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

CONTENTS

Revision history of this document

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

SECTION A. General description of small-scale project activity

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

Title : Methane Capture and Utilization Project at Carotino Palm Oil Mill, Malaysia
Version : 02.3
Date : 27/07/2012

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

The "Methane Capture and Utilization Project at Carotino Palm Oil Mill", Malaysia ("the project activity") will be implemented at the Carotino Palm Oil Mill ("the mill") located in Sri Jaya, Maran, Pahang in Peninsular Malaysia. The proposed project activity is being implemented by Carotino Sdn Bhd ("the project 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 144,000 tons[2] of FFB in the year 2011, which increases to approximately 216,000 tons of FFB per year in year 2013 onwards. Each tonne of FFB processed results in approximately 0.65 m^3 of POME produced[3].

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

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

An enclosed flare system and/or biogas burner will be installed at boiler system to combust excess biogas generated from project activity. However, the scope of biogas utilisation will not be included as type I renewable energy project.. Implementation of the proposed project will result in an estimated reduction of emissions of 27,394 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;

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[1] Carotino Business Registration Form

[2] Palm Oil Mill Board (MPOB) Processing Capacity License_ Carotino

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

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

2. *Environmental:* Conserve and minimise the impact on the environment. The project activity reduces GHG emissions through the avoidance of methane emissions from the existing open ponds directly to the atmosphere and improves the quality of wastewater discharged to the public waterways;

3. *Economic:* Enhance the national economic development through the use of technology. The project promotes and disseminates the successful application and integration of renewable energy technology for replication across Malaysia.

4. *Social:* Improve the quality of life for all. The project activity contributes to increase the stability and security of the local power supply which will in turn support an improved living standard.

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.3. Project participants:

Name of Party involved (*) ((host) indicates a host Party)	**Private and/or public entity(ies) project participants (*) (as applicable)**	**Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)**
Malaysia (host)	Carotino Sdn Bhd (Private)	No
Australia	Perenia Pty Ltd (Private)	No

Contact information on the above participants is provided in Annex I.

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

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

[7] Carotino company documents (Form 13 & Form 24)

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

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

A.4.1.1. Host Party(ies):

Malaysia

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

Pahang

A.4.1.3. City/Town/Community etc:

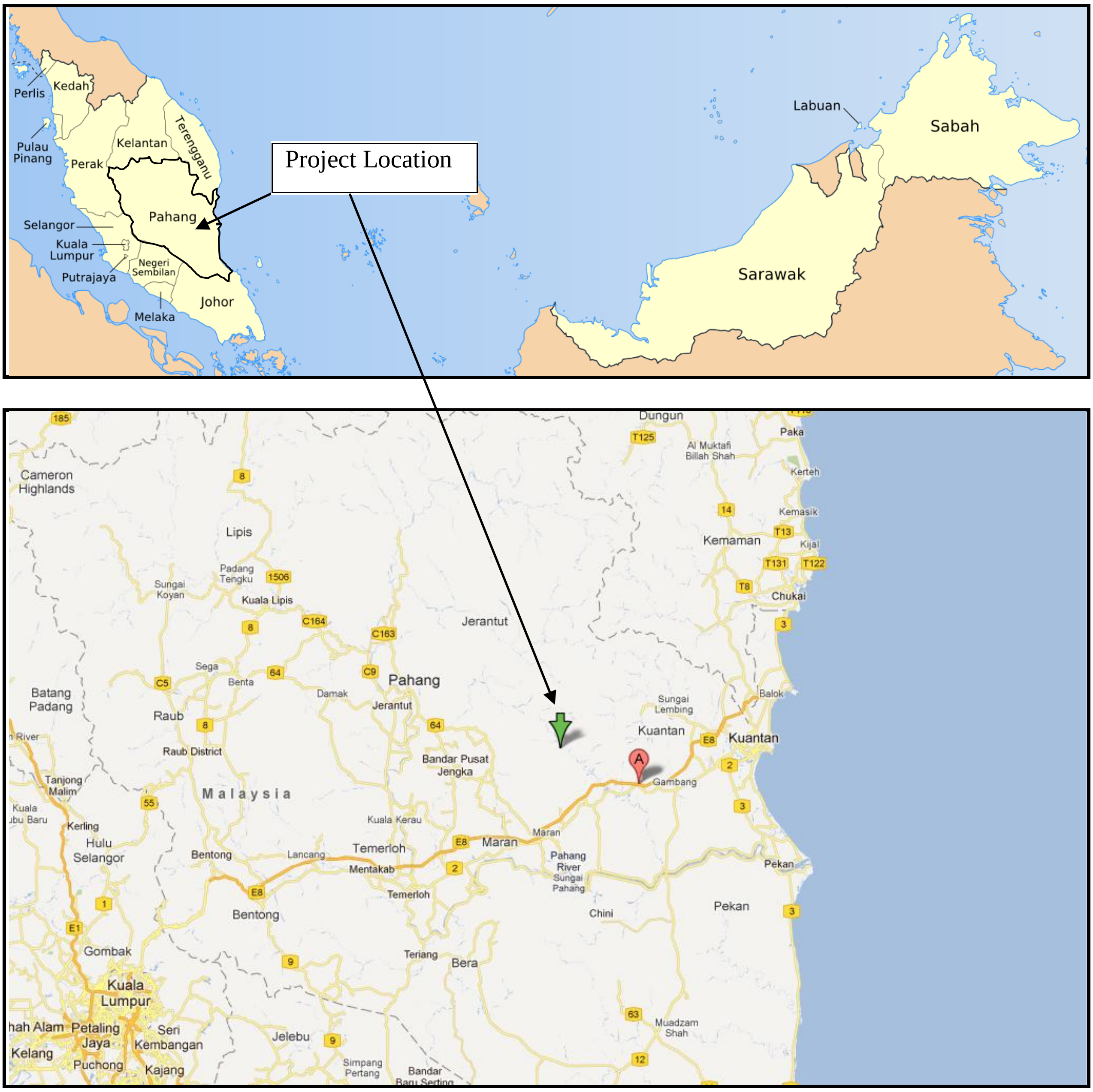
Maran, Sri Jaya

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

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

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

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



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

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

In accordance with Appendix B of the simplified modalities and procedures for small-scale CDM project activities ("SSC M&P"), the proposed project activity falls under the following types and categories.
The primary purpose of the proposed project activity is the capture of biogas from wastewater treatment. Therefore, the applicable methodology is AMS-III.H, Methane Recovery in Wastewater Treatment. The relevant type and category is shown below.

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

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

(2) Technology of the small-scale project activity

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

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

The generated biogas will be channelled through a desulphurisation plant before being transferred to biogas engine system[8].

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

Figure A.2 illustrates the overall treatment process in details.

