Component project activity design document form
(Version 09.0)

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

BASIC INFORMATION	
Title of the CPA	CPA-02: Methane recovery and combustion with renewable energy generation from anaerobic animal manure management systems under the Land Bank of the Philippines' (LBP) Carbon Finance Support Facility
Scale of the CPA	☐ Large-scale ☒ Small-scale
Version number of the CPA-DD	13
Completion date of the CPA-DD	22/12/2020
Title and UNFCCC reference number of the registered CDM PoA	PoA 5979: "Methane recovery and combustion with renewable energy generation from anaerobic animal manure management systems under the Land Bank of the Philippines's (LBP) Carbon Finance Support Facility"
Title and reference number of the corresponding generic CPA	5979-P1-00XX-CP1: Methane recovery and combustion with renewable energy generation from anaerobic animal manure management systems under the Land Bank of the Philippines' (LBP) Carbon Finance Support Facility
Coordinating/managing entity	Land Bank of the Philippines
Host Party	Republic of the Philippines
Applied methodologies and standardized baselines	AMS-III.D version 17, Methane recovery in animal manure management systems AMS-I.F version 2, Renewable electricity generation for captive use and mini-grid
Sectoral scopes	Sectoral scope 13: Waste handling and disposal Sectoral scope 1: Energy industries (renewable / non-renewable sources)
Estimated amount of annual average GHG emission reductions	63,041 tCO_2

SECTION A. Description of component project activity (CPA)

A.1. Purpose and general description of CPA

1. (a) The location of the CPA: Biotech Farms is located in Barrio 6, Barangay San Vicente, Banga, South Cotabato, Philippines.

(b) The technologies/measures to be employed and/or implemented by the CPA: The CPA replaces an open anaerobic manure management system with an enclosed anaerobic digestion system with methane recovery and combustion in the Philippines. Through construction of the enclosed anaerobic methane recovery system, the CPA will reduce GHG emissions from methane compared to the emissions that would have occurred with the open anaerobic system. With the installation of electricity generation units, GHG emissions will be further reduced by replacing grid electrical power sourced from fossil fuel plants with renewable energy from the recovered methane.

(c) The project boundary; The spatial extent of the project boundary encompasses the physical and geographical site of the methane recovery facility and of the renewable generation units.

(d) The baseline scenario; Prior to the project implementation, Biotech Farms implemented an open anaerobic treatment system that comprised an anaerobic lagoon for piggery manure, and an anaerobic storage area for chicken dung. The anaerobic lagoon/storage area released methane directly into the atmosphere.

(e) The annual average GHG emission reductions is **63,041 tCO_2/yr**, and the total GHG emission reductions for the chosen crediting period is **441,284 tCO_2**.

2. A full description of 1(a)–(e) above are provided in sections A.2, A.3, B.2, B.3 and B.4 below, respectively.
3. The small-scale project Type I, and Type III are applicable to the CPA in accordance with the corresponding generic CPA.
4. Corresponding to the generic CPA, AMS-III.D. version 17, Methane recovery in animal manure management systems and AMS-I.F version 2, Renewable electricity generation for captive use and mini-grid are indicated for this CPA.

A.2. Location of CPA

Host Party: The Philippines
Address of Biotech Farms: Barrio 6, Barangay San Vicente, Banga, South Cotabato, Philippines
Latitude: 6.4469, Longitude: 124.8014

Figure A.2: Map and situation of Banga, South Cotabato in the archipelago of the Philippines

A.3. Technologies/measures

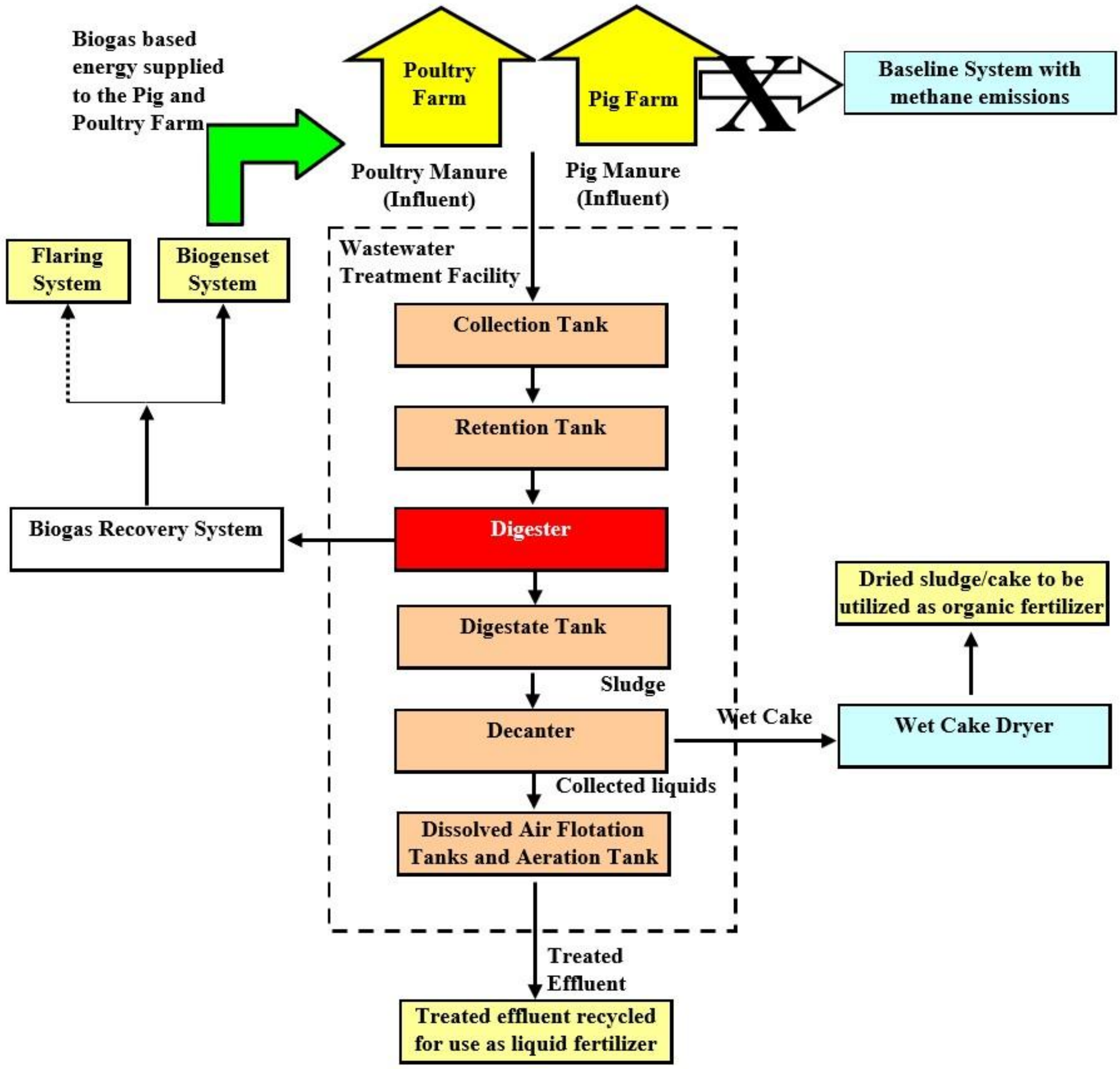
The CPA replaces an open anaerobic manure management system with an enclosed anaerobic digestion system with methane recovery and combustion. The project consists of the following:

Anaerobic digestion system:
The waste produced from the livestock houses of the farm will be treated in an enclosed anaerobic wastewater treatment facility that will prevent the release of methane. The system will consist of anaerobic biodigesters to collect the biogas and prevent atmospheric gases from leaking into the tank. The 60,000 m3 anaerobic digestion system might be modified during the crediting period, in this case the modification using more efficient, modular 8 x 4,830 m3 volume digesters (with future addition of 4 x 4,830 m3). Total digester volume planned to approximate 57,860 m3 after the first crediting period.

Biogas recovery and combustion system:
A system of collection and combustion of the biogas produced by the reactor will also be installed. The system will include a blower system, piping system to collect the gas, a gas filtering system, gas engine(s) where the gas will be combusted and/or a flare. Initially, an enclosed flare of 100 m3/hr was installed. The electricity generated by the generator set will be used solely and on-site by the farm. The biogas recovery system might be modified during the crediting period in this case additional generator sets from 1000 kW to 8,834 kW (seven units of gas engines/microturbines) completed by 15/07/2019. Generator sets will be operated alternately at a maximum operating capacity of 2,858 kW. The rest of the gensets will be on stand-by/back-up. Likewise, the enclosed flare capacity is increased to 1,500 m3/hr.

Sludge management system:
The treatment system will produce sludge. The sludge will be removed from the biodigester through a pipe, dried using a wet cake dryer and applied to soil as fertilizer in a manner that ensures aerobic conditions and avoids methane emissions.

Other components:
After the anaerobic digesters, digested wastewater will be discharged to Dissolved Air Flotation (DAF) tanks and aeration tank. The final effluent will be recycled for use as liquid fertilizer in the corn field. All power to run the project activity will be provided by the generator set and as a result no fossil fuel-based electricity or other fuel will be used.



A.4. Coordinating/managing entity

Land Bank of the Philippines

A.5. Parties and CPA implementers

Parties involved	CPA implementers	Indicate if the Party involved wishes to be considered as CPA implementer (Yes/No)
The Philippines (host)	CPA Implementer: Biotech Farms, Inc. (Private entity)	No

A.6. Public funding of CPA

There is no public funding involved in the CPA.

A.7. History of CPA

a. This is to confirm that:

i. The proposed CPA is neither registered as a CDM project activity nor included in another registered CDM PoA;

ii. The proposed CPA is not a project activity that has been deregistered.

b. This is to declare that:
i. The proposed CPA was not a CPA that has been excluded from a registered CDM PoA;

ii. A registered CDM project activity or a CPA under a registered CDM PoA whose crediting period has or has not expired (hereinafter referred to as former project) does not exist in the same geographical location as the proposed CPA.

A.8. Debundling

The proposed CPA is not a de-bundled component of a large project activity as the activity implementer, Biotech Farms, Inc., has not registered or applied to register another small-scale CPA of any PoA, and has not registered a CDM project activity.

SECTION B. Application of methodologies and standardized baselines

B.1. References to methodologies and standardized baselines

The CPA will consider the Small-Scale Methodology AMS III.D version 17: Methane Recovery in Animal Manure Management Systems (EB 58) and the Small-Scale Methodology AMS I.F. version 2: Renewable electricity generation for captive use and mini-grid (EB 61).

The combination of these two approved methodologies has been approved by the CDM EB on its 59th meeting, paragraph 11a), and included in the list of combinations of methodologies that can be applied in a PoA without a pre-approval.

Both methodologies are available at the UNFCCC website at the following links respectively:
https://cdm.unfccc.int/methodologies/DB/H9DVSB24O7GEZQYLYNWUX23YS6G4RC
https://cdm.unfccc.int/UserManagement/FileStorage/41JF08WD9MSEB5YLHTZ6KVAPUC7XNQ.

The CPA will also use the “Tool to calculate the emission factor for an electricity system”, version 2 (EB 50) and “Tool to determine project emissions from flaring gases containing methane” (EB28).

Both mentioned tools are available at the UNFCCC website at the following links:
https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v2.pdf
https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-06-v1.pdf

B.2. Project boundary, sources and greenhouse gases (GHGs)

The spatial extent of the project boundary encompasses the physical and geographical site of the methane recovery facility and of the renewable generation unit. In terms of GHG emissions, the project is limited to CH_4 emissions from leakage, and CO_2 and CH_4 from the generator set or flare. As the project activity includes the generation of renewable energy and does not include many electrical appliances except for blowers of minimal electricity consumption that is to be supplied by the system itself, the anthropogenic emission from use of fossil fuel-based electricity is considered to be zero.

