Project design document form
(Version 11.0)

Complete this form in accordance with the instructions attached at the end of this form.

BASIC INFORMATION	
Title of the project activity	Blue Fire Bio wastewater treatment and biogas utilization project
Scale of the project activity	☐ Large-scale ☒ Small-scale
Version number of the PDD	2.0
Completion date of the PDD	28/11/2019
Project participants	Blue Fire Bio Co.,Ltd (Thailand) South Pole Carbon Asset Management Ltd. (Switzerland)
Host Party	Thailand
Applied methodologies and standardized baselines	AMS-III.H version 19 – Methane Recovery in Wastewater Treatment AMS-I.D version 18 – Grid connected renewable electricity generation
Sectoral scopes	1: Energy industries (renewable - / non-renewable sources) 13: Waste handling and disposal
Estimated amount of annual average GHG emission reductions	59,898

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The proposed project entails the installation of two sets of upflow anaerobic sludge blanket technology (UASB) biogas reactors and 3.128 MW_{el} gas engines at an existing starch factory in Thailand for:

a) the extraction of methane (biogas) from the wastewater stream through the biogas reactors; and
b) the reuse of biogas as fuel for power generation.

The proposed project is implemented by Blue Fire Bio Co.,Ltd at the Chaodee Starch (2004) facility in the northeast of Thailand with a total wastewater flow-rate of 5,780 m^3/day and an average COD concentration of 12,000 mg/l.

Prior to the implementation of the project, the wastewater was treated by an open lagoon system, consisting of six anaerobic ponds all with a depth of over 4 metres. After the lagoons, the wastewater was re-used for starch cleaning. There was no discharge. Heavy fuel oil was used in boiler for heating purposes and electricity was provided by the grid.

The project introduces successively two sets of biogas reactors with methane capture and utilisation for energy purposes. The first set of the biogas reactors (hereafter called BFR 1 and BFR 2) is introduced into the existing open anaerobic lagoon based wastewater treatment system. After the installation of the BFR 1 and BFR 2, in 2008, the second set of biogas reactor (hereafter called BFR 3) is introduced along with a new starch production line as per the expansion plan of the starch factory, while the lagoon system is extended to 15 lagoons. As a consequence of the new anaerobic reactors, the organic load entering the lagoon system is drastically reduced because most of the organic matter is converted to biogas in the reactor. The project activity avoids the release of methane into the atmosphere, which would occur due to the anaerobic digestion of the organic content in the open lagoon based wastewater treatment system (anaerobic conditions, leading to methane generation within the lagoon are the result of a lagoon depth greater than 2-4 metres and an average atmospheric temperature of about 28°C).

The biogas reactors produce sufficient quantities of biogas to fuel a gas engine for the production of power for both in-house use and/or sale to the electricity grid (PEA[1]) under a firm power purchase agreement under the Very Small Power Producer[2] (VSPP) program. The remaining biogas is used as fuel in thermal oil boilers for starch drying, replacing partly the use of heavy fuel oil.

Up to 5,794 MWh are generated annually with the biogas generators. A first 1.128 MW_{el} biogas gensets are installed in 2009, and the second one with a capacity up to 2 MW_{el} is planned to be installed upon the performance of the biogas reactor. The partial displacement of electricity from the national grid, which is generated by fossil fuel fired power plants from the Thai national grid to a large extent, will lead to further reductions of greenhouse gases.

The average estimated emission reduction is 59,898 tonnes per year of CO_2 equivalent and the total emission reduction for the second crediting period is 419,286 tonnes of CO_2 equivalent.

[1] The Provincial Electricity Authority (PEA) is a government enterprise under the Ministry of Interior. The authority's responsibility is primarily concerned with the generation, distribution, sales and provision of electric energy services to the business and industrial sectors as well as to the general public in provincial areas, with the exception of Bangkok, Nonthaburi and Samut Prakran provinces.

[2] A Very Small Power Producer (VSPP) can be any private entity, government or state-owned enterprise that generates electricity either (a) from non-conventional sources such as wind, solar and mini-hydro energy or fuels such as waste, residues or biomass, or (b) from conventional sources provided they also produce steam through cogeneration. As per the VSPP program, the VSPP is limited to sell no more than 10MW of its electrical power output to the designated distribution utility, such as Metropolitan Electricity Authority (MEA) and/or Provincial Electricity Authority (PEA).

Sustainable Development Benefits of the Project

According to the definition of sustainable development criteria for CDM projects by Thai DNA[3], the project will directly contribute to sustainable development in Thailand in several ways as shown below:

Natural Resources and Environment benefits

- Reduction of greenhouse gas emissions through the avoided electricity generation by other grid connected power plants;
- Reduction of offensive odour;
- Reduction in usage of non-renewable energy, i.e. fossil fuel for grid electricity generation;
- Improvement of the quality of water discharged into the environment;

Social benefits

- Involvement of local communities through a public participation meeting, in which people accepted the project;
- Increased employment by employing 17 full time staff to operate the system;

Technology transfer benefits

- Promoting technological excellence in Thailand, which could be replicated across Thailand and the region;
- Necessary training on the management of the power plant will be provided to staff;

Economic benefits

- Reduction in dependency on fossil fuel for electricity generation while at the same time enhancing energy security by increasing diversity of supply;
- Generating incomes to the local community through additional local employment;
- Demonstrating the use of CDM as an incentive for bringing about an renewable energy project;
- Besides, due to rapidly, continuously rising and unstable of oil prices, the Thai government has set an ambitious target for the share of renewable energy in electricity production. In year 2003, the government has published the “Energy Strategies for Competitiveness” which targets to increase the share of renewable energy in Thailand from 0.5% in year 2002 to 8% in year 2011 (source: http://www.eppo.go.th/doc/strategy2546/strategy.html). This national plan will benefit from initiatives in industries such as this project. The project, by producing energy from biogas, will directly complement the Thai government’s efforts to reduce the country’s dependency of imported fossil fuels. Besides, National’s electricity generation, which is dominated by natural gas, lignite and imported fuel oil, will also benefit from this kind of project where the electricity fed to the grid come from renewable energy sources.

The Project is, also, implemented on a pure voluntary basis. There is no regulation that requires implementing such a project.

A.2. Location of project activity

The proposed project is located in Chaodee Starch factory, in Dan Khun Tot district, Nakhorn Ratchasima, Korat, Thailand. It is situated at about 250 km north of Bangkok, in the Northeast of Thailand. Most of the starch plants in Thailand are located in this province.

The exact location of the plant is 15.1303N 101.5586E.

A map indicating the location of the project is provided in Figure 1.

[3] http://www.tgo.or.th/2015/english/content.php?s1=33&s2=78&sub3=sub3 (accessed on 28/11/2019)

Figure 1. Location of the project activity

A.3. Technologies/measures

Situation prior project implementation:
Before the implementation of the project, the wastewater is treated by an open lagoon system, consisting of six anaerobic ponds all with a depth of over 4 metres. After the lagoons, the wastewater is re-used in the starch factory for cleaning purpose. This mode of treatment is the prevalent practice in this kind of industry, particularly where there is a relative abundance of land. There is no generator on site. The electricity is provided by the grid.

Situation after project implementation:
Under the project, the effluent from the starch factory is instead diverted to an anaerobic digester with biogas recovery. The proposed project uses local know-how so called “Biofuel reactor” (BFR) in order to extract methane gas from wastewater treatment system.

The project is done in two stages.

- Stage I of the project includes the installation of a new set of biogas reactors and of two generators with a capacity of 0.5 MW each. It treats the wastewater coming currently from the factory.
- Stage II of the project will follow the extension of the factory. As it expands its starch production by two, the wastewater flows are doubled. A new biodigester is introduced. Two generators of 1MW capacity are planned to be installed. The lagoon system is expanded to 15 anaerobic ponds to be used as a backup system.

The two systems are very similar and are described below:

Pre-treatment
There are two main sources of wastewater from factory. One is separator unit in the process line, the other is washing activity. Wastewater from separation unit which is consisted of high organic substances is firstly treated in primary sedimentation tank in order to extract suspended solid from the wastewater. Clear wastewater from primary sedimentation is treated further in equalizing and acid pond. This pond is also used for storage of the generated biogas. The sludge removed from the sedimentation tank is then directly sent to the anaerobic lagoons (secondary treatment). The sedimentary tank has a very low retention time (0.03 days); therefore no methane emissions occur in the sedimentation tank.

Anaerobic treatment
The effluent from equalization lagoon flows then into a pump sump and is pumped into the methane reactors through an influent distribution system at the bottom of the reactor. In BFR tank, organic compounds in wastewater are transformed mainly into biogas by anaerobic bacteria in the system. There are three tanks, two for the first line and one for the second line. The tanks have a total volume of 14,000m^3 and are designed to handle about 3,400 m^3/day for each phase. The removal efficiency is 80%. The production of biogas is estimated to be 7,575,000 Nm^3/year (with 55% of methane).

Biogas handling
The biogas (40%) is used as fuel in power generators (gensets) consisting of a biogas fired engine and an alternator each, with a planned total installed capacity of 3 MW_{el}.[4] A rented small gas engine with a capacity of 0.128 MW_{el} is used as backup system during the project activity. Electricity will be used on site or sent to the grid. The remaining biogas (60%) is used as fuel in existing thermal oil boilers used for starch drying. If some biogas remains, it is flared off in a monitoring open flaring system. The flaring system will be used only in case of emergency.

Secondary treatment
Effluent from the BFR system is treated in the secondary treatment, consisting of a series of six existing lagoons. The lagoons receive around 20% of the COD loading directed into the digester. The lagoons system is extended to 15 anaerobic ponds after implementation of the second line.
Wastewater from root washing is primarily treated in screening unit and grit chamber in order to remove debris and gravel; both effluent from grit chamber and floor cleaning wastewater, containing low amount of COD, are treated in the secondary treatment unit.

Final sludge and wastewater treatment
After the treatments, the wastewater shall have a low COD concentration and will be re-used at the factory or used by farmers for land application.
Some excess sludge may accumulate over the years in the bio-digesters and can be removed from the bottom of the reactors. The sludge will be handled once the suitable quantity of sludge will be reached in the 3 BFRs. The excess sludge will be managed by one of the methods below:

1. To use for starting up other systems or for any other purposes.
2. To fill the land and level the soil inside the boundary of the project.
3. To use as fertilizer inside the project boundary.

[4] The final total capacity of the generators is not decided yet. There might be some changes in the future.

Figure 2. The BFR tanks (left) and the open lagoons (right)

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Thailand (host)	Blue Fire Bio Co.,Ltd	No
Switzerland	South Pole Carbon Asset Management Ltd.	No

A.5. Public funding of project activity

No public funding from Annex I countries has been sought for this project.

A.6. History of project activity

The Project participants confirm that the project activity is registered as a CDM project activity on 09/04/2011[5] with the CDM reference number 4219. The project is neither a project activity that has been deregistered nor included as a component project activity (CPA) in a registered CDM programme of activities (PoA).

The project activity was not a CPA that has been excluded from a registered CDM PoA. There is no registered CDM project activity or a CPA under a registered CDM PoA whose crediting period has or has not expired existing in the same geographical location as the proposed CDM project activity.

This project design document is developed for the renewal of the crediting period. The first crediting period of the project activity is from 09/04/2011 to 08/04/2018 and will be from 09/04/2018 to 08/04/2025 for the second crediting period.

A.7. Debundling

[5] http://cdm.unfccc.int/Projects/DB/TUEV-RHEIN1291833824.78/view

In reference to the “Tool20: Assessment of debundling for small-scale project activities”, version 04.0, the project participants confirm that there is no registered small-scale CDM project activity or an application to register another small-scale CDM project activity with the same project participants and whose project boundary is within 1 km of the Project boundary of the proposed small-scale activity, at the closest point. Therefore, the project activity is not a de-bundled component of a large-scale project activity.

SECTION B. Application of methodologies and standardized baselines

B.1. References to methodologies and standardized baselines

According to paragraph 279 (a) of the CDM Project Standard version 2.0, the version of the methodologies and methodological tools applied in the PDD are updated with the latest version at the time of the submission of the request for renewal of crediting period.

The following Small-Scale methodologies are applied:

- AMS III.H “Methane recovery in wastewater treatment”, version 19.0, for the methane avoidance and recovery aspect of the project;
- AMS I.D “Grid connected renewable electricity generation”, version 18.0, for the electricity generation component.