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

Figure A.2: Process Flow diagram of Project Activity

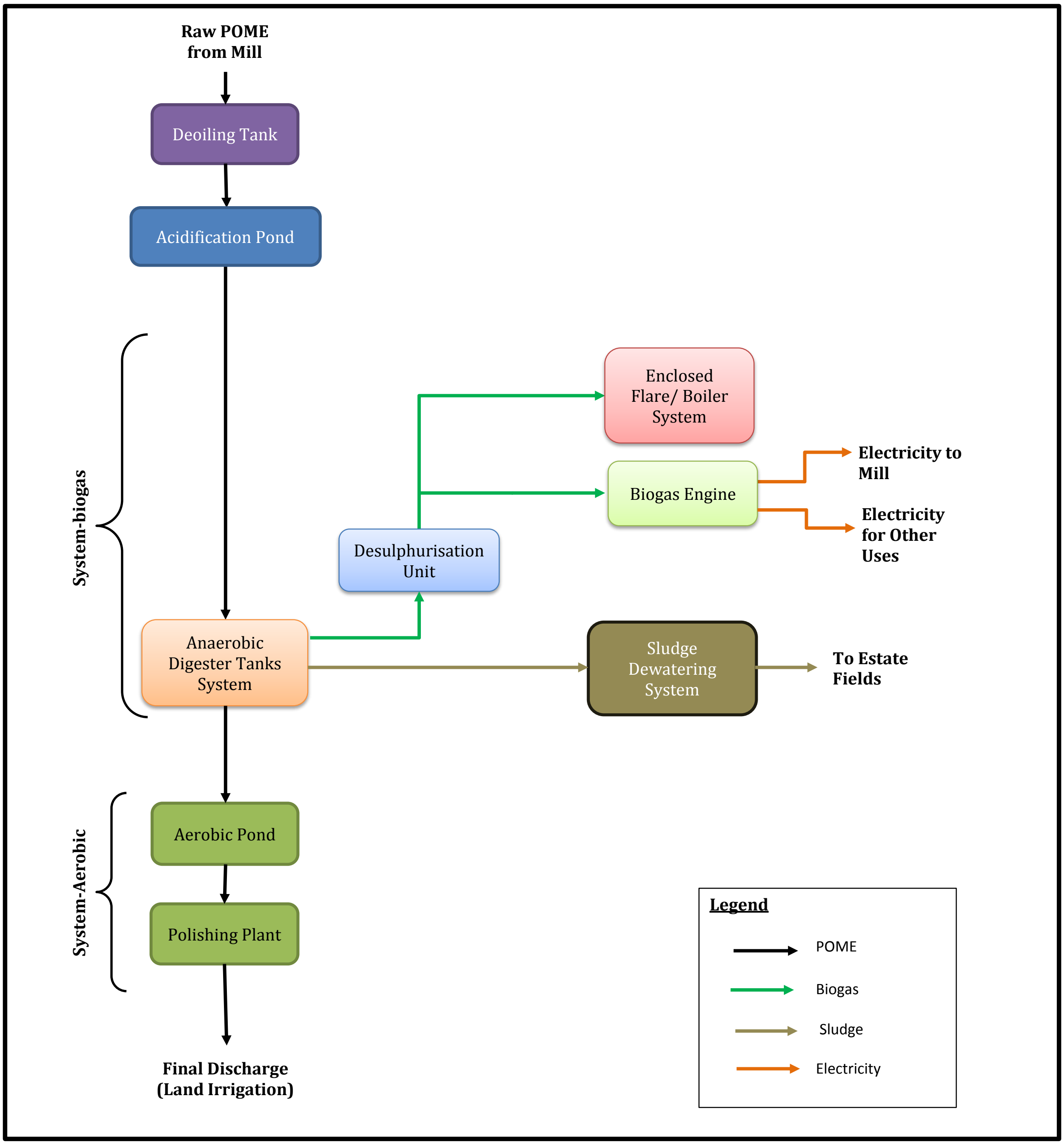


Table A.1.: Proposed Design Characteristics System

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

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

Year	Estimation of total annual emission reductions from the project in tCO_2e
2013	27,394
2014	27,394
2015	27,394
2016	27,394
2017	27,394
2018	27,394
2019	27,394
2020	27,394
2021	27,394
2022	27,394
Total estimated reductions (tCO_2e)	**273,940**
Total number of crediting years	10
Annual average of the estimated reductions over the crediting period (tCO_2e)	27,394

 # Year 1 of crediting period starts on the date specified in section C.2.1.1., and corresponds to a period of 12 months.

A.4.4. Public funding of the small-scale 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.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

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

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

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 a baseline and monitoring methodology

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

The 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 Justification of the choice of the project category:

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

Table B.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,	a) The anaerobic open ponds are all deeper than 2 meters[10], without aeration. b) The average temperature in Malaysia is consistently above 15°C[11]. c) The desludging of accumulated

[10] Effluent Treatment Plant Drawing

[11] Malaysia average temperature is 27.5 °C (82 °F). http://www.climatetemp.info/malaysia

#	Applicability conditions	Project Scenario
	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.	solids in the anaerobic ponds in the baseline treatment system has more than 30 days of interval[12].
3	The recovered biogas from the above measures may also be utilised for the following applications instead of combustion/flaring: (a) Thermal or electrical energy generation directly	The proposed project activity includes the utilisation of the recovered biogas to generate electricity for its auxiliary consumption. Therefore the proposed project activity is in compliance with option (a).
4	If the recovered biogas is used for project activities covered under paragraph 3(a), that component of the proposed project activity can use a corresponding methodology under type I.	The recovered biogas is used to generate electricity for its auxiliary consumption. No emission reductions will be claimed from generation of renewable energy, thus methodologies under type I are not applied.
13	The location of the wastewater treatment plant shall be uniquely defined as well as the source generating the wastewater and described in the PDD.	The location of the wastewater treatment plant is uniquely defined in Section A.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 27,394 tCO_2e per annum as demonstrated in Section B.6.3 which is lower than the 60,000 tCO_2e threshold.

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.