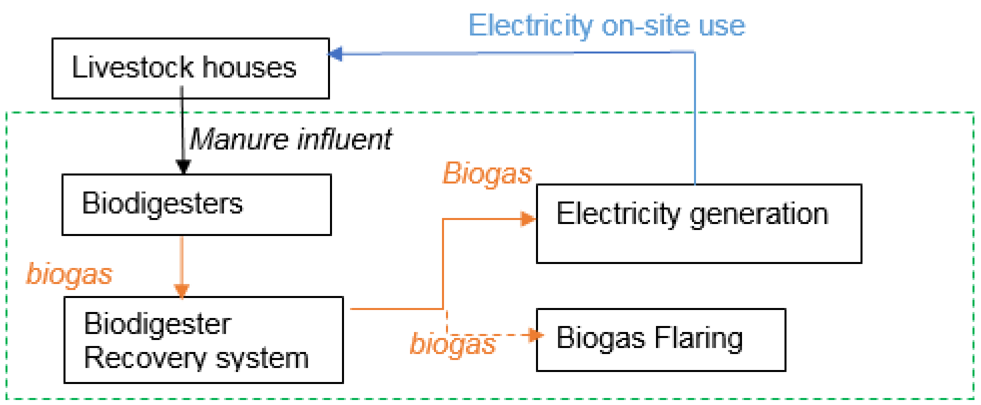
In line with AMS-III.D, the following sources and gases are included in the project boundary:

Source		GHG	Included?	Justification/Explanation
Baseline	Anaerobic digestion in the open lagoons/storage	CO_2	Excluded	Excluded for simplification.
		CH_4	Included	The major source of emissions in the baseline.

	Source	GHG	Included?	Justification/Explanation
		N_2O	Excluded	Excluded for simplification. This is conservative.
	Emissions from Electricity Consumption from the Grid	CO_2	Excluded	Excluded for simplification. This is conservative.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
	Emissions from heat generation	CO_2	Excluded	Excluded for simplification. This is conservative
		CH4	Excluded	Excluded for simplification. This is conservative
		N_2O	Excluded	Excluded for simplification. This is conservative.
Project activity	On-site fossil electricity or fuel use due to the project activity	CO_2	Excluded	It will be excluded since it has been demonstrated by the CPA that the level of anthropogenic emissions from use of fossil fuel for electricity use can be considered negligible.
		CH_4	Excluded	Excluded for simplification. Emissions assumed to be very small.
		N_2O	Excluded	Excluded for simplification. Emissions assumed to be very small.
	Physical leakage	CO_2	Excluded	Excluded for simplification. Emissions assumed to be very small.
		CH_4	Included	Estimated with conservative assumptions based on AMS-III.D.
		N_2O	Excluded	Excluded for simplification. Emissions assumed to be very small.
	Flaring	CO_2	Included	Calculated with the flaring gas tool.
		CH_4	Included	Calculated with the flaring gas tool.
		N_2O	Excluded	Excluded for simplification. Emissions assumed to be very small.

In line with AMS I.F, the following sources and gases are included in the project boundary:

	Source	GHG	Included?	Justification/Explanation
Baseline	Emissions from Electricity consumption from the Grid	CO_2	Included	The major source of emissions in the baseline.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
Project activity	On-site fossil electricity or fuel use due to the project activity	CO_2	Excluded	Engine used will not require fossil fuel and/or fossil fuel-based electricity during start-up or at any stage of generation.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.



B.3. Establishment and description of baseline scenario

As per AMS-III.D, the baseline scenario of the methane recovery component is the situation where, in the absence of the project activity, animal manure is left to decay anaerobically within the project boundary and methane is emitted to the atmosphere. The applicability criteria for use of AMS-III.D. include:

- The livestock farm has livestock populations managed under confined conditions.
- The livestock farm has manure, or the streams obtained after treatment is not discharged into natural water resources (e.g. rivers and estuaries).
- The baseline system of waste management is an open anaerobic system with no methane recovery and destruction by flaring, combustion or gainful use.
- For anaerobic treatment systems in the baseline, the retention time of manure waste must be greater than 1 month.
- For anaerobic lagoons in the baseline the depth is at least 1 m.

The criteria were identified as part of the development of this CPA through site inspections, measurements and documented accordingly.

Prior to the project implementation, Biotech Farms used several open anaerobic lagoons to treat their wastewater. The farm was serviced by several open lagoons, with the following dimensions:

Lagoons	Width (m)	Length (m)	Depth (m)
Lagoon 1	20.3	20	2
Lagoon 2	20.3	20	2.5
Lagoon 3	20.3	20	2.5
Lagoon 4	20.3	63	3

The wastewater was stored indefinitely as there was no discharge as validated on-site.
The open lagoons released the methane directly into the atmosphere.

Biotech Farms' open anaerobic lagoons

The piggery has operated its wastewater treatment system since 2001 without any environmental violations. The continued operation of the treatment technology for the piggery would require costs for operation and maintenance of the system and to accommodate the expansion of the piggery population the digging of an additional open lagoon.

B.4. Estimation of emission reductions

B.4.1. Explanation of methodological choices

The emissions reductions were estimated ex-ante using the equations and procedures outlined in the PoA-DD and detailed in section below. These parameters were optimized to the situation of the Biotech CPA. In particular:
Use of sequential manure management systems: Biotech Farms' manure management system will not be sequential and therefore no special calculation (using RVS) for treatment stages is necessary.
Emissions from power: The calculation of the emissions from power will depend on the source of energy used in powering the system. In this case, all power used in the project activity will come from the biogas fuel produced by the project activity and therefore it is not necessary to calculate electricity use or fuel use by the project activity, or use the associated emissions factors to do so.
Use of Annex I country VS and Bo: Biotech Farms will use VS and Bo values from Annex I countries and therefore the genetic source of the livestock will need to be monitored.
Adjustment of VS for site specific animal weight: The default VS will be adjusted for site specific animal weight.
Operating Margin Methodology: The Average OM approach is used since low-cost / must run energy resources in the Mindanao electricity grid constitute more than 50% of the total grid connected generated electricity; while data for Dispatch Analysis is not publicly available.

The methodology applied to the CPA is AMS-III.D (version 17) and AMS-I.F (version 2). *Ex ante* emissions of the project activity are calculated using the following formula:

PER_y = $MER_y + GER_y$

Where
MER_y Emission reduction in year “y” (tCO_2-e) from methane recovery (as per AMS-III.D)
GER_y Emission reduction in year “y” (tCO_2-e) from renewable electricity generation (as per AMS-I.F)

***Ex ante* emissions from methane recovery and destruction** are calculated using the following formula:

MER_y = $MBE_y - (MPE_y + MLeakage_y)$

Where
MER_y Emission reduction in year “y” (tCO_2-e) from methane recovery
MBE_y Baseline emissions in year “y” (tCO_2-e) from methane recovery
MPE_y Project emissions in year “y” (tCO_2-e) from methane recovery
$MLeakage_y$ Project leakage in year “y” (tCO_2-e) from methane recovery

Baseline emissions (MBE_y), project emissions (MPE_y) and leakage ($MLeakage_y$) from the recovery of methane are to be calculated based on AMS III D as shown below:

Baseline Emissions from methane recovery and destruction (MBE_y)

Baseline emissions related to the recovery of methane are calculated using the amount of the waste or raw material that would decay anaerobically in the absence of the project activity. The following formula was used:

$$MBE_y = GWP_{CH4} * D_{CH4} * Uf_b * \sum_{j,LT} MCFj * B_{O,LT} * N_{LT,y} * VS_{LT,y} * MS\%_{Bl,j}$$

where:

MBE_y	baseline emissions in year “y” (tCO_2-e/yr)
GWP_{CH4}	Global Warming Potential (GWP) of CH_4
D_{CH4}	CH_4 density (0.00067 t/m^3 at room temperature (20ºC) and 1 atm pressure).
LT	Index for all types of livestock
j	Index for animal waste management system
MCF_j	Annual methane conversion factor (MCF) for the baseline animal waste management system “j” in percentages (digester in project scenario).
$B_{0,LT}$	Maximum methane producing potential of the volatile solid generated for animal type “LT” (m^3 CH_4/kg dm)
$N_{LT,y}$	Annual average number of animals of type “LT” in year “y” (numbers) calculated using the formula below.
$VS_{LT,y}$	Volatile solids for livestock “LT” entering the animal manure management system in year “y” (on a dry matter weight basis, kg dm/animal/year)
$MS\%_{Bl,j}$	Fraction of manure handled in baseline animal manure management system “j”
Uf_b	Model correction factor to account for model uncertainties (0.94)

The annual average animal population ($N_{LT,y}$) in the CPA is determined from a livestock census and calculated using equation (3) of AMS-IIID ver. 17 .

$$N_{LT,y} = N_{da,y} * (N_{p,y}/365)$$

where:

$N_{da,y}$	Number of days animal is alive in the farm in the year “y” (numbers)
$N_{p,y}$	Number of animals produced annually of type “*LT*” for the year “y” (numbers)

The various constants used in the above equations are to be estimated in line with the baseline scenario description in the methodology AMS-III.D.

B_0 and VS are dependent on country and site-specific conditions for the CPA. In particular:

Choice of defaults for B_0 and VS:

For B_o, default values for genetic source provided in tables 10 A-7 to A-8 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 10 will be used.

For VS, default values for genetic source provided in tables 10 A-7 to A-8 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 10 will be used.

The genetic source of the production operations livestock (swine) originates from an Annex I country (North America) for this CPA, the project proponent can use the above approach to determine B_0 or VS or may choose to use default values corresponding to Annex I species, in which case the following will be demonstrated:

- The farm uses formulated feed rations (FFR) which are optimized for the various stages of animal growth, category, weight gain, productivity and genetics;
- The use of FFR can be validated and recorded in the CPA (through on-site records, feed supplier, etc.);
- The project's specified animal weight is more similar to developed country IPCC default values than to Asian default values.

Calculation of VS: VS are calculated by adjusting default VS using site specific animal weights as follows:

$VS_{site,LT,y} = (W_{site} / W_{default}) \times VS_{default} * nd_y$

where:
$VS_{site,LT,y}$: Adjusted volatile solid excretion per day on dry-matter basis for defined livestock population at project site, in kg-dm/animal.
W_{site} Average site animal weight for defined population, in kg.
$W_{default}$ Default average animal weight for defined population, in kg.
$VS_{default}$ Default value (IPCC) for the volatile solid excretion per day on a dry- matter basis for defined livestock population, in kg-dm/animal.
nd_y Number of days in year "y" where the treatment plant was operational.

Project Emissions from methane recovery and destruction (MPE)

Project emissions, as per the methodology, are calculated using the following formula:

$MPE_y = PE_{PL,y} + PE_{flare,y} + PE_{power,y} + PE_{transp,y} + PE_{storage,y}$

Where:
MPE_y Project emissions in year "y" (tCO_2e)
$PE_{PL,y}$ Emissions due to physical leakage of biogas in year "y" (tCO_2e)
$PE_{flare,y}$ Emissions from flaring of the biogas stream in the year "y" (tCO_2e)
$PE_{power,y}$ Emissions from the use of fossil fuel or electricity for the operation of the installed
$PE_{transp,y}$ Emissions from incremental transportation in the year y (tCO_2e)
$PE_{storage,y}$ Emissions from the storage of manure (tCO_2e) facilities in the year "y" (tCO_2e)

The latter two parameters will be considered as zero, as manure systems are within the farm, and no incremental transportation will occur, nor storage of manure, as it will flow directly into the farm's digester.

