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

CONTENTS

Annexes

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:

Methane Recovery and Utilization at Prosper Palm Oil Mill, Malaysia.

Version of document: 3.4

Date of completion: 24/12/2012

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

Methane Recovery and Utilization at Prosper Palm Oil Mill, Malaysia Project (hereafter referred to as "the proposed project") is located at the plant site of Prosper Palm Oil Mill, Negeri Sembilan, Malaysia.

Prosper Palm Oil Mill is a palm oil mill with a processing capacity of 60 tonnes Fresh Fruit Bunches (FFBs) per hour. This facility processes averagely 229,685 tonnes of Fresh Fruit Bunches (FFB) per year between 2007 and 2011[1]. *According to Industrial Processes & The Environment (Handbook No.3) Crude Palm Oil Industry*[2], with the national average of 0.7 cubic meters per tonne FFB, Prosper Palm Oil Mill is producing averagely 160,780m^3 of palm oil mill effluent (POME) every year between 2007 and 2011. An assessment of the palm oil facility determined that a system of open lagoons is used to treat POME in the baseline scenario. This is the most common practice in Malaysian palm oil mills. In fact, over 85% of the palm oil mills use ponding systems or open lagoons[3]. Subsequent to treatment in the system of lagoons, the treated POME will be applied to land (with a BOD limit of 5,000 mg/l)[4].

The facility was also found to comply with current effluent discharge standards. Because POME is quite concentrated, its handling and disposal can create profound environment consequences, such as greenhouse gas emission (principally methane (CH_4), odour, and water/land contamination (including seepage, runoff, and over application).

This project will recover methane by introducing methane recovery and combustion to the existing anaerobic effluent treatment system (lagoons). The project activity utilizes a simple, effective and reliable technology to capture lagoon-produced biogas: covered in-ground anaerobic reactor system by installing sealed HDPE covers over existing two open anaerobic lagoons to create anaerobic digestion system. The project participants will use the biogas output for renewable energy as the priority (i.e. the creation of electricity and thermal energy). Biogas utilization will occur at the time during implementation of the current project activity. This utilization of biogas for renewable energy is not part of the CDM project activity; therefore, credits for renewable energy generation are not requested in this PDD. During the maintenance of the renewable energy options or the excessive of biogas, the captured biogas will be routed to one or more high temperature, enclosed flares to destroy methane gas as it is produced. It is estimated 24,369 tCO_2e per year will be reduced from the methane capture and destruction.

---

[1] Prosper POM 5 Years Historical FFB Processing Rate

[2] Industrial Processes & The Environment (Handbook No.3) Crude Palm Oil Industry (pg 25)

[3] http://www.cogen3.net/doc/countryinfo/malaysia/TechnicalEconomicAnalysisCHPPalmEffluent_BG.pdf

[4] http://www.doe.gov.my/dmdocuments/legislation/pua0342y1977.pdf (Regulation 13)

Sustainable Development Benefits of the Project

The proposed project activity is foreseen to have few positive impacts that contribute to a sustainable development for Malaysia. By providing positive impacts, the project activity will facilitate multi-dimensional sustainable development benefits to the local communities as well as to the nation, which are furnished below:

(i) Environmental

The project proposes to reduce GHG emissions by moving from a high-GHG-emitting open lagoon system to a lower-GHG-emitting anaerobic digester with capture and combustion of the resulting biogas. The project will not only significantly reduce GHG emissions from the project site, but also provide a potential source of clean renewable energy to the mill (this may also help offset future infrastructure growth needs by the local power producer). With the supply of renewable energy to the mill, renewable energy provide many immediate environmental benefits by avoiding impacts and risks of electricity generation using fossil fuels which causes global warming. Renewable energy also has environment impacts but these impacts are generally much smaller and more localized than those of fossil fuels and nuclear fuels. Renewable fuels can be harvested at sustainable rates. The potential breeding ground for fly populations is kept to a minimum and the emission of Volatile Organic Compounds (VOCs) and odour is reduced.

(ii) Social

Economic activities arising from the implementation of the CDM project may increase revenue per capita in local communities. The project activity will create new employment opportunities for skilled labor involved in the fabrication, construction, installation, operation and maintenance of the anaerobic digestion technology system. In addition, such project drives the requirement to establish a local administrative and project management infrastructure for the continued project management and logistics of facilitating appropriate audit review, which improves technical knowledge and skills of local workers.

(iii) Economic

The project seeks to introduce and transfer new and ecologically more efficient technology to replace the current industry-standard open lagoons, with their high GHG emissions and large ecological footprint. Under this project activity, the project's potential in terms of promoting sustainable economic development can assist in the overall enhancement of economics activities in the region, including:

a) Stimulates employment opportunities for the local people;
b) Generates potential revenue streams from carbon credit trading; and
c) Create more electricity available to facilitate possible business expansion, such as downstream activities of palm oil mill.

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)	Green Lagoon Technology Sdn Bhd	No

United Kingdom of Great Britain and Northern Ireland	Camco South East Asia Ltd	No

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

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

A.4.1.1. Host Party(ies):

The Host Party for this project is **Malaysia**.

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

The project is located within the Negeri Sembilan, Malaysia.

A.4.1.3. City/Town/Community etc:

The project site is located in Seri Jempol, Bahau.

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

The project location is shown in Figure 1 and details are provided in Table 1. A short description of the site is provided below:

Prosper Palm Oil Mill is a palm oil mill with a processing capacity of 60 tonnes per hour. This facility processes an average of 229,685 tonnes of Fresh Fruit Bunches (FFBs) per year. The mill, which is in regulatory compliance, operates approximately 20 hours per day, 312 days per year[5]. A system of open lagoons is used to process POME effluent: one cooling lagoons, five anaerobic lagoons, and two facultative lagoons[6]. Pond measurements are listed in Table 1 below. *At this facility, lagoon depth averages 3.3 - 4 meters but occasionally may vary due to sludge build-up. As a result, these lagoons are subject to sludge removal as needed. Upon removal, the sludge is land applied.*

Table 1: Measurement of Wastewater Treatment System of Prosper Palm Oil Mill

No.	Items	Measurements
1	*Anaerobic Pond 1*	*117m x 32m x 3.3m*
2	*Anaerobic Pond 2*	*117m x 32m x 3.3m*
3	*Anaerobic Pond 3*	*60m x 31m x 4m*
4	*Anaerobic Pond 4*	*44m x 31m x 4m*
5	*Anaerobic Pond 5*	*39m x 18m x 4m*
6	*Facultative lagoon 1*	*67m x 45m x 4m*

[5] Prosper POM 2011 AS3

[6] Open Lagoons Treatment System Layout

7	*Facultative lagoon 2*	*79m x 36.5m x 4m*

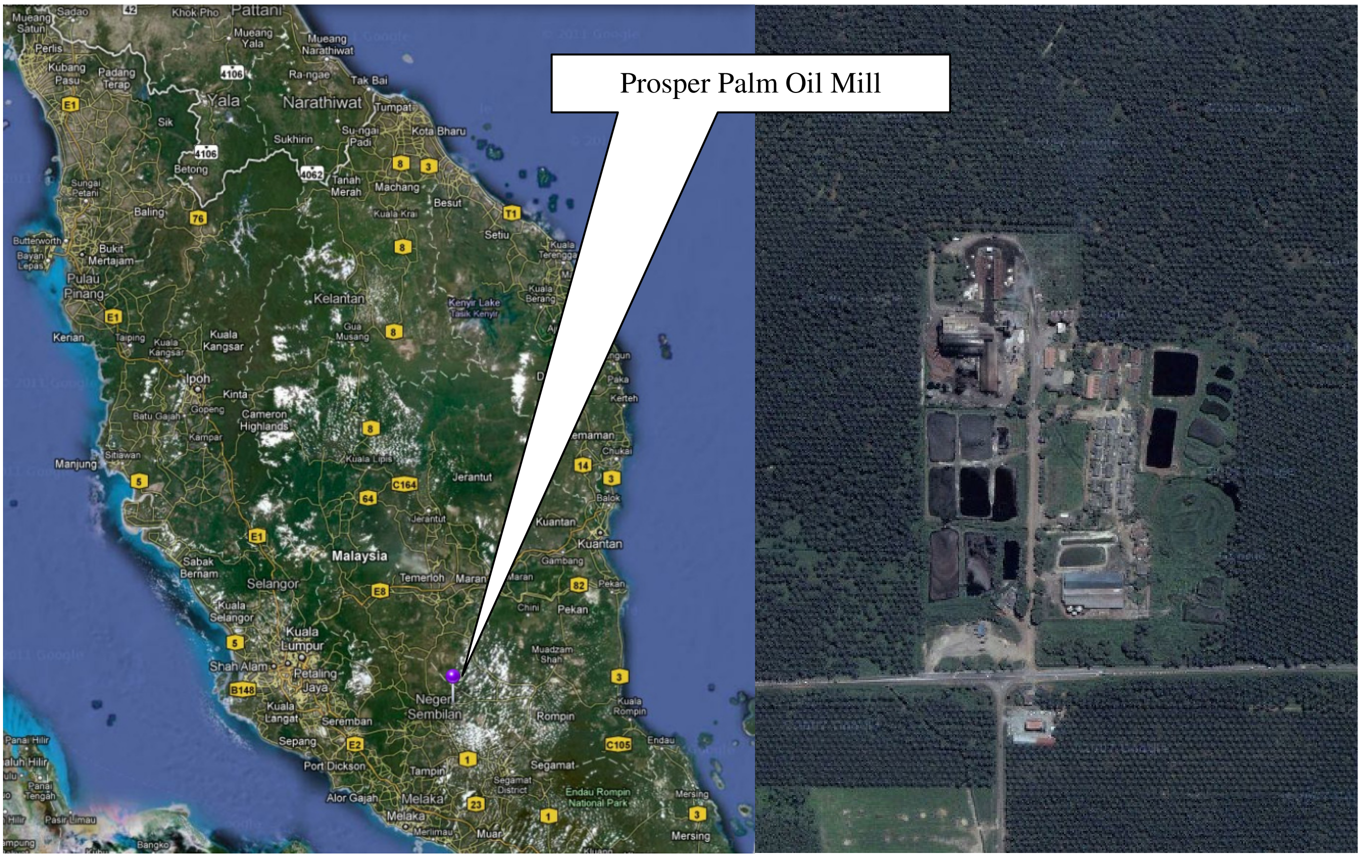

Figure 1: Project Activity site in Negeri Sembilan, Malaysia

Table 2: Detailed physical location / identification of project site

Site Name	Address	Town/State	Contact	Phone	GPS
Prosper Palm Oil Mill	Batu 15, Lebuhraya Bahau-Keratong, Bandar Seri Jempol, 72100 Bahau.	Negeri Sembilan, Malaysia.	Mr. Lim Tai Chew	+606-4611906	N2 53.356 E102 31.331

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

The project activity recovers biogas from biogenic organic matter in wastewater, which falls into the category of waste handling and disposal (Sectoral Scope: 13). This project activity will introduce biogas recovery and combustion to an anaerobic wastewater treatment system such as anaerobic reactor. The recovered biogas from the project activity will be utilized for thermal and electrical energy generation directly, besides flaring.

Process and technology description

The project activity utilizes a simple, effective and reliable technology to capture lagoon-produced biogas: covered in-ground anaerobic reactor system by installing sealed covers over existing two open anaerobic lagoons to create an anaerobic digestion system. This anaerobic digestion system would have at least 85% of COD removal efficiency[7]. Each cover will consist of a synthetic high-density polyethylene (HDPE) geo-membrane which is sealed by means of strip-to-strip welding and a peripheral anchor trench dug around the perimeter of the existing lagoon. The welded seams of the cover system will be tested to ensure air-tight coupling between all HDPE pieces.

