 Project design document form (Version 11.0)	
Complete this form in accordance with the instructions attached at the end of this form.	
BASIC INFORMATION	
Title of the project activity	Methane Capture and Utilization Project at Carotino Palm Oil Mill, Malaysia
Scale of the project activity	<input type="checkbox"/> Large-scale <input checked="" type="checkbox"/> Small-scale
Version number of the PDD	03.1
Completion date of the PDD	19/06/2020
Project participants	Carotino Sdn Bhd (Malaysia; host country) Perenia Pty Ltd (Australia; private)
Host Party	Malaysia
Applied methodologies and standardized baselines	AMS-III.H Methane recovery in wastewater treatment version 16.0
Sectoral scopes	Sectoral Scope 13: Waste handling and disposal
Estimated amount of annual average GHG emission reductions	32,611 tCO ₂ e

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SECTION A. Description of project activity

A.1. Purpose and general description of project activity

>> The "Methane Capture and Utilization Project at Carotino Palm Oil Mill", Malaysia ("the project activity") will be implemented at the Carotino Palm Oil Mill ("the mill") located in Sri Jaya, Maran, Pahang in Peninsular Malaysia. The proposed project activity is being implemented by Carotino Sdn Bhd ("the project owner¹").

The processing of crude palm oil from fresh palm fruit bunches (FFB) produces large amounts of Palm Oil Mill Effluent (POME) with high organic matter. The mill has a processing capacity of 144,000 tons² of FFB in the year 2011, which increases to approximately 216,000 tons of FFB per year in year 2013 onwards. Each tonne of FFB processed results in approximately 0.65 m³ of POME produced³.

The aim of the project activity is to capture anthropogenic methane emissions from the Palm Oil Mill aerobic effluent treatment system and utilize the methane gas to generate renewable energy.

In the baseline scenario, POME is treated via a series of open anaerobic ponds, while electricity is generated primarily from biomass based boilers. The proposed project activity involves the installation of a new covered anaerobic digester tank system equipped with methane capture and collection system to replace existing open anaerobic ponds. Methane captured from the anaerobic digester system will be transferred to a biogas engine system for electricity generation.

An enclosed flare system and/or biogas burner will be installed at boiler system to combust excess biogas generated from project activity. However, the scope of biogas utilisation will not be included as type I renewable energy project. Implementation of the proposed project will result in an estimated reduction of emissions of 32,611 tonnes of CO₂e per year.

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The project activity contributes towards sustainable development of the agricultural sector in the region and will increase reuse of wastes from palm oil processing. The project activity contributes the National Green Technology Policy⁴, assists towards sustainable development of the Host Country and in line with the four key policy pillars:

1. *Energy*: Seek to attain energy independence and promote efficient utilisation. The project activity conserves non-renewable natural resources (fossil fuels) through partially replacing fossil fuel sourced electricity generation;
2. *Environmental*: Conserve and minimise the impact on the environment. The project activity reduces GHG emissions through the avoidance of methane emissions from the existing open ponds directly to the atmosphere and improves the quality of wastewater discharged to the public waterways;
3. *Economic*: Enhance the national economic development through the use of technology. The project promotes and disseminates the successful application and integration of renewable energy technology for replication across Malaysia.
4. *Social*: Improve the quality of life for all. The project activity contributes to increase the stability and security of the local power supply which will in turn support an improved living standard.

¹ Carotino Business Registration Form

² Palm Oil Mill Board (MPOB) Processing Capacity License. Carotino

³ LudinN, Bakri MM, HashimM, SawillaB, MenonN, MokhtarH. "Palm Oil Biomass for Electricity Generation in Malaysia"; 2004.p.1–6. Pusat Tenaga Malaysia, Malaysia Palm Oil Board, SIRIM Berhad

⁴ National Green Technology Policy, 24/08/2012. <http://www.greentechmalaysia.my/index.php/green-technology/green-technology-policy/national-green-technology-policy.html>

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The project activity is also in line with the National CDM Criteria⁵ as following:

Criterion 1: Project supports towards achieving sustainable development (social, economic, energy and environmental), benefitting the sector concerned and the economy as a whole. The project utilizes at biogas for energy utilisation;

Criterion 2: Annex 1 Party for this project has been identified upfront;

Criterion 3: The project leads to adoption of local technology⁶ with higher energy efficiency and increases the deployment of energy resources in the palm oil mil. The project activity also enhances the indigenous capacity of Malaysians to apply, develop and implement environmentally sound technology that leads to less carbon intensive emission;

Criterion 4: Voluntary participation of the project owner in view of its long term benefits for mitigations of climate change. Reductions in emissions that are additional to any that would occur in the absence of the certified project activity.

Criterion 5: Project owner is a locally incorporated company and has the ability to implement and finance the project⁷.

A.2. Location of project activity

>> The proposed project activity site is located within the Carotino Palm Oil Mill located at 23 km off Sri Jaya, Maran, Pahang in Peninsular Malaysia.

The project activity GPS coordinates are: 3° 49' 01" N, 102° 49' 04" E as illustrated in Figure.1.

⁵ National CDM Criteria, 24/08/2012. <http://cdm.greentechmalaysia.my/cdm-malaysia/cdm-criteria.aspx>

⁶ Wastewater Treatment, Biogas Capture (Anaerobic System), http://www.watermech.com/p_anaerobic_digester_tank.php

⁷ Carotino company documents (Form 13 & Form 24)

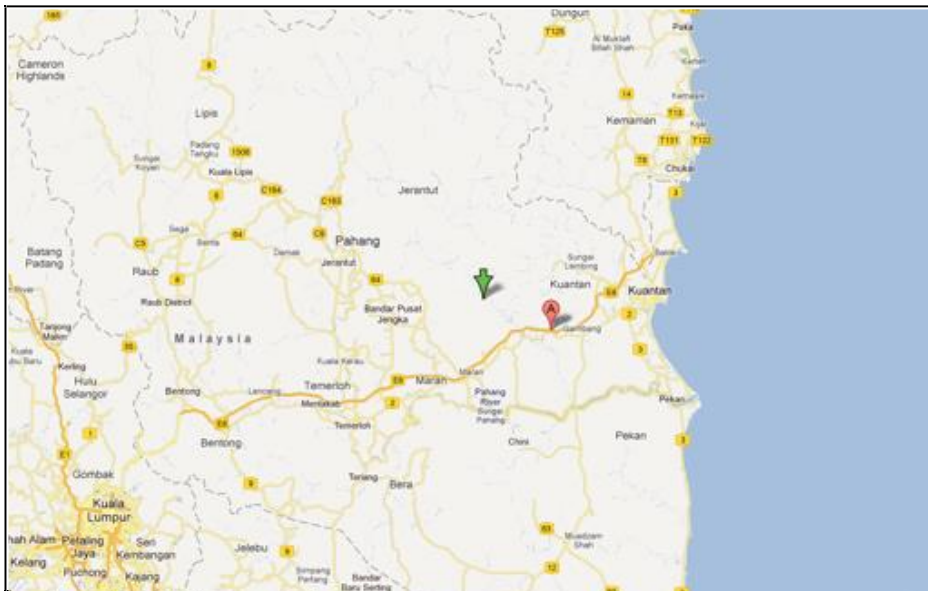
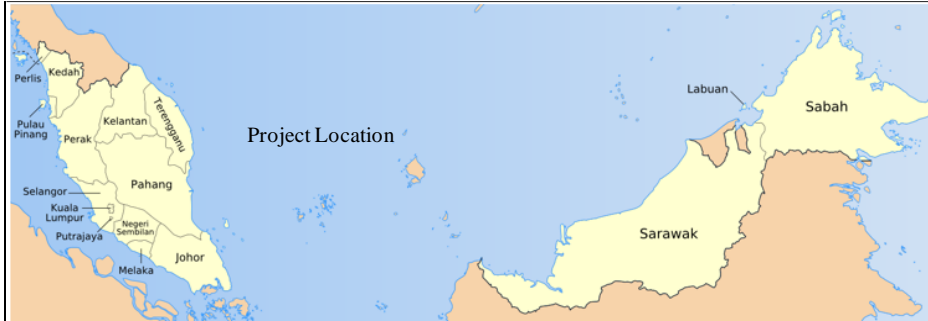


Figure 1: Map of Malaysia, Indicating the Location of Pahang State and Location of Mill



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A.3. Technologies/measures

(1) Types and categories of the small-scale project activity

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

The primary purpose of the proposed project activity is the capture of biogas from wastewater treatment. Therefore, the applicable methodology is AMS-III.H, Methane Recovery in Wastewater Treatment. The relevant type and category is shown below.

Type III	: Other Project Activities
Category H	: Methane recovery in wastewater treatment
Reference	: Version 16, EB 58, Scope 13

The proposed project activity will also generate renewable electricity from biogas captured during wastewater treatment. However, as no emission reductions are claimed from generation of renewable energy, the generated electricity has been excluded from the project boundary.

(2) Technology of the small-scale project activity

Watermech WM Closed Tank Anaerobic Digester System is designed to operate in the mesophilic temperature of approximately 37°C and 15 - 20 days of hydraulic retention time. The feeding, mixing and discharge system incorporated in the cylindrical digester tank is equipped with withdrawal pipes for grit/sludge removal. The design allows for uniformity of environmental condition within the digester tank to be maintained.

The raw POME will be undergoing hydrolysis and acidification process at the acidification pond. The larger materials in POME will be screened off prior to being pumped and distributed to the first stage digester system. The discharge from the first stage digester system overflows to the second stage digester system, while the effluent from the second digester tanks will be recycled and returned to the first stage digester system for better mixing and to maintain optimum percentage total solid. Treated effluent from the second stage digester overflows to the existing aerobic pond, settling pond and subsequently to an existing effluent polishing plant, prior to discharge to land irrigation. Digested excess sludge from the project activity will be dewatered periodically prior to land application in the plantation.

The generated biogas will be channelled through a desulphurisation plant before being transferred to biogas engine system⁸.

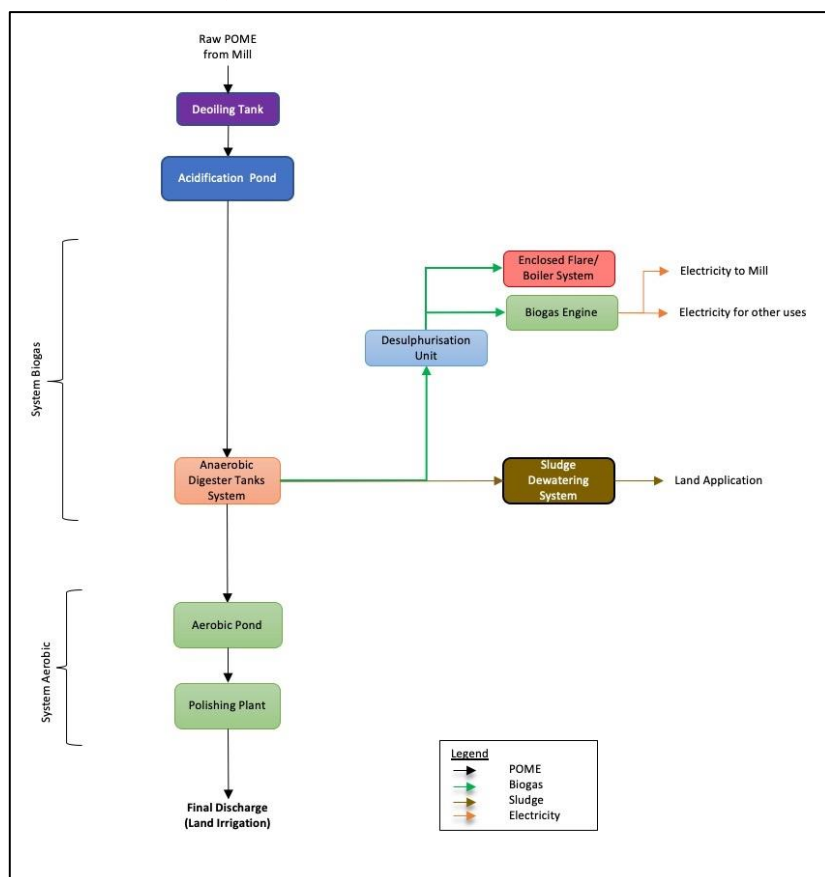
The auxiliary power consumption of the project activity would be sourced from the renewable energy generated from the biogas engine. The net electricity generated from the gas engine will be supplied back to mill and for other uses e.g. Staff quarters, plantation offices and future down-stream plants. Any excess biogas will be flared in an enclosed flare and/or biomass boiler system.

Figure 2 illustrates the overall treatment process in details.

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⁸ General Specification of System & Project Process Flow by Watermech
Version 11.0

Figure 2 Process flow diagram of Project Activity



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Table 1: Proposed Design Characteristics System

Anaerobic Digester Tank c/w Methane Capture System	
System Provider	Watermech Engineering Sdn. Bhd.
Design Capacity	500 m ³ /day (max.)
COD Inflow	58,479 mg/l (10 days measurement average)
Average COD Removal Efficiency	80% ⁹

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Malaysia (host Party)	Carotino Sdn Bhd	No
Australia	Perenia Pty Ltd (Private)	No

⁹ Wastewater Treatment, Biogas Capture (Anaerobic System http://www.watermech.com/p_anaerobic_digester_tank.php)

A.5. Public funding of project activity

>> The project will not receive any public funding from Parties included in Annex I to the United Nations Convention on Climate Change.