Emissions due to physical leakage are estimated as 10% of: the maximum methane producing potential of the manure fed into the management systems implemented by the project activity. As the Biotech Farms system is not a sequential treatment system, no adjustment (RVS) is necessary to account for sequential stages.

$PE_{PL,y} = 0.10 * GWP_{CH4} * D_{CH4} * \sum_{j,LT} B_{0,LT} * N_{LT,y} * VS_{LT,y} * MS\%_{i,y}$

Where:
$MS\%_{i,y}$ Fraction of manure handled in system “i" in year “y”

Emissions due to flaring or combustion ($PE_{flare,y}$) The Biotech Farms system will flare gas when the energy generator is not in use. The ex-ante project emissions are calculated using the calculated amount of gas that will be sent to the flare during downtime of the energy generator and using the ‘Tool to determine project emissions from flaring gases containing methane’ (EB28) through the following formula:

$PE_{flare} = \Sigma TM_{RG,h} * (1 - \eta_{flare,h}) * GWPCH_4 / 1000$

Where:
$TM_{RG,h}$ is the mass flow rate of methane in residual gas in hour h in kg/h which is summed over the hours per year of operation.
$\eta_{flare,h}$ is the flare efficiency in hour h
GWP_{CH4} is the GWP of methane according to IPCC.

In case of open flares, the flare efficiency cannot be measured in a reliable manner (i.e. external air will be mixed and will dilute the remaining methane) and a default value of 50%[1] is to be used provided that it can be demonstrated that the flare is operational (e.g. through a flame detection system reporting electronically on continuous basis)). If the flare is not operational the default value to be adopted for flare efficiency is 0%.

For enclosed flares, the temperature in the exhaust gas of the flare is measured to determine whether the flare is operating or not.

For enclosed flares, either of the following two options can be used to determine the flare efficiency:
(a) To use a 90% default value. Continuous monitoring of compliance with manufacturer’s specification of flare (temperature, flow rate of residual gas at the inlet of the flare) must be performed. If in a specific hour any of the parameters are out of the limit of manufacturer’s specifications, a 50% default value for the flare efficiency should be used for the calculations for this specific hour.
(b) Continuous monitoring of the methane destruction efficiency of the flare (flare efficiency).

In both cases, if there is no record of the temperature of the exhaust gas of the flare or if the recorded temperature is less than 500 °C for any particular hour, it shall be assumed that during that hour the flare efficiency is zero.
Emission for power use ($PE_{power,y}$) is zero as Biotech Farms relies on no electricity or fuel for the operation of the facility. The power is derived from the biogas system which emits no greenhouse gases relative to the baseline.

Leakage from methane recovery and destruction (MLeakage)

[1] Whenever the default value for the flare efficiency (either open flare or enclosed flare) is to be used for calculation of project emissions in equation for PE_{flare} of the tool, the value should be converted into fraction (e.g. 50/100= 0.5) before use in the equation.

The Biotech CPA does not involve replacement of equipment and therefore leakage is zero.

***Ex ante* emissions from renewable electricity generation are calculated using the following formula:**

GER_y = GBE_y - (GPE_y + $GLeakage_y$)

Where

GER_y Emission reduction in year "y" (tCO_2-e) from electricity generation
GBE_y Baseline emissions in year "y" (tCO_2-e) from renewable electricity generation
GPE_y Project emissions in year "y" (tCO_2-e) from renewable electricity generation
$GLeakage_y$ Project leakage in year "y" (tCO_2-e) from renewable electricity generation

Baseline emissions (GBE_y), project emissions (GPE_y) and leakage ($GLeakage_y$) from renewable electricity generation are to be calculated based on AMS I. F as shown below:

Baseline Emissions from electricity generation (GBEy)

Baseline emissions related to the use of the recovered methane for electricity generation that displaces electricity from a fossil fuel-based electricity distribution system are equivalent to the amount of electricity (MWh) produced by the project activity multiplied by the emission factor (tCO_2/MWh) of the relevant electrical grid.

$GBE_y = (EG_y - EG_{baseline}) * EF_{CO2,y}$

Where

GBE_y Baseline emissions in year y (tCO_2) from renewable electricity generation
EG_y Electricity generated by the project in year y (MWh/yr)
$EG_{baseline}$ Baseline electricity supplied to the grid in case of modified or retrofit units (MWh/yr) ,0
$EF_{CO2,y}$ Baseline emissions factor (tCO_2-e/MWh)

Baseline electricity generated ($EG_{baseline}$) is considered zero as the project does not involve any modification / retrofit or addition to an existing generating facility.
$EG_{baseline}$ = 0 MWh

Baseline emissions factor ($EF_{CO2,y}$) are calculated using the combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the 'Tool to calculate the emission factor for an electricity system'. The electricity system considered is the Mindanao grid.

EF_{CO2y} = 0.5418 tCO_2-e/MWh

Project emission from electricity generation (GPE_y)

As per methodology AMS III.D. (version 17 paragraph 15), "If recovered methane is used to power auxiliary equipment of the project it should be taken into account accordingly, using zero as its emission factor." Thus, when the project activities include the generation of electricity using the recovered methane to power auxiliary equipment i.e. blowers of minimal consumption, electricity generation will be taken into account and zero will be used as its emission factor.

$PE_{power,y} = EC_{AE} * 0$

In the event that there is not enough gas, or for any other reason the energy generator is not operating, the project activity shall monitor the energy consumption from the grid $EC_{PJ,y}$, and shall

consider it as project activity emissions, where the emission factor will be that for the Philippine grid it is connected to. Where:

$PE_{power,y} = EC_{PJ,y} * EF_{CO2,y}$

Leakage from energy generation (GLeakage)
No leakage calculation is required as per AMS III.D version 17 paragraph 17.

B.4.2. Data and parameters fixed ex ante

Data / Parameter	**W_{site}**
Data Unit	kg
Description	Average site animal weight for defined population (market and breeding)
Source of data	Biotech Farms data recording system.
Value(s) applied	80 for market; 250 (boars) and 200 (sows) for breeding
Choice of data or Measurement methods and procedures	Used for calculating $VS_{LT,y}$ adjusted for animal weight. Based on average weight of breeding and market pigs based on the census for Biotech Farms.
Purpose of data	Calculation of baseline emissions
Additional comment	None

Data / Parameter	**$W_{default}$**
Data Unit	kg.
Description	Default animal weight for defined population (market and breeding).
Source of data	IPCC default Tables 10 A-7, A-8 of IPCC 2006 Emissions from livestock and manure management.
Value(s) applied	46 for market; 198 for breeding.
Choice of data or Measurement methods and procedures	Based on North American breeds for swine as justified under the methodology and described in this section under the parameters **$B_{o,LT}$** and **$VS_{LT,y}$**.
Purpose of data	Calculation of baseline emissions
Additional comment	None

Data / Parameter	**$N_{da,y}$**
Data Unit	Days
Description	Number of days animal is alive in the farm in the year “y”
Source of data	Based on farm records and estimates.
Value(s) applied	365 days for market; 365 for breeders
Choice of data or Measurement methods and procedures	Used in the calculation of $N_{LT,y}$ as per AMS III.D.
Purpose of data	Calculation of baseline emissions
Additional comment	None

Data / Parameter	**$N_{p,y}$**

Data Unit	Number
Description	Number of animals produced annually of type “LT” for the year “y”
Source of data	Based on farm records
Value(s) applied	For 2013-2014 N breed 6,601 Sow 6,489 Boar 112 N market 54,999 For 2015-2020 N breed 7,223 Sow 7,100 Boar 123 N market 60,177
Choice of data or measurement methods and procedures	Based on actual farm data
Purpose of data	Calculation of baseline emissions
Additional comment	None

Data / Parameter	**MCF_j**
Data Unit	Fraction
Description	Annual methane conversion factor (MCF) for the baseline animal waste management system “j”
Source of data	Table 10.17 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Chapter 10, “Uncovered Anaerobic Lagoon”;
Value(s) applied	0.8 for swine
Choice of data or Measurement methods and procedures	Corresponds to ‘uncovered anaerobic lagoon’ manure management systems for swine with a mean annual temperature of greater than 26°C. According to the Philippine Atmospheric Geophysical & Astronomical Services Administration (PAGASA[2]), the mean annual temperature is >26°C
Purpose of data	Calculation of baseline emissions
Additional comment	None

Data / Parameter	**$B_{o,LT}$**
Data Unit	m^3 CH_4/kg dm
Description	Maximum methane producing potential of the volatile solid generated for animal type “LT”.
Source of data	The genetic source of the production operations livestock originates from an Annex I country, and the CPA will use default values corresponding to Annex I species found in Table 10A-7 (market animals) & 10A-8 (breeding animals) of IPCC Guidelines for National Greenhouse Gas Inventories, volume 4, Chapter 10.
Value(s) applied	Bo,breed = 0.48 ; Bo,market = 0.48

[2] For details and record of annual mean temperature http://bagong.pagasa.dost.gov.ph/information/climate-philippines

Choice of data or Measurement methods and procedures	The use of Annex I species defaults for Bo for swines is justified based on the requirements of AMS III.D as follows: (i) Biotech Farms uses formulated feed rations (FFR) which are optimized for the various stages of animal growth, category, weight gain, productivity and genetics evidence of which is available for review by the DOE. (ii) The project's specified animal weight (50 kg for market pigs and 250 kg -boars and 200 kg – sows for breeding pigs) is more similar to developed country IPCC default values (46 kg for market and 198 kg for breeding) than to Asian default values (28 kg for market and breeding).
Purpose of data	Calculation of baseline emissions
Additional comment	None

Data / Parameter	**$VS_{LT,y}$**
Data Unit	Kg dm/animal/year
Description	Volatile solids for livestock "LT" entering the animal manure management system in year "y" (on a dry matter weight basis, kg dm/animal/year).
Source of data	(i) Default values: The genetic source of the production operations livestock originates from an Annex I country, and the CPA will use default values corresponding to Annex I species found in Table 10A-7 (market animals) & 10A-8 (breeding animals) of IPCC Guidelines for National Greenhouse Gas Inventories, volume 4, Chapter 10. (ii) Adjustment for animal weight: VS is adjusted for animal weight according to the calculations outlined in AMS III.D and shown in section B.4.3.
Value(s) applied	Default values: $VS_{breed,\ y}$ = 0.5; $VS_{market,\ y}$= 0.27
Choice of data or Measurement methods and procedures	The use of Annex I species defaults for VS is justified based on the requirements of AMS III.D as follows: (i) Biotech Farms uses formulated feed rations (FFR) which are optimized for the various stages of animal growth, category, weight gain, productivity and genetics evidence of which is available for review by the DOE (ii) The project's specified animal weight (50 kg for market pigs and 250 kg -boars and 200 kg - sows for breeding pigs) is more similar to developed country IPCC default values (46 kg for market and 198 kg for breeding) than to Asian default values (28 kg for market and breeding).
Purpose of data	Calculation of baseline emissions
Additional comment	Calculations are shown in Section B.4.3.