These methodologies refer to the following tools:

- “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”, version 03.0
- “Project emissions from flaring”, version 03.0
- “Tool to calculate the emission factor for an electricity system”, version 07.0
- “Tool to determine the remaining lifetime of equipment”, version 01
- “Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period”, version 03.0.1
- “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”, version 03.0

More information about the methodologies and tools can be found on the following website:
http://cdm.unfccc.int/methodologies/SSCmethodologies/approved

B.2. Applicability of methodologies and standardized baselines

The project meets all the applicability conditions of the methodologies, as described below:

Applicability conditions for small-scale project activity

As per paragraph 11 of General guidelines for SSC CDM methodologies version 23.0, for the following requirements, project participants and coordinating/managing entities must refer to applicable provisions for project activity eligibility for small-scale project activities in the Project standard:

(a) Eligibility of project activities as small-scale CDM project activities;
(b) Output capacity of renewable energy equipment.

The CDM project standard for project activities version 02.0 in paragraph 119 requires selection of project type and output capacity. The project belongs to:

(a) Type I: Renewable energy project activities with a maximum output capacity of 15 MW (or an appropriate equivalent).

The project has installed a gas engine which has an installed capacity less than 15MW.

(b) *Type III: Other project activities not included in Type I or Type II that result in GHG emission reductions not exceeding 60 kt CO_2e per year in any year of the crediting period.*
The project activity implements the methane avoidance component and results in emission reductions which are less than 60kt CO_2e and the same is mentioned in the table below.

<u>Applicability conditions for AMS-III.H</u>

	Applicability conditions	Project case
2	This methodology comprises measures that recover methane from biogenic organic matter in wastewaters by means of one, or a combination, of the following options: (a) Substitution of aerobic wastewater or sludge treatment systems with anaerobic system with biogas recovery and combustion; (b) Introduction of anaerobic sludge treatment system with biogas recovery and combustion to a wastewater treatment plant without sludge treatment; (c) Introduction of biogas recovery and combustion to a sludge treatment system; (d) Introduction of biogas recovery and combustion to an anaerobic wastewater treatment system such as anaerobic reactor, lagoon, septic tank or an on-site industrial plant;1 (e) Introduction of anaerobic wastewater treatment with biogas recovery and combustion, with or without anaerobic sludge treatment, to an untreated wastewater stream; (f) **Introduction of a sequential stage of wastewater treatment with methane recovery and combustion, with or without sludge treatment, to an existing wastewater treatment system without methane recovery (e.g. introduction of treatment in an anaerobic reactor with methane recovery as a sequential treatment step for the wastewater that is presently being treated in an anaerobic lagoon without methane recovery).**	In absence of the project activity, the wastewater would be treated in open lagoons and then reused in the factory. The project activity involves the installation of new system: the wastewater from the separator is treated sequentially in a primary sediment tank, an acid pond, the biofuel reactor with methane recovery and finally to a succession of six anaerobic ponds (15 anaerobic ponds after implementation of phase II) before being reused in the factory. Therefore, the project activity satisfies the applicability criterion (f).
3	In cases where baseline system is anaerobic lagoon the methodology is applicable if: (a) The lagoons are ponds with a depth greater than two meters, without aeration. 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 28°C, at least during part of the year, on a monthly	In the baseline scenario, the wastewater was treated in existing open anaerobic lagoons. • The depth of the lagoons is greater than two meters and do not have any aeration. • On monthly average basis the ambient temperature in Nakhorn Ratchasima is above 29°C[6]. • No sludge has been removed from the baseline system and if any sludge would have been removed, it would have been definitely greater than 30 days.

[6] The average ambient temperature of Province by the Energy Policy and Planning Office, Ministry of Energy. Available from: http://www.e-report.evnergy.go.th/weather.html

	Applicability conditions	Project case
	average basis; (c) The minimum interval between two consecutive sludge removal events shall be 30 days.	As mentioned above, the project activity satisfies the conditions for the anaerobic lagoons for the baseline system.
4	The recovered biogas from the above measures may also be utilised for the following applications instead of combustion/flaring: (a) **Thermal or mechanical, electrical energy generation directly; or** (b) Thermal or mechanical, electrical energy generation after bottling of upgraded biogas, in this case additional guidance provided in the appendix shall be followed; or (c) Thermal or mechanical, electrical energy generation after upgrading and distribution, in this case additional guidance provided in the appendix shall be followed: (i) Upgrading and injection of biogas into a natural gas distribution grid with no significant transmission constraints; or (ii) Upgrading and transportation of biogas via a dedicated piped network to a group of end users; or (iii) Upgrading and transportation of biogas (e.g. by trucks) to distribution points for end users; (d) Hydrogen production; (e) Use as fuel in transportation applications after upgrading.	The biogas from the system is utilized for thermal and electricity energy generation directly. Therefore, the project activity satisfies the criterion (a).
5	If the recovered methane is used for project activity covered under paragraph 4(a), that component of the project activity can use a corresponding category under type I.	The approved baseline and monitoring methodologies AMS-I.C. and AMS-I.D. are used for the thermal and electricity generation components of the project activity.
6	For project activities covered under paragraph 4(b), if bottles with upgraded biogas are sold outside the project boundary, the end-use of the biogas shall be ensured via a contract between the bottled biogas vendor and the end-user. No emission reductions may be claimed from the displacement of fuels from the end use of bottled biogas in such situations. If, however, the end use of the bottled biogas is included in the project boundary and is monitored during the crediting period CO_2 emissions avoided by the displacement of fossil fuel can be claimed under the corresponding Type I methodology, e.g. "AMS-I.C.: Thermal energy production with or without electricity".	The project activity satisfies paragraph 4(a). Therefore, this condition is not relevant to the project activity.
7	For project activities covered under paragraph 4(c)(i), emission reductions from the displacement of the use of natural gas are eligible under this methodology, provided the geographical extent of the natural gas distribution grid is within the host country boundaries.	The project activity satisfies paragraph 4(a). Therefore, this condition is not relevant to the project activity.
8	For project activities covered under paragraph 4(c)(ii), emission reductions from the displacement of the use of fuels can be claimed following the provision in the corresponding Type I methodology, e.g. AMS-I.C.	The project activity satisfies paragraph 4(a). Therefore, this condition is not relevant to the project activity.
9	In particular, for the case of paragraph 3(b) and (c)(iii), the physical leakage during storage and	The project activity satisfies paragraph 4(a). Therefore, this condition is not relevant to

	Applicability conditions	Project case
	transportation of upgraded biogas, as well as the emission from fossil fuel consumed by vehicles for transporting biogas shall be considered. Relevant procedures in paragraph 18 of the appendix of “AMS-III.H.: Methane recover in wastewater treatment” shall be followed in this regard.	the project activity.
10	For project activities covered under paragraph 3(b) and (c), this methodology is applicable if the upgraded methane content of the biogas is in accordance with relevant national regulations (where these exist) or, in the absence of national regulations, a minimum of 96 per cent (by volume).	The project activity satisfies paragraph 4(a). Therefore, this condition is not relevant to the project activity.
11	If the recovered is utilized for production of hydrogen (project activities covered under paragraph 3 (d)), that component of project activity shall use the corresponding methodology “AMS-III.O.: Hydrogen production using methane extracted from biogas”.	The project activity satisfies paragraph 4(a). Therefore, this condition is not relevant to the project activity.
12	If the recovered biogas is used for project activities covered under paragraph 3(e), that component of the project activity shall use corresponding methodology “AMS-III.AQ.: Introduction of Bio-CNG in transportation applications”.	The project activity satisfies paragraph 4(a). Therefore, this condition is not relevant to the project activity.
13	New facilities (Greenfield projects) and project activities involving a change of equipment resulting in a capacity addition of the wastewater or sludge treatment system compared to the designed capacity of the baseline treatment system are only eligible to apply this methodology if they comply with the requirements in the “General Guidance for SSC methodologies”. In addition the requirements for demonstrating the remaining lifetime of the equipment replaced, as described in the general guidance shall be followed.	The project involves a capacity increase of the factory, but it doesn’t involve a change in equipment resulting in a capacity addition. The BFR 3 of the project is a new installation and it is therefore considered as a Greenfield project. It is demonstrated that the most plausible baseline scenario for the Greenfield part is the baseline provided in the methodology.
14	The location of the wastewater treatment plant shall be uniquely defined as well as source generating the wastewater and described in the PDD.	The WWT plant and the source generating the WW are situated at the Chaodee plant, as described in section A.2.
15	Measures are limited to those that result in aggregate emission reductions of less than or equal to 60 kt CO_2 equivalent annually from all Type III components of the project activity.	The emission reductions to be achieved by the project activity are estimated 56,011 tCO_2 per year from all type III component, which is lower than 60 $ktCO_2e$ per year over the crediting period. Therefore, the project activity satisfies this applicability criterion as well.

<u>Applicability conditions for AMS-I.D</u>

	Reference to AMS I.D	Relevance of the project activity
2	This methodology comprises renewable energy generation units, such as photovoltaics, hydro, tidal/wave, wind, geothermal and renewable biomass: (a) Supplying electricity to a national or a regional grid; or (b) Supplying electricity to an identified consumer facility via national/regional grid through a contractual arrangement such as wheeling.	The project involves the installation of generators that use biogas as fuel to produce electricity. The total capacity of the generators for producing electricity is planned to be 3.128 MW. First set consists of 2 generators of 0.5MW and one generator used a back-up system of 0.128MW. Second set consists of 2 generators of 1 MW. However, the generators for second set are not yet bought. The electricity generated after in-house consumption is supplied to a national grid as per the signed Power Purchase Agreement (PPA) with the Provincial Electricity Authority (PEA).

	Reference to AMS I.D	Relevance of the project activity
		Therefore, the project activity satisfies this applicability criterion.
3	Illustration of respective situations under which each of the methodology (i.e. “AMS-I.D.: Grid connected renewable electricity generation”, “AMS-I.F.: Renewable electricity generation for captive use and mini-grid” and “AMS-I.A.: Electricity generation by the user) applies is included in the appendix.	The project activity will use a part of biogas (a renewable fuel) which is captured from the methane avoidance component of the project activity to generate electricity in the gas engine. The electricity generated will be exported to the national grid. Therefore, this can be concluded that the AMS-I.D is the appropriate methodology.
4	This methodology is applicable to project activities that (a) Install a Greenfield plan; (b) Involve a capacity addition in (an) existing plant(s); (c) Involve a retrofit of (an) existing plant(s); (d) Involve a rehabilitation of (an) existing plant(s)/unit(s); or (e) Involve a replacement of (an) existing plant(s).	The project activity will install a power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project.
5	Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to this methodology: (a) The project activity is implemented in an existing reservoir with no change in the volume of reservoir; (b) The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the project emissions section, is greater than 4 W/m_2; (c) The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the project emissions section, is greater than 4 W/m^2.	Not applicable
6	If the new unit has both renewable and non-renewable components (e.g. a wind/diesel unit), the eligibility limit of 15MW for a small-scale CDM project activity applies only to the renewable component. If the unit added co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15MW.	The total capacity of the generators for producing electricity is 3.128MW. Hence, the project activity satisfies this applicability criterion. The project does not consist of co-firing system. Only biogas is used in generator.
7	Combined heat and power (co-generation) systems are not eligible under this category.	Not applicable
8	In the case of project activities that involve the capacity addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct from the existing units.	Not applicable
9	In the case of retrofit, rehabilitation or replacement, to qualify as a small-scale project, the total output of the retrofitted, rehabilitated or replacement power plant/unit shall not exceed the limit of 15 MW.	Not applicable
10	In the case of landfill gas, waste gas, wastewater treatment and agro-industries projects, recovered methane emissions are eligible under a relevant Type III category. If the recovered methane is used for electricity generation for supply to a grid then the baseline for the electricity component shall be in	The approved baseline and monitoring methodologies AMS-I.C. and AMS-I.D. are used for the thermal and electricity generation components of the project activity.