A.6. History of project activity

>> Methane Capture and Utilization Project at Carotino Palm Oil, Malaysia was successfully registered as a CDM project activity on 02/10/2012 (Date of registration action 03/01/2013). The CDM reference number of the registered project activity is 6762. The project activity is neither a project activity that has been deregistered nor included as a component project activity (CPA) in a registered CDM programme of activities (PoA).

This project design document is for post registration change purpose. There is no change to the project activity location.

According to the confirmation above can declare that the proposed project activity is not a CPA that has been excluded from a registered CDM PoA. It is located in the same geographical location as the proposed CDM project activity. And the proposed CDM project activity meets all conditions for registration in accordance with CDM project standard for project activities; version 02.0, section 7.3 Description of project activity.

A.7. Debundling

>> As defined in paragraph 2 of Appendix C of the modalities and procedures for small scale projects (SSC M&P), a proposed small-scale project activity shall be deemed to be a de-bundled component of a large project activity if there is a registered small-scale CDM project activity or a request for registration by another small-scale project activity:

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

The proposed project activity is not a de-bundled component of any large scale project activity as there is no other small-scale project activity that fulfils the above mentioned criteria.

SECTION B. Application of methodologies and standardized baselines**B.1. References to methodologies and standardized baselines**

>> The following approved small scale baseline and monitoring methodologies are applied to the proposed project activity.

- AMS-III.H. "Methane Recovery in Wastewater Treatment" (Version 16; EB 58, Scope 13), and

In accordance with the provisions of AMS-III.H. (Version 16; EB 58, Scope 13), the following tools are used:

- "Tool to determine project emissions from flaring gases containing methane" (Version 1, EB 28)
- "Tool to calculate baseline, project and/or leakage emissions from electricity consumption (Version 01, EB39)"

Deleted: As defined in paragraph 9 of the Methodological tool "Assessment of debundling for small-scale project activities, version 04.0", a proposed small-scale project activity shall be deemed to be a de-bundled component of a large project activity if there is a registered small-scale CDM project activity or a request for registration by another small-scale CDM project activity:¶
 With the same project participants;¶
 In the same project category and technology/measure; and¶
 Registered within the previous 2 years; and¶
 Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.¶
 ¶
 The proposed project activity is not a de-bundled component of any large scale project activity as there is no other small-scale project activity that fulfils the above mentioned criteria.

B.2. Applicability of methodologies and standardized baselines

>> The proposed project activity is eligible to utilise AMS-III.H. "Methane Recovery in Wastewater Treatment" (Version 16) as it meets all of the applicability conditions of the methodology as described in Table 2 below.

Table 2: Applicability conditions for AMS-III.H.

#	Applicability conditions	Project Scenario
1	This methodology comprises measures that recover biogas from biogenic organic matter in wastewaters by means of the following options: (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 pond without methane recovery).	The proposed project activity involves the introduction of an anaerobic digester tank system equipped with methane capture and collection system without sludge treatment. The existing system comprises anaerobic open ponds which does not have biogas recovery. Therefore the project activity complies with option (f).
2	In cases where baseline system is anaerobic pond the methodology is applicable if: a) The ponds are ponds with a depth greater than two meters, without aeration. The value for depth is obtained from engineering design documents, or through direct measurement, or by dividing the surface area by the total volume. If the pond filling level varies seasonally, the average of the highest and lowest levels may be taken; 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.	a) The anaerobic open ponds are all deeper than 2 meters ¹⁰ , without aeration. b) The average temperature in Malaysia is consistently above 15°C ¹¹ . c) The desludging of accumulated solids in the anaerobic ponds in the baseline treatment system has more than 30 days of interval ¹² .
3	The recovered biogas from the above measures may also be utilised for the following applications instead of combustion/flaring: (a) Thermal or electrical energy generation directly	The proposed project activity includes the utilisation of the recovered biogas to generate electricity for its auxiliary consumption. Therefore the proposed project activity is in compliance with option (a).
4	If the recovered biogas is used for project activities covered under paragraph 3(a), that component of the proposed project activity can use a corresponding methodology under type I.	The recovered biogas is used to generate electricity for its auxiliary consumption. No emission reductions will be claimed from generation of renewable energy, thus methodologies under type I are not applied.
13	The location of the wastewater treatment plant shall be uniquely defined as well as the source generating the wastewater and described in the PDD.	The location of the wastewater treatment plant is uniquely defined in Section A.2 of the PDD. The wastewater is generated through the production of crude palm oil from FFB processing.
14	Measures are limited to those that result in aggregate emission reductions of less than or equal to 60 kt CO ₂ equivalent annually from all type III components of the project activity.	The estimated emission reductions are <u>32,611</u> tCO ₂ e per annum as demonstrated in Section B.6.3 which is lower than the 60,000 tCO ₂ e threshold.

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¹⁰ Effluent Treatment Plant Drawing¹¹ Malaysia average temperature is 27.5 °C (82 °F). <http://www.climatetemp.info/malaysia>¹² Desludging Approvals from Department of Environment

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AMS-III.H. (Version 16; EB58) applicability conditions 5 – 12 are not relevant to the proposed project activity, as the proposed project activity does not fall under paragraph 3 (b), (c) or (d) and is not a Greenfield project. The project activity complies with all applicable eligibility requirements of the methodologies and therefore qualifies to be implemented as a small scale project activity and will remain as such during the entire crediting period.

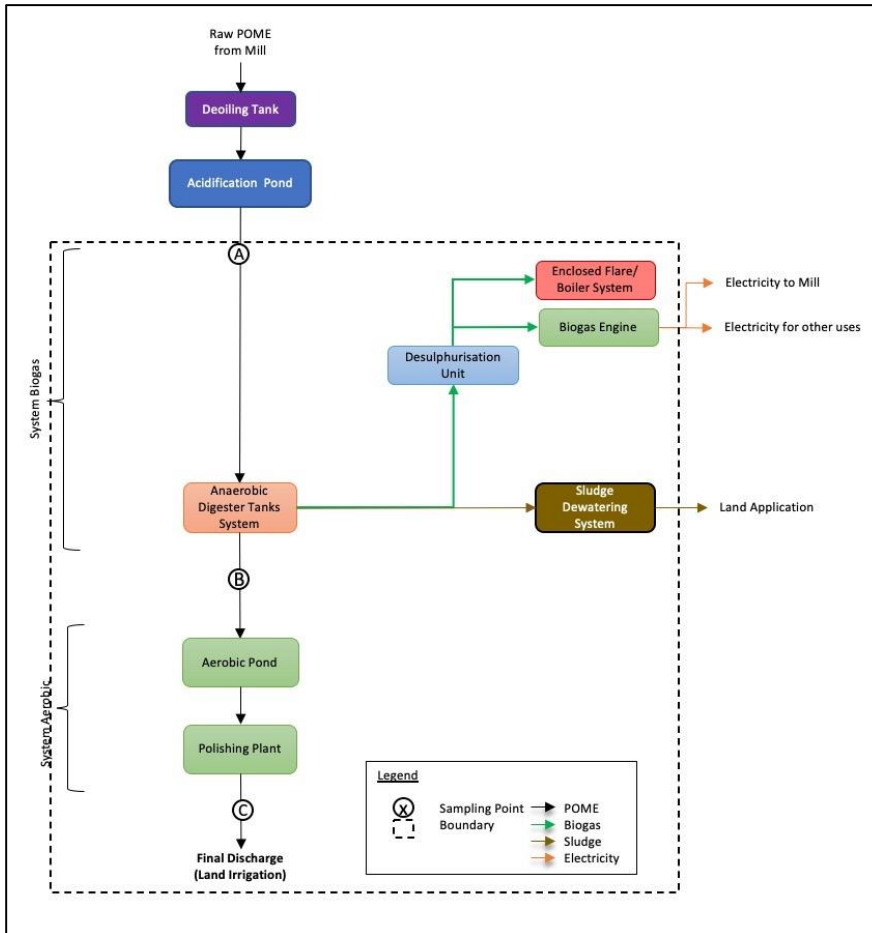
B.3. Project boundary, sources and greenhouse gases (GHGs)

>> As per paragraph 15 of AMS-III.H. (Version 16; EB58), the project boundary is the physical, geographical site where the wastewater treatment takes place in the baseline and project scenario. It also covers all facilities affected by the project activity including sites where processing, transportation and application or disposal of waste products as well as biogas takes place.

For the proposed project activity, the project boundary encompasses the existing open pond treatment system and the new anaerobic digester tank system, land application of treated POME and sludge, biogas desulphurisation system, biogas engine, biomass boiler system and enclosed flare system.

The combustion of biogas in the biomass boiler and its installation cost was not accounted in the financial analysis for investment decision. However, the biomass boiler was included within the project boundary as a future provision if the project proponent decides to use biogas in new biomass boiler or modify existing biomass boiler with biogas burner.

Figure 3 Proposed project activity boundary



Ex-ante assessment and identification of the systems affected by the project activity

AMS-III.H (Version 16; EB58) paragraph 16 requires that an ex-ante assessment and identification of the systems affected by the project activity be undertaken. The purpose of this assessment is to identify any systems which are not affected by the proposed project activity, and hence can be excluded from baseline and project emission calculations.

The proposed project activity alters the baseline treatment system by introducing an anaerobic digester tank system upstream of the wastewater system; after the acidification pond.

The treatment system affected by the project activity is categorized as System-Biogas & System-Aerobic (Figure 3).

The inflow COD into System-Biogas in project activity is the same as in baseline System- Anaerobic (Figure 4). However the COD removal efficiency differs in the baseline scenario and project activity. COD removal efficiency using anaerobic ponds in baseline scenario is 99% and the COD removal

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efficiency in project activity using new anaerobic digesters is 80%. Thus, the COD loading to System-aerobic from project activity will be relatively higher than baseline scenario.

The COD removal efficiency for System-Aerobic in baseline scenario and project activity is same at 61% as the same ponds were used for both scenarios. However, the COD inflow to System-Aerobic in project activity will be higher; changing the characteristic of the treated water from the digester system flowing to the existing aerobic pond and polishing plant.

Therefore, the operation of the baseline system will be affected by the proposed project activity and in accordance with AMS-III.H (Version 16; EB58) emissions from affected open ponds will be accounted for in the calculation of baseline and project emissions.

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	Source	GHG	Included?	Justification/Explanation
Baseline	<u>Existing wastewater treatment system; ie: open lagoon system</u> <u>Thermal energy production</u>	CO ₂	<u>Excluded</u>	<u>CO₂ emission from the decomposition of organic matter is not accounted for because biogenic in nature.</u>
		CH ₄	<u>Included</u>	<u>The major source of emissions in the baseline from open lagoons (decay of organic matter in anaerobic conditions).</u>
		N ₂ O	<u>Excluded</u>	<u>Excluded for simplification. This is conservative</u>
Project activity	<u>Wastewater Treatment process; Anaerobic digester tank</u>	CO ₂	<u>Excluded</u>	<u>CO₂ emission from decomposition of organic waste are not accounted in the calculation.</u>
		CH ₄	<u>Included</u>	<u>The treatment of wastewater or sludge under the project activity may cause different emission:</u> <ul style="list-style-type: none"> <u>Physical leakage from the digester tank.</u> <u>Incomplete flaring</u>
		N ₂ O	<u>Excluded</u>	<u>Excluded for simplification. This is conservative.</u>
	<u>On-site electricity use</u>	CO ₂	<u>Excluded</u>	<u>The source of on-site electricity consumed by project activity is from electricity generated from biogas engine.</u> <u>In the event the biogas engine generated electricity is lesser than auxiliary power consumption, the remaining electricity will be supplied by the biomass turbines from the mill. As the electricity generation is primarily from a renewable source, it is assumed as carbon neutral..</u>
		CH ₄	<u>Excluded</u>	<u>This emission source is assumed to be very small.</u>
		N ₂ O	<u>Excluded</u>	<u>This emission source is assumed to be very small.</u>
	<u>On-site fossil fuel consumption</u>	<u>CO₂</u>	<u>Excluded</u>	<u>This emission source is assumed to be very small.</u>
		<u>CH₄</u>	<u>Excluded</u>	<u>Excluded for simplification. This is conservative.</u>
		<u>N₂O</u>	<u>Excluded</u>	<u>Excluded for simplification. This is conservative.</u>

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B.4. Establishment and description of baseline scenario**>> Baseline Wastewater Treatment Plant**

In the absence of the proposed project activity, POME from the mill would continue to be treated in the existing open pond treatment system.