HDPE is an excellent product for large applications requiring UV, ozone, and chemical resistance and because of these attributes is one of the most commonly used geo-membranes worldwide. This covering approach effectively enables capture/combustion of nearly 100% of the biogas produced in these lagoons. The complete capture of biogas produced reduces odour and prevents methane emissions. The local Department of Environment granted its approval for the CDM project activity, thus it is considered environmentally safe according to local regulations[8].

The in-ground anaerobic reactor system is fitted with multiple inlet pipes which are fed to the bottom of the lagoon, whereby the hydraulic movement of the POME causes a minor turbulence, which encourages better mixing of the POME and allowing better interaction with the bacteria in the POME. The multiple inlet pipes also aids in reducing dead-zones, where the suspended solids in the system is not allowed to settle and create sludge deposits.

The agitation pipes along the length of the lagoon also help to ensure that the sludge deposits are minimised along the path of the hydraulic flow of the POME. As a precaution, several sludge removal pipes will be installed also in the lagoon system to allow for sludge removal in the event of sludge build-up in the system. The sludge will be stored in a sludge pond (no deeper than 2m depth), and after it is sufficiently dried, removed for land application.

The gas that is released is trapped in the air-tight HDPE cover and will be channelled to the biogas usage facility (biogas engine, boiler and flare). PE pipes will be used for this purpose, and similar to the HDPE membrane, is resistant to UV, ozone, ambient heat and many types of chemicals and solvents.

POME will continue to flow through the entire existing lagoon system (same as in the baseline) so that the effluents discharge requirements can be met. The mill owner will utilize the captured biogas as fuel for renewable energy with two Shendong Biogas Engine Power Generating Set (Model: 500GF1-1RZ) with total installed capacity of 1,000 kWel as priority[9]. The remaining captured biogas will be used in the Biogas Burner (Model: BIO-BRN-2010) at its existing biomass boiler for steam generation as second priority[10]. This utilization of biogas for renewable energy is not part of the current project activity. Therefore, credits for renewable energy generation are not requested in this PDD.

A high temperature, enclosed flare[11] will be used during maintenance of gas engine or to combust the excess biogas. The flaring combustion system is automated to ensure that all biogas that exits the digester and passes through the flowmeter and is combusted. An automatic flare ignition system ensures methane is combusted

[7] Justification for 85% COD removal efficiency of covered in-ground anaerobic reactor system

[8] Prosper POM EIA Exemption Letter

[9] Prosper POM Biogas Engine Quotation and Power Requirement and Specification

[10] Prosper POM Biomass Boiler Burner Quotation and Specification

[11] Enclosed Flare Quotation and Specification

whenever biogas is present at the flare. This continuous ignition system is activated by a pressure switch or transducer prior to the flow of biogas to the flare by the blower system. The flare includes thermocouples to monitor flare exhaust gas temperature, which is measured and recorded more often than hourly. The component parts are verified functional on a periodic basis in accordance with manufacturer and other technical specifications.

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

A fixed crediting period is selected for the proposed project. The estimated average annual emission reductions over the crediting period are 24,369 tCO_2e.

Table 3: Estimated Emission Reductions over the Crediting Period

Estimated Emission Reduction over the chosen crediting period	
Year	**Annual estimation of emission reductions in tonnes of CO_2e**
2013	19,770
2014	21,686
2015	23,602
2016	25,519
2017	25,519
2018	25,519
2019	25,519
2020	25,519
2021	25,519
2022	25,519
Total estimated reductions (tonnes CO_2e)	243,690
Total number of crediting years	10
Annual average of estimated reductions over the crediting period (tonnes CO_2e)	**24,369**

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

No public funding is being provided for this project.

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

Based on the *Guidelines on assessment of de-bundling for SSC project activities, Version 3,* this project is not a debundled component of any large scale project activity, according to the following definition:

"*A proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:*

(a) *With the same project participants;*
(b) *In the same project category and technology/measure; and*
(c) *Registered within the previous 2 years; and*
(d) *Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point."*

It is assessed that neither this proposed project activity complies with any of the above listed. In addition, the project participants have no other on-going or future activity related to this project in anyway. Hence, this proposed project activity is not a de-bundled activity of a large project.

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 project activity applies the UNFCCC-approved small scale methodology AMS III.H., *Methane recovery in wastewater treatment, Version. 16*. The proposed project activity is a small scale project as it comprises methane recovery from agro-industries and the aggregated emission reductions will not exceed 60 kt CO_2 equivalent annually.

The methodology is used in conjunction with the following tools:

(i) Tool to calculate baseline, project and/or leakage emissions from electricity consumption, Version 1;
(ii) Project emissions from flaring, EB68 Annex 15, Version 02.0.0;
(iii) Non-binding best practice examples to demonstrate additionality for SSC project activities, EB35 Annex 34;
(iv) Guidelines on the demonstration of additionality of small-scale project activity, EB68 Annex 27, Version 0.9.

For more information on these tools, please see http://cdm.unfccc.int/Reference/Guidclarif/ssc/index_guid.html.

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

The following tables present applicable applicability and the relation of the project case to each applicability criteria is described.

The applicability criteria for the methodology *AMS III.H, Version 16* are as below:

Table 4: Applicability conditions and project scenario

	Applicability condition	Project Scenario
1	This methodology comprises measures that recover biogas from biogenic organic matter in wastewaters by means of one, or a combination, of the following options: (d) Introduction of biogas recovery and	This proposed project activity introduces biogas recovery and combustion to an existing anaerobic wastewater treatment system such as anaerobic lagoons (described in Section A.4.1.4 and A.4.2). Without the proposed project activity, biogas from existing anaerobic lagoons would continue to be

	combustion to an anaerobic wastewater treatment system such as anaerobic reactor, lagoon, septic tank or an onsite industrial plant.	emitted into the atmosphere. Therefore, the proposed project activity satisfied the applicability criterion (d).
2	In cases where baseline system is anaerobic lagoon the methodology is applicable if: (a) The lagoons are ponds with a depth greater than two meters, without aeration. The value for depth is obtained from engineering design documents, or through direct measurement, or by dividing the surface area by the total volume. If the lagoon 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.	In the baseline scenario, the wastewater is treated by 5 anaerobic lagoons and 2 facultative lagoons. According to the engineering design document, the minimum depth of these lagoons is 3.3 meters.[12] The average minimum and maximum temperature in Malaysia is above $15^{O}C$ through the year 2011[13]. The previous two sludge removal events occurred on 8th April 2010 and 6th May 2011, which the interval between these two sludge removal events are more than 30 days.[14]
3	The recovered methane from the above measures may also be utilized for the following applications instead of combustion/flaring: (a) Thermal or electrical energy generation directly; or (b) Thermal or electrical energy generation after bottling of upgraded biogas; (c) Thermal or electrical energy generation after upgraded and distribution: (i) Upgrading and infection of biogas into a natural gas distribution grid with no significant transmission constraints; (ii) Upgrading and transportation of biogas via a dedicated pipes network to a group of end users; (d) Hydrogen production (e) Use as fuel in transportation applications after upgrading	The proposed project activity will utilize the recovered methane for thermal ~~and~~ electricity energy generation directly, besides flaring. This is in accordance with option (a) for Thermal and electrical energy generation directly. The utilization of biogas for renewable energy is not part of the current project activity. Therefore, credits for renewable energy generation are not requested in this PDD.
4	If the recovered methane is used for project activity covered under paragraph 3 (a), that component of the project activity can use a corresponding category under type I.	The mill owner will utilize the captured biogas as fuel for electricity generation with two gas engines as first priority. The remaining captured biogas will be used in its existing biomass boiler for steam generation as second priority. This utilization of biogas for renewable energy is not part of the current proposed project activity. Therefore, credits for renewable energy generation are not

[12] Open Lagoons Treatment System Layout

[13] http://www.bbc.co.uk/weather/1735161

[14] Prosper POM Desludging Events

		requested in this PDD and the approved baseline and monitoring methodologies AMS I.C and AMS I.F are not used for thermal and electricity generation component of the project activity.
5	New facilities (Greenfield projects) and project activities involving a change of equipment resulting in a capacity addition of the wastewater or sludge treatment system compared to the designed capacity of the baseline treatment system are only eligible to apply this methodology if they comply with the relevant requirements in the "General guidelines to SSC CDM methodologies". In addition the requirements for demonstrating the remaining lifetime of the equipment replaced, as described in the general guidelines shall be followed.	The proposed project activity is converting two existing anaerobic lagoons into covered in-ground anaerobic reactor system. The proposed project activity is not therefore a Greenfield project. The project activity equipment are new and does not result in any capacity addition of the wastewater treatment system compared to baseline treatment system.
6	The location of the wastewater treatment plant as well as the source generating the wastewater shall be uniquely defined and described in the PDD.	The location of the baseline wastewater treatment plant as well as the source generating the wastewater is described in Section A.4.1 of the PDD.
7	Measures are limited to those that result in emission reductions of less than or equal to 60kt CO2 equivalent annually from all Type III components of the project activity.	Ex-ante emission reductions due to the wastewater treatment were estimated at 24,369 tCO2e annually. The result is lower than the 60 kt CO2e threshold.

B.3. Description of the project boundary:

As stated in the AMS III.H methodology, the project boundary "*is the physical, geographical site where the wastewater and sludge treatment takes place in baseline and project situation. 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 this project, the project boundary includes all lagoons described in Section A.4.1.4. (two of which is covered using HDPE to enable the capturing and combustion of lagoon generated methane) and any new project activity equipment (e.g. pumps) used in the wastewater treatment process.

Project activity emissions will be based upon the total kilowatt hours (kWh) consumed by project activity equipment. To remain conservative, project activity equipment will be assumed in operation 24 hours per day, 365 days per year. Sludge treatment is not affected by the implementation of the project activity as the sludge will be disposed of in the same manner as it was prior to the project activity (land application). The project site has no connection to grid electricity. Actual biogas destruction (via flare or combustion equipment) is monitored and included within the project boundary. The end result of biogas utilization (i.e. heat or electricity generated as a result of biogas destruction) is not part of the project boundary and will not contribute to credits requested as part of the CDM project activity.