	Reference to AMS I.D	Relevance of the project activity
	accordance with procedure prescribed under this methodology. If the recovered methane is used for heat generation or cogeneration other applicable Type-I methodologies such as "AMS-I.C.: Thermal energy production with or without electricity" shall be explored.	
11	In case biomass is sourced from dedicated plantations, the applicability criteria in the tool "Project emissions from cultivation of biomass" shall apply.	Not applicable

<u>Applicability conditions for "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation", version 03.0</u>

	Reference to methodological tool	Relevance of the project activity
5	If emissions are calculated for electricity consumption, the tool is only applicable if one out of the following three scenarios applies to the sources of electricity consumption: (a) Scenario A: Electricity consumption from the grid. The electricity is purchased from the grid only, and either no captive power plant(s) is/are installed at the site of electricity consumption or, if any captive power plant exists on site, it is either not operating or it is not physically able to provide electricity to the electricity consumer; (b) Scenario B: Electricity consumption from (an) off-grid fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants are installed at the site of the electricity consumer and supply the consumer with electricity. The captive power plant(s) is/are not connected to the electricity grid; or TOOL05 Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation Version 03.0 4 of 25 (c) Scenario C: Electricity consumption from the grid and (a) fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants operate at the site of the electricity consumer. The captive power plant(s) can provide electricity to the electricity consumer. The captive power plant(s) is/are also connected to the electricity grid. Hence, the electricity consumer can be provided with electricity from the captive power plant(s) and the grid.	The project involves the installation of generators that use biogas as fuel to produce electricity. The total capacity of the generators for producing electricity is planned to be 3.128 MW. First set consists of 2 generators of 0.5MW and one generator used a back-up system of 0.128MW. Second set consists of 2 generators of 1 MW. However, the generators for second set are not yet bought. The electricity generated after in-house consumption is supplied to a national grid as per the signed Power Purchase Agreement (PPA) with the Provincial Electricity Authority (PEA). Therefore, the project activity satisfies paragraph 5 (a).
6	This tool can be referred to in methodologies to provide procedures to monitor amount of electricity generated in the project scenario, only if one out of the following three project scenarios applies to the recipient of the electricity generated: (a) Scenario I: Electricity is supplied to the grid; (b) Scenario II: Electricity is supplied to consumers/electricity consuming facilities; or	The electricity generated in the project scenario will be supplied to (a) Scenario I: the national grid.

	Reference to methodological tool	Relevance of the project activity
	(c) Scenario III: Electricity is supplied to the grid and consumers/electricity consuming facilities.	
7	This tool is not applicable in cases where captive renewable power generation technologies are installed to provide electricity in the project activity, in the baseline scenario or to sources of leakage. The tool only accounts for CO_2 emissions.	The project does not consist of a captive renewable power generation technology. Therefore, the tool is applicable.

Applicability conditions for "Project emissions from flaring", version 03.0

	Reference to methodological tool	Relevance of the project activity
3	This tool is applicable to the flaring of flammable greenhouse gases where: (a) Methane is the component with the highest concentration in the flammable residual gas; and (b) The source of the residual gas is coal mine methane or a gas from a biogenic source (e.g. biogas, landfill gas or wastewater treatment gas).	By the wastewater treatment process, the organic compounds in wastewater are transformed mainly into biogas by anaerobic bacteria in the BFR system. The biogas used as fuel in power generators and in existing thermal oil boilers used for starch drying. The open flaring system will be used only in case of emergency. Therefore, the tool is applicable.
4	The tool is not applicable to the use of auxiliary fuels and therefore the residual gas must have sufficient flammable gas present to sustain combustion. For the case of an enclosed flare, there shall be operating specifications provided by the manufacturer of the flare.	The use of auxiliary fuel is not required for the residual gas to sustain combustion. Therefore, the tool is applicable.

Applicability conditions for "Tool to calculate the emission factor for an electricity system", version 07.0

	Reference to methodological tool	Relevance of the project activity
3	This tool may be applied to estimate the OM, BM and/or CM when calculating baseline emissions for a project activity that substitutes grid electricity that is where a project activity supplies electricity to a grid or a project activity that results in savings of electricity that would have been provided by the grid (e.g. demand-side energy efficiency projects).	The project activity involves in electricity supply to the national grid. Therefore, this tool is applicable.
4	Under this tool, the emission factor for the project electricity system can be calculated either for grid power plants only or, as an option, can include off-grid power plants. In the latter case, two sub-options under the step 2 of the tool are available to the project participants, i.e. option IIa and option IIb. If option IIa is chosen, the conditions specified in "Appendix 1: Procedures related to off-grid power generation" should be met. Namely, the total capacity of off-grid power plants (in MW) should be at least 10 per cent of the total capacity of grid power plants in the electricity system; or the total electricity generation by off-grid power plants (in MWh) should be at least 10 per cent of the total electricity generation by grid power plants in the electricity system; and that factors which negatively affect the reliability and stability of the grid are primarily due to constraints in generation and not to other aspects such as transmission capacity	The steps involved in calculation of the emission factor is included in the most recent report made available by the Thailand DNA. More details can be found in Appendix 4.
5	In case of CDM projects the tool is not applicable if the project electricity system is located partially or totally in an Annex I country.	The project activity is not located in an Annex I country. Therefore, this tool is applicable.

	Reference to methodological tool	Relevance of the project activity
6	Under this tool, the value applied to the CO_2 emission factor of biofuels is zero.	There is no use of biofuel involved in the project activity. Hence, this is not applicable.

Applicability conditions for "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", version 03.0

	Reference to methodological tool	Relevance of the project activity
5	Typical applications of this tool are methodologies where the flow and composition of residual or flared gases or exhaust gases are measured for the determination of baseline or project emissions.	The project activity applies the methodological tool for ""Project emissions from flaring", version 03.0. Therefore, this tool is applicable.
6	Methodologies where CO_2 is the particular and only gas of interest should continue to adopt material balances as the means of flow determination and may not adopt this tool as material balances are the cost effective way of monitoring flow of CO_2.	The project activity applies the methodological tool for ""Project emissions from flaring", version 03.0, where the flaring of CH_4 is incomplete. Therefore, this criterion is not applicable.
7	The underlying methodology should specify: (a) The gaseous stream the tool should be applied to; (b) For which greenhouse gases the mass flow should be determined; (c) In which time intervals the flow of the gaseous stream should be measured; and (d) Situations where the simplification offered for calculating the molecular mass of the gaseous stream (equations (3) or (17)) is not valid (such as the gaseous stream is predominantly composed of a gas other than N_2).	These relevant details can be found in section B.7.

The following methodological tools are applied under section B.3 due to the renewal of crediting period.

- Tool to determine the remaining lifetime of equipment", version 01
- "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period", version 03.0.1

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

With reference to AMS-III.H, the project boundary is the physical, geographical site where the wastewater and sludge treatment takes place in baseline and project situation. It covers all facilities affected by the project activity including sites where the processing, transportation and application or disposal of waste products as well as biogas takes place It includes the biogas tanks, the biogas storage vessel, the methane flaring system, the aeration ponds (aerobic treatment where emissions of methane still occur), and the usage of solid sludge for soil application.

With reference to AMS-I.D, the project boundary encompasses the physical, geographical site of the renewable generation. In the case of this project, the boundary is therefore limited to the biogas engines and the grid.

The baseline and the project boundaries are as follows:

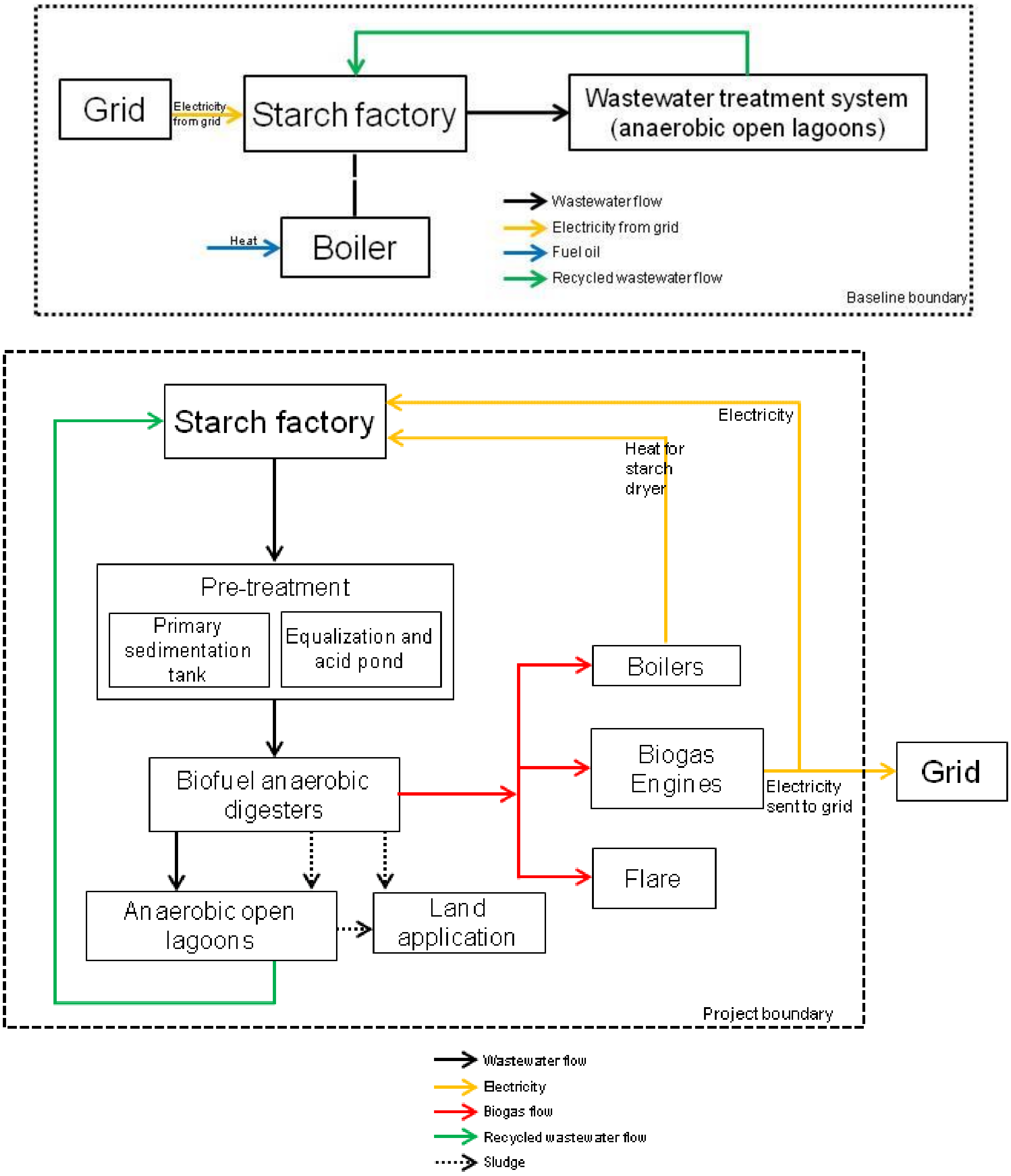

Figure 3. Baseline situation and project boundary

	Source	GHG	Included?	Justification/Explanation
Baseline	Wastewater treatment processes	CO_2	Excluded	CO2 emissions from the decomposition of organic waste are not accounted for.
		CH_4	Included	Emission from open lagoons (decay of organic matter in anaerobic conditions).
		N_2O	Excluded	Excluded for simplification. This is conservative.
	Electricity generation	CO_2	Included	Emission from electricity generation in the grid displaced by the project activity.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
Project activity	Wastewater treatment processes	CO_2	Excluded	The treatment of wastewater under the project activity may cause different emissions: (i) Methane emissions from lagoons (ii) Fugitive emissions due to inefficiencies in capture systems Methane emissions from flaring
		CH_4	Included	Fugitive emissions on account of inefficiencies in capture systems.
		N_2O	Excluded	No land application of sludge
	Flare	CH_4	Included	Emission due to incomplete flaring
	On-site electricity use	CO_2	Included	If the biogas reactor uses electricity generated from the biogas fired gas engine, this will be excluded. However, if the electricity is sourced from the grid, this will be included.
		CH_4	Excluded	Excluded for simplification
		N_2O	Excluded	Excluded for simplification

B.4. Establishment and description of baseline scenario

As per paragraph 282 of the CDM project standard for project activities version 2.0, the validity of the original baseline shall be demonstrated in accordance with paragraph 283-286. The details are as follows.