In the baseline scenario, POME is treated in a sequential anaerobic and aerobic wastewater treatment system without biogas recovery system. From acidification pond 1 & 2, POME enters a series of anaerobic open ponds; primary anaerobic pond 1A, secondary anaerobic pond and secondary anaerobic pond 1B. Then it flows to an aerobic treatment system encompassing aerobic pond and effluent polishing plant before discharged for land irrigation. Sludge accumulated in the ponds will be desludged periodically to avoid siltation problems¹³.

The methane correction factor (MCF) of baseline ponds are determined based on MCF values stated in table III.H.1, AMS IIIH (Version 16, EB 58). Based on Figure 4, primary anaerobic pond 1A, secondary anaerobic pond and secondary anaerobic pond 1B has depth of more than two (2) metres, thus a methane correction factor of 0.8 for anaerobic deep has been applied. However, aerobic pond with depth of 2.65 m is equipped with diffusers for aeration purpose. Thus, the aerobic pond and effluent polishing plant are aerobically well managed¹⁴ and a methane correction factor of zero has been applied.

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Table 3: Baseline open ponds¹⁵

Type of Ponds	Pond Depth (m)	MCF factor used as per AMS-III.H ver16
Primary Anaerobic Pond 1A	4.38 m	0.8
Secondary Anaerobic Pond 2	4.42 m	0.8
Secondary Anaerobic Pond 1B	4.20 m	0.8
Aerobic Pond	2.65 m	0.0

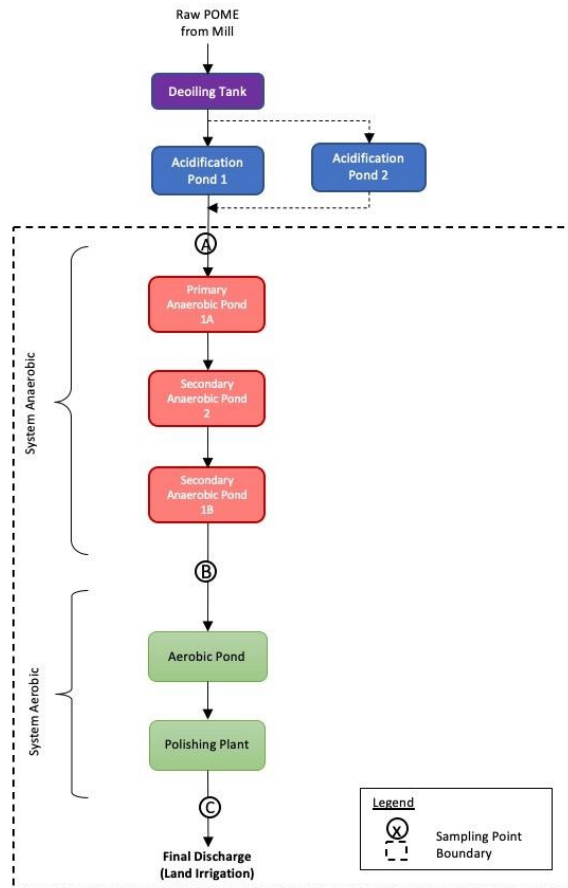
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¹³ Desludging Approvals from Department of Environment

¹⁴ Description of Effluent Tertiary Plant

¹⁵ [Effluent Treatment Plant Drawing](#)

Figure 4 Baseline scenario existing open pond treatment system prior to implementation of the proposed project activity



The methodology for calculating baseline emissions has been developed in line with AMS-III.H (Version 16; EB58), paragraph 27 specifies that the parameters required to calculate the baseline emissions should be determined by a measurement campaign in the baseline wastewater systems in accordance with paragraph 27 where historical records from at least one year prior to the implementation of the project are not available.

There are no other types of data available in the mill that can be used to determine COD removal efficiency as stated in Paragraph 27 (a). Based on the existing Compliance Schedule issued by Department of Environment¹⁶, the only effluent parameter to be monitored is BOD of the final discharge. Thus, the mill did not monitor effluent COD in the past and could not provide any data for validation purpose.

In accordance with paragraph 27 (b), an ex-ante measurement campaign was undertaken for 10 normal operation days from 13th August – 22nd August 2011. The measurements were taken during a period of normal operation, which is representative of the typical operating conditions and ambient temperature of the site.

¹⁶ Carotino_Department of Environment Licence

CDM-PDD-FORM

Comparison of baseline emissions between Paragraph 27 (a) and Paragraph 27 (b) cannot be made since there is no other types of data available that can be used to determine COD removal efficiency as in paragraph 27 (a). Thus results obtained from measurement campaign in paragraph 27 (b) has been adopted.

Measurements were taken at three sampling points during the measurement campaign. With reference to Figure 4, these are:

- Sample Point A: Wastewater entering the baseline anaerobic wastewater treatment system at the Primary Anaerobic Pond 1A inlet;
- Sample Point B: Wastewater exiting the baseline anaerobic wastewater treatment system at Secondary Anaerobic Pond 1B outlet; and
- Sample Point C: Wastewater exiting the polishing plant to land irrigation.

For each sampling point, the average COD value was taken and the results were multiplied by 0.89 to account for the uncertainty range (30-50%) associated with this approach, compared to one-year historical data.

The resulting values at Sampling Point A and Sampling Point B represent the *ex-ante* estimate of COD inflow and COD outflow of the baseline anaerobic wastewater system. COD removed is therefore calculated as $COD_{inflow,y} - COD_{outflow,y}$ and used to determine the COD removal efficiency for baseline anaerobic wastewater system.

The difference of COD between Sampling Point B and Sampling Point C represent ex-ante estimate of baseline aerobic wastewater system and determines the COD removal efficiency. The implementation of the project activity does not change the operational characteristics of baseline aerobic wastewater treatment system

Based on the results of the measurement campaign, the COD removal efficiency of the baseline anaerobic system and baseline aerobic system is 99.30% and 61.11% respectively.

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Table 4: Summary of key data used to determine the baseline emissions

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Parameter	Value	Description	Source
Operating Hours	4,800	Operating hours per year (hours/year)	Mill Processing Capacity from year 2013 onwards (16/hr/day * 300 days/y)
FFB Production	216,000	Average processing rate of FFB per year (tonnes/year)	Mill Processing Capacity from year 2013 onwards (45 t/hr * 300 days/y * 16 hrs/day)
POME generation rate	0.65	Amount of wastewater produced (m ³) per tonne of FFB.	LudinN, Bakri MM, HashimM, SawillaB, MenonN, MokhtarH. "Palm Oil Biomass for Electricity Generation in Malaysia"; 2004.p.1–6. Pusat Tenaga Malaysia, Malaysia Palm Oil Board, SIRIM Berhad
Q _{ww,y}	155,060	Volume of wastewater treated in baseline wastewater treatment system the year y (m ³ /y)	Calculated as FFB x 0.65
COD _{inflow,y}	0.05850	COD of the wastewater entering the baseline wastewater system the year y (tonnes/m ³)	Measurement Campaign, Sample Point A
COD _{outflow,y}	0.00041	Chemical Oxygen Demand of the wastewater leaving the baseline wastewater system the year y (tonnes/m ³)	Measurement Campaign, Sample Point B
COD _{ww,discharge,BL,y}	0.00016	COD of the treated wastewater sent for plantation irrigation purpose (tonnes/m ³)	Measurement Campaign, Sample Point C

The power supply to the existing wastewater treatment system is supplied mainly by mill's biomass boiler, operated using mesorcarp fibre and/or palm kernel shell. Diesel generators are used during start-up, shut down or emergencies. There are two units of biomass boilers with turbine capacity of 640 kW and 1,000 kW. The two units back-up diesel engines has a capacity of 200 kW each¹⁷.

As the electricity generation is primarily from a renewable source, it is assumed as carbon neutral. Thus, the baseline emission for power displacement is assumed as 0.

However, as the project activity displaces diesel use in the mill, the avoided cost for purchasing the diesel¹⁸ will be calculated and added as revenue stream in project financial analysis. The amount of potential saving is increased conservatively to the mill's capacity expansion.

B.5. Demonstration of additionality

>> Prior Consideration of the CDM

The start date of the project activity as defined in the *CDM Glossary of Terms* is 09/08/2011¹⁹. On this date the project proponent signed a letter of acceptance with project technology supplier. In line with the requirements in the "*Guidance on the demonstration and assessment of prior consideration of the CDM*", the project participant informed the Host Party DNA and the UNFCCC Secretariat of

¹⁷ Approval Licence for Turbine and Gen-set Capacity

¹⁸ Diesel Consumption Data from July 2010 – Jun 2011

¹⁹ "Letter of Acceptance of Offer" with Watermech Engineering Sdn. Bhd.

CDM-PDD-FORM

its intention to seek CDM status on 21/10/11²⁰. Acknowledgement was received from UNFCCC secretariat on 21/10/11²¹ and the Host Party DNA on 15/11/2011²².

A chronology of the key events in the development of the proposed project activity is provided in Table 5, that demonstrates continuous real actions to secure CDM status:

Table 5: Chronology of events and documents

Document Name	Date
Board approving development of the proposed project activity as a CDM project.	14/04/2011
Term sheet signed between Perenia and project proponent	10/06/2011
Project Proponent Signed "Letter of Acceptance of Offer" with Watermech Engineering Sdn. Bhd	09/08/2011
ERPA signed between Perenia & Carotino Sdn. Bhd.	18/10/2011
Prior consideration notification posted on UNFCCC website	21/10/2011
Response received from UNFCCC	21/10/2011
Prior consideration sent out to Malaysian DNA for the proposed biogas activity	21/10/2011
Local Stakeholder Consultation Meeting	02/11/2011
Response received from Malaysian DNA	15/12/2011

Demonstration and assessment of additionality

The proposed project was assessed based on Attachment A to Appendix B (Version 8.0, EB 63) of the simplified modalities and procedures for small-scale CDM project activities. The additionality of the proposed project is demonstrated and assessed by the "*Investment Barrier*" via investment analysis. It does not apply examples of barrier analysis as described in the "Guidelines for objective demonstration and assessment of barriers" EB50, Annex 13.

Investment Barrier Analysis

The baseline scenario for the project activity is continuation operation of the existing open pond treatment system without methane recovery and combustion. The baseline option (business as usual) is financially attractive because it represents the lowest cost option but led to higher CO₂ emission to atmosphere. The following sections explain on how the proposed project activity would not have occurred in the absence of the CDM due to the presence of an investment barrier.

Additionally, according to "Non-binding best practice examples to demonstrate additionality for SSC project activities" (EB 35, Annex 34): Best practice examples include but are not limited to, the application of investment comparison analysis using a relevant financial indicator, application of a benchmark analysis or a simple cost analysis (where CDM is the only revenue stream such as end-use energy efficiency). It is recommended to use national or global accounting practices and standards for such an analysis. Since the project activity will receive revenue from fuel saving, benchmark analysis is selected for the project's financial analysis.

Benchmark Analysis

To demonstrate that the proposed project activity is not financially attractive, a benchmark analysis has been conducted, which is consistent with the requirements of the "*Guidelines on the Assessment of Investment Analysis*" (Version 05; EB 62).

The default expected return on equity, of 10.9% for 'Waste Handling and Disposal' (Group 1, Sectoral Scope 13) in the Host Country, Malaysia as defined in the "*Guidelines on the Assessment of Investment Analysis*" is applied.

²⁰ Prior Consideration Form

²¹ Notification of Receipt by UNFCCC

²² Notification of Receipt by Malaysian DNA

CDM-PDD-FORM

This value is applicable as a simple default option as the project is funded internally, and an Equity IRR calculation is carried out.

Equity IRR of the Proposed Project Activity

The project generates no significant revenue except for cost savings from diesel displacement and revenue from Certified Emission Reductions (CERs). The diesel cost savings are negligible as electricity is primarily generated from biomass which is available at no cost.

The Equity IRR of the proposed project activity without the additional revenue from the sale of CERs is negative 13.4%. The complete financial model (provided with the PDD) includes justification of all of the parameters used and assumptions made.

Table 6: Key Financial Inputs

Assumption	Value	Unit	Source
Project life	15	years	Watermech Engineering Sdn. Bhd; Life Span, Operation & Maintenance Cost of Equipment
Total Capital Expenditure	13,913,790	RM	Board approving development of the proposed project activity as a CDM project ²³
Operation and maintenance expenses	744,295	RM/year	COM Operation & Maintenance Expenses & Watermech Engineering Sdn. Bhd; Life Span, Operation & Maintenance Cost of Equipment
Diesel Consumption Displaced	345,623	liter	Diesel Consumption Data from July 2010 – Jun 2011 x 100% ²⁴
Diesel Unit Cost	2.74	RM/liter	Diesel Purchase Price from July 2010 – Jun 2011 ²⁵ . The diesel purchase price was highest in April 2011 ²⁶
Tax rate	25%	-	Lembaga Hasil Dalam Negeri Malaysia; (http://www.hasil.gov.my/goindex.php?kump=5&skum=2&posi=5&unit=1&sequ=1)
General Plants and Equipment Depreciation	15	Years	Malaysian Accounting Standards Board, based on paragraph 50-62 of the Financial Reporting Standards, FRS 116 http://www.masb.org.my/index.php?option=com_content&view=article&id=142:frs116-pg4&catid=6:masb-exclude-private
Initial Allowances: General Plants and Equipment	20%	-	http://www.hasil.gov.my/goindex.php?kump=5&skum=1&posi=6&unit=1&sequ=1
Annual Allowances: General Plants and Equipment	14%	-	http://www.hasil.gov.my/goindex.php?kump=5&skum=1&posi=6&unit=1&sequ=1
Fair Value	0	RM	Paragraph 3 & 4, "Guidelines on the Assessment of Investment Analysis" (Version 05; EB 62)
Construction Start Date	01/10/2011	-	Project Implementation Schedule
Operation Start Date	01/01/2013	-	Project Implementation Schedule

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The IRR has been calculated based on the expected 15 years operating life of the anaerobic digester which is the most significant capital item²⁷. It is assumed that the fair value of the asset at the end of the 15 years operational life is zero, in accordance with local accounting regulations as the assets have fully devalued²⁸, as the investment period is equal to the technical lifetime of the equipment.

²³ Board approving development of the proposed project activity as a CDM project (14/04/2012)

²⁴ Diesel Consumption Data from July 2010 – Jun 2011. From July 2010 – Jun 2011, Diesel Consumption = 172,811 l/y & FFB Processed = 118,322 t/y. Estimated FFB processed for project activity = 216,000 t/y, thus a conservative 100% increase in diesel consumption is assumed.

²⁵ Diesel Purchase Price Summary from July 2010 – Jun 2011

²⁶ Diesel Purchase Invoices

²⁷ Watermech Engineering Sdn. Bhd; Life Span, Operation & Maintenance Cost of Equipment

²⁸ 2008 Malaysian Tax and Business Booklet (Page 22)

Sensitivity analysis

An analysis was conducted to demonstrate at what value each scenario included in the sensitivity analysis changes such that the IRR of the proposed project activity hits the nominated benchmark. The results of this analysis demonstrate that each of these scenarios is unlikely to occur.

The combustion of biogas in the biomass boiler and its installation cost was not accounted in the financial analysis for investment decision. However, an additional sensitivity analysis was conducted (with complete financial model) to demonstrate the scenario if there is no electricity generation and all the generated biogas is combusted in the biomass boiler. This will potentially displace palm kernel shell (PKS) utilization and gives sales revenue for the mill²⁹.

Table 7: Value at each Sensitivity Scenario Hits the Nominated Benchmark

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Scenario	Change at Which Scenario Hits Benchmark	Percentage Change at Which Scenario Hits Benchmark	Likelihood of Occurring
Project capital costs	Project Cost reduced from MYR 13,913,970 million to MYR 0	- 100%	The capital costs included within the financial model are taken from board meeting. The costing was primarily estimated based on proposal received from Watermech Engineering Sdn. Bhd ³⁰ . Additionally, the project does not generate any significant revenue. Even if the total project cost is reduced to zero, their IRR will not hit the benchmark.
Operating & Maintenance Cost	Operation & Maintenance cost reduced from MYR 744,295 n annually to MYR 0	- 100%	The operational costs primarily based on estimated operation cost and plant maintenance cost provided by technologist ³¹ . Even if the total cost is reduced to zero, it is unlikely that project will hit the benchmark as the calculated IRR is 0.2%.
Diesel Cost	Diesel cost increase over the years from RM 2.74 to RM 9.29	239%	It is extremely unlikely that the cost of diesel purchase price will increase by 239% to hit the benchmark.
Saving from using 100% generated methane to Displace Palm Kernel Shell (PKS)	PKS cost increase over the years from RM 80 to RM 768	860%	It is extremely unlikely that the cost of PKS purchase price will increase by 860% to hit the benchmark as the mill is located in a remote location and this will incur high transportation cost.

Summary

In conclusion, the project will never become financially attractive when the key parameters fluctuate within a reasonable range. The project activity would not have occurred without CDM revenues due to the financially unattractiveness, therefore, the project activity is additional.

²⁹ Carotino Financial analysis for Biomass Boiler

³⁰ Watermech Engineering Sdn.Bhd Proposal

³¹ Watermech Engineering Sdn. Bhd; Life Span, Operation & Maintenance Cost of Equipment

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

>> The primary purpose of the proposed project activity is the capture of methane from wastewater treatment. Therefore, emission reductions have been calculated using AMS-III.H, Methane Recovery in Wastewater Treatment (Version 16; EB 58).

AMS-III.H is applicable to activities which comprise measures that recover biogas from biogenic organic matter in wastewaters by means of six options outlined in paragraph 1 of the methodology. Of these methods, option (f) is the option relevant to the proposed project activity.

(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 pond without methane recovery).

Baseline Emissions

As per AMS-III.H (Version 16; EB 58), baseline emissions are calculated using the following formula.

$$BE_y = \{BE_{power,y} + BE_{ww,treatment,y} + BE_{s,treatment,y} + BE_{ww,discharge,y} + BE_{s,final,y}\} \quad (1)$$

Where:

BE_y	Baseline emissions in year y (tCO ₂ e)
$BE_{power,y}$	Baseline emissions from electricity or fuel consumption in year y (tCO ₂ e)
$BE_{ww,treatment,y}$	Baseline emissions of the wastewater treatment systems affected by the project activity in year y (tCO ₂ e)
$BE_{s,treatment,y}$	Baseline emissions of the sludge treatment systems affected by the project activity in year y (tCO ₂ e)
$BE_{ww,discharge,y}$	Baseline methane emissions from degradable organic carbon in treated wastewater discharged into sea/river/lake in year y (tCO ₂ e)
$BE_{s,final,y}$	Baseline methane emissions from anaerobic decay of the final sludge produced in year y (tCO ₂ e)

Baseline Emissions from electricity or fuel consumption ($BE_{power,y}$)

The treatment systems (aerobic pond, polishing plant) affected by project activity biogas recovery will continue to operate with the same operational characteristics, as in the baseline scenario. Furthermore, power supply to the wastewater treatment system is from the mill biomass boiler. Thus, the baseline electricity consumption, $BE_{power,y} = 0$.

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

The baseline treatment systems consist of anaerobic ponds and aerobic ponds as described in section B.4.

The MCF for baseline aerobic wastewater treatment is zero, for well managed aerobic ponds. Therefore the baseline emissions from the aerobic wastewater treatment = 0.
The baseline emissions of the anaerobic wastewater treatment systems are determined as:

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

$Q_{ww,i,y}$	Volume of wastewater treated in baseline anaerobic wastewater treatment system <i>i</i> in year y (m ³). For <i>ex ante</i> estimation, forecasted wastewater generation volume or the designed capacity of the wastewater treatment facility
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CDM-PDD-FORM

	can be used. However, the <i>ex post</i> 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 anaerobic treatment system 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, determined as per the paragraphs 26, 27 or 28 in AMS-III.H (Version 16)
$MCF_{ww,treatment,BL,i}$	Methane correction factor for baseline anaerobic wastewater treatment systems i (MCF values as per Table III.H.1)
i	Index for baseline wastewater treatment system
$B_{o,ww}$	Methane producing capacity of the wastewater (IPCC value of 0.25 kg CH_4 /kg COD)
UF_{BL}	Model correction factor to account for model uncertainties (0.89)
GWP_{CH_4}	Global Warming Potential for methane (value of 25)

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In accordance with paragraph 20 of AMS-III.H, (Version 16; EB 58), if the baseline wastewater treatment system is different from the treatment system in the project scenario the monitored values of COD inflow during the crediting period will be used to calculate the baseline emissions *ex-post*.

Therefore: Ex-ante estimate of baseline emissions in accordance with AMS-III.H:

$$COD_{removed,y} = COD_{inflow,y} - COD_{outflow,y}$$

Historical records of the COD removal efficiency of the baseline wastewater treatment system were not available. Therefore, in accordance with AMS-III.H, (Version 16; EB 58), paragraph 27, and a measurement campaign was undertaken in the baseline wastewater system, as detailed in Section B.4.

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

The baseline scenario does not involve sludge treatment. Therefore, on this basis $BE_{treatment,s,y} = 0$.

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

The baseline scenario involves well managed wastewater discharge for plantation irrigation purpose (MCF values as per Table III.H.1 is = 0). Therefore, on this basis $BE_{ww,discharge,y} = 0$.

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

In the baseline scenario sludge is periodically removed from the anaerobic open ponds and sent to the plantation for soil application as a fertiliser. All sludge removed is used for soil application under aerobic conditions. Therefore, on this basis $BE_{s,final,y} = 0$.

Total Baseline Emissions

The total baseline emissions in year y , is:

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

Project Activity Emissions

As per AMS-III.H. (Version 16; EB 58) project emissions are calculated using the following formula.

$$PE_y = \{PE_{power,y} + PE_{ww,treatment,y} + PE_{s,treatment,y} + PE_{ww,discharge,y} + PE_{s,final,y} + PE_{fugitive,y} + PE_{biomass,y} + PE_{flaring,y}\} \quad (3)$$

Where:

PE_y	Project activity emissions in the year y (tCO ₂ e)
$PE_{power,y}$	Emissions from electricity or fuel consumption in the year y (tCO ₂ e). These emissions shall be calculated as per paragraph 19, 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 (tCO ₂ e). These emissions shall be calculated as per equation 2 in paragraph 20, using an uncertainty factor of 1.12 and data applicable to the project situation (MCF _{ww,treatment,PJ,k} and COD _{removed,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 III.H.1.)
$\eta_{PJ,k}$	Chemical oxygen demand removal efficiency of the project wastewater treatment system k in year y (tonnes/m ³), measured based on inflow COD and outflow COD in system k.
$PE_{s,treatment,y}$	Methane emissions from sludge treatment systems affected by the project activity, and not equipped with biogas recovery, in year y (tCO ₂ e).
$PE_{ww,discharge,y}$	Methane emissions from degradable organic carbon in treated wastewater in year y (tCO ₂ e).
$PE_{s,final,y}$	Methane emissions from anaerobic decay of the final sludge produced in year y (tCO ₂ e).
$PE_{fugitive,y}$	Methane emissions from biogas release in capture systems in year y (tCO ₂ e).
$PE_{biomass,y}$	Methane emissions from biomass stored under anaerobic conditions. In case storage of biomass under anaerobic conditions takes place due to the project activity that doesn't occur in the baseline situation, methane emissions due to anaerobic decay of this biomass shall be considered and be determined as per the procedure in the "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site" (tCO ₂ e).
$PE_{flaring,y}$	Methane emissions due to incomplete flaring in year y as per the "Tool to determine project emissions from flaring gases containing methane" (tCO ₂ e). These emissions are accounted for when the flare is in use.

Project activity emission from fuel consumption ($PE_{power,y}$)

The auxiliary power consumption for project activity is sourced from electricity generated from biogas engine. Therefore $PE_{power,y} = 0$ if electricity generated from biogas engine is more than auxiliary power consumption. In the event the biogas engine generated electricity is lesser than auxiliary power consumption, the remaining electricity will be supplied by mill.

The mill's primary electricity supply is from biomass turbines. Diesel engines are used during shut-down/start-up or emergencies. The emission factor of the electricity sourced from the mill can be calculated in accordance to the 'Tool to calculate baseline, project and/or leakage emissions from electricity consumption (Version 01, EB39)'. The maximum estimated project emissions, assuming the total amount of electricity generated from biogas engine is zero, and auxiliary power is consumed 8,760 hours per year is calculated below:

CDM-PDD-FORM

Parameter	Units	Value	Source
Total Electricity generated by biomass turbine from July 2010 – June 2011	kWh/y	2,651,540	Historical Generation Data July 2010 – June 2011 (a) ³²
Total Electricity generated by diesel engine from July 2010 – June 2011	kWh/y	393,760	Historical Generation Data July 2010 – June 2011 (b) ³³
% of Electricity Supply by Biomass Boiler	%	87.07	Calculated (a / (a+b))
% of Electricity Supply by Diesel Engines	%	12.93	Calculated (b / (a+b))
Emission Factor (EF) of electricity from Biomass turbine (renewable source)	tCO ₂ /MWh	0.0	EF = 0 for renewable energy
Emission Factor (EF) of electricity from Diesel engines	tCO ₂ /MWh	1.3	Conservative default value as per 'Option B2, Page 8 of Tool to calculate baseline, project and/or leakage emissions from electricity consumption (Version 01, EB39).
Weighted average Emission Factor	tCO ₂ /MWh	0.17	Calculated (0.1293 * 1.3 tCO ₂ /MWh)
Auxiliary power consumption for project activity operation	kW	157.64	Power Generation Information ³⁴
Total project emission	tCO₂	235	0.15764 MW * 8,760 h/y x 0.17 tCO ₂ /MWh

The calculated % of project emission from fossil fuel consumption at project activity much is lesser than 1% of the emissions reduction (32,611 tCO₂e/y) under an unlikely scenario. Thus, CO₂ emissions from the combustion of fossil fuels is estimated as negligible (< 1%), of the overall expected average annual emissions reductions and not accounted for as project emissions; in accordance to Paragraph 77 of Validation and Verification Manual (Version 01.2, EB 55).

Therefore, PE_{power,y} = 0.

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

$$PE_{ww,treatment,y} = (Q_{ww,y} * COD_{ww,treated,PJ,y} * \eta_{PJ,k} * MCF_{ww,treatment,k}) * B_{o,ww} * UF_{PJ} * GWP_{CH4} \quad (4)$$

Where:

Q _{ww,y}	Volume of wastewater treated in project wastewater treatment system (system biogas) in the year y (m ³)
COD _{ww,treated,PJ,y}	Chemical Oxygen Demand of the wastewater leaving the project wastewater treatment system (system biogas) in year y.
η _{PJ,k}	Chemical oxygen demand removal efficiency of the project wastewater treatment system (not equipped with biogas recovery) in year y (t/m ³). This is equivalent to COD removal efficiency of the baseline aerobic treatment system, determined as per the paragraphs 26, 27 or 28 in AMS III.H (η _{PJ,aerobic})
MCF _{ww,treatment,PJ,k}	Methane correction factor of baseline aerobic wastewater treatment system (MCF values as per table III.H.1.) (MCF _{ww,treatment,PJ,aerobic})
B _{o,ww}	Methane producing capacity of the wastewater (IPCC value of 0.25 kg CH ₄ /kg COD)
UF _{PJ}	Model correction factor to account for model uncertainties (1.12)
GWP _{CH4}	Global Warming Potential for methane (value of 25)

Wastewater treatment systems (aerobic ponds) affected by the project activity that are not equipped with biogas recovery, will continue be the same as in the baseline scenario and the MCF values as

³² Historical Power Generation Turbine and Genset (July 2010 – June 2011)

³³ Historical Power Generation Turbine and Genset (July 2010 – June 2011)

³⁴ Power Generation Information

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CDM-PDD-FORM

per Table III.H.1 is '0', for aerobic treatment well managed ponds. The implementation of the project activity does not change the operational characteristics of the aerobic ponds.

Therefore, $PE_{ww,treatment,y} = 0$.

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

In the proposed project activity sludge from the wastewater ponds will be used land application which is an aerobic process. Therefore on this basis $PE_{s,treatment,y} = 0$.

Methane emissions from degradable organic carbon in treated wastewater ($PE_{ww,discharge,y}$)

In the proposed project activity, the final treated effluent is sent for land irrigation. The implementation of the project activity does not change the operational characteristics of treated wastewater discharged to plantation as in the baseline and the MCF values as per Table III.H.1 is = 0.

Therefore, on this basis $PE_{ww,discharge,y} = 0$.

Methane emissions from the decay of the final sludge generated by the project activity treatment systems ($PE_{s,final,y}$)

The sludge removed periodically from the digester will be sent to the palm plantation as soil application and applied in a thin layer under aerobic conditions.

Therefore on this basis $PE_{s,final,y} = 0$.

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

$$PE_{fugitive,y} = PE_{fugitive,ww,y} + PE_{fugitive,s,y} \quad (5)$$

Where:

$PE_{fugitive,ww,y}$ Fugitive emissions through capture inefficiencies in the anaerobic wastewater treatment systems in the year y (tCO₂e)

$PE_{fugitive,s,y}$ Fugitive emissions through capture inefficiencies in the anaerobic sludge treatment systems in the year y (tCO₂e)

In the proposed project activity, there is no sludge treatment as sludge will be used as fertilizer. Therefore on this basis $PE_{fugitive,s,y} = 0$.

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

Where

$$PE_{fugitive,ww,y} = (1 - CFE_{ww}) * MEP_{ww,treatment,y} * GWP_{CH4} \quad (6)$$

Where:

CFE_{ww} Capture efficiency of the biogas recovery equipment in the wastewater treatment systems (a default value of 0.9 shall be used)

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

And:

$$MEP_{ww,treatment,y} = Q_{ww,y} * B_{o,ww} * UF_{PJ} * \sum_k COD_{removed,PJ,k,y} * MCF_{ww,treatment,PJ,k} \quad (7)$$

Where:

$COD_{removed,PJ,k,y}$ The chemical oxygen demand removed by the treatment system k of the project activity equipped with biogas recovery in the year y (tonnes/m³)

CDM-PDD-FORM

$MCF_{ww,treatment,PJ,k}$ Methane correction factor for the project wastewater treatment system k equipped with biogas recovery equipment (MCF values as per table III.H.1)
 UF_{PJ} Model correction factor to account for model uncertainties (1.12)

$$MEP_{ww,treatment,y} = Q_{ww,y} * B_{o,ww} * UF_{PJ} * COD_{removed,PJ,y} * MCF_{ww,treatment,y} \quad (8)$$

Methane emissions from biomass stored under anaerobic conditions ($PE_{biomass}$)

Storage of biomass under anaerobic conditions will not take place due to the proposed project activity, therefore on this basis $PE_{Biomass} = 0$.

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

All the biogas that is produced in the anaerobic digester will be combusted in the biogas engines for electricity generation. Excess biogas will be combusted at biomass boiler system and/or flared using enclosed flare system. In this situation, any methane emissions that occur due to incomplete flaring will be calculated as per the "Tool to determine project emissions from flaring gases containing methane" (Version 1, EB28).

The flare that will be installed in the proposed project activity is an enclosed flare. Therefore in accordance with section II, step 6 of the "Tool to determine project emissions from flaring gases containing methane" (Version 1, EB28), a default value of 90% efficiency will be used. The flare efficiency will be determined using a default value.

Calculation of annual project emission from flaring

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

$$PE_{flare} = \sum_{h=1}^{8760} TM_{RG,h} * (1 - \eta_{flare,h}) * (GWP_{CH4}/1000) \quad (9)$$

Where:

PE_{flare} Project emission from flaring of methane in the residual gas in year y
 $TM_{RG,h}$ Mass flow rate of methane in hour h
 $\eta_{flare,h}$ Flare efficiency in hour h
 GWP_{CH4} Global warming potential of methane

The mass flow rate of methane is estimated as following:

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

Where:

$FV_{RG,h}$ Volumetric flow rate of the residual gas in dry basis at normal conditions in hour h (m^3/h)
 $fv_{CH4,RG,h}$ Volumetric fraction of methane in the residual gas on dry basis in hour h
 $\rho_{CH4,n}$ Density of methane at normal conditions (0.716)

In the proposed project activity, biogas will be typically combusted in the gas engines and/or biomass boiler system. In emergency situations biogas will be combusted in the enclosed flare system.

Leakage

As per AMS-III.H.(Version 16, EB 58), paragraph 31, there is no leakage expected from proposed project activity as the technology and equipment used is not transferred from another activity.

Emission Reductions

In accordance with paragraph 32 of AMS-III.H. (Version 16, EB 58), emission reductions associated with wastewater treatment are estimated *ex ante*, as follows:

$$ER_{y,ex\ ante} = BE_{y,ex\ ante} - (PE_{y,ex\ ante} + LE_{y,ex\ ante}) \quad (10)$$

Where:

$ER_{y,ex\ ante}$	Ex ante emission reduction in year y (tCO ₂ e)
$LE_{y,ex\ ante}$	Ex ante leakage emissions in year y (tCO ₂ e)
$PE_{y,ex\ ante}$	Ex ante project emissions in year y calculated as per formula 8 (tCO ₂ e)
$BE_{y,ex\ ante}$	Ex ante baseline emissions in year y calculated as per formula 1 (tCO ₂ e)

In accordance with paragraph 33 of AMS-III.H. (Version 16, EB 58), the emission reductions achieved by the project activity will be determined as follows:

Ex post emission reductions will be based on the lowest value of the following:

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

$$ER_{y,ex\ post} = \min ((BE_{y,ex\ post} - PE_{y,ex\ post} - LE_{y,ex\ post}), (MD_y - PE_{power,y} - PE_{biomass,y} - LE_{y,ex\ post})) \quad (11)$$

Where:

$ER_{y,ex\ post}$	Emission reductions achieved by the project activity based on monitored values for year y (tCO ₂ e)
$BE_{y,ex\ post}$	Baseline emissions calculated using ex post monitored values (tCO ₂ e)
$PE_{y,ex\ post}$	Project emissions calculated using ex post monitored values (tCO ₂ e)
MD_y	Methane captured and destroyed/gainfully used by the project activity in year y (tCO ₂ e)

In case of flaring/combustion MD_y will be measured using the conditions of the flaring process in accordance with AMS-III.H. (Version 16, EB 58), paragraph 35, as follows:

$$MD_y = BG_{burnt,y} * w_{CH4,y} * D_{CH4} * FE * GWP_{CH4} \quad (12)$$

Where:

$BG_{burnt,y}$	Biogas flared/combusted in year y (m ³)
$w_{CH4,y}$	Methane content in 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 (tonnes/m ³)
FE	Flare efficiency in year y (fraction). In the case that biogas is destructured for gainful purpose, e.g., fed to the engine, an efficiency of 100% is to be applied.

In the proposed project activity, biogas will be typically combusted in the gas engines. Excess biogas will be utilized in the biomass boiler system. A default value of 100% flare efficiency will be used for biogas combusted in gas engines or biomass boiler system.

In emergencies, biogas will be combusted in the flare. In addition, flare efficiency is already monitored in order to determine PE_{flare} and therefore $FE = \eta_{flare,h}$

B.6.2. Data and parameters fixed ex ante

Data/Parameter	$MCF_{ww,treatment,BL}$
Data unit	Factor
Description	Methane correction factor for the baseline anaerobic wastewater treatment system
Source of data	IPCC default value for anaerobic decay of the untreated wastewater
Value(s) applied	0.8
Choice of data or measurement methods and procedures	MCF values as per table III.H.1, AMS III.H (Anaerobic deep lagoon depth more than 2m).
Purpose of data	Baseline emission calculation
Additional comment	=

Data/Parameter	$MCF_{ww,treatment,aerobic}$
Data unit	Factor
Description	Methane correction factor for the baseline aerobic wastewater treatment system
Source of data	IPCC default value for aerobic treatment, well managed pond
Value(s) applied	0
Choice of data or measurement methods and procedures	MCF values as per table III.H.1, AMS III.H (Aerobic treatment, well managed pond).
Purpose of data	Project emission calculation
Additional comment	=

Data/Parameter	$\eta_{COD,BL}$
Data unit	%
Description	COD removal efficiency of the baseline treatment system, determined as per the paragraphs 26, 27 or 28 in AMS III.H
Source of data	Measurement campaign
Value(s) applied	99
Choice of data or measurement methods and procedures	Measurement campaign was undertaken in the baseline wastewater treatment system for 10 normal operation days from 13 th August – 22 nd August 2011.
Purpose of data	Baseline emission calculation
Additional comment	=

CDM-PDD-FORM

Data/Parameter	$\eta_{PJ,aerobic}$
Data unit	%
Description	Chemical oxygen demand removal efficiency of the project wastewater treatment system (System-Aerobic) which is not equipped with biogas recovery digester in year y.
Source of data	Measurement campaign
Value(s) applied	61
Choice of data or measurement methods and procedures	Measurement campaign was undertaken in the baseline wastewater treatment system for 10 normal operation days from 13 th August – 22 nd August 2011.
Purpose of data	Project emission calculation
Additional comment	Equivalent to COD removal efficiency of the baseline aerobic treatment system, determined as per the paragraphs 26, 27 or 28 in AMS III.H

Data/Parameter	$B_{o,ww}$
Data unit	tCH ₄ /t COD
Description	Methane producing capacity of wastewater
Source of data	AMS-III.H. Default value
Value(s) applied	0.25
Choice of data or measurement methods and procedures	The default value as specified in AMS-III.H (Version 16; EB58).
Purpose of data	Baseline and Project emission calculation
Additional comment	=

Data/Parameter	$MCF_{ww,treatment,PJ}$
Data unit	Factor
Description	Methane correction factor for project activity equipped with biogas recovery in the year,y.
Source of data	IPCC default value
Value(s) applied	0.8
Choice of data or measurement methods and procedures	MCF values per table III.H.1, AMS III.H for equipped with biogas recovery system digester
Purpose of data	Project emission calculation
Additional comment	=

Data/Parameter	$MCF_{ww,treatment,PJ,aerobic}$
Data unit	Factor
Description	Methane correction factor for project activity not equipped with biogas recovery in the year,y.
Source of data	IPCC default value for aerobic treatment, well managed
Value(s) applied	0.0
Choice of data or measurement methods and procedures	MCF values per table III.H.1, AMS III.H (Aerobic treatment, well managed pond).
Purpose of data	Project emission calculation
Additional comment	=

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Data/Parameter	$MCF_{ww,BL,discharge}$, $MCF_{ww,PJ,discharge}$
Data unit	Factor
Description	Methane correction factor of baseline and project wastewater treatment system sent for plantation irrigation purpose
Source of data	IPCC default value for aerobic treatment, well managed
Value(s) applied	0.0
Choice of data or measurement methods and procedures	
Purpose of data	Project emission calculation
Additional comment	=

Data/Parameter	GWP_{CH_4}
Data unit	tCO ₂ / t CH ₄
Description	Global warming potential of methane
Source of data	IPCC default value
Value(s) applied	21 - for the first commitment period 25* - for the second commitment period
Choice of data or measurement methods and procedures	The default value as specified in AMS-III.H (Version 16; EB58)
Purpose of data	Baseline and Project emission calculation
Additional comment	*According to EB69 - Annex3, the second commitment period GWP of 25 tCO ₂ / t CH ₄ shall be effective from 01/01/2013.

Data/Parameter	UF_{PJ}
Data unit	-
Description	Model correction factor to account for model uncertainties
Source of data	AMS-III.H. Default value
Value(s) applied	1.12
Choice of data or measurement methods and procedures	The default value as specified in AMS-III.H (Version 16; EB58)
Purpose of data	Project emission calculation
Additional comment	=

Data/Parameter	CFE_{ww}
Data unit	Factor
Description	Capture efficiency of the biogas recovery equipment in wastewater treatment system
Source of data	AMS-III.H. Default value
Value(s) applied	0.9
Choice of data or measurement methods and procedures	The default value as specified in AMS-III.H (Version 16; EB58)
Purpose of data	Project emission calculation
Additional comment	=

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B.6.3. Ex ante calculation of emission reductions

>>

The ex-ante estimate of emission reductions has been calculated as per AMS-III.H (Version 16; EB58). In accordance with paragraphs 32 - 36 the *ex-ante* emission reductions are estimated, and the actual emission reductions achieved will be calculated *ex-post*.

The ex-ante estimate of emission reductions is therefore based on:

- the methodology outlined in Section B.6.1;
- the parameters available at validation as listed in Section B.6.2; and
- the ex-ante estimates of certain parameters that will be monitored as listed in Section B.7.1.

Baseline Emissions

Baseline emissions are calculated as follows;

$BE_y = \{BE_{power,y} + BE_{ww,treatment,y} + BE_{s,treatment,y} + BE_{ww,discharge,y} + BE_{s,final,y}\}$			
Parameter	Value	Description	Unit
BE_y	36,291	Baseline emissions in year y	tCO ₂ e
$BE_{power,y}$	0	Baseline emissions from electricity or fuel consumption in year y	tCO ₂ e
$BE_{ww,treatment,y}$	36,291	Baseline emissions of the wastewater treatment systems affected by the project activity in year y	tCO ₂ e
$BE_{s,treatment,y}$	0	Baseline emissions of the sludge treatment systems affected by the project activity in year y	tCO ₂ e
$BE_{ww,discharge,y}$	0	Baseline methane emissions from degradable organic carbon in treated wastewater discharged to plantation for land irrigation in year y	tCO ₂ e
$BE_{s,final,y}$	0	Baseline methane emissions from anaerobic decay of the final sludge produced in year y (tCO ₂ e). If the sludge is controlled combusted, disposed in a landfill with biogas recovery, or used for soil application in the baseline scenario, this term shall be neglected.	tCO ₂ e

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(a) Baseline emissions from electricity consumption ($BE_{power,y}$)

As described in Section B.6.1, $BE_{power,y} = 0$.

(b) Baseline emissions of the wastewater treatment systems affected by the proposed project activity ($BE_{ww,treatment,y}$)

$BE_{ww,treatment,y} = (Q_{ww,y} * COD_{inflow,y} * \eta_{COD,BL} * MCF_{ww,treatment,BL}) * B_{o,ww} * UF_{BL} * GWP_{CH4}$			
Parameter	Value	Description	Unit
$BE_{ww,treatment,y}$	36,291	Baseline emissions of the wastewater treatment systems affected by the project activity in year y	tCO ₂ e
$Q_{ww,y}$	140,400	Volume of wastewater treated in baseline wastewater treatment system i in year y (m ³). For ex ante estimation, projected FFB amount was multiplied by the default POME:FFB ratio of 65%.	m ³
$COD_{inflow,y}$	0.05850	Chemical oxygen demand of the wastewater inflow to the baseline anaerobic treatment system (System- anaerobic) in year y . Average value may be used through sampling with the confidence/ precision level 90/10.	t/m ³
$\eta_{COD,BL}$	0.99	COD removal efficiency of the baseline anaerobic treatment system (System- anaerobic), determined as per the paragraphs 26, 27 or 28 in AMS III.H (Version 16).	
$MCF_{ww,treatment,BL}$	0.8	Methane correction factor for baseline wastewater treatment systems (System- anaerobic)	
$B_{o,ww}$	0.25	Methane producing capacity of the wastewater	
UF_{BL}	0.89	Model correction factor to account for model uncertainties	
GWP_{CH4}	25	Global Warming Potential of methane	

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Baseline Emission for aerobic waste water treatment system consisting of aerobic ponds is considered to be zero as the MCF value as per table III.H.1 applied is equal to 0 (aerobic treatment, well managed ponds).

(c) Baseline emissions of the sludge treatment systems affected by the project activity ($BE_{treatment,s,y}$)

The baseline scenario does not involve sludge treatment. Therefore, on this basis $BE_{treatment,s,y} = 0$.

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

The baseline scenario, the final treated wastewater is used for land irrigation which indicates well managed aerobic treatment. Therefore, on this basis $BE_{ww,discharge,y} = 0$.

(e) Baseline methane emissions from anaerobic decay of the final sludge produced ($BE_{s,final,y}$)

As defined in Section B.6.1, $BE_{s,final,y} = 0$.

Project Activity Emissions

Project activity emissions are calculated as follows:

$PE_y = PE_{power,y} + PE_{ww,treatment,y} + PE_{s,treatment,y} + PE_{ww,discharge,y} + PE_{s,final,y} + PE_{fugitive,y} + PE_{biomass,y} + PE_{flaring,y}$			
Parameter	Value	Description	Unit
PE_y	3,680	Project activity emissions in the year y	tCO ₂ e
$PE_{power,y}$	0	Emissions from electricity or fuel consumption in the year y	tCO ₂ e
$PE_{ww,treatment,y}$	0	Methane Emissions from wastewater treatment systems affected by the project activity, and not equipped with biogas recovery, in year y	tCO ₂ e
$PE_{s,treatment,y}$	0	Methane emissions from sludge treatment systems affected by the project activity and not equipped with biogas recovery in year y	tCO ₂ e
$PE_{ww,discharge,y}$	0	Methane emissions from degradable organic carbon in treated wastewater in year y	tCO ₂ e
$PE_{s,final,y}$	0	Methane emissions from anaerobic decay of the final sludge produced in year y	tCO ₂ e
$PE_{fugitive,y}$	3,680	Methane emissions from biogas release in capture systems in year y	tCO ₂ e
$PE_{flaring,y}$	0	Methane emission due to incomplete flaring in year y	tCO ₂ e
$PE_{biomass,y}$	0	Methane emission from biomass stored under anaerobic conditions	tCO ₂ e

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Project activity emissions are calculated as follows:

(a) Project activity emissions from electricity consumption ($PE_{power,y}$)

As described in Section B.6.1, $PE_{power,y} = 0$.

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

As described in Section B.6.1, $PE_{ww,treatment,y} = 0$.

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

As described in Section B.6.1, $PE_{s,treatment,y} = 0$.

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

As discussed in Section B.6.1, $PE_{ww,discharge,y} = 0$.

(e) **Methane emissions from the decay of the final sludge generated by the project activity treatment systems ($PE_{s,final,y}$)**

As described in Section B.6.1, $PE_{s,final,y} = 0$.

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

The fugitive emissions through capture inefficiencies are calculated below:

$PE_{fugitive,y} = PE_{fugitive,ww,y} + PE_{fugitive,s,y}$			
Parameter	Value	Description	Unit
$PE_{fugitive,y}$	3,680	Methane emissions from biogas release in capture system in year y	tCO ₂ e
$PE_{fugitive,ww,y}$	3,680	Fugitive emissions through capture inefficiencies in the anaerobic wastewater treatment system year y	tCO ₂ e
$PE_{fugitive,s,y}$	0	Fugitive emissions through capture inefficiencies in the sludge treatment in year y	tCO ₂ e

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Where:

$PE_{fugitive,ww,y} = (1 - CFE_{ww}) * MEP_{ww,treatment,y} * GWP_{CH4}$			
Parameter	Value	Description	Unit
$PE_{fugitive,ww,y}$	3,680	Fugitive emissions through capture inefficiencies in the anaerobic wastewater treatment system year y	tCO ₂ e
CFE_{ww}	0.9	Capture efficiency of the biogas recovery equipment in the wastewater treatment systems	Default Value
$MEP_{ww,treatment,y}$	1,472	Methane emission potential of the wastewater treatment system equipped with biogas recovery system in year y (t)	t
GWP_{CH4}	25	Global Warming Potential of methane	tCO ₂ e/tCH ₄

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Where:

$MEP_{ww,treatment,y} = Q_{ww,y} * B_{o,ww} * UF_{PJ} * \sum_k COD_{removed,PJ,k} * MCF_{ww,treatment,PJ,k}$			
Parameter	Value	Description	Unit
$MEP_{ww,treatment,y}$	1,472	Methane emission potential of the wastewater treatment system equipped with biogas recovery system in year y	tCH ₄ /y
$Q_{ww,y}$	140,400	Volume of wastewater treated in project wastewater treatment system (System-Aerobic) in year,y.	m ³
$B_{o,ww}$	0.25	Methane producing capacity of the wastewater	kgCH ₄ /kgCOD
UF_{PJ}	1.12	Model correction factor to account for model uncertainties	
$COD_{removed,PJ}$	0.04680	The chemical oxygen demand removed by the project wastewater treatment system (System-biogas) which is equipped with biogas recovery digester in year y. Ex-ante estimate as per the Measurement Campaign Sample Point A; COD _{inflow,y} less design value of digester removal efficiency (80%). Parameter to be recalculated ex-post in accordance with paragraph 20.	tonnes/m ³
$MCF_{ww,treatment,PJ}$	0.8	Methane correction factor for project wastewater treatment system (System-biogas) which is equipped with biogas recovery digester. (not equipped with biogas recovery) (MCF values as per Table III.H.1).	

As described in Section B.6.1, $PE_{fugitive,s,y} = 0$.

(g) Methane emissions from biomass stored under anaerobic conditions ($PE_{Biomass}$)

As described in Section B.6.1 $MEP_{s,treatment,y} = 0$.

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

The project emission from flaring is calculated below:

$PE_{flare} = \sum_{h=1}^{8760} TM_{RG,h} * (1 - \eta_{flare,h}) * (GWP_{CH4}/1000)$			
Parameter	Value	Description	Unit
PE_{flare}	0	Project emission from flaring of methane in year y	tCO ₂ e
h	4,800.00	Hours of operation per year	h/y
$TM_{RG,h}$	0	Mass flow rate of methane in hour	kg/y
$\eta_{flare,h}$	0.9	Flare efficiency in hour h	
GWP_{CH4}	25	Global Warming Potential of methane	

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Leakage

$LE_y = 0$

Emission reductions

Based on the steps outlined above, the ex-ante estimation of emission reductions associated with wastewater treatment is as follows:

$ER_{y,ex\ ante} = BE_{y,ex\ ante} - (PE_{y,ex\ ante} + LE_{y,ex\ ante})$			
Parameter	Value	Description	Unit
$ER_{y,ex\ ante}$	32,611	Ex ante emission reduction in year y	tCO ₂ e
$LE_{y,ex\ ante}$	0	Ex ante leakage emissions in year y	tCO ₂ e
$PE_{y,ex\ ante}$	3,680	Ex ante project emissions in year y calculated as per equation 8	tCO ₂ e
$BE_{y,ex\ ante}$	36,291	Ex ante baseline emissions in year y calculated as per equation 1	tCO ₂ e

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Where:

Baseline Emissions

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

$$= 0 + 36,291 + 0 + 0 + 0$$

$$= 36,291 \text{ tCO}_2\text{e/yr}$$

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Project Emissions

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

$$= 0 + 0 + 0 + 0 + 0 + 3,091 + 0 + 0$$

$$= 3,680 \text{ tCO}_2\text{e/yr}$$

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Leakages

$LE_y = 0$

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

Year	Baseline emissions (t CO ₂ e)	Project emissions (t CO ₂ e)	Leakage (t CO ₂ e)	Emission reductions (t CO ₂ e)
2014 ³⁵	1,193	121	0	27,394
2015	36,291	3,680	0	27,394
2016	36,291	3,680	0	27,394
2017	36,291	3,680	0	27,394
2018	36,291	3,680	0	27,394
2019	36,291	3,680	0	27,394
2020	36,291	3,680	0	27,394
2021	36,291	3,680	0	27,394
2022	36,291	3,680	0	27,394
2023	36,291	3,680	0	27,394
2024 ³⁶	35,098	3,559	0	31,539
Total number of crediting years	10			
Annual average over the crediting period	36,291	3,680	0	32,611

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data/Parameter	Q _{ww,i,y}
Data unit	m ³ /month
Description	The flow of wastewater entering the project anaerobic digester system
Source of data	Measured
Value(s) applied	11,700 (ex-ante value – see comment)
Measurement methods and procedures	Flow of wastewater will be measured continuously (at-least hourly) using calibrated cumulative flow meters; data will be recorded monthly. Data will be kept electronically in a systematic and transparent manner during crediting period and two years after crediting period.
Monitoring frequency	continuously
QA/QC procedures	Equipment will be calibrated according to manufacturer specifications, or at least once in three years.
Purpose of data	Baseline and project emission calculation
Additional comment	For the purpose of the ex-ante estimate of emission reductions the volume of wastewater treated in the baseline and project wastewater systems was estimated to be 140,400 m ³ /year.

Data/Parameter	COD _{ww,untreated,y}
Data unit	tCOD/m ³
Description	COD of wastewater entering the anaerobic digester system
Source of data	Laboratory testing
Value(s) applied	0.05850

³⁵ The crediting period of the project activity starts from 20/12/2014 to 19/12/2024. For year 2014, the period starts from 20/12/2014 to 31/12/2014 which is 12 days, out of 365 days. The baseline estimation has been applied with 12/365, please see following calculation: $36,291 \times 12/365 = 1,193$. The same has been applied to project emission value and the emission reduction.

³⁶ The 2024 estimation is based on different of annual estimation and the value in 2016: $36,291 - 1,193 = 35,098$ for the baseline emission. The same pattern has been applied to project emission value and the emission reduction.

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Measurement methods and procedures	COD sample will be tested once every two weeks according to national or international standards. The average of the COD measurement readings will be used. Samples and measurements shall ensure a 90/10 confidence/precision level.
Monitoring frequency	Once every two weeks
QA/QC procedures	The COD testing will be carried out by an accredited laboratory. Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the crediting period.
Purpose of data	Baseline and project emission calculation
Additional comment	-

Data/Parameter	COD_{ww,treated,y}
Data unit	tCOD/m ³
Description	COD of wastewater exiting the anaerobic digester system
Source of data	Laboratory testing
Value(s) applied	0.01107
Measurement methods and procedures	COD sample will be tested once every two weeks according to national or international standards. The average of the COD measurement readings will be used. Samples and measurements shall ensure a 90/10 confidence/precision level.
Monitoring frequency	Once in two weeks
QA/QC procedures	The COD testing will be carried out by an accredited laboratory. Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the crediting period.
Purpose of data	Baseline and project emission calculation
Additional comment	-

Data/Parameter	COD_{ww,discharge,PJ,y}
Data unit	tCOD/m ³
Description	COD of wastewater leaving the final discharge point
Source of data	Laboratory testing
Value(s) applied	0.00455
Measurement methods and procedures	COD sample will be tested once every two weeks according to national or international standards. The average of the COD measurement readings will be used. Samples and measurements shall ensure a 90/10 confidence/precision level.
Monitoring frequency	Once in two weeks
QA/QC procedures	The COD testing will be carried out by an accredited laboratory. Data will be kept electronically in a systematic and transparent manner during the crediting period and two years after the crediting period.
Purpose of data	Project emission calculation
Additional comment	-

Data/Parameter	BG_{burnt,y}
Data unit	Nm ³
Description	Amount of biogas fuelled or flared in year,y
Source of data	Calculated
Value(s) applied	2,846,050
Measurement methods and procedures	Calculated as the sum of BG_{fuelled,y} and BG_{flared,y}

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Monitoring frequency	Please see BG_{fuelled,y} and BG_{flared,y}
QA/QC procedures	Please see BG_{fuelled,y} and BG_{flared,y}
Purpose of data	Please see BG_{fuelled,y} and BG_{flared,y}
Additional comment	Ex-ante estimation based on STP condition

Data/Parameter	BG_{fuelled,y}
Data unit	Nm ³
Description	Amount of biogas fuelled in the gas engine and/or boiler in year,y
Source of data	Measured
Value(s) applied	2,846,050
Measurement methods and procedures	The biogas flow, temperature and pressure will be measured continuously (at least hourly) using calibrated volumetric flow meters, and a cumulative normalised flow (Nm ³) of the biogas will be calculated continuously by a flow meter or flow calculator.
Monitoring frequency	Continuously
QA/QC procedures	The meters will undergo maintenance/calibration as per the manufacturer's specifications, or at least once every three years.
Purpose of data	Baseline and project emission calculation
Additional comment	Ex-ante estimation based on STP condition

Data/Parameter	BG_{flared,y}
Data unit	Nm ³
Description	Amount of biogas flared in year,y
Source of data	Measured
Value(s) applied	0
Measurement methods and procedures	The biogas flow, temperature and pressure will be measured continuously (at least hourly) using calibrated volumetric flow meters, and a cumulative normalised flow (Nm ³) of the biogas will be calculated continuously by a flow meter or flow calculator.
Monitoring frequency	Continuously
QA/QC procedures	The meters will undergo maintenance/calibration as per the manufacturer's specifications, or at least once every three years.
Purpose of data	Baseline and project emission calculation
Additional comment	Ex-ante estimation based on STP condition. Data used to calculate FV_{RG,i}

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Data/Parameter	WCH_{4,y}
Data unit	%
Description	Methane content in biogas in the year y
Source of data	Measured
Value(s) applied	65
Measurement methods and procedures	Measured with a continuous analyser or, alternatively, with periodical measurements at a 90/10 confidence/precision level. The methane content measurement will be carried out close to a location in the system where a biogas flow measurement takes place
Monitoring frequency	continuously
QA/QC procedures	The analyzer will undergo maintenance/calibration as per the manufacturer's specifications, but at least once every three years.
Purpose of data	Baseline and project emission calculation
Additional comment	Data used to calculate fVCH_{4,RG,i}

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Data/Parameter	T_{flare}
Data unit	°Celsius
Description	Temperature in the exhaust gas of the flare
Source of data	Measured
Value(s) applied	> 500°C
Measurement methods and procedures	Measure the temperature of the exhaust gas stream in the flare by a Type N thermocouple. A temperature above 500 °C indicates that a significant amount of gases are still being burnt and that the flare is operating.
Monitoring frequency	continuously
QA/QC procedures	Thermocouples should be replaced or calibrated every year.
Purpose of data	<u>N/A</u>
Additional comment	Temperature in the exhaust gas of the flare will be monitored according to "Tool to determine project emissions from flaring gases containing methane"

Data/Parameter	$\eta_{flare,h}$
Data unit	%
Description	Flare efficiency in hour h
Source of data	Calculated
Value(s) applied	90%
Measurement methods and procedures	Default flare efficiency for enclosed flare is estimated based on hourly flaring efficiency: <ul style="list-style-type: none"> 0% if the temperature in the exhaust gas of the flare (T_{flare}) is below 500 °C for more than 20 minutes during the hour h. 50%, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500 °C for more than 40 minutes during the hour h, but the manufacturer specifications on proper operation of the flare are not met at any point in time during the hour h. 90%, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500 °C for more than 40 minutes during the hour h and the manufacturer specifications on proper operation of the flare are met continuously during the hour h.
Monitoring frequency	N/A
QA/QC procedures	N/A
Purpose of data	<u>Baseline and project emission calculation</u>
Additional comment	-

Data/Parameter	$S_{final,P,I,y}$
Data unit	-
Description	End use of final sludge from the digester system
Source of data	Records
Value(s) applied	-
Measurement methods and procedures	The sludge removed periodically from the digester will be sent to the palm plantation as soil application and applied in a thin layer under aerobic conditions. Records of when sludge is removed and where the sludge is applied will be kept.
Monitoring frequency	periodically
QA/QC procedures	-
Purpose of data	<u>N/A</u>
Additional comment	In any event of removal of sludge and soil application, the process will be monitored to ensure the conditions are aerobic.

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B.7.2. Sampling plan

>> This is not applicable for the project activity.

B.7.3. Other elements of monitoring plan

>> The purpose of the monitoring plan is to ensure that the required data are accurately monitored and recorded to enable the calculation of the emission reductions achieved by the proposed project activity. The final monitoring plan will be prepared based on actual project implementation.

Organization of the Monitoring Activities and Monitoring Management

In order to obtain effective monitored data, a monitoring management structure which identified the relative staffs for data recording, collection and preservation will be established as proposed in Table 8.

Table 8: Proposed CDM Monitoring and Management Team

Position	Outline of Responsibilities	Reporting
Mill Manager/ Assistant Mill Manager	<ul style="list-style-type: none"> Reviews the monthly reports and investigate any irregularities. Ensures on-going compliance with the CDM monitoring plan. Supervises meter calibration requirements 	Management Team
Administration Officer	<ul style="list-style-type: none"> Oversees the collection, recording and storage of data. Responsible for ensuring data recording and meters are functioning correctly. 	Mill Manager/ Assistant Mill Manager
Plant operators and Engine Driver (Shift Based)	<ul style="list-style-type: none"> The person appointed for each shift involves in operating and maintaining the plant. Responsible for data recording and checking meters functions. 	Administration Officer
Laboratory Assistant	<ul style="list-style-type: none"> Responsible for collection of wastewater samples for the purpose of the COD measurement Undertakes regular internal audits of the project. 	Mill Manager/ Assistant Mill Manager

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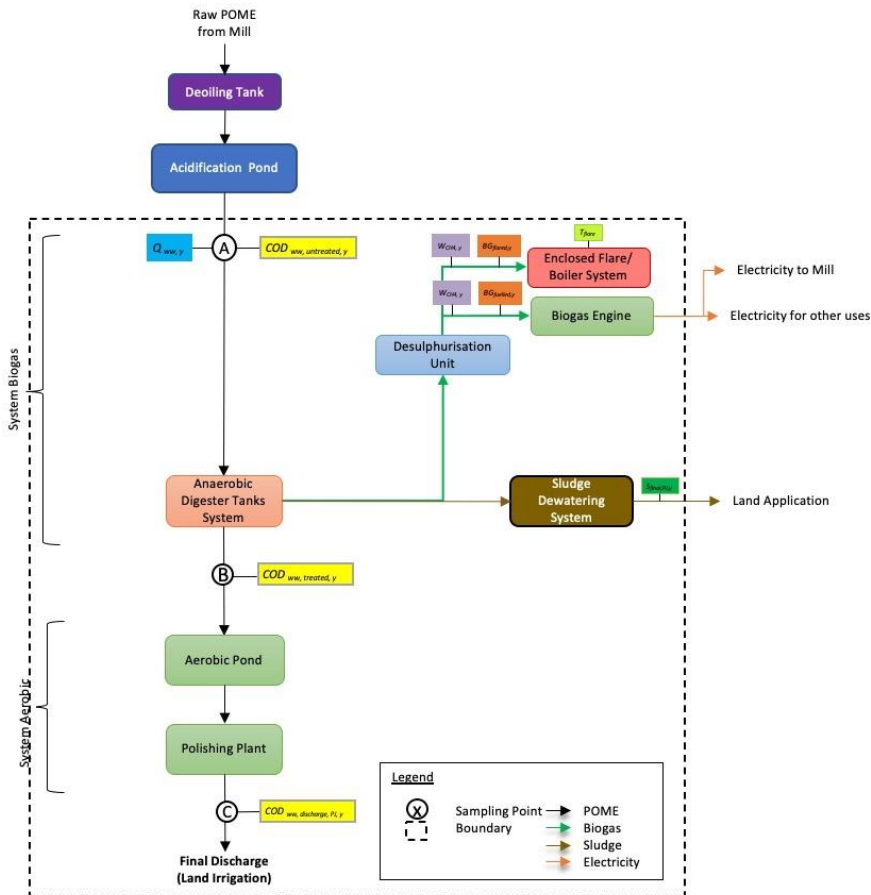
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Table B.8: Proposed CDM Monitoring and Management Team

Monitoring

The proposed measurement and sampling points for the project activity is illustrated in Figure 5:

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Figure 5 Proposed Monitoring for Project Activity



Training

Training for operating and maintaining the wastewater treatment system will be provided by the technology provider and internal operation team respectively.

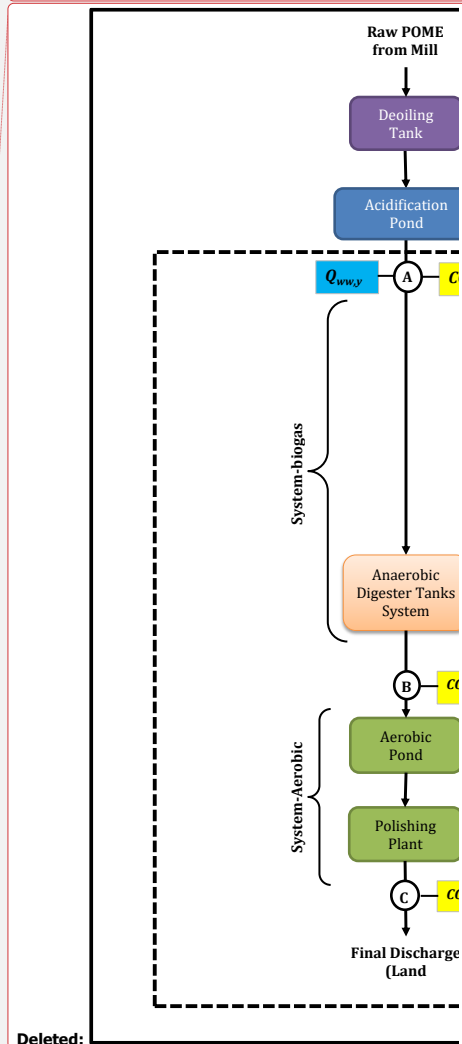
All persons that are involved with monitoring for CDM purposes shall also receive appropriate CDM training. The training will provide an overview of the CDM and cover all elements of the monitoring plan in detail.

Quality Assurance and Quality Control

The CDM Monitoring and Management team mentioned above will ensure proper and timely calibration as scheduled for applicable monitoring instrumentation in accordance with the manufacturer's specification of system, data acquisition and storage. The responsible person will also undertake regular follow ups to ensure data measured is consistent.

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Figure B.4: Proposed Monitoring for Project Activity¶



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Emergency Preparedness

The project activity is not expected to result in any emergency that can result in substantial emissions. The proposed project activity has the necessary provisions for emergency preparedness to deal with any unforeseen events such as fire or an electrical blackout.

An emergency management procedure will be developed that will outline steps to be followed to quantify emission reductions in the event of equipment or meter failures.

Uncertainty in Data and Data Management

Some uncertainties may result due to malfunction of meters, calibration issues and wrong data collection (gaps in manual log sheets, human errors by plant operators, electronic recording system failure, etc.). The operator is expected to put best efforts to prevent such errors, however regular internal checks shall rectify any such uncertainty in the monitored data.

The management of data records shall be kept both in soft copy and hard copy format with proper archive system by the CDM management team. All data should be electronically archived for a period of two years from the end of the crediting period.

SECTION C. Start date, crediting period type and duration**C.1. Start date of project activity**

>>09/08/2011³⁷

C.2. Expected operational lifetime of project activity

>>15 years³⁸

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

>> 20/12/2014

During validation/ registration stage, the project activity was scheduled to operate on 01/01/2013. The project activity got registered as CDM project activity on 03/01/2013. There was delay in construction of the biogas plant, thus delay in commissioning of the project activity.

According to the commissioning report: successful commissioning and hand over, it shows that the plant was tested and put in operational as per the contract on the 20/12/2014.

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C.3.3. Duration of crediting period

>> Ten (10) years and zero (0) months.

³⁷ "Letter of Acceptance of Offer" with Watermech Engineering Sdn. Bhd.

³⁸ Watermech Engineering Sdn. Bhd; Life Span, Operation & Maintenance Cost of Equipment

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>> There is no requirement under Malaysia law⁴⁰ for an environmental impact assessment to be undertaken for this type of project. The Project activity complies with all local and national regulations related to establishment and operation of wastewater treatment. The proposed project activity will have a positive environmental impact on the local environment and neighbouring communities. A summary of the identified positive impacts are as follows:

- Improvement of local air quality. An issue associated with wastewater treatment in open ponds is the pungent odour produced due to the anaerobic decomposition of organic matter. By treating the wastewater in an anaerobic covered pond reactor that facilitates accelerated decomposition in a controlled environment, thereby eliminating the release of biogas to the atmosphere, the local air quality will be significantly improved for the benefit of neighbouring communities and staff working at the facility.
- Reduction in greenhouse gas emissions and generation of renewable energy. By utilising the methane in the biogas produced through the anaerobic decomposition of the POME to generate electricity, the proposed project activity avoids the release of methane to the atmosphere.
- During the construction, some minor environmental impacts were identified, such as noise, dust and increased movement of vehicles. However, as the construction period is brief and construction activity is constrained within the existing palm oil mill these impacts were not considered significant.

D.2. Environmental impact assessment

>> As described above, no negative environmental impacts are identified with the project.

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

>> A stakeholder meeting was held on 2nd November 2011 at Zenith Hotel, in Kuantan, Malaysia.

Stakeholders were invited by local newspaper advertisement; in The Star & Utusan Malaysia from 24th – 27th October 2011. Personal letter invitations were also sent out to relevant Government and Administrative organisations and local villagers.

The mill management team thanked all the participants for their attendance and provided an overview of the purpose of the stakeholder meeting. Ms. Jeyashri of Perenia Carbon introduced participants to the concept of climate change and CDM. Mr. Syed Salim of Watermech Engineering Sdn. Bhd., technologist described the proposed project activity in detail, including its positive environmental impacts.

Following the initial presentations a question and answer session was held where participants were given the opportunity to raise issues and provide comments on the presentations.

Thirty (30) participants attended the meeting⁴¹.

⁴⁰ Environmental Quality (Prescribed) (Crude Palm Oil) Regulations 1977

⁴¹ Refer to Stakeholder Meeting Report

E.2. Summary of comments received

>> A summary of question received and responses provided is outlined below.

#	QUESTIONER	QUESTION	ANSWER
1.	Mr Ngoh Chin Huan, Bakti Juwita Sdn Bhd	Please elaborate on the utilization of generated electricity.	<ul style="list-style-type: none"> The generated electricity is used mainly for mill operation and associated downstream activities. There is no potential for supply to the grid as the mill is located 23 km away from the main road and does not have any grid connectivity. This makes possible connection too expensive and not a viable option.
2.	Mr Chong Tian Sang, Assistant Manager, ZCM (local mining company)	Does the project pose any social impact to the local community?	<ul style="list-style-type: none"> For the local economy, there are employment opportunities and technology knowledge transfer for the locals both during project construction and implementation. Environmental perspective, the project potentially will improve the air quality from the avoidance of methane emissions and release of odour from hydrogen sulphide. From a health and safety aspect, no impact is expected to affect the health of the locals. The steel tank digester has been designed with DOSH approval to qualify as a non-pressure vessel, with necessary safety devices installed to minimize leakages. If leakages do occur, the design allows it to flow through the top of the tanks or at elevated pipes. Risk is only if there is presence of oxygen, which is addressed by flaring of biogas when in contact with the air outside of the tank.
3.	Mr Seow Chee Siang, JC Chang	Can the gas be directed to be used for cooking purposes?	<ul style="list-style-type: none"> This is possible, although gas for cooking must be compressed in order to become economical, which will require additional equipment. In fact, technology wise there are future considerations for extraction and bottling of carbon dioxide and methane for industrial purposes.
4.	Mr Hong Chat Chai, Dara Lam Soon Sdn Bhd	Is 100% of the POME supplied to the wastewater treatment plant?	<ul style="list-style-type: none"> Yes. The design will accommodate 100% of the POME treatment – continuous flow into the digester tanks. Existing anaerobic ponds will not be used, but will be maintained only for emergency use.
5.	Mr Eric Choo, Secretary, ZCM (local mining company)	Please elaborate further on the sludge handling system.	<ul style="list-style-type: none"> Upon completion of the anaerobic system, digested effluent shall flow out into the sludge handling system which will terminate the anaerobic process. Sludge handling consists of a settling tank, a forced aeration process of the effluent. Solids are processed using a backpress filter system to produce fertilizers. Treated effluent is pumped back into the aerobic ponds.
6.	Mr Hong Chat Chai, Dara Lam Soon Sdn Bhd	How do you dispose of the desulphurization residues?	<ul style="list-style-type: none"> Quantity of chemical used is very small and can be disposed of by sending to Kualiti Alam under Department of Environment regulation. It is also possible to recycle back into consumption.
7.	Mr Hong Chat Chai, Dara Lam Soon Sdn Bhd	What is the cost of the whole project?	<ul style="list-style-type: none"> The cost of the whole project depends on mill size. The overall cost including biogas engines for electricity generation cost from RM 11 – 20 million depending on mill capacity, the bigger mills needs bigger treatment system, soil

CDM-PDD-FORM

#	QUESTIONER	QUESTION	ANSWER
			condition for earthwork & piling and power transmission costs.
8.	Mr Chong Tian Sang, Assistant Manager, ZCM (local mining company)	How many job opportunities will the project create?	<ul style="list-style-type: none"> The project will potentially require 3 – 4 workers as operators to run the biogas plant, as the project is fully automated. Otherwise additional resources required to supervise and monitor the project for compliance purpose.

E.3. Consideration of comments received

>> All comments were addressed during the stakeholder meeting.

SECTION F. Approval and authorization

>> The approval timeline from the following parties that wish to be involved in the project activity are available at the time of submitting the PRC PDD to the DOE for validation.

<u>Date of Approval</u>	<u>Documentation</u>	<u>Parties involved in the project activity</u>
<u>14/08/2012</u>	<u>letters of approval</u>	<u>Malaysian (host country)</u>
<u>23/07/2012</u>	<u>letters of approval</u>	<u>Australia</u>

Appendix 1. Contact information of project participants

Organization name	Carotino Sdn. Bhd. (Project Owner)
Country	Malaysia
Address	Unit 30-01, Mail Box 300, Menara Landmark, No. 12 Jalan Ngee Heng, Johor Bahru, Johor, 80000, Malaysia
Telephone	+6007 223 1633
Fax	+6007 224 1546
E-mail	taycl@jcc.com.my
Website	-
Contact person	Mr. Leong Chwee Tay (Mill Director)

Organization name	Perenia Pty Ltd
Country	Australia
Address	PO Box 627, North Sydney, NSW, Australia, 2059
Telephone	+61 2 9926 1700
Fax	+61 2 9926 1799
E-mail	registration@southpolecarbon.com
Website	www.southpole.com
Contact person	Mr. Renart Heuberger

Deleted: enquiries@pereniicarbon.comDeleted: <http://www.pereniicarbon.com>

Deleted: Mr. Michael Wiener

Appendix 2. Affirmation regarding public funding

No public funding is involved in the proposed project activity.

Appendix 3. Applicability of methodologies and standardized baselines

[Please refer to section B.2](#)

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

[Please see ex-ante calculation file submitted during validation.](#)

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Appendix 5. Further background information on monitoring plan

[Please refer to details in section B.7](#)

Appendix 6. Summary report of comments received from local stakeholders

[Please refer to details in section E](#)

Appendix 7. Summary of post-registration changes

There are three changes to the project activity.

1) Change to the start date of the crediting period

In this revised PDD, the post registration change involves the change of the crediting period from 01/01/2013 to 20/12/2014 due to delay on commissioning of the project activity. As per the commissioning report of the project activity, the technology provider has successfully handed over the project activity on 20/12/2014.

By considering the actual COD of the project activity, the proposed change of the start date of crediting period is between one and two years. This is in line with paragraph 235 of CDM project standard for project activities (CDM-EB93-A04-STAN). As per paragraph 235 of CDM-EB93-A04-STAN, the impact of the actual change to the registered project activity is justified below.

<u>Impact of change</u>	<u>Justification</u>
a) <u>Demonstrate that no changes have occurred to the project activity that would result in a less conservative baseline, or update the baseline using conservative data;</u>	The change in the start date of the crediting period has no impact to baseline scenario. Regarding to table 5 chronology of events and documents, can already prove that the project owner intends to develop the project activity since 2011. The board has approved development of the proposed project activity as a CDM project on 14/04/2011 and the construction of the project activity was started in 2012 as per the project work timeline ⁴² . The construction delay was due to the monsoon season and technical problems while installing the biogas system. The project proponent has not changed or updated anything that would have resulted to a less conservative baseline, or update the baseline using conservative data. The baseline scenario is still complied with the regulation or sectoral policy of the host country. Therefore, this change has no impact to the baseline of the project activity.
b) <u>Demonstrate that substantive progress has been made by the project participants to start the project activity</u>	According to the project work timeline, the surveying works was started in October 2011. With the problem for finding new contracted civil work has delayed the construction and relevant work process. Though successful commissioning and hand over of the project activity from the technology provider, Watermech Eng Sdn Bhd., was on 24/12/2014. The above justification has already shown that the substantive progress has been made by the project participants to start the project activity. The commissioning report and the project work timeline have been submitted to DOE as supportive evidences for this matter.

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2) Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents

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Update GWP of methane from 21 to 25

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As per para 27 of the Project Standard (version 02), the PP has corrected GWP of methane from 21 to 25 in keeping with the second commitment period of the Kyoto Protocol, the global warming potentials used by Parties to calculate the carbon dioxide equivalence of anthropogenic emissions by sources and removals by sinks of the greenhouse gases listed in Annex A to the Kyoto Protocol shall be those listed in the column entitled "Global Warming Potential for Given Time Horizon" in table 2.14 of the errata to the contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.

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⁴² Project work timeline prepared by the project proponent

Conclusion:

The actual changes involved in the project activity are the change of crediting period, and update of GWP. According to all the proposed changes, these changes have no impact to the registered project activity.

Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
11.0	31 May 2019	Revision to: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • Improve consistency with the "CDM project standard for project activities" and with the PoA-DD and CPA-DD forms; • Make editorial improvement.
09.0	24 May 2017	Revision to: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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.

CDM-PDD-FORM

<i>Version</i>	<i>Date</i>	<i>Description</i>
05.0	25 June 2014	Revision to: <ul style="list-style-type: none">• 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.
Decision Class: Regulatory Document Type: Form Business Function: Registration Keywords: project activities, project design document		