion will be conducted and the PP will ensure that the national labour law is complied.
3. The project activity will not reduce the quality of any public service (e.g. health, education, energy, etc) provided for local community in any way.

Social Sustainability

1. The project activity has encouraged community participation. A local stakeholder consultation has been conducted. More details of the local stakeholder comments and the responses and further actions taken by PP are provided in section E of this PDD.
2. The project activity will not cause any conflicts in the community that can affect the social integrity of the local communities.

Technological Sustainability

1. The use of foreign imported technology will stimulate and promote the development and transfer of more wastewater treatment technologies into Indonesia. The technology supplier

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

will ensure that the employees can operate and maintain the system at ease independently. Further, there will be technology transfer with regards to construction of the project and the use of biogas.

2. The technology is a new anaerobic reactor imported from India. It is not obsolete and neither is in trial period. Implementation of this project will encourage the use of similar technical design technology in Indonesia and thus will promote the sustainability of this technology.
3. Through the technology transfer (i.e. skills upgrading and trainings), this project activity will involve use the new technology in the treatment system and will enhance local operators' knowledge and expertise. Thus, the local capability and workforce quality will be improved.

A.3. Project participants:

Name of the party involved ((host) indicates a host party)	Private and/or public entity(ies) Project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Indonesia	PT Umbul Mas Wisesa	No
Indonesia	Knowledge Integration Services (Singapore) Pte Ltd	No

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

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

A.4.1.1. Host Party(ies):

Republic of Indonesia

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

North Sumatra Province, Sumatra Island

A.4.1.3. City/Town/Community etc:

Panai Tengah, Labuhan Batu Regency

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

The project activity will be located at Tanjung Mulia village, Panai Tengah sub-district, 212 km South East of Medan, the capital city of North Sumatra Province. The coordinates for the CDM project activity at the palm oil mill site is approximately 2^o12'50.55"N and 100^o16'15.14"E.

Figure 1: Labuhan Batu, North Sumatra (Source: Wikipedia, 2011)

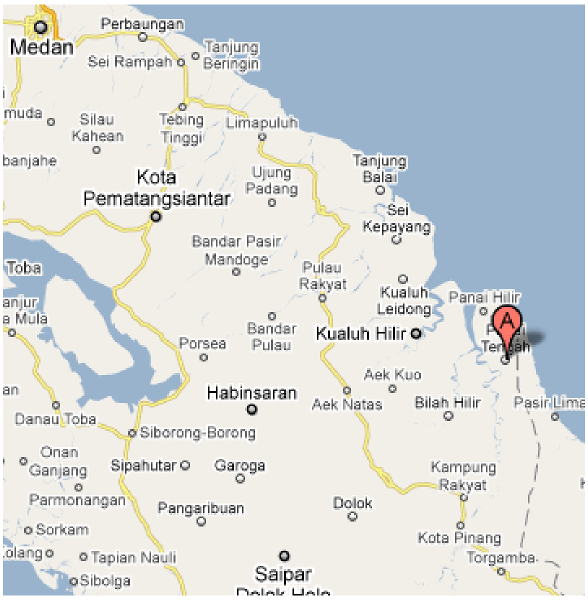

Figure 2: Location map for Panai Tengah (Source: Google Map, 2011)

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

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[2]:

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 introduction of a sequential stage wastewater treatment system utilising an anaerobic digester system with methane recovery for treatment of POME generated from the palm oil milling operations.

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

The flow of raw POME from the palm oil mill will be stabilized in an equalization tank. The stabilized POME will then be cooled through a heat exchanger system. The cooled POME will then be treated in a Dissolve Air Flotation and primary clarifier system for removing the suspended solids and emulsified oil.

The POME will be treated biologically to reduce the COD content in an anaerobic digester. The digester will be equipped with biogas recovery system to recover the generated biogas. The sludge generated during the digestion process will be separated from the POME in the subsequent clarifier. A portion of the sludge is then re-circulated to the digester to help maintaining adequate population of active bacteria inside the digester. The remaining of the sludge will be dried and then used for land application under aerobic condition.

The clarified overflow POME from the clarifier will be further treated in the downstream activities. This includes aerobic treatment in conventional and extended aeration tanks followed by post treatment of the POME (i.e. chlorination, de-chlorination and filtration with multi grade and activated carbon). The final treated POME will be discharged to nearby plantation area under aerobic condition.

The anaerobic digester used in the project activity will have the following characteristics:

- Capacity: 8,495 m^3
- Hydraulic residence time: 11 days (=8,495m^3 / 780 m^3/day)
- COD removal efficiency: 85%

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

Years	Annual estimation of emission reductions in tonnes of CO_2 equivalent (tCO_2e)
2012-13	51,399
2013-14	51,399
2014-15	51,399
2015-16	51,399
2016-17	51,399
2017-18	51,399
2018-19	51,399
2019-20	51,399
2020-21	51,399
2021-22	51,399
Total estimated reductions (tonnes of CO_2e)	513,990
Total number of crediting years	10
Annual average of the estimated reductions over the crediting period (tCO_2e)	51,399

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

No public funding is involved for this project activity.

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

In accordance to the Appendix C of the simplified modalities and procedures for the small-scale CDM project activities, 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 (PP) has reviewed the list of projects published on the UNFCCC website and based on such review it is concluded that the project activity is not a de-bundled component of a large scale project activity.

SECTION B. Application of a baseline and monitoring methodology

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

The baseline and monitoring of this project activity is based on the following approved methodology, guidelines and tools:

(1) **AMS-III-H (version 16)**: "Methane recovery in wastewater treatment"
(2) General Guidelines to SSC CDM methodologies (version 17).
(3) Tool to determine project emissions from flaring gases containing methane (EB 28, Annex 13).
(4) Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion (EB 41, Annex 11).

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

The project activity involves the installation of a Greenfield anaerobic digester based wastewater treatment facility, which will be built in parallel to a completely new palm oil mill. 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	The proposed project activity implements a Greenfield anaerobic digester with biogas recovery, without sludge treatment, to an untreated wastewater stream generated from a Greenfield palm oil mill. This therefore refers to option 1 (e).

Para. No.	AMS-III.H Applicability Requirements	Project activity
	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).	
2	In cases where baseline system is anaerobic 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.	As this is a Greenfield project, the 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. The details of the projects are provided in Annex 3 of this PDD. 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

Para. No.	AMS-III.H Applicability Requirements	Project activity
		baseline COD removal efficiency for this project activity is referred (i.e. 85%), is 6 meters[3]. The ambient temperature in 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^{o}C[4]. 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[5]" the lagoons are able to properly function without sludge removal for up to 5 to 10 years.

[3] The list of projects from which this value was taken is provided in Annex 3 of this PDD.

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

[5] National Small Flows Claringhouse (1997). *Lagoons Need Propoer 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
3	The recovered biogas from the above measures may also be utilised for the following applications instead of combustion/flaring: 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.	The recovered biogas will be combusted either by use in a boiler for energy generation or by flaring or by a combination of both.
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 some of the generated biogas from the project activity might potentially be used for electricity generation in biogas engine, the PP will not claim any emission reductions generated from it.
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 to 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.

Para. No.	AMS-III.H Applicability Requirements	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 defined under section A.4.1.
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 51,399 tCO_2e during the crediting period (refer to Section A.4.3 above)

B.3. Description of the project boundary:

The project boundary is delineated in Figure 3.

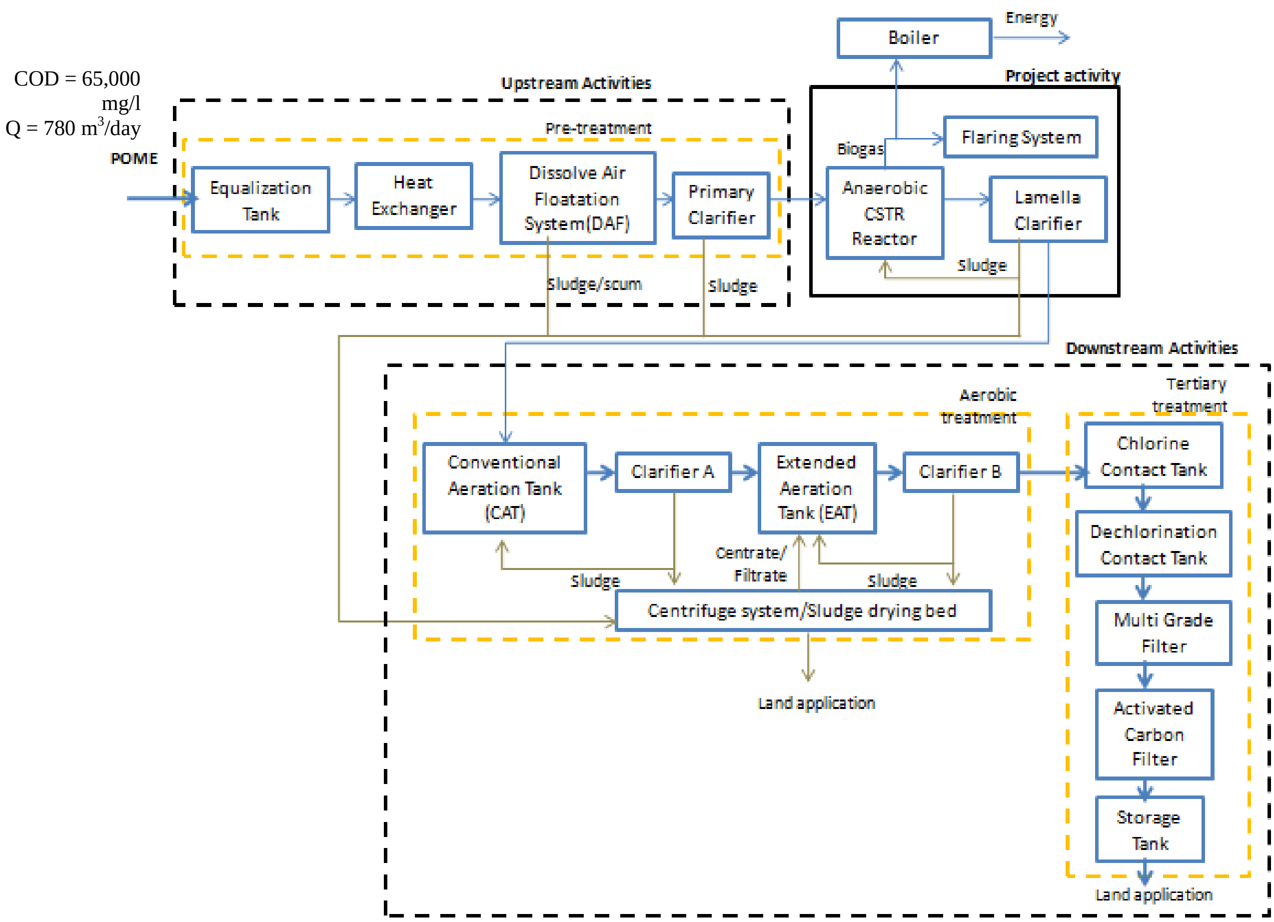

Figure 3: Delineation of Project Activity

The most plausible baseline scenario identified is open anaerobic lagoons which result in baseline methane emissions from wastewater treatment. The baseline scenario is delineated in the figure below.

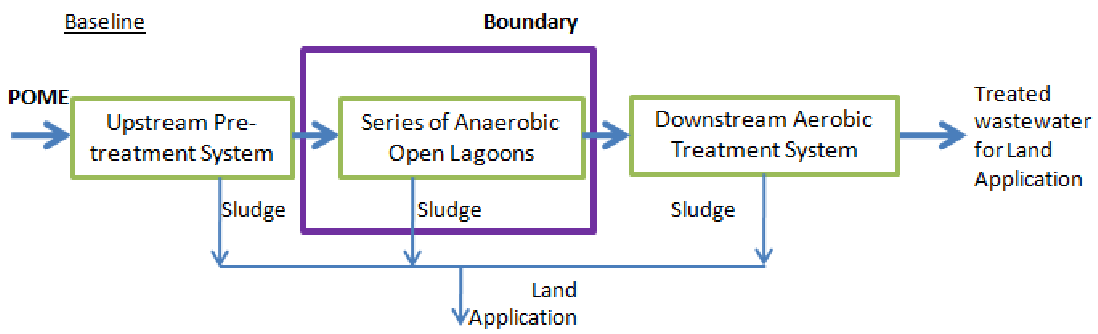

Figure 4: Delineation of Baseline Scenario

Table 2: Possible Greenhouse gas produced in the baseline and project activity

	Source	**Gas**	**Inclusion**	**Justification**
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 or fossil fuel consumption will not be accounted for because there will be 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	The treated water is used for land application under aerobic condition and there will be no discharge to any river/lake/sea.
		CH_4	No	
		N_2O	No	

	Source	Gas	Inclusion	Justification
Project activity	Emissions from electricity or fuel consumption in the project activity	CO_2	No	The electricity source is from biomass and/or 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 back-up generator 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	The wastewater will be used for land application under aerobic condition and will not be discharged to any river/lake/sea.
		CH_4	No	
		N_2O	No	
	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

	Source	Gas	Inclusion	Justification
				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.
		CH_4	No	
		N_2O	No	

B.4. Description of baseline and its development:

In accordance with "General Guidelines to SSC CDM methodologies (Version 17)", 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	Installation 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	Installation 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 Scenario 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 for POME's organic-loading is too high for direct aerobic treatment[6].
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%[7].
Alternative 5	Anaerobic digester without methane recovery	The anaerobic digester tanks can generally achieve COD removal efficiency of 83-95%[8].
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%.

[6] 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

[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 6, pg 1472.

[8] 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.

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 analysed 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)[9]. 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 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[10]

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, 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.

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

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

Table 5: Summary of Barrier Analysis in POME Treatment

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[11]. Anaerobic treatment in open lagoons will be regarded as the most financially viable.	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. In addition, several projects in relation to methane recovery from covered lagoons have been registered as CDM projects in the country thus demonstrating that this alternative already faces significant barriers compared to the most prevalent practice of treating wastewater in anaerobic open lagoons.	Operation of aerobic digester (i.e. activated sludge system) will not generate any revenue to the company. It involves higher capital cost and operational cost compared to the conventional anaerobic lagoon system. The aeration system in the aerobic digestion is very energy intensive. Lack of incentive together with the financial costs incurred is a prohibitive barrier for this option. Therefore, it will be unlikely for the project owner to select this alternative.	Operation of anaerobic digester will not generate any revenue to the company. It involves higher capital cost and operational cost compared to the conventional anaerobic lagoon system. Lack of incentive together with the financial costs incurred is a prohibitive barrier for this alternative. Therefore, it will be unlikely for the project owner to select this alternative.	The investment barriers applicable to Alternative 5 (i.e. anaerobic digester without methane recovery) will be also applicable here. 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 option.

[11] 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. http://www.eng.monash.edu.my/adminpanel/publication/upload/pub_532.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
Technological Barrier	The ponding system technology is reliable and stable[12]. 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 has the capacity to tolerate wider range of Organic Loading Rate (OLR)[13].	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. The biogas collecting cover system is subject to wear and tear due to: - Chemical corrosion (due to H_2S presence in the biogas); - Mechanical fatigue (the cover expands and contracts continuously); - UV light aggression	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 bulking and foaming, polysaccharide bulking and foaming[14]. In addition, in order to operate under optimum condition, the dissolved oxygen (DO) level in	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 process[15]. Each step involves a 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	All the discussion of 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 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.

[12] 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. http://www.eng.monash.edu.my/adminpanel/publication/upload/pub_532.pdf
[13] Poh P.E., Chong M.F. (2009) *Development of anaerobic digestion methods for palm oil mill effluent (POME) treatment*, Bioresource Technology 100, pg 6.
[14] Activated Sludge Microbiology Problems and Their Control, page 2. http://www.dec.ny.gov/docs/water_pdf/DrRichard.pdf
[15] Information Sheet on Anaerobic Digestion, pg 4. http://www.waste.nl/page/419

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
		- Other extreme weather conditions (e.g. high temperature, lightning, monsoon damage etc.); - Excessive pressure or stress (e.g. during peak production periods); and - Accidental damage and risk from fire / explosion.	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.	daily subject to the chemical properties of POME and the volume discharged to the treatment system[16]. Due to the complex association of different types of bacteria, digesters have a higher risk of breakdown and may be difficult to control[17]. 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.	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 practice in order to avoid leakages. Hydrogen sulphide (H_2S) gas which is present in the biogas imposes some risks as this H_2S gas could accumulate in bottom tanks and is harmful in high concentration[18].

[16] 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
[17]Information Sheet on Anaerobic Digestion, pg 4. http://www.waste.nl/page/419

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

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
Other barrier: Lack of prevailing regulatory requirement	In Indonesia, the quality of the wastewater discharged from palm oil mill is regulated by the Decree of Ministry of Environment 51/1995. This regulates the maximum allowable concentration of COD and BOD in the discharged effluent. However, there is no regulation on how to treat the effluent. Therefore, it is most unlikely that the project owner will invest in technologies which entail higher investments and/or technical barriers. The following technologies have been predominantly used in the region (i.e. Indonesia) is Alternative 1, which is installation of anaerobic lagoons for wastewater treatment[19].				
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.	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.

[19] The list of project activities (registered or under validation) in the region with the information of their baseline POME treatment technology is provided in Annex 3 of this PDD.

This step has shown that Alternative 1 needs the least investment and faces minimum technological barriers in comparison with the others. On the other hand, Alternatives 2, 4, 5 and 6 face prohibitive barriers due to higher capital and operational cost requirement as well as technological risks introduced.

The outcome of this step is elimination of Alternatives 2, 4, 5 and 6. Only Alternative 1 remains.

Step 4: Comparison of baseline emission of remaining alternatives
The plausible baseline is, therefore, "Installation of open anaerobic lagoons for wastewater treatment without methane recovery".

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

Table 6: CDM consideration for Project Implementation

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.
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 this PDD, the most plausible baseline scenario in the absence of this project activity would have been the implementation of a series of open anaerobic lagoons without methane recovery. Operation of open lagoons is the most economical as it requires minimum human intervention and energy consumption for their operations[20] and is the most prevalent method for treating wastewater in palm oil mills in Indonesia.

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 cheaper than the project activity. Hence, as compared to the

[20] 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.

http://www.eng.monash.edu.my/adminpanel/publication/upload/pub_532.pdf 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 reactor 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[21]. 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*" [22] 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 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[23]. 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

[21]Information Sheet on Anaerobic Digestion. http://www.waste.nl/page/419
[22] 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

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

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

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

Other barrier: Lack of prevailing regulatory requirement
In Indonesia, the quality of POME discharged from palm oil mill is regulated by the Decree of Ministry of Environment 51/1995. 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. 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[24]. 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 recover 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. 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:

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:

[24] Expanded Market Study for Indonesia Sustainable Energy Finance, Renewable Energy Opportunities in Palm Oil Mills in Kalimantan and Sumatra, IFC. http://www.ifc.org/ifcext/eastasia.nsf/AttachmentsByTitle/Market_study_sustainable_energy_finance/$FILE/Expanded+Market+Study+for+Sustainable+Energy+Finance.pdf

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

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 for project 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. Treated wastewater is put to land application under aerobic conditions and there is no discharge to the river/lake/sea.
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:

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

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

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). Please refer to Annex 3 for the steps and processes.

Table 8: 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	Value from the technology provider/mill owner.
$\eta_{COD,BL,i}$	85 %	COD removal efficiency obtained from the average values of the top 20% wastewater treatment plants from CDM projects (registered and under validation) with the lowest project COD removal efficiency designed for the same country to treat the same type of wastewaters as the project activity. This is as per paragraph 28 (b) of AMS-III.H version 16.
$Q_{ww,i,y}$	284,700 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.
$MCF_{ww,treatment,BL,i}$	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[25]	Value as per AMS-III.H (version 16) paragraph 20.
GWP_{CH4}	21	Value as per AMS-III.H (version 16) paragraph 20.

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 follow

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

Table 9: 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 assumed zero. However, for *ex-post* estimation, this emission might be included in the case when back-up generator is used.

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

No.	Project emissions	Descriptions	Remarks
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 anaerobic digester will be equipped with biogas capture and recovery. Further, 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	$PE_{y,ww,discharge}$	Methane emissions from degradable organic in treated wastewater in year *y*	Not applicable. The treated effluent will be used for land application under aerobic conditions.
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 emission to atmosphere.
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-ante* estimation, this emission is assumed zero since all the biogas will be combusted in the boiler. However, for *ex-post* estimation, in the case when flaring system is activated, such emissions will be accounted accordingly.
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:

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

<u>Project emissions from fossil fuel consumption</u>

This source of emissions will be accounted *ex-post*, as per formula given in Annex 4.

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)

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

$Q_{ww,y,treated}$	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

Table 10: Value of parameters used in project emissions calculation

Parameter	Value	Source
$Q_{ww,y,treated}$	284,700 m^3/year	Design value provided by the PP
GWP_{CH4}	21	Value as per AMS-III.H (version 16) paragraph 20.
$B_{o,ww}$	0.25 kg CH_4/kg COD	Value as per AMS-III.H (version 16) paragraph 20.
UF_{PJ}	1.12	Value as per AMS-III.H (version 16) paragraph 29.
$COD_{removed,PJ,y}$	0.05525 t COD/m^3	**For ex-ante estimation**, it is based on (a) $COD_{untreated}$ (design value) and (b) COD removal efficiency of the anaerobic CSTR reactor provided by the technology supplier (85%), i.e. 0.065 t COD/m^3 * 85%. **Ex-post monitoring:** the $COD_{removed,PJ,y}$ will be calculated as the difference between the monitored values of $COD_{untreated,y}$ and $COD_{treated,y}$.
$MCF_{ww,treatment,PJ,k}$	0.8	IPCC value as per Table 6.8 Volume 5 Chapter 6 of IPCC 2006 Guideline for anaerobic reactor

Parameter	Value	Source
CFE_{ww}	0.9	Default value as per AMS-III.H (version 16) paragraph 30

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:

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

<u>Project emissions from flaring of biogas</u>

This source of emissions will be accounted *ex-post*, as per formula given in Annex 4.

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 reduction is 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 that are available at validation:

1 Parameters for calculation of baseline emission

1.1

Data / Parameter:	$\mathbf{MCF_{ww,treatment,BL,i}}$
Data unit:	-
Description:	Methane correction factor for baseline wastewater treatment system *i*
Source of data used:	Table III.H.1 in AMS-III.H (version 16)
Value applied:	0.8
Justification of the choice of data or description of measurement methods and procedures actually applied :	The baseline situation is anaerobic deep lagoons with depth of more than 2 m
Any comment:	-

1.2

Data / Parameter:	$\mathbf{B_{o,ww}}$
Data unit:	kg CH_4/kgCOD
Description:	Methane producing capacity of the wastewater
Source of data used:	Paragraph 19 of AMS-III.H (version 16)
Value applied:	0.25
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC value, as per AMS-III.H (version 16) paragraph 19
Any comment:	-

1.3

Data / Parameter:	$\mathbf{UF_{BL}}$
Data unit:	-
Description:	Model correction uncertainty factor to account for model uncertainties
Source of data used:	Paragraph 22 of AMS-III.H (version 16)
Value applied:	0.89
Justification of the choice of data or description of measurement methods	As per paragraph 22 of AMS-III.H (version 16)

and procedures actually applied :	
Any comment:	-

1.4

Data / Parameter:	$\mathbf{GWP_{CH4}}$
Data unit:	-
Description:	Global warming potential of methane
Source of data used:	IPCC value as per paragraph 20 of AMS-III.H (version 16)
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per paragraph 20 of AMS-III.H (version 16)
Any comment:	-

1.5

Data / Parameter:	$\boldsymbol{\eta_{COD,BL,i}}$
Data unit:	%
Description:	COD removal efficiency of the baseline treatment system *i*
Source of data used:	The lowest COD removal efficiency from registered projects in Indonesia using the similar technology as that in the proposed project activity is used for baseline emission calculation. This is a conservative approach.
Value applied:	85
Justification of the choice of data or description of measurement methods and procedures actually applied :	The data has been determined (please refer to Annex 3) in line with the requirements of paragraph 28 of the baseline and monitoring methodology AMS-III.H (version 16).
Any comment:	-

2 Parameters for calculation of project emission

2.1

Data / Parameter:	$\mathbf{MCF_{ww,treatment\ PJ,k}}$
Data unit:	-
Description:	Methane correction factor for project wastewater treatment system *k*
Source of data used:	Table 6.8 of Volume 5 Chapter 6 IPCC 2006 guideline
Value applied:	0.8

Justification of the choice of data or description of measurement methods and procedures actually applied :	The project activity wastewater treatment system is an anaerobic digester
Any comment:	-

2.2

Data / Parameter:	**UF_{PJ}**
Data unit:	-
Description:	Model correction to account for model uncertainties.
Source of data used:	Paragraph 30 of AMS-III.H (version 16)
Value applied:	1.12
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per paragraph 30 of AMS-III.H (version 16)
Any comment:	-

2.3

Data / Parameter:	**$\rho_{CH4,n}$**
Data unit:	Kg/m^3
Description:	Density of methane at normal condition
Source of data used:	Page 9 of tool to determine project emissions from flaring gases containing methane (EB 28, Annex13)
Value applied:	0.716
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per page 9 of the Tool to determine project emissions from flaring gases containing methane (EB 28, Annex13)
Any comment:	-

2.4

Data / Parameter:	**$\eta_{COD,PJ,j}$**
Data unit:	%
Description:	COD removal efficiency of the project treatment system *j*.
Source of data used:	The COD removal efficiency is obtained from the supplier of the anaerobic digester.

Value applied:	85%
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

2.5

Data / Parameter:	CFE_{ww}
Data unit:	-
Description:	Capture efficiency of the biogas recovery equipment in the wastewater treatment systems
Source of data used:	Default value as per paragraph 30 of AMS III.H version 16
Value applied:	0.9
Justification of the choice of data or description of measurement methods and procedures actually applied :	In line with the requirement of the baseline monitoring methodology
Any comment:	-

B.6.3 Ex-ante calculation of emission reductions:

Baseline emissions

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

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

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

$BE_{ww,treatment,y}$ = 284,700 m^3 * (0.065 tonnes COD/m^3 * 85% * 0.8) * 0.25 tonnes CH_4/tonnes COD * 0.89 * 21
= 58,798 tCO_2e

$BE_y = BE_{ww,treatment,y}$
= 58,798 tCO_2e

Project emissions

As explained in section B.6.1, the emission from project activity is as follow:
$PE_y = PE_{fugitive,y}$

Fugitive emission

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

$PE_{fugitive,ww,y} = (1 - CFE_{ww}) * MEP_{ww,treatment,y} * GWP_{CH4}$
$= (1 - 0.9) * 3,523 * 21 = 7,399\ tCO_2e$

$PE_{fugitive,y} = PE_{fugitive,ww,y} = 7,399\ tCO_2e$

$PE_y = PE_{fugitive,y}$
$= 7,399\ tCO_2e$

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:

$ER_{y\ ex\ ante} = BE_{y\ ex\ ante} – (PE_{y\ ex\ ante} + LE_{y,\ ex\ ante})$
$= 58,798\ tCO_2e – (7,399\ tCO_2e + 0\ tCO_2e)$
$= 51,399\ tCO_2e$

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

Year of crediting period	Baseline emission (tCO_2e)	Project emission (tCO_2e)	Emission reduction (tCO_2e)
2012-2013	58,798	7,399	51,399
2013-2014	58,798	7,399	51,399
2014-2015	58,798	7,399	51,399
2015-2016	58,798	7,399	51,399
2016-2017	58,798	7,399	51,399
2017-2018	58,798	7,399	51,399
2018-2019	58,798	7,399	51,399
2019-2020	58,798	7,399	51,399
2020-2021	58,798	7,399	51,399
2021-2022	58,798	7,399	51,399
Total (tCO_2e)	**587,980**	**73,990**	**513,990**

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

B.7.1 Data and parameters monitored:

1 **Calculation of baseline emissions**

1.1

Data / Parameter	**$Q_{ww,i}$**
Data unit:	m^3/month
Description:	Monthly volume of untreated wastewater entering (inflow) the anaerobic digester in project activity
Source of data to be used:	Measurements will be undertaken using flow meter.
Value of data	23,725
Description of measurement methods and procedures to be applied:	Measurements are undertaken by using flow meter at inlet of the anaerobic digester. Location of the meter is indicated in Figure 5: Monitoring diagram of Annex 4. Information on the accuracy and class of the meter will be included at the time of validation.
QA/QC procedures to be applied:	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 also be conducted as specified by vendor.
Any comment:	Data will be archived for 2 years from the end of the crediting period or the last request for issuance whichever is later.

1.2

Data / Parameter:	**$COD_{untreated,i,y}$**
Data unit:	$tCOD/m^3$
Description:	Chemical Oxygen Demand of the wastewater entering the Anaerobic Digester
Source of data to be used:	Representative Sampling by PP
Value of data	0.065
Description of measurement methods and procedures to be applied:	Location of where the measurement takes place is indicated in Figure 5: Monitoring diagram of Annex 4.Measurement of COD is according to national or international standards by an accredited laboratory. COD is measured through representative sampling.
QA/QC procedures to be applied:	Average value will be used through sampling with 90/10 confidence/precision level.
Any comment:	Data will be archived for 2 years from the end of the crediting period or the last request for issuance whichever is later.

2 **Calculation of project emissions**

2.1

Data / Parameter:	**$COD_{ww,treated,y}$**
Data unit:	$tCOD/m^3$
Description:	Chemical oxygen demand of the treated wastewater leaving the anaerobic digester
Source of data to be used:	Representative Sampling by PP
Value of data	0.00975
Description of measurement methods and procedures to be applied:	Location of where the measurement takes place is indicated in Figure 5: Monitoring diagram of Annex 4. Measurement of COD is according to national or international standards by an accredited laboratory. COD is measured through representative sampling.
QA/QC procedures to be applied:	Average value will be used through sampling with 90/10 confidence/precision level.
Any comment:	Data will be archived for 2 years from the end of the crediting period or the last request for issuance whichever is later.

2.2

Data / Parameter:	**End-use of the final sludge**
Data unit:	-
Description:	The final sludge produced from the project system.will be applied as land application
Source of data to be used:	Sludge removal reports
Value of data	-
Description of measurement methods and procedures to be applied:	Sludge removal and its end-use will be monitored whenever the sludge is removed from the drying bed and a record will be maintained in the plant. The sludge will be used for soil application under aerobic conditions.
QA/QC procedures to be applied:	-
Any comment:	Data will be archived for 2 years from the end of the crediting period or the last request for issuance whichever is later.

2.3

Data / Parameter:	**$BG_{burnt,y}$**
Data unit:	m^3
Description:	Annual volume of biogas combusted in year *y*
Source of data to be used:	Measured using continuous flow meters.
Value of data	Not applicable for *ex-ante* calculation
Description of measurement methods and procedures to be	Continuous flow meter will be mounted in the stream fed into the boiler. The methane content measurement shall be carried out close to a location in the system where a biogas flow measurement takes place (i.e. the biogas stream

applied:	fed into the boiler). Location of the meter is indicated in Figure 5: Monitoring diagram of Annex 4. Information on the accuracy and class of the meter will be included at the time of validation.
QA/QC procedures to be applied:	The measurement will be monitored continuously (at least hourly measurements are undertaken, if less, confidence/precision level of 90/10 will be attained). Meters will be calibrated as per vendor's specifications.
Any comment:	Data will be archived for 2 years from the end of the crediting period or the last request for issuance whichever is later.

2.4

Data / Parameter:	$\mathbf{w_{CH4,y}}$
Data unit:	volume fraction
Description:	Methane content in biogas in year *y*
Source of data to be used:	Measured using a continuous analyser (E&H Kit) or alternatively with periodical measurements at 90/10 confidence/precision level.
Value of data	Not applicable for *ex-ante* calculation
Description of measurement methods and procedures to be applied:	The equipment will be able to measure methane directly in the biogas. The measurement will be carried out close to a location in the system where a biogas flow measurement takes place (i.e. the biogas stream fed into the boiler). Location of the analyser is indicated in Figure 5: Monitoring diagram of Annex 4. Information on the accuracy and class of the meter will be included at the time of validation.
QA/QC procedures to be applied:	The measurement will be monitored regularly and the analyzer used will be calibrated periodically as per vendor's specifications.
Any comment:	Data will be archived for 2 years from the end of the crediting period or the last request for issuance whichever is later.

2.5

Data / Parameter:	**T**
Data unit:	^{o}C
Description:	Temperature of the biogas
Source of data to be used:	Measurements from the temperature meter
Value of data	-
Description of	The temperature of the biogas is required to determine the density of the

measurement methods and procedures to be applied:	methane combusted. The temperature will be monitored continuously by temperature indicators. The temperature will be measured at the same time when methane content ($w_{CH4,y}$) is measured (i.e. at the biogas stream fed into the boiler). Location of the meter is indicated in Figure 5: Monitoring diagram of Annex 4. Information on the accuracy and class of the meter will be included at the time of validation.
QA/QC procedures to be applied:	The temperature of the biogas will be measured separately from measurement of methane content in biogas ($w_{CH4,y}$). Calibration of the meter will be as per vendor's specifications.
Any comment:	Data will be archived for 2 years from the end of the crediting period or the last request for issuance whichever is later.

2.6

Data / Parameter:	**P**
Data unit:	Pa
Description:	Pressure of the biogas
Source of data to be used:	Absolute pressure transmitter E+H Cerabar PMC71.
Value of data	-
Description of measurement methods and procedures to be applied:	The pressure of the biogas is required to determine the density of the methane combusted. The pressure will be measured continuously. However the PP to make sure that the gas flow meter used is displaying the normalised flow of the biogas. Location of the meter is indicated in Figure 5: Monitoring diagram of Annex 4. Information on the accuracy and class of the meter will be included at the time of validation.
QA/QC procedures to be applied:	The pressure of the biogas will be measured at the same time when methane content in biogas ($w_{CH4,y}$) is measured using gas flow meter. Calibration of the meter will be as per vendor's specifications.
Any comment:	Data will be archived for 2 years from the end of the crediting period or the last request for issuance whichever is later.

2.7

Data / Parameter:	**$fv_{i,h}$**
Data unit:	-
Description:	Volumetric fraction of component *i* in the residual gas in the hour *h* where *i* = CH_4
Source of data to be used:	Measured using a continuous analyser (E&H Kit)
Value of data	Not applicable for *ex-ante* calculation
Description of	The data is measured by using a continuous gas analyser. The same basis (dry

measurement methods and procedures to be applied:	or wet) will be ensured for this measurement and the measurement of the volumetric flow rate of the residual gas ($FV_{RG,h}$) when the residual gas temperature exceeds 60°C. The parameter will be monitored on continuous basis. Values will be averaged hourly or at a shorter time interval. Location of the analyser is indicated in Figure 5: Monitoring diagram of Annex 4. Information on the accuracy and class of the meter will be included at the time of validation.
QA/QC procedures to be applied:	Analysers will be periodically calibrated according to the manufacturer's recommendation. A zero check and a typical value check will be performed by comparison with a standard certified gas.
Any comment:	As a simplified approach, project proponent will only measure the methane content of the residual gas and consider the remaining part as N_2. Data will be archived for 2 years from the end of the crediting period or the last request for issuance whichever is later.

2.8

Data / Parameter:	**$FV_{RG,h}$**
Data unit:	m^3/h
Description:	Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour *h*
Source of data to be used:	Measurement by project proponent(s) by using flow meter
Value of data	Not applicable for *ex-ante* calculation
Description of measurement methods and procedures to be applied:	The same basis (dry or wet) will be ensured for this measurement and the measurement of volumetric fraction of all components in the residual gas ($fv_{i,h}$) when the residual gas temperature exceeds 60 ^oC. The parameter will be monitored on continuous basis. Values will be averaged hourly or at a shorter time interval. Location of the meter is indicated in Figure 5: Monitoring diagram of Annex 4. Information on the accuracy and class of the meter will be included at the time of validation.
QA/QC procedures to be applied:	Calibration of the flow meters will be done periodically according to the manufacturer's recommendation
Any comment:	Data will be archived for 2 years from the end of the crediting period or the last request for issuance whichever is later.

2.9

Data / Parameter:	**Other flare operation parameters**
Data unit:	-
Description:	This should include all data parameters that are required to monitor whether the flare operates within the range of operating conditions according to manufacturer's specifications.
Source of data to be	Measurements by project participant

used:	
Value of data	
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	This will be monitored on a continuous basis
Any comment:	Applicable because default value of flare efficiency used.

2.10

Data / Parameter:	**$FC_{i,y}$**
Data unit:	mass or volume unit per year (e.g. t/yr or m^3/yr)
Description:	Total quantity of fuel type *i* used in back-up generators during the year *y*
Source of data to be used:	Onsite measurement
Value of data	-
Description of measurement methods and procedures to be applied:	• Mass or volume meters will be used. In cases when fuel is supplied from small daily tanks, rulers will be used to determine mass or volume of the fuel consumed, with the following conditions: The ruler gauge will be part of the daily tank and calibrated at least once a year and have a book of control for recording the measurements (on a daily basis or per shift). • Accessories such as transducers, sonar and piezoelectronic devices accepted if they are properly calibrated with the ruler gauge and receiving a reasonable maintenance. • In case of daily tanks with pre-heater for heavy oil, the calibration will be made with the system at typical operational condition. Location of where the measurement takes place is indicated in Figure 5: Monitoring diagram of Annex 4. Information on the accuracy and class of the meter will be included at the time of validation.
QA/QC procedures to be applied:	The consistency of metered fuel consumption quantities will be cross-checked by an annual energy balance that is based on a purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities will also be cross-checked with available purchase invoices from the financial records.
Any comment:	This parameter is only measured when back-up generator is used.

2.11

Data / Parameter:	**$EG_{i,project}$**
Data unit:	MWh
Description:	Quantity of electricity generated in back-up generator used for the project activity in the year *y*
Source of data to be	Electricity meters

used:	
Value of data	-
Description of measurement methods and procedures to be applied:	Continuously, aggregated at least annually. Location of where the measurement takes place is indicated in Figure 5: Monitoring diagram of Annex 4. Information on the accuracy and class of the meter will be included at the time of validation.
QA/QC procedures to be applied:	
Any comment:	This parameter is only measured when back-up generator is used.

2.12

Data / Parameter:	**$EG_{i,,y}$**
Data unit:	MWh
Description:	Total quantity of electricity generated in back-up generator in the year *y*
Source of data to be used:	Electricity meters
Value of data	-
Description of measurement methods and procedures to be applied:	Continuously, aggregated at least annually. Location of the meter is indicated in Figure 5: Monitoring diagram of Annex 4. Information on the accuracy and class of the meter will be included at the time of validation.
QA/QC procedures to be applied:	
Any comment:	This parameter is only measured when back-up generator is used.

2.13

Data / Parameter:	**$NCV_{i,y}$**
Data unit:	GJ per mass or volume unit (e.g. GJ/t or GJ/m^3)
Description:	Weighted average net calorific value of fuel type *i* in year *y*.
Source of data to be used:	IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2. of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories.
Value of data	-
Description of measurement methods and procedures to be applied:	Any future revision of the IPCC Guidelines will be taken into account.
QA/QC procedures to be applied:	
Any comment:	Data from the supplier and national/regional data are not available.

2.14

Data / Parameter:	**$EF_{CO2,i,y}$**
Data unit:	tCO_2/GJ
Description:	Weighted average CO_2 emission factor of fuel type *i* in year *y*
Source of data to be used:	IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.4. of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value of data	-
Description of measurement methods and procedures to be applied:	Any future revision of the IPCC Guidelines will be taken into account.
QA/QC procedures to be applied:	-
Any comment:	Data from the supplier and national/regional data are not available.

B.7.2 Description of the 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.

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 familiarised on the procedure.

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

The baseline and monitoring study was completed on 11/08/2011 by "Knowledge Integration Services (Singapore) Pte Ltd".

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

Date of execution of the contract to implement the project: 10/02/2011.

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

20 years

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

C.2.1. Renewable crediting period

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

Not applicable

C.2.1.2. Length of the first crediting period:

Not applicable

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

The start date of the crediting period will be 31/08/2012 (i.e. the expected operational start date of the project activity) or the date of CDM registered whichever is later.

C.2.2.2. Length:

10 years

SECTION D. Environmental impacts

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

UMW is in the progress of conducting the environmental impacts assessment. Any negative environmental impacts identified during this analysis will be included in this section.

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

If there are significant environmental impacts identified, these will be included in this section.

SECTION E. Stakeholders' comments

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

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.
5. Question and answer (Q&A) session.

E.2. Summary of the comments received:

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

E.3. Report on how due account was taken of any 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 POME treated. 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.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	PT Umbul Mas Wisesa
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding available in this project.

Annex 3

BASELINE INFORMATION

As per paragraph 26 of AMS-III.H (version 16), in determining baseline emissions using the above equation, historical records of at least one year prior to the project implementation shall be used. This includes the COD removal efficiency of the wastewater treatment systems.

However, as the proposed project activity is Greenfield, one year historical data of the plausible baseline scenario is not available. As per paragraph 28 of AMS-III.H (version 16), there are two options, i.e. 2(a) and 2(b), to obtain the parameter values in case of Greenfield projects. The two options are as follow:

2a) This first option involves taking value obtained from a measurement campaign in a comparable existing wastewater treatment plant i.e. having similar environmental and technological circumstances for example treating similar type of wastewater. Average values from the measurement campaign shall be used and the result shall be multiplied by 0.89 to account for the uncertainty range (30% to 50%) associated. An existing plant would be said to be comparable to the plausible baseline scenario if the following conditions are satisfied:

(i) The two sources of wastewater are of the same type

(ii) The selected plant and the baseline plants employ the same treatment technology, and the hydraulic retention times in their biological and physical treatment systems do not vary by more than 20%

(iii) Both treatments have the same raw material and final products, and apply the same industrial technology.

2b) The second option is to use value provided by the designer of a Greenfield wastewater treatment plant using the same technology demonstrated to be conservative.

COD removal efficiency of the baseline system ($\eta_{COD,BL,i}$) obtained from the average values of the top 20% wastewater treatment plants from CDM projects (registered in the Sumatra) with the lowest project COD removal efficiency designed for the same country to treat the same type of wastewaters as the project activity. This is as per paragraph 28 (b) of AMS-III.H version 16.

Table 11. COD removal efficiency of the baseline system ($\eta_{COD,BL,i}$)

S/N	CDM Project	Project COD removal efficiency (%)	Average anaerobic lagoons depth (m)	Baseline POME treatment technology
1.	Nubika Jaya Biogas Extraction for Bio-Hydrogen Production	94.23	5	Series of open anaerobic lagoons
2.	Methane Recovery and Utilisation at PT Pinago Utama Sugihwaras Palm Oil Mill, Sumatra Indonesia	85	6	Series of open anaerobic lagoons

S/N	CDM Project	Project COD removal efficiency (%)	Average anaerobic lagoons depth (m)	Baseline POME treatment technology
3.	Harapan Biogas Project	90	4 – 10	Series of open anaerobic lagoons

For the purpose of estimating baseline emissions, using the top 20% projects out of three projects means identifying only one project that has the lowest COD removal efficiency.

The lowest COD removal efficiency from the table above is 85% which belongs to project number 2. Therefore the COD removal efficiency of 85% is taken as the baseline COD removal efficiency.

Annex 4

MONITORING INFORMATION

Sample size determination

During monitoring period, there are few parameters such as COD level and Q_{ww} which will be determined through sampling. Representative sample size will be taken to ensure the 90/10 confidence/precision level requirement. Followings are four different population size scenarios and their respective sample size that meets the 90/10 confidence/precision level requirement.

Table 12. Determination of representative sample size

Population size	Representative sample size for 90/10 confidence/precision level[26]
365 x 1 (daily)	57
52 x 1 (weekly)	30
12 x 1 (monthly)	10
4 x 1 (quarterly)	4

Based on table above, on a conservative basis, 57 samples will be taken for the monitoring of required parameters (including $COD_{untreated,i,y}$, $COD_{ww,treated,y}$ and $Q_{ww,i,}$) if there is no provision for continuous monitoring.

Monitoring Parameters

Table 13: Parameters for monitoring during the crediting period

No.	Parameter	Unit	Source of Data	Monitoring/ recording Frequency
1	The monthly flow of untreated wastewater entering the anaerobic digester ($Q_{ww,i}$)	m³/month	Measurements are undertaken by using flow meter at inlet to the feeding tank before anaerobic digester.	The measurements will be monitored continuously (at least hourly measurements will be undertaken, if less, confidence/ precession level of 90/10 will be attained- See Table 12 for sample size determination). Calibration of the flow meters will also be conducted as specified by vendor
2	Chemical Oxygen Demand of the wastewater entering the anaerobic digester ($COD_{untreated,i,y}$)	t COD /m³	Measurement of COD is according to national or international standards by an accredited laboratory. COD is measured through representative sampling.	Average value will be used through sampling with 90/10 confidence/precision level (See Table 12 for sample size determination).

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

No.	Parameter	Unit	Source of Data	Monitoring/ recording Frequency
3	Chemical Oxygen Demand of the treated wastewater leaving the anaerobic digester ($COD_{ww,treated,y}$)	t COD /m³	Measurement of COD is according to national or international standards by an accredited laboratory. COD is measured through representative sampling.	Average value will be used through sampling with 90/10 confidence/precision level (See Table 12 for sample size determination).
4	End-use of the final sludge	-	Sludge removal reports	Sludge removal and its end-use will be monitored whenever the sludge is removed from the drying bed and a record will be maintained in the plant. The sludge will be used for soil application under aerobic conditions.
5	Annual volume of biogas combusted in year *y* ($BG_{burnt,y}$)	m^3	Measured using continuous flow meters.	Continuous flow meter will be mounted in the stream fed into the boiler. The methane content measurement shall be carried out close to a location in the system where a biogas flow measurement takes place.
6	Methane content in biogas in the year $y(w_{CH4,,y})$	%	Measured using a continuous analyser (E&H Kit) or alternatively with periodical measurements at 90/10 confidence/precision level.	The equipment will be able to measure methane directly in the biogas. The measurement will be carried out close to a location in the system where a biogas flow measurement takes place (i.e. in the stream fed into the boiler).
7	Temperature of the biogas (T)	^oC	Measurements from the temperature meter.	The temperature of the biogas is required to determine the density of the methane combusted. The temperature will be monitored continuously by temperature meters. The temperature will be measured at the same time when methane content ($w_{CH4,y}$) is measured.
8	Pressure of the biogas (P)	Pa	Measured using absolute pressure transmitter E+H Cerabar PMC71	The pressure of the biogas is required to determine the density of the methane combusted. The pressure will be measured continuously. However the PP to make sure that the gas flow meter used displays or outputs the

No.	Parameter	Unit	Source of Data	Monitoring/ recording Frequency
				normalised flow of the biogas.
9	Volumetric fraction of component *i* in the residual gas in the hour *h* where *i* = CH_4 ($fv_{i,h}$)		Measured using a continuous analyser (E&H Kit)	The data is measured by using a continuous gas analyser. The same basis (dry or wet) will be ensured for this measurement and the measurement of the volumetric flow rate of the residual gas ($FV_{RG,h}$) when the residual gas temperature exceeds 60°C. The parameter will be monitored on continuous basis. Values will be averaged hourly or at a shorter time interval.
10	Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour *h* ($FV_{RG,h}$)	m^3/h	Measurement by PP by using flow meter	The same basis (dry or wet) will be ensured for this measurement and the measurement of volumetric fraction of all components in the residual gas ($fv_{i,h}$) when the residual gas temperature exceeds 60 ^{o}C. The parameter will be monitored on continuous basis. Values will be averaged hourly or at a shorter time interval.
11	Other flare operation parameters		Measurement by PP	This is monitored continuously.
12	Total quantity of fuel type *i* used in back-up generators during the year *y* ($FC_{i,y}$)	t/yr or m^3/yr	Onsite measurement	PP will continuously measure the fuel consumption using the following procedures: • Mass or volume meters will be used. In cases when fuel is supplied from small daily tanks, rulers will be used to determine mass or volume of the fuel consumed, with the following conditions: The ruler gauge will be part of the daily tank and calibrated at least once a year and have a book of control for recording the measurements (on a daily basis or per shift). • Accessories such as transducers, sonar and piezoelectronic devices

No.	Parameter	Unit	Source of Data	Monitoring/ recording Frequency
				accepted if they are properly calibrated with the ruler gauge and receiving a reasonable maintenance.
13	Quantity of electricity generated in back-up generator used in the project activity in the year *y* (**$EG_{i,project}$**)	MWh	Measured using electricity meters	Continuously, aggregated at least annually
14	Total quantity of electricity generated in back-up generator in the year *y* (**$EG_{i,y}$**)	MWh	Electricity meters	Continuously, aggregated at least annually
15	Weighted average net calorific value of fuel type *i* in year *y* ($NCV_{i,y}$)	GJ/m^3 or GJ/t	IPCC default values.	-
16	Weighted average CO_2 emission factor of fuel type *i* in year *y* ($EF_{CO2,i,y}$)	tCO_2/ GJ	IPCC default values.	-

Monitoring diagram

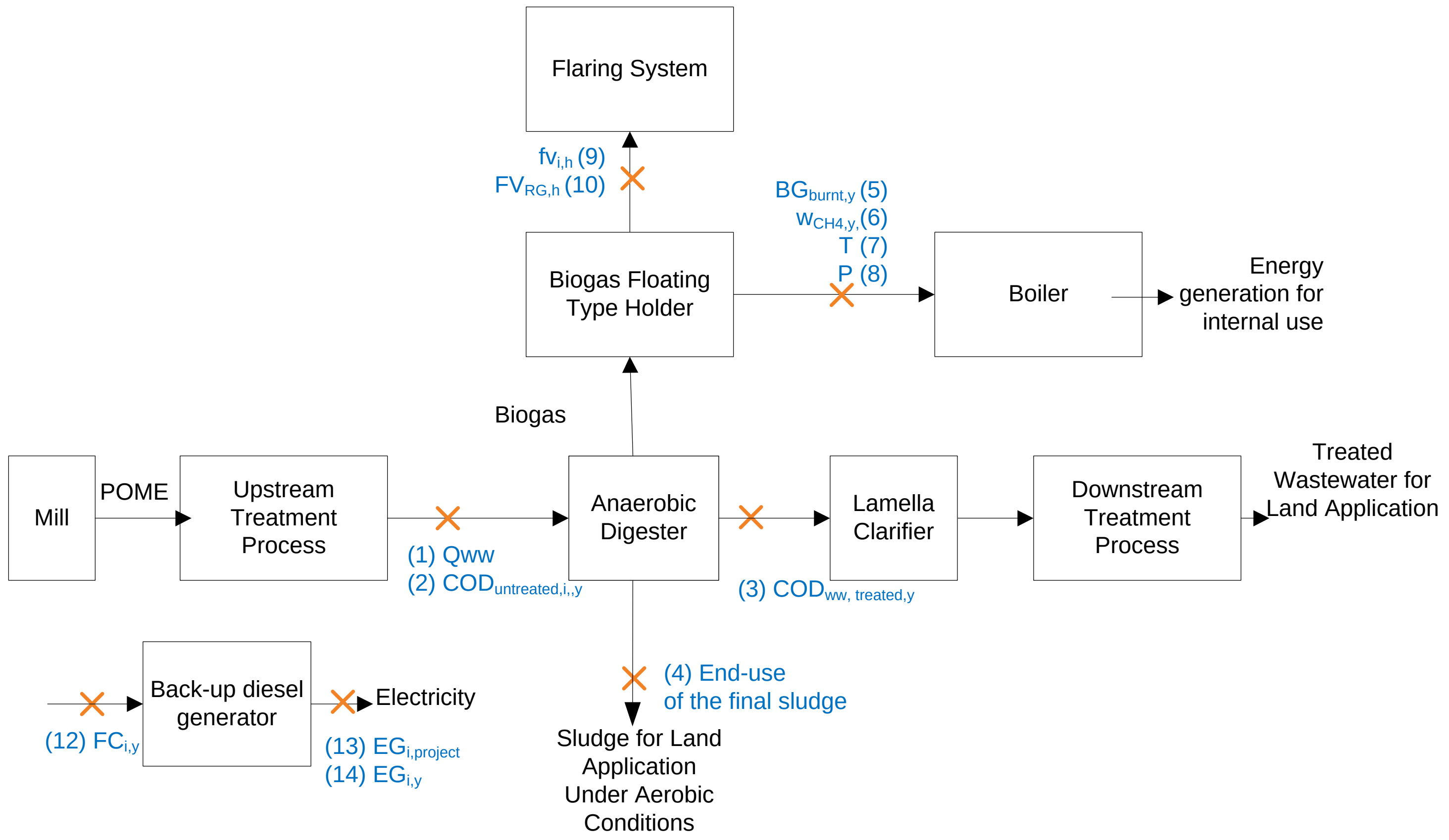

Figure 5: Monitoring Diagram

The indicator numbers correspond to the number of parameters in the Table 13 above.

***Ex-post* monitoring of flaring emissions as per "Methodological tool to determine project emissions from flaring gases containing methane"**

Based on Annex 13 of EB Report 28 "Methodological tool to determine project emissions from flaring gases containing methane", in the case where it is necessary to include fugitive emissions due to incomplete flaring, the emission ($PE_{flaring,y}$) is determined by the following steps:

The flaring system chosen by project proponent is open flaring with default flaring efficiency of 50% when the flare is operational and 0% when the flare is not operational (as per methodological tool to determine project emissions from flaring gases containing methane). As a simplified approach, project proponent will only measure the volumetric fraction of methane and consider the difference to 100% as being nitrogen (N_2) (as per section III of tool to determine project emissions from flaring gases containing methane).

As this project activity uses the default value, the manufacturer's specifications for operation of the flare and the required data and procedures to monitor these specifications will be included at the time of validation.

STEP 1. Determination of the mass flow rate of the residual gas that is flared

This step is not applicable for this project activity, since PP measure only the volumetric fraction of methane and consider the difference to 100% as being nitrogen (N_2).

STEP 2. Determination of the mass fraction of carbon, hydrogen, oxygen and nitrogen in the residual gas

This step is not applicable for this project activity, since PP measure only the volumetric fraction of methane and consider the difference to 100% as being nitrogen (N_2).

STEP 3. Determination of the volumetric flow rate of the exhaust gas on a dry basis

This step is not applicable for this project activity, since open flaring system is used.

STEP 4. Determination of methane mass flow rate in the exhaust gas on a dry basis

This step is not applicable for this project activity, since open flaring system is used.

STEP 5. Determination of methane mass flow rate in the residual gas on a dry basis

The quantity of methane in the residual gas flowing into the flare is the product of the volumetric flow rate of the residual gas ($FV_{RG,h}$), the volumetric fraction of methane in the residual gas ($fv_{CH4,RG,h}$) and the density of methane ($\rho_{CH4,n,h}$) in the same reference conditions (normal conditions and dry or wet basis).
It is necessary to refer both measurements (flow rate of the residual gas and volumetric fraction of methane in the residual gas) to the same reference condition that may be dry or wet basis. If the residual gas moisture is significant (temperature greater than 60ºC), the measured flow rate of the residual gas that is usually referred to wet basis should be corrected to dry basis due to the fact that the measurement of methane is usually undertaken on a dry basis (i.e. water is removed before sample analysis).

$TM_{RG,h} = FV_{RG,h} * fv_{CH4,RG,h} * \rho_{CH4,n}$

Where:

$TM_{RG,h}$	Mass flow rate of methane in the residual gas in the hour h (kg/h)
$FV_{RG,h}$	Volumetric flow rate of the residual gas in dry basis at normal conditions in hour h (m^3/h)
$fv_{CH4,RG,h}$	Volumetric fraction of methane in the residual gas on dry basis in hour h (NB: this corresponds to $fv_{i,RG,h}$ where i refers to methane)
$\rho_{CH4,n,h}$	Density of methane at normal conditions (0.716 kg/m^3)

STEP 6. Determination of the hourly flare efficiency

The determination of the hourly flare efficiency depends on the operation of flare (e.g. temperature), the type of flare used (open or enclosed) and, in case of enclosed flares, the approach selected by project proponents to determine the flare efficiency (default value or continuous monitoring).

The project activity involves the use of open flare. The flare efficiency ($\eta_{flare,h}$) in the hour h is:

- 0% if the flame is not detected for more than 20 minutes during the hour h.
- 50% if the flare is detected for more than 20 minutes during the hour h.

STEP 7. Calculation of annual project emissions from flaring

Project emissions from flaring are calculated as the sum of emissions from each hour h, based on the methane flow rate in the residual gas ($TM_{RG,h}$) and the flare efficiency during each hour h ($\eta_{flare,h}$), as follows:

$$PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} * (1-\eta_{flare,h}) * GWP_{CH4} / 1,000$$

Where:

$PE_{flare,y}$	Project emissions from flaring of the residual gas stream in year *y* (tCO_2e)
$TM_{RG,h}$	Mass flow rate of methane in the residual gas in the hour *h* (kg/h)
$\eta_{flare,h}$	Flare efficiency in hour *h*
GWP_{CH4}	Global Warming Potential of methane valid for commitment period (IPCC default value of 21)

***Ex-post* project emissions calculations for fossil fuel consumption**

In case fossil fuel is combusted in project scenario as back-up of the captive electricity system from biomass, the emission from the fossil fuel combustion will be accounted using “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion (version 2)”

$$PE_{FC,j,y} = \sum_{i} FC_{i,project} * COEF_{i,y}$$

Where:

$PE_{FC,j,y}$	The CO_2 emissions from fossil fuel combustion in process j during the year *y* (tCO_2/yr)
$FC_{i,project}$	The quantity of fuel type *i* combusted in back-up generators during the year *y*, specifically for the project activity (mass or volume or mass unit/yr)
$COEF_{i,y}$	CO_2 emission coefficient of fuel type *i* in year *y* (tCO_2/mass or volume unit)
i	Type of fuel combusted in process *j* during the year *y* (-)

The quantity of fuel combusted in back-up generators during the year *y* will be measured or calculated as follows:

$FC_{i,project} = FC_{i,y} *(EG_{i,project}/EG_{i,y})$

Where:

$FC_{i,y}$	Total quantity of fuel type *i* combusted in back-up generators during the year *y*, (mass or volume or mass unit/yr)
$EG_{i,project}$	Quantity of electricity generated in back-up generator used specifically in the project activity in the year *y* (MWh)
$EG_{i,y}$	Total quantity of electricity generated in back-up generator in the year *y* (MWh)

The CO_2 emission coefficient $COEF_{i,y}$ will be calculated based on net calorific value and CO_2 emission factor of the fuel type *i* as follows:

$COEF_{i,y} = NCV_{i,y} * EF_{CO2,i,y}$

Where:

$NCV_{i,y}$	Weighted average net calorific value of the fuel type *i* in year *y* (GJ/mass or volume unit)
$EF_{CO2,i,y,}$	Weighted average CO_2 emission factor of fuel type *i* in year *y* (tCO_2/GJ)

***Ex-post* emission reduction calculations**

According to paragraph 33 of AMS-III.H version 16, for case 1(e), *ex-post* emission reductions shall be the difference between baseline emissions and the sum of the project emissions and leakage, as per the following equation (paragraph 36 of AMS-III.H version 16):

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

Where:

$ER_{y,\,ex\,post}$	Emission reductions achieved by the project activity based on monitored values for year *y* (tCO_2e)
$BE_{y,\,ex\,post}$	Baseline emissions calculated using *ex-post* monitored values (tCO_2e)
$PE_{y,\,ex\,post}$	Project emissions calculated using *ex-post* monitored values (tCO_2e)
$LE_{y,\,ex\,post}$	Leakage calculated using *ex-post* monitored values (tCO_2e)

The historical records of the COD content of untreated and treated wastewater will be used for the baseline calculation.

The monitoring plan is further described in section B.7.2.

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