Demonstration	Justification
283. To demonstrate the validity of the original baseline or its update, the project participants are not required to reassess the baseline scenario. Instead, the project participants shall assess the GHG emission reductions or net anthropogenic GHG removals that would have resulted from that scenario.	The assessment of GHG emission reductions that would have resulted for the scenario is mentioned under section B.6.
284. The project participants shall assess and incorporate the impact of national and/or sectoral policies and circumstances, existing at the time of requesting renewal of crediting period, on the current baseline GHG emissions, without reassessing the baseline scenario.	The impact of national and/or sectoral policies and circumstances existing at the time of requesting renewal of crediting period is assessed as per the Methodological too: Assessment of the validity of the original/current baseline and update of the

	baseline at the renewal of the crediting period under section B.4.
285. The requirements contained in paragraph 284 above are not applicable to a registered CDM project activity applying the valid version of an applicable approved standardized baseline that standardizes baseline scenario in accordance with paragraph 281 above.	This is not related to the project activity since there is no approved standardized baseline applied.
286. If data and parameters used for determining the original baseline, that were determined ex ante and not monitored during the crediting period, are no longer valid, the project participants shall update such data and parameters in accordance with the "Methodological tool: Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period".	Since there are no longer valid data and parameters used for determining the original baseline, such data and parameters are updated in accordance with the Methodological too: Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period under section B.4.

Demonstration of the validity of baseline scenario

The baseline of the project activity has been developed by using two categories listed in the simplified modalities and procedure for small-scale CDM project activity:

1. Type III – Other project activities, Category III.H – Methane recovery in wastewater treatment Version 19 (AMS-III.H)

   The baseline scenario is described by paragraph 2 (f) of AMS-III.H version 19 as being the existing anaerobic wastewater treatment system without methane recovery. In the project's case, the system is a series of six deep open anaerobic lagoons which is extended to 15 lagoons during the expansion of the second starch production line.

   During the first crediting period, the project activity was registered under the version 13 of AMS III.H and there was no at least one year historical data available. The COD removal efficiency was determined by a measurement campaign in the baseline wastewater systems for at least 10 days. Due to these reasons, the paragraph 36, 37 (a) and 37 (c) of AMS-III.H version 19 cannot be applied in the renewal of crediting period.
   As per paragraphs 37 (b) of the applied methodology, historical records of at least one year prior to the project implementation shall be used. In case one year of historical data is not available, the parameters shall be determined by a measurement campaign in the baseline wastewater systems for at least 10 days. In the case of the project, one year historical records for the COD removal efficiency of the lagoons system are not available. However, measurements in the lagoons system have been conducted during a 10 day campaign prior the project start date. Therefore, the chemical oxygen demand removal efficiency of the baseline wastewater treatment system (the 6 anaerobic lagoons) is calculated based on these values of the COD of the wastewater discharge from the starch factory before treatment and at the last lagoon of baseline treatment, multiplied by 0.89 to account for the uncertainty range associated with this approach compared to one-year historical data. Actual reduction across the system is approximately 99% as per the 10 day measurement campaign. Therefore, a value of 89% for the COD removal efficiency is used for the baseline.

   The baseline system consists of 15 anaerobic lagoons. The minimum depth of the lagoon is 4 metres. The following table gives the details of the lagoon system.

No.		Depth (m.)	Area (m2)	Volume (m3)
1	Anaerobic pond	6	55,772	334,632
2	Anaerobic pond	6	36,511	219,066
3	Anaerobic pond	6	25,576	153,456
4	Anaerobic pond	6	20,105	120,630
5	Anaerobic pond	6	18,670	112,020
6	Anaerobic pond	6	56,518	339,108
7	Anaerobic pond	4	29,155	116,620
8	Anaerobic pond	4	13,520	54,080
9	Anaerobic pond	4	27,995	111,980
10	Anaerobic pond	4	21,810	87,240
11	Anaerobic pond	4	16,960	67,840
12	Anaerobic pond	4	38,685	154,740
13	Anaerobic pond	4	25,054	100,216
14	Anaerobic pond	6	55,461	332,766
15	Anaerobic pond	6	35,588	213,528
	Total		**477,380**	**2,517,922**

2. Type I – Renewable energy projects, Category I.D – Grid connected renewable electricity generation Version 18 (AMS-I.D).

   The baseline for the electricity component, as per AMS-I.D (version 18.0), is the electricity produced by the project activity that displaces electricity from the Thai national grid. AMS.I.D (version 18), paragraph 10 confirms that the methane component baseline scenario shall be defined according to a type III category methodology (AMSIII.H in this case), which has been elaborated above.

Update data and parameters for renewal of crediting period

In accordance with paragraph 286 of the CDM project standard for project activities, version 02.0, at the renewal of the crediting period, there are no longer valid data and parameters used for determining the original baseline. The update of the data and parameters shall be provided as per the methodological tool "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of a crediting period", version 3.0.1.

The tool consists of two steps; to evaluate whether the current baseline is still valid and to update the baseline in case that the current baseline is not valid anymore for the next crediting period. The assessment is detailed as follows:

Step 1: Assess the validity of the current baseline for the next crediting period
The "Procedure for the renewal of the crediting period of a registered CDM project activity" approved by the CDM Executive Board require assessing the impact of new relevant national and/or sectoral policies and circumstances on the baseline.

The validity of the current baseline is assessed using the following Sub-steps:

Step 1.1: Assess compliance of the current baseline with relevant mandatory national and/or sectoral policies

Methane avoidance component:
In accordance with relevant mandatory national and/or sectoral policies in Thailand, there is no mandatory national and/or sectoral policies requirement for the implementation of a specific wastewater treatment technology, such as an anaerobic digester or aerobic treatment system, at tapioca starch processing plants. The current relevant law and regulations allow the use of open lagoon systems and other wastewater treatment technologies, which meet the effluent standard in

Thailand for the discharge of treated wastewater into the environment. However, such the effluent standard only applies if the starch factory releases wastewater outside its premises which is not the case. Furthermore, there is no current mandatory policies or law/regulation that enforces anaerobic wastewater treatment to be included/changed to biogas collection and utilization.

It is assessed that the use of the original open anaerobic lagoon system for wastewater treatment is in compliance with regulation and it is not mandatory to use specific technologies.

Electricity generation component:
In Thailand, there is no mandatory national and/or sectoral policies requirement for the implementation of power generation at a wastewater treatment plant. The electricity generated in the project would have been generated in the grid, which is primarily based on fossil fuel. Therefore, it is assessed that the current baseline for the electricity generation component is in compliance with regulation.

Step 1.2: Assess the impact of circumstances
It is assessed that there are no circumstances existing at the time of requesting renewal of the crediting period which would impact the current baselines. The conditions used to determine the baseline emissions in the previous crediting period are still valid, except some updated parameters which have been assessed in further stepwise.

Step 1.3: Access whether the continuation of use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which renewal is requested.

The use of current baselines is the continuation of the current practice without any investment. As per the assessment of Step 1.1, the project proponent would have used the current baseline in absence of the project implementation as there is no requirements enforce change or modification of the current baselines. The technical lifetime of the equipment has been certified by third party with the continuation of more than 10 years.

Step 1.4: Assessment of the validity of the data and parameters

As per the methodological tool, some data and parameters, which were only determined at the start of the crediting period and not monitored during the crediting period following parameters are updated for the second crediting period, are not valid and should be updated for application for the second crediting period. Such updated data and parameters are addressed as follows.

Cases	Determination
• Where IPCC default values are used, the values should be updated if any new default values have been adopted and published by the IPCC, for example, in guidelines for national GHG inventories, IPCC assessment report or special reports by the IPCC;	As per the requirements in Annex 3 of EB 69 Report, the global warming potential (GWP), which is IPCC default value used in the first crediting period, is updated for the second crediting period. Please refer to section B.6.1 for the updated value.
• Where emission factors, values or emission benchmarks are used and determined only once for the crediting period, they should be updated, except if the emission factors, values or emission benchmarks are based on the historical situation at the site of the project activity prior to the implementation of the project and cannot be updated because the historical situation does not exist anymore as a result of the CDM project	Since there is an updated value for combined margin CO_2 emission factor for grid connected power generation available, which is recently studied by Thai DNA, the updated value shall be applied for the second crediting period. Please refer to section B.6.1 for more details.

Cases	Determination
activity.	

Although the application of Steps 1.1, 1.2 and 1.3 confirms that the current baseline is still valid for the second crediting period, the data and parameters as mentioned in Step 1.4 above need to be updated. Thus, Step 2 is proceeded.

Step 2: Update the current baseline and the data and parameters
Step 2.1: Update the current baseline

The current baseline emissions for the second crediting period is updated with use of the valid data and parameters as mentioned in Step 1.4, without reassessing the baseline scenario, based on the latest approved version of the methodologies applicable to the project activity. Please refer to following determination of the baseline emission and section B.6.1 and B.6.3 for more details.

Step 2.2: Update the data and parameters

As per the result of assessment in Step 1.4 above, all applicable data and parameters for the second crediting period are updated based on the latest version of the methodologies applied in the project activity. Please refer to section B.6 and B.7 for the updated data and parameters for the second crediting period.

B.5. Demonstration of additionality

According to paragraph 280 of the Project Standard, version 02.0, for the request for renewal of crediting period of a registered CDM project activity there is no requirement to reassess the additionality of the project activity and update the section relating to additionality. Hence, the same details of the demonstration of additionality in the registered PDD of the previous crediting period shall be applied for this section.

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

The amount of methane that would be emitted to the atmosphere in the absence of the project activity is estimated according to AMS-III.H, Version 19.

For the emission reduction on account of fuel and power savings the applicable methodologies are AMS-I.C, Version 21 and AMS-I.D, Version 18.

This section details the applicable formulas from the methodologies applied to the project activity.

Baseline emissions

Baseline emissions are the sum of emissions from the degradable organic matter in the treated wastewater (calculated according to AMS-III.H. Version 19), the emissions due to the displacement of electricity from the grid (calculated according to AMS-I.D. Version 18) :

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

Where:

BE_y	=	Baseline emissions in year y (t CO_2e)
$BE_{elec,y}$	=	Baseline emissions from electricity generation component (t CO_2e)
$BE_{power,y}$	=	Baseline emissions from electricity or fuel consumption in year y (t CO_2e)

$BE_{ww,treatment,y}$	=	Baseline emissions of the wastewater treatment systems affected by the project activity in year y (t CO_2e)
$BE_{s,treatment,y}$	=	Baseline emissions of the sludge treatment systems affected by the project activity in year y (t CO_2e)
$BE_{ww,discharge,y}$	=	Baseline methane emissions from degradable organic carbon in treated wastewater discharged into sea/river/lake in year y (t CO_2e).
$BE_{s,final,y}$	=	Baseline methane emissions from anaerobic decay of the final sludge produced in year *y* (t CO_2e). If the sludge is controlled combusted, disposed in a landfill with biogas recovery, or used for soil application in the baseline scenario, this term shall be neglected

AMS-III.H

$BE_{power,y}$ - Baseline emissions from electricity or fuel consumption:
The baseline emissions from electricity and fossil fuel consumption are not considered as the electricity consumption of the open anaerobic lagoons in the baseline scenario was very low. Furthermore, it is conservative to neglect this emission source. The baseline emissions from fuel consumption are zero as no fossil fuels have been consumed in the operation of the open anaerobic lagoons in the baseline scenario.

Therefore, $\mathbf{BE_{power,y}}$ is assumed zero and removed from further consideration.

$BE_{ww,treatment,y}$ - Baseline emissions of the wastewater treatment systems affected by the project activity:
Methane emissions from the baseline wastewater treatment systems affected by the project ($BE_{ww,treatment,y}$) are determined using the COD removal efficiency of the baseline plant:

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

Where:

$Q_{ww,i,y}$	=	Volume of wastewater treated in baseline wastewater treatment system i in year y (m^3)
$COD_{inflow,i,y}$	=	Chemical oxygen demand of the wastewater inflow to the baseline treatment system i in year y (t/m^3). Average value may be used through sampling with the confidence/precision level 90/10
$\eta_{COD,BL,i}$	=	COD removal efficiency of the baseline treatment system i
$MCF_{ww,treatment,BL,i}$	=	Methane correction factor for baseline wastewater treatment systems i
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)[7]
UF_{BL}	=	Model correction factor to account for model uncertainties (0.89)[8]
GWP_{CH4}	=	Global Warming Potential for methane

As the baseline treatment system is different from the treatment system in the project scenario, the monitored values of COD inflow during the crediting period will be used to calculate the baseline emissions ex-post.

The COD removal efficiency of the baseline system has been measured ex-ante through measurement campaign as per paragraph 37(b). Please refer to Appendix 4 for more details.

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

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[7] Project activities may use the default value of 0.6 kg CH_4/kg BOD, if the parameter $BOD_{5,20}$ is used to determine the organic content of the wastewater. In this case, baseline and project emissions calculations shall use BOD instead of COD in the equations, and the monitoring of the project activity shall be based in direct measurements of $BOD_{5,20}$, i.e. the estimation of BOD values based on COD measurements is not allowed.

[8] Reference: FCCC/SBSTA/2003/10/Add.2, page 25.

There is no baseline sludge treatment system. Therefore, this baseline emission source is excluded from further consideration.

$BE_{ww,discharge,y}$ - Baseline methane emissions from degradable organic carbon in treated wastewater discharged into sea/river/lake
In the baseline treatment system the wastewater is not discharged into a sea/lake/river, therefore this baseline emission source is excluded from further consideration.

$BE_{s,final,y}$ – Baseline methane emissions from anaerobic decay of the final sludge produced:
The baseline treatment system would not have generated any sludge. Therefore, this baseline emission source is excluded from further consideration.

As per AMS III.H, paragraph 4 and 5, since the recovered biogas is used for thermal and electricity generation, type I methodologies are used. As per AMS-III.H, paragraph 26, baseline emissions for supply of electricity to and/or displacement electricity from a grid shall be calculated as per the procedures described in AMS-I.D. For emissions from fossil fuel consumption, the emission factor for the fossil fuel shall be used (tCO_2/tonne).

AMS-I.D

$$BE_{elec,y} = EG_{PJ,y} \times EF_{grid,y}$$

Where:

BE_y	=	Baseline emissions in year y (t CO_2)
$EG_{PJ,y}$	=	Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh)
$EF_{grid,y}$	=	Combined margin CO_2 emission factor for grid connected power generation in year y (t CO_2/MWh)

<u>Project emissions (PE_y)</u>

AMS III H
Project emissions are the sum of emissions from the wastewater treatment systems affected by the project and not equipped with biogas recovery, methane fugitive emissions on account of inefficiencies in capture systems, methane emissions due to incomplete flaring, CO_2 emissions on account of power and fuel used by the project activity facilities (calculated according to AMS III.H-Version 19, paragraph 39).
The project activity emissions are calculated as follows:

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

Where:

PE_y	=	Project activity emissions in the year y (t CO_2e)
$PE_{power,y}$	=	Emissions from electricity or fuel consumption in the year *y* (t CO_2e)
$PE_{ww,treatment,y}$	=	Methane emissions from wastewater treatment systems affected by the project activity, and not equipped with biogas recovery, in year *y* (t CO_2e)
$PE_{s,treatment,y}$	=	Methane emissions from sludge treatment systems affected by the project activity, and not equipped with biogas recovery, in year *y* (t CO_2e)
$PE_{ww,discharge,y}$	=	Methane emissions from degradable organic carbon in treated wastewater in year *y* (t CO_2e).
$PE_{s,final,y}$	=	Methane emissions from anaerobic decay of the final sludge produced in year *y* (t CO_2e).
$PE_{fugitive,y}$	=	Methane emissions from biogas release in capture systems in year *y* (t CO_2e)
$PE_{flaring,y}$	=	Methane emissions due to incomplete flaring in year y (t CO_2e).

$PE_{biomass,y}$	=	Methane emissions from biomass stored under anaerobic conditions. (t CO_2e)

$PE_{power,y}$ – Emissions from electricity or fuel consumption :
Project emissions due to electricity consumption attributed to the project activity, can be calculated based on paragraph 26 of the methodology, whereas $PE_{power,y}$ shall be estimated according to the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"[9].

The *Scenario A: Electricity consumption from the grid* will be applied to the project activity for electricity imported from the grid. The generic approach is used to calculate the project emissions as follows:

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

Where:

$PE_{power,y}$	=	Project emissions from electricity consumption in year y (tCO_2/yr)
$EC_{PJ,j,y}$	=	Quantity of electricity consumed by the project electricity consumption source j in year y (MWh/yr)
$EF_{EL,j,y}$	=	Emission factor for electricity generation 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

Determination of emission factor for the electricity generation ($EF_{EL,j,y}$)

Option A1 has been used to determine emission factor. This option proposes to calculate the combined margin emission factor of the applicable electricity system, using the procedures in the latest approved version of the "Tool to calculate the emission factor for an electricity system" ($EF_{EL,j,y} = EF_{grid,CM,y}$).

Determination of average technical transmission and distribution losses
$TDL_{j,y}$ will be taken from the recent data available within the host country.

$PE_{ww,treatment,y}$ – Methane emissions from wastewater treatment systems affected by the project activity, and not equipped with biogas recovery:
This emission source is applicable to the open lagoons which will be used as a secondary treatment for the wastewater treated in the project activity. The same is calculation as per paragraph 27 in the methodology:

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

Where:

$Q_{ww,k,y}$	=	Volume of wastewater treated in baseline wastewater treatment system i in year y (m^3)
$COD_{inflow,k,y}$	=	Chemical oxygen demand of the wastewater inflow to the project treatment system k in year y (t/m^3). This is same as $COD_{ww,treated,k,y}$ as mentioned in monitoring section B.7.1
$\eta_{PJ,k,y}$	=	Chemical oxygen demand removal efficiency of the project wastewater treatment system *k* in year *y* (t/m^3)
$MCF_{ww,treatment,PJ,k}$	=	Methane correction factor for project wastewater treatment system k
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)[10]

[9] Available version of the Methodological tool is version 03.0 "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"

UF_{PJ}	=	Model correction factor to account for model uncertainties (1.12)[11]
GWP_{CH4}	=	Global Warming Potential for methane

It should be noted that $Q_{ww,k,y} = Q_{ww,i,y}$

$PE_{s,treatment,y}$ – Methane emissions from sludge treatment systems affected by the project activity, and not equipped with biogas recovery:
There is no sludge treatment system prior to the implementation of the project activity. Therefore, this parameter is not applicable in the calculations and has been excluded from further consideration.

$PE_{ww,discharge,y}$ – Methane emissions from degradable organic carbon in treated wastewater:
In the project activity, the treated wastewater will not be discharged into to a river, sea or lake. Therefore, project emissions from this component have not been included in the assessment.

$PE_{s,final,y}$ – Methane emissions from anaerobic decay of the final sludge produced:
It is not expected that the project activity will generate significant amount of sludge. The excess sludge may be used for starting up other systems equipped with biogas recovery or for soil application under aerobic conditions. Therefore, as per the methodology paragraph 39 (h), this term is neglected ex-ante.

The final disposal of sludge shall be monitored during the crediting period. In case the application of sludge cannot be monitored, as a conservative measure, it will be assumed that the sludge removed would have decayed in anaerobic manner. The emissions will be accounted as per equation 7 in paragraph 35 of the methodology.

$PE_{fugitive,y}$ - Methane emissions from biogas release in capture systems:
Project activity emissions from methane release in capture systems are determined as per the methodology paragraph 40 (a) Based on the methane emission potential of wastewater and/or sludge.

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

Where:

$PE_{fugitive,ww,y}$	=	Fugitive emissions through capture inefficiencies in the anaerobic wastewater treatment systems in the year y (t CO_2e)
$PE_{fugitive,s,y}$	=	Fugitive emissions through capture inefficiencies in the anaerobic sludge treatment systems in the year *y* (t CO_2e)

$PE_{fugitive,ww,y}$
These emissions are calculated as follow:

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

Where:

CFE_{ww}	=	Capture efficiency of the biogas recovery equipment in the wastewater treatment systems (a default value of 0.9 shall be used)
$MEP_{ww,treatment,y}$	=	Methane emission potential of wastewater treatment systems equipped with biogas recovery system in year *y* (t)

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

[10] Project activities may use the default value of 0.6 kg CH_4/kg BOD, if the parameter $BOD_{5,20}$ is used to determine the organic content of the wastewater. In this case, baseline and project emissions calculations shall use BOD instead of COD in the equations, and the monitoring of the project activity shall be based in direct measurements of $BOD_{5,20}$, i.e. the estimation of BOD values based on COD measurements is not allowed.
[11] Reference: FCCC/SBSTA/2003/10/Add.2, page 25.

Where:

$COD_{removed,PJ,k,y}$	=	The chemical oxygen demand removed[12] by the treatment system *k* of the project activity equipped with biogas recovery in the year *y* (t/m^3)
$MCF_{ww,treatment,PJ,k}$	=	Methane correction factor for the project wastewater treatment system *k* equipped with biogas recovery equipment
UF_{PJ}	=	Model correction factor to account for model uncertainties (1.12)

$PE_{fugitive,s,y}$

There is no anaerobic sludge treatment in the project activity. Therefore, this source of emissions is excluded from further consideration.

Thus, the fugitive emissions through capture inefficiencies in the anaerobic wastewater treatment systems are given as:

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

$PE_{flaring,y}$ - Methane emissions due to incomplete flaring:

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

The project emissions calculation procedure is given in the following steps:

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

This step determines the mass flow of methane ($F_{CH4,m}$) as kg unit in the residue gaseous stream in the minute *m* as per the guidance given in the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", version 03.

$F_{CH4,RGm}$, 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. Therefore, the measurement option A as per the Table 2 of the tool is selected to determine the volume flow and the volumetric fraction of the residue gaseous stream on the dry basis. The temperature of the gaseous stream (T_t) is less than 60 deg C at the flow measurement point. Therefore as per Option A (b), the gaseous stream is considered dry.

$F_{CH4,m}$ is determined as following equation;

$$F_{CH4,m} = V_{t,db} \times v_{CH4,m,db} \times \rho_{CH4,m}$$

Where:

$F_{CH4,m}$	=	Mass flow of greenhouse gas CH_4 in the residual gaseous stream in the minute m (kg gas/m)
$V_{t,db}$	=	Volumetric flow of the residual gaseous stream in minute m on dry basis (Nm^3 dry gas/m)
$v_{CH4,m,db}$	=	Volumetric fraction of the greenhouse gas CH_4 in the gaseous stream in minute m on dry basis (%)
$\rho_{CH4,m}$	=	Density of greenhouse gas CH_4 in the gaseous stream in minute m (0.716 kg/m^3) at reference conditions

Step 2: Determination of flare efficiency

The open flare is used in the project activity. As per the tool of project emission from flaring, in the case of open flares, the flare efficiency in the minute m ($\eta_{flare,m}$) is 50% when the flame is detected in the minute m ($Flare_m$), otherwise is 0%

[12] Difference between the inflow COD and the outflow COD.

Step 3: Calculation of project emissions from flaring

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 residue gas ($F_{CH4,RG,m}$) and the flare efficiency ($\eta_{flare,m}$), as follow:

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

Where:

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

$PE_{biomass,\ y}$ - Methane emissions from biomass stored under anaerobic conditions:

There is no biomass storage in the project activity. Therefore, this source of emissions has been excluded from further consideration.

Leakage emissions (LE_y)

The used technology is not equipment transferred from another activity, therefore according to the AMS.III.H, there is no leakage to be considered.

All the equipment used in the project activity for power generation is either brought for purpose of project activity and no shifting of old equipment takes place. No energy equipment currently being utilised is transferred from outside the boundary to the project activity. Therefore, there is no leakage as per AMS-I.D.

Emission reductions (ER_y)

As per the guidance given in the paragraph 44 of AMS-III.H, *ex post* emission reductions shall be based on the lowest value of the following:

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

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

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

As per paragraph 47 of AMS III.H, in the case of flaring/combustion MD_y will be measured using the conditions of the flaring process:

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

Where:

$BG_{burnt,y}$	=	Biogas flared/combusted in year *y* (m^3)
$w_{CH4,y}$	=	Methane content of the biogas in the year *y* (volume fraction)
D_{CH4}	=	Density of methane at the temperature and pressure of the biogas in the year *y* (t/m^3)
FE	=	Flare efficiency in year y (fraction). If the biogas is combusted for gainful purposes, e.g. fed to an engine, an efficiency of 100 per cent may be applied

B.6.2. Data and parameters fixed ex ante

All data and parameters used for the emission reductions calculations but not monitored during the crediting period are provided in the following tables.

Data and parameters from the AMS.III.H

Data/Parameter	GWP_{CH4}
Data unit	
Description	Global warning potential for methane
Source of data	According EB 69 - Annex 3, the second commitment period GWP shall be effective from 01/01/2013
Value(s) applied	25
Choice of data or measurement methods and procedures	-
Purpose of data	The data is used for baseline and project emission calculations.
Additional comment	-

Data/Parameter	$B_{o,ww}$
Data unit	kg CH_4/kg COD
Description	Methane producing capacity of the wastewater
Source of data	IPCC default value as per methodology AMS III-H version 18
Value(s) applied	0.25
Choice of data or measurement methods and procedures	-
Purpose of data	The data is used for baseline and project emission calculations.
Additional comment	-

Data/Parameter	UF_{BL}
Data unit	-
Description	Model correction factor to account of model uncertainties
Source of data	AMS-III.H version 18
Value(s) applied	0.89
Choice of data or measurement methods and procedures	As per AMS-III.H version 18
Purpose of data	The data is used for baseline emission calculation.
Additional comment	-

Data/Parameter	UF_{PJ}
Data unit	-
Description	Model correction factor to account of model uncertainties
Source of data	AMS-III.H version 18
Value(s) applied	1.12
Choice of data or measurement methods and procedures	As per AMS-III.H version 18
Purpose of data	The data is used for project emission calculation.
Additional comment	-

Data/Parameter	$MCF_{ww,treatment,BL,i}$
Data unit	-
Description	Methane correction factor for the baseline anaerobic wastewater treatment systems
Source of data	Table 2 from AMS-III.H, Version 18, IPCC default values
Value(s) applied	0.8
Choice of data or measurement methods and procedures	The baseline wastewater treatment system consists of a succession of anaerobic deep lagoons (depth more than 2 metres) therefore the MCF value is chosen as 0.8
Purpose of data	The data is used for baseline emission calculation.
Additional comment	IPCC Default values from chapter 6 of volume 5. Waste in 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

Data/Parameter	$MCF_{ww,treatment,PJ,k}$
Data unit	-
Description	Methane correction factor for project wastewater treatment system k
Source of data	Table 2 from AMS-III.H, Version 18, IPCC default values
Value(s) applied	0.8
Choice of data or measurement methods and procedures	In the project scenario the post treatment of wastewater treatment system without biogas recovery consists of a succession of lagoons, with depth greater than 2 metres, thus the value of 0.8 has been chosen.
Purpose of data	The data is used for project emission calculation.
Additional comment	IPCC Default values from chapter 6 of volume 5. Waste in 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

Data/Parameter	CFE_{ww}
Data unit	Fraction
Description	Capture efficiency of the biogas recovery equipment in the wastewater treatment systems
Source of data	AMS-III.H version 18
Value(s) applied	0.9
Choice of data or measurement methods and procedures	Default value as per AMS-III.H version 18
Purpose of data	The data is used for project emission calculation.
Additional comment	-

Data/Parameter	$\eta_{COD,BL,i}$
Data unit	%
Description	COD removal efficiency of the baseline system i
Source of data	Measurement campaign in the baseline wastewater system for 10 days
Value(s) applied	88.73%
Choice of data or measurement methods and procedures	The COD removal efficiency value is based on COD campaign data and multiplied by a factor of 0.89 to account of uncertainty range due to data from the campaign measurement in the referenced plant. This is in line with the AMS III.H given in paragraph 39 (b) which requires a measurement campaign in the baseline wastewater systems for at least 10 day.
Purpose of data	The data is used for project emission calculation.
Additional comment	-

Data/Parameter	$\rho_{CH4,n}$
Data unit	kg/m^3
Description	Density of methane gas at reference conditions
Source of data	Methodological tool “Project emission from flaring” Version 02.0.0
Value(s) applied	0.716
Choice of data or measurement methods and procedures	-
Purpose of data	The data is used for project emission calculation.
Additional comment	-

Data and parameters from the AMS.I.D

Data/Parameter	$EF_{grid,y}$
Data unit	tCO_2e/MWh
Description	Combined margin CO_2 emission factor for grid connected power generation in year y
Source of data	A Study on Thailand Grid Emission Factor by Thai DNA
Value(s) applied	0.5637
Choice of data or measurement methods and procedures	The study of the estimation of grid emission factor is carried out by Thai DNA in accordance with the Methodological Tool: Tool to calculate the emission factor for an electricity system. The choice of data has been detailed in the published study by Thai DNA[13].
Purpose of data	The data is used for baseline and project emission calculations.
Additional comment	-

B.6.3. Ex ante calculation of emission reductions

The following section gives details of ex – ante estimation of CERs for the project activity, calculated as defined in section B.6.1.

The data sheet of calculations will be provided to the DOE.

The main calculation parameters and results are provided below:

[13] The latest study in 2017 is available at the time of validation for renewable of crediting period. http://ghgreduction.tgo.or.th/download-tver/68-2017-11-28-06-43-22/353-2559.html

Methodology: AMS-III.H (Methane avoidance component)		
Formula: $BE_{ww,treatment,y} = \sum(Q_{ww,i,y} \times COD_{inflow,i,y} \times \eta_{COD,BL,i} \times MCF_{ww,treatment,BL,i}) \times B_{o,ww} \times UF_{BL} \times GWP_{CH4}$		
$Q_{ww,i,y}$	1,849,600 Nm^3	Based on wastewater flow rate of 6,800 m^3/day, 85% of starch plant load factor and operation of 320 days.
$COD_{inflow,i,y}$	12,000 mg/l	BFR proposal
$\eta_{COD,BL,i}$	88.73%	BFR proposal
$MCF_{ww,treatment,BL,i}$	0.8	Default value for anaerobic deep lagoons
$B_{o,ww}$	0.25 kg CH_4/kg COD	Default value
UF_{BL}	0.89	Default value
GWP_{CH4}	25	Default value
Calculation: $\mathbf{BE_{ww,treatment,y}}$ = (1,849,600 x 12,000 x 88.73% x 0.8 / 1000000) x 0.25 x 0.89 x 25 = **87,633 tCO_2e**		
Methodology: AMS-I.D (Power generation component)		
Formula: $BE_{elec,y} = EG_{PJ,y} * EF_{grid,y}$		
$EG_{PJ,y}$	6,898 MWh	Based on info available for gas engine and biogas used for generation process (40% of total biogas generated). Efficiency of gas engine (10,300 kJ/kWh) and NCV of methane
$EF_{grid,y}$	0.5637 tCO_2/MWh	Grid emission factor
Calculation: $\mathbf{BE_{elec,y}}$ = 6,898 x 0.5637 = **3,887 tCO_2e**		

Project emissions:

Methodology: AMS-III.H (Methane avoidance component)		
Emissions in wastewater treatment system without biogas recovery		
Formula: $PE_{ww,treatment,y} = \sum(Q_{ww,k,y} \times COD_{inflow,k,y} \times \eta_{PJ,k,y} \times MCF_{ww,treatment,PJ,k}) \times B_{o,ww} \times UF_{PJ} \times GWP_{CH4}$		
$Q_{ww,k,y}$	1,849,600 Nm^3	Based on wastewater flow rate of 3400 m^3/day for one phase, 75% of starch plant load factor and operation of 320 days.
$COD_{inflow,i,y}$	2,400 mg/l	Based on 80% of removal efficiency of the BFR
$\eta_{PJ,k,y}$	88.73%	Calculated based on measurement historical data
$MCF_{ww,treatment,PJ,k}$	0.8	Default value for anaerobic deep lagoons
$B_{o,ww}$	0.25 kg CH_4/kg COD	Default value
UF_{PJ}	1.12	Default value
GWP_{CH4}	25	Default value
Calculation: $\mathbf{PE_{ww,treatment,y}}$ = (1,849,600 x 2,400 x 88.73% x 0.8 / 1000000) x 0.25 x 1.12 x 25 = **22,057 tCO_2 e**		
Fugitive emissions in wastewater treatment system with biogas recovery		
Formula: $PE_{fugitive,ww,y} = (1 – CFE_{ww}) * MEP_{ww,treatment,y} * GWP_{CH4}$		
CFE_{ww}	0.9	Default value
$MEP_{ww,treatment,y}$	3,182 t	Methane emission potential of wastewater treatment systems equipped with biogas recovery: $MEP_{ww,treatment,y} = Q_{y,ww} * B_{o,ww} * UF_{PJ} * \sum COD_{removed,PJ,BFR,y} * MCF_{ww,treatment,PJ,BFR}$, with $COD_{y,removed} = COD_{y,in} * \eta_{BFR} = COD_{y,in} * 0.80$.
Calculation: $\mathbf{PE_{fugitive,ww,y}}$ = (1-0.9) x 3,182 x 25 = **7,955 tCO_2 e**		
Methane emissions due to incomplete flaring		
Formula: $PE_{flare,y} = \Sigma TM_{RG,h} * (1- \eta_{flare,h}) * GWP_{CH4}/1000$		
$\eta_{flare,h}$	0.5	Efficiency of the open flare
$\Sigma TM_{RG,h}$	0 t	No biogas flared (only emergency)
Calculation:		

0 x (1-0.5) x 21 = **0 tCO_2e**		
Methodology: AMS-I.D (Power generation component)		
Formula: $PE_{power,y} = \sum EC_{PJ,j,y} \times EF_{EL,j,y} \times (1+TDL_{j,y})$		
$EC_{PJ,j,y}$	2,691 MWh	Based on power capacity installed (279.22kW for both line), and assuming that all relevant electrical equipments operate at full capacity, plus 10% to account for distribution losses, for 8760 hours per annum.
EF_{CO2}	0.5637 tCO_2/MWh	Grid emission factor of Thailand
$TDL_{j,y}$	6.11%	
Calculation: **$PE_{power,y}$** = 2,691 x 0.5637 x (1+6.11%) = **1,610 tCO_2e**		

Emission reductions due to type III component (methane avoidance):

$ER_{III} = BE_{ww,treatment,y} – PE_{power,y} – PE_{ww,treatment,y} – PE_{fugitive,\ ww,y} – PE_{flare,y}$
= 87,633 – 1,610 – 22,057 – 7,955 – 0
= **56,011 tCO_2e**

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

Methane avoidance component, AMS-III.H version 19.0:

Year	Baseline emissions ($t\ CO_2e$)	Project emissions ($t\ CO_2e$)	Leakage ($t\ CO_2e$)	Emission reductions ($t\ CO_2e$)
Year 1	87,633	31,622	0	56,011
Year 2	87,633	31,622	0	56,011
Year 3	87,633	31,622	0	56,011
Year 4	87,633	31,622	0	56,011
Year 5	87,633	31,622	0	56,011
Year 6	87,633	31,622	0	56,011
Year 7	87,633	31,622	0	56,011
Total	613,431	221,354	0	392,077
Total number of crediting years	7			
Annual average over the crediting period	87,633	31,622	0	56,011

Power generation component, AMS-I.D version 18.0:

Year	Baseline emissions ($t\ CO_2e$)	Project emissions ($t\ CO_2e$)	Leakage ($t\ CO_2e$)	Emission reductions ($t\ CO_2e$)
Year 1	3,887	0	0	3,887
Year 2	3,887	0	0	3,887
Year 3	3,887	0	0	3,887
Year 4	3,887	0	0	3,887
Year 5	3,887	0	0	3,887
Year 6	3,887	0	0	3,887
Year 7	3,887	0	0	3,887
Total	27,209	0	0	27,209

Total number of crediting years	7			
Annual average over the crediting period	3,887	0	0	3,887

Total ex ante estimates of emission reductions:

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
Year 1	91,520	31,622	0	59,898
Year 2	91,520	31,622	0	59,898
Year 3	91,520	31,622	0	59,898
Year 4	91,520	31,622	0	59,898
Year 5	91,520	31,622	0	59,898
Year 6	91,520	31,622	0	59,898
Year 7	91,520	31,622	0	59,898
Total	640,640	221,354	0	419,286
Total number of crediting years	7			
Annual average over the crediting period	91,520	31,622	0	59,898

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

The following data and parameters will be monitored after the implementation of the project activity. The values provided in this section are the ones used for the ER estimations provided in this PDD.