[12] Desludging Approvals from Department of Environment

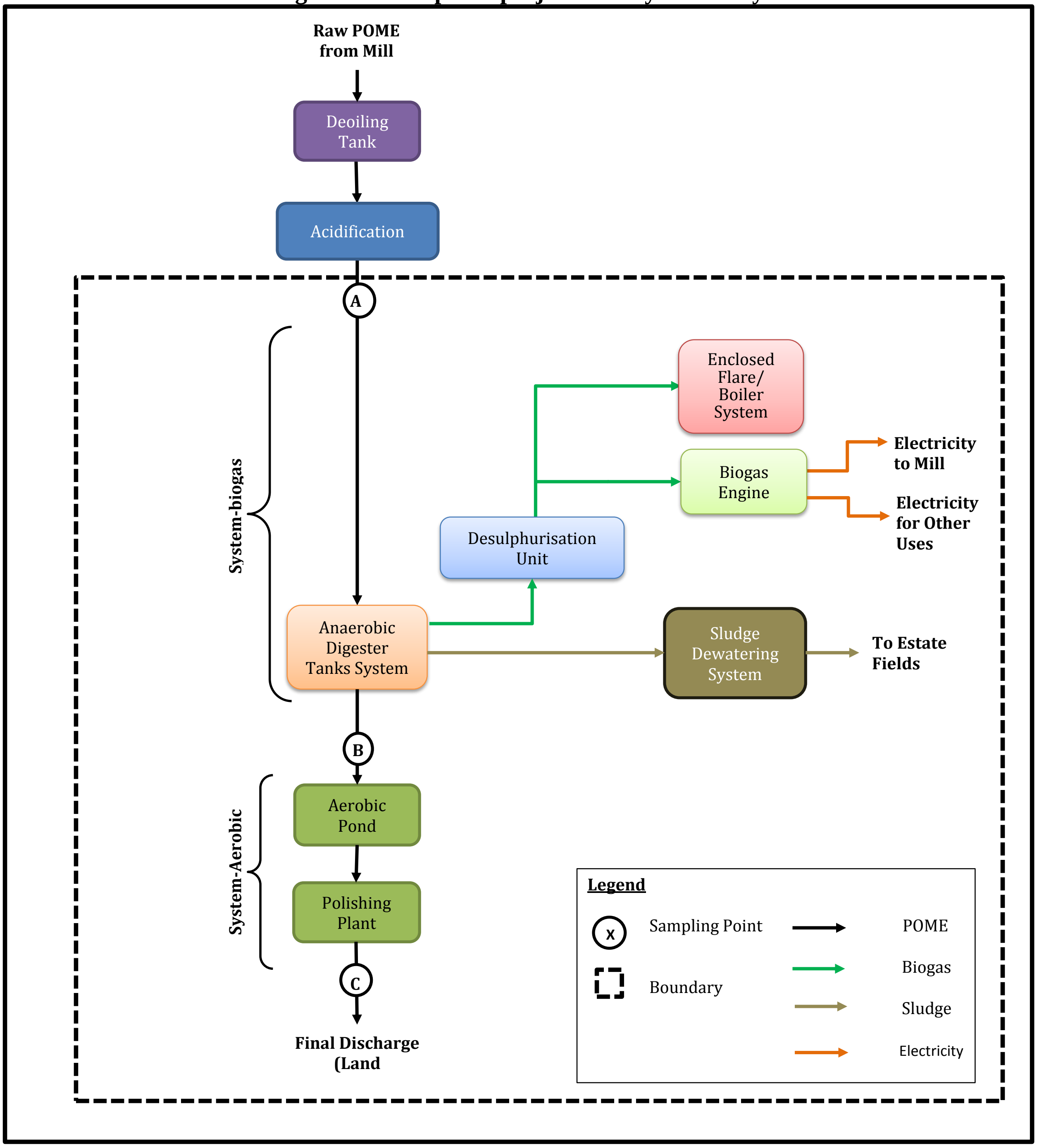
B.3. Description of the project boundary:

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

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

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

Figure B.2: Proposed project activity boundary



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

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

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

The treatment system affected by the project activity is categorized as System-Biogas & System-Aerobic (Figure B.2).

The inflow COD into System-Biogas in project activity is the same as in baseline System- Anaerobic (Figure B.3). However the COD removal efficiency differs in the baseline scenario and project activity. COD removal efficiency using anaerobic ponds in baseline scenario is 99% and the COD removal efficiency in project activity using new anaerobic digesters is 80%. Thus, the COD loading to System-aerobic from project activity will be relatively higher than baseline scenario.

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

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

B.4. Description of baseline and its development:

Baseline Wastewater Treatment Plant

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

In the baseline scenario, POME is treated in a sequential anaerobic and aerobic wastewater treatment system without biogas recovery system. From acidification pond 1 & 2, POME enters a series of anaerobic open ponds; primary anaerobic pond 1A, secondary anaerobic pond and secondary anaerobic pond 1B. Then it flows to an aerobic treatment system encompassing aerobic pond and effluent polishing plant before discharged for land irrigation. Sludge accumulated in the ponds will be desludged periodically to avoid siltation problems[13].

The methane correction factor (MCF) of baseline ponds are determined based on MCF values stated in table III.H.1, AMS IIIH (Version 16, EB 58). Based on Figure B.3, primary anaerobic pond 1A, secondary anaerobic pond and secondary anaerobic pond 1B has depth of more than two (2) metres, thus a methane correction factor of 0.8 for anaerobic deep has been applied. However, aerobic pond with depth of 2.65 m is equipped with diffusers for aeration purpose. Thus, the aerobic pond and effluent polishing plant are aerobically well managed[14]and a methane correction factor of zero has been applied.

Table B.3: Baseline open ponds[15]

Type of Ponds	Pond Depth (m)	MCF factor used as per AMS-III.H ver16
Primary Anaerobic Pond 1A	4.38 m	0.8

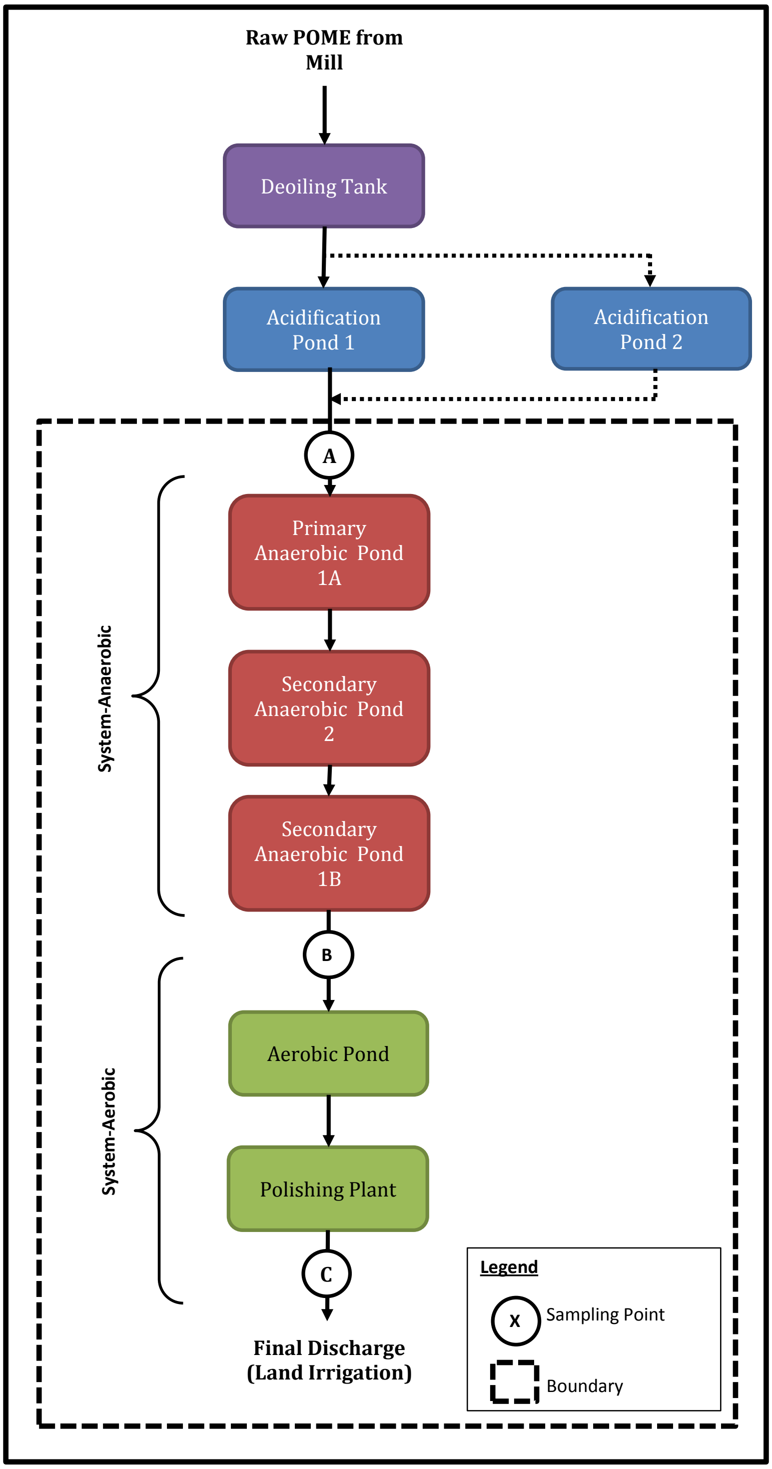
[13] Desludging Approvals from Department of Environment

[14] Description of Effluent Tertiary Plant

[15] Effluent Treatment Plant Drawing

Secondary Anaerobic Pond 2	4.42 m	0.8
Secondary Anaerobic Pond 1B	4.20 m	0.8
Aerobic Pond	2.65 m	0.0

Figure B.3: 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[16], the only effluent parameter to be monitored is BOD of the final discharge. Thus, the mill did not monitor effluent COD in the past and could not provide any data for validation purpose.

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

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

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

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

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

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

[16] Carotino_Department of Environment Licence

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

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

The power supply to the existing wastewater treatment system is supplied mainly by mill’s biomass boiler, operated using mesorcarp fibre and/or palm kernel shell. Diesel generators are used during start-up, shut down or emergencies. There are two units of biomass boilers with turbine capacity of 640 kW and 1,000 kW. The two units back-up diesel engines has a capacity of 200 kW each[17].

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[18] will be calculated and added as revenue stream in project financial analysis. The amount of potential saving is increased conservatively to the mill’s capacity expansion.

[17] Approval Licence for Turbine and Gen-set Capacity

[18] Diesel Consumption Data from July 2010 – Jun 2011

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

Prior Consideration of the CDM

The start date of the project activity as defined in the *CDM Glossary of Terms* is 09/08/2011[19]. 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[20]. Acknowledgement was received from UNFCCC secretariat on 21/10/11[21] and the Host Party DNA on 15/11/2011[22].

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

Table B.5: Chronology of events and documents

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

Demonstration and assessment of additionality

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

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

[20] Prior Consideration Form

[21] Notification of Receipt by UNFCCC

[22] Notification of Receipt by Malaysian DNA

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 negative 13.4%. The complete financial model (provided with the PDD) includes justification of all of the parameters used and assumptions made.

Table B.6: Key Financial Inputs

Assumption	Value	Unit	Source
Project life	15	years	Watermech Engineering Sdn. Bhd; Life Span, Operation & Maintenance Cost of Equipment
Total Capital Expenditure	13,913,790	RM	Board approving development of the proposed project activity as a CDM project[23]
Operation and	744,295	RM/year	COM Operation & Maintenance Expenses &

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

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

The IRR has been calculated based on the expected 15 years operating life of the anaerobic digester which is the most significant capital item[27] . 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[28], 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.

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

[25] Diesel Purchase Price Summary from July 2010 – Jun 2011

[26] Diesel Purchase Invoices

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

[28] 2008 Malaysian Tax and Business Booklet (Page 22)

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[29].

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

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

Summary

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

[29] Carotino Financial analysis for Biomass Boiler

[30] Watermech Engineering Sdn.Bhd Proposal

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

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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

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

(f) Introduction of a sequential stage of wastewater treatment with biogas recovery and combustion, with or without sludge treatment, to an anaerobic wastewater treatment system without biogas recovery (e.g. introduction of treatment in an anaerobic reactor with biogas recovery as a sequential treatment step for the wastewater that is presently being treated in an anaerobic pond without methane recovery).

Baseline Emissions

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

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

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

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

The baseline treatment systems consists 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:

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

$Q_{ww,i,y}$	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 21)

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 calculated the baseline emissions *ex-post*.

Therefore:

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

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

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

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

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

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

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

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

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

Total Baseline Emissions

The total baseline emissions in year y, is:

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

Project Activity Emissions

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

$$\mathbf{PE_y = \{PE_{power,y} + PE_{ww,treatment,y} + PE_{s,treatment,y} + PE_{ww,discharge,y} + PE_{s,final,y} + PE_{fugitive,y} + PE_{biomass,y} + PE_{flaring,y}\}} \quad \mathbf{(8)}$$

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"(tCO2e). These emissions are accounted for when the flare is in use.

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

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

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

Parameter	Units	Value	Source
Total Electricity generated by biomass turbine from July 2010 – June 2011	kWh/y	2,651,540	Historical Generation Data July 2010 – June 2011 (a)[32]
Total Electricity generated by diesel engine from July 2010 – June 2011	kWh/y	393,760	Historical Generation Data July 2010 – June 2011 (b)[33]
% of Electricity Supply by Biomass Boiler	%	87.07	Calculated (a /(a+b))
% of Electricity Supply by Diesel Engines	%	12.93	Calculated (b /(a+b))
Emission Factor (EF) of electricity from Biomass turbine (renewable source)	tCO_2/MWh	0.0	EF = 0 for renewable energy
Emission Factor (EF) of electricity from Diesel engines	tCO_2/MWh	1.3	Conservative default value as per 'Option B2, Page 8 of Tool to calculate baseline, project and/or leakage emissions from electricity consumption (Version 01, EB39).
Weighted average Emission Factor	tCO_2/MWh	0.17	Calculated (0.1293 * 1.3 tCO_2/MWh)
Auxiliary power consumption for project activity operation	kW	157.64	Power Generation Information[34]
Total project emission	**tCO_2**	**235**	0.15764 MW * 8,760 h/y x 0.17 tCO_2/MWh

The calculated % of project emission from fossil fuel consumption at project activity much is lesser than 1% of the emissions reduction (27,394 tCO_2/y) under an unlikely scenario.

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

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

[34] Power Generation Information

Thus, CO_2 emissions from the combustion of fossil fuels is estimated as negligible (< 1%), of the overall expected average annual emissions reductions and not accounted for as project emissions; in accordance to Paragraph 77 of Validation and Verification Manual (Version 01.2, EB 55).

Therefore, $PE_{power,y} = 0$.

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

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

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)[6]
UF_{PJ}	Model correction factor to account for model uncertainties (1.12)
GWP_{CH4}	Global Warming Potential for methane (value of 21)

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 land application which is an aerobic process. Therefore on this basis $PE_{s,treatment,y} = 0$.

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

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

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

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

The sludge removed periodically from the digester will be sent to the palm plantation as soil application and applied in a thin layer under aerobic conditions.
Therefore on this basis $PE_{s,final,y} = 0$.

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

$$\mathbf{PE_{fugitive,y} = PE_{fugitive,ww,y} + PE_{fugitive,s,y}} \qquad \mathbf{(9)}$$

Where:

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

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

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

Where

$$\mathbf{PE_{fugitive,ww,y} = (1-CFE_{ww}) * MEP_{ww,treatment,y} * GWP_{CH4}} \qquad \mathbf{(10)}$$

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:

$$\mathbf{MEP_{ww,treatment,y} = Q_{ww,y} * B_{o,ww} * UF_{PJ} * \Sigma_k COD_{removed,PJ,k,y} * MCF_{ww,treatment,PJ,k}} \qquad \mathbf{(11)}$$

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)

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

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 ($PE_{flaring,y}$)

All the biogas that is produced in the anaerobic digester will be combusted in the biogas engines for electricity generation. Excess biogas will be combusted at biomass boiler system and/or flared using enclosed flare system. In this situation, any methane emissions that occur due to incomplete flaring will

be calculated as per the "Tool to determine project emissions from flaring gases containing methane" (Version 1, EB28).

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

Calculation of annual project emission from flaring

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

$$PE_{flare} = \sum_{h=1}^{8760} TM_{RG,h} * (1-\eta_{flare,h}) * (GWP_{CH4}/1000) \quad (15)$$

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

The mass flow rate of methane is estimated as following:

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

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

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

Leakage

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

Emission Reductions

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

$$ER_{y,ex\ ante} = BE_{y,ex\ ante} - (PE_{y,ex\ ante} + LE_{y,ex\ ante}) \quad (14)$$

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.

$$\mathbf{ER_{y,ex\text{-}post} = min\ ((BE_{y,ex\text{-}post} - PE_{y,ex\text{-}post} - LE_{y,ex\text{-}post}), (MD_y - PE_{power,y} - PE_{biomass,y} - LE_{y,ex\text{-}post}))} \qquad \textbf{(15)}$$

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:

$$\mathbf{MD_y = BG_{burnt,y} * w_{CH4,y} * D_{CH4} * FE * GWP_{CH4}} \qquad \textbf{(16)}$$

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 that are available at validation:

Data / Parameter:	$\mathbf{MCF}_{ww,treatment,BL}$
Data unit:	Factor
Description:	Methane correction factor for the baseline anaerobic wastewater treatment system
Source of data used:	IPCC default value for anaerobic decay of the untreated wastewater
Value applied:	0.8
Justification of the choice of data or description of measurement methods and procedures actually applied :	MCF values as per table III.H.1, AMS III.H (Anaerobic deep lagoon depth more than 2m).
Any comment:	-

Data / Parameter:	$\mathbf{MCF}_{ww,treatment, aerobic}$
Data unit:	Factor
Description:	Methane correction factor for the baseline aerobic wastewater treatment system
Source of data used:	IPCC default value for aerobic treatment, well managed pond
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	MCF values as per table III.H.1, AMS III.H (Aerobic treatment, well managed pond).
Any comment:	-

Data / Parameter:	$\eta_{COD,BL}$
Data unit:	%
Description:	COD removal efficiency of the baseline treatment system, determined as per the paragraphs 26, 27 or 28 in AMS III.H
Source of data used:	Measurement campaign
Value applied:	99
Justification of the choice of data or description of measurement methods and procedures actually applied :	Measurement campaign was undertaken in the baseline wastewater treatment system for 10 normal operation days from 13th August – 22nd August 2011.
Any comment:	-

Data / Parameter:	$\eta_{PJ,,aerobic}$
Data unit:	%
Description:	Chemical oxygen demand removal efficiency of the project wastewater treatment system (System-Aerobic) which is not equipped with biogas recovery digester in year y.
Source of data used:	Measurement campaign
Value applied:	61
Justification of the choice of data or description of measurement methods and procedures actually applied :	Measurement campaign was undertaken in the baseline wastewater treatment system for 10 normal operation days from 13th August – 22nd August 2011.
Any comment:	Equivalent to COD removal efficiency of the baseline aerobic

	treatment system, determined as per the paragraphs 26, 27 or 28 in AMS III.H

Data / Parameter:	**$B_{o,ww}$**
Data unit:	tCH_4/t COD
Description:	Methane producing capacity of wastewater
Source of data used:	AMS-III.H. Default value
Value applied:	0.25
Justification of the choice of data or description of measurement methods and procedures actually applied :	The default value as specified in AMS-III.H (Version 16; EB58).
Any comment:	-

Data / Parameter:	**UF_{BL}**
Data unit:	-
Description:	Model correction factor to account for model uncertainties
Source of data used:	AMS-III.H. Default value
Value applied:	0.89
Justification of the choice of data or description of measurement methods and procedures actually applied :	The default value as specified in AMS-III.H (Version 16; EB58) for the calculation of baseline emissions.
Any 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 used:	IPCC default value
Value applied:	0.8
Justification of the choice of data or description of measurement methods and procedures actually applied :	MCF values per table III.H.1, AMS III.H for equipped with biogas recovery system digester
Any 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 used:	IPCC default value for aerobic treatment, well managed
Value applied:	0.0
Justification of the choice of data or description of measurement methods and procedures actually applied :	MCF values per table III.H.1, AMS III.H (Aerobic treatment, well managed pond).
Any comment:	

Data / Parameter:	**$MCF_{ww,BL,discharge}$, $MCF_{ww,PJ,discharge}$**
Data unit:	Factor
Description:	Methane correction factor of baseline and project wastewater

	treatment system sent for plantation irrigation purpose
Source of data used:	IPCC default value for aerobic treatment, well managed
Value applied:	0.0
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	-

Data / Parameter:	**GWP_{CH4}**
Data unit:	tCO_2/ t CH_4
Description:	Global warming potential of methane
Source of data used:	IPCC default value
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied :	The default value as specified in AMS-III.H (Version 16; EB58)
Any comment:	-

Data / Parameter:	**UF_{PJ}**
Data unit:	-
Description:	Model correction factor to account for model uncertainties
Source of data used:	AMS-III.H. Default value
Value applied:	1.12
Justification of the choice of data or description of measurement methods and procedures actually applied :	The default value as specified in AMS-III.H (Version 16; EB58)
Any comment:	-

Data / Parameter:	**CFE_{ww}**
Data unit:	Factor
Description:	Capture efficiency of the biogas recovery equipment in wastewater treatment system
Source of data used:	AMS-III.H. Default value
Value applied:	0.9
Justification of the choice of data or description of measurement methods and procedures actually applied :	The default value as specified in AMS-III.H (Version 16; EB58)
Any 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	**30,485**	Baseline emissions in year *y*	tCO_2e
$BE_{power,y}$	0	Baseline emissions from electricity or fuel consumption in year *y*	tCO_2e
$BE_{ww,treatment,y}$	**30,485**	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 soil application in the baseline scenario, this term shall be neglected.	tCO_2e

(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**
$BE_{ww,treatment,y}$	**30,485**	Baseline emissions of the wastewater treatment systems affected by the project activity in year y	tCO_2e
$Q_{ww,y}$	140,400	Volume of wastewater treated in baseline wastewater treatment system i in year y (m^3). For ex ante estimation, projected FFB amount was multiplied by the default POME:FFB ratio of 65%.	m^3
$COD_{inflow,y}$	0.05850	Chemical oxygen demand of the wastewater inflow to the baseline anaerobic treatment system (System- anaerobic) in year y. Average value may be used through sampling with the confidence/ precision level 90/10.	t/m^3
$\eta_{COD,BL}$	0.99	COD removal efficiency of the baseline anaerobic treatment system (System- anaerobic), determined as per the paragraphs 26, 27 or 28 in AMS III.H (Version 16).	
$MCF_{ww,treatment,BL}$	0.8	Methane correction factor for baseline wastewater treatment systems (System- anaerobic)	
$B_{o,ww}$	0.25	Methane producing capacity of the wastewater	
UF_{BL}	0.89	Model correction factor to account for model uncertainties	
GWP_{CH4}	21	Global Warming Potential of methane	

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

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

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

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

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

(e) Baseline methane emissions from anaerobic decay of the final sludge produced ($BE_{s,final.y}$)
As defined in Section B.6.1, $BE_{s,final,y} = 0$.

Project Activity Emissions

Project activity emissions are calculated as follows:

$PE_y = PE_{power,y} + PE_{ww,treatment,y} + PE_{s,treatment,y} + PE_{ww,discharge,y} + PE_{s,final,y} + PE_{fugitive,y} + PE_{biomass,y} + PE_{flaring,y}$			
Parameter	**Value**	**Description**	**Unit**
PE_y	**3,091**	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
$PE_{fugitive,y}$	3,091	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**
$PE_{fugitive,y}$	**3,091**	Methane emissions from biogas release in capture system in year y	tCO_2e
$PE_{fugitive,ww,y}$	3,091	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**
$PE_{fugitive,ww,y}$	3,091	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
$MEP_{ww,treatment,y}$	1,472	Methane emission potential of the wastewater treatment system equipped with biogas recovery system in year y (t)	t
GWP_{CH4}	21	Global Warming Potential of methane	tCO_2e/tCH_4

Where:

$MEP_{ww,treatment,y} = Q_{ww,y} * B_{o,ww} * UF_{PJ} * \sum_k COD_{removed,PJ,k} * MCF_{ww,treatment,PJ,k}$			
Parameter	**Value**	**Description**	**Unit**
$MEP_{ww,treatment,y}$	1,472	Methane emission potential of the wastewater treatment system equipped with biogas recovery system in year *y*	tCH_4/y
$Q_{ww,y}$	140,400	Volume of wastewater treated in project wastewater treatment system (System-Aerobic) in year,y.	m^3
$B_{o,ww}$	0.25	Methane producing capacity of the wastewater	$kgCH_4$ /kgCOD
UF_{PJ}	1.12	Model correction factor to account for model uncertainties	
$COD_{removed,PJ}$	0.04680	The chemical oxygen demand removed by the project wastewater treatment system (System-biogas) which is equipped with biogas recovery digester in year y. Ex-ante estimate as per the Measurement Campaign Sample Point A; $COD_{inflow,y}$ less design value of digester removal efficiency (80%). Parameter to be recalculated ex-post in accordance with paragraph 20.	tonnes/m^3

$MCF_{ww,treatment,PJ}$	0.8	Methane correction factor for project wastewater treatment system (System-biogas) which is equipped with biogas recovery digester. (not equipped with biogas recovery) (MCF values as per Table III.H.1).	

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

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

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

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

The project emission from flaring is calculated below:

$PE_{flare} = \sum_{h=1}^{8760} TM_{RG,h} * (1-\eta_{flare,h}) * (GWP_{CH4}/1000)$			
Parameter	**Value**	**Description**	**Unit**
PE_{flare}	**0**	Project emission from flaring of methane in year y	tCO_2e
h	4,800.00	Hours of operation per year	h/y
$TM_{RG,h}$	0	Mass flow rate of methane in hour	kg/y
$\eta_{flare,h}$	0.9	Flare efficiency in hour h	
GWP_{CH4}	21	Global Warming Potential of methane	

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**
$ER_{y,ex\ ante}$	**27,394**	Ex ante emission reduction in year y	tCO_2e
$LE_{y,ex\ ante}$	0	Ex ante leakage emissions in year y	tCO_2e
$PE_{y,ex\ ante}$	3,091	Ex ante project emissions in year y calculated as per equation 8	tCO_2e
$BE_{y,ex\ ante}$	30,485	Ex ante baseline emissions in year y calculated as per equation 1	tCO2e

Where:

Baseline Emissions

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

$= 0 + 30,485 + 0 + 0 + 0$

$\mathbf{= 30,485\ tCO_2e/yr}$

Project Emissions

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

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

= 3,091 tCO_2e/yr

Leakages
$LE_y = 0$

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

Year	Estimation of project activity emission reductions (tonnes of CO_2e)	Estimation of baseline emission reductions (tonnes of CO_2e)	Estimation of leakage (tonnes of CO_2 e)	Estimation of Emission reductions (tonnes of CO_2e)
2013	3,091	30,485	0	27,394
2014	3,091	30,485	0	27,394
2015	3,091	30,485	0	27,394
2016	3,091	30,485	0	27,394
2017	3,091	30,485	0	27,394
2018	3,091	30,485	0	27,394
2019	3,091	30,485	0	27,394
2020	3,091	30,485	0	27,394
2021	3,091	30,485	0	27,394
2022	3,091	30,485	0	27,394
Total (tonnes of CO_2e)	**30,910**	**304,850**	**0**	**273,9450**
Average per annum	3,091	30,485	0	27,394

 # Year 1 of crediting period starts on the date specified in section C.2.1.1., and corresponds to a period of 12 months.

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

B.7.1 Data and parameters monitored:

Data / Parameter:	$Q_{ww,y}$
Data unit:	m^3 /month
Description:	The flow of wastewater entering the project anaerobic digester system
Source of data to be used:	Measured
Value of data:	11,700 (ex-ante value –see comment)
Description of measurement methods and procedures to be applied:	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.
QA/QC procedures to be applied:	Equipment will be calibrated according to manufacturer specifications, or at least once in three years.
Any comment:	For the purpose of the ex-ante estimate of emission reductions the volume

	of wastewater treated in the baseline and project wastewater systems was estimated to be 140,400 m^3/year.

Data / Parameter:	$\mathbf{COD}_{\mathbf{\mathit{ww,untreated,y}}}$
Data unit:	$tCOD/m^3$
Description:	COD of wastewater entering the anaerobic digester system
Source of data used:	Laboratory testing
Value of data:	0.05850
Description of measurement methods and procedures to be applied:	COD sample will be tested 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.
QA/QC procedures to be applied:	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.
Any comment:	

Data / Parameter:	$\mathbf{COD}_{\mathbf{\mathit{ww,treated,y}}}$
Data unit:	$tCOD/m^3$
Description:	COD of wastewater exiting the anaerobic digester system
Source of data used:	Laboratory testing
Value of data:	0.01170
Description of measurement methods and procedures to be applied:	COD sample will be tested 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.
QA/QC procedures to be applied:	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.
Any comment:	

Data / Parameter:	$\mathbf{COD}_{ww,discharge,PJ,y}$
Data unit:	$tCOD/m^3$
Description:	COD of wastewater leaving the final discharge point
Source of data used:	Laboratory testing
Value of data:	0.00455
Description of measurement methods and procedures to be applied:	COD sample will be tested 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.
QA/QC procedures to be applied:	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.
Any comment:	

Data / Parameter:	$\mathbf{BG}_{burnt,y}$
Data unit:	Nm^3
Description:	Amount of biogas fuelled or flared in year,*y*.
Source of data used:	Calculated

Value of data:	2,846,050
Description of measurement methods and procedures to be applied:	Calculated as the sum of $\mathbf{BG}_{fuelled,y}$ and $\mathbf{BG}_{flared,y}$
QA/QC procedures to be applied:	
Any comment:	*Ex-ante estimation based on STP condition*

Data / Parameter:	$\mathbf{BG}_{fuelled,y}$
Data unit:	Nm^3
Description:	Amount of biogas fuelled in the gas engine and/or boiler in year,*y*.
Source of data used:	Measured
Value of data:	2,846,050
Description of measurement methods and procedures to be applied:	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.
QA/QC procedures to be applied:	The meters will undergo maintenance/calibration as per the manufacturer's specifications, or at least once every three years.
Any comment:	*Ex-ante estimation based on STP condition*

Data / Parameter:	$\mathbf{BG}_{flared,y}$
Data unit:	Nm^3
Description:	Amount of biogas flared in year,*y*
Source of data used:	Measured
Value of data:	0
Description of measurement methods and procedures to be applied:	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.
QA/QC procedures to be applied:	The meters will undergo maintenance/calibration as per the manufacturer's specifications, or at least once every three years.
Any comment:	*Ex-ante estimation based on STP condition. Data used to calculate* $FV_{RG,h}$

Data / Parameter:	$\mathbf{w}_{CH4,y}$
Data unit:	%
Description:	Methane content in biogas in the year y
Source of data used:	Measured
Value of data:	65
Description of measurement methods and procedures to be applied:	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
QA/QC procedures to be applied:	The analyser will undergo maintenance/calibration as per the manufacturer's specifications, but at least once every three years.
Any comment:	*Data used to calculate* $fv_{CH4,RG,h}$

Data / Parameter:	$\mathbf{T}_{flare}$
Data unit:	°Celsius
Description:	Temperature in the exhaust gas of the flare
Source of data to be used:	Measured
Value of data:	> 500°C
Description of measurement methods and procedures to be applied:	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.
QA/QC procedures to be applied:	Thermocouples should be replaced or calibrated every year.
Any 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 to be used:	Calculated
Value of data:	90%
Description of measurement methods and procedures to be applied:	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.
QA/QC procedures to be applied:	
Any comment:	-

Data / Parameter:	$\mathbf{S}_{final,PJ,y}$
Data unit:	-
Description:	End use of final sludge from the digester system
Source of data to be used:	Records
Value of data:	-
Description of measurement methods and procedures to be applied:	The sludge removed periodically from the digester will be sent to the palm plantation as soil application and applied in a thin layer under aerobic conditions. Records of when sludge is removed, and where the sludge is applied to will be kept.
QA/QC procedures to	-

be applied:	
Any 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 Description of the 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.

<u>Organization of the Monitoring Activities and Monitoring Management</u>

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 B.8.

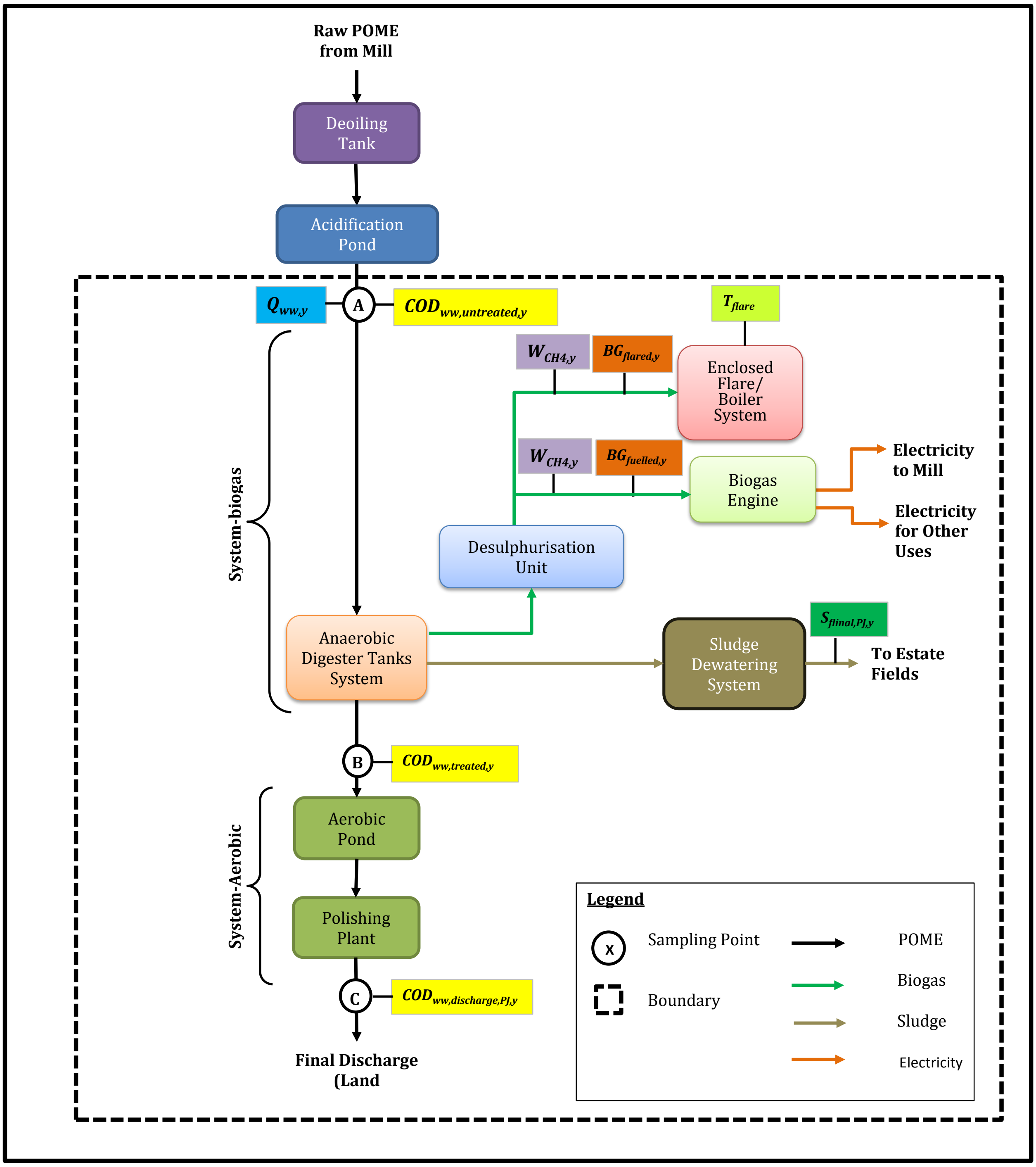
Table B.8: Proposed CDM Monitoring and Management Team

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

<u>Monitoring</u>

The proposed measurement and sampling points for the project activity is illustrated in Figure B.4:

Figure B.4: 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.

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

Date of completion of the baseline development: 15/11/2011

Company Name:	Perenia Pty Ltd
Email Address:	cdm@pereniacarbon.com
Contact Address	
Head Office:	Level 7, 111 Pacific Highway North Sydney, NSW 2060 Australia
Telephone Number:	+61 2 9926 1700
Fax Number:	+61 2 9926 1799

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

09/08/2011[35]

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

15 years[36]

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

C.2.1. Renewable crediting period

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

C.2.1.2. Length of the first crediting period:

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

01/01/2013 or date of registration, whichever is later[37].

C.2.2.2. Length:

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

[35] "Letter of Acceptance of Offer" with Watermech Engineering Sdn. Bhd.

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

[37] Project Implementation Schedule

SECTION D. Environmental impacts

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

There is no requirement under Malaysia law[38] 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. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

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

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

SECTION E. Stakeholders' comments

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

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

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

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

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

Thirty (30) participants attended the meeting[39].

E.2. Summary of the comments received:

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

NO.	QUESTIONER	QUESTION	ANSWER
1.	Mr Ngoh Chin Huan, Bakti Juwita Sdn Bhd	Please elaborate on the utilization of generated electricity.	• The generated electricity is used mainly for mill operation and associated downstream activities. • There is no potential for supply to the grid as the mill is located 23 km away from the main road and does not have any grid connectivity. This makes possible connection too expensive and not a viable option.
2.	Mr Chong Tian Sang, Assistant Manager, ZCM (local mining company)	Does the project pose any social impact to the local community?	• For the local economy, there are employment opportunities and technology knowledge transfer for the locals both during project construction and implementation. • Environmental perspective, the project potentially will improve the air quality from the avoidance of methane emissions and release of odour from hydrogen sulphide. • From a health and safety aspect, no impact is expected to affect the health of the locals. The steel tank digester has been designed with DOSH approval to qualify as a non-pressure vessel, with necessary safety devices installed to minimize leakages. • If leakages do occur, the design allows it to flow through the top of the tanks or at elevated pipes.

[39] Refer to Stakeholder Meeting Report

NO.	QUESTIONER	QUESTION	ANSWER
			Risk is only if there is presence of oxygen, which is addressed by flaring of biogas when in contact with the air outside of the tank.
3.	Mr Seow Chee Siang, JC Chang	Can the gas be directed to be used for cooking purposes?	• This is possible, although gas for cooking must be compressed in order to become economical, which will require additional equipment. In fact, technology wise there are future considerations for extraction and bottling of carbon dioxide and methane for industrial purposes.
4.	Mr Hong Chat Chai, Dara Lam Soon Sdn Bhd	Is 100% of the POME supplied to the wastewater treatment plant?	• Yes. The design will accommodate 100% of the POME treatment – continuous flow into the digester tanks. Existing anaerobic ponds will not be used, but will be maintained only for emergency use.
5.	Mr Eric Choo, Secretary, ZCM (local mining company)	Please elaborate further on the sludge handling system.	• Upon completion of the anaerobic system, digested effluent shall flow out into the sludge handling system which will terminate the anaerobic process. • Sludge handling consists of a settling tank, a forced aeration process of the effluent. Solids are processed using a backpress filter system to produce fertilizers. Treated effluent is pumped back into the aerobic ponds.
6.	Mr Hong Chat Chai, Dara Lam Soon Sdn Bhd	How do you dispose of the desulphurization residues?	• Quantity of chemical used is very small and can be disposed of by sending to Kualiti Alam under Department of Environment regulation. It is also possible to recycle back into consumption.
7.	Mr Hong Chat Chai, Dara Lam Soon Sdn Bhd	What is the cost of the whole project?	• The cost of the whole project depends on mill size. The overall cost including biogas engines for electricity generation cost from RM 11 – 20 million depending on mill capacity, the bigger mills needs bigger treatment system, soil condition for earthwork & piling and power transmission costs.
8.	Mr Chong Tian Sang, Assistant Manager, ZCM (local mining company)	How many job opportunities will the project create?	• The project will potentially require 3 – 4 workers as operators to run the biogas plant, as the project is fully automated. Otherwise additional resources required to supervise and monitor the project for compliance purpose.

E.3. Report on how due account was taken of any comments received:

All comments were addressed during the stakeholder meeting.

Annex 1

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding is involved in the proposed project activity.

Annex 3

BASELINE INFORMATION

Annex 4

MONITORING INFORMATION

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