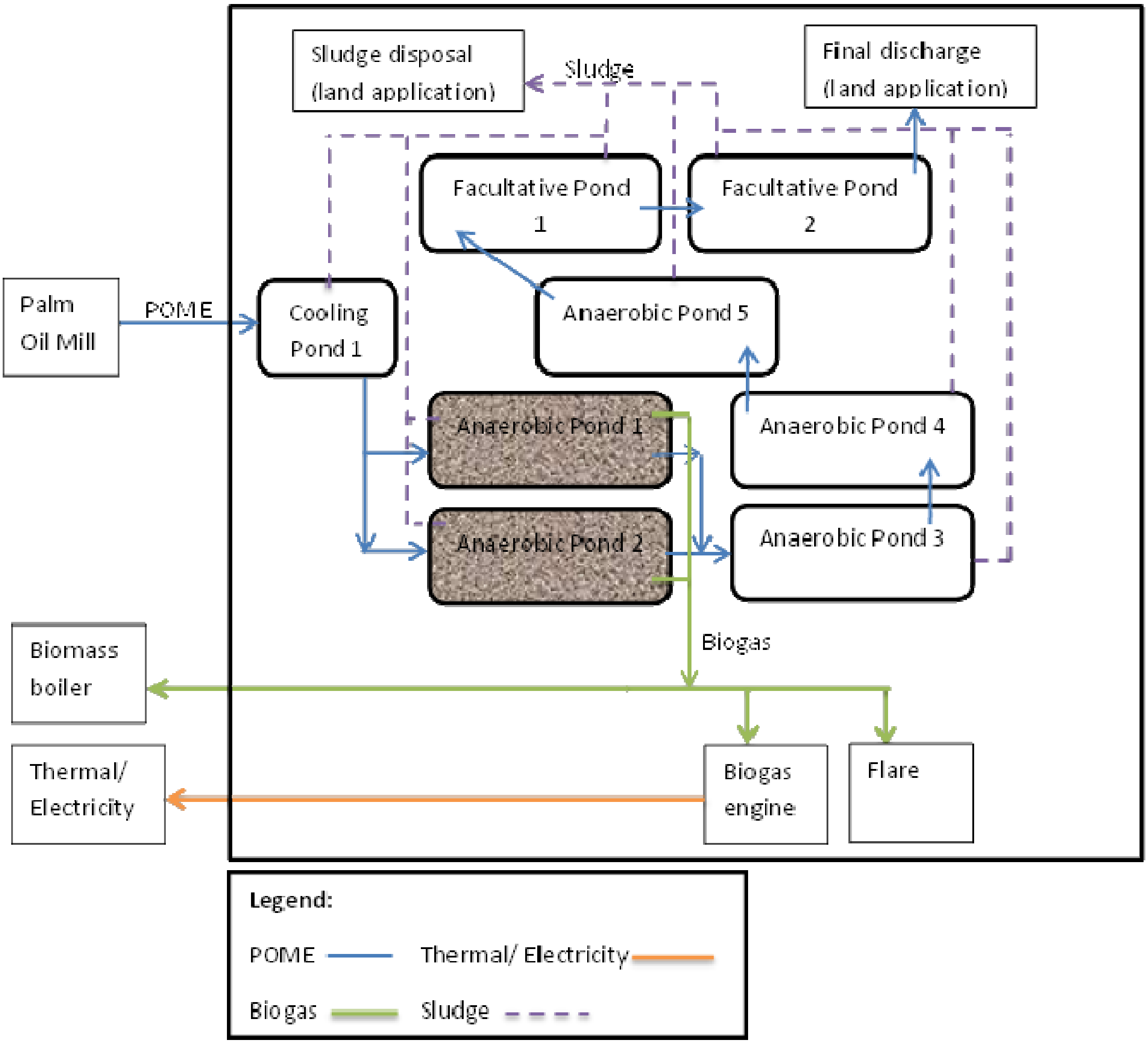

Figure 2: Project Boundary

The table below indicates the GHG emissions that are considered in the proposed CDM project activity.

Table 5: GHG emissions considered in the proposed CDM project activity

Source	Source	Gas	Included/Excluded	Justification/Explanation
Baseline	Wastewater treatment System	CO_2	Excluded	CO_2 emissions from the decomposition of organic waste are not accounted for.
		CH_4	Included	Main source of emissions in the baseline from open lagoons.
		N_2O	Excluded	Excluded for simplification. This is conservative.
	Thermal Heat Generation	CO_2	Excluded	The thermal energy generated under the project activity will displace heat generated using biomass, while the end result of biogas

				utilization (i.e. heat or electricity generated as a result of biogas destruction) will not contribute to credits requested as part of the CDM project activity. Thus, this is excluded.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
	Electricity consumption / generation	CO_2	Excluded	Excluded for simplification. This is conservative.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
Project Activity	Wastewater treatment System	CO_2	Excluded	CO_2 emissions from the decomposition of organic waste are not accounted for.
		CH_4	Included	Emissions through degradable organic carbon in treated wastewater are accounted for. Fugitive emissions from biogas release in the capture system and emission from incomplete flaring are accounted for.
		N_2O	Excluded	Excluded for simplification. This is conservative.
	Thermal Heat Generation	CO_2	Excluded	The thermal energy generated under the project activity will displace heat generated using biomass, while the end result of biogas utilization (i.e. heat or electricity generated as a result of biogas destruction) will not contribute to credits requested as part of the CDM project activity. Thus, this is excluded.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
	On site Electricity Consumption	CO_2	Included	The electricity consumption source for project activity auxiliary equipment is from off-grid captive renewable power generation technology (biomass boiler) using biomass fuel such as palm fibre and palm kernel shell. In order to take into consideration the use of diesel at the back-up diesel generator during the biomass boiler are not in operation, the project emissions from electricity consumption are accounted for.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is

				conservative.

Since the technology used in the proposed project activity does not consist of equipment from another project activity, leakage is not considered in accordance to the methodology.

B.4. Description of baseline and its development:

The discharge of POME into watercourse or land application in Malaysia is regulated by Malaysian Environmental Quality Act 1974 [Act 127], P.U. (A) 342/77[15], Environmental Quality (Prescribed Premises) (Crude Palm Oil) Regulations 1977. According to this regulation, the BOD limit of POME discharge direct to watercourse shall not exceed 100 mg/liter, and the BOD limit of POME applied to land shall not exceed 5,000 mg/l. Considering the high BOD content of untreated POME, therefore it is prohibited by law to discharge the untreated POME into land application or watercourse.

However, there is no national or sectoral policy or regulation in Malaysia to stipulate any type of wastewater treatment technology for treatment, except that POME for final discharge must meet the criteria listed. For this reason, although anaerobic digestion is a versatile biological treatment technology that could yield biogas as a useful bioenergy from treating POME, majority of palm oil mills still use solely open lagoons system to treat POME due to their low capital and operating cost. The Malaysian palm oil industry perceives that the installation of wastewater treatment system as a means to satisfy statutory effluent discharge requirement, rather than a potential revenue stream. For these reasons, high-GHG-emitting open lagoons system is opted by majority Malaysian palm oil mills to treat POME to adhere to Malaysian Department of Environment requirement, and is significantly lower in capital and operating cost as compared to anaerobic digestion system.

It is worth noting that the site include in this project activity has been existence for a number of years, during which time open lagoons system has been used as the prevailing wastewater management practice. There is no regulatory requirement to alter the existing practice. Therefore, mill owner has no other reason to alter the existing wastewater treatment practice into lower-GHG-emitting anaerobic digester without the existence of CDM. Continuation of existing open lagoons system requires no additional investment and it represents a financially more viable option which would lead to higher GHG emissions.

The implementation of the project activity into a lower-GHG-emitting anaerobic digester requires significant investment in capital and operating costs. The capital investment for the project activity is approximately RM 2,032,815 while the operating and maintenance costs are estimated to be RM 233,774 per year. The only potential revenue is from the future CERs generated by this project activity. Any revenues or cost savings for electricity or heat generation will remain with mill owner, as the mill owner has the right to the biogas as stated in the contract between Green Lagoon and mill owner. Without the assistance of CDM, the high development cost and no other revenue will prevent Green Lagoon from pursuing the project activity. The open lagoons system, which results in higher GHG emissions, would continue to be used. Therefore, the baseline scenario is the continuation of the present wastewater treatment system and the release of biogas into the atmosphere.

For *ex ante* estimation, forecasted wastewater generation based on the forecasted FFB production and national average of 0.7 cubic meters wastewater generation per tonne FFB was utilized. However, the *ex post* emissions reduction calculation shall be based on the actual monitored volume of treated wastewater.

[15] http://www.doe.gov.my/dmdocuments/legislation/pua0342y1977.pdf

As explained above the baseline is in conformance with UNFCCC-approved methodology AMS III.H, version 16, *Methane recovery in wastewater treatment.* In determining the baseline emission, paragraph 27 is referred to; even though the existing wastewater treatment for the project site has been in operation for at least three years, one year historical records on COD removal was not available. This is due to local environmental monitoring only requires COD testing of the final discharge and not for COD of inflow into the wastewater system; there is no data to calculate the COD removal efficiency (for adherence to paragraph 27(a)). Therefore, for the determination of baseline emission per paragraph 27 (c), the COD removal efficiency has been determined through an ex-ante measurement campaign of at least 10 days (an 11-day measurement campaign was conducted) following paragraph 27(b) of the methodology. Please refer to Annex 3 for the detail of key assumptions and rationale to determine the baseline emission.

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:

It has been demonstrated earlier that POME is treated by open lagoons system without biogas recovery in the baseline scenario. This means that the anthropogenic GHGs (biogas consists of methane) are emitted into the atmosphere via decomposition of POME at the current open lagoons system without being collected or destroyed. The proposed project activity intends to improve the current wastewater treatment practice by installing sealed HDPE covers over existing two anaerobic POME lagoons to create an anaerobic digester system with biogas recovery. These changes will result in the mitigation of anthropogenic GHGs emissions, by capturing and combusting the biogas via biogas utilization.

Prior considerations of CDM

According to the *Guidelines on the demonstration and assessment of prior consideration of the CDM, Version 4*, "*for project activities with a starting date on or after 2 August 2008, the project participant must inform the Host Party Designated National Authority (DNA) and the UNFCCC secretariat in writing of the commencement of the project activity and of their intention to seek CDM status. Such notification must be made within six months of the project activity start date.*"

In accordance with the definition stated in *Glossary of CDM terms, Version 5*, Starting date of a CDM project activity is defined as *"The starting date of a CDM project activity is the earliest date at which either the implementation or construction or real action of a project activity begins… In light of the above definition, the start date shall be considered to be the date on which the project participant has committed to expenditures related to the implementation or related to the construction of the project activity."* Therefore, the signing date of contract for key equipment by the project participant would be considered the starting date of this project activity. Relevant detailed timeline is summarized in the following table to prove that the CDM was seriously considered in decision-making of the project.

Table 6: Events Chronology on Prior Consideration of CDM

Date	Events	Supporting Documents
5th Mar 2011	Green Lagoon proposed a CDM project of Methane Recovery to Prosper Palm Oil Mill	MoU to Prosper Palm Oil Mill[16]
13th Apr 2011	Green Lagoon conducted a feasibility study on the	Feasibility Study Report[17]

[16] Prosper POM MOU between GLT and Prosper

[17] Simple FS report to Prosper

	proposed project	
9th May 2011	Green Lagoon signed contract with Prosper Palm Oil Mill	Contract with Prosper Palm Oil Mill[18]
13th Jun 2011	Green Lagoon designed the covered in-ground anaerobic reactor to two existing anaerobic lagoons	Engineering Design Documents of anaerobic lagoons[19]
17th Sep 2011	Notification to DNA	Letter and Prior Consideration Notice to DNA[20]
19th Sep 2011	Notification to UNFCCC	Prior Consideration Notice to UNFCCC by email[21]
12th Oct 2011	UNFCCC confirmation on notification	Email from UNFCCC[22]
10th Nov 2011	EIA Approval	EIA Exemption Letter from Department of Environment[23]
28th Nov 2011	Issuance of Purchase Order for key equipment (project start date)	Purchase Order from Green Lagoon to key equipment supplier[24]
21st Dec 2011	Date of start of construction	Project Report[25]
30th Mar 2012	Estimated date of start of operation	Project Schedule[26]
30th May 2012	Signing ERPA with Camco South East Asia Ltd	ERPA between Green Lagoon and Camco South East Asia Ltd[27]

The above chronology of events clearly demonstrates that CDM was seriously considered in the decision to proceed with the proposed project activity. The documents and information mentioned in the table above are in line with paragraph 6 of the *Guidance on the demonstration and assessment of prior consideration of the CDM, Version 4*. These verified documents and information are applicable to prove that (a) the project participants were aware of the CDM prior to the project activity start date, and that the benefits of the CDM were a decisive factor in the decision to proceed with the project; and (b) that continuing and real actions were taken to secure CDM status for the project in parallel with its implementation.

[18] Prosper POM Contract between GLT and Prosper

[19] Design Engineering Drawing of the Covered Inground Anaerobic Reactor

[20] Prior Consideration Notice Evidence to Host Country DNA

[21] Prior Consideration Notice Evidence to UNFCCC

[22] Prior Consideration Notice Email Evidence to UNFCCC

[23] Prosper POM EIA Exemption Letter

[24] PO to key equipment supplier from Green Lagoon

[25] Prosper Project Report

[26] Prosper Project Schedule

[27] ERPA between Green Lagoon and Camco South East Asia Ltd

Additionality

In accordance with *Guidelines on the demonstration of additionality of small-scale project activities (version 09.0),* "project participants shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers:

(e) Investment barrier: a financially more viable alternative to the project activity would have led to higher emissions;

(f) Technological barrier: a less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty or low market share of the new technology adopted for the project activity and so would have led to higher emissions;

(g) Barrier due to prevailing practice: prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions;

(h) Other barriers: without the project activity, for another specific reason identified by the project participant, such as institutional barriers or limited information, managerial resources, organizational capacity, financial resources, or capacity to absorb new technologies, emissions would have been higher."

The most relevant barrier which prevents this project activity from being implemented without the assistance of CDM is as follows:

Investment barrier

In accordance with the *Non-binding best practice examples to demonstrate additionality for SSC project activities (EB35, Annex 34)* "a financially more viable alternative to the project activity would have led to higher emissions".

The analysis without CDM income consideration for the proposed project activity and alternatives are summarized as below. The simple cost analysis is taken as the project activity generates no other revenue other than carbon credits to the project developer.

Table 7: Summary of investment analysis of the proposed project activity and alternative scenario

Alternatives	Scenario Description	CAPEX (RM)	OPEX[28] (RM)	NPV[29] (RM)
Alternative 1	Methane recovery by using covered in-ground anaerobic digester and utilization for heat and electricity generation (proposed project without CDM assistance)	2,032,815	233,774	(3,476,116)
Alternative 2	Open lagoons system without biogas recovery (continuation of the current situation)	0	0	0

[28] OPEX cost is 11.5% of CAPEX based on seven registered CDM projects in West Malaysia using same type of methodology and technology

[29] Discount rate of 6.60% is based on Malaysia Base Lending Rate (BLR) effective since 11 May 2011

From the investment analysis conducted, Alternative 2 (open lagoons system without biogas recovery) is considered as the most economical or financially attractive project activity. In addition, as described in Section A.4.1.4, this palm oil mill currently uses an anaerobic lagoon system without biogas recovery to treat POME prior to its land application in the current situation. Therefore, the baseline scenario of this project activity is the continuation of the present open lagoons system and the release of biogas into the atmosphere. From the analysis conducted, the proposed project cannot be seen as financially or economically attractive and the proposed project is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

Estimating the Baseline Emissions

The amount of biogas that would be emitted to the atmosphere in the absence of the project activity can be estimated by referring to AMS III.H, *Methane recovery in wastewater treatment*, *Version 16.* According to this methodology, "Baseline emissions for the systems affected by the project activity may consist of:

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

Item (i), (iii), (iv) and (v) will not be applicable to the project activity emissions due to the following reasons:

- Item (i), $\mathbf{BE_{power,y}}$,is excluded for simplification as the baseline emission and project emission from fuel or electricity consumption is equal and only power from auxiliary equipment for project activity will be taken into account for project emissions.
- Item (iii), $\mathbf{BE_{s,treatment,y}}$,is not applicable as the baseline wastewater treatment system does not have sludge treatment system.
- Item (iv), $\mathbf{BE_{ww,discharge}}$, is not applicable as final discharge is land applied aerobically.
- Item (v), $\mathbf{BE_{s,final,y}}$,is not applicable as sludge is land applied aerobically.

Equation 1: Total baseline emissions

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

Where:

BE_y	Baseline emissions in year *y (tCO2e)*
$BE_{ww,treatment,y}$	Baseline emissions of the wastewater treatment systems affected by the project activity in year *y (tCO2e)*

In paragraph 26 of the methodology states: *"In determining baseline emissions using equation 1, historical records of at least one year prior to the project implementation shall be used. This shall include for example the COD removal efficiency of the wastewater treatment systems…"* Since one year historical data is not available, paragraph 27(b) is applicable:

(b) An ex ante measurement campaign shall be implemented to determine the required parameters (COD removal efficiency, specific energy consumption and specific sludge production). The measurement campaign shall be implemented in the baseline wastewater systems for at least 10 days. The measurements should be undertaken during a period that is representative for the typical operation conditions of the systems and ambient conditions of the site (temperature, etc). Average values from the measurement campaign shall be used and the result shall be multiplied by 0.89 to account for the uncertainty range (30% to 50%). The parameters from the measurement campaign are used to calculate the baseline emission in year y;

The following equation (Equations 2) is used to determine the values applied in Equation 1.

Equation 2: Baseline emissions of the wastewater treatment systems

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

Where:

$Q_{ww,i,y}$	Volume of wastewater treated in baseline wastewater treatment system *i* in year *y* (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 wastewater treatment system *i* in year *y* (t/m^3). Average value may be used through sampling with the confidence/precision level 90/10
$\eta_{COD,BL,i}$	COD removal efficiency of the baseline wastewater treatment system *i*, determined as per the paragraphs 26, 27 or 28 of AMS.III.H, Version 16
$MCF_{ww,treatment,BL,i}$	Methane correction factor for baseline 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)

Estimating the Project Emissions

As stated by the methodology AMS.III.H, Version 16, the project activity emissions affected by the project activity are:

(i) CO_2 emissions from electricity and fuel used by the project facilities (PE_{power});

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

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

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

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

(vi) Methane fugitive emissions due to inefficiencies in capture systems ($PE_{fugitive,y}$);

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

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

Item (iii), (iv), (v), and (viii) will not be applicable to the project activity emissions due to the following reasons:

- Item (iii), $\mathbf{PE_{s,treatment,y}}$,is neglected since there is no sludge treatment system or methane recovery applied to sludge in the project scenario.
- Item (iv), $\mathbf{PE_{ww,discharge,y}}$, is neglected since the final discharge is land applied aerobically.
- Item (v), $\mathbf{PE_{s,final,y}}$,is neglected since the sludge is used for soil application in aerobic conditions in the project scenario.
- Item (viii), $\mathbf{PE_{biomass,y}}$,is neglected as there is no biomass stored in the project activity.

Equation 3: Total project activity emissions

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

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 of methodology AMS.III.H, Version 16 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 3, using an uncertainty factor of 1.12 and data applicable to the project situation ($MCF_{ww,treatment,PJ,k}$ and $\eta_{,PJ,k,y}$) and with the following changed definition of parameters:
	$MCF_{ww,treatment,PJ,k}$ — Methane correction factor for project wastewater treatment system k (MCF values as per Table III.H.1)
	$\eta_{,PJ,k,}$ — Chemical oxygen demand removal efficiency of the project wastewater treatment system k in year y (t/m^3), measured based on inflow COD and outflow COD in system k
$PE_{fugitive,y}$	Methane emissions from biogas release in capture systems in year y, calculated as per paragraph 30 of methodology AMS.III.H, Version 16 (tCO_2e)
$PE_{flaring,y}$	Methane emissions due to incomplete flaring in year y (tCO_2e). For *ex ante* estimation, baseline emission calculation for wastewater and/or sludge treatment (i.e. equation 2 of the methodology AMS.III.H, Version 16) can be used but without the consideration of GWP for CH_4. However, the *ex post* emission reduction shall be calculated as per the methodological tool *Project emissions from flaring* by using actual monitored data

The following equations (Equations 4 through 9) are used to determine the values applied in Equation 3.

As per paragraph 19 of methodology AMS.III.H, Version 16, the project emissions from electricity and fossil fuel consumption are determined as per the procedures described in the "Tool to calculate baseline, project and/ or leakage emissions from electricity consumption", using energy consumption data of all equipment/devices used in the project activity wastewater treatment systems and systems for biogas recovery and flaring/gainful use (project activity equipment).

Equation 4: Emissions from electricity or fuel consumption

$$PE_{power,y} = \sum_{m} EC_{PJ,j,y} \times EF_{EL,j,y} \times (1 + TDL_{j,y})$$

Where:

$PE_{power,y}$	Project emissions from electricity or fuel consumption in year $y(tCO_2e)$
$EC_{PJ,j,y}$	Quantity of electricity that would be consumed by the project electricity consumption source j in year y *(MWh/yr)*
$EF_{EL,j,y}$	Emission factor of electricity generation for source j in year $y(tCO_2/MWh)$
$TDL_{j,y}$	Average technical transmission and distribution losses for providing electricity to source j in year y
j	Source of electricity consumption in the project activity

The mill's wastewater treatment system does not use grid electricity. The mill produces its own electricity primary from biomass with diesel fuel used only for start-up or as backup. As the project site is not grid connected and the electricity consumption source is from either biomass boiler or backup diesel generator, both electricity consumption sources are considered as **Scenario B: Electricity consumption from (an) off-**

grid fossil fuel fired captive power plant(s). To remain conservation, the electricity consumption source for project activity equipment is assumed from backup diesel generator.

Project participant has selected **Option B2** approach in “Tool to calculate baseline, project and/ or leakage emissions from electricity consumption” to determine the emission factor for electricity generation ($EF_{EL,j,y}$ = 1.3 tCO_2/MWh) for project emissions from electricity consumption. In addition, project activity equipment will be assumed in operation 24 hours per day, 365 days per year for *ex ante* estimation. For *ex post* calculation, the actual quantity of electricity consumed by the project activity equipment will be measured on site during the project activity.

Equation 5: Methane emissions from wastewater treatment systems

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

Where:

$Q_{ww,y}$	Volume of wastewater treated in project wastewater treatment system *k* 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
$COD_{inflow,k,y}$	Chemical oxygen demand of the wastewater entering into the project wastewater treatment system *k* not equipped with biogas recovery in year *y* (t/m^3). Average value may be used through sampling with the confidence/precision level 90/10
$\eta_{COD,PJ,k}$	COD removal efficiency of the baseline wastewater treatment system k, measured based on inflow COD and outflow of COD in system *k* not equipped with biogas recovery
$MCF_{ww,treatment,PJ,k}$	Methane correction factor for project wastewater treatment systems *k* (MCF values as per table III.H.1)
k	Index for project 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 (1.12)
GWP_{CH4}	Global Warming Potential for methane (value of 21)

Equation 6: Methane emissions from biogas release in capture systems

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

Where:

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

In the project activity, fugitive emissions through capture inefficiencies in the anaerobic sludge treatment system ($PE_{,fugitive,s,y}$) are not calculated since sludge is not subject to any methane capture and flare system. Therefore, total fugitive emissions ($PE_{fugitive,y}$) consists solely of fugitive emissions through capture inefficiencies in the anaerobic wastewater treatment systems ($PE_{fugitive,ww,y}$).

Equation 7: Fugitive emissions through capture inefficiencies in the anaerobic wastewater treatment systems

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

Where:

$PE_{fugitive,ww,y}$	Fugitive emissions through capture inefficiencies in the anaerobic wastewater treatment systems in the year *y* (tCO_2e)
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* (t)
GWP_{CH4}	Global Warming Potential for methane (value of 21)

Equation 8: Methane emission potential of the wastewater treatment systems

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

Where:

$MEP_{ww,treatment,y}$	Methane emission potential of wastewater treatment systems equipped with biogas recovery system in year *y* (t)
$Q_{ww,y}$	Volume of treated wastewater discharge in year *y* (m^3)
$B_{o,ww}$	Methane producing capacity of the wastewater (IPCC value of 0.25 kg CH_4/kg COD)
UF_{PJ}	Model correction factor to account for model uncertainties (1.12)
$COD_{removed,PJ,k}$	The chemical oxygen demand removed by the treatment system *k* of the project activity equipped with biogas recovery in the year *y* (t/ m^3)
$MCF_{ww,treatment,PJ,k}$	Methane correction factor for the project wastewater treatment system *k* equipped with biogas recovery equipment (MCF value as per Table III.H.1)

Equation 9: Methane emission due to incomplete flaring

In accordance to methodology AMS.III.H, Version 16, for *ex ante* estimation, baseline emission calculation for wastewater treatment (i.e. equation 2) can be used to calculate the methane emission due to incomplete flaring, but without the consideration of GWP for CH_4.

$$PE_{flaring,y} = \sum_{i} (Q_{ww,y} * COD_{\inf low,k,y} * \eta_{COD,PJ,k} * MCF_{ww,treatment,PJ,k}) * B_{o,ww} * UF_{PJ}$$

Where:

$Q_{ww,y}$	Volume of wastewater treated in baseline wastewater treatment in year y (m^3)
$COD_{inflow,k,y}$	Chemical oxygen demand of the wastewater entering into the project wastewater treatment system k equipped with biogas recovery in year y (t/m^3). Average value may be used through sampling with the confidence/precision level 90/10
$\eta_{COD,PJ,k}$	COD removal efficiency of the baseline wastewater treatment system k, measured based on inflow COD and outflow COD in system k equipped with biogas recovery
$MCF_{ww,treatment,PJ,k}$	Methane correction factor for project wastewater treatment systems k (MCF values as per table III.H.1)
$B_{o,ww}$	Methane producing capacity of the wastewater (IPCC value of 0.25 kg CH_4/kg COD)
UF_{PJ}	Model correction factor to account for model uncertainties (1.12)

The assumption for this parameter is that all biogas will enter into the flaring system *ex-ante* to cater for if gainful use is unavailable. However, on-site measurement during project activity will be tabulated *ex-post* using the methodological tool “Project emissions from flaring” version 02.0.0 in the following steps:

STEP 1: Determination of the methane mass flow of the residual gas;
STEP 2: Determination of the flare efficiency;
STEP 3: Calculation of project emissions from flaring

Step 1: Determination of the methane mass flow in the residual gas
The “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” version 02.0.0 shall be used to determine the parameter $F_{CH4,m}$ “Mass flow of methane in the residual gaseous stream in the minute *m*”

The following requirements apply:
- The gaseous stream tool shall be applied to the residual gas;
- The flow of the gaseous stream shall be measured continuously;
- CH_4 is the greenhouse gas *i* for which the mass flow should be determined;
- The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations 3 and 17 in the tool); and
- The time interval *t* for which mass flow should be calculated is every minute *m*.

$F_{CH4,m}$, which is measured as the mass flow during minute *m*, shall then be used to determine the mass of methane in kilograms fed to the flare in minute *m* ($F_{CH4,RG,m}$). $F_{CH4,m}$ shall be determined on a dry basis, and per measurement options in the Tool, option D of the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” version 02.0.0 shall be used to determine the parameter $F_{CH4,m}$.

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

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

The mass flow of greenhouse gas *i* ($F_{i,t} = F_{CH4,RG,m}$) is determined using equations (5) and (6) of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 02.0.0 as follows:

$$F_{CH4,RG,m} = V_{t,db} * v_{i,t,db} * \rho_{i,t}$$

With

$$\rho_{i,t} = \frac{P_t * MM_i}{R_u * T_t}$$

Where

Data	Description
$F_{CH4,RG,m}$	Mass flow of greenhouse gas *i* in the gaseous stream in time interval t (kg gas/h)
$V_{t,db}$	Volumetric flow of the gaseous stream in time interval *t* on a dry basis (m³ dry gas/h)
$v_{i,t,db}$	Volumetric fraction of greenhouse gas *i* in the gaseous stream in a time interval *t* on a dry basis (m³ gas i/m³ dry gas)
$\rho_{i,t}$	Density of greenhouse gas *i* in the gaseous stream in time interval *t* (kg gas *i*/m³ gas *i*)
P t	Absolute pressure of the gaseous stream in time interval *t* (Pa)
MM_i	Molecular mass of greenhouse gas *i* (kg/kmol)
R_u	Universal ideal gases constant (Pa.m 3 /kmol.K)
T_t	Temperature of the gaseous stream in time interval *t* (K)

The volumetric flow of the gaseous stream in time interval t on a dry basis ($V_{t,db}$) is determined by converting the mass flow of the gaseous stream to a volumetric flow as follows:

$$V_{t,db} = M_{t,db} / \rho_{t,db}$$

Where

Data	Description
$V_{t,db}$	Volumetric flow of the gaseous stream in time interval *t* on a dry basis (m^3 dry gas/h)
$M_{t,db}$	Mass flow of the gaseous stream in time interval *t* on a dry basis (kg/h)
$\rho_{t,db}$	Density of the gaseous stream in time interval t on a dry basis (kg dry gas/m^3 dry gas)

$$\rho_{t,db} = \frac{P_t * MM_{t,db}}{R_u * T_t}$$

Where

Data	Description
$\rho_{t,db}$	Density of the gaseous stream in a time interval *t* on a dry basis (kg dry gas/m^3 dry gas)
$MM_{t,db}$	Molecular mass of the gaseous stream in a time interval *t* on a dry basis (kg dry gas/kmol dry gas)
P_t	Pressure of the gaseous stream in time interval *t* (Pa)
T_t	Temperature of the gaseous stream in time interval *t* (K)

The molecular mass of the gaseous stream ($MM_{t,db}$) is estimated as follow:

$$MM_{t,db} = \sum_k (V_{k,t,db} \quad MM_k \;)$$

Where

Data	Description
$MM_{t,db}$	Molecular mass of the gaseous stream in time interval *t* on a dry basis (kg dry gas/kmol dry gas)
$V_{k,t,db}$	Volumetric fraction of gas k in the gaseous stream in time interval *t* on a dry basis (m³ gas k/m³ dry gas)
MM_k	Molecular mass of gas *k* (kg/kmol)
k	All gases, except H 2 O, contained in the gaseous stream (e.g. N_2, CO_2, O_2, CO, H_2, CH_4, N_2O, NO, NO_2, SO_2, SF_6 and PFCs).

The determination of the molecular mass of the gaseous stream ($MM_{t,db}$) requires measuring the volumetric fraction of all gases (k) in the gaseous stream. However as a simplification, the volumetric fraction of only the gases k that are greenhouse gases and are considered in the emission reduction calculation.

<u>Step 2: Determination of flare efficiency</u>
The flare efficiency depends on the efficiency of combustion in the flare and the time that the flare is operating.

The project activity is utilizing enclosed flare, therefore step 2(b) is referred to and Option A on the flare efficiency for minute m ($\eta_{flare,m}$) is selected:

<u>Option A: Default value</u>
The flare efficiency for the minute m ($\eta_{flare,m}$) is 90% when the following two conditions are met to demonstrate that the flare is operating:

1. The temperature of the flare ($T_{EG,m}$) and the flow rate of the residual gas to the flare ($F_{RG,m}$) is within the manufacturer's specification for the flare ($SPEC_{flare}$) in minute *m*; and
2. The flame is detected in minute *m* ($Flame_m$)

The manufacture's specification for the flare is listed as per following[30]:

(a) Inlet flow rate – 250 Nm3/hr (max)
(b) Operating temperature - >500°C
(c) Duration between maintenance events – per maintenance plan

Otherwise $\eta_{flare,m}$ is 0%.

<u>Step 3: Calculation of project emissions from flaring</u>
Project emissions from flaring are calculated as the sum of emissions for each minute *m* in year *y*, based on the methane mass flow in the residual gas ($F_{CH4,RG,m}$) and the flare efficiency ($\eta_{flare,m}$), as follows:

$$PE_{flare,y} = GWP_{CH4} * \sum_{m=1}^{525600} F_{CH4,RG,m} * (1- \eta_{flare,m}) * 10^{-3} \qquad \text{(Equation 11e)}$$

Where:

[30] Flare specifications from the manufacturere

$PE_{flare,y}$	Project emissions from flaring of the residual gas in year y (tCO_2e)
GWP_{CH4}	Global warming potential of methane valid for the commitment period (tCO_2e/tCH_4)
$F_{CH4,RG,m}$	Mass flow of methane in the residual gas in the minute *m* (kg)
$\eta_{flare,m}$	Flare efficiency in minute *m*

Leakage

In accordance with the methodology, leakage calculations are not required since the technology being employed in this project is not transferred from or to another activity.

Equation 10: Estimated emission reductions

For the purposes of estimation, emission reductions shall be estimated ex ante in the PDD using the equations provided in the baseline, project and leakage emission equations above. Emission reductions shall be estimated ex ante as follows:

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

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 paragraph 29 of AMS.III.H, Version 16 methodology (tCO_2e)

$BE_{y,ex\,ante}$ *Ex ante* baseline emissions in year *y* calculated as per paragraph 18 of AMS.III. H, Version 16 methodology (tCO_2e)

For case1 (d) in the project activity: it is possible that the project activity involves wastewater treatment systems with higher methane conversion factors (*MCF*) or with higher efficiency than the treatment systems used in the baseline situation. Therefore the emission reductions achieved by the project activity is limited to the *ex post* calculated baseline emissions minus project emissions using the actual monitored data for the project activity. The emission reductions achieved in any year are the lowest value of the following:

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

Where:

$ER_{y,ex\ post}$ Emission reductions achieved by the project activity based on monitored values for year *y* (tCO_2e)

$BE_{y,ex\ post}$ Baseline emissions calculated as per paragraph 18 using *ex post* monitored values

$PE_{y,ex\ post}$ Project emissions calculated as per paragraph 29 using *ex post* monitored values

MD_y	Methane captured and destroyed/gainfully used by the project activity in the year *y* (tCO_2e)

In the case of flaring/combustion MD_y will be measured using the conditions of the flaring process:

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

Where:

$BG_{burnt,y}$	Biogas[31] flared/combusted in year *y* (m^3)
$W_{CH4,y}$	Methane content in the biogas in the year *y* (mass 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)
GWP_{CH4}	Global Warming Potential for methane (value of 21)

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	**GWP_{CH4}**
Data unit:	-
Description:	Global Warming Potential of Methane
Source of data used:	Refer to AMS III-H, V.16 methodology.
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied:	In accordance with the parameter definition in AMS III H, V.16.
Any comments:	Used for baseline and project emissions calculation.

Data / Parameter:	**$B_{o,ww}$**
Data unit:	kg CH_4 / kg COD
Description:	Methane producing capacity of the wastewater
Source of data used:	IPCC default value for domestic wastewater as cited in AMS III H, V.16 methodology.
Value applied:	0.25
Justification of the choice of data or description of measurement methods and procedures actually applied:	In accordance with the parameter definition in AMS III H, V.16.
Any comments:	Used for baseline and project emissions calculation.

Data / Parameter:	**UF_{BL}**

[31] Biogas volume and methane content measurements shall be on the same basis (wet or dry).

Data unit:	-
Description:	Model correction factor to account for model uncertainties
Source of data used:	Refer to AMS III-H, V.16 methodology.
Value applied:	0.89
Justification of the choice of data or description of measurement methods and procedures actually applied :	In accordance with the parameter definition in AMS III H, v.16.
Any comment:	Used for baseline emissions calculation.

Data / Parameter:	$\mathbf{UF_{PJ}}$
Data unit:	Fraction
Description:	Model correction factor to account for model uncertainties
Source of data used:	Refer to AMS III-H, V.16 methodology.
Value applied:	1.12
Justification of the choice of data or description of measurement methods and procedures actually applied :	In accordance with the parameter definition in AMS III H, V.16.
Any comment:	Used for project emissions calculation.

Data / Parameter:	$MCF_{ww,treatment,BL,i}$
Data unit:	-
Description:	Methane correction factor for baseline wastewater treatment systems *i*
Source of data used:	IPCC default value from Table III.H.1 in AMS III H, V.16 methodology.
Value applied:	0.8
Justification of the choice of data or description of measurement methods and procedures actually applied :	The current type of wastewater treatment and discharge pathway or system to which this project will be applied from Table III.H.1 is *Anaerobic deep lagoon (depth more than 2 metres).*
Any comment:	Used for baseline emissions and project emissions ($\mathbf{PE_{flaring,y}}$)calculation.

Data / Parameter:	$MCF_{ww,BL,discharge}$
Data unit:	-
Description:	Methane correction factor based on discharge pathway in the baseline situation of the wastewater
Source of data used:	IPCC default value from Table III.H.1 in AMS III H, V.16 methodology.
Value applied:	0.0
Justification of the choice of data or description of measurement methods and procedures	The final discharge in the baseline is land application, as such the current type of wastewater treatment and discharge pathway or system to which this project will be applied from Table III.H.1 is *aerobic treatment, well managed.*

actually applied :	
Any comment:	Used for baseline emissions calculation.

Data / Parameter:	$MCF_{ww,treatment,PJ,k}$
Data unit:	-
Description:	Methane correction factor for project wastewater treatment systems *k*
Source of data used:	IPCC default value from Table III.H.1 in AMS III H, V.16 methodology.
Value applied:	0.8
Justification of the choice of data or description of measurement methods and procedures actually applied :	The type of treatment and discharge pathway of the treated wastewater from Table III.H.1 is *anaerobic deep lagoon (depth more than 2 metres).*
Any comment:	Used for project emissions calculation.

Data / Parameter:	CFE_{ww}
Data unit:	Fraction
Description:	Capture efficiency of the biogas recovery equipment in the wastewater treatment system
Source of data used:	Refer to AMS III-H, V.16 methodology.
Value applied:	0.9
Justification of the choice of data or description of measurement methods and procedures actually applied:	Default value as accordance to AMS III H, V.16 methodology.
Any comments:	-

Data / Parameter:	$D_{CH4,y}$
Data unit:	kg/m^3
Description:	Density of methane at temperature and pressure of the biogas
Source of data used:	As defined in methodology in methodological tool “Project emissions from flaring” version 02.0.0 EB68 Annex 15
Value applied:	0. 716
Justification of the choice of data or description of measurement methods and procedures actually applied:	Density of methane gas at normal conditions
Any comments:	-

Data / Parameter:	$EF_{EL,j,y}$
Data unit:	tCO_2/MWh
Description:	Emission factor of electricity generation for source *j* in year *y*
Source of data used:	*Tool to calculate baseline, project and/or leakage emissions from electricity consumption, Version 1,* Option B2.

Value applied:	1.3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Since the project sites are not grid connected and the electricity consumption source are from either biomass boiler or backup diesel generator, both electricity consumption sources are considered as **Scenario B: Electricity consumption from (an) off-grid fossil fuel fired captive power plant(s).**
Any comment:	Used for project emission calculation

Data / Parameter:	$TDL_{j,y}$
Data unit:	-
Description:	Average technical transmission and distribution losses for providing electricity to source *j* in year *y*
Source of data used:	*Tool to calculate baseline, project and/ or leakage emissions from electricity consumption, V.1.*
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	In accordance to *Tool to calculate baseline, project and/ or leakage emissions from electricity consumption, V.1:* In case of scenario B and scenario C, case C.II, assume $TDL_{j/k/l,y} = 0$.
Any comment:	Used for project emission calculation

B.6.3 Ex-ante calculation of emission reductions:

Baseline emissions are calculated using Equation 2 through 3 in Section B.6.1:

Table 8: Estimated Baseline Emissions

Prosper Palm Oil Mill	**AMS III. H version 16**			
Year	**2013**	**2014**	**2015**	**2016 - 2022**
Baseline emissions in the year y (BE_y)	28,121	30,677	33,234	35,790
Emissions on account of electricity or fossil fuel used ($BE_{power,y}$)	0	0	0	0
Methane emissions from baseline wastewater treatment systems ($BE_{ww,treatment,y}$)	28,121	30,677	33,234	35,790
Methane emissions from baseline sludge treatment systems ($BE_{s,treatment,y}$)	0	0	0	0
Methane emissions on account of inefficiencies in the baseline wastewater treatment systems and presence of degradable organic carbon in the treated wastewater discharged into river/lake/sea ($BE_{ww,discharge,y}$)	0	0	0	0
Methane emissions from the decay of the final sludge generated by the baseline treatment systems ($BE_{s,final,y}$)	0	0	0	0

Project emissions are calculated using Equation 5 through 11 in Section B.6.1:

Table 9: Estimated Project Emissions

Prosper Palm Oil Mill	AMS III. H version 16			
Year	**2013**	**2014**	**2015**	**2016 - 2022**
Project emissions in the year y (PE_y)	8,351	8,991	9,631	10,271
CO_2 emissions from electricity and fuel used by the project facilities ($PE_{power,y}$)	1,310	1,310	1,310	1,310
Methane emissions from wastewater treatment systems affected by the project activity, and not equipped with biogas recovery in the project scenario ($PE_{ww,treatment,y}$)	1,375	1,500	1,625	1,750
Methane emissions from sludge treatment systems affected by the project activity, and not equipped with biogas recovery in the project situation ($PE_{s,treatment,y}$)	0	0	0	0
Methane emissions on account of inefficiency of the project activity wastewater treatment systems and presence of degradable organic carbon in treated wastewater ($PE_{ww,discharge,y}$)	0	0	0	0
Methane emissions from the decay of the final sludge generated by the project activity treatment systems ($PE_{s,final,y}$)	0	0	0	0
Methane fugitive emissions due to inefficiencies in capture systems ($PE_{fugitive,y}$)	3,839	4,188	4,537	4,886
Methane emissions due to incomplete flaring ($PE_{flaring,y}$)	1,828	1,994	2,160	2,326
Methane emissions from biomass stored under anaerobic conditions which would not have occurred in the baseline situation ($PE_{biomass,y}$)	0	0	0	0

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

Table 10: Ex-ante Estimation of Emission Reductions

Year	Estimation of project activity emissions (tCO_2e)	Estimation of baseline emissions (tCO_2e)	Estimation of leakage (tCO_2e)	Estimation of overall emission reductions (tCO_2e)
2013	8,351	28,121	0	19,770
2014	8,991	30,677	0	21,686
2015	9,631	33,234	0	23,602
2016	10,271	35,790	0	25,519
2017	10,271	35,790	0	25,519
2018	10,271	35,790	0	25,519
2019	10,271	35,790	0	25,519
2020	10,271	35,790	0	25,519
2021	10,271	35,790	0	25,519
2022	10,271	35,790	0	25,519
Total (tonnes CO_2e)	**98,874**	**342,564**	**0**	**243,690**

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
Description:	Volume of wastewater treated in project wastewater treatment system *k* in year *y*
Source of data to be used:	Measured data
Value of data	-
Description of measurement methods and procedures to be applied:	The data is measured and recorded continuously by using flowmeter electronically with accuracy specified by manufacturer.
QA/QC procedures to be applied:	The flowmeter will be recalibrated at appropriate intervals according to manufacturer specifications, but at least once in three years.
Any comment:	-

Data / Parameter:	$COD_{ww,untreated,y}$ ($COD_{inflow,k,y}$)
Data unit:	t/m^3
Description:	Chemical oxygen demand of the wastewater inflow to the project wastewater treatment system *k* in year *y*
Source of data to be used:	Sampling analysis
Value of data	-
Description of measurement methods and procedures to be applied:	Monthly sampling will be collected by project participant and sent to external accredited laboratory for analysis. Monthly analysed value will be recorded , or alternatively with periodical measurement at a 90/10 confidence/ precision level. Annual average will be used for calculation.
QA/QC procedures to be applied:	COD data will be analysed according to national or international standards.
Any comment:	-

Data / Parameter:	$COD_{ww,treated,y}$ ($COD_{outflow,k,y}$)
Data unit:	t/m^3
Description:	Chemical oxygen demand of the wastewater outflow from the project wastewater treatment system *k* in year *y*
Source of data to be used:	Sampling analysis
Value of data	-
Description of measurement methods and procedures to be applied:	Monthly sampling will be collected by project participant and sent to external accredited laboratory for analysis. Monthly analysed value will be recorded , or alternatively with periodical measurement at a 90/10 confidence/ precision level. Annual average will be used for calculation.
QA/QC procedures to be applied:	COD data will be analysed according to national or international standards.
Any comment:	-

Data / Parameter:	$w_{CH4,y,flare}$
Data unit:	%
Description:	Concentration of methane in the biogas entering the flare in the year y
Source of data to be used:	Measured data

Value of data	-
Description of measurement methods and procedures to be applied:	Using calibrated continuous gas analyser or alternatively with periodical measurement at a 90/10 confidence/ precision level
QA/QC procedures to be applied:	The equipment will be recalibrated at appropriate intervals according to manufacturer specifications, but at least once in a year.
Any comment:	Used for project and baseline (MD_y) emissions calculation.

Data / Parameter:	$w_{CH4,y,engine}$
Data unit:	%
Description:	Concentration of methane in the biogas entering the gas engines in the year y
Source of data to be used:	Measured data
Value of data	-
Description of measurement methods and procedures to be applied:	Using calibrated continuous gas analyser or alternatively with periodical measurement at a 90/10 confidence/ precision level
QA/QC procedures to be applied:	The equipment will be recalibrated at appropriate intervals according to manufacturer specifications, but at least once in a year.
Any comment:	Used for project and baseline (MD_y) emissions calculation.

Data / Parameter:	$w_{CH4,y,boiler}$
Data unit:	%
Description:	Concentration of methane in the biogas entering the biomass boiler in the year y
Source of data to be used:	Measured data
Value of data	-
Description of measurement methods and procedures to be applied:	Using calibrated continuous gas analyser or alternatively with periodical measurement at a 90/10 confidence/ precision level
QA/QC procedures to be applied:	The equipment will be recalibrated at appropriate intervals according to manufacturer specifications, but at least once in a year.
Any comment:	Used for project and baseline (MD_y) emissions calculation.

Data / Parameter:	$BG_{burnt,y,flare}$ ($FV_{RG,h}$)
Data unit:	m^3/h
Description:	Volumetric flow rate of the residual gas in dry basis at normal conditions entering the flare in the hour *h*
Source of data to be used:	Measured data
Value of data	-
Description of measurement methods and procedures to be applied:	The data is measured and recorded continuously by using flowmeter electronically with accuracy specified by manufacturer. The flowmeter measures biogas flow and automatically converts to normalize volumetric output. The biogas flowmeter is normalized to 0 degrees Celsius at 1 ATM and calibrated by the manufacturer.

QA/QC procedures to be applied:	The flowmeter will be recalibrated at appropriate intervals according to manufacturer specifications, but at least once in three years.
Any comment:	Used for project and baseline (MD_y) emissions calculation.

Data / Parameter:	**$\eta_{flare,h}$ (= FE)**
Data unit:	%
Description:	Flare efficiency of enclosed flare in hour *h* based on default values
Source of data to be used:	Methodological tool *"Project emissions from flaring" version 02.0.0 EB 68, Annex 15*
Value of data	90%
Description of measurement methods and procedures to be applied:	• 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's 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's specifications on proper operation of the flare are met continuously during the hour *h*.
QA/QC procedures to be applied:	-
Any comment:	Used for project and baseline (MD_y) emissions calculation.

Data / Parameter:	**T_{flare}**
Data unit:	^oC
Description:	Temperature in the exhaust gas of the flare
Source of data to be used:	Measured data
Value of data	-
Description of measurement methods and procedures to be applied:	Measurement of the exhaust gas temperature of the flare by using Type N thermocouple. A temperature of above 500^{o}C indicates that a significant amount of gases are still being burnt and that the flare is operating.
QA/QC procedures to be applied:	Thermocouple will be replaced or calibrated every year.
Any comment:	Used for project and baseline (MD_y) emissions calculation.

Data / Parameter:	**$BG_{burnt,y,engine}$ (Biogas entering gas engines)**
Data unit:	m^3/yr
Description:	Volumetric flow rate of biogas in dry basis at normal conditions entering the gas engines in year *y*
Source of data to be used:	Measured data
Value of data	-
Description of measurement methods and procedures to be applied:	The data is measured and recorded continuously by using flowmeter electronically with accuracy specified by manufacturer. The flowmeter measures biogas flow and automatically converts to normalize volumetric output. The biogas flowmeter is normalized to 0 degrees Celsius at 1 ATM and calibrated by

	the manufacturer.
QA/QC procedures to be applied:	The flowmeter will be recalibrated at appropriate intervals according to manufacturer specifications, but at least once in three years.
Any comment:	Used for baseline emissions (MD_y) calculation.

Data / Parameter:	**$BG_{burnt,y,boiler}$ (Biogas entering biomass boiler)**
Data unit:	m^3/yr
Description:	Volumetric flow rate of biogas in dry basis at normal conditions entering the biomass boiler in year *y*
Source of data to be used:	Measured data
Value of data	-
Description of measurement methods and procedures to be applied:	The data is measured and recorded continuously by using flowmeter electronically with accuracy specified by manufacturer. The flowmeter measures biogas flow and automatically converts to normalize volumetric output. The biogas flowmeter is normalized to 0 degrees Celsius at 1 ATM and calibrated by the manufacturer.
QA/QC procedures to be applied:	The flowmeter will be recalibrated at appropriate intervals according to manufacturer specifications, but at least once in three years.
Any comment:	Used for baseline emissions (MD_y) calculation.

Data / Parameter:	$EC_{PJ,j,y}$
Data unit:	MWh/yr
Description:	Quantity of electricity consumed by the project electricity consumption source *j* in year *y*
Source of data to be used:	Measured data
Value of data	-
Description of measurement methods and procedures to be applied:	The data is measured continuously by using power meter. The data is recorded monthly and aggregated annually for calculation.
QA/QC procedures to be applied:	The power meter will be recalibrated at appropriate intervals according to manufacturer specifications, but at least once in three years.
Any comment:	Used for project emissions calculation.

Data / Parameter:	**End use of final sludge**
Data unit:	-
Description:	End use of final sludge
Source of data to be used:	Mill records
Value of data	-
Description of measurement methods and procedures to be applied:	Sludge treatment is not different in baseline and project activity and the sludge is used for soil application in aerobic conditions in the project activity. Verified and recorded as sludge disposition is required.
QA/QC procedures to	End use of sludge will be monitored and documented on-site.

be applied:	
Any comment:	Data will be archived electronically or on paper and kept for the duration of the project + 2 years.

Data / Parameter:	**$T_{EG,m}$**
Data unit:	°C
Description:	Temperature in the exhaust of the enclosed flare in minute *m*
Source of data to be used:	On-site measurement
Value of data	Value monitored *ex-post*
Description of measurement methods and procedures to be applied:	Measure the temperature of the exhaust gas in the flare by an appropriate temperature measurement equipment. Measurements outside the operational temperature specified by the manufacturer may indicate that the flare is not functioning correctly and may require maintenance. Flare manufacturers must provide suitable monitoring ports for the monitoring of the temperature of the flare. These would normally be expected to be in the middle third of the flare. Where more than one temperature port is fitted to the flare, the flare manufacturer must provide written instructions detailing the conditions under which each location shall be used and the port most suitable for monitoring the operation of the flare according to manufacturer's specifications for temperature
QA/QC procedures to be applied:	Temperature measurement equipment should be replaced or calibrated in accordance with their maintenance schedule
Any comment:	Unexpected changes such as a sudden increase/drop in temperature can occur for different reasons. These events should be noted in the site records along with any corrective action that was implemented to correct the issue. Monitoring of this parameter is applicable in case of enclosed flares. Measurements are required to determine if manufacturer's flare specifications for operating temperature are met

Data / Parameter:	**$Flame_m$**
Data unit:	Flame on or flame off
Description:	Flame detection of flare in the minute *m*
Source of data to be used:	On-site measurement
Value of data	Value monitored *ex-post*
Description of measurement methods and procedures to be applied:	Measure using a fixed installation optical flame detector: Ultra Violet detector or Infra Red or both
QA/QC procedures to be applied:	Equipment shall be maintained and calibrated in accordance with manufacturer's recommendations
Any comment:	Applicable to all flares

Data / Parameter:	**Maintenance**
Data unit:	Calendar dates

Description:	Maintenance events completed in year y for flaring equipment
Source of data to be used:	Project participant
Value of data	Value monitored *ex-post*
Description of measurement methods and procedures to be applied:	Record the date that maintenance events were completed in year *y*. Records of maintenance logs must include all aspects of the maintenance including the details of the person(s) undertaking the work, parts replaced, or needing to be replaced, source of replacement parts, serial numbers and calibration certificates.
QA/QC procedures to be applied:	Records must be kept in a maintenance log for two years beyond the life of the flare
Any comment:	Monitoring of this parameter is required for the case of enclosed flares and the project participant selects Option B to determine flare efficiency. These dates are required so that they can be compared to the maintenance schedule to check that maintenance events were completed within the minimum time between maintenance events specified by the manufacturer ($SPEC_{flare}$)

Data / Parameter:	$\mathbf{M_{t,db}}$
Data unit:	kg/h
Description:	Mass flow of the gaseous stream in time interval *t* on a dry basis
Source of data to be used:	Project participant
Value of data	Value monitored *ex-post*
Description of measurement methods and procedures to be applied:	Calculated based on the wet basis flow measurement plus water concentration measurement
QA/QC procedures to be applied:	Calibration and frequency of calibration is according to manufacturer's specifications
Any comment:	-
Any comment:	-

Data / Parameter:	$\mathbf{T_t}$
Data unit:	K
Description:	Temperature of the gaseous stream in time interval t
Source of data to be used:	Project participant
Value of data	Value monitored *ex-post*
Description of measurement methods and procedures to be applied:	Instruments with recordable electronic signal (analogical or digital) are required. Examples include thermocouples, thermo resistance, etc
QA/QC procedures to be applied:	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. Calibration and frequency of calibration is according to manufacturer's specifications
Any comment:	Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture

	content determination and therefore it should be metered only when performing such measurements (with same frequency). However, if the applicability condition related to the gaseous stream flow temperature being below 60ºC is adopted, this parameter must be monitored continuously to assure the applicability condition is met

Data / Parameter:	P_t
Data unit:	Pa
Description:	Pressure of the gaseous stream in time interval t
Source of data to be used:	Project participant
Value of data	Value monitored *ex-post*
Description of measurement methods and procedures to be applied:	Instruments with recordable electronic signal (analogical or digital) are required. Examples include pressure transducers, etc
QA/QC procedures to be applied:	Periodic calibration against a primary device must be performed periodically and records of calibration procedures must be kept available as well as the primary device and its calibration certificate. Pressure transducers (either capacitive or resistive) must be calibrated monthly
Any comment:	Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture content determination and therefore it should be metered only when performing such measurements (with same frequency)

Data / Parameter:	$v_{k,t,db}$
Data unit:	m³ gas k/m³ dry gas
Description:	Volumetric fraction of gas *k* in the gaseous stream in time interval *t* on a dry basis
Source of data to be used:	Project participant
Value of data	Value monitored *ex-post*
Description of measurement methods and procedures to be applied:	Continuous gas analyser operating in dry-basis
QA/QC procedures to be applied:	Calibration should include zero verification with an inert gas (e.g. N_2) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases must have a certificate provided by the manufacturer and must be under their validity period
Any comment:	-

B.7.2 Description of the monitoring plan:

Monitoring team

Green Lagoon is aware of the importance of having good operational and management team in order to execute a well-defined monitoring plan for the project activity. A monitoring plan has been developed to ensure that accurate and relevant measurements and observations are made to document project biogas production and equipment operation, including emissions and leakage. This plan reflects good monitoring

practice appropriate to this type of project activity and meets the requirements of the *Simplified modalities and procedures for small-scale clean development mechanism project activities.*[32] The responsible of data monitoring, archiving and analysing will fall on different members of monitoring team. The team members include CDM Project Manager, CDM Officer, CDM QA Supervisor, and CDM Operation Technician.

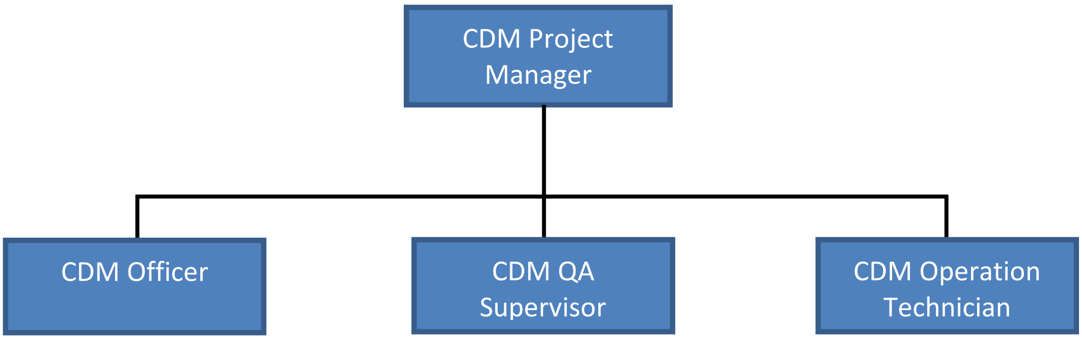

Figure 3: Organization chart of monitoring team

The table below summarized the responsibilities of each team member on the project activity

Table 11: Responsibilities of monitoring team members

Position	Responsibilities
CDM Project Manager	Responsible for overall project and monitoring management, in full charge of issues related to CDM projects, keeping communication with EB, DNA and related agencies, supervising the project operation status. Quarterly review monthly monitoring report and related documents
CDM Officer	Responsible for whole process of CDM project operation. CDM officer will calculate the CERs and prepare monthly monitoring report based on the verified operation data by CDM QA Supervisor. Responsible for archiving operation data, documents, and reports.
CDM QA Supervisor	QA/QC and verify the operation data collected by CDM Operation Technician and operation data recorded by the monitoring equipment. Cross-check the monitoring equipment are in the calibrated periodically according to manufacturer recommendation
CDM Operation Technician	Operate project site. Maintain and calibrate the monitoring equipment to ensure their correct functioning. Collect operation data from project site

Data management

The management of data records is undertaken as follows: All operation data collected will be kept both in soft copy and archived in hard copy documents at the end of every month in a systematic and transparent manner by CDM Operation Technician. CDM QA Supervisor will QA/QC and verify the operation data collected. Other documents, such as calibration reports, will be used to support the monitoring plan to check the authenticity of data. Subsequently, the verified operation data will be submitted to CDM Officer for monthly monitoring report preparation, including the calculation of ex-post emission reduction estimation.

[32] http://cdm.unfccc.int/Reference/COPMOP/08a01.pdf#page=43

The monthly monitoring reports and relevant documents will be archived in soft copy and hard copy documents systematic and transparent manner by CDM Officer for internal verification on quarterly basis by CDM Project Manager. All the soft copy and hard copy documentation will be kept in the archives and will have one copy as back-up. This documentation will be verified again by an independent Designated Operational Entity annually and will be saved for 2 years after the crediting period.

Quality assurance and quality control (QA/QC)

Calibration on the monitoring equipment will be carried out in accordance with manufacturer's recommendation. Green Lagoon will take responsibilities for the quality assurance and quality control for recording and data collection, maintaining and archiving all the data and related documents, equipment calibration and overall maintenance on a regular basis throughout the crediting period. Green Lagoon will provide necessary training in order to at least maintain or improve the efficiency and accuracy of data monitoring and management.

Error handling procedures and corrective actions

Green Lagoon will implement an Emergency Procedure, which will be developed in a monitoring manual. This manual will contain instructions such as how to handle an emergency situation and measures to be taken to ensure there is no unintended methane leakage from the system. Stand-by unit of monitoring equipment will be in placed to ensure continuous measurement and its accuracy if the reading of monitoring equipment is not precise, exceeds the allowed error range, or the equipment is abnormal.

Training

Training will be conducted prior to operational start-up. Training topics will include, but are not limited to, CDM project overview, system overview, data collection and quality control, monitoring equipment functionality, malfunction diagnostics and replacement procedures, and facility personnel orientation. Follow-up training will be provided on an as-needed basis.

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

The date of completion of the application of the baseline and monitoring methodology: 19 January 2012
Name of persons determining the baseline study and monitoring methodology:

Contact Information of the responsible person	**Is organisation a Project Participant *Yes/No***
Chiah Wai Chun 27, Jalan 3/108C, Taman Sungai Besi, 57100 Kuala Lumpur, Malaysia. Tel: +6017-2002779	Yes

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:

The starting date of the project activity is 28 November 2011 (Issuance of Purchase Order for key equipment).

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

The expected lifetime of this project activity is 10 y-0m.

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

C.2.1. Renewable crediting period

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

Not applicable.

C.2.1.2. Length of the first crediting period:

Not applicable.

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

1st January 2013or the project registration date, whichever is later.

C.2.2.2. Length:

The length of the crediting period is 10 y-0m.

SECTION D. Environmental impacts

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

Malaysia law does not require an Environmental Impact Assessment (EIA) for the implementation of project activity[33]. However, state-level approval of the project activity by the Malaysian Department of Environment is required. This is done via periodic renewal of the mill's wastewater discharge licence[34].

---

[33] Prosper POM EIA Exemption Letter

[34] Prosper POM 2011 AS3

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:

There is no significant negative impact resulting from the proposed project activity. Conversely, this project activity will result in positive environmental co-benefits, besides reducing GHG emissions. These co-benefits include a reduction in atmospheric emissions of Volatile Organic Compounds (VOCs)[35] that cause odour and acid rain, and promotion of an improved, modernized image of the palm oil production industry.

SECTION E. Stakeholders' comments

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

The public stakeholders forum meeting was organized on 21st November 2011 near the project site, in the conference room of Prosper Palm Oil Mill, Bandar Seri Jempol, Negeri Sembilan, Malaysia. Invitations were issued to all the stakeholders such as representatives of Malaysian Department of Environment, local palm oil fruit planters, and members from the local community living near to the project area. Public announcement of the meeting also appeared in the *The Star Newspaper*[36].

In the meeting, detailed information about the project and its benefits were presented by the project developer to the participants in Bahasa language. This event also provided a forum for all stakeholders to raise questions about the impact of the project and share opinions among others. The following topics are presented by the project developer during the stakeholders forum meeting:

- The Purpose of meeting
- An overview of global warming and Effects of Greenhouse Gases
- Project overview
- Benefits of the project (environment, social, and economic)

E.2. Summary of the comments received:

After the presentation, participants were given opportunity to raise questions regarding the proposed project activity. Overall, the comments from the participants at the stakeholders meeting were positive and supportive of the project. A summary of questions and answers from the meeting is presented below:

Stakeholder Questions	Project Developer responses
Is there any possible impact or effect from the combustion of the biogas captured to the local community? (By Amran Nor, local smallholder of palm fruit planters)	There is no negative impact from the combustion of the biogas captured. The process of combustion is to convert the biogas captured, which consist of approximately 60% of methane, into energy like electricity of heat. The result of the combustion would be carbon dioxide. Therefore, the effect of the combustion of the biogas captured is to produce energy, while reducing the methane emissions to the atmosphere.
After the project implemented, would there be any similar fouling smell that	The fouling smell from the wastewater treatment ponds is associated with the emission of biogas produced into atmosphere.

[35] http://www.enviropedia.org.uk/Air_Quality/VOCs.php

[36] Prosper POM Global Stakeholders Forum Public Announcement

emitted from the existing wastewater treatment ponds? (By Hassan Bin Yusuff, Assistant Mill Manager)	During the project implementation, most of the biogas will be captured and later for combustion usage. Therefore, this fouling smell will be significantly reduced once the project implemented.
Can the biogas captured utilize for household usage, such as cooking? (By Noreda Binti Basar, members of local community near project area)	The biogas produced from the anaerobic wastewater treatment process consists of approximately 60% of methane. This biogas has very high burning temperature and it is corrosive. Special handling is required if it is used for cooking. However, Green Lagoon has an agreement with mill owner that the right of use of the biogas captured is belongs to mill owner, who planned for electricity and heat generation.
Would there be any burning hazard during the project implementation? (By Sazaly Bin Mohd Amir, representative of Malaysian Department of Environment)	The burning hazard remains the same in between project activity and current practice. Smoking, naked flame, and open burning are not allowed in the surrounding area of the project activity. Safety trainings will be conducted prior the operation of the project site and safety signage will be displayed at the surrounding area of project activity.

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

The details of the proposed project activity and its benefits (reduced air pollution and fouling smell as compared to current open lagoons treatment system) were explained well during the stakeholders forum meeting, which the participants understood and aware of. As there were no serious comments on the environmental impacts or safety aspects, there are no actions required on the comments received.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Project Participant	
Organization:	Green Lagoon Technology Sdn Bhd
Street/P.O.Box:	No. 27, Jalan 3/108C
Building:	-
City:	Taman Sungai Besi
State/Region:	Kuala Lumpur
Postfix/ZIP:	57100
Country:	Malaysia
Telephone:	+603 7981 9768
FAX:	+603 7981 7611
E-Mail:	
URL:	
Represented by:	
Title:	Managing Director
Salutation:	Mr
Last Name:	Wai Chun
Middle Name:	
First Name:	Chiah
Department:	
Mobile:	+6017 200 2779
Direct FAX:	+603 7981 7611
Direct tel:	+603 7981 9768
Personal E-Mail:	Raymond@greenlagoontech.com

Project Participant	
Organization:	Camco South East Asia Ltd
Street/P.O.Box:	P.O. Box 80
Building:	Felix House, 24 Dr. Joseph Riviere Street
City:	Port Louis
State/Region:	-
Postfix/ZIP:	-
Country:	Mauritius
Telephone:	+603 2302 2302
FAX:	+603 2302 2303
E-Mail:	-
URL:	http://seasia.camcoglobal.com
Represented by:	(primary signatory)
Title:	Managing Director
Salutation:	Mr
Last Name:	Carter
Middle Name:	-
First Name:	Kent
Department:	-
Mobile:	-
Direct FAX:	+603 2302 2302
Direct tel:	+603 2302 2303
Personal E-Mail:	Project.participant.sea@camcoglobal.com
Represented by:	(secondary signatory)
Title:	Associate-Carbon
Salutation:	Mr
Last Name:	Ludlow
Middle Name:	-
First Name:	Graeme
Department:	-
Mobile:	-
Direct FAX:	+44 207 1216 101
Direct tel:	+44 207 1216 100
Personal E-Mail:	Project.participant.sea@camcoglobal.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

This proposed project activity will not receive any public funding.

Annex 3

BASELINE INFORMATION

Wastewater Sampling Campaign Results

The existing wastewater treatment for the project site has been in operation for at least three years, however one year historical records on COD removal was not available. This is due to local environmental monitoring does not require COD testing of the inflow into the wastewater system; there is no data to calculate the COD removal efficiency (for adherence to paragraph 27(a)). Therefore, for the determination of baseline emission per paragraph 27 (c), the COD removal efficiency has been determined through an ex-ante measurement campaign of at least 10 days (an 11-day measurement campaign was conducted) following paragraph 27(b) of the methodology.

Wastewater Sampling Campaign Results (11 days Sampling)

	COD, mg/liter											Average
	27/10/2011	28/10/2011	29/10/2011	31/10/2011	1/11/2011	2/11/2011	3/11/2011	4/11/2011	8/11/2011	9/11/2011	10/11/2011	
	Day 1	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**	**Day 8**	**Day 9**	**Day 10**	**Day 11**	
AN 1 Inltet	62,328	55,889	57,803	54,426	57,420	54,585	54,585	58,429	49,381	64,195	43,512	55,686.64
AN 1 Outlet	2,634	2,281	2,756	2,316	2,726	2,353	2,199	2,045	1,960	2,921	1,929	2,374.55
AN 2 Inlet	62,328	55,889	57,803	54,426	57,420	54,585	54,585	58,429	49,381	64,195	43,512	55,686.64
AN 2 Outlet	3,732	3,399	3,491	3,829	3,338	3,413	2,260	2,353	2,511	2,030	2,838	3,017.64
Final Discharge	862	880	1,210	795	819	669	692	738	689	746	682	798.36

Final COD Data		AN 1		AN 2		Average of AN 1 and AN2	
		mg/liter	tonne/m^3	mg/liter	tonne/m^3	mg/liter	tonne/m^3
COD Entering Anaerobic System	$COD_{inflow,y}$	55,686.6	0.05569	55,686.6	0.05569	55,686.6	0.05569
COD Leaving Anaerobic System	$COD_{outflow,y}$	2,374.5	0.00237	3,017.6	0.00302	2,696.1	0.00270
COD of Final Discharge	$COD_{ww,discharge,y}$	798.4	0.00080	798.4	0.00080	798.4	0.00080

Annex 4

MONITORING INFORMATION

No further information

- - - - -