Data/Parameter	$Q_{ww,i,y}$
Data unit	m³/month
Description	The flow of wastewater
Source of data	Measured – Volumetric flow meter
Value(s) applied	1,849,600 after the implementation of the second line. Based on 320 operating days, 3,400 m³/d wastewater generation and a 0.85 factor of workload that comes from an average of three years historical workload of the factory.
Measurement methods and procedures	Data will be measured continuously (at least hourly measurement will be undertaken and if less, confidence level of 90/10 shall be attained) using flow meter installed before UASB. The data will be recorded manually in monthly log sheet on a daily basis and later transferred to electronic files.
Monitoring frequency	Continuous measurement
QA/QC procedures	The flow meter will be calibrated at regular intervals based on instrument specification and/or manufacturer's recommendation. The calibration will be performed by a certified testing agency using national/international standards.
Purpose of data	The data is used for baseline and project emission calculations.
Additional comment	

Data/Parameter	$COD_{ww,untreated,y} = COD_{y,in,BFR}$
Data unit	t COD/m³

Description	The chemical oxygen demand of the wastewater before the treatment system affected by the project activity
Source of data	Measured – Close Reflux Titrimetric analysis
Value(s) applied	12,000
Measurement methods and procedures	The COD content will be analyzed using a Close Reflux Titrimetric method in the on-site laboratory of the treatment plant. The results will be logged in the plant operation report on a daily basis. The measurements shall ensure a 90/10 confidence/precision level.
Monitoring frequency	Daily basis
QA/QC procedures	The Close Reflux Titrimetric method is well documented and well accepted either by national or international standards[14]. The average value shall be ensured a 90/10 confidence/precision level.
Purpose of data	The data is used for baseline and project emission calculations.
Additional comment	

Data/Parameter	$COD_{ww,treated,y}$ – $COD_{y,out,BFR}$
Data unit	t COD/m³
Description	The chemical oxygen demand of the wastewater after the treatment system affected by the project activity
Source of data	Measured – Close Reflux Titrimetric analysis
Value(s) applied	0.0024 This would be monitored during the monitoring period. However for estimation of project emissions for the anaerobic collection of methane, maximum possible value is assumed from 80% efficiency.
Measurement methods and procedures	The COD content will be analyzed using a Close Reflux Titrimetric method in the on-site laboratory of the treatment plant. The results will be logged in the plant operation report on a daily basis. The measurements shall ensure a 90/10 confidence/precision level.
Monitoring frequency	Daily basis
QA/QC procedures	The Close Reflux Titrimetric method is well documented and well accepted either by national or international standards[42]. The average value shall be ensured a 90/10 confidence/precision level.
Purpose of data	The data is used for baseline and project emission calculations.
Additional comment	

Data/Parameter	$S_{final,PJ,y}$
Data unit	t
Description	Amount of dry matter in the sludge
Source of data	Measured – same weighbridge at starch plant for tapioca procuring
Value(s) applied	0
Measurement methods and procedures	The project proponent doesn’t envisage the generation of any sludge on regular basis, requiring regular treatment. If any, the sludge will be weighted and used as soil fertilizer or other applications.
Monitoring frequency	The frequency cannot be set ex-ante. 100% of the sludge amount will be monitored through continuous or batch measurement. To ensure the 90/10 confidence/precision level, representative samples are taken to determine the moisture content.
QA/QC procedures	The measurement equipment shall be calibrated on regular basis.
Purpose of data	The data is used for project emission calculation.
Additional comment	

[14] The Close Reflux Titrimetric method is approved by Standard Methods Committee: the method 5220D is described in “*Standard Methods for the Examination of Water and Wastewater*, 17th edition, American Public Health Association, American Water Works Association et Water Pollution Control Federation, 1989, Washington, DC.

Data/Parameter	$BG_{burnt,flared,y}$
Data unit	Nm^3
Description	Amount of biogas that is flared
Source of data	Measured - Gas Flow meter provided at the inlet of flare system
Value(s) applied	0 Used only in case of emergency
Measurement methods and procedures	In case the flare operated, the measurements of volume of biogas sent to flare are done continuously using gas flow meters. In recording these parameters, plant's operators shall first manually achieve the monitored data onto log sheets then transfer to the computer for electronic storage. Continuously measurements will be done and cumulative reading will be recorded daily.
Monitoring frequency	Continuous measurement
QA/QC procedures	The flow meter will be calibrated at regular intervals based on instrument specification and/or manufacturer's recommendation. The calibration will be performed by a certified testing agency using national/international standards.
Purpose of data	The data is used for baseline emission calculation.
Additional comment	

Data/Parameter	$BG_{burnt,generator,y}$
Data unit	Nm^3
Description	Quantity of biogas combusted in electricity generators
Source of data	Measured – Gas flow meter
Value(s) applied	10,330,856
Measurement methods and procedures	Measurement of volume of biogas are done continuously using gas flow meters. In recording these parameters, plant's operators shall first manually achieve the monitored data onto log sheets then transfer to the computer for electronic storage. Continuously measurements will be done and cumulative reading will be recorded daily.
Monitoring frequency	Continuous measurement
QA/QC procedures	The flow meter will be calibrated at regular intervals based on instrument specification and/or manufacturer's recommendation. The calibration will be performed by a certified testing agency using national/international standards.
Purpose of data	The data is used for baseline emission calculation.
Additional comment	

Data/Parameter	$w_{CH4,y}$
Data unit	%
Description	Methane content in biogas
Source of data	Measured on a dry basis - portable gas analyser
Value(s) applied	55% (for ex-ante calculation)
Measurement methods and procedures	The methane content shall be measured by using portable methane analyser and recorded manually into log books at least four times per day.
Monitoring frequency	Periodical - at least four times per day
QA/QC procedures	The gas analyser will be calibrated at regular intervals based on instrument specification and/or manufacturer's recommendation.
Purpose of data	The data is used for baseline emission calculation.
Additional comment	

Data/Parameter	$T_{EG,m}$
Data unit	°C
Description	Flame temperature of the flare

Source of data	Measurements
Value(s) applied	Value to be monitored
Measurement methods and procedures	The flame temperature will be continuously measured with a thermocouple sensor. Data will be recorded and stored electronically on a continuous basis.
Monitoring frequency	Continuous basis
QA/QC procedures	The temperature meter shall be subject to periodic calibration according to the equipment's specifications and applicable industrial standards.
Purpose of data	The data is used for project emissions from flaring.
Additional comment	If there is no record of $T_{EG,m}$, it shall be assumed that the flare efficiency is zero.

Data/Parameter	$v_{CH4,RG,m}$
Data unit	-
Description	Volumetric fraction of component *methane* in the residual gas on a dry basis in minute m
Source of data	Measured on a dry basis - continuous gas analyser
Value(s) applied	55% (for ex-ante calculation)
Measurement methods and procedures	In case the flare operated, this parameter will be measured by using continuous gas analyser. The data on a minute basis shall be recorded through the automatic data logging.
Monitoring frequency	Continuous measurement and values to be recorded on a minute basis
QA/QC procedures	The gas analyser will be calibrated at regular intervals based on instrument specification and/or manufacturer's recommendation. The calibration will be performed by a certified testing agency using national/international standards.
Purpose of data	The data is used for project emissions from flaring.
Additional comment	If there is no record of $v_{CH4,RG,m}$, it shall be assumed that the flare efficiency is zero.

Data/Parameter	$V_{RG,m}$
Data unit	Nm^3
Description	Volumetric flow of the residual gas on dry basis at normal conditions in the minute *m*
Source of data	Measured on a dry basis – Gas Flow meter provided at the inlet of flare system (same gas flow meter for $BG_{burnt,flared,y}$)
Value(s) applied	0 Used only in case of emergency
Measurement methods and procedures	In case the flare operated, the measurements of volume of biogas sent to flare are done continuously using gas flow meters. In recording these parameters, plant's operators shall first manually achieve the monitored data onto log sheets then transfer to the computer for electronic storage. Continuously measurements will be done and cumulative reading will be recorded daily.
Monitoring frequency	Continuous measurement
QA/QC procedures	The flow meter will be calibrated at regular intervals based on instrument specification and/or manufacturer's recommendation. The calibration will be performed by a certified testing agency using national/international standards.
Purpose of data	The data is used for baseline emission calculation.
Additional comment	

Data/Parameter	$Flame_m$
Data unit	Flame on or Flame off
Description	Flame detection of flare in the minute m
Source of data	Measured – using UV flame detector
Value(s) applied	-

Measurement methods and procedures	In case the flare operated, the $Flame_m$ will be measured using a fixed installation optical flame detector on a minute basis.
Monitoring frequency	Once per minute. Detection of flame recorded as a minute that the flame was on, otherwise recorded as a minute that the flame was off
QA/QC procedures	Equipment shall be maintained and calibrated in accordance with manufacturer's recommendations.
Purpose of data	The data is used for project emissions from flaring.
Additional comment	If there is no record of $Flame_m$, it shall be assumed that the flare efficiency is zero.

Data/Parameter	$\eta_{flare,m}$
Data unit	%
Description	Flare efficiency of the open flare
Source of data	Methodological tool: Project emissions from flaring, version 02
Value(s) applied	50%
Measurement methods and procedures	Default value. In the case of open flares, the flare efficiency in the minute *m* ($\eta_{flare,m}$) is 50% when the flame is detected in the minute *m* ($Flame_m$), otherwise $\eta_{flare,m}$ is 0%.
Monitoring frequency	
QA/QC procedures	
Purpose of data	The data is used for project emissions from flaring.
Additional comment	

Data/Parameter	$EC_{PJ,j,y}$
Data unit	MWh
Description	Quantity of electricity consumed by the project activity in year y
Source of data	Measured – Electricity meter owned and maintained by Provincial Electricity Authority (PEA)
Value(s) applied	2,446 (for ex-ante calculation)
Measurement methods and procedures	The measurement of this parameter shall be done continuously using electricity meter supplied by the grid operator. Reading shall be recorded and reported on a monthly basis by PEA.
Monitoring frequency	Continuous measurement and monthly recording
QA/QC procedures	The electricity meter is owned and maintained by PEA. Monthly report issued by PEA shall be used to get the amount of electricity supplied to grid. The calibration of meter, including the frequency of calibration, shall be done in accordance with national standards and requirements set by the grid operator (PEA).
Purpose of data	The data is used for baseline emission calculation.
Additional comment	The meter maintenance is not under the jurisdiction of project proponent

Data/Parameter	$EG_{PJ,y}$
Data unit	MWh
Description	Quantity of net electricity generation that is produced and fed into the grid by the project activity in year y
Source of data	Measured – Electricity meter owned and maintained by Provincial Electricity Authority (PEA)
Value(s) applied	5,794 after the operation of the gas engines for the second line. Based on same assumptions as the total biogas production parameter
Measurement methods and procedures	The measurement of this parameter shall be done continuously using electricity meter supplied by the grid operator. Reading shall be recorded and reported on a monthly basis by PEA.
Monitoring frequency	Continuous measurement and monthly recording

QA/QC procedures	The electricity meter is owned and maintained by PEA. Monthly report issued by PEA shall be used to get the amount of electricity supplied to grid. The calibration of meter, including the frequency of calibration, shall be done in accordance with national standards and requirements set by the grid operator (PEA).
Purpose of data	The data is used for baseline emission calculation.
Additional comment	The meter maintenance is not under the jurisdiction of project proponent

Data/Parameter	$TDL_{j,y}$
Data unit	%
Description	Average technical transmission and distribution losses for providing electricity to the project activity (electricity import)
Source of data	Recent data available for the host country
Value(s) applied	6.11% (based on most recent report published by World Bank for 2014[15])
Measurement methods and procedures	As per the guidance given in the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption", most recent data available within the host country will be used during monitoring and verification.
Monitoring frequency	Annually In the absence of data from the relevant year, most recent figures should be used, but not older than 5 years.
QA/QC procedures	Not applicable.
Purpose of data	The data is used for project emission calculation.
Additional comment	

B.7.2. Sampling plan

This is not applicable for the project activity.

B.7.3. Other elements of monitoring plan

1. Monitoring Management

The project will hire people to operate the new plant. The required monitoring equipment is installed in consultation with the equipment supplier under supervision of operation manager and QC manager.

Data acquisition for the gas and wastewater flow meters is executed through the process control unit of the biogas plant and the plant operations software. Lab data is fed into the operations software through a manual data entry user interface.
The plant is operated by trained operators who also collect data under the supervision of qualified managers.

Please refer to Annex 4 for further information.

2. Quality Assurance and Quality Control
The Plant Manager monitors overall performance of the plant, ensures proper and timely calibration, data acquisition and storage.

3. On-site Procedures
The operations software creates daily logs of plant performance which are printed out and recorded electronically for periodic download onsite or remote transfer for further processing.

[15] https://data.worldbank.org/indicator/EG.ELC.LOSS.ZS

Procedures for Calibration of Equipment are included in GHG performance protocol.
The operation manager and QC manager are responsible to execute timely calibration as per the specification from equipment supplier or at least once in three years.

4. Data Storage and Filing – Electric Workbook
All relevant data is stored electronically with the process control computer unit, external storage media and transferred. A daily log is printed.
All parameters monitored under the monitoring plan will be kept for a period of two years following the end of the crediting period or the last issuance of CERs for the project activity, whichever occurs later.

5. Emergency preparedness
The project activity does not result in any unidentified activity that can result in substantial emissions from the project activity.

However, the leakages, if any, in the piping or digester shall come under notice of plant operator either instantly on the control screens else at the time of data logging, due to mismatch between expected biogas generation from wastewater quantities processed or other way around.

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

26/10/2005
The starting date is the earliest date at which either the implementation or construction or real action of the project activity begins. In line with this definition, the start date considered for this project activity is the date on which the contract between BFB and BFR has been signed for the construction of the biofuel reactor.
Since the starting date is earlier than the date of publication of the PDD, the description of how the benefits of the CDM were considered prior to the starting date is included in Section B.5.

C.2. Expected operational lifetime of project activity

15 years

C.3. Crediting period of project activity

C.3.1. Type of crediting period

Renewable crediting period – second crediting period

C.3.2. Start date of crediting period

09/04/2018

C.3.3. Duration of crediting period

7 years

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

No negative environmental effects are expected from the implementation of the project as a result of Initial Environmental Evaluation required by Thai DNA.

D.2. Environmental impact assessment

The project does not lead to any additional emissions. The proposed project is not required to undertake an Environmental Impact Assessment according to the Thailand regulations (http://www.onep.go.th/eia/).

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

Procedure followed to invite stakeholder comments

Public hearing for local stakeholders:

Invitation procedure
The Initial Stakeholder Consultation has been conducted by the project owner Blue Fire Bio Co Ltd. with assistance from South Pole Carbon Asset Management Limited (Switzerland based company responsible for CDM project development) and BFR Co Ltd. (Thai engineering company response for implementation of the wastewater treatment plant).

Stakeholder groups have been identified and informed through oral and written means about the meeting. The invitation letter was sent by fax to participants located a long distance from the project, by regular mail to participants without access to a fax and there was an announcement of this meeting posted at the community hall for people who had not received an invitation letter. This invitation process was done 2 weeks before the meeting date.

The persons or organizations invited are:

Government Sector, State Agency, Independent Entity and Private Organization
- National Science and Technology Development Agency (NSTDA)
- Thailand Environment Institute (TEI)
- Energy and Climate Change Part of World Wildlife Fund Thailand
- Office of Natural Resources and Environmental Policy and Planning
- Ministry of Agriculture and Cooperatives
- Green Leaf Foundation
- International Institute for Energy Conservation (IIEC)
- Thailand Development Research Institute (TDRI)
- Appropriate Technology Association (ATA)
- The Environmental Engineering Association of Thailand (EEAT)
- Thailand Greenhouse Gas Management Organization (TGO)
- Department of Environmental Engineering of Chulalongkorn University
- Department of Environmental Engineering of King Mongkut’s University of Technology Thonburi (KMUTT)
- Faculty of Environment and Resource Studies of Mahidol University

Local Participants

- Assistant district officer of Dankuntod district
- Mayor of Dankuntod
- Superintendent of Dankuntod Police Station
- Provincial Electricity Authority of Dankuntod
- Headman in surrounding area of the project
- Village headman in surrounding area of the project
- Villager of Hindad Subdistrict

Place and date of the meeting
The initial stakeholder consultation was held at a meeting room within Chaodee Starch factory which is located 400m away from the wastewater treatment plant, on November 10, 2008.

Meeting Participants
The mentioned meeting was attended by local residents and representatives from the following stakeholder categories:

1. Local residents
2. Local government representatives
3. Local entrepreneurs
4. Employees
5. Local farmers

There are 41 participants who have followed the invitation, attended the meeting and returned the questionnaire.

Language
Documentation and meeting was held in Thai which is the local language.

Meetings procedure

- Opening (15 min)
- Purpose of the consultation (5 min)
- Description of the project and environmental impacts (20 min)
- Questions and Answers session (10 min)
- Completing checklists (10 min)
- General feedback (15 min)

Meeting documents and protocols
On completion of the various meetings, the following documents were collected and attested by the signatures of the stakeholders that were present at the venue:

1. Presence list with name, address and occupation.
2. Non-technical description of the project
3. Documentation on environmental impacts of the project
4. Notes for additional comments on the project activity

These documents are available as hardcopies and will be handed over to the designated operational entity (DOE).

E.2. Summary of comments received

The overall response to the project, from all invited stakeholders, was encouraging and positive. Most of the questions from the participant are more concern on the environmental impact regarding the bad odour from the current open lagoon which was clarified during the meeting. The greatest asset achieved by the project appears to be the positive effect on the environment. Stakeholders acknowledge that the improvement of wastewater treatment technology will reduce odors released to the surrounding area, which previously was a major concern for the surrounding community like other cases of tapioca starch factory. This project is viewed as a positive environmental plan that is important for local water resources and the community's quality of life. This project is considered a financially risky plan due to the required investment and rate of return.

To sum up the sustainability of the project, the various benefits (as reported by local stakeholders) are listed below.

1. The installed technology contributes to clean soil, water and reduced odors.
2. Use of biogas represents a sustainable way for generating energy.
3. While the system operates within strict environmental standards there will be no negative impacts to the environment due to the plant.
4. The project is well designed, returning clean water to the environment and not producing additional pollution.
5. The plant will create new jobs at the plant.

In all, no adverse reaction/comments/clarifications have been sought/received during the Initial Stakeholder Consultation process. The participants of the meetings have not raised any significant concerns related to potential impacts of the Project.

Summary of comments received during forum:

A Q&A session was conducted at the event, where questions were invited from the related parties. The questions were answered by the BFB with additional explanation on technical details by the technology supplier, BFR. The questions and answers are listed in the following sections:

- *Does the carbon dioxide gas affect the environment?*

Yes, the carbon dioxide gas is one of the GHG. However, it has lower impact on the environment than methane. Furthermore, the plant can use carbon dioxide gas.

- *Where does the wastewater come from?*

It comes from the starch production of Chaodee Starch (2004) Co.,Ltd. and the project will use it in the new system. The biofuel reactor is a closed system and the biogas produced is utilized for electricity and heat generation, so there is no biogas released to the environmental.

- *How can we have confidence in the performance of the biogas system? Are there any site references for this technology?*

Biogas systems have been developed and implemented since 10 years in many sectors. For biogas in starch plants: out of the 83 starch plants in Thailand, 3 plants have installed this technology with a positive track record.

E.3. Consideration of comments received

As no major environmental concerns were raised during the entire initial stakeholder consultation process, it was neither necessary to make any changes to the Project design nor to incorporate any additional measures to limit or avoid negative environmental impacts. The same applies to socio-economic concerns, which have not been raised at all.

It is evident from the stakeholder consultation process, that the project is perceived as a positive example for the Tapioca starch factory in Thailand and that it contributes to sustainable development of the region.

SECTION F. Approval and authorization

The letters of approval from following parties to be involved in the project activity are available at the time of submitting the PDD to the validating DOE.

Date of approval	Parties to be involve in the project activity
21/08/2009	Thailand (horst country)
28/09/2009	Switzerland

Appendix 1. Contact information of project participants

Organization name	Blue Fire Bio Co.,Ltd.
Country	Thailand
Address	61 Moo 14, Dan Khun Thot district, Nakhon Ratchasima
Telephone	+6644331234
Fax	-
E-mail	bugtee@hotmail.com
Website	-
Contact person	Mr.Chanchai Chaodee

Organization name	South Pole Carbon Asset Management Ltd.
Country	Switzerland
Address	Technoparkstrasse 1, Zurich, 8005
Telephone	+41 43 501 35 50
Fax	+41 43 501 35 99
E-mail	registration@southpole.com
Website	https://www.southpole.com/
Contact person	Mr.Renat Heuberger

Appendix 2. Affirmation regarding public funding

No public funding is involved in the project.

Appendix 3. Applicability of methodologies and standardized baselines

Please refer to details in section B.2.

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

Data/Parameter of $\eta_{COD,BL,I}$:COD removal efficiency of the baseline system i

COD campaign data

COD campaign was conducted in the starch factory. The samples were taken in the wastewater treatment system consisting of open anaerobic lagoons. The results from the campaign are as follows:

Sampling date	COD_{in} (mg/l)	COD_{out} (mg/l)	$\%COD_{removal}$
7/10/2005	22,976	79.00	99.66%
8/10/2005	25,611	81	99.68%
9/10/2005	24,827	86	99.65%
10/10/2005	22,736	85	99.63%

11/10/2005	23,987	77	99.64%
12/10/2005	21,168	65	99.72%
13/10/2005	23,073	59	99.77%
14/10/2005	25,232	61	99.76%
15/10/2005	23,917	59	99.75%
16/10/2005	23,173	79	99.66%
17/10/2005	23,912	71	99.70%
Average	**23,692**	**73**	**99.69%**
Uncertainty factor			0.89
Removal efficiency			88.73%

Grid emission factor:
The emission factor of the Thai national grid has been taken from the most recent data made available by the Thailand DNA[16].

Tool	Weight	Emission Factor	Unit
Operating Margin: OM	0.5	0.5719	tCO_2/MWh
Build Margin: BM	0.5	0.5609	
Combined Margin: CM – General Project		**0.5664**	

According to the methodology tool "emission factor for an electricity system, version 07, paragraph 86(b). The following default values for the second crediting period should be used as of w_{om} = 0.25 and w_{bm} = 0.75. Thus the emission factor for project second crediting period can be revised as following.

Tool	TH DNA*		2nd CP - para 86 of the tool	
	Weight (w)	Emission Factor (tCO2/MWh)	Weight (w)	Emission Factor (tCO2/MWh)
Operation Margin: OM ($EF_{grid,OM,y}$)	0.5	0.5719	0.25	
Build Margin: BM ($EF_{grid,BM,y}$)	0.5	0.5609	0.75	
Combined Margin: CM - General Project		0.5664		**0.5637**

Appendix 5. Further background information on monitoring plan

Please refer to details in section B.7

Appendix 6. Summary report of comments received from local stakeholders

Please refer to details in section E.2

Appendix 7. Summary of post-registration changes

There is no change after project registration.

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[16] http://ghgreduction.tgo.or.th/download-tver/68-2017-11-28-06-43-22/353-2559.html

Document information

Version	*Date*	*Description*
11.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the "CDM project standard for project activities" (CDM-EB93-A04-STAN); • Make editorial improvements.
10.1	28 June 2017	Revision to make editorial improvement.
10.0	7 June 2017	Revision to: • Improve consistency with the "CDM project standard for project activities" and with the PoA-DD and CPA-DD forms; • Make editorial improvement.
09.0	24 May 2017	Revision to: • Ensure consistency with the "CDM project standard for project activities" (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the "Project design document form for small-scale CDM project activities" (CDM-SSC-PDD-FORM); • Make editorial improvement.
08.0	22 July 2016	EB 90, Annex 1 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the "Standard: Applicability of sectoral scopes" (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revision to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Make editorial improvement.
05.0	25 June 2014	Revision to: • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from F-CDM-PDD to CDM-PDD-FORM; • Make editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the project design document form for CDM project activities" (EB 66, Annex 8).

Version	*Date*	*Description*
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

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