Data / Parameter	**$\eta_{flare,h}$**
Data unit	%
Description	Flare efficiency
Source of data	Based on defaults provided in AMS III.D and "Tool for calculation of emissions from flaring gases containing methane"
Value(s) applied	90%
Choice of data or Measurement methods and procedures	The default value corresponds to that of an enclosed flare.
Purpose of data	Calculation of project emissions

Additional comment	None

Data / Parameter	GWP_{CH4}
Data unit	tCO_2-e/tCH_4
Description	Global warming potential for CH_4
Source of data	IPCC
Value(s) applied	25 from 01/01/2013 and onwards
Choice of data or Measurement methods and procedures	Default value used.
Purpose of data	Calculation of baseline emissions
Additional comment	None

Data / Parameter	$MS\%_{Bl,j}$
Data unit	Fraction
Description	Fraction of manure handled in the baseline animal manure management system "j"
Source of data	Based on baseline system operation.
Value(s) applied	1.0
Choice of data or Measurement methods and procedures	All manure was treated in the open lagoons.
Purpose of data	Calculation of baseline emissions
Additional comment	None

Data / Parameter	$W_{CH4,y}$
Data unit	mass fraction
Description	Methane content in biogas in year "y"
Source of data	Based on options provided in AMS III D
Value(s) applied	60%
Choice of data or Measurement methods and procedures	Default value used.
Purpose of data	Calculation of baseline emissions
Additional comment	None

Data / Parameter	nd_y
Data unit	Days
Description	Number of days in year "y" where the treatment plant is operational.
Source of data	Based on project design.
Value(s) applied	365
Choice of data or Measurement methods and procedures	Used in calculating $VS_{LT,y}$ adjusted for animal weight
Purpose of data	Calculation of baseline emissions
Additional comment	None

Data / Parameter	**EG_y**
Data unit	MWh
Description	Net quantity of electricity estimated to be generated in the project plant during the year y
Source of data	Estimated based on project design
Value(s) applied	For 2013-2014: 5,376 For 2015-15/07/2019: 6,720 For 16/07/2019-2020:19,205
Choice of data or Measurement methods and procedures	Based on requirements of AMS I.F and dependent on the particulars of the CPA; whether addition on capacity, retrofit, or otherwise as per AMS I.F.
Purpose of data	Calculation of baseline emissions
Additional comment	None

Data / Parameter	**$EF_{CO2,y}$**
Data unit	tCO_2 / MWh
Description	Factor of emissions of the Mindanao electricity grid
Source of data	Calculated according to CDM guidelines and data from the Philippines Department of Energy (DOE). See http://cdmdna.emb.gov.ph and Appendix 3 for complete details
Value(s) applied	0.5418
Choice of data or Measurement methods and procedures	Combined margin (including inter-regional and cross-border electricity transfers) calculated according to the “Tool to calculate the emission factor for an electricity system”, version 2. Fuel consumption and electricity generation data for plants connected to the grid, provided by Philippine Official Statistics of the DOE (Department of Energy).
Purpose of data	Calculation of baseline emissions
Additional comment	$EF_{CO2,y}$ is calculated as a weighted sum of the OM and BM emission factors

Data / Parameter	Information on plants used in calculating OM and BM
Data unit	-
Description	Identification of basic information for power plants for the OM and BM
Source of data	Department of Energy published information
Value(s) applied	The following information will be presented for each plant. 1. Plant name; 2. Date of commissioning; 3. Capacity (MW; 4. Fuel type(s) used; 5. In cases where the simple OM or the simple adjusted OM is used, information on whether the plant or unit is low cost must run; 6. Identification of whether the plant is used for the build margin or operating margin calculation;
Choice of data or Measurement methods and procedures	Based on requirements of “Tool to calculate the emission factor for an electricity system”, version 2.
Purpose of data	Calculation of baseline emissions
Additional comment	Identification of plants to calculate OM and BM

Data / Parameter	**$EG_{m,y}$, EG_{y}, $EG_{j,y}$, $EG_{k,y}$, and $EG_{n,h}$**
Data unit	MWh
Description	Net electricity generated and delivered to the grid by power plant / unit m,j,k or n (or in the project electricity system in case of EGy) in year y or hour h.
Source of data	Government data using most recent three historical years for which data is available at the time of submission of the CPA-DD to the DOE for inclusion in the PoA.
Value(s) applied	This will be provided for all plants used in the calculation of OM and BM for the individual CPA.
Choice of data or Measurement methods and procedures	As per requirements of “Tool to calculate the emission factor for an electricity system”, version 2
Purpose of data	Calculation of baseline emissions
Additional comment	None

Data / Parameter	**$FC_{i,m,y}$, $FC_{i,y}$, $FC_{i,j,y}$, $FC_{i,k,y}$, $FC_{i,n,y}$ and $FC_{i,n,h}$**
Data unit	Mass or volume unit
Description	Amount of fossil fuel type i consumed by a power plant per unit m,j,k or n (or in the project electricity system in case of FCi,y) in year y or hour h.
Source of data	Calculated using government data from the most recent three historical years for which data is available at the time of submission of the CPA-DD to the DOE.
Value(s) applied	-
Choice of data or Measurement methods and procedures	Will be reported for all power plants used to calculate the OM and BM and will be used in the ex-ante calculation methods for determining the OM and BM based on the “Tool to calculate the emission factor for an electricity system”, version 2. Note that the methods to be applied to CPAs under the PoA are only those that can be applied ex-ante (Simple OM, simple adjusted OM, average OM and ex-ante BM).
Purpose of data	Calculation of baseline emissions
Additional comment	Since data of the amount of fuel i (in a mass or volume unit) consumed by relevant power sources are not available for all power plants in the Philippines, it is reliably estimated with the PFR per MWh formula: 3.6*10^9/(NEC*10^12) =TJ, where the NECs are the actual ones of each power plant as provided in the most recent DOE Annual Statistics. Parameter 5 should be monitored using the most recent information published by the NEC. This parameter is included in the COEF calculation

Data / Parameter	$NCV_{i,y}$
Data unit	GJ/mass or volume unit
Description	Net calorific value (energy content) of fossil fuel type I in year y

Source of data	The following data sources may be used if the relevant conditions apply: <table><tr><td>Data source</td><td>Conditions for using the data source</td></tr><tr><td>Values provided by the fuel supplier of the power plants in invoices</td><td>If data is collected from power plant operators (e.g, utilities).</td></tr><tr><td>Regional or national average default values.</td><td>If values are reliable and documented in regional or national energy statistics /energy balances.</td></tr><tr><td>IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories.</td><td></td></tr></table>
Value(s) applied	-
Choice of data or Measurement methods and procedures	Calculated using government data from the most recent three historical years for which data is available at the time of submission of the CPA-DD to the DOE.
Purpose of data	Calculation of baseline emissions
Additional comment	The gross calorific value (GCV) of the fuel can be used, if gross calorific values are provided by the data sources used. In these cases, a gross calorific value will also be used as a basis for the CO_2 emission factor.

Data / Parameter	**$EF_{CO2,i,y}$ and $EF_{CO2,m,i,y}$**
Data unit	tCO2/GJ
Description	CO2 emission factor of fossil fuel type i in year y
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Chapter 1, Table 1.4, Pages 1.23 and 1.24, for conservativeness lower limit of the 95% confidence interval for the default factor has been applied.
Value(s) applied	Natural Gas: 0.0543 Diesel: 0.0726 Residual Fuel Oil: 0.0755 Coal: 0.0873
Choice of data or Measurement methods and procedures	As per the methodology, since values from power plant operators are not available, and there is not reliable data at the regional or national level, then for conservativeness the lower limit of the 95% confidence interval for the default IPCC value is considered.
Purpose of data	Calculation of baseline emissions
Additional comment	None

Data / Parameter	$\eta_{m,y}$
Data unit	-
Description	Average net energy conversion efficiency of power unit m in year y

<table>
<tr><td>Source of data</td><td>Use either:
□ Documented manufacturer's specification (if the efficiency of the plant is not significantly increased through retrofits or rehabilitations);
□ Data from the utility, the dispatch center or official records if it can be deemed reliable; or
□ Default values below.</td></tr>
<tr><td>Value(s) applied</td><td>Default values
<table>
<tr><td></td><td>Old (before 2000)</td><td>New (after 2000)</td></tr>
<tr><td>Coal</td><td></td><td></td></tr>
<tr><td>- Subcritical</td><td>37%</td><td>39%</td></tr>
<tr><td>- Supercritical</td><td></td><td>45%</td></tr>
<tr><td>-Ultrasupercritical</td><td></td><td>50%</td></tr>
<tr><td>IGCC</td><td></td><td>50%</td></tr>
<tr><td>FBS</td><td>35%</td><td></td></tr>
<tr><td>CFBS</td><td>36.5%</td><td>40%</td></tr>
<tr><td>PFBS</td><td></td><td>41.5%</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Oil</td><td></td><td></td></tr>
<tr><td>- Steam turbine</td><td>37.5%</td><td>39%</td></tr>
<tr><td>-Open cycle</td><td>30%</td><td>39.5%</td></tr>
<tr><td>-Combined cycle</td><td>46%</td><td>46%</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Natural gas</td><td></td><td></td></tr>
<tr><td>- Steam turbine</td><td>37.5%</td><td>37.5%</td></tr>
<tr><td>-Open cycle</td><td>30%</td><td>39.5%</td></tr>
<tr><td>-Combined cycle</td><td>46%</td><td>60%</td></tr>
</table>
From Annex I of "Tool to calculate the emission factor for an electricity system", version 2.</td></tr>
<tr><td>Choice of data or Measurement methods and procedures</td><td>Based on the "Tool to calculate the emission factor for an electricity system", version 2</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Additional comment</td><td>None</td></tr>
</table>

B.4.3. Ex ante calculation of emission reductions

Ex ante emission reductions of the project activity were calculated using the following formula:

$PER_y = MER_y + GER_y$

Where:

MER_y Emission reduction in year "y" (tCO_2-e) from methane recovery (as per AMS III.D)

GER_y Emission reduction in year "y" (tCO_2-e) from renewable electricity generation (as per AMS I.F)

Ex ante emissions from methane recovery were calculated using the following formula:

$MER_y = MBE_y - (MPE_y + MLeakage_y)$

Where:

MER_y Emission reduction in year "y" (tCO_2-e)

MBE_y Baseline emissions in year "y" (tCO_2-e)

MPE_y Project emissions in year "y" (tCO_2-e)

$MLeakage_y$ Project leakage in year "y" (tCO_2-e)

Baseline emissions (MBE_y), project emissions (MPE_y) and leakage ($MLeakage_y$) were calculated based on AMS III D as shown below:

Baseline Emissions from methane recovery and destruction (MBE_y)

Baseline emissions are calculated using the amount of the waste or raw material that would decay anaerobically in the absence of the project activity. The following formula was used:

$MBE_y = GWP_{CH4} * D_{CH4} * Uf_b * \sum_{j,LT} MCF_j * B_{0,LT} * N_{LT,y} * VS_{LT,y} * MS\%_{Bl,j}$

Where:

MBE_y	baseline emissions in year "y" (tCO_2-e/yr)
GWP_{CH4}	Global Warming Potential (GWP) of CH_4
D_{CH4}	CH_4 density (0.00067 t/m^3 at room temperature (20 ºC) and 1 atm pressure).
LT	Index for all types of livestock
j	Index for animal waste management system
$MCFj$	Annual methane conversion factor (MCF) for the baseline animal waste management system "j" in percentages (digester in project scenario).
$B_{0,LT}$	Maximum methane producing potential of the volatile solid generated for animal type "LT" (m^3 CH_4/kg dm)
$N_{LT,y}$	Annual average number of animals of type "LT" in year "y" (numbers) calculated using the formula below.
$VS_{LT,y}$	Volatile solids for livestock "LT" entering the animal manure management system in year "y" (on a dry matter weight basis, kg dm/animal/year)
$MS\%_{Bl,j}$	Fraction of manure handled in baseline animal manure management system "j"
UF_b	Model correction factor to account for model uncertainties (0.94)

As shown in the figure in section A.3, the farm has extended the design to combine manure from the poultry farm (which can be considered negligible, i.e. << 5% contribution to baseline and GHG emissions, and thus not considered in the ER calculations) with the manure influent from the piggery farm to the anaerobic digestion system. Ex-post calculations will consider a 1% discount on $BG_{burnt,y}$ (Biogas flared or combusted in year y) for the poultry manure added.

Annual average animal population ($N_{LT,y}$) for breeding and market pigs determined from actual pig census for Biotech Farms:

Breeding Swine					Market Swine	
Sow			Boar		Finisher	
Year	average population	average weight (kg)	average population	average weight (kg)	average population	average weight (kg)
2013	6,489	200	112	250	54,999	80
2014	6,489	200	112	250	54,999	80
2015	7,100	200	123	250	60,177	80
2016	7,100	200	123	250	60,177	80
2017	7,100	200	123	250	60,177	80
2018	7,100	200	123	250	60,177	80
2019	7,100	200	123	250	60,177	80
2020	7,100	200	123	250	60,177	80

Calculation of VS: VS are calculated by adjusting default VS using site specific animal weights as follows:

$VS_{site,LT,y} = (W_{site} / W_{default}) \times VS_{default} * nd_y$

Where:

$VS_{site, LT,y}$	Adjusted volatile solid excretion for livestock "LT" entering the animal manure management system in year "y" (on a dry matter weight basis, kg dm/animal/year)
W_{site}	Average site animal weight for defined population, in kg
$W_{default}$	Default average animal weight for defined population, in kg.
$VS_{default}$	Default value (IPCC) for the volatile solid excretion per day on a dry- matter basis for defined livestock population, in kg-dm/animal/day
nd_y	Number of days in year "y" where the treatment plant was operational

Parameter	W_{site}	$W_{default}$	$VS_{default}$	nd_y	Calculated value ($VS_{site, LT,y}$)
$VS_{breed,y}$					
Sow	200	198	0.5	365	184.34
Boar	250	198	0.5	365	230.43
$VS_{market-,y}$	80	46	0.27	365	171.39

Summary of Calculation of Annual Baseline Emissions: Summarized below are the constants and outcome of the calculation from the formula above for MBE_y.

Parameter	Value
GWP_{CH4}	25
D_{CH4}	0.00067
Uf_b	0.94
MCF_j	0.8
Bo breed,y	0.48
Bo market,y	0.48
VS breed,y	
Sow	184.34
Boar	230.43
VS market,y	171.39
N breed,y	
For 2013-2014	6,601
Sow	6,489
Boar	112
For 2015-2020	7,223
Sow	7,100
Boar	123
N market, y	
For 2013-2014	54,999
For 2015-2020	60,177
MS%Bl,j	1.0
MBEy	
For 2013-2014	**64,380 tCO_2-e/yr**
For 2015-2020	**70,442 tCO_2-e/yr**

Project Emissions from methane recovery and destruction (MPE_y)

Project emissions are calculated using the following formula:

$$MPE_y = PE_{PL,,y} + PE_{flare,y} + PE_{power,y}$$

Where:

MPE_y	Project emissions in year "y" (tCO_2e)
$PE_{PL,y}$	Emissions due to physical leakage of biogas in year "y" (tCO_2e)
$PE_{flare,y}$	Emissions from flaring of the biogas stream in the year "y" (tCO_2e)
$PE_{power,y}$	Emissions from the use of fossil fuel or electricity for the operation of the installed facilities in the year "y" (tCO_2e)

Emissions due to physical leakage ($PE_{PL,y}$) are estimated as per AMS III.D as 10% of: the maximum methane potential of the manure fed into the management systems implemented by the project activity. As the Biotech Farms system is not a sequential treatment system no adjustment (RVS) is necessary to account for sequential stages.

$PE_{PL,y} = 0.10 * GWP_{CH4} * D_{CH4} * \sum j,LT\ B_{0,LT} * N_{LT,y} * VS_{LT,y} * MS\%_{i,j}$

Parameter	Value
GWP_{CH4}	25
D_{CH4}	0.00067
Bo breed,y	0.48
Bo market,y	0.48
VS breed,y	
Sow	184.34
Boar	230.43
VS market,y	171.39
N breed,y	
For 2013-2014	6,601
Sow	6,489
Boar	112
For 2015-2020	7,223
Sow	7,100
Boar	123
N market, y	
For 2013-2014	54,999
For 2015-2020	60,177
$MS\%B_{l,j}$	1.0
$PE_{PL,y}$	
For 2013-2014	**8,561 tCO_2-e/yr**
For 2015-2020	**9,367 tCO_2-e/yr**

Emissions due to flaring or combustion ($PE_{flare,y}$) The Biotech Farms system will flare gas when the energy generator is not in use. The ex-ante project emissions are calculated using the calculated amount of gas that will be sent to the flare during downtime of the energy generator. This will be calculated using the 'Tool to determine project emissions from flaring gases containing methane' (EB28) through the following formula:

$PE_{flare} = \Sigma\ TM_{RG,h} * (1 - \eta_{flare,h}) * GWP_{CH4} / 1000$

Where:

$TM_{RG,h}$ is the mass flow rate of methane in residual gas in hour h in kg/h which is summed over the hours per year of operation.
$\eta_{flare,h}$ is the flare efficiency in hour h
GWP_{CH4} is the GWP of methane according to IPCC.

Parameter	**Value**
GWP_{CH4}	25
$\eta_{flare, h}$	90%
Σ $TM_{RG,h}$ (2013-2014)	616
Σ $TM_{RG,h}$(2015-2020)	674
PE_{flare}	
For 2013-2014	1541
For 2015-2020	1686

Emission for power use ($PE_{power,y}$) is zero as Biotech Farms relies on no electricity or fuel for the operation of the facility. The power is derived from the biogas system which emits no greenhouse gases relative to the baseline.

Total project emissions from methane recovery and destruction *(M**PE$_y$**)*

Parameter	**Value**
$PE_{PL,,y}$	
For 2013-2014	8,561
For 2015-2020	9,367
$PE_{flare,y}$	
For 2013-2014	1,541
For 2015-2020	1,686
$PE_{power,y}$	
For 2013-2014	0
For 2015-2020	0
MPE_y	
For 2013-2014	**10,103 tCO_2-e/yr**
For 2015-2020	**11,054 tCO_2-e/yr**

Leakage from methane recovery and destruction *(MLeakage$_y$)*
As per paragraph 17 of AMS-III.D version 17, no leakage calculation is required; value of $MLeakage_y$ is taken to be zero.

The annual emission reduction from methane recovery is estimated as:

MERy = MBEy - (MPEy + $MLeakage_y$)

For 2013-2014
MERy = 64,380 tCO_2-e/yr - (10,103 tCO_2-e/yr + 0)
MERy = 54,277 tCO_2-e/yr

For 2015-2020
MERy = 70,442 tCO_2-e/yr - (11,054 tCO_2-e/yr + 0)
MERy = 59,388 tCO_2-e/yr

***Ex ante* emissions from renewable electricity generation** are calculated using the following formula:

$$GER_y = GBE_y - (GPE_y + GLeakage_y)$$

Where

GER_y	Emission reduction in year "y" (tCO_2-e) from electricity generation
GBE_y	Baseline emissions in year "y" (tCO_2-e) from renewable electricity generation
GPE_y	Project emissions in year "y" (tCO_2-e) from renewable electricity generation
$GLeakage_y$	Project leakage in year "y" (tCO_2-e) from renewable electricity generation

Baseline emissions (GBE_y), project emissions (GPE_y) and leakage ($GLeakage_y$) from renewable electricity generation are to be calculated based on AMS-I.F as shown below:

Baseline Emissions from electricity generation (GBE_y)

Baseline emissions related to the use of the recovered methane for electricity generation that displaces electricity from a fossil fuel-based electricity distribution system are equivalent to the amount of electricity (MWh) produced by the project activity multiplied by the emission factor (tCO_2/MWh) of the relevant electrical grid.

$$GBE_y = (EG_y - EG_{baseline}) * EF_{CO2,y}$$

Where

GBE_y	Baseline emissions in year y (tCO_2) from renewable electricity generation
EG_y	Electricity generated by the project in year y (MWh/yr)
$EG_{baseline}$	Baseline electricity supplied to the grid in case of modified or retrofit units (MWh/yr)
$EF_{CO2,y}$	Baseline emissions factor (tCO_2-e/MWh)

Electricity generated by the project (EG_y) were estimated based on the rated capacity of 800 kW (for 2013-2014), 1,000 kW (for 2015-15/07/2019), and 1,429 kW x 2 units (for 16/07/2019-2020). The 800 kW microturbine was solely in operation (2015-2016) until it broke down in July 2016 and has not been in use since. The generator set is assumed to run 24 hours a day, (365-n) days a year, where n=15 is the amount of days that the generator is expected to be on maintenance, for a total of 8,400 hours a year at an operating rate of 80%.

The total annual amount of electricity displaced from the grid by the project activity is estimated as:

For 2013-2014
EG_y = 0.8 MW * 80% * 8,400 hours
EG_y = 5,376 MWh / year

For 2015-15//07/2019
EG_y = 1.0 MW * 80% * 8,400 hours
EG_y = 6,720 MWh / year

For 16/07/2019-2020
EG_y = 1.429 MW * 80% * 8,400 hours* 2 units
EG_y = 19,205 MWh / year

Since the increase in capacity for up to 2 x 1.429 MW occurred on 16/07/2019 (169 days in 2019) and taking the annual values above:

EG_{2019} = 6,720 MWh/year* (196 days/365 days) + 19,205 MWh *(169 days/365 days)
= 12,501 MWh

Baseline electricity generated ($EG_{baseline}$) is considered zero as the project does not involve any modification / retrofit or addition to an existing generating facility.
$EG_{baseline}$ = 0 MWh

Baseline emissions factor ($EF_{CO2,y}$) are calculated using the combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the 'Tool to calculate the emission factor for an electricity system'. The electricity system considered is the Mindanao grid.

$EF_{CO2,y}$ = 0.5418 tCO_2-e/MWh

The total annual baseline emission to be considered in electricity generation is estimated as:

For 2013-2014
GBE_y = (5,376 MWh - 0 MWh) * 0.5418 tCO_2-e/MWh
GBE_y = 2,912 tCO_2-e / year

For 2015-2018
GBE_y = (6,720 MWh - 0 MWh) * 0.5418 tCO_2-e/MWh
GBE_y = 3,640 tCO_2-e / year

For 2019:
GBEy = (12,501 MWh - 0 MWh) * 0.5418 tCO_2-e/MWh
= 6,773 tCO2-e / year

For 2020
GBEy = (19,205 MWh - 0 MWh) * 0.5418 tCO_2-e/MWh
GBEy = 10,405 tCO_2-e / year

Project emission from electricity generation (GPE_y)
As per methodology AMS III.D. (version 17 paragraph 15), "If recovered methane is used to power auxiliary equipment of the project it should be taken into account accordingly, using zero as its emission factor." Thus, when the project activities include the generation of electricity using the recovered methane to power auxiliary equipment i.e. blowers of minimal consumption, electricity generation will be taken into account and zero will be used as its emission factor.

$PE_{power,y} = EC_{AE} * 0$

In the event that there is not enough gas, or for any other reason the energy generator is not operating, the project activity shall monitor the energy consumption from the grid $EC_{PJ,y}$, and shall consider it as project activity emissions, where the emission factor will be that for the Philippine grid it is connected to. Where:

$PE_{power,y} = EC_{PJ,y} * EF_{CO2,y}$

Leakage from electricity generation *($GLeakage_y$)*
No leakage calculation is required as per AMS III.D version 17 paragraph 17.
The annual emission reduction by the generation of electricity from recovered methane that displaces fossil fuel-based electricity from the grid is estimated as:

$GER_y = GBE_y - (GPE_y + GLeakage_y)$

For 2013-2014

GER_y = 2,912 tCO_2-e - (0 + 0)

GER_y = 2,912 tCO_2-e / year

For 2015-2018

GER_y = 3,640 tCO_2-e - (0 + 0)

GER_y = 3,640 tCO_2-e / year

For 2019

GERy = 6,773 tCO_2-e - (0 + 0)

GERy = 6,773 tCO_2-e / year

For 2020

GER_y = 10,405 tCO_2-e - (0 + 0)

GER_y = 10,405 tCO_2-e / year

The total annual emission reduction of the project activity is estimated as:

$PER_y = MER_y + GER_y$

For 2013-2014
PER_y = 54,277 tCO_2-e/yr + 2,912 tCO_2-e/year
PER_y = 57,189 tCO_2-e/yr

For 2015-2018
PER_y = 59,388 tCO_2-e/yr + 3,640 tCO_2-e/year
PER_y = 63,028 tCO_2-e/yr

For 2019
PER_y = 59,388 tCO_2-e/yr + 6,773 tCO_2-e/year
PER_y = 66,161 tCO_2-e/yr

For 2020
PER_y = 59,388 tCO_2-e/yr + 10,405 tCO_2-e/year
PER_y = 69,793 tCO_2-e/yr

B.4.4. Summary of ex ante estimates of emission reductions

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
08/09/2013-31/12/2013	21,201	3,183	0	18,018
2014	67,292	10,103	0	57,189
2015	74,082	11,054	0	63,028
2016	74,082	11,054	0	63,028
2017	74,082	11,054	0	63,028
2018	74,082	11,054	0	63,028
2019	77,215	11,054	0	66,161
01/01/2020 - 07/09/2020	55,375	7,571	0	47,804
TOTAL	517,411	76,127	0	441,284
Total number of crediting years	7			

Annual average over the crediting period	73,916	10,875	0	63,041

* The first year, starts by the expected date of renewal for the CPA, therefore the crediting period ends seven years after. For complete details please refer to emission reduction calculation spreadsheet.

B.5. Monitoring plan

B.5.1. Data and parameters to be monitored

Data / Parameter	**$BG_{burnt,y}$**
Data unit	Nm^3
Description	Biogas flared or combusted in year “y”
Source of data	Flow meters on site
Value(s) applied	-
Measurement methods and procedures	Flow meters will measure continuously the volume of gas subject to combustion and/or use. If the biogas flared and fueled (or utilized) is continuously monitored separately, the two fractions can be added to determine the biogas recovered. In that case, recovered biogas need not be monitored separately. The system should be built and operated to ensure that there is no air ingress into the biogas pipeline.
Monitoring frequency	Continuously, aggregated as required for the period used for the verification of the PoA
QA/QC procedures	Flow meters shall be subject to regular maintenance, testing and calibration. Calibration will be done as per the equipment’s manufacturer specifications.
Purpose of data	Calculation of baseline emissions
Additional comment	Project activities where a portion of the biogas is destroyed through flaring and the other portion is used for energy may consider applying the flare efficiency to the portion of the biogas used for energy, if separate measurements of the respective flows are not performed. When the amount of methane that is combusted for energy and that is flared is separately monitored, a destruction efficiency of 100% can be used for the amount that is combusted for energy. Data will be kept for two years after the end of the crediting period. Alternatively, if the CPA utilizes the recovered methane for power generation and if no flow meter is installed on site, this parameter will not be reported for monitoring.

Data / Parameter:	**T**
Data unit:	ºC
Description:	Temperature of the biogas
Source of data:	Project implementer
Value(s) applied	-
Measurement methods and procedures:	Measured continuously. No separate monitoring is necessary when using flow meters that automatically measure the temperature and pressure, expressing biogas volumes in normalized cubic meters
Monitoring frequency:	Monitored continuously
QA/QC procedures:	Measuring instruments shall be subject to a regular maintenance and testing regime, based on the manufacturer/supplier’s recommendations

Purpose of data	Calculation of baseline emissions
Additional comment:	Alternatively, if the CPA utilizes the recovered methane for power generation and if no flow meter is installed on site, this parameter will not be reported for monitoring. Data will be kept for two years after the end of the crediting period

Data / Parameter:	**P**
Data unit:	Pa
Description:	Pressure of the biogas
Source of data:	Project implementer
Value(s) applied	-
Measurement methods and procedures:	Measured continuously. No separate monitoring is necessary when using flow meters that automatically measure the temperature and pressure, expressing biogas volumes in normalized cubic meters
Monitoring frequency:	Monitored continuously.
QA/QC procedures:	Measuring instruments shall be subject to a regular maintenance and testing regime, based on the manufacturer/supplier's recommendations
Purpose of data	Calculation of baseline emissions
Additional comment:	Alternatively, if the CPA utilizes the recovered methane for power generation and if no flow meter is installed on site, this parameter will not be reported for monitoring. Data will be kept for two years after the end of the crediting period

Data / Parameter	$\eta_{flare,h}$
Data unit	%
Description	Flare efficiency in the year "y"
Source of data	Default will be used as per the "Tool to determine project emissions from flaring gases containing methane"
Value(s) applied	0.9 applied ex-ante
Measurement methods and procedures	As per the "Tool to determine project emissions from flaring gases containing methane"
Monitoring frequency	Continuous
QA/QC procedures	Regular maintenance shall be carried out to ensure optimal operation of flares as per manufacturer/supplier recommendations.
Purpose of data	Calculation of project emissions
Additional comment	Data will be kept for two years after the end of the crediting period

Data / Parameter	T_{flare}
Data Unit	^{o}C
Description	Temperature in the exhaust gas of the flare.
Source of data	Measurements by farm owners.
Value(s) applied	-
Measurement methods and procedures	Measure the temperature of the exhaust gas stream in the flare by a thermocouple.
Monitoring frequency	Continuous

QA/QC procedures	Thermocouples will be calibrated or replaced each year. Calibration will be done as per the equipment's manufacturer specifications.
Purpose of data	Calculation of baseline emissions
Additional comment	Data will be kept for two years after the end of the crediting period

Data / Parameter	Other flare operation parameters
Data Unit	--
Description	This will include all data and parameters (in addition to temperature- T_{flare} such as a flame detection system) that are required to monitor whether the flare operates within the range of operating conditions according to the manufacturer's specifications
Source of data	Measurements by farm owners.
Value(s) applied	-
Measurement methods and procedures	Will be used to compare against manufacturers specifications.
Monitoring frequency	Continuously
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	Data will be kept for two years after the end of the crediting period

Data / Parameter	nd_y
Data unit	Days
Description	The number of days that the animal manure management system capturing methane and flaring/combusting methane was operational.
Source of data	Recorded on farm based on actual operation.
Value(s) applied	To be provided by CPA implementer
Measurement methods and procedures	Recorded data.
Monitoring frequency	Continuously, aggregated as required for the period used for the verification of the PoA
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	Data will be kept for two years after the end of the crediting period

Data / Parameter	$MS\%_{i,y}$
Data unit	Fraction
Description	Fraction of manure handled in system i in project activity in year y
Source of data	Recorded on farm based on actual operation.
Value(s) applied	1
Measurement methods and procedures	Recorded data.
Monitoring frequency	Annually
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions

Additional comment	Data will be kept for two years after the end of the crediting period

Data / Parameter	Np,y
Data unit	Number
Description	Number of animal produced annually of type "LT" for the year y
Source of data	Farm records
Value(s) applied	Please refer to calculation spreadsheet
Measurement methods and procedures	Based on pig census and pig production reports provided by farmer
Monitoring frequency	Continuously, aggregated as required for the period used for the verification of the PoA
QA/QC procedures	Cross checked against indirect information (records of sales and food purchases for example).
Purpose of data	Calculation of baseline emissions
Additional comment	Data will be kept for two years after the end of the crediting period

Data / Parameter	$\mathbf{N_{da,y}}$
Data unit	Days
Description	Number of days animal is alive in the farm in the year "y"
Source of data	Farm recorded data keeping system
Value(s) applied	Please refer to calculation spreadsheet
Measurement methods and procedures	As per farm records
Monitoring frequency	Continuously, aggregated as required for the period used for the verification of the PoA
QA/QC procedures	Cross checked records for sale of animals
Purpose of data	Calculation of baseline emissions
Additional comment	Data will be kept for two years after the end of the crediting period

Data / Parameter	$\mathbf{W_{site}}$
Data unit	kg
Description	Average animal weight of the farm's livestock population.
Source of data	Farm recorded data keeping system
Value(s) applied	Please refer to calculation spreadsheet
Measurement methods and procedures	Sampling procedures can be used to estimate this variable as per the "Standard for sampling and surveys for CDM project activities and Programmes of Activities"
Monitoring frequency	Annually
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	Data will be kept for two years after the end of the crediting period

Data / Parameter	**Genetic source of the production operations livestock originating from an Annex I Party**
Data unit	-

Description	Genetic source of the production operations livestock as applicable
Source of data	Based on documentation of purchases of livestock.
Value(s) applied	Values for North America
Measurement methods and procedures	As per certificate
Monitoring frequency	Annually
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	Data will be kept for two years after the end of the crediting period

Data / Parameter	**FFR**
Data unit	--
Description	Use of formulated feed rations.
Source of data	Based on on-farm record keeping, feed supplier and other documentation.
Value(s) applied	To be provided by CPA implementer
Measurement methods and procedures	Information collected will validate that the farm is using formulated feed rations which are optimized for the various animal(s), stage of growth, category, weight gain/productivity and/or genetics.
Monitoring frequency	-
QA/QC procedures	As per farm veterinarians report
Purpose of data	Calculation of baseline emissions
Additional comment	Data will be kept for two years after the end of the crediting period

Data / Parameter	**EG_y**
Data unit	MWh
Description	Total electricity generated from the recovered biogas in the year y
Source of data	Power plant
Value(s) applied	Please refer to calculation spreadsheet
Measurement methods and procedures	Measurement using energy meter. Only required for project activities that utilize the recovered methane for power generation
Monitoring frequency	Continuously, aggregated as required for the period used for the verification of the PoA
QA/QC procedures	Equipment shall be maintained as per manufacturer/supplier specifications
Purpose of data	Calculation of baseline emissions
Additional comment	Data will be kept for two years after the end of the crediting period

Data / Parameter	**EC_{AE}**
Data unit	kWh
Description	Electricity consumed by the auxiliary equipment within the project activity during the year y
Source of data	Electricity sub-meter
Value(s) applied	0
Measurement methods and procedures	To be measured from electrical sub-meters installed at the site. Data will be archived electronically.

Monitoring frequency	Continuously, aggregated as required for the period used for the verification of the PoA
QA/QC procedures	internal audits, capacity assessments, equipment monitoring & performance standards, equipment calibration, process control
Purpose of data	Calculation of project emissions
Additional comment	Only to be monitored if the recovered biogas is used to power auxiliary equipment of the project activity.

Data / Parameter	**$EC_{PJ,j,y}$**
Data unit	MWh
Description	Quantity of electricity from the grid consumed by the project activity during the year MWh
Source of data	Project participants, electricity meter to be installed
Value(s) applied	Estimated to be 0 for ex-ante calculations.
Measurement methods and procedures	Electricity meter. Measured
Monitoring frequency	Continuously, aggregated as required for the period used for the verification of the PoA
QA/QC procedures	Electricity meter will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy. Calibration will be done as per the equipment's manufacturer specifications
Purpose of data	Calculation of project emissions
Additional comment	As per the *"Tool to calculate baseline, project and/or leakage emissions from electricity consumption";* scenario A Data will be kept for at least two years after the end of the crediting period Alternatively, in case no separate electricity meter is installed to monitor the electricity consumption of the project, it will be estimated based on the relevant equipment operating at full rated capacity plus 10% to account for distribution losses, for 8760 hours per annum", in accordance with para. 26 of the methodology.

Data / Parameter:	**EE_y**
Data unit:	%
Description:	Energy conversion efficiency of the project equipment
Source of data:	-
Value(s) applied	Default: 40%
Measurement methods and procedures:	Specification provided by the equipment manufacturer. The equipment shall be designed to utilize biogas as fuel, and efficiency specification is for this fuel. If the specification provides a range of efficiency values, the highest value of the range shall be used for the calculation
Monitoring frequency:	-
QA/QC procedures:	-
Purpose of data	Calculation of baseline emissions

Additional comment:	Report this parameter for monitoring only if default value of 40% is not applied

B.5.2. Sampling plan

A sampling plan may be applied for the parameter $\mathbf{W_{site}}$ (average animal weight for defined population). The sampling design described below is in line with the requirements of the "Standard for sampling and surveys for CDM project activities and programme of activities":

- *Target population*: categories of pigs: breeding / market / sow / boar / finisher / nursery / suckling etc.

- *Sampling method*: simple random sampling approach with a level of confidence and precision of 90/10. This method is applicable because population is homogeneous within each category of pigs

- *Sample size*: it will depend on the total number of heads per category in each farm (parameter to be monitored as N_{LT})
  - *Parameter of interest*: average value of animal weight per type of animal (W_{site})
  - *Target value*: it will depend on the practice of the farm during the monitoring period
  - *Expected standard deviation*: as per paragraph 6 of Appendix 1 of the Guidelines on Sampling and surveys for CDM project activities and programme of activities (version 3.0), the standard deviation will be estimated as the range (maximum – minimum) divided by 4

  The following equation will be used to calculate the sample size

  $$n \geq \frac{1.645^2 NV}{(N-1)\times 0.1^2 + 1.645^2 V}$$

  Where:
  n = sample size
  V = (SD / mean)²
  N = total number of heads (same as N_{LT})
  Mean = our expected mean
  SD = our expected standard deviation
  1.645 = represents the 90% confidence required
  0.1 = represents the 10% relative precision

  Alternately, if the total number of heads is more than 5000, the following approximate equation can be used:

  $n = (1.645^2 V) / 0.1^2$, where $V = (SD / mean)^2$

  If the sample size calculation returns a value of less than 30 samples, the Student's t distribution shall be used to verify the reliability of the results, or alternately a minimum sample size of 30 shall be chosen.

- *Data to be collected:* total number of heads per type of animal, animal weight per type and number of samples.

B.5.3. Other elements of monitoring plan

The approved monitoring methodology follows the "Indicative Simplified Baseline and Monitoring Methodologies for Selected Small-Scale CDM Project Activity Categories", version 12 and the approved methodologies for AMS-III.D version 17 and AMS-I.F version 2.

<u>CPA Operations Plan:</u> Biotech Farms will develop an operations plan that defines a standard against which the project performance will be measured in terms of its emission reductions (ER) and conformance with all standards and criteria under the PoA. It will assist Biotech Farms in establishing a credible, transparent, and adequate data measurement, collection, recording and management system to coordinate all the monitoring requirements for generating certified emission reductions from their project and for ensuring compliance with the obligations with LBP under the PoA.

The CPA Operations Plan outlines the following plan:

<u>Monitoring:</u> To be monitored are those parameters described in the tables above which also detail the means of measurement and QA/QC procedures. These parameters were adapted to the situation of this CPA. In particular:

> *Type of flare or combustion system:* The type of combustion system affects the default flare efficiency $\eta_{flare,h}$ used as outlined below. Biotech Farms will use a generator set with an enclosed flare. Biotech Farms will monitor and record the use and compliance with manufacturers specifications as described in the monitoring plan.
>
> *Use of sequential manure management systems*: Biotech Farms manure management system will not be sequential and therefore no special monitoring protocols for treatment stages are necessary.
>
> *Type of fuel used*: The monitoring of the emissions from power will depend on the source of energy used in powering the system.
>
> *Use of Annex I country VS and Bo:* Biotech Farms will use VS and Bo values from Annex I countries and therefore the genetic source of the livestock (i.e. for swine) will need to be monitored.

<u>Quality Assurance and Quality Control:</u> The proponent will have a quality assurance and quality control plan in order to ensure that monitoring is done accurately and with properly calibrated instruments. The basic requirements are outlined in the tables in the monitoring plan section. In particular, scales, methane measurement devices, waste flow measurement devices, biogas flow meters, thermometers, pressure meters and electricity meters will be calibrated as per manufacturer specifications.

<u>Data recording:</u> Proper management processes and systems records will be required by the operator, as the auditors will request copies of such records to judge compliance with the required management systems. All data recording of the monitored data will include paper and/or electronic versions, backup systems and periodic checking for data entry mistakes.

<u>Reporting:</u> Monitoring data will be reported quarterly to LBP along with any major issues related to the monitoring system that may need attention. The estimation of emission reductions and reporting of the data for verification purposes will be done annually by LBP.

<u>Calculation of emissions reductions:</u> Based on the monitoring data the emission reductions will be calculated ex-post using the following approach:

$$PER_y = MER_{y,\ ex\text{-}post} + GER_{y,\ ex\text{-}post}$$

Where:

$MER_{y,\ ex\text{-}post}$	Emission reduction in year “y” (tCO_2-e) from methane recovery (as per AMS III.D)
$GER_{y,\ ex\text{-}ost}$	Emission reduction in year “y” (tCO_2-e) from renewable electricity generation (as per AMS I.F)

The emission reductions achieved in any year from methane recovery are the lowest value of the following:

$$MER_{y,ex\text{-}post} = \min [(MBE_{y,ex\text{-}post} - MPE_{y,ex\text{-}post}) , (MD_y)]$$

Where:

$MER_{y,ex\text{-}post}$ Emission reductions achieved by the project activity based on monitored values for year "y" (tCO_2 e)

$MBE_{y,ex\text{-}post}$ Baseline emissions calculated using the formula found in Section B.4.1 using *ex post* monitored values of $N_{LT,y}$ and if applicable $VS_{LT,y}$

$MPE_{y,ex\text{-}post}$ Project emissions calculated using the formula found in Section B.4.1 using *ex post* monitored values of $N_{LT,y}$, $MS\%_{i,y}$ and if applicable $VS_{LT,y}$

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

$$MD_y = BG_{burnt,y} * W_{CH4,y} * D_{CH4} * \eta_{flare,h} * GWP_{CH4}$$

Where:

$BG_{burnt,y}$ Biogas flared or combusted in year "y" (m_3).

$W_{CH4,y}$ Methane content in biogas in the year "y" (mass fraction)

$\eta_{flare,h}$ Flare efficiency in the year "y" (fraction) when biogas is flared

Methane content in biogas, W_{CH4}: As per AMS-III.D version 17 there are three options to monitor/determine the fraction of methane in the biogas: a) should be measured with a continuous analyzer or alternatively, b) with periodical measurements at a 90/10 confidence/precision level or, alternatively c) a default value of 60% methane content can be used. For all CPAs under this PoA **option c) will be adopted**: a default value of 60% methane content

Flare efficiency ($\eta_{flare,h}$) will be determined using default values. $PE_{flare,y}$ will be calculated using this default flare efficiency value.

Flare efficiency will be determined using default values. $PE_{flare,y}$ will be calculated using this default flare efficiency value.

$$PE_{flare} = \Sigma\ TM_{RG,h} * (1 - \eta_{flare,\ h}) * GWP_{CH4} / 1000$$

Where:

$TM_{RG,h}$ is the mass flow rate of methane in residual gas in hour h in kg/h which is summed over the hours per year of operation.
$\eta_{flare,\ h}$ is the flare efficiency in hour h
GWP_{CH4} is the GWP of methane according to IPCC.

During the crediting period, the enclosed flare (100 m^3/hr) was replaced with a larger enclosed flare (1,500 m^3/hr).

Alternatively, if the CPA utilizes the recovered methane for power generation, MD_y may be calculated as follows, based on the amount of monitored electricity generation, without monitoring methane flow and concentration:

$$MD_y = EG_y \times 3600 / (NCV_{CH4} \times EE_y) \times D_{CH4} \times GWP_{CH4}$$

Where:

EG_y Total electricity generated from the recovered biogas in year *y* (MWh)
3600 Conversion factor (1 MWh = 3600 MJ)
NCV_{CH4} NCV of methane (MJ/Nm_3) use default value: 35.9 MJ/Nm^3)

EE_y Energy conversion efficiency of the project equipment, which is determined by adopting one of the following criteria:
- Specification provided by the equipment manufacture. The equipment shall be designed to utilize biogas as fuel, and efficiency specification is for this fuel. If the specification provides a range of efficiency values, the highest value of the range shall be used for the calculation;
- Default efficiency of 40%

Project emissions are estimated using the equations given in section B.4.1 of the CPA-DD using ex-post values of monitored parameters.

The emission reductions achieved in any year from renewable electricity generation are the following:

$GBE_{y,ex\text{-}post} = (EG_{y,\ ex\text{-}post} - EG_{baseline}) * EF_{CO2,y,ex\text{-}ante}$

Where:

$GBE_{y,\ ex\text{-}post}$ Baseline emissions based on monitored values for year “y” (tCO_2) from renewable electricity generation

$EG_{y,ex\text{-}post}$ Electricity generated based on monitored values and calculated using the formula found in Section. B.4.1 for year “y” (MWh/yr)

$EG_{baseline}$ Baseline electricity supplied to the grid in case of modified or retrofit units based on monitored values and calculated using the formula found in Section B.4.1

$EF_{CO2,y,ex\text{-}ante}$ Baseline emissions factor calculated using the value found in Section B.4.1. (tCO2-e/MWh) *ex-ante* values applied throughout the crediting period

SECTION C. Start date, crediting period type and duration

C.1. Start date of CPA

03/09/2007, the date when the Statement of Account for the HDPE liner was placed.

C.2. Expected operational lifetime of CPA

25 years, 0 months

C.3. Crediting period of CPA

C.3.1. Type of crediting period

Renewable crediting period

C.3.2. Start date of crediting period

08/09/2013

C.3.3. Duration of crediting period

Seven (7) years, 0 months

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

Analysis of the environmental impacts is done at the CPA level.

The CPA will contribute to the improvement of the local environment by reducing odor and air pollution by containing liquid waste slurry in an enclosed digester. The enclosure ensures the capture of biogas and minimizes the leakage of methane as a form of air pollution caused by the facility. The impact is a direct benefit to the local community living around the area who will smell nothing in the vicinity of the project activity. The only risk of the system is related to proper operation to ensure no water pollution occurs in the local area and also safe operation of the gas collection and combustion system to ensure no explosion or fires occur. These are considered in Biotech Farms' design and operation.

In the case of Biotech Farms, the digester is covered by the ECC and discharge permit issued to the livestock farm.

D.2. Environmental impact assessment

No environmental compliance certificate (ECC), Initial Environmental Examination, or Environmental Impact Assessment (EIA) are necessary for the project activity (e.g., biodigester, methane capture facility) under Philippine law.

Biotech has provided to LBP current compliance with the law with the ECC certificate from DENR and corresponding discharge permits for the farm, according to LBP's requirements.

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

The Stakeholders' Consultation was conducted at The Farm at Carpenter Hill, Brgy. Carpenter Hill, Koronadal, South Cotabato, last 15/12/2009 at about 2:00PM. Key stakeholders are listed below and include representatives of the people living in the vicinity and those that have administrative, social or political interest in the project or its vicinity. They were invited by letter.

a) Barangay Captain of Barangay Malaya, Banga, South Cotabato
b) Barangay Secretary of Barangay Malaya, Banga, South Cotabato
c) Barangay Captain of Barangay San Vicente, Banga, South Cotabato
d) Barangay Councilors of Barangay San Vicente, Banga, South Cotabato
e) Barangay Councilor of Bo. 6, Banga, South Cotabato
f) Pollution Control Officer / Sanitary Inspector from Municipal Health Office
g) Farm Veterinarian of Biotech Farms, Inc.
h) Representatives from Environmental Management Bureau, Region 12
i) Account Officer, Land Bank of the Philippines, Koronadal Lending Center

To set the stage for the consultation, the following were initially presented/discussed:

- Climate Change
- Clean Development Mechanism
- Process of CDM
- LBP Carbon Finance Support Facility
- Biotech Farms, Inc. CDM Project

Comments/concerns of the stakeholders were subsequently solicited in an open manner and discussed.

E.2. Summary of comments received

Issues Raised	Responses/ Recommended Measures to Address Response
The participants expressed concern on the	Engr. Cabance enumerated a number of mitigating
foul odor particularly on certain period of the day around 7:00 pm and the wastewater which was partly being discharged to a nearby creek.	measures to address these aspects. He also emphasized the need for monitoring on the implementation of the EMP. The DENR-EMB representative requested the barangay representative to coordinate with the DENR should they encounter concern/problem on odor and wastewater. He emphasized the need for the joint conduct of assessment by DENR and the barangay council on the said concerns as these require technical expertise in analyzing the problem/complaint.
A barangay kagawad raised a concern that permit applications are not being consulted at the barangay level	The DENR representative explained that some of the permits are required at a national level. The application of said permits is directly submitted to the DENR for processing. The DENR encouraged that if there is a complaint, the complainant may file his/her concern at the DENR and the DENR will address the issue, which may be through conducting an investigation together with the complainant, if necessary.
Wastewater being discharged to the river which was alleged to pollute due to the dark colouring of the water.	Mr. Cordura explained that they had been treating the wastewater prior to discharge to the river. He also mentioned that the river has many tributaries. The livestock farm farm of Biotech may not only be the one discharging to the river, but rather there may be other activities in the area that may contribute to the colouring of the river. The DENR representative advised the participants that they may conduct wastewater sampling, investigate the area during the colouring of the river to determine its source and notify DENR should there be findings. Mr. Cordura emphasized that under the new design, the issue on odor and wastewater discharge will be properly addressed since the biogas will be captured thereby reducing odor and at the same time there will be no wastewater to be discharge since this will be recycled/re-used. The participants greatly appreciated the plan to recycle the treated wastewater and that there will be no discharge to the river.

E.3. Consideration of comments received

See above.

SECTION F. Eligibility for inclusion

No.	Eligibility criterion - Category	Eligibility criterion - Required condition	Supporting evidence for inclusion	Description of this CPA in relation to the criterion and supporting evidence
	Project Baseline			

No.	Eligibility criterion - Category	Eligibility criterion - Required condition	Supporting evidence for inclusion	Description of this CPA in relation to the criterion and supporting evidence
1	As per PoA Guidelines, CPA is not a component of another CDM programme, has not been registered as a project activity of another CDM project, is undergoing validation within another CDM project, nor is a debundled component of a large-scale project activity.	LBP CFSF Reply Form, with confirmation statement by the farm owner, indicating that the CPA is not a component of another CDM programme, has not been registered as a project activity of another CDM project, is undergoing validation within another CDM project, nor is a debundled component of a large-scale project activity.	Signed CFSF Reply Form and confirmation statement by Biotech Farms	Signed CFSF Reply Form by the CPA Implementer has been documented.
2	Piggery farms from livestock populations managed under confined conditions.	As per AMS-III.D, para 1.	Documented evidence from site visit by LBP staff.	Yes- the piggery did and continues to be managed under confined conditions.
3	Piggery farms where manure or the streams obtained after treatment is not discharged into natural water resources (e.g. rivers and estuaries).	As per AMS-III.D, para 1.	Documented evidence from site visit by LBP staff.	Yes- The effluent was stored in an on-site pond with no discharge into natural water resources.
4	Annual average temperature of baseline site where anaerobic manure treatment facility is located is higher than 5ºC	As per AMS-III.D, para 1.	The Philippines has a mean annual temperature over 5ºC. The mean annual temperature for the country is 26.6ºC.	Yes- The Philippines has a mean annual temperature of 26.6ºC The difference between the mean annual temperature of the southernmost station in Zamboanga and that of the northernmost station in Laoag is insignificant. In other words, there is essentially no difference in the mean annual temperature of places in Luzon, Visayas or Mindanao measured at or near sea level. http://bagong.pagasa.dost.gov.ph/information/climate-philippines
5	For anaerobic treatment systems in the baseline, the retention time of manure waste must be greater than 1 month.	As per AMS-III.D, para 1	Documented evidence on site visit along with information provided by CPA implementer: Dimension of existing lagoon/s and water consumption and/or farm discharge permits	Yes— The whole system in anaerobic and holds the waste indefinitely.

No.	Eligibility criterion - Category	Eligibility criterion - Required condition	Supporting evidence for inclusion	Description of this CPA in relation to the criterion and supporting evidence
6	For anaerobic lagoons in the baseline the depth is at least 1 meter.	As per AMS-III.D, para 1	Documented evidence provided by CPA implementer.	Yes – the baseline open lagoons are 2-3 meters deep.
7	The baseline system of waste management is an open anaerobic system with no methane recovery and destruction by flaring, combustion or gainful use.	As per para 1. AMS-III.D	Documented evidence from site visit by LBP staff or document provided by CPA implementer.	Yes— The baseline system was a series of open anaerobic lagoons with no methane recovery and destruction by flaring, combustion or gainful use.
8	Connection to an electricity distribution system that is supplied by at least one fossil fuel generating unit.	As per para 1. AMS-I.F. v2	Documented evidence on site visit and provided by CPA implementer: grid electricity consumption receipts of the site.	Yes- the farm is connected to the Mindanao electricity grid that is supplied by more than one fossil fuel generating plant.
	Project Activity			
9	The project objective is the replacement of existing open lagoons and anaerobic ponds in livestock farms for anaerobic digesters with combustion equipment to destroy methane by utilizing either open or standardized enclosed stainless steel flares, sized to handle the generated biogas design volume to ensure high combustion efficiency, and/or use of the recovered methane for electricity generation with gas engines	As per para 1. AMS-III.D	Documented as per project design	Yes- The project will replace the open anaerobic lagoon with an anaerobic system that will collect methane and destroy it through combustion in the microturbine generator set (note that a microturbine is a type of a combustion engine) and stainless steel flare sized to handle the excess gas generated that is not used by the electricity generator.
10	The sludge is handled aerobically, and final application is made in proper conditions (i.e., not resulting in methane emissions).	As per AMS-III.D, para 2.	Documented as per project design	Yes- Sludge will be handled under aerobic conditions. It will be collected from the digester, dried, processed and applied in the soil as organic fertilizer in a manner that avoids anaerobic conditions.
11	Technical measures are used (e.g. flared, combusted) to ensure that all biogas produced by the digester is utilized and combusted.	As per AMS-III.D, para 2.	Documented as per project design	Yes- Methane recovered will be combusted in a microturbine generator set and gas engine generator sets or flared.

No.	Eligibility criterion - Category	Eligibility criterion - Required condition	Supporting evidence for inclusion	Description of this CPA in relation to the criterion and supporting evidence
12	The storage time of the manure after removal from the animal barns, including transportation, should not exceed 45 days before being fed into the anaerobic digester.	As per AMS-III.D, para 2	Documented as per project design	Yes- It does not exceed 45 days.
13	New facilities (Greenfield projects) and project activities involving capacity additions compared to the baseline scenario are only eligible if they comply with the related and relevant requirements in the General Guidelines to SSC CDM methodologies.	As per AMS-III.D, para 5.	Not applicable	The project does not involve a new facility, but an existing facility, therefore this does not apply
14	The requirements concerning demonstration of the remaining lifetime of the replaced equipment shall be met as described in the General Guidelines to SSC CDM methodologies.	As per AMS-III.D, para 6.	Not applicable	For this CPA no equipment is being replaced, therefore this does not apply.
	SSC CDM methodologies			
15	All type III components result in emission reductions less than or equal to 60,000 tCO2-e/yr.	As per AMS-III.D, para 7;	Documented as per project design and ER spreadsheet calculation.	The maximum ERs in a given year are estimated to be 59,388 tCO2e/yr which is less than 60,000 tCO2e/yr
16	Renewable electricity generation from the recovered methane emissions with a maximum output capacity of 15MW.	As per AMS-I.F v2 para 2	Documented as per project design	The maximum output capacity is up to 2,858 kW (or 2.858 MW).
17	The maximum capacity of the renewable energy component (in cases where it is a combination of renewable and non-renewable) is 15 MW	As per AMS-I.F v2 para 9	Not Applicable	Not Applicable. The project is not a combination of renewable and non-renewable

No.	Eligibility criterion - Category	Eligibility criterion - Required condition	Supporting evidence for inclusion	Description of this CPA in relation to the criterion and supporting evidence
18	Installation of additional generation units utilizing the recovered methane emissions at an existing renewable energy facility provided that the added capacity of the project should be lower than or equal to 15 MW and is physically distinct [3] from the existing units.	As per AMS-I.F v2 para 7	Not Applicable	Not Applicable. There is no existing renewable energy facility.
19	Retrofitting or modification of an existing electricity generation facility to utilize the recovered methane emissions as fuel with the total output of the modified or retrofitted generating unit not exceeding 15 MW and with the facility having a minimum of 3 years operational data prior to implementation	As per AMS I.F. v2 para 8	Not Applicable	Not Applicable. There is no existing electricity generation facility.
	Additionality			

[3] Physically distinct units are those that are capable of generating electricity without the operation of existing units and that do not directly affect the mechanical, thermal or electrical characteristics of the existing facility

No.	Eligibility criterion - Category	Eligibility criterion - Required condition	Supporting evidence for inclusion	Description of this CPA in relation to the criterion and supporting evidence
20	The farm is operating an open anaerobic wastewater system in the baseline and the project technology involves higher costs of installation and operation to the farm owner coupled with higher technical requirements for construction, operation and maintenance than continued operation of the open system. Hence this shall be demonstrated through: 1- Project technology involves the installation of a biogas collection and flare/use system 2- Project needs to be financed with future carbon revenues, used as securities to repay the loan.	As per Attachment A of Appendix B of the simplified modalities and procedures for CDM small scale activities and Sections E.5.1 and E.5.2 of PoA-DD.	Documented evidence on site visit and provided by CPA implementer: 1.Project design with biogas collection system and 2. Confirmation letter from the financial institution providing the loan, where future carbon revenues have been presented for the loan evaluation and are partial security to repay the loan	1. Evidence has been documented by LBP staff during the site inspection and are provided by CPA implementer to demonstrate that the project design comprises a biogas collection system (and therefore higher technical requirements than settling ponds or lagoons) and 2. A confirmation from LBP Koronadal Lending Center who is the financial institution providing the loan, where future carbon revenues have been presented for the loan evaluation and are partial security to repay the loan.
21	The farm is compliant with the applicable Philippine environmental rules and regulations	Permits	Copy of the environmental compliance certificate to be provided by the project implementer	Yes - Copy of the environmental compliance certificate (ECC) has been provided
	Requirement to be part of the programme			
22	After all the above conditions have been met and documented, the project proponent must have signed an MOA with LBP to be in a CPA in this program.	MOA	Signed MOA between LBP and each CPA implementer	Yes- MOA between LBP and Biotech Farms, Inc. has been signed on 09/09/2009.

No.	Eligibility criterion - Category	Eligibility criterion - Required condition	Supporting evidence for inclusion	Description of this CPA in relation to the criterion and supporting evidence
23	Emission reductions claimed under the CