Project design document form
(Version 11.0)

BASIC INFORMATION	
Title of the project activity	Methane capture project
Scale of the project activity	☐ Large-scale ☒ Small-scale
Version number of the PDD	03
Completion date of the PDD	05/11/2020
Project participants	PT. Tintin Boyok Sawit Makmur
Host Party	Indonesia
Applied methodologies and standardized baselines	**Methodology:** AMS-III.H- Methane recovery in wastewater treatment, Version-19, EB 103, Annex-08 **Standardized baseline:** Not applicable
Sectoral scopes	13: Waste handling and disposal 01: Energy industries (renewable - / non-renewable sources)
Estimated amount of annual average GHG emission reductions	58,985 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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The proposed small-scale project activity is methane recovery measures to be implemented in wastewater treatment facility at palm oil mill of PT. Tintin Boyok Sawit Makmur, a subsidiary of LG International Corp. The palm oil mill is already in operation and has series of anaerobic lagoons for palm oil mill effluent (POME) treatment system. The palm oil mill is located at DUSUN BELANDUNG TINTING BOYOK SEKADAU HULU KAB, SEKADAU KALIMANTAN BARAT-79883, Indonesia.

The palm oil mill processes fresh fruit bunch (FFB) with existing capacity of 40 tonne FFB/hour to produce palm oil. During this process, wastewater effluent (around 520 m^3/day) is generated which contains high content of organic compound (around 76,242 mg COD/l). The project participant has decided to increase the fresh fruit bunch (FFB) processing capacity from 40 tonne FFB/hour to 60 tonne FFB/hour. The POME generation with planned capacity increase will increase to around 741 m^3/day. In the absence of the project activity, the POME is treated in open anaerobic lagoons. Decomposition of the organic compound in the POME produces biogas (i.e. methane gas) which under the baseline scenario (i.e. open anaerobic lagoons) is emitted to the atmosphere.

The proposed project activity will be fully financed and implemented by LG International Corp., Korea.

Purpose:

The purpose of proposed project activity is extraction and capture of methane enriched bio-gas generated from treatment of waste water (POME) and to utilize it for generation of power required for the operating process and any excess methane gas will be flared in controlled manner in an enclosed flare. This reduces methane emissions a potential Greenhouse gas (GHG) into the atmosphere that would have otherwise been emitted from the treatment of wastewater in anaerobic open lagoons without methane recovery.

The proposed project activity is installation of anaerobic digester system (ZPHB® reactor) to treat the POME from the palm oil mill and recover the biogas generated during the treatment. The recovered biogas will be combusted in Gas Engine set (within the mill) for energy generation. The biogas will displace the use of diesel used for power generation for captive consumption. Any excess of the recovered biogas will be flared in a controlled manner in an enclosed flare. Both, the anaerobic digester system as well as the biogas management system (i.e. energy generation with any excess being flared) will be under the control of the project participant. The emission reductions resulting from the use of biogas will not be accounted for in the project activity.

The ZPHB® Technology to be employed by the project activity comprises of three sub-activities; pre-treatment of POME, Anaerobic digestion and aerobic treatment. The upstream activities involve (a) stabilization of the POME's flow, (b) cooling of the POME and (c) removal of emulsified oil if any. The flow of raw POME from the palm oil mill will be directed to the cooling pond/ de-oiling pond for storage as well as cooling purpose and then sent to cooling tower. POME will be cooled through Cooling Tower system. The cooled POME will then flow to Buffer Tank for feeding to anaerobic digester.

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

- ZPHB® reactor tank capacity: 10,800 m^3
- Hydraulic residence time: around 14 days (=10,800 m^3 / 741m^3/day)
- COD removal efficiency: 85%

The POME will be treated biologically to reduce the COD content. The digester will be equipped with biogas recovery system to recover the generated biogas. The sludge generated from the digestion process will then be separated from the POME in a clarifier and a portion of the sludge will be re-circulated to the digester to maintain adequate population of microorganism for optimum digestion

process. The clarified overflow POME from the clarifier will be aerobically treated in lagoons and treated wastewater will be used for land application in palm oil plantation or discharge to water course.

The estimated annual average and the total CO_2e emission reduction by the project activity over the fix crediting period of 10 years are expected to be 58,985 tCO_2e and **589,850** tCO_2e respectively.

The proposed project activity is small scale project falls under Type-III-Other project activities.

The project boundary includes the physical, geographical site of wastewater treatment system and Palm Oil Mill which is source of wastewater generation (POME) and will be using the biogas recovered in boiler/gas engine. The project boundary also includes the DG set/power source used for electricity requirement at plant.

Baseline scenario:
As established in section B.4 of the PDD, the baseline scenario of the project activity is continuation of current practice i.e. treatment of discharged POME in open anaerobic lagoons without biogas recovery. Therefore, in the absence of the project, the methane gas from anaerobic open lagoons would have been emitted into the atmosphere resulting in GHG emissions.

The PP hereby confirms that proposed CDM project activity is not a CPA that has been excluded from a registered CDM PoA as a result of erroneous inclusion of CPAs.

Contribution to sustainable development

Environmental Sustainability:

- The proposed project activity involves wastewater treatment through anaerobic digestion using anaerobic tank-based technologies with methane recovery. Thus, avoids methane emissions into the atmosphere and therefore contribute in reducing GHG emissions.
- The recovered methane replaces the use of fossil fuel for energy generation will also contribute in conservation of natural resources to be used as fuel.
- The proposed project activity will not cause any disturbance to the biodiversity and the natural habitats in the surrounding areas.
- The proposed project activity implements best practices for issues related to health and safety, and thus will not impose health risk for the employees or for the local community. Further, the avoidance of methane emissions will reduce the unpleasant odor associated with the wastewater treatments without methane recovery.

Economic Sustainability:

- The proposed project activity has created employment opportunity to the community during construction as well as for the long-term employment opportunity during operation and maintenance. The local workforce technical skills and knowledge will improve thus leading to capacity and knowledge building.
- The use of the captured methane for steam/power generation will lead to saving of kernel shell (biomass), which will be available for other industrial users, thereby contributes to reduction of the use of depleting fossil fuel.

Social Sustainability:

- Improve the agro-industry companies' way of doing business in a sustainable manner.
- Provide knowledge and awareness to the residents, especially in the local community, with respect to environment, climate change and renewable energy.
- Improve the quality of life and environmental condition of the local community leading to a healthier population.

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

Technology Transfer:

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

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

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

A.2. Location of project activity

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Project activity is located at, PT. Tintin Boyok Sawit Makmur
DUSUN BELANDUNG TINTING BOYOK SEKADAU HULU KAB, SEKADAU KALIMANTAN BARAT-79883, Indonesia

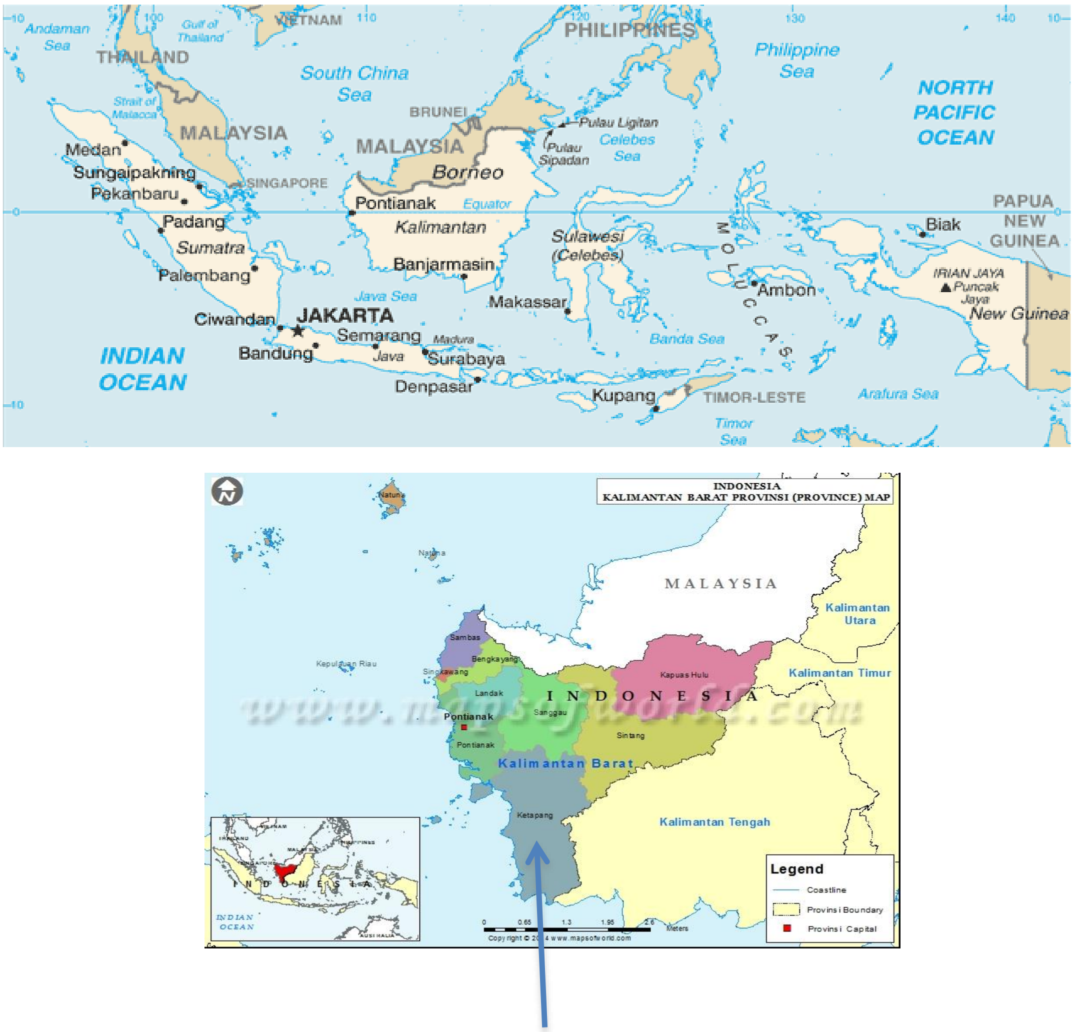

Fig: Project site

The geo-coordinates of the project activity are: 0^0 06' 32.1" S and 110^0 44' 31.4" E.

A.3. Technologies/measures

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Project activity:

The project activity involves replacing anaerobic open lagoons by anaerobic ZPHB® reactor for treatment of wastewater (POME) generated during the production of palm oil from Fresh Fruit Bunch (FFB) in the closed digester system (mesophilic ZPHB® reactor) and recovery of methane enriched biogas in an efficient manner. The project activity consists of installation of 10800 m^3 bio-digesters for the anaerobic treatment of the POME. The anaerobic digester system converts organic matter of wastewater into methane rich biogas, by a consortium of anaerobic bacteria inside the reactor. The biogas thus generated is extracted, captured in the digester and utilized for Gas Engine/ Boiler. If any excess pressure inside the digester, the biogas is flared in enclosed flare system. The technology will be supplied by Knowledge Integration Services Ltd. is a well-known name in the industry.

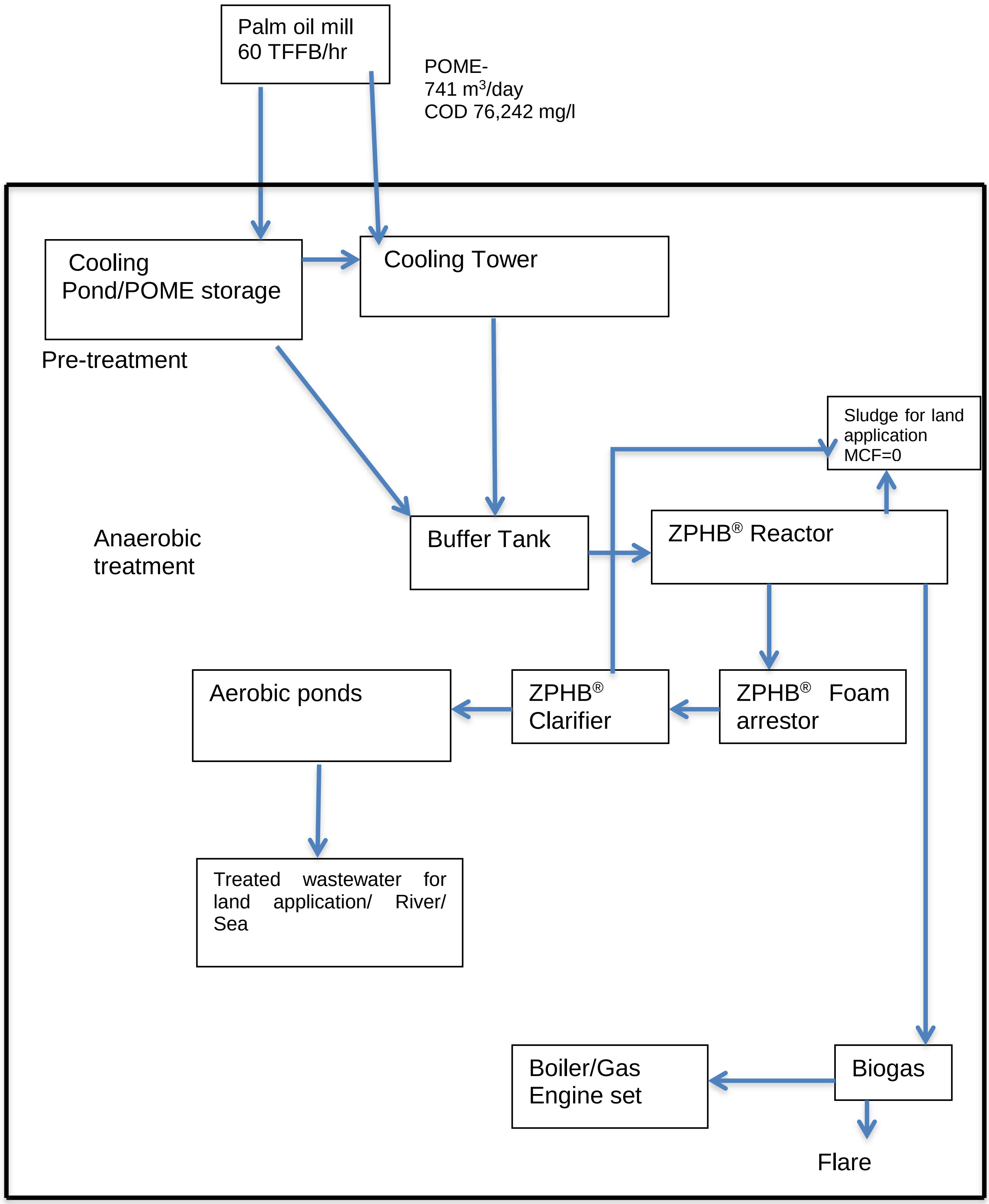

Fig: Project activity

The project activity will reduce emission of greenhouse gases (GHG) by installation of anaerobic digester system to treat the POME from the palm oil mill and recover the biogas generated during the treatment. The recovered biogas will be combusted in Boiler/Gas Engine set (within the mill) for energy generation. The biogas will displace the use of diesel oil. Any excess of the recovered biogas will be flared in a controlled manner in an enclosed flare. Both, the anaerobic digester system as well as the biogas management system (i.e. energy generation with any excess being flared) will be under the control of the project participant.

The technology to be employed by the project activity will have 3 (three) sub-activities:

1. Upstream activities
2. Anaerobic digestion using anaerobic tank-based technology/system
3. Downstream activities

The upstream activities involve (a) stabilization of the POME's flow, (b) cooling of the POME and (c) removal of suspended solids and emulsified oil if any. The flow of raw POME from the palm oil mill will be directed to the Cooling pond/ de-oiling pond for storage as well as cooling purpose and sent to Cooling Tower. POME will be cooled through cooling tower system. The cooled POME will then flow to Buffer tank for feeding to anaerobic digester. The pre-treated POME will then be passed on to the anaerobic digester for POME treatment.

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

- Capacity: 10800 m^3
- Hydraulic residence time: around 14 days
- COD removal efficiency: 85±5%

The POME will be treated biologically to reduce the COD content. The digester will be equipped with biogas recovery system to recover the generated biogas. The sludge generated from the digestion process will then be separated from the POME in a clarifier and a portion of the sludge will be re-circulated to the digester to maintain adequate population of microorganism for optimum digestion process. The remaining sludge will be used in mill's plantation. In the aerobic digestion the sludge is sufficiently mineralized and does not require further treatment before disposal.

The clarified overflow POME from the clarifier will be discharged to the existing anaerobic lagoons, which will be converted into well-managed aerobic lagoons. The final treated POME will be used for land application in palm plantation field or discharged to water course. The lifetime of the bio-digester to be employed by project activity is 20 years as per manufacturing specification. The technology to be employed by the project activity is environmentally safe to operate.

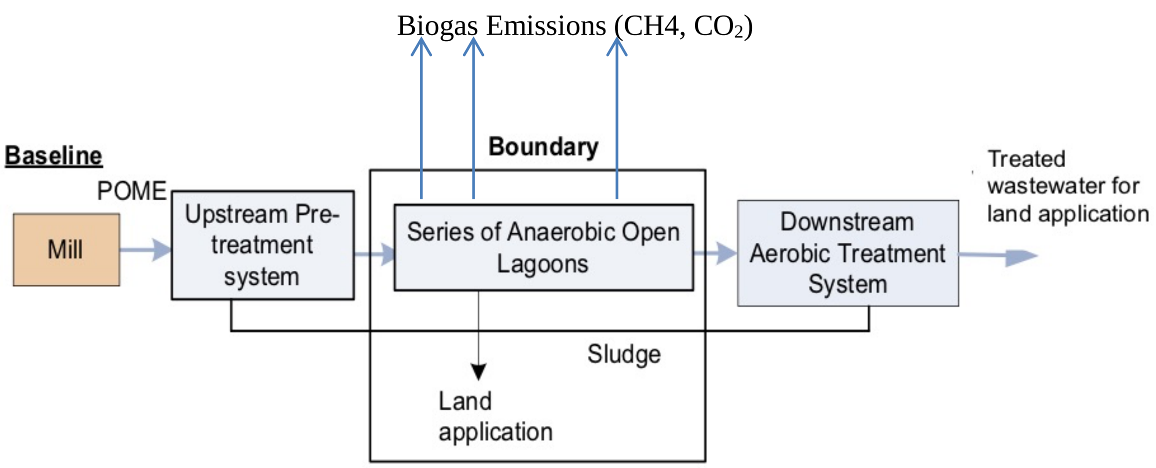

Fig: Baseline scenario

Baseline scenario:

PT. Tintin Boyok Sawit Makmur, palm oil mill having processing capacity of 40 tonnes per hour. The last three years processed 2017-220,500 MT, 2018-224,400 MT and 2019- 227,400 MT of Fresh Fruit Bunches (FFBs. The project participant has decided to increase the fresh fruit bunch (FFB) processing capacity from 40 tonne FFB/hour to 60 tonne FFB/hour. The POME generation with planned capacity increase will increase to around 741 m^3/day. The palm oil production process generates POME (effluent). The FFB to POME ratio is approx. 0.65. The COD inflow to pond is

0.076242 tCOD/m^3.

Currently, the POME generated by mill is treated in anaerobic open lagoons without methane recovery, wherein the methane is emitted to atmosphere. The operating parameter e.g. COD inflow, quantity of wastewater and mill capacity will be same in baseline and project scenario. The mill, which is in regulatory compliance, operates approximately 19 hours per day, 300 days per year. A system of open lagoons is used to process POME effluent: 2 anaerobic lagoons, and 1 facultative lagoon.

The anaerobic lagoons measure approximately 255xm x 25m x 4m, respectively. The facultative lagoon measures approximately 110m x 25m x 5m. At this facility, lagoon depth averages 4-5 meters but occasionally may vary due to sludge build-up. As a result, these lagoons are subject to sludge removal as needed. Upon removal, the sludge is land applied. The existing open lagoons at site are capable to treat the increased POME generation and no addition investment needed for open lagoons due to increase in milling capacity.

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Indonesia (host Party)	Private entity- PT. Tintin Boyok Sawit Makmur	No

A.5. Public funding of project activity

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There will be no use public funding or ODA by the project activity.

A.6. History of project activity

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The PP hereby confirms in line with PDD completion guidelines that
a) The proposed CDM project activity is neither registered as a CDM project activity nor included as a component project activity (CPA) in a registered CDM programme of activities (PoA); and
b) The proposed CDM project activity is not a project activity that has been deregistered.
c) The CDM project activity is neither registered CDM project activity nor a CPA under a registered CDM PoA whose crediting period has or has not expired (hereinafter referred to as former project) exists in the same geographical location as the proposed CDM project activity.

A.7. Debundling

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The project activity is not a debundled component of a larger project activity as explained below. As per clause 12(c) of the Simplified Modalities and Procedures for small scale clean development mechanism project activities (decision 4/CMP.1, Annex II), "*To use simplified modalities and procedures for small-scale CDM project activities, a proposed project activity shall: Not be a debundled component of a larger project activity, as determined through appendix C to this annex.*"

As per para 9 of the tool "Assessment of de-bundling for SSC project activities, Version 4, EB83, Annex-13), "A proposed small-scale project activity shall be deemed to be a debundled 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:

(a) With the same project participants;
(b) In the same project category and technology/measure; and
(c) Registered within the previous 2 years; and

(d) Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point."

The PP has published another CDM project activity for Global Stakeholder consultation, which is
(a) With the same project participants; and
(b) In the same project category and technology/measure;

However the project boundary is not within 1 km of the proposed small scale project activity; hence, the project activity is not a de-bundled component of a large-scale project activity.

SECTION B. Application of methodologies and standardized baselines

B.1. References to methodologies and standardized baselines

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Applied Methodology: AMS-III.H - Methane recovery in wastewater treatment, Version-19
Ref: https://cdm.unfccc.int/methodologies/DB/K7FDTJ4FL3432I1UKRNKLDCUFAMBX7

Tools:

- Project emissions from flaring (Version 03.0);
(Ref: https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-06-v3.0.pdf)
- Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (Version 03.0);
(Ref: https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v3.0.pdf)
- Tool to determine the mass flow of a greenhouse gas in a gaseous stream (Version 03.0).
(Ref: https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-08-v3.0.pdf)

Guidelines:

- General guidelines for SSC CDM methodologies (Version 23.0);

Ref: https://cdm.unfccc.int/filestorage/e/x/t/extfile-20190916153418116-MethSSC_guid25.pdf/MethSSC_guid25.pdf?t=cmh8cWIzYm45fDA0Su8MU0Nh-GJCnKbWcN7F

- Sampling and surveys for CDM project activities and programme of activities (Version 04);

Ref: https://cdm.unfccc.int/filestorage/e/x/t/extfile-20151023152925164-Meth_GC48_-ver04.0-.pdf/Meth_GC48_%28ver04.0%29?t=SWN8cWIzY3F6fDA3vFqO-QJNqyZfLKi-uO-m

B.2. Applicability of methodologies and standardized baselines

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The project activity involves implementation of sequential stage wastewater treatment plant i.e. anaerobic digester system for wastewater treatment with biogas recovery and combustion. Thus, option 1(f) is applicable to the project activity i.e. introduction of a sequential stage of wastewater treatment with biogas recovery and combustion, to an anaerobic wastewater treatment system without biogas recovery. This simplified baseline methodology is applicable to this project activity because without the proposed project activity, methane from the existing anaerobic treatment system would continue to be emitted into the atmosphere.

Table 1: Justification of the choice of the project category AMS-III.H (version 19)

Para. No.	AMS-III.H Applicability Requirements	Project activity
2	This methodology comprises measures that recover biogas from biogenic organic matter in wastewater by means of one, or a combination, of the following options:	As per Section B.4, the most plausible baseline scenario for the project activity is continuation of current practice i.e. treatment of wastewater in open anaerobic lagoons without biogas recovery.

Para. No.	AMS-III.H Applicability Requirements	Project activity
	a. Substitution of aerobic wastewater or sludge treatment systems with anaerobic systems with biogas recovery and combustion; b. Introduction of anaerobic sludge treatment system with biogas recovery and combustion to a wastewater treatment plant without sludge treatment; c. Introduction of biogas recovery and combustion to a sludge treatment system; d. Introduction of biogas recovery and combustion to an anaerobic wastewater treatment system such as anaerobic reactor, lagoon, septic tank or an on-site industrial plant e. Introduction of anaerobic wastewater treatment with biogas recovery and combustion, with or without anaerobic sludge treatment, to an untreated wastewater stream; f. Introduction of a sequential stage of wastewater treatment with biogas recovery and combustion, with or without sludge treatment, to an anaerobic wastewater treatment system without biogas recovery (e.g. introduction of treatment in an anaerobic reactor with biogas recovery as a sequential treatment step for the wastewater that is presently being treated in an anaerobic lagoon without methane recovery).	The project activity involves implementation of sequential stage wastewater treatment plant i.e. anaerobic digester system for wastewater treatment with biogas recovery and combustion. Thus, option 1(f) is applicable to the project activity i.e. introduction of a sequential stage of wastewater treatment with biogas recovery and combustion, to an anaerobic wastewater treatment system without biogas recovery.
3	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 baseline scenario is, the wastewater continued to be treated in series of anaerobic lagoons without methane recovery. As mentioned in section A.3 of the PDD, the average depth existing open anaerobic lagoons at site ranges from 4-5 meters. The ambient temperature at project site is estimated using the average temperature of the west Kalimantan province. The average annual temperature in this area is 26.7°C[1]. Taking into the consideration of the required manpower to conduct de-sludging, the typical interval between

[1] https://en.climate-data.org/asia/indonesia/west-kalimantan/kalimantan-590136/

Para. No.	AMS-III.H Applicability Requirements	Project activity
		two consecutive sludge removal events would be more than 30 days. Further, as per the publication "Pipeline[2]" the lagoons are able to properly function without sludge removal for up to 5 to 10 years.
4	The recovered biogas from the above measures may also be utilized 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 in a Gas Engine set/boiler for energy generation and any excess biogas will be flared using enclosed flaring system.
5	If the recovered biogas is used for project activities covered under paragraph 3(a), that component of the project activity can use a corresponding methodology under type I	Even though the generated biogas from the project activity will be used for energy generation, PP will not claim any emission reductions associated with such energy generation.
6	For project activities covered under paragraph 4(b), if bottles with upgraded biogas are sold outside the project boundary, the end-use of the biogas shall be ensured via a contract between the bottled biogas vendor and the end-user. No emission reductions may be claimed from the displacement of fuels from the end use of bottled biogas in such situations. If, however, the end use	The project activity does not claim emission reduction from end use of biogas, hence not applicable.

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

Para. No.	AMS-III.H Applicability Requirements	Project activity
	of the bottled biogas is included in the project boundary and is monitored during the crediting period CO_2 emissions avoided by the displacement of fossil fuel can be claimed under the corresponding Type I methodology, e.g. "AMS-I.C.: Thermal energy production with or without electricity".	
7	For project activities covered under paragraph 4(c)(i), emission reductions from the displacement of the use of natural gas are eligible under this methodology, provided the geographical extent of the natural gas distribution grid is within the host country boundaries.	The project activity does not claim emission reduction from end use of biogas, hence not applicable.
8	For project activities covered under paragraph 4(c)(ii), emission reductions for the displacement of the use of fuels can be claimed following the provision in the corresponding Type I methodology, e.g. AMS-I.C.	The project activity does not claim emission reduction from end use of biogas, hence not applicable.
9	In particular, for the case of paragraph 4(b) and (c)(iii), the physical leakage during storage and transportation of upgraded biogas, as well as the emissions from fossil fuel consumed by vehicles for transporting biogas shall be considered. Relevant procedures in paragraph 18 of the appendix of "AMS-III.H.: Methane recovery in wastewater treatment" shall be followed in this regard.	The biogas produced in project activity is used at site, hence not applicable.
10	For project activities covered under paragraph 4(b) and (c), this methodology is applicable if the upgraded methane content of the biogas is in accordance with relevant national regulations (where these exist) or, in the absence of national regulations, a minimum of 96 per cent (by volume).	The project activity does not upgrade biogas, hence not applicable.
11	If the recovered is utilized for the production of hydrogen (project activities covered under paragraph 3(d)), that component of the project activity shall use the corresponding methodology "AMS-III.O.: Hydrogen production using methane extracted from biogas".	Not applicable
12	If the recovered biogas is used for project activities covered under paragraph 4(e), that component of the project activity shall use corresponding methodology "AMS-III.AQ.: Introduction of Bio-CNG in transportation applications"	Not applicable, as biogas produced is used at site only.
13	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	This project activity was having existing lagoons, wherein biogas recovery system being introduced, which complies with the "General guidelines for SSC CDM methodologies" Version 23.0. The determination of plausible baseline scenario is presented in section B.4.

Para. No.	AMS-III.H Applicability Requirements	Project activity
	demonstrating the remaining lifetime of the equipment replaced, as described in the general guidelines shall be followed.	There will be no equipment replaced; therefore, provisions pertaining to remaining lifetime of the equipment are not relevant to the project activity.
14	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.2 of the PDD
15	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 58,985 tCO_2e during the crediting period.

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

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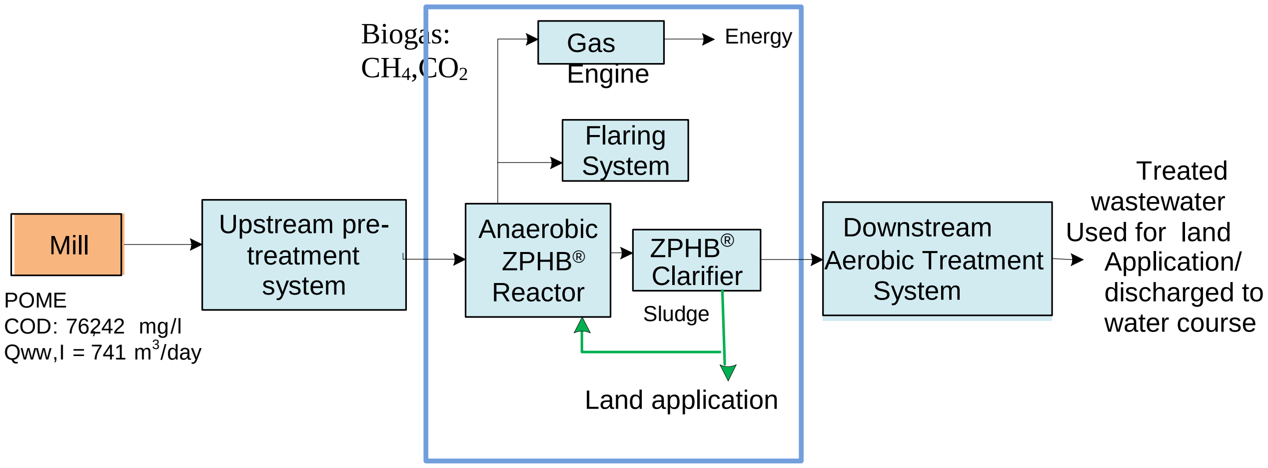
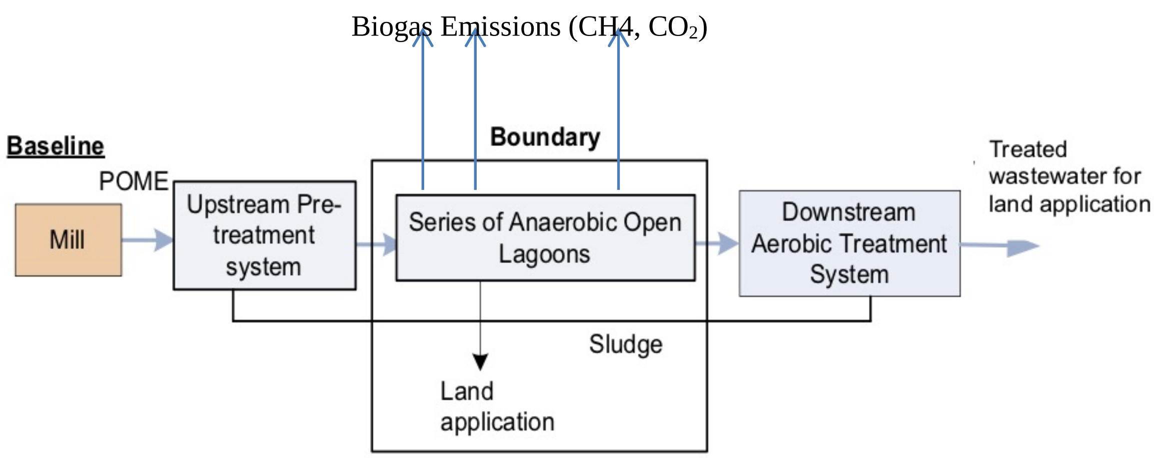
The project boundary is delineated in figure below.



Project Activity



	Source	GHG	Included?	Justification/Explanation
Baseline	Emissions from the baseline wastewater treatment system.	CO_2	No	CO_2 emission is not accounted because this is generated from the decomposition of organic matter.
		CH_4	Yes	CH_4 is the major component in the biogas produced during anaerobic wastewater treatment
		N_2O	No	Excluded for simplification.
	Emissions from the baseline sludge treatment system.	CO_2	No	There is no baseline sludge treatment system which will be affected by the project activity.
		CH_4	No	
		N_2O	No	
	Emissions on account of electricity or fossil fuel used	CO_2	No	Baseline emissions from electricity consumption will not be accounted for because there would have been negligible electricity consumption in the baseline scenario.
		CH_4	No	
		N_2O	No	
	Emissions from the discharge of the effluent into river/lake/sea	CO_2	No	The treated wastewater used for land application, hence not considered.
		CH_4	No	
		N_2O	No	
Project activity	Emissions from electricity or fuel consumption in the project activity	CO_2	Yes	For *ex-ante* estimation, this emission is assumed zero. However, for *ex-post* estimation, this emission will be included in the case when electricity generated by diesel back-up generators is used.
		CH_4	No	Excluded for simplification.
		N_2O	No	Excluded for simplification.
	Emissions from wastewater treatment system affected by the project activity and not equipped with biogas recovery	CO_2	No	There is no component of the wastewater treatment system affected by the project activity which is not equipped with biogas recovery system.
		CH_4	No	
		N_2O	No	
	Emissions from sludge treatment system affected by the project activity and not equipped with biogas recovery	CO_2	No	There is no provision for sludge treatment system in the project activity.
		CH_4	No	
		N_2O	No	
	Emissions from the discharge of the effluent into river/lake/sea	CO_2	No	Excluded for simplification
		CH_4	Yes	The treated water will be used for land application.
		N_2O	No	Excluded for simplification
	Emissions from biogas release in capture system	CO_2	No	CO_2 emission from biogas release is not accounted.
		CH_4	Yes	CH_4 is the major component in any fugitive biogas not captured by the capture system.
		N_2O	No	Excluded for simplification.
	Emissions due to incomplete flaring of biogas	CO_2	No	It is assumed that CO_2 emissions from recovered biogas do not lead to changes of carbon pools in the LULUCF sector.
		CH_4	Yes	Emission source due to incomplete flaring of biogas. For *ex-ante* estimation, this emission is assumed zero since flaring system will operate only in emergency (i.e. during maintenance or shutdown of the boiler). However, for *ex-post* estimation, this emission will be accounted whenever flaring system is used.
		N_2O	No	Excluded for simplification
		CO_2	No	

Source		GHG	Included?	Justification/Explanation
	Emissions from biomass stored under anaerobic conditions	CH_4	No	No biomass will be stored under anaerobic conditions in the project activity.
		N_2O	No	

B.4. Establishment and description of baseline scenario

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As the project falls in Type III existing project, the most plausible baseline scenario for the project activity has to be demonstrated as per the baseline determination provided in the AMS-III.H Version 19 and "General Guidelines to SSC CDM methodologies" Version 23.

As per AMS-III.H version 19 (hereinafter referred to as the "baseline and monitoring methodology"), in case of existing industrial wastewater treatment facilities, the baseline will be the continuation of the existing system for wastewater treatment. This is evident in the paragraph 36 and 37 of the baseline and monitoring methodology where the past historic records or baseline measurement campaign undertaken before project implementation is required for estimating emissions associated with the prevailing baseline. Further as the proposed project activity also involves capacity expansion of the FFB processing capacity, which will increase the generation of wastewater, however the existing open lagoons capacity is sufficient to treat the additional wastewater generation as well. Thus, there will no investment required in baseline even with capacity expansion. Hence, as per "General Guidelines to SSC CDM methodologies" Version 23 and applied small scale approved methodology the baseline scenario is continuation of current practice i.e. treatment of wastewater in existing open lagoons.

The assessment of the palm oil facility determined that a system of open lagoons is used to treat POME. This is the most common practice in Indonesian palm oil mills. Subsequent to treatment in the system of lagoons, the treated POME is normally either:

- Applied to land or
- Directed to waterways

At this site, treated POME is used either for land application or discharged to waterways.

As per CDM project standard Version-02 the impact of national/sectoral policies assessed on continuation of current practice i.e. treatment of wastewater in anaerobic lagoons without methane recovery. The baseline option is in compliance with all relevant mandatory national and/or sectoral policies, as there is no mandatory legal requirement on selection of technology for treatment of wastewater in Indonesia. The project activity is required to treat the wastewater stream and sludge to achieve COD level specified by the host country.

The existing regulation applicable to project activity is Ministerial Regulation of Environment number 5/2014 about Waste Water Quality Standards", which have no regulation on technology selection, however, the waste water quality can be discharged to sea/river is required to be as BOD 100 mg/l and COD 350 mg/l.

The current practice at site that is in anaerobic lagoon is in compliance with above regulation. The existing facility i.e. treatment of wastewater (POME) was also found to comply with current effluent discharge standards. The palm oil mill is using an open-air anaerobic lagoon system (without methane recovery) to treat wastewater prior to land application. Therefore, the baseline scenario is the continuation of the present wastewater treatment system and the release of methane into the atmosphere.

Baseline data and assumptions used to determine the baseline emissions include the following:

Parameter	Description	Value	Unit	Source

$Q_{WW,I,y}$	Volume of wastewater treated in baseline wastewater treatment system i in year y	222,300	m^3/year	Based on historical record 2017, 2018, 2019 and planned processing capacity of the mill.
$COD_{inflow,I,y}$	Chemical oxygen demand of the wastewater inflow to the baseline treatment system i in year y	76,242	mg/l	Based on 10 days measurement campaign from 12/03/2020 to 30/03/2020.
$\eta_{COD, BL,y}$	COD removal efficiency of the baseline treatment system i	92.61	%	Based on 10 days measurement campaign dated 12/03/2020 to 30/03/2020.
$MCF_{ww, treatment, BL,y}$	Methane correction factor for baseline wastewater treatment systems i	0.8	--	As per Table-2 AMS-III.H version 19

B.5. Demonstration of additionality

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The project activity meets the eligibility criteria to use the simplified baseline and monitoring methodology listed in annexure B of simplified modalities and procedure for small-scale CDM project activities. In accordance with “demonstration of additionality of small scale project activity” Version-13.0, PP shall provide an explanation to show that the project activity would not have occurred due to at least one of the following barrier

- Investment barrier:
- Technological barrier:
- Barrier due to prevailing practice:
- Other barriers

The project proponent identified “investment barrier” as the most relevant barrier faced by the project activity.

The investment decision for proposed project activity was taken on 13 March 2020.

The investment analysis method recommends three analysis methods: simple cost analysis, investment comparison analysis and benchmark analysis. The proposed project produces economic benefits through saving of diesel oil other than CDM related income; therefore, the simple cost analysis cannot be taken. The investment comparison analysis is not applicable to the proposed project as the alternative to project activity is continuation or current practice. And the baseline scenario does not require additional investment.

As per tool Investment Analysis, the benchmark approach is suited to circumstances where the baseline does not require investment or is outside the direct control of the project developer, i.e. cases where the choice of the developer is to invest or not to invest.

Hence, the benchmark analysis is chosen and the project IRR is used as the financial indicator to assess the financial viability of the project activity.

Benchmark:
As per the "Investment Analysis" tool, Local commercial lending rates or weighted average costs of capital (WACC) are appropriate benchmarks for a project IRR. Hence the benchmark for the proposed project is based upon Local commercial lending rates.

Since in this project activity, project IRR has been considered as financial indicator, hence as per tool EB101 Annex11, Local commercial lending rates are considered as appropriate benchmarks and lending rate published by banks has been used.

The lending rate of banks in Indonesia is published and available on public domain hence considered authentic and appropriate. The benchmark thus selected complies as per the relevant guidelines on Investment Analysis.

The lending rate as per bank in January 2020 was 11.43%[3], which is also lowest considering previous trend, hence considered as conservative and appropriate.

Calculation and comparison of financial indicators
The period considered for Post Tax project IRR calculations is 20 years, which corresponds to the operational lifetime of the project activity. Depreciation, and other non-cash items related to the project activity, which have been deducted in estimating gross profits on which tax is calculated, is added back to net profits for the purpose of calculating the financial indicator.

The project participant has decided to increase the fresh fruit bunch (FFB) processing capacity from 40 tonne FFB/hour to 60 tonne FFB/hour, which will increase the POME generation from 520 m^3/day to 741m^3/day, however the existing lagoons size currently on site are capable of handling additional wastewater load for treatment. Hence no additional investment needed for lagoons development.

The following table illustrates the assumptions used for the calculation of the financial indicator i.e. Post Tax Project IRR for the given project activity. The use of these parameters indicating if they are assumed or based on actual figures is explained in the table. All the relevant costs and revenues for the project activity have been considered for calculation.

Capital Investment Item	Value (US$)	Source
Total project cost	2,673,525	Based on the offer letter by technology supplier (KIS) for the wastewater treatment project dated 01/2/2020
Revenue		
Annual Diesel cost savings	86,916.4 US$	Calculated by multiplying (a) diesel consumption (litre per MT) based on historical consumption, (b) price per litre of diesel (in USD)
Diesel price	0.67 USD/liter	Diesel price on 9th March 2020 https://www.globalpetrolprices.com/Indonesia/diesel_prices/
Escalation on diesel price	3.59%	Based on 10 years average (March 2011 to March 2020) Please see IRR sheet for calculation
PKS saving	16.2 MT/day	Calculated based on biogas quantity to be used in boiler

3 https://www.ceicdata.com/en/indonesia/lending-rate-by-banks/lending-rate-idr-consumption-commercial-bank

Price of PKS	23.38 US$	Market price based on quotation[4]
Revenue from PKS sale	113,626.8 US$	Calculated based on 300 days of operation
Total revenue	200,543.2 US$	Calculated
Cost Items	**Value (US$)**	
Operation cost including Manpower cost, maintenance & repair and Chemical & Consumables	**89,429**	As per the offer letter for EPC for the project dated 01/02/2020 (Man power cost (US$ 59429), chemical & consumable cost (US$ 30000). No escalation is considered on O&M cost, which is conservative
Depreciation	133,676	Straight line method
Income Tax	25%	Income Tax Law 36 of 2008[5]
Operational life time	20 years	Offer letter by Technology supplier (KIS) dated 01/02/2020.

Outcome of the Post-tax Project IRR Assessment

Particulars	Post-tax project IRR without CDM revenues	Benchmark	Post-tax project IRR with CDM revenues
	2.65%	11.43%	11.24%

Sensitivity Analysis

Sensitivity analysis is done to demonstrate how variations in key parameters affect the post tax project IRR for the project (without CDM revenues). Below are the project parameters which constitute either 20% of the total capital cost (for capital items) or 20% of total sales (for revenue and expenditure items) and which were subjected to variations in values for sensitivity assessment. Following parameter subjected to sensitivity analysis

1. Project cost
2. Revenue due to diesel and PKS
3. O&M cost

Particulars	+10% variations	0% variations	-10% variations	Breaching value
Initial capital outlay	1.91%	2.65%	3.49%	decrease by 61.50%
Cost saving due to replacement of diesel by biogas and sale of PKS	3.76%	2.65%	1.41%	increase by 99.2%
O &M cost	2.26%	2.65%	3.02%	decrease by 281.2%

Cost:
The cost is taken from the offer letter from technology supplier, there may be variation during signing of EPC, however possibility on decrease in more than 61.50% to breach the benchmark value is not a possibility as PP has already considered lower value than cost proposed by removing miscellaneous expenses. Moreover the cost from other similar project is found in same range to proposed cost. Hence, decrease in cost to breach the benchmark value is not likely scenario.

[4] Quotation from PT Fasela March 2020

[5] https://www2.deloitte.com/content/dam/Deloitte/id/Documents/tax/id-tax-indonesian-tax-guide-2019-2020-en.pdf

Revenue:
The revenue is calculated based on saving due to replacement of diesel and PKS sale, the value is taken on higher side as a conservative approach and increase 99.20% to breach the benchmark value is not a possibility. The escalation on diesel price is applied based on 10 years average increase which is appropriate, the PP has also applied the escalation on PKS price which is conservative as no such trend is there in market on PKS price. Hence, increase in diesel/PKS price to breach the benchmark value is not a likely scenario.

O&M cost:
The decrease in O&M cost by 281.2% is hypothetical and is not a realistic scenario.

It is therefore evident from the sensitivity analysis that the post tax project IRR for the project activity without consideration of CDM is below the benchmark value. This indicates that post tax project IRR estimates are robust representation of alleviation of the investment barrier if CDM revenues could be provided to the project activity. The calculation shows with CDM revenue the project can reduce the gap significantly.

In the absence of CDM consideration, the project participant would most likely would have continued with existing system i.e. open lagoons for POME treatment.

CDM prior considerations:

For a proposed CDM project activity with a start date on or after 2 August 2008, the project participants shall notify the designated national authority (DNA) of the host Party of the project activity, if such DNA exists, and the UNFCCC secretariat (hereinafter referred to as the secretariat), in writing of the commencement of the project activity and their intention to seek the CDM status for the project activity, or, through a DOE, publish the PDD for global stakeholder consultation, within 180 days of the start date in accordance with the “CDM project cycle procedure for project activities”.

The start date for the project activity is 02/11/2020 (date of EPC). The project proponent intimated the UNFCCC and DNA of their intention to seek CDM status on 16/03/2020, which is well before the project start date.

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

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Baseline emissions

As explained in Section B.4, the baseline scenario for the project activity is continuation of current practice i.e. treatment of wastewater in anaerobic open lagoons without methane recovery.

In line with para 25 of AMS III.H Version-19, Baseline emissions for the systems affected by the project activity may consist of:

(a) Emissions on account of electricity or fossil fuel used ($BE_{power,y}$);
(b) Methane emissions from baseline wastewater treatment systems ($BE_{ww,treatment,y}$);
(c) Methane emissions from baseline sludge treatment systems ($BE_{s,treatment,y}$);
(d) Methane emissions on account of inefficiencies in the baseline wastewater treatment systems and presence of degradable organic carbon in the treated wastewater discharged into river/lake/sea ($BE_{ww,discharge,y}$);
(e) Methane emissions from the decay of the final sludge generated by the baseline treatment systems ($BE_{s,final,y}$)

Baseline emissions are calculated as follows:

$BEy = BE_{power,y} + BE_{ww,treatment,y} + BE_{s,treatment,y} + BE_{ww,discharge,y} + BE_{s,final,y}$ ------ (Eq.-1 AMS III.H)

where:

BE_y = Baseline emissions in year y (tCO_2e)

$BE_{power,y}$ = Baseline emissions from electricity or fuel consumption in year y (tCO_2e)

$BE_{ww,treatment,y}$ = Baseline emissions of the wastewater treatment systems affected by the project activity in year y (tCO_2e)

$BE_{s,treatment,y}$ = Baseline emissions of the sludge treatment systems affected by the project activity in year y (t CO_2e)

$BE_{ww,discharge,y}$ = Baseline methane emissions from degradable organic carbon in treated wastewater discharged into sea/river/lake in year y (tCO_2e).

$BE_{s,final,y}$ = Baseline methane emissions from anaerobic decay of the final sludge produced in year y (tCO_2e).

In case of the project activity following is not applicable

1. There was no power requirement in baseline scenario, hence $BE_{power,y}$ =0
2. The treated wastewater in baseline was used for land application, however taking a conservative approach the same is considered zero, hence $BE_{ww,discharge,y}$ =0
3. Further emission due to sludge treatment systems affected by the project activity is considered as zero as there was no sludge treatment system in baseline, $BE_{s,treatment,y}$ =0, which is conservative.

Therefore baseline equation reduces to

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

• **Baseline emissions of the wastewater treatment systems affected by the project activity**

$$BE_{ww,treatment,y} = \Sigma_i(Q_{ww,i,y} * COD_{inflow,i,y} * \eta_{COD,BL,i} * MCF_{ww,treatment,BL,i}) * B_{o,ww} * UF_{BL} * GWP_{CH4} \quad \text{Eq.2}$$

Where:

$Q_{ww,i,y}$ Volume of wastewater treated in baseline wastewater treatment system i in year y (m^3). For ex ante estimation, forecasted wastewater generation volume or the designed capacity of the wastewater treatment facility can be used. However, the ex post emissions reduction calculation shall be based on the actual monitored volume of treated wastewater

$COD_{inflow,i,y}$ Chemical oxygen demand of the wastewater inflow to the baseline treatment system i in year y (t/m^3). Average value may be used through sampling with the confidence/precision level 90/10

$\eta_{COD,BL,i}$ COD removal efficiency of the baseline treatment system i, determined as per the paragraphs 36 of AMS III.H Version-19

$MCF_{ww,treatment,BL,i}$ Methane correction factor for baseline wastewater treatment systems i (MCF values as per Table.2 of AMS III.H)

i	Index for baseline wastewater treatment system
$B_{o,ww}$	Methane producing capacity of the wastewater (IPCC value of 0.25 kg CH_4/kg COD)
UF_{BL}	Model correction factor to account for model uncertainties (0.89)
GWP_{CH4}	Global Warming Potential for methane (value of 25)

- **Baseline methane emissions from anaerobic decay of final sludge produced by the project activity**

$$BE_{s,final,y} = S_{final,BL,y} * DOC_s * UF_{BL} * MCF_{s,BL,final} * DOC_F * F * 16/12 * GWP_{CH4}$$

Where,

$S_{final,BL,y}$	Amount of dry matter in the final sludge generated by the baseline wastewater treatment systems in the year y (t). If the baseline wastewater treatment system is different from the project system, it will be estimated using the monitored amount of dry matter in the final sludge generated by the project activity ($S_{final,PJ,y}$) corrected for the sludge generation ratios of the project and baseline systems as per equation (5) of AMS III.H Version-19
$MCF_{s,BL,final}$	Methane correction factor of the disposal site that receives the final sludge in the baseline situation, estimated as per the procedures described in the methodological tool “Emissions from solid waste disposal sites”
DOC_s	Degradable organic content of the untreated sludge generated in the year y (fraction, dry basis). Default values of 0.5 for domestic sludge and 0.257 for industrial sludge shall be used
j	index for baseline sludge treatment system
UF_{BL}	Model correction factor to account for model uncertainties (0.89)
DOC_F	Fraction of DOC dissimilated to biogas (IPCC default value of 0.5)
F	Fraction of CH_4 in biogas (IPCC default of 0.5)

NOTE: In the baseline scenario, this equation is not applicable since no methane recovery will be applied to sludge

As per para 36 of AMS III.H Version-19, “*In determining baseline emissions using equation (1), historical records of at least one year prior to the project implementation shall be used. This shall include for example the COD removal efficiency of the wastewater treatment systems, the amount of dry matter in sludge, power and electricity consumption per m^3 of wastewater treated the amount of final sludge generated per tonne of COD removed, and all other parameters required for determination of baseline emissions”.*

Where one year historical records prior to project implementation is not available, the parameter to be determined using para 37 of AMS III.H Version-19, which states

For wastewater treatment plant that has been operating for at least three years and if one year of historical data is not available, the following procedures shall be followed:

(a) All the available data in determining the required parameters (COD removal efficiency, specific energy consumption and specific sludge production) shall be used to determine the baseline emissions in year y;

(b) An ex ante measurement campaign shall be implemented to determine the required parameters (COD removal efficiency, specific energy consumption and specific sludge production). The measurement campaign shall be implemented in the baseline wastewater systems for at least 10 days. The measurements should be undertaken during a period that is representative for the typical

operation conditions of the systems and ambient conditions of the site (temperature, etc). 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 per cent to 50 per cent). The parameters from the measurement campaign are used to calculate the baseline emission in year y;

(c) The baseline emissions in year y is taken as the minimum between the result of (a) and (b).

As partial historical record of the project operation prior to implementation of the project activity is available, therefore in line with para 37 of AMS III.H Version-19, for determination of baseline emission, the parameters are determined using 10 days measurement campaign in existing system.

Project emissions

a) CO_2 emissions from the electricity and fuel used by the project activity ($PE_{power,y}$)

b) Methane emissions from wastewater treatment systems affected by the project activity, and not equipped with biogas recovery in the project scenario ($PE_{ww,treatment,y}$)

c) Methane emissions from sludge treatment systems affected by the project activity, and not equipped with biogas recovery in the project situation ($PE_{s,treatment,y}$)

d) Methane emissions on account of inefficiency of the project activity wastewater treatment systems and presence of degradable organic carbon in treated wastewater ($PE_{ww,discharge,y}$)

e) Methane emissions from anaerobic decay of the final sludge ($PE_{s,final,y}$)

f) Methane emissions from biogas release in capture systems ($PE_{fugitive,y}$)

g) Methane emissions due to incomplete flaring ($PE_{flaring,y}$)

h) Methane emissions from biomass stored under anaerobic conditions which would not have occurred in the baseline situation ($PE_{biomass,y}$)

Project activity emissions from the systems affected by the project activity are calculated as follows:

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

-------Eq. 8 (AMS III.H Version-19)

Where

PE_y = Project activity emissions in the year y (t CO_2e)

$PE_{power,y}$ = Emissions from electricity or fuel consumption in the year y (t CO_2e). These emissions shall be calculated as per paragraph 26, for the situation of the project scenario, using energy consumption data of all equipment/devices used in the project activity wastewater and sludge treatment systems and systems for biogas recovery and flaring/gainful use

$PE_{ww,treatment,y}$ = Methane emissions from wastewater treatment systems affected by the project activity, and not equipped with biogas recovery, in year y (t CO_2e). These emissions shall be calculated as per equation (2) in paragraph 27 using an uncertainty factor of 1.12 and data applicable to the project situation ($MCF_{ww,treatment,PJ,k}$ and $\eta_{,PJ,k,y}$) and with the following changed definition of parameters:

$MCF_{ww,treatment,PJ,k}$ Methane correction factor for project wastewater treatment system k (MCF values as per Table 2 above)

$\eta_{,PJ,k,y}$ Chemical oxygen demand removal efficiency of the project wastewater treatment system k in year y (t/m^3), measured based on inflow COD and outflow COD in system k

$PE_{s,treatment,y}$ = Methane emissions on account of inefficiency of the project activity wastewater treatment systems and presence of degradable organic carbon in treated wastewater, in year y (t CO_2e). These emissions shall be calculated as per equations (3) and (4) in paragraphs 30 and 31, using an uncertainty factor of 1.12 and data applicable to the project situation ($S_{l,PJ,y}$, $MCF_{s,treatment,l}$) and with the following changed definition of parameters:

$S_{l,PJ,y}$ Amount of dry matter in the sludge treated by the sludge treatment system l in the project scenario in year y (t)

$MCF_{s,treatment,i}$ Methane correction factor for the project sludge treatment system l (MCF values as per table 2)

$PE_{ww,discharge,y}$ = Methane emissions on account of inefficiency of the project activity wastewater treatment systems and presence of degradable organic carbon in treated wastewater in year y (t CO2e). These emissions shall be calculated as per equation (6) in paragraph 33 of AMS III.H V19, using an uncertainty factor of 1.12 and data applicable to the project conditions ($COD_{ww,discharge,PJ,y}$, $MCF_{ww,PJ,discharge}$) and with the following changed definition of parameters:

$COD_{ww,discharge,PJ,y}$ Chemical oxygen demand of the treated wastewater discharged into the sea, river or lake in the project scenario in year y (t/m^3)

$MCF_{ww,discharge, PJ,y}$ Methane correction factor based on the discharge pathway of the wastewater in the project scenario (e.g. into sea, river or lake) (MCF values as per Table 2)

$PE_{s,final,y}$ = Methane emissions from anaerobic decay of the final sludge produced in year y (t CO_2e). These emissions shall be calculated as per equation (7) in paragraph 35, using an uncertainty factor of 1.12 and data applicable to the project conditions ($MCF_{s,PJ,final}$, $S_{final,PJ,y}$). If the sludge is controlled combusted, disposed in a landfill with biogas recovery, or used for soil application in aerobic conditions in the project activity, this term shall be neglected, and the sludge treatment and/or use and/or final disposal shall be monitored during the crediting period with the following revised definition of the parameters:

$MCF_{s,PJ,final}$ Methane correction factor of the disposal site that receives the final sludge in the project situation, estimated as per the procedures described in the methodological tool "Emissions from solid waste disposal sites"

$S_{final,PJ,y}$ Amount of dry matter in final sludge generated by the project wastewater treatment systems in the year y (t)

$PE_{fugitive,y}$ = Methane emissions from biogas release in capture systems in year y, calculated as per paragraph 40 (t CO_2e)

$PE_{flaring,y}$ = Methane emissions due to incomplete flaring in year y (t CO_2e). For ex ante estimation, baseline emission calculation for wastewater and/or sludge treatment (i.e. equation (2) and/or equation (3)) can be used but without the consideration of GWP for CH_4. However, the ex post emission reduction shall be calculated as per methodological tool "Project emissions from flaring"

$PE_{biomass,y}$ = Methane emissions from biomass stored under anaerobic conditions. If storage of biomass under anaerobic conditions takes place in the project and does not occur in the baseline, methane emissions due to anaerobic decay of

this biomass shall be considered and be determined as per the procedure in the methodological tool "Emissions from solid waste disposal sites" (t CO_2e)

In this case, following are not applicable to the project activity for the following reasons:

- Project emission from Item (b) is not applicable as there are no system in project activity not equipped with biogas/methane recovery, which affected by the project activity. Therefore, $\mathbf{PE_{WW,treatment,y}}$ is considered as zero.
- Project emission from Item (c) may be neglected since there was no sludge treatment system in baseline, which affected by the project activity. Therefore, $\mathbf{PE_{s,treatment,y}}$ is considered as zero
- Project emission from Item (e) may be neglected since the methodology states in for $\mathbf{PE_{s,final,y}}$ "*If the sludge is controlled combusted, disposed in a landfill with biogas recovery, or used for soil application in aerobic conditions in the project activity, this term shall be neglected, and the sludge treatment and/or use and/or final disposal shall be monitored during the crediting period.*" Therefore, $\mathbf{PE_{s,final,y}}$ can be neglected since sludge disposition in this project is soil application. However the quantity of sludge generation and usage will be monitored ex-post.
- Item (h) may be neglected there will be no biomass stored under the project activity. Therefore, $\mathbf{PE_{biomass,y}}$ can be neglected.

Hence project emission will be calculated using final equation

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

• **Project emissions from electricity and fuel used by the project facilities**

Project emissions from electricity and fossil fuel consumption ($PE_{power,y}$) are determined as per the procedures described in the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" Version-03 and "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" Version-03, respectively. The energy consumption shall include all equipment/devices in the project wastewater and sludge treatment facility.

$PE_{power,y}$ Emissions from electricity or fuel consumption in the year y will be calculated as follows:

Project emissions from electricity consumption

It will be calculated as per the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" as follows:

One of the following scenarios may be applicable to or selected by project activity

Scenario A: Electricity consumption from the grid. The electricity is purchased from the grid only, and either no captive power plant(s) is/are installed at the site of electricity consumption or, if any captive power plant exists on site, it is either not operating or it is not physically able to provide electricity to the electricity consumer;

Scenario B: Electricity consumption from an off-grid fossil fuel fired captive power plant. One or more fossil fuel fired captive power plants are installed at the site of the electricity consumption source and supply the source with electricity. The captive power plant(s) is/are not connected to the electricity grid.

Scenario C: Electricity consumption from the grid and fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants operate at the site of the electricity consumption source.

The captive power plant(s) can provide electricity to the electricity consumption source. The captive power plant(s) is/are also connected to the electricity grid.

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

Scenario B: Electricity consumption from an off-grid captive power plant
The project participant has decided to use option B2 conservative default value

Option B2:

(a) A value of 1.3 t CO_2/MWh if:

(i) The electricity consumption source is a project or leakage electricity consumption source; or
(ii) The electricity consumption source is a baseline electricity consumption source; and the electricity consumption of all baseline electricity consumptions sources at the site of the captive power plant(s) is less than the electricity consumption of all project electricity consumption sources at the site of the captive power plant(s);

(b) A value of 0.4 t CO_2/MWh if:

(i) The electricity consumption source is a baseline electricity consumption source; or
(ii) The electricity consumption source is a project electricity consumption source and the electricity consumption of all baseline electricity consumptions sources at the site of the captive power plant(s) is greater than the electricity consumption of all project electricity consumption sources at the site of the captive power plant(s).

The equation to be used as

$$PE_{y,DG} = EC_{PJ,DG,y} * EF_{CO2,DG}$$

Where,

$PE_{y,DG}$ =Project emission due to electricity generation in DG set in year y(tCO_2e)

$EC_{PJ,DG,y}$= Electricity generation in DG set in year y (MWh)

$EF_{CO2,DG}$= Emission factor of DG set (tCO_2/MWh)

Project emissions from fossil fuel consumption

In line with para 26 of applied approved methodology the baseline emission on account of fossil fuel consumption can be calculated using “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”.

CO_2 emissions from fossil fuel combustion in process j are calculated based on the quantity of fuels combusted and the CO_2 emission coefficient of those fuels, as follows:

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

where:

$PE_{FC,j,y}$	The CO_2 emissions from fossil fuel combustion in process j during the year y (tCO_2/yr)
$FC_{i,j,y}$	Quantity of fuel type i combusted in process j during the year y (mass or volume unit/yr).

$COEF_{i,y}$ CO_2 emission coefficient of fossil fuel type i in year y (tCO_2/mass or volume unit).

i Fuel type combusted in process j during the year y.

The CO_2 emission coefficient $COEF_{i,y}$ can be calculated using one of the following two Options, depending on the availability of data on the fossil fuel type i, as follows:

(a) Option A: The CO_2 emission coefficient $COEF_{i,y}$ is calculated based on the chemical composition of the fossil fuel type i, using the following approach:
If $FC_{i,k,y}$ is measured in a mass unit:

$$COEF_{i,y} = w_{c,i,y} \times 44/12$$

If $FC_{i,j,y}$ is measured in a volume unit:

$$COEF_{i,y} = w_{c,i,y} \times \rho_{I,y} \times 44/12$$

Where,

$COEF_{i,y}$ = Is the CO_2 emission coefficient of fuel type i (tCO_2/mass or volume unit);
$w_{c,i,y}$ = Is the weighted average mass fraction of carbon in fuel type i in year y (tC/mass unit of the fuel)
$\rho_{I,y}$ = Is the weighted average density of fuel type i in year y (mass unit/volume unit of the fuel)
i = Are the fuel types combusted in process j during the year y

(b) Option B: The CO_2 emission coefficient $COEF_{i,y}$ is 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,
$COEF_{i,y}$ Is the CO_2 emission coefficient of fuel type i (tCO_2/mass or volume unit);
$NCV_{i,y}$ Weighted average net calorific value of the fuel type i in the 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).
i Are the fuel types combusted in process j during the year y

- **Project emissions on account of inefficiency of the project activity wastewater treatment systems and presence of degradable organic carbon in treated wastewater**

$PE_{ww,discharge,y}$ Methane emissions from degradable organic carbon in treated wastewater in year y (tCO_2e). These emission will be calculated as that for $BE_{ww,discharge,y}$, using uncertainty factor of 1.12 and data applicable to the project conditions ($COD_{ww,discharge,PJ,y}$ and $MCF_{ww,PJ,discharge}$) and with the following changed definition of parameters:

$COD_{ww,discharge,PJ,y}$ Chemical oxygen demand of the treated wastewater discharged to the sea, river or lake in the project scenario in year y (t/m^3)

$MCF_{ww,PJ,discharge}$ Methane correction factor based on the discharge pathway of the wastewater in the project scenario (e.g. into the sea, river or lake) (MCF values as per Table 2)

The following equation will be used

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

Where, $Q_{ww,discharge,y} = Q_{ww,I,y}$

• **Project emissions due to inefficiencies in capture systems**
(a) Based on the methane emission potential of wastewater and/or sludge:

$PE_{fugitive,y}$ Methane emissions from biogas release in capture systems in year y

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

As project participant envisage no sludge treatment system in project case for biogas recovery, hence equation simplifies to

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

Where,

$PE_{fugitive,ww,y}$ 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 (t CO_2e)

$$PE_{fugitive,ww,y} = (1 - CFE_{ww}) * MEP_{ww,treatment,y} * GWP_{CH4}$$

where:

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 19)

$MEP_{ww,treatment,y}$ Methane emission potential of wastewater treatment systems equipped with biogas recovery system in year y (tonne)

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

where:

$Q_{ww,i,y}$ Amount of wastewater to be treated in the wastewater treatment system (m^3/year)

$COD_{removed,PJ,k,y}$ The Chemical Oxygen Demand removed[6] 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

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[6] Calculated based on monitored value as difference between the inflow COD and the outflow COD

(b) Optionally project proponent may take a default value of 0.05m[3] of biogas leaked per m[3] of biogas produced.

- **Project emissions due to incomplete flaring**

$PE_{flaring,y}$ Methane emissions due to incomplete flaring. For ex-ante estimation, project emission calculation for $PE_{ww,treatment,y}$ will be used without the consideration of GWP of CH_4. However, the ex post emission reduction will be calculated as per the "Tool to determine project emissions from flaring gases containing methane" as follows:

Project emissions from flaring of methane will be calculated as:

Methane emissions that occur due to incomplete flaring will be calculated ex post as per the "Project emissions from flaring (Version 3)".

This tool is applicable to the flaring of flammable greenhouse gases where:

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

The calculation procedure in this tool determines the project emissions from flaring the residual gas ($PE_{flare,y}$) based on the flare efficiency ($\eta_{flare,m}$) and the mass flow of methane to the flare ($F_{CH4,RG,m}$). The flare efficiency is determined for each minute m of year y based either on monitored data or default values.

The project emissions calculation procedure is given in the following steps:
(a) STEP 1: Determination of the methane mass flow of the residual gas;
(b) STEP 2: Determination of the flare efficiency;
(c) STEP 3: Calculation of project emissions from flaring.

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

In the "Project emissions from flaring (Version 3)", the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream (Version 3)" shall be used to determine $F_{CH4,m}$ which is used to determine the mass of methane in kilograms fed to the flare in minute m ($F_{CH4,RG,m}$). $F_{CH4,m}$ shall be determined on a dry basis.

The following requirements apply to use the "tool to determine the mass flow of a greenhouse gas in a gaseous stream":
(a) The gaseous stream tool shall be applied to the residual gas;
(b) The flow of the gaseous stream shall be measured continuously;
(c) CH_4 is the greenhouse gas i for which the mass flow should be determined;
(d) The simplification offered for calculating the molecular mass of the gaseous stream is valid; and
(e) The time interval t for which mass flow should be averaged is every minute m.

The calculation procedure in this tool determines the project emissions from flaring the residual gas ($PE_{flare,y}$) based on the flare efficiency ($\eta_{flare,m}$) and the mass flow of methane to the flare ($F_{CH4,RG,m}$). The flare efficiency is determined for each minute m of year y based either on monitored data or default values.

According to the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream (Version 3)", there are six options shown in the below table.

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

OPTION C	Volume flow - wet basis	Measured on wet basis ($v_{i,t,wb}$)
OPTION D	Mass flow - dry basis	Measured on dry basis ($v_{i,t,db}$)
OPTION E	Mass flow - wet basis	Measured on dry basis ($v_{i,t,db}$)
OPTION F	Mass flow - wet basis	Measured on wet basis ($v_{i,t,wb}$)

As per tool the particular Option from above table can be chosen based on whether residual gas stream is dry or wet.

In case the residual gas stream is wet, it requires determination of absolute humidity of gaseous stream.

Determination of absolute humidity of gaseous stream:
There are two option provided in tool

Option1: **Calculation using measurement of the moisture content**
This option provides a procedure to determine the absolute humidity of the gaseous stream ($m_{H2O,t,db}$) from measurements of the moisture content of the gas

Option2: **Simplified calculation without measurement of the moisture content**
This option provides a simple and conservative approach to determine the absolute humidity by assuming the gaseous stream is dry or saturated depending on which is the conservative situation

The project proponent has chosen option 2, which mentions
If it is conservative to assume that the gaseous stream is dry, then $m_{H2O,t,db}$ is assumed to equal 0. If it is conservative to assume that the gaseous stream is saturated, then $m_{H2O,t,db}$ is assumed to equal the saturation absolute humidity ($m_{H2O,t,db,sat}$) and calculated using equation

$$m_{H2O,t,db,sat} = (P_{H2O,t,Sat} \times MM_{H2O})/((P_t - P_{H2O,t,Sat}) \times MM_{t,db}))$$

Where,

$m_{H2O,t,db,sat}$ = Saturation absolute humidity in time interval t on a dry basis (kg H_2O/kg dry gas)
$P_{H2O,t,Sat}$ = Saturation pressure of H_2O at temperature Tt in time interval t (Pa)
T_t = Temperature of the gaseous stream in time interval t (K)
P_t = Absolute pressure of the gaseous stream in time interval t (Pa)
MM_{H2O} = Molecular mass of H_2O (kg H_2O/kmol H_2O)
$MM_{t,db}$ = Molecular mass of the gaseous stream in a time interval t on a dry basis (kg dry gas/kmol dry gas)

$MM_{t,db}$ is calculated using below equation

$$MM_{t,db} = \sum_k (v_{k,t,db} \times MM_k)$$

Where,

$v_{k,t,db}$ = Volumetric fraction of gas k in the gaseous stream in time interval t on a dry basis (m^3 gas k/m^3 dry gas)
MM_k = Molecular mass of gas k (kg/kmol)
k = All gases, except H2O, contained in the gaseous stream (e.g. N2, CO2, O2, CO, H2, CH4, N2O, NO, NO2, SO2, SF6 and PFCs). See available simplification below

The determination of the molecular mass of the gaseous stream ($MM_{t,db}$) requires measuring the volumetric fraction of all gases (k) in the gaseous stream. However, as a simplification, the volumetric fraction of only the gases k that are greenhouse gases and are considered in the emission reduction calculation in the underlying methodology must be monitored and the difference to 100% may be considered as pure nitrogen.

Further the tool provides various options of gaseous stream, either Option A or Option B will be applicable to project activity

Option A: To demonstrate that residual gas stream is dry basis, or
Option B: Volumetric flow of the gaseous stream in time interval t on a dry basis ($V_{t,db}$) is determined by converting the measured volumetric flow from wet basis to dry basis

As per technology employed by project activity, the temperature of residual gas stream will be less than 60^0C, hence in line with para 23 (b) of the tool dry basis monitoring is possible, hence project proponent decided to apply Option A.

Option A

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

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

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

The mass flow of methane is determined as follows:

$$F_{i,t} = V_{t,db} * v_{i,t,db} * \rho_{i,t}$$

Where:

$F_{i,t}$ Mass flow of greenhouse gas i in the gaseous stream in time interval t (kg gas/h)
$V_{t,db}$ Volumetric flow of the gaseous stream in time interval t on a dry basis (m³ dry gas/h)
$v_{i,t,db}$ Volumetric fraction of greenhouse gas i in the gaseous stream in a time interval t on a dry basis (m³ gas i/m³ dry gas)
$\rho_{i,t}$ Density of greenhouse gas i in the gaseous stream in time interval t (kg gas i/m³gas i)

With:

$$\rho_{i,t} = (P_t \times MM_i) / (R_u \times T_t)$$

Where,

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

Step2. Determination of flare efficiency

Open flares: Thus, according to the "Project emissions from flaring (Version 3)", the flare efficiency in the minute m ($n_{flare,m}$) is 50% when the flame is detected in the minute m ($Flame_m$), otherwise $n_{flare,m}$ is 0%.

Enclosed flares: Use a 90% default value. Continuous monitoring of compliance with manufacturer’s specification of flare (temperature, flow rate of residual gas at the inlet of the flare) will be performed. If in a specific hour any of the parameters are out of the limit of manufacturer’s specifications, a 50% default value for the flare efficiency will be used for the calculations for that specific hour.

If there is no record of the temperature of the exhaust gas of the flare or if the recorded temperature is less than 500 °C for any particular hour, it will be assumed that during that hour the flare efficiency is zero.

Step3. Calculation of project emissions from flaring

$PE_{flare,y} = GWP_{CH4} \times \sum_{m=1 \text{ to } 525600} F_{CH4,RG,m} \times (1 - \eta_{flare,m}) \times 10^{-3}$

Where:

$PE_{flare,y}$ Project emissions from flaring of the residual gas in year y (tCO_2e)

GWP_{CH4} Global warming potential of methane valid for the commitment period (tCO_2e/tCH_4)

$F_{CH4,RG,m}$ Mass flow of methane in the residual gas in the minute m (kg)

$\eta_{flare,m}$ Flare efficiency in minute m

OM_y Operating minutes in year y

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

Where:

$F_{CH4,RG,m}$ = Mass flow of methane in the residual gas in the minute m (kg)

$F_{i,t}$ = Mass flow of greenhouse gas i in the gaseous stream in time interval t (kg gas/h)

OM_y = Operating minutes in year y

However, for ex ante estimation, in accordance with AMS-III.H version 19 equation 8, baseline emission calculation for wastewater treatment (i.e. equation 2 of AMS-III.H) can be used but without the consideration of GWP for CH_4 according to AMS-III.H. Thus, ex ante methane emissions due to incomplete flaring in year y is calculated as follows:

$PE_{Flare,y} = Q_{ww,i,y} * COD_{inflow,i,y} * \eta_{COD,BL,I} * MCF_{ww,treatment,BL.i} * B_{o,ww} * UF_{BL}$

Where:

$Q_{ww,i,y}$ Volume of wastewater treated in baseline wastewater treatment system i in year y (m^3). For ex ante estimation, forecasted wastewater generation volume or the designed capacity of the wastewater treatment facility can be used. However, the ex post emissions reduction calculation shall be based on the actual monitored volume of treated wastewater

$COD_{inflow,i,y}$ Chemical oxygen demand of the wastewater inflow to the baseline treatment system i in year y (t/m^3). Average value may be used through sampling with the confidence/precision level 90/10

$\eta_{COD,BL,i}$ COD removal efficiency of the baseline treatment system i, determined as per the paragraphs 28(2)

$MCF_{ww,treatment,BL.i}$ Methane correction factor for baseline wastewater treatment systems i (MCF values as per Table III.H.2)

i Index for baseline wastewater treatment system

$B_{o,ww}$ Methane producing capacity of the wastewater (IPCC value of 0.25 kg CH_4/kg COD)

UF_{BL} Model correction factor to account for model uncertainties (0.89)

Since the biogas is planned to utilize totally and completely combusted for steam/electricity generation in the project activity, then the $PE_{flaring}$ will be considered as zero for ex-ante emission reduction. The ex post emission reduction will be calculated as per “Tool to determine project emissions from flaring gases containing methane” by using actual monitored data.

Leakage

If the project activity implements equipment transferred from another facility, leakage effects at the site of the other activity are to be considered and estimated (LE_y). There are no equipment transfer involved in the project activity, therefore $LE_y=0$

Emission reduction

Emission reductions will be estimated ex-ante as follows:

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

where:

$ER_{y,ex\ ante}$ Ex-ante emission reduction in year y (tCO_2e)

$BE_{y,ex\ ante}$ Ex-ante baseline emissions in year y (tCO_2e)

$PE_{y,ex\ ante}$ Ex-ante project emissions in year y (tCO_2e)

$LE_{y,ex\ ante}$ Ex-ante leakage emissions in year y (tCO_2e)

Ex post emission reductions shall be determined for case 2(a) and 2(e) as per paragraph 49. For cases 2(b), 2(c), 2(d) and 2(f), ex post emissions reductions shall be based on the lowest value of the following, as per paragraph 44:

i. The amount of biogas recovered and fuelled or flared (MD_y) during the crediting period, that is monitored ex-post.
ii. Ex-post calculated baseline, project and leakage emissions based on actual monitored data for the project activity.

For cases 2(d), it is possible that the project activity involves wastewater systems with higher methane conversion factors (MCF) or with higher efficiency than the treatment systems used in the baseline situation. Therefore the emission reductions achieved by the project activity is limited to the ex-post calculated baseline emissions minus project emissions using actual monitored data for the project activity.

The emission reductions achieved in any year are the lowest value of the following:

$$ER_{y,ex\ post} = \min((BE_{y,ex\ post} – PE_{y,ex\ post} – LE_{y,ex\ post}),(MD_y – PE_{power,y} – PE_{biomass,y} – LE_{y,ex\ post}))$$

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 as per paragraph 27 of AMS-III.H version 19 using ex post monitored values (tCO_2e)
$PE_{y,ex\ post}$	Project emissions calculated as per paragraph 39 of AMS-III.H version 19 using ex post monitored values (tCO_2e)
MD_y	Methane captured and destroyed/gainfully used by the project activity in the year y (tCO_2e)
$LE_{y,ex\ post}$	Leakage as per paragraph 41 of AMS-III.H version 19 (tCO_2e)

In the case of flaring/combustion MD_y will be calculated as:

$$MD_y = BG_{burnt,y} * w_{CH4,y} * D_{CH4} * FE * GWP_{CH4}$$

Where

$BG_{burnt,y}$	Annual volume of biogas burnt in year y (m^3/year)
$w_{CH4,y}$	Methane content of the biogas in the year y (volume fraction)
D_{CH4}	Density of methane at the temperature and pressure of the biogas in the year y (t/m^3)
FE	Flare efficiency in year y (fraction). If the biogas is combusted for gainful purposes, e.g. fed to an engine, an efficiency of 100% will be applied
GWP_{CH4}	Global warming potential of methane

For case 2(d), the emission reduction achieved by the project activity (ex-post) will be the difference between the baseline emissions and the sum of the project emissions and leakage:

$ER_y = BE_{y,ex\ post} – (PE_{y,ex\ post} + LE_{y,ex\ post})$

B.6.2. Data and parameters fixed ex ante

Data/Parameter	**GWP_{CH4}**
Data unit	tCO_2e/tCH_4
Description	Global Warming Potential of Methane
Source of data	IPCC value for second commitment period
Value(s) applied	25
Choice of data or measurement methods and procedures	IPCC default value for second commitment period
Purpose of data	To calculate baseline and project emission
Additional comment	--

Data/Parameter	**$B_{o,ww}$**
Data unit	kg CH_4 / kg COD
Description	Methane producing capacity of the wastewater
Source of data	Paragraph 27 of AMS-III.H (version 19)
Value(s) applied	0.25
Choice of data or measurement methods and procedures	In line with the requirement of the baseline and monitoring methodology
Purpose of data	To calculate baseline emission
Additional comment	--

Data/Parameter	$\eta_{COD,BL,i}$
Data unit	%
Description	COD removal efficiency of the baseline treatment system i
Source of data	Average of the samplings conducted and analyzed by an independent laboratory. Inflow COD is the wastewater entering the anaerobic wastewater treatment system and outflow COD is the “final treated wastewater discharged into sea, river, or lake”.
Value(s) applied	92.61
Choice of data or measurement methods and procedures	In line with the requirement of the baseline and monitoring methodology, the COD removal efficiency is calculated based on actual samples taken and analysed by third party in independent laboratory.
Purpose of data	To calculate baseline emission
Additional comment	The value is fixed ex-ante.

Data/Parameter	UF_{BL}
Data unit	--
Description	Model correction uncertainty factor to account for model uncertainties
Source of data	AMS-III.H (version 19) paragraph 27
Value(s) applied	0.89
Choice of data or measurement methods and procedures	In line with the requirement of the baseline and monitoring methodology
Purpose of data	To calculate baseline emission
Additional comment	--

Data/Parameter	$MCF_{WW,treatment,BL,i}$
Data unit	--
Description	Methane correction factor for baseline wastewater treatment system i
Source of data	Table-2 of AMS-III.H (version 19)
Value(s) applied	0.8
Choice of data or measurement methods and procedures	The current type of wastewater treatment and discharge pathway or system to which this project will be applied from Table III.H.2 is *Anaerobic deep lagoon (depth more than 2 metres).*
Purpose of data	To calculate baseline emission
Additional comment	--

Data/Parameter	$MCF_{WW,treatment,PJ,k}$
Data unit	--
Description	Methane correction factor for project wastewater treatment system k
Source of data	Table 2 of AMS-III.H version 19 or Table 6.8 of Volume 5 Chapter 6 IPCC 2006 Guideline
Value(s) applied	0.8
Choice of data or measurement methods and procedures	The current type of wastewater treatment system to which this project will be applied from Table III.H.2 is *Anaerobic deep lagoon (depth more than 2 metres)*
Purpose of data	To calculate project emission
Additional comment	--

Data/Parameter	**$MCF_{WW,PJ,discharge}$**
Data unit	--
Description	Methane correction factor based on the discharge pathway of the wastewater in the project scenario (e.g. into sea, river or lake or land application)
Source of data	Table 2. of AMS-III.H version 19
Value(s) applied	0.1
Choice of data or measurement methods and procedures	In line with the requirement of the baseline and monitoring methodology
Purpose of data	To calculate project emission
Additional comment	--

Data/Parameter	**UF_{PJ}**
Data unit	--
Description	Model correction to account for model uncertainties
Source of data	AMS-III.H (version 19) paragraph 40
Value(s) applied	1.12
Choice of data or measurement methods and procedures	Default value as per AMS-III.H (version 19) paragraph 39 In line with the requirement of the baseline and monitoring methodology
Purpose of data	To calculate project emission
Additional comment	--

Data/Parameter	**CFE_{WW}**
Data unit	--
Description	Capture efficiency of the biogas recovery equipment in the wastewater treatment systems
Source of data	Default value as per paragraph 40 of AMS-III.H version 19
Value(s) applied	0.9
Choice of data or measurement methods and procedures	In line with the requirement of the baseline and monitoring methodology
Purpose of data	To calculate project emission
Additional comment	--

Data/Parameter	**$\eta_{PJ,k,y}$**
Data unit	%
Description	COD removal efficiency of the project treatment system j
Source of data	Manufacturer specification
Value(s) applied	85
Choice of data or measurement methods and procedures	The value is provided by the technology supplier.
Purpose of data	To calculate project emission
Additional comment	--

Data/Parameter	$\eta_{flare,h}$
Data unit	%
Description	Flare efficiency in hour h
Source of data	Default value for enclosed flaring as per “Project emissions from flaring V03.0”
Value(s) applied	90%, if temperature of exhaust gas is more than 500 ^{0}C in a given hour. 0, otherwise
Choice of data or measurement methods and procedures	The flaring system used in the project activity will be enclosed flaring. Default value of 90% flare efficiency can be used if the flare is detected in an hour and temperature of exhaust gas is measured more than 500 ^{0}C. Otherwise, the default efficiency to be considered as 0%.
Purpose of data	To calculate project emission
Additional comment	--

Data/Parameter	$EF_{EL,j,y}$
Data unit	tCO_2/MWh
Description	Emission factor for electricity generation for source j in year y
Source of data	Value determined based on the source of electricity as explained under methodological above.
Value(s) applied	1.3
Choice of data or measurement methods and procedures	The project activity uses off grid Gas Engine set to meet its electricity requirement, hence as per applied tool (Tool 05, Version-03) Option B is used to determine the value.
Purpose of data	To calculate project emission
Additional comment	The value is fixed ex-ante for entire crediting period

Data/Parameter	$FE_{combusted}$
Data unit	%
Description	Flare efficiency of the biogas used for gainful purpose
Source of data	AMS-III.H (version 19).
Value(s) applied	100
Choice of data or measurement methods and procedures	This default value is as per the baseline and monitoring methodology
Purpose of data	To calculate project emission
Additional comment	--

Data/Parameter	$SPEC_{flare}$
Data unit	Temp- ^{0}C Flow rate- m^3/h Maintenance schedule- Year
Description	Manufacturer's flare specifications for temperature, flow rate and maintenance schedule
Source of data	Flare manufacturer
Value(s) applied	Temp- $500^{0}C$ or more Flow rate- 1000 to 13000 m^3/h Maintenance schedule- yearly
Choice of data or measurement methods and procedures	The value taken as per manufacturer specification.
Purpose of data	To calculate project emission
Additional comment	--

Data/Parameter	$\rho_{CH4,n}$
Data unit	Kg/m^3
Description	Density of methane gas at normal conditions.
Source of data	Table-1 of Tool "Project emission from flaring" V03.0
Value(s) applied	0.716
Choice of data or measurement methods and procedures	Default value as per AMS-III.H (version 19)
Purpose of data	To calculate project emission
Additional comment	--

B.6.3. Ex ante calculation of emission reductions

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Baseline emissions from wastewater treatment system

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

Table : 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 19)
$COD_{inflow,i,y}$	0.076242 $tCOD/m^3$	Average value based on sampling of COD inflow from third-party laboratory for the palm oil mill. This parameter will be monitored in the ex-post scenario.
$\eta_{COD,BL,i}$	92.61 %	Average value calculated based on sample for COD inflow and COD treated of the baseline deep lagoons. Please refer Appendix for details.
$Q_{ww,i,y}$	222,300 m^3/year	For *ex-ante* estimation in the PDD, historical 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.2 in AMS-III.H version 19. The 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.

Parameters	Value	Source
UF_{BL}	0.89	Value as per AMS-III.H (version 19)
GWP_{CH4}	25	IPCC default value

$BE_{ww,treatment,y}$ = 222,300 m^3 * (0.073 t COD/m^3 * 92.61% * 0.8) * 0.25 t CH_4/t COD * 0.89 * 25
= 69,847.62 tCO_2e

$BE_y = BE_{ww,treatment,y}$
= 69,847 tCO_2e (rounded down)

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

<u>Project emissions calculations due to electricity consumption is assumed zero for ex-ante calculation</u>

$PE_{power,y}$ =0 tCO_2e

<u>Project emissions from the treated wastewater discharged</u>

$PE_{ww,discharge,y}$ = *0 for ex-ante*

<u>Project emissions from biogas release in capture system</u>

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

= 222,300 m^3 * 0.25 t CH_4/t COD * 1.12 * 0.06481*0.8

$MEP_{ww,treatment,y}$ = 3,227 tCH_4/year

$PE_{fugitive,y} = (1-CFE_{ww}) * MEP_{ww,treatment,y} * GWP_{CH4}$

$PE_{fugitive,y}$ = (1- 0.9) * 3,227 tCH_4*25 tCO_2e/ tCH_4

$PE_{fugitive,y}$ = 8,068 tCO_2e

<u>Project emissions from flare</u>

$PE_{flaring,y} = Q_{ww,i,y} * COD_{inflow,i,y} * \eta_{COD,BL,i} * MCF_{ww,treatment,BL,i} * B_{o,ww} * UF_{BL}$

$PE_{flaring,y}$ =222,300 m^3 * (0.076242 t COD/m^3 * 92.61% * 0.8) * 0.25 t CH_4/t COD * 0.89

$PE_{flaring,y}$ = 2,794 tCO_2e

Total project emission

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

PE_y = 0 + 0 + 8068 + 2794
PE_y =10,862 tCO_2e

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

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

$ER_{y\ ex\ ante} = BE_{y\ ex\ ante} - (PE_{y\ ex\ ante} + LE_{y,\ ex\ ante})$
$= 69{,}847\ tCO_2e - (10{,}862\ tCO_2e + 0\ tCO_2e)$
$= 58{,}985\ tCO_2e$

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

Year	Baseline emissions ($t\ CO_2e$)	Project emissions ($t\ CO_2e$)	Leakage ($t\ CO_2e$)	Emission reductions ($t\ CO_2e$)
Year 1	69,847	10,862	0	58,985
Year 2	69,847	10,862	0	58,985
Year 3	69,847	10,862	0	58,985
Year 4	69,847	10,862	0	58,985
Year 5	69,847	10,862	0	58,985
Year 6	69,847	10,862	0	58,985
Year 7	69,847	10,862	0	58,985
Year 8	69,847	10,862	0	58,985
Year 9	69,847	10,862	0	58,985
Year 10	69,847	10,862	0	58,985
Total	**698,470**	**108,620**	**0**	**589,850**
Total number of crediting years	10			
Annual average over the crediting period	69,847	10,862	0	58,985

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data/Parameter	$\mathbf{Q_{WW,I,y}}$
Data unit	m^3
Description	Volume of the wastewater treated in the year “y”
Source of data	Plant log book
Value(s) applied	222,300
Measurement methods and procedures	Measurements will be undertaken by using flow meter at inlet to the project activity wastewater treatment system.
Monitoring frequency	Monitored continuously (at least hourly measurements are undertaken, if less, confidence/precision level of 90/10 shall be attained)
QA/QC procedures	The meter will be operated and calibrated according to manufacturer’s specifications (but no less than every 3 years). A calibration/service log will be maintained for each meter.
Purpose of data	To calculate baseline emission
Additional comment	Data will be archived electronically and kept for the duration of the project + 2 years.

Data/Parameter	$\mathbf{COD_{inflow,I,y}}$
Data unit	$Tonnes/m^3$
Description	Chemical oxygen demand of the wastewater entering the anaerobic treatment/reactor system in the year “y”

Source of data	Sampling analysis.
Value(s) applied	0.076242
Measurement methods and procedures	Measurement of COD is according to national or international standards at in-house and/or by an accredited laboratory. COD is measured through representative sampling. Refer section B.7.1 for sample size determination.
Monitoring frequency	Samples and measurements shall ensure a 90/10 confidence/precision level
QA/QC procedures	Average value will be used through sampling with 90/10 confidence/precision level.
Purpose of data	To calculate baseline emission
Additional comment	Data will be archived electronically and kept for the duration of the project + 2 years.

Data/Parameter	$COD_{WW,treated,y}$
Data unit	Tonnes/m^3
Description	Chemical oxygen demand of the treated wastewater discharged in the year “y”
Source of data	Sampling analysis.
Value(s) applied	0.06481
Measurement methods and procedures	Measurement of COD is according to national or international standards at in-house and/or by an accredited laboratory. COD is measured through representative sampling. Refer section B.7.1 for sample size determination.
Monitoring frequency	Samples and measurements shall ensure a 90/10 confidence/precision level
QA/QC procedures	Average value will be used through sampling with 90/10 confidence/precision level.
Purpose of data	To calculate baseline emission
Additional comment	Data will be archived electronically and kept for the duration of the project + 2 years.

Data/Parameter	$COD_{WW,discharge,y}$
Data unit	tCOD/m^3
Description	Chemical oxygen demand of the treated wastewater discharged to river/water/lake.
Source of data	Representative Sampling
Value(s) applied	0.00035
Measurement methods and procedures	Measurement of COD is according to national or international standards at in-house and/or by an accredited laboratory. COD is measured through representative sampling. Refer to Section B.7.1 for further information on sample size determination.
Monitoring frequency	Samples and measurements shall ensure a 90/10 confidence/precision level
QA/QC procedures	Average value will be used through sampling with 90/10 confidence/precision level.
Purpose of data	To calculate project emission
Additional comment	Data will be archived electronically and kept for the duration of the project + 2 years.

Data/Parameter	$S_{final,PJ,y}$
Data unit	Tonnes
Description	Amount of dry matter in final sludge
Source of data	Plant log book
Value(s) applied	0 for ex-ante

Measurement methods and procedures	Measure the total quantity of sludge on a wet basis. The volume (m3) and density or direct weighing will be used to determine the sludge amount (wet basis). Representative samples are taken to determine the moisture content to calculate the total sludge amount on dry basis. If the methane emissions from anaerobic decay of the final sludge are to be neglected because the sludge is controlled combusted, disposed of in a landfill with methane recovery, or used for soil application, then the end-use of the final sludge will be monitored during the crediting period. If the baseline emissions include the anaerobic decay of final sludge generated by the baseline treatment systems in a landfill without methane recovery, the baseline disposal site shall be clearly defined, and verified by the DOE.
Monitoring frequency	Monitoring of 100 per cent of the sludge amount through continuous or batch measurements and moisture content through representative sampling to ensure the 90/10 confidence/precision level
QA/QC procedures	100% of the sludge will be monitored.
Purpose of data	To calculate project emission
Additional comment	Data will be archived electronically and kept for the duration of the project + 2 years.

Data/Parameter	**$BG_{burnt,y}$**
Data unit	m^3
Description	Biogas volume in year y
Source of data	Plant log book
Value(s) applied	Not applicable for ex-ante calculation
Measurement methods and procedures	In all cases, the amount of biogas recovered, fuelled, flared or otherwise utilized (e.g. injected into a natural gas distribution grid or distributed via a dedicated piped network) shall be measured using continuous flow meters. If the biogas streams flared and fuelled (or utilized) are monitored separately, the two fractions can be added together to determine the total biogas recovered, without the need to monitor the recovered biogas before separation. The methane content measurement shall be carried out close to the biogas flow meters.
Monitoring frequency	Continuous monitoring (at least hourly measurements are undertaken, if less, confidence/precision level of 90/10 shall be attained)
QA/QC procedures	Meters will be calibrated as per vendor's specifications or at least once in 3 years, whichever is less.
Purpose of data	To calculate baseline emission
Additional comment	Data will be archived electronically and kept for the duration of the project + 2 years.

Data/Parameter	**w_{CH4}**
Data unit	%
Description	Methane content in biogas in year y
Source of data	Plant log book
Value(s) applied	Not applicable for ex-ante calculation

Measurement methods and procedures	The fraction of methane in the gas will be measured with a continuous analyser or, alternatively, with periodical measurements. It will be measured using equipment that can directly measure methane content in the biogas - the estimation of methane content of biogas based on measurement of other constituents of biogas such as CO2 is not permitted. The methane content measurement shall be carried out close to a location in the system where a biogas flow measurement takes place. Details e.g. location, configuration, accuracy, class of the measurement device are to be provided in the project activity. 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. In case of periodic measurements, the same will be taken at least once a month.
Monitoring frequency	At least once in a month
QA/QC procedures	The measurement will be monitored regularly and the analyser used will be calibrated periodically as per vendor’s specifications or at least once in 3 years, whichever is less.
Purpose of data	To calculate baseline and project emission
Additional comment	Data will be archived electronically and kept for the duration of the project + 2 years.

Data/Parameter	**T**
Data unit	^0C
Description	Temperature of the biogas
Source of data	Plant log book
Value(s) applied	Not applicable for ex-ante calculation
Measurement methods and procedures	The temperature of the biogas is required to determine the density of the methane combusted. If the biogas flow meter employed measures flow, pressure and temperature and displays or outputs the normalised flow of biogas, then there is no need for separate monitoring of pressure and temperature of the biogas. The temperature will be monitored continuously.
Monitoring frequency	Shall be measured at the same time when methane content in biogas ($w_{CH4,y}$) is measured
QA/QC procedures	Calibration of the meter will be as per vendor’s specifications or once in 3 years, whichever is less.
Purpose of data	To calculate project emission
Additional comment	Data will be archived electronically and kept for the duration of the project + 2 years.

Data/Parameter	**P**
Data unit	Pa
Description	Pressure of the biogas
Source of data	Plant log book
Value(s) applied	Not applicable for ex-ante calculation
Measurement methods and procedures	The pressure of the biogas is required to determine the density of the methane combusted. If the biogas flow meter employed measures flow, pressure and temperature and displays or outputs the normalised flow of biogas, then there is no need for separate monitoring of pressure and temperature of the biogas. The pressure will be monitored continuously.
Monitoring frequency	Shall be measured at the same time when methane content in biogas ($w_{CH4,y}$) is measured.
QA/QC procedures	To be determined for each project activity according to the technical specification of the project systems. Calibration of the meter will be as per vendor’s specifications or once in 3 years, whichever is less.
Purpose of data	To calculate project emission

Additional comment	Data will be archived electronically and kept for the duration of the project + 2 years.

Data/Parameter	**$EC_{PJ,I,y}$**
Data unit	MWh/yr
Description	Quantity of electricity that would be consumed by the project electricity consumption source j in year y
Source of data	Electricity meter
Value(s) applied	Not applicable for ex-ante calculation
Measurement methods and procedures	The electricity consumption will be continuously monitored by electricity meter and aggregated monthly.
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	The accuracy and class of the meter will as per industry standard. Calibration of the meter will be done periodically according to the manufacturer's recommendation or at least once every 3 years, whichever is lesser.
Purpose of data	To calculate project emission
Additional comment	Data will be archived electronically and kept for the duration of the project + 2 years.

Data/Parameter	**BG_{Flare}**
Data unit	Nm^3
Description	Amount of biogas recovered and directed to flare for combustion
Source of data	Continuous flow meter
Value(s) applied	To be monitored
Measurement methods and procedures	Measured continuously and recorded monthly (dry basis).
Monitoring frequency	Measured continuously and recorded monthly (dry basis).
QA/QC procedures	The flow meter will be operated and calibrated according to manufacturer's specifications. A calibration/service log will be maintained for the flow meter.
Purpose of data	To calculate project emission
Additional comment	Data will be archived electronically and kept for the duration of the project + 2 years.

Data/Parameter	**$BG_{combusted}$**
Data unit	Nm^3
Description	Amount of biogas recovered and directed to boiler/ Gas Engine set for combustion
Source of data	Continuous flow meter
Value(s) applied	To be monitored
Measurement methods and procedures	Measured continuously and recorded monthly (dry basis).
Monitoring frequency	Measured continuously and recorded monthly (dry basis).
QA/QC procedures	The flow meter will be operated and calibrated according to manufacturer's specifications. A calibration/service log will be maintained for the flow meter.
Purpose of data	To calculate project emission
Additional comment	Data will be archived electronically and kept for the duration of the project + 2 years.

Data/Parameter	vi,t,db
Data unit	m3 of gas i/m3 dry gas
Description	Volumetric fraction of component i in the residual gas in the minute m where i = CH_4
Source of data	Plant log book

Value(s) applied	To be monitored
Measurement methods and procedures	The fraction of methane in the gas will be measured with a continuous analyser or, alternatively, with periodical measurements taken at least once a month. It shall be measured using equipment that can directly measure methane content in the biogas - the estimation of methane content of biogas based on measurement of other constituents of biogas such as CO_2 is not permitted. The methane content measurement shall be carried out close to a location in the system where a biogas flow measurement takes place. The accuracy and class of the equipment will be as per applicable industry standard.
Monitoring frequency	Continuous analyser or at least once in a month
QA/QC procedures	The measurement equipment will be periodically calibrated according to the manufacturer's recommendation or once every 3 years, whichever is less. A zero check and a typical value check may be performed by comparison with a standard certified gas.
Purpose of data	To calculate project emission
Additional comment	As a simplified approach, project proponent will only measure the methane content of the residual gas and consider the remaining part as N2. Data will be archived for 2 years from the end of the crediting period or the last request for issuance whichever is later.

Data/Parameter	$V_{t,db}$
Data unit	m^3
Description	Volumetric flow rate of the residual gas in dry basis at normal conditions in the minute m
Source of data	Plant log book
Value(s) applied	To be monitored ex-post
Measurement methods and procedures	Both measurements (flow rate of the residual gas and volumetric fraction of methane in the residual gas) will be measured with 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 will be corrected to dry basis. The parameter will be monitored on continuous basis. Values will be averaged hourly or at a shorter time interval. The accuracy and class of the meter will be as per applicable industry standard.
Monitoring frequency	Continuous
QA/QC procedures	Calibration of the flow meter will be done periodically according to the manufacturer's recommendation or once every 3 years, whichever is less.
Purpose of data	To calculate project emission
Additional comment	Data will be archived electronically and kept for the duration of the project + 2 years.

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

Data/Parameter	**$Flame_m$**
Data unit	Flame on or Flame off
Description	Flame detection of flare in the minute m
Source of data	Plant log book
Value(s) applied	To be monitored
Measurement methods and procedures	Measure using a fixed installation optical flame detector: Ultra Violet detector or Infra-Red or both
Monitoring frequency	once per minute
QA/QC procedures	The equipment will be calibrated once in 3 years or as per manufacturer specifications.
Purpose of data	To calculate project emission
Additional comment	Data will be archived electronically and kept for the duration of the project + 2 years.

Data/Parameter	**$Maintenance_y$**
Data unit	Calendar dates
Description	Maintenance events completed in year y
Source of data	Plant log book
Value(s) applied	To be monitored
Measurement methods and procedures	Records of maintenance logs will include all aspects of the maintenance including the details of the person(s) undertaking the work, parts replaced, or needing to be replaced, source of replacement parts, serial numbers and calibration certificates. The log book will be maintained for maintenance.
Monitoring frequency	Annual
QA/QC procedures	Records must be kept in a maintenance log for two years beyond the life of the flare
Purpose of data	To calculate project emission
Additional comment	Data will be archived electronically and kept for the duration of the project + 2 years.

Data/Parameter	**$T_{EG,m}$**
Data unit	^0C
Description	Temperature in the exhaust gas of the enclosed flare in minute m
Source of data	Plant log book
Value(s) applied	To be monitored
Measurement methods and procedures	Measure the temperature of the exhaust gas in the flare by an appropriate temperature measurement equipment. Measurements outside the operational temperature specified by the manufacturer may indicate that the flare is not functioning correctly and may require maintenance. Flare manufacturers must provide suitable monitoring ports for the monitoring of the temperature of the flare. These would normally be expected to be in the middle third of the flare.
Monitoring frequency	once per minute
QA/QC procedures	Temperature measurement equipment should be replaced or calibrated in accordance with their maintenance schedule.The equipment will be calibrated once in 3 years or as per manufacturer specifications.
Purpose of data	To calculate project emission

Additional comment	Unexpected changes such as a sudden increase/drop in temperature can occur for different reasons. These events should be noted in the site records along with any corrective action that was implemented to correct the issue. Data will be archived electronically and kept for the duration of the project + 2 years.

B.7.2. Sampling plan

>>

Sample Plan:

The monitoring plan is designed to monitor the parameters listed in Section above, which are required for calculation of the actual GHG emission reduction achieved by the project activity using ex post sampling survey. The COD value of inflow wastewater, treated wastewater and wastewater discharged (if applicable) will be determined based on sampling procedures as outlined below. The PP will be responsible for conducting the sampling of wastewater and maintaining the records.

As per the Guideline for Sampling and Surveys for CDM Project Activities and Programme of Activities, version 04, the sampling plan is the following:

(a) Sampling Design

As wastewater flow is continuous with little variation in COD values both at inlet of digester and corresponding treated wastewater, the reasonable precision in value used for calculation of emission reduction required. Further it is not practically possible to get continuous measurement of COD values. Therefore, representative sampling will be undertaken in line with the requirements of the "Sampling and surveys for CDM project activities and programme of activities", version 04.

(i) Objective and Reliability Requirements:

The objective is to obtain an unbiased and reliable estimate of the proportion or mean value of the following key variables over the course of the crediting period, and with 90/10 confidence/precision for the parameters.

Monitored Parameter

COD_{inflow}	Chemical oxygen demand of the treated wastewater leaving the project treatment system
$COD_{treated}$	Chemical oxygen demand of the treated wastewater leaving the waste treatment systems affected by the project activity and not equipped with bi recovery in year y
$COD_{Discharge}$	Chemical oxygen demand of the treated wastewater discharge river/water/lake.

(ii) Target Population

The target population for the mean value of COD of the project is number of days of operation of the plant during monitoring period.

(iii) Sampling Frame

The project is to be implemented in industrial unit and parameter of interest is COD value of wastewater, thus each PP requires to sample the wastewater in their specific location. The sampling frame will be number of days of operation.

(iii) Sampling Method

During monitoring period, COD levels, which will be determined through sampling. Representative sample size will be taken to ensure at least 90/10 confidence/precision level requirement. The project activity will follow the "Best Practice Examples Focusing on Sample Size and Reliability Calculations" (hereinafter referred to as "Best Practice Examples") for determining the number of COD samples to be taken in order to ensure 90/10 confidence precision level. The PP will follow the relevant guidance applicable to "Measurement in Biogas Projects" from clause 97 through clause 108 of the best practice examples.

Random COD samples will be taken over a campaign period of 10 days at the start of any monitoring period for obtaining the COD values. These monitored results will be used to calculate the mean and standard deviation for COD results as input parameters in equation 39 (page 27, Annex 6, EB 67 Report) for determining the actual/required sample size for COD measurements over the entire monitoring period.

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

Sample size calculation:

The calculation of the required sample size for the selected parameter during monitoring period is illustrated below for a 90/10 level of confidence and precision. In all cases a conservative approach is taken, however, if the required 90/10 confidence/precision is not met then the PP will apply the deduction in CERs as a conservative approach.

Please refer example 10 of EB 67 Annex-06 for sample size calculation.

Oversampling is strongly encouraged, not only to compensate for any attrition, outliers or non-response associated with the sample, but also to prevent a situation at the analysis stage where the required reliability is not achieved as in proposed project activity it is not possible to do sampling at later stage.

Based on 10 days measurement campaign of the COD inflow and COD outflow the sample size is calculated using tool for 90/10 confidence/precision level as below

COD inflow- number of samples 6 per year
COD outflow- number of samples 9 per year

Please refer ER sheet for sample size calculation.

B.7.3. Other elements of monitoring plan

>>

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

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

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

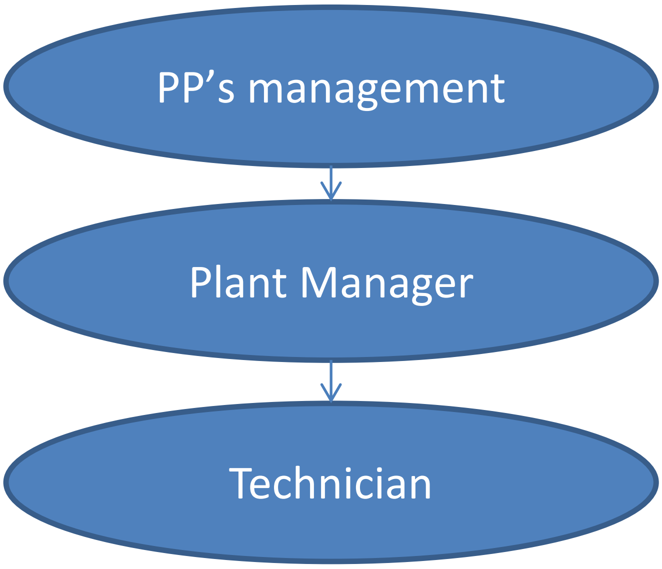

Figure: Organizational Structure

Role	Responsibility description
Technician	• *Data collection* ○ Collect the data on the various monitoring parameters as per the monitoring plan. ○ Report to the plant manager if there any abnormalities • *Data archiving* ○ Well-defined protocols and routine procedures, with good, professional data entry, extraction and reporting will be encouraged to maximize transparency of data archiving • *Data aggregation and emission reduction calculations* ○ Data for various parameters will be aggregated and used in emission reduction calculations. • *Verification* ○ Coordinate with the DOE during verification.
Plant Manager	• Review and confirm the raw data collected, aggregated and emission reduction calculations done by the technician. • Assist the technician during verification. • Responsible for reporting the following to the management: • Estimated emission reductions during the monitoring period • Outcome of the verification and status of issuance of CERs

Quality assurance and quality control

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

Emergency procedure

PP will implement an Emergency Procedure in the plant, for which a detailed manual will be developed. The manual will contain instructions on how to handle an emergency situation in the

plant, and measures to be taken to ensure that there is no unintended methane leakage from the system. All the plant operators will be familiarized on the procedure.

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

>>
02/11/2020 (date of EPC with technology supplier)

C.2. Expected operational lifetime of project activity

>>
20 years

C.3. Crediting period of project activity

C.3.1. Type of crediting period

>>
Fixed crediting period

C.3.2. Start date of crediting period

>>
15/12/2020

C.3.3. Duration of crediting period

>>
10 years 00 months

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>
The environmental approval for the operation of palm oil mill and plantations was already granted by consent nodal agency and plant is operational. Along with palm oil mill the PP has taken consent to treat wastewater using open lagoons and the same was able to meet the host country regulation on discharge of wastewater standards.

The proposed project activity i.e. POME treatment using bio-digester and capture of methane for energy generation does not require separate EIA as this technology is better in terms environmental, social and technological aspect and will have positive impacts over existing technology.

D.2. Environmental impact assessment

>>
As mentioned in section D.1, the proposed project activity does not require to conduct EIA, however some of the impacts on air quality and noise level may be during construction phase. However, Post-construction, during operation, the project will reduce the methane emission which otherwise would have been emitted to atmosphere. The project will have overall positive impact.

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

>>
LG International Corp., Korea has awarded Biogas projects to PT. Knowledge Integration Services Indonesia & Knowledge Integration Services PTE Ltd (KIS).

The Stakeholders have been identified on the basis of their involvement at various stages of project activity. The local stakeholder consultation meeting for proposed project activity has been conducted on 09/04/2020 from 10.00 AM to 12.00PM at DUSUN Beladung Tinting Boyak, Sekadau Hulu, Kabupaten Sekadau, Kalimantan Barat-79883, Indonesia. The Stakeholders were informed by publishing stakeholder notice in 3 leading newspapers named The Jakarta post, Pontianak post and Tribun Pontianak dated 02/04/2020. The personal invitation letter being also send to nearby villagers with venue and time detail on 30/03/2020.

The local stakeholder meeting was organised with various mode of interaction considering social distancing requirement by participant as per given situation

1. Video conferencing
2. Stakeholders were given option to call on telephone for feedback concern
3. Physical meeting
4. Email

There were 30 participants participated physically on site and 10 participants joined through video conferencing.

The stakeholder meeting process is followed in the following sequence

- Welcome Speech by the organizers.
- Introduction to 'Clean Development Mechanism'
- Project's contribution to sustainable development.
- Interactive Sessions with the stakeholders.
- Vote of Thanks

E.2. Summary of comments received

>>

The stakeholder connected through video conference and present at site have raised following queries

Query 1: What is the benefit of this project activity?

Response from PP: The propose project activity will capture biogas (methane) from treatment of POME and will use for power/steam generation. The project activity will help in reducing GHG emission by capturing methane and utilizing the captured methane for power generation to avoid use of diesel. The project activity will also generate employment opportunity.

Query 2: How many employment opportunities the proposed project will generate?

Response from PP: The project activity will generate around 30 employment for 12 months during construction phase and will generate around 12 employment during lifetime of the project i.e. 20 years for operation of the plant.

Query 3: How much GHG emission reduction will take place due to project activity?

Response from PP: The estimated annual emission reduction due to project activity is around 59,000 tCO_2e and 590,000 tCO_2e during lifetime of the project activity due to methane avoidance, in addition project will also reduce emission due to avoidance of diesel usage.

E.3. Consideration of comments received

>>

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

SECTION F. Approval and authorization

>>

The PP has achieved host country approval dated 26/10/2020 having reference number S.307/PPT/MSQR/KIN.0110/2020.

Appendix 1. Contact information of project participants

Organization name	PT. Tintin Boyok Sawit Makmur
Country	Indonesia
Address	DUSUN BELANDUNG TINTING BOYOK SEKADAU HULU KAB, SEKADAU KALIMANTAN BARAT-79883
Telephone	+ 82-2-6984-5023/5541
Fax	--
E-mail	arlee@lgi.co.kr
Website	www.lgi.co.kr
Contact person	Ms Aram Lee

Appendix 2. Affirmation regarding public funding

The project participant confirms no use of public funding and ODA by the project activity.

Appendix 3. Applicability of methodologies and standardized baselines

As per paragraph 38 of AMS-III.H (version 19), in determining baseline emissions, historical records of at least three years prior to the project implementation shall be used. This shall include the COD removal efficiency of the wastewater treatment systems. If three years of historical data is not available, an ex-ante measurement campaign shall be implemented in the baseline wastewater systems for at least 10 days as per paragraph 37 of AMS-III.H (version 19). The measurement should be undertaken during a period that is representative for the typical operation conditions of the systems and ambient conditions of the site (temperature, etc). 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%).

For the project activity as the historical data on COD removal efficiency is not available for last three years, the data from 10-day measurement campaign in the baseline wastewater treatment systems will be used. The result from 10 Days measurement campaign in the baseline wastewater treatment system is presented in the following tables. Readings for COD inflow were taken at the inlet of the 1st anaerobic pond in the baseline scenario i.e. “Anaerobic Pond” and the COD outflow is taken at the outlet of the last anaerobic pond in the baseline scenario i.e. “Anaerobic Pond”.

Result from 10 days measurement campaign: PT. Tintin				
SI NO	**Date**	**COD_{inflow} (mg/l)**	**$COD_{outflow}$ (mg/l)**	**Air temperature (^0C)**
	Average	76,242	5,631	28.5

From the above table the baseline COD removal efficiency is calculated as

COD_{inflow} = 76,242 mg/l = 0.076242 tCOD/m^3
$COD_{outflow}$ =5,631 mg/l =0.005631 tCOD/m^3

$\eta_{COD,BL,i}$ = (0.076242 – 0.005631)/ 0.076242 = 92.61%

Further as per plant record the amount of annual FFB processed is given as below

Parameter/Year	2017	2018	2019	Average
FFB (MT)	220,500	244,400	227,400	224,100

However, the PP has decided to increase the milling capacity of the plant from 40 MT/hr to 60 MT/hr as per plant operational data, the plant operates can operate 300 days and 19 hours per day, as per this the FFB processing capacity is calculated as 342,000 MT/year. The FFB to POME ratio is 0.65.

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

Please refer section B.6.1 of PDD

Appendix 5. Further background information on monitoring plan

Please refer section B.7.3 of PDD

Appendix 6. Summary report of comments received from local stakeholders

Please refer section E of PDD

Appendix 7. Summary of post-registration changes

Not applicable

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Document information

Version	*Date*	*Description*
11.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the "CDM project standard for project activities" (CDM-EB93-A04-STAN); • Make editorial improvements.
10.1	28 June 2017	Revision to make editorial improvement.
10.0	7 June 2017	Revision to: • Improve consistency with the "CDM project standard for project activities" and with the PoA-DD and CPA-DD forms; • Make editorial improvement.

Version	*Date*	*Description*
09.0	24 May 2017	Revision to: • Ensure consistency with the “CDM project standard for project activities” (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the “Project design document form for small-scale CDM project activities” (CDM-SSC-PDD-FORM); • Make editorial improvement.
08.0	22 July 2016	EB 90, Annex 1 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the “Standard: Applicability of sectoral scopes” (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revision to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Make editorial improvement.
05.0	25 June 2014	Revision to: • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from F-CDM-PDD to CDM-PDD-FORM; • Make editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

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