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 Melewar Palm Oil Mill, Malaysia
Scale of the project activity	☐ Large-scale ☒ Small-scale
Version number of the PDD	03.1
Completion date of the PDD	19/06/2020
Project participants	Melewar Properties 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 version16.0
Sectoral scopes	Sectoral Scope 13: Waste handling and disposal
Estimated amount of annual average GHG emission reductions	53,232 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

>> The “Methane Capture and Utilization Project at Melewar Palm Oil Mill”, Malaysia (“the project activity”) will be implemented at the Melewar Palm Oil Mill (“the mill”) located at 1.6km off the 45 km Lahad Datu Sandakan Highway, Sabah. The proposed project activity is being implemented by Melewar Properties Sdn Bhd (“the project owner[1]”).

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 384,000 tons[2] of FFB. Each tonne of FFB processed results in approximately 0.65 m^3 of POME produced[3].

The aim of the project activity is to capture anthropogenic methane emissions from the Palm Oil Mill anaerobic 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 53,232 tonnes of CO_2e per year.

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 Policy[4], 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. Promote and disseminate 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] Business Registration Form
[2] Palm Oil Mill Board (MPOB) Processing Capacity License_ Melewar
[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-techology-policy.html

The project activity is also in line with the National CDM Criteria[5] 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 technology[6] 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 project[7].

A.2. Location of project activity

>> The proposed project activity site is located within the Melewar Palm Oil Mill located at 1.6 km off the 45 km Lahad Datu – Sandakan Highway, Lahad Datu, Sabah in East Malaysia.

The project activity GPS coordinates are: 5° 16’ 17” N, 118° 3’ 7” E.

[5] National CDM Criteria, 24/08/2012. http://cdm.greentechmalaysia.my/cdm-malaysia/cdm-criteria.aspx
[6] Wastewater Treatment, Biogas Capture (Anaerobic System), 24/08/2012 http://www.watermech.com/p_anaerobic_digester_tank.php
[7] Melewar_Form 13 & Form 24

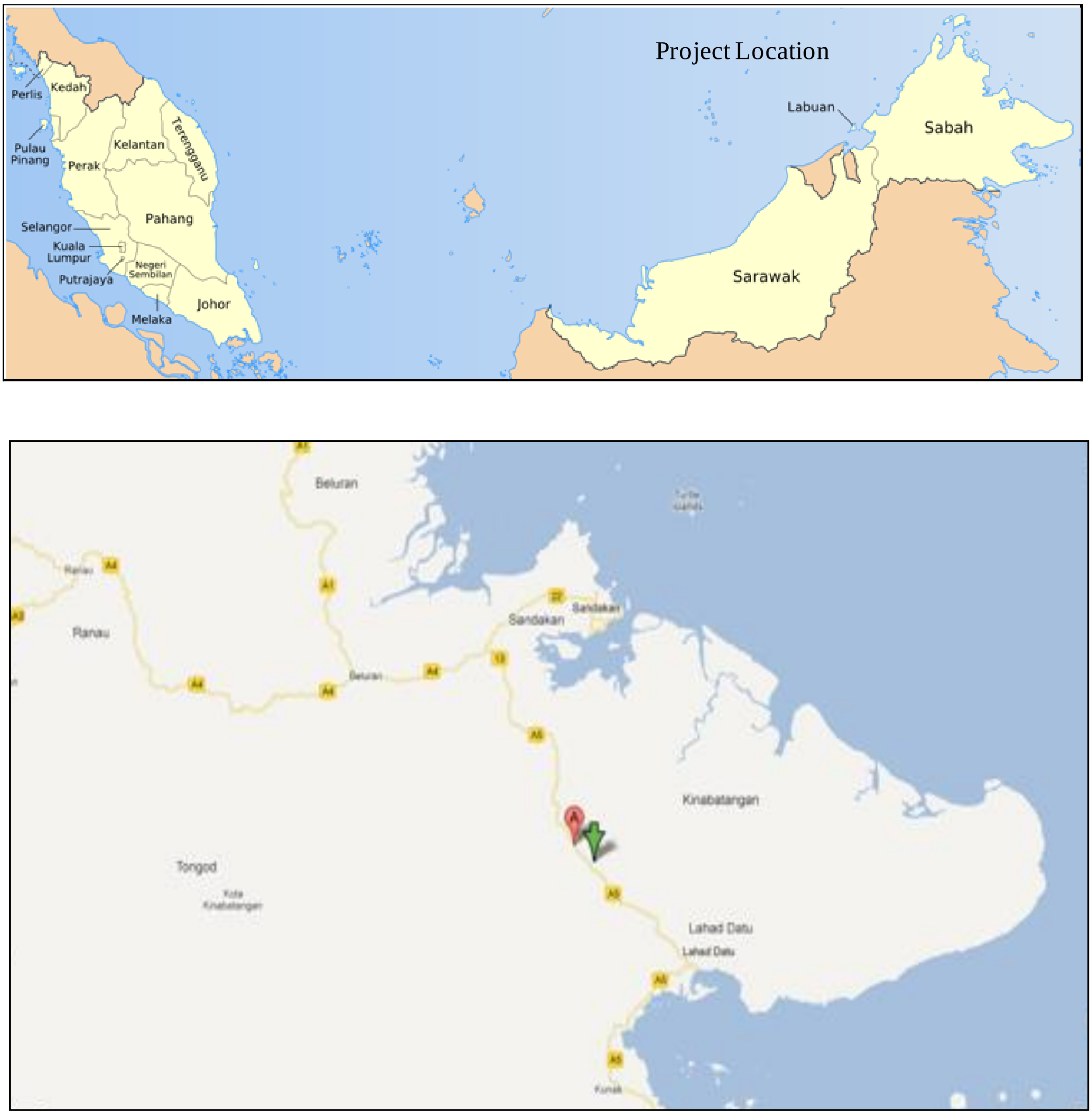


Figure 1: Map of Malaysia, Indicating the Location of Sabah State and Location of Mill

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 are 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 undergo hydrolysis and acidification process at the buffering ponds. 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 system overflows to the existing aerobic pond, settling pond and subsequently to an existing effluent polishing plant, prior to discharge to land irrigation. Digested sludge from the project activity will be utilised for land application in the plantation. The sludge will not be stored for longer periods to ensure that there are no anaerobic conditions developed,

The generated biogas will be channelled through a desulphurisation plant before being transferred to biogas engine system[9]. 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. to staff quarters, plantation offices and other 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 detail.

[9] General Specification of System & Project Process Flow by Watermech

Figure 2: Process Flow Diagram of Project Activity

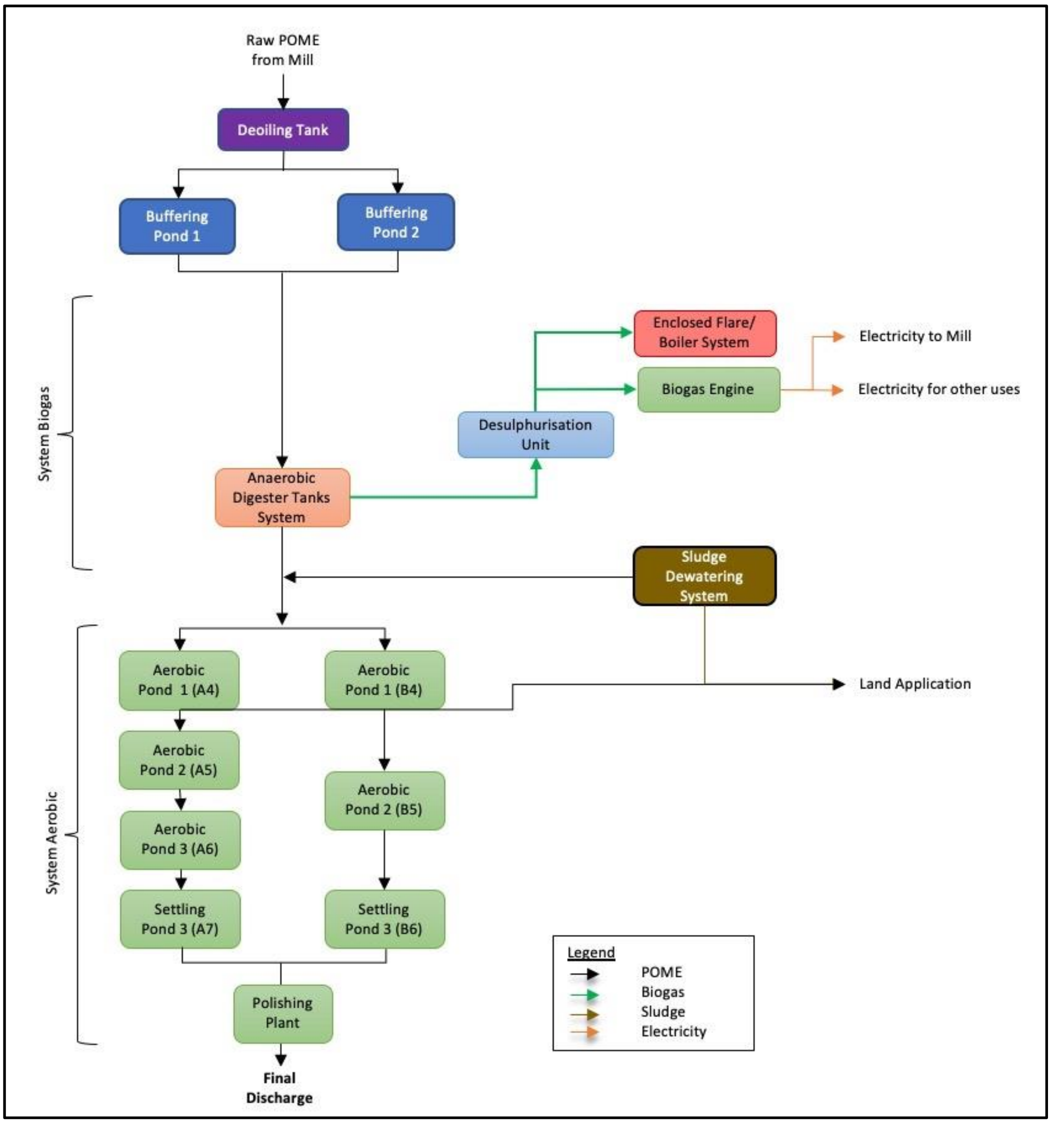


Table 1: Proposed Design Characteristics System

Anaerobic Digester Tank c/w Methane Capture System	
System Provider	Watermech Engineering Sdn. Bhd.
Design Capacity	850 m^3/day (max.)
COD Inflow	55,361 mg/l (10 days measurement average)
Average COD Removal Efficiency	80%[10]

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)	Melewar Properties Sdn Bhd	No
Australia	Perenia Pty Ltd (Private)	No

[10] Wastewater Treatment, Biogas Capture (Anaerobic System), 24/08/2012 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 Melewar Palm Oil, Malaysia was successfully registered as a CDM project activity on 02/10/2012 (Date of registration action on 03/01/2013). The CDM reference number of the registered project activity is 6488. 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)”

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; EB58) 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[11], without aeration. b) The average temperature in Sandakan, Malaysia is consistently above 15ºC[12]. c) The desludging of accumulated solids in the anaerobic ponds in the baseline treatment system has more than 30 days of interval[13].
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.4.1.4 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 53,232 tCO_2e per annum as demonstrated in Section B.6.3 which is lower than the 60,000 tCO_2e threshold.

[11] Effluent Treatment Plant Drawing
[12] Sandakan, Borneo, Malaysia average temperature is 26.8 °C (80 °F). http://www.climatemp.info/malaysia/sandakan-borneo.html
[13] Desludging Approvals from Department of Environment

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.

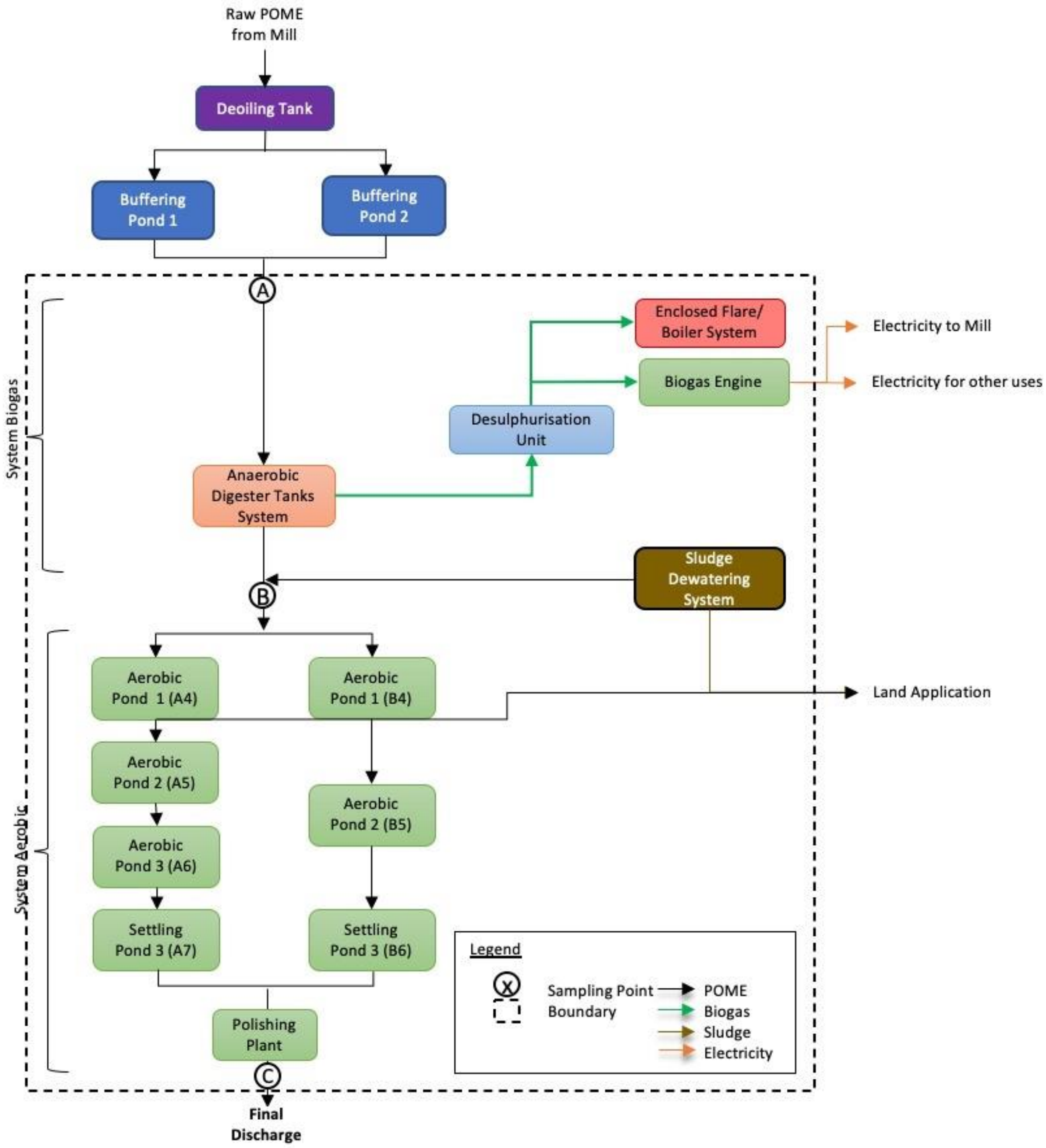
B.3. Project boundary, sources and greenhouse gases (GHGs)

>> 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, 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 15 & 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 that 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 buffering ponds.

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 97% and the COD removal 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 72% 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 ponds, settling ponds 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.

There are no additional project emissions from sludge processing as the sludge is not processed in baseline and project. There is no incremental transport or project emissions due to transportation of sludge from Anaerobic Digester system to the plantation. The end use of sludge application will be monitored to ensure aerobic and well managed condition is maintained.

Thus, the project emission from the processing, transportation and application or disposal of sludge is negligible and not accounted as project emissions.

Source		GHG	Included?	Justification/Explanation
Baseline	Existing wastewater treatment system; ie: open lagoon system	CO_2	Excluded	CO_2 emission from the decomposition of organic matter is not accounted for because biogenic in nature.
		CH_4	Included	The major source of emissions in the baseline from open lagoons (decay of organic matter in anaerobic conditions).
		N_2O	Excluded	Excluded for simplification. This is conservative
Project Activity	Wastewater Treatment process; Anaerobic digester tank	CO_2	Excluded	CO2 emission from decomposition of organic waste are not accounted in the calculation.
		CH_4	Included	The treatment of wastewater or sludge under the project activity may cause different emission: • Physical leakage from the digester tank. • Incomplete flaring
		N_2O	Excluded	Excluded for simplification. This is conservative.
	On-site electricity use	CO_2	Excluded	The source of on-site electricity consumed by project activity is from reneable energy generated from the biogas engine. 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.
		CH_4	Excluded	This emission source is assumed to be very small.
		N_2O	Excluded	This emission source is assumed to be very small.
	On-site fossil fuel consumption	CO_2	Excluded	This emission source is assumed to be very small.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.

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 sequential anaerobic and aerobic wastewater treatment system without biogas recovery system. From buffering ponds, POME enters Anaerobic Pond 1 (A1), then splits in parallel to Anaerobic Pond 2 (A2) and Primary Anaerobic ponds (B1 & B2).

From pond A2, the effluent flows subsequently to anaerobic pond 3 (A3) and subsequently to aerobic treatment system; aerobic pond 1 (A4), aerobic pond 2 (A5), aerobic pond 3 (A6) and settling pond 3 (A7).

From ponds B1 & B2, POME flows to secondary anaerobic pond (B3) and subsequently to aerobic treatment system; aerobic pond 1 (B4), aerobic pond 2 (B5) and settling pond 3 (B6). The treated effluents from both lines are further treated in polishing plant before discharged for land irrigation.

Sludge accumulated in the ponds will be desludged periodically to avoid siltation problems[14].

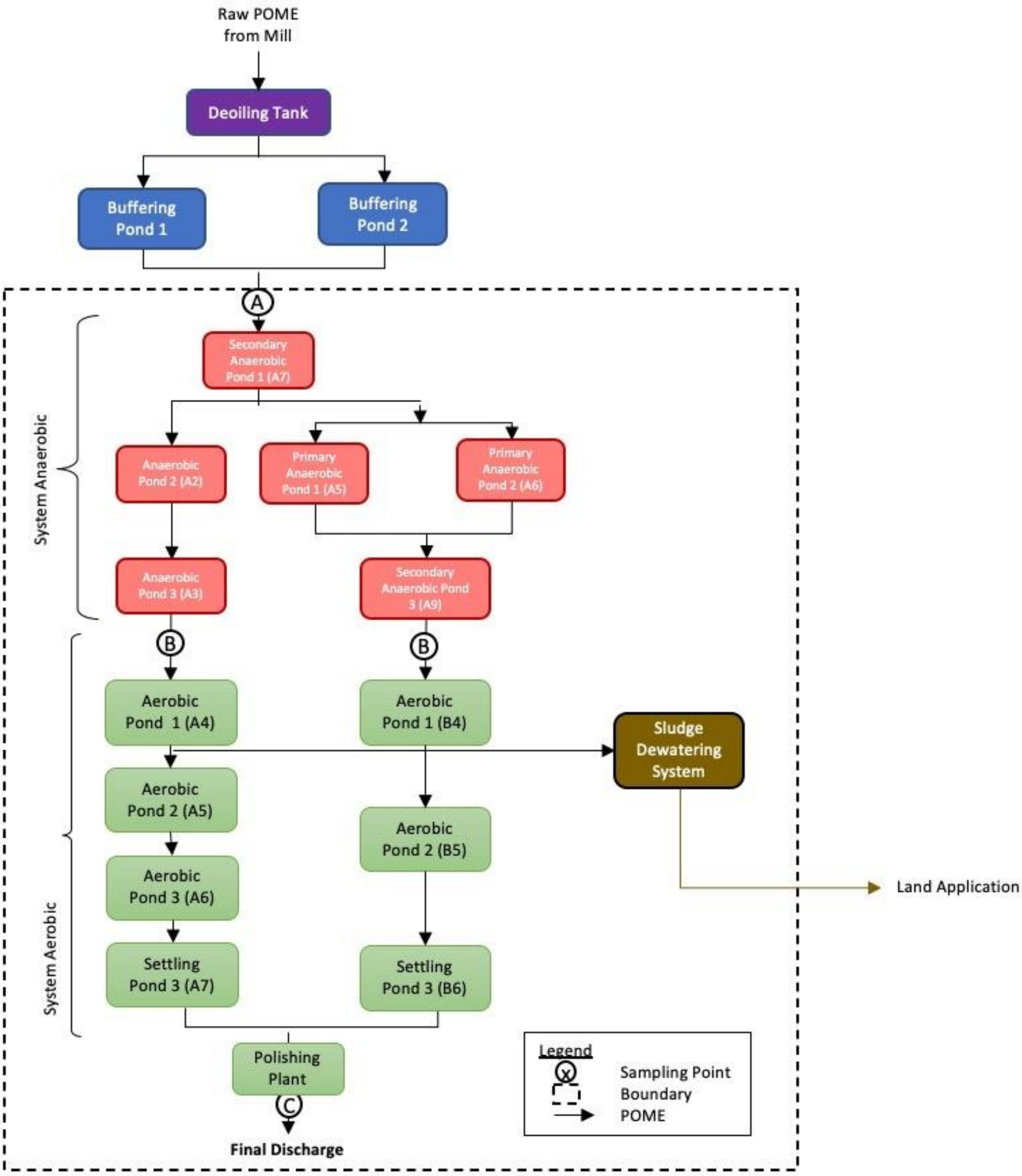
The methane correction factor (MCF) of baseline ponds are determined based on MCF values stated in table III.H.1, AMS III.H (Version 16, EB 58). Based on Figure 4, ponds with depth exceeding two (2) metres, a methane correction factor of 0.8 for anaerobic deep has been applied. However, for aerobic pond 2 (A5 & B5) which is 3.0 m deep, it is equipped with diffusers for aeration purpose. Hence, the aerobic pond and effluent polishing plant are considered as aerobically well managed[15] and a methane correction factor of zero has been applied.

Table 3: Baseline open ponds[16]

Pond Name	Depth (m)	MCF factor used as per AMS-III.H ver16
Anaerobic Pond 1 (A1)	4.25	0.8
Anaerobic Pond 2 (A2)	4.25	0.8
Anaerobic Pond 3 (A3)	4.25	0.8
Aerobic Pond 1 (A4)	1.85	0.0
Aerobic Pond 2 (A5)	3.0	0.0
Aerobic Pond 3 (A6)	1.50	0.0
Settling Pond (A7)	1.50	0.0
Primary Anaerobic Pond (B1)	4.50	0.8
Primary Anaerobic Pond (B2)	4.50	0.8
Secondary Anaerobic Pond (B3)	4.50	0.8
Aerobic Pond 1 (B4)	1.85	0.0
Aerobic Pond 2 (B5)	3.0	0.0
Settling Pond (B6)	1.5	0.0

[14] Desludging Approvals from Department of Environment
[15] Description of Effluent Tertiary Plant
[16] 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 Environment[17], the only effluent parameter to be monitored is BOD of the final

[17] Melewar_Department of Environment Licence

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 12th August – 25th 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.

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 B.3, these are:

- Sample Point A: Wastewater entering the baseline anaerobic ponds at the inlet of Anaerobic Pond A1;
- Sample Point B: Wastewater exiting the baseline anaerobic ponds (a combined sample from the outlet of Anaerobic Pond 3 (A3) and Secondary Anaerobic Pond (B3); and
- Sample Point C: Wastewater exiting 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 $COD_{inflow} – COD_{outflow}$ and used to determine the COD removal efficiency for 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 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 96.64% and 72.19% respectively**.**

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

Parameter	Value	Description	Source
Operating Hours	5,744	Operating hours per year (hours/year)	Average based on Historical Mill Processing (July 2008 - Jun 2011)
FFB Production	384,000	Average processing rate of FFB per year(tonnes/year)	Melewar Palm Oil Mill Processing Capacity License by Malaysian Palm Oil Board (MPOB)
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

$Q_{ww,y}$	249,600	Volume of wastewater treated in baseline wastewater treatment system the year y (m^3/y)	Calculated as FFB x 0.65
$COD_{inflow,y}$	0.05536	COD of the wastewater entering the baseline wastewater system the year y ($tonnes/m^3$)	Measurement Campaign, Sample Point A
$COD_{outflow,y}$	0.00186	Chemical Oxygen Demand of the wastewater leaving the baseline wastewater system the year y($tonnes/m^3$)	Measurement Campaign, Sample Point B
$COD_{ww,discharge,BL,y}$	0.00052	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. The total biomass boilers turbines and three units of back-up diesel engines have a total capacity of 4,037 kW[18].

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 diesel[19] will be calculated and added as revenue stream in project financial analysis. The amount of potential saving is increased proportionately 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 05/08/2011[20]. 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 its intention to seek CDM status on 21/10/11[21]. Acknowledgement was received from UNFCCC secretariat on 21/10/11[22] and the Host Party DNA on 15/11/2011[23].

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	05/08/2011
ERPA signed between Perenia & Melewar Properties Sdn Bhd	18/10/2011
Prior consideration notification posted on UNFCCC website	21/10/2011

[18] Energy Commission License No. SSD 317/2011 & Boiler and Diesel Generator Approvals
[19] Diesel Consumption Data from July 2010 – Jun 2011
[20] "Letter of Acceptance of Offer" with Watermech Engineering Sdn. Bhd
[21] Prior Consideration Form
[22] Notification of Receipt by UNFCCC
[23] Notification of Receipt by Malaysian DNA

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	09/11/2011
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.

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 CO_2 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.

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 -11.7%. 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	17,002,050	RM	Board approving development of the proposed project activity as a CDM project[24].
Operation and maintenance expenses	895,682	RM/year	MOM - Operational Cost & MOM - Life Span and Maintenance Cost
Diesel Consumption Displaced	442,817	liter	Diesel Consumption Data from July 2010 – Jun 2011 * 150%[25]
Diesel Unit Cost	2.815	RM/liter	Diesel Purchased Price from July 2010 – Jun 2011[26]. The diesel purchase price was highest in May 2011[27].
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

The IRR has been calculated based on the expected 15 years operating life of the anaerobic digester which is the most significant capital item[28]. 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 devalued[29], as the investment period is equal to the technical lifetime of the equipment.

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 mill[30].

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

Scenario	Change at Which Scenario Hits Benchmark	Percentage Change at Which Scenario	Likelihood of Occurring

[24] Board approving development of the proposed project activity as a CDM project
[25] Diesel Consumption Data from July 2010 – Jun 2011. From July 2010 – Jun 2011, Diesel Consumption = 295,211 l/y & FFB Processed = 326,694 t/y. FFB Processed Estimated for project activity = 384,000 t/y, thus 50% increase in diesel consumption assumed.
[26] Diesel Purchased Price from July 2010 – Jun 2011
[27] Diesel Purchase Invoices
[28] Watermech Engineering Sdn. Bhd; Life Span, Operation & Maintenance Cost of Equipment
[29] 2008 Malaysian Tax and Business Booklet (Page 22)
[30] Melewar FM - Biogas to Boiler

		Hits Benchmark	
Project capital costs	Project Cost reduced from MYR 17.002 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 [31]. 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 0.896 million annually to MYR 0	- 100%	The operational costs primarily based on estimated operation cost and plant maintenance cost provided by technologist [32]. Even if the total cost is reduced to zero, it is unlikely that project will hit the benchmark as the calculated IRR is – 3.7%.
Diesel Cost	Diesel cost increase over the years from RM 2.815 to RM 8.56	204%	It is extremely unlikely that the cost of diesel purchase price will increase by 204% 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 540	575%	It is extremely unlikely that the cost of PKS purchase price will increase by 575% 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 (investment barrier). Therefore, the project activity is additional.

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

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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

[31] Proposal received from Watermech Engineering Sdn. Bhd

[32] Watermech Engineering Sdn. Bhd; Life Span, Operation & Maintenance Cost of Equipment

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_2e)
$BE_{power,y}$	Baseline emissions from electricity or fuel consumption in year y (tCO_2e)
$BE_{ww,treatment,y}$	Baseline emissions of the wastewater treatment systems affected by the project activity in year y (tCO_2e)
$BE_{s,treatment,y}$	Baseline emissions of the sludge treatment systems affected by the project activity in year y (tCO_2e)
$BE_{ww,discharge,y}$	Baseline methane emissions from degradable organic carbon in treated wastewater discharged into sea/river/lake in year y (tCO_2e)
$BE_{s,final,y}$	Baseline methane emissions from anaerobic decay of the final sludge produced in year y (tCO_2e)

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

The treatment systems (anaerobic ponds, aerobic ponds, settling ponds, 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 baseline 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:

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

$Q_{ww,i,y}$	Volume of wastewater treated in baseline anaerobic wastewater treatment system *i* in year *y* (m^3). For *ex ante* estimation, forecasted wastewater generation volume or the designed capacity of the wastewater treatment facility can be used. However, the *ex post* emissions reduction calculation shall be based on the actual monitored volume of treated wastewater
$COD_{inflow,i,y}$	Chemical oxygen demand of the wastewater inflow to the baseline 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_{CH4}	Global Warming Potential for methane (value of 25)

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 estimates 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. This is described in detail in section B.4 above.

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. 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_2e)
$PE_{power,y}$	Emissions from electricity or fuel consumption in the year y (tCO_2e). 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_2e). 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_2e).
$PE_{ww,discharge,y}$	Methane emissions from degradable organic carbon in treated wastewater in year y (tCO_2e).
$PE_{s,final,y}$	Methane emissions from anaerobic decay of the final sludge produced in year *y* (tCO_2e).
$PE_{fugitive,y}$	Methane emissions from biogas release in capture systems in year y (tCO_2e).
$PE_{biomass,y}$	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_2e).
$PE_{flaring,y}$	Methane emissions due to incomplete flaring in year *y* as per the "Tool to determine project emissions from flaring gases containing methane"(tCO_2e). 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 the 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 '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:

Parameter	Units	Value	Source
Total Electricity generated by biomass turbine from Jan 2010 – Dec 2010	kWh/y	7,652,172	Historical Generation Data Jan 2010 – Dec 2010 (a)
Total Electricity generated by diesel engine from Jan 2010 – Dec 2010	kWh/y	980,262	Historical Generation Data Jan 2010 – Dec 2010 (b)
% of Electricity Supply by Biomass Boiler	%	88.64	Calculated (a /(a+b))
% of Electricity Supply by Diesel Engines	%	11.36	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	0.15	Calculated (0.1136 * 1.3 tCO_2/MWh)

Parameter	Units	Value	Source
Auxiliary power consumption for project activity operation	kW	289	Auxiliary Power Information[33]
Total project emission	**tCO_2/y**	**373**	0.288 MW * 8,760 h/y x 0.15 tCO_2/MWh

The calculated % of project emission from fossil fuel consumption at project activity is lesser than 1% of emissions reduction (53,232 tCO_2/y) under an unlikely scenario.

Thus, CO_2 emissions from the combustion of fossil fuels is estimated as negligible (< 1%) and not accounted for as project emissions.

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.
$\eta_{,PJ,k}$	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 ($\eta_{,PJ,aerobic}$)
$MCF_{ww,treatment,PJ,k}$	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 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 for 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.

[33] Auxiliary Power Consumption by Watermech Sdn. Bhd.

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 applied 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:

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

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/m^3)
$MCF_{ww,treatment,PJ,k}$	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)

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

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 ($PE_{flare,y}$)

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, EB 28).

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;

$$PE_{flare} = \sum_{h=1}^{8760} TM_{RG,h} * (1-\eta_{flare,h}) * (GWP_{CH4}/1000) \quad (8)$$

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 flare.

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:

$$ER_{y,ex\ ante} = BE_{y,ex\ ante} - (PE_{y,ex\ ante} + LE_{y,ex\ ante}) \quad (9)$$

Where:

$ER_{y,ex\ ante}$	Ex ante emission reduction in year y (tCO_2e)
$LE_{y,ex\ ante}$	Ex ante leakage emissions in year y (tCO_2e)
$PE_{y,ex\ ante}$	Ex ante project emissions in year y calculated as per formula 8 (tCO_2e)
$BE_{y,ex\ ante}$	Ex ante baseline emissions in year *y* calculated as per formula 1 (tCO_2e)

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:

a) The amount of biogas recovered and fuelled or flared (MD_y) during the crediting period, that is monitored *ex post*;

b) *Ex post* calculated baseline, project and leakage emissions based on actual monitored data for the project activity.

$$\mathbf{ER_{y,ex\text{-}post} = min ((BE_{y,ex\text{-}post} - PE_{y,ex\text{-}post} - LE_{y,ex\text{-}post}), (MD_y - PE_{power,y} - PE_{biomass,y} - LE_{y,ex\text{-}post}))} \quad \textbf{(10)}$$

Where:

$ER_{y,ex\text{-}post}$	Emission reductions achieved by the project activity based on monitored values for year y (tCO_2e)
$BE_{y,ex\text{-}post}$	Baseline emissions calculated using ex post monitored values (tCO_2e)
$PE_{y,ex\text{-}post}$	Project emissions calculated using ex post monitored values (tCO_2e)
MD_y	Methane captured and destroyed/gainfully used by the project activity in year y (tCO_2e)

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:

$$\mathbf{MD_y = BG_{burnt,y} * w_{CH4,y} * D_{CH4} * FE * GWP_{CH4}} \quad \textbf{(11)}$$

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 destructed 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 2 m).
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 anaerobic treatment system, determined as per the paragraphs 26, 27 or 28 in AMS III.H
Source of data	Measurement campaign
Value(s) applied	97
Choice of data or measurement methods and procedures	Measurement campaign was undertaken in the baseline wastewater treatment system for 10 normal operation days from 12th August – 21st August 2011.
Purpose of data	Baseline emission calculation
Additional comment	-

Data/Parameter	$\eta_{COD,aerobic}$
Data unit	%
Description	COD removal efficiency of the baseline aerobic treatment system, determined as per the paragraphs 26, 27 or 28 in AMS III.H
Source of data	Measurement campaign
Value(s) applied	72
Choice of data or measurement methods and procedures	Measurement campaign was undertaken in the baseline wastewater treatment system for 10 normal operation days from 12th August – 21st August 2011.
Purpose of data	Project emission calculation
Additional comment	-

Data/Parameter	$B_{o,ww}$
Data unit	t CH_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	UF_{BL}
Data unit	-
Description	Model correction factor to account for model uncertainties
Source of data	AMS-III.H. default value
Value(s) applied	0.89
Choice of data or measurement methods and procedures	The default value as specified in AMS-III.H (Version 16; EB58) for the calculation of baseline emissions.
Purpose of data	Baseline 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	-

Data/Parameter	**$MCF_{ww,BL,discharge}$, $MCF_{ww,PJ,discharge}$**
Data unit	Factor
Description	Methane correction factor of baseline wastewater treatment system sent for plantation irrigation purpose 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 version 16.0
Purpose of data	Project emission calculation
Additional comment	Methane correction factor of baseline wastewater treatment system sent for plantation irrigation purpose

Data/Parameter	**GWP_{CH4}**
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	CEF_{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	-

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	**59,423**	Baseline emissions in year *y*	tCO_2e
$BE_{power,y}$	0	Baseline emissions from electricity or fuel consumption in year *y*	tCO_2e
$BE_{ww,treatment,y}$	59,423	Baseline emissions of the wastewater treatment systems affected by the project activity in year *y*	tCO_2e
$BE_{s,treatment,y}$	0	Baseline emissions of the sludge treatment systems affected by the project activity in year *y*	tCO_2e
$BE_{ww,discharge,y}$	0	Baseline methane emissions from degradable organic carbon in treated wastewater discharged to plantation for land irrigation in year *y*	tCO_2e
$BE_{s,final,y}$	0	Baseline methane emissions from anaerobic decay of the final sludge produced in year y (tCO_2e). If the sludge is controlled combusted, disposed in a landfill with biogas recovery, or used for	tCO_2e

		soil application in the baseline scenario, this term shall be neglected.	

(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**
$BE_{ww,treatment,y}$	**59,423**	Baseline emissions of the wastewater treatment systems affected by the project activity in year y	tCO_2e
$Q_{ww,y}$	249,600	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
$COD_{inflow,y}$	0.05536	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
$\eta_{COD,BL}$	0.97	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 (second commitment period[35])	

Baseline Emission for aerobic wastewater 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.

[35] According to EB69 -Annex3, the second commitment period GWP of 25 tCO_2/ t CH_4 shall be effective from 01/01/2013.

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	**6,191**	Project activity emissions in the year y	tCO_2e
$PE_{power,y}$	0	Emissions from electricity or fuel consumption in the year y	tCO_2e
$PE_{ww,treatment,y}$	0	Methane Emissions from wastewater treatment systems affected by the project activity, and not equipped with biogas recovery, in year y	tCO_2e
$PE_{s,treatment,y}$	0	Methane emissions from sludge treatment systems affected by the project activity and not equipped with biogas recovery in year y	tCO_2e
$PE_{ww,discharge,y}$	0	Methane emissions from degradable organic carbon in treated wastewater in year y	tCO_2e
$PE_{s,final,y}$	0	Methane emissions from anaerobic decay of the final sludge produced in year y	tCO_2e
$PE_{fugitive,y}$	6,191	Methane emissions from biogas release in capture systems in year y	tCO_2e
$PE_{flaring,y}$	0	Methane emission due to incomplete flaring in year y	tCO_2e
$PE_{biomass,y}$	0	Methane emission from biomass stored under anaerobic conditions	tCO_2e

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**
$PE_{fugitive,y}$	**6,191**	Methane emissions from biogas release in capture system in year y	tCO_2e
$PE_{fugitive,ww,y}$	6,191	Fugitive emissions through capture inefficiencies in the anaerobic wastewater treatment system year y	tCO_2e

$PE_{fugitive,s,y}$	0	Fugitive emissions through capture inefficiencies in the sludge treatment in year y	tCO_2e

Where:

$PE_{fugitive,ww,y} = (1 - CFE_{ww}) * MEP_{ww,treatment,y} * GWP_{CH4}$			
Parameter	**Value**	**Description**	**Unit**
$PE_{fugitive,ww,y}$	6,191	Fugitive emissions through capture inefficiencies in the anaerobic wastewater treatment system year y	tCO_2e
CFE_{ww}	0.9	Capture efficiency of the biogas recovery equipment in the wastewater treatment systems	Default Value
$MEP_{ww,treatment,y}$	2,476	Methane emission potential of the wastewater treatment system equipped with biogas recovery system in year y	t
GWP_{CH4}	25	Global Warming Potential of methane	tCO_2e/tCH_4

Where:

$MEP_{ww,treatment,y} = Q_{ww,y} * B_{o,ww} * UF_{PJ} * \sum_k COD_{removed,PJ} * MCF_{ww,treatment,PJ,k}$			
Parameter	**Value**	**Description**	**Unit**
$MEP_{ww,treatment,y}$	2,476	Methane emission potential of the wastewater treatment system equipped with biogas recovery system in year *y*	tCH_4/y
$Q_{ww,y}$	249,600	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	
$COD_{removed,PJ}$	0.04429	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 ($PE_{flaring,y}$)

As described in Section B.6.1, $\mathbf{PE}_{flare}$ = 0.

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**

$ER_{y,ex\ ante}$	**53,232**	Ex ante emission reduction in year y	tCO_2e
$LE_{y,ex\ ante}$	0	Ex ante leakage emissions in year y	tCO_2e
$PE_{y,ex\ ante}$	6,191	Ex ante project emissions in year y calculated as per equation 8	tCO_2e
$BE_{y,ex\ ante}$	59,423	Ex ante baseline emissions in year y calculated as per equation 1	tCO_2e

Where:

Baseline Emissions

$BE_y = BE_{power,y} + BE_{ww,treatment,y} + BE_{s,treatment,y} + BE_{ww,discharge,y} + BE_{s,final,y}$
$= 0 + 59{,}423 + 0 + 0 + 0$
$= 59{,}423\ tCO_2e/yr$

Project Emissions

$PE_y = PE_{power,y} + PE_{ww,treatment,y} + PE_{s,treatment,y} + PE_{ww,discharge,y} + PE_{s,final,y} + PE_{fugitive,y} + PE_{biomass,y} + PE_{flaring,y}$
$PE_y = 0 + 0 + 0 + 0 + 0 + 6{,}191 + 0 + 0$
$= 6{,}191\ tCO_2e/yr$

Leakages

LE_y = **$0\ tCO_2e/yr$**

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

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
2016[36]	31,010	3,231	0	27,780
2017	59,423	6,191	0	53,232
2018	59,423	6,191	0	53,232
2019	59,423	6,191	0	53,232
2020	59,423	6,191	0	53,232
2021	59,423	6,191	0	53,232
2022	59,423	6,191	0	53,232
2023	59,423	6,191	0	53,232
2024	59,423	6,191	0	53,232
2025	59,423	6,191	0	53,232
2026[37]	28,413	2,960	0	25,452
Total	594,230	61,910	0	532,320
Total number of crediting years	10			
Annual average over the crediting period	**59,423**	**6,191**	**0**	**53,232**

[36] The crediting period of the project activity starts from 24/06/2016 to 23/06/2026. For year 2016, the period starts from 24/06/2016 to 31/12/2016 which is 191 days, out of 365 days. The baseline estimation has been applied with 191/366, please see following calculation; 59,423 * 193/366 = 31,420. The same has been applied to project emission value and the emission reduction.
[37] The 2026 estimation is based on different of annual estimation with the value in 2016.

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	20,800 (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 249,600 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	0.05536
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	0.00308
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	4,788,499
Measurement methods and procedures	Calculated as the sum of $BG_{fuelled,y}$ and $BG_{flared,y}$
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	4,788,499
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/Parameter	$w_{CH4,y}$
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/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 ºC 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	N/A
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: • 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	Baseline and Project emission calculation
Additional comment	-

Data/Parameter	$S_{final,PJ,y}$
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 and will not be stored for longer periods to ensure that it is under aerobic conditions. Records of when sludge is removed, where the sludge is applied and its application to ensure aerobic condition will be kept.
Monitoring frequency	Whenever sludge is removed
QA/QC procedures	-
Purpose of data	N/A
Additional comment	In any event of removal of sludge and soil application, the process will be monitored to ensure the conditions are aerobic.

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

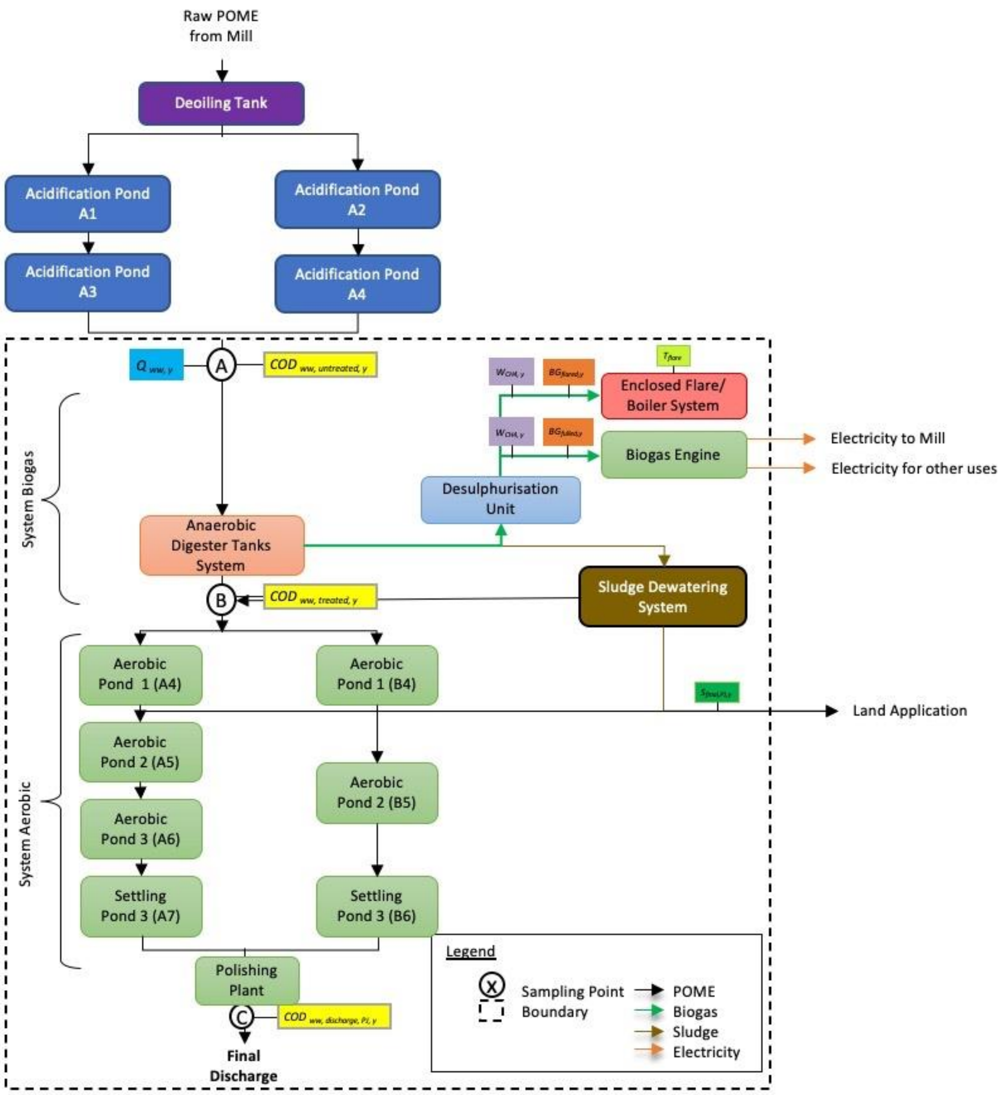
Position	Outline of Responsibilities	Reporting
Mill Manager/ Assistant Mill Manager	• Reviews the monthly reports and investigates any irregularities. • Ensures on-going compliance with the CDM monitoring plan. • Supervises meter calibration requirements	Management Team

Administration Officer	• 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)	• 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	• 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

Monitoring

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

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.

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 outlines 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

>> 05/08/2011[38]

C.2. Expected operational lifetime of project activity

>> 15 years[39]

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

>> 24/06/2016

[38] "Letter of Acceptance of Offer" with Watermech Engineering Sdn. Bhd.
[39] Watermech Engineering Sdn. Bhd; Life Span, Operation & Maintenance Cost of Equipment (15/12/2011)

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 24/06/2016.

C.3.3. Duration of crediting period

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

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>> There is no requirement under Malaysia law[41] 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 9th November 2011 at De Leon, in Lahad Datu Malaysia.

Stakeholders were invited by local newspaper advertisement; in Utusan Borneo & Daily Express from 25th – 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

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[41] Environmental Quality (Prescribed) (Crude Palm Oil) Regulations 1977

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. Fifty-one (51) participants attended the meeting[42].

E.2. Summary of comments received

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

NO	QUESTIONER	QUESTION	ANSWER
1.	P H Tan (Peace Industries)	How safe is the biogas system?	It is a safe & quiet operation. Safety devices such as flare arrestor and vacuum condition will overcome any unwarranted events. The biogas transfer pipes are installed in elevated position so that in the event of leakages, the gas leakage will disperse to atmosphere. Pressure of gas supplied to gas engine is also always maintained a positive pressure. There will not be any probability of explosion as the tanks will not be exposed to any oxygen. Explosion is only like to happen with 20 – 25% of oxygen mixture.
2.	Kee Beng Hwa (KBQ Engineering)	In the event of explosion, how far does it affect?	The explosion is only on the top of tank with sound of “pop” and burns itself. It will not affect any other nearby equipment. We had never experienced such in the past. However, we did come across some unwarranted incidents faced by others using different technology. The incidents happen mainly while completing the project or maintenance works e.g. welding works. The operators deliberately conducted the “fire related” work in partially open tanks without realizing that in oxygen presence, mixture with methane and ignition will cause explosion. The correct way to carry out any work related to anaerobic digester system is to purge the excess methane with nitrogen.
3.	Ronny Ng (Yuletele)	How efficient is the biogas generator compared to diesel generator? Will the biogas engine function if the mill is not in operation?	The biogas production is dependent of continuous POME feed to anaerobic digester system. The digesters and gas holding tanks are designed to store additional biogas produced for future use or during mill non-operation hours. In terms of efficiency, generators could have same efficiency, however this is subjective, dependable the equipment make, designed efficiency etc. However, the diesel can be consumed directly but biogas will need to go through “treatment” to remove the hydrogen sulphide content as it will corrode the biogas engines.
4.	Mong Yah Chiun (PW Biotech)	Can you explain if among the 1.5 million CERs issued in Malaysia originated from Palm Oil Mills? And how many of total 500 mills in Malaysia has been issued by CERs up to date?	The biggest portion of CER claim from Malaysia comes from Lafarge (Replacement of Fossil Fuel by Palm Kernel Shell Biomass in the production of Portland Cement) with an issuance of 0.5 million CERs to date. Few major biomass power generation projects also generate high volume of CERs by utilizing Empty Fruit Bunches as combustion fuel. Overall approximately 15 mills have been issued CERs for either biomass power generation or methane avoidance from generated wastewater. Many others are in the pipeline of CER claim. To conclude, most of the CERs issued in Malaysia are originated from palm oil related wastes.

[42] Refer to Stakeholder Meeting Report

NO	QUESTIONER	QUESTION	ANSWER
5.	Ronny Ng (Yuletele)	Please elaborate what CER represents? Is it a monetary term?	CER represents Certified Emission Reduction. It represents an equivalent of displaced 1 ton carbon dioxide. The CER price varies, depending on the time frame the negotiation of CER takes place. An upfront agreement would give approximately USD 10 per CER but the price at actual current market can be fluctuating at much higher prices.

E.3. Consideration of comments received

>> All comments were addressed by project technologist and mill management team 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.

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

Appendix 1. Contact information of project participants

Organization name	Melewar Properties Sdn. Bhd. (Project Owner)
Country	Malaysia
Address	Unit 30-02, Level 30, Menara Landmark, No. 12 Jalan Ngee Heng, (Mail Box No. 288), Johor Bahru city, Johor state, Malaysia, 80000
Telephone	07-2231633; mobile: +6019 725 2818
Fax	07-2241546
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

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 of the PDD

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

Please see ex-ante calculation file submitted during validation.

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 24/06/2016 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 24/06/2016.

By considering the actual COD of the project activity, the proposed change of the start date of crediting period is more than two year. This is in line with paragraph 236 of CDM project standard for project activities (CDM-EB93-A04-STAN). As per paragraph 236 of CDM-EB93-A04-STAN, the impact of the actual change to the registered project activity is justified below.

Impact of change	Justification
a) Demonstrate that the project activity remains additional;	The change in the start date of the crediting period has no impact to the additionality of the project activity. 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 October 2012 as per the project work timeline[43]. The construction delay was due to the monsoon season and technical problems while installing the biogas system. The project proponent has not invested on any additional equipment nor capacity or anything that would have resulted to additional revenue sources other than CDM. Therefore, this change has no impact to the additionality of the project.
b) Demonstrate that the original baseline scenario established in the registered PDD remains valid, or update the baseline scenario using the latest data, as appropriate;	The baseline scenario of the project complies with all applicable eligibility requirements of the methodology; AMS-III.H (version 16; EB 58). There is no change in the baseline scenario. In the absence of project, the existing baseline system comprised of anaerobic open ponds deeper than 2 meters which had no biogas recovery. The project is located at the same location; in Sandakan, Malaysia, which the temperature is consistently above 15ºC. While the desludging of accumulated solids in the anaerobic ponds in the baseline treatment system has more than 30 days of interval.
c) Demonstrate that substantive progress has been made by the project participants to start the project activity	According to the project timeline, the surveying works was started in October 2011, following with earthworks in July 2013. With the longer monsoon season beginning in July 2013, this climate situation delayed the construction and relevant work process. The commissioning test at the project activity was conducted in November 2015. Later on, the successful commissioning and hand over of the project activity from the technology provider; Watermech Eng Sdn Bhd., was on 24/06/2016. 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 evidence for this matter.

[43] Project work timeline prepared by the project proponent

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

Update GWP of methane from 21 to 25

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.

3) Change to project design

The composting plant and biogas utilization have been excluded from the project boundary. The reason for change is to avoid complexity and future confusion. Since the end use sludge will be utilized for soil application. The emission from the final sludge are to be neglected.

This actual change in the project is relevant to the change to project design as removal of a component specified in the registered PDD. This is in line with paragraph 241 (d) of CDM project standard for project activities (CDM-EB93-A04-STAN). As per paragraph 242 of CDM-EB93-A04-STAN, the impact of the actual change to the registered project activity is justified below.

Impact of change	Justification
(a) The applicability and application of the applied methodologies, the applied standardized baselines and the other applied methodological regulatory documents with which the project activity has been registered;	The existing system comprises anaerobic open ponds, which does not have biogas recovery which complies with option (f) of the applicability criteria. The proposed project activity still involves the installation of a new covered anaerobic digester tank system equipped with methane capture and collection system without sludge treatment. to replace existing open anaerobic ponds. Methane captured from the anaerobic digester system will be transferred to a biogas engine system for electricity generation. The proposed project activity has also generated 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 to avoid any future confusion. Hence removal of the composting plant and the biogas utilization from the project boundary has no impact on the applicability of the methodology and baseline situation.
(b) The compliance of the monitoring plan with the applied methodologies, the applied standardized baselines and the other applied methodological regulatory documents;	There is no change to the monitoring plan of the project activity. Though end use of sludge application will be monitored to ensure aerobic and well managed condition is maintained.
(c) The level of accuracy and completeness in the monitoring of the project activity compared with the requirements contained in the registered monitoring plan;	Removal of the composting plant and biogas utilization from the project diagram will not have any impact on the registered monitoring plan. As there is no monitored parameter involved with the project activity.
(d) The additionality of the project activity;	There is no impact on the additionality of the project. As nothing have been invested/ reinvested or removed from the project activity.
(e) The scale of the project activity.	The proposed project activity is still eligible under the small scale as registered PDD. There is no change in scale of the project activity.

Conclusion:

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

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Document information

Version	*Date*	*Description*
11.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN); • Make editorial improvements.
10.1	28 June 2017	Revision to make editorial improvement.
10.0	7 June 2017	Revision to: • Improve consistency with the “CDM project standard for project activities” and with the PoA-DD and CPA-DD forms; • Make editorial improvement.
09.0	24 May 2017	Revision to: • Ensure consistency with the “CDM project standard for project activities” (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the “Project design document form for small-scale CDM project activities” (CDM-SSC-PDD-FORM); • Make editorial improvement.
08.0	22 July 2016	EB 90, Annex 1 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the “Standard: Applicability of sectoral scopes” (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revision to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Make editorial improvement.

Version	*Date*	*Description*
05.0	25 June 2014	Revision to: • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from F-CDM-PDD to CDM-PDD-FORM; • Make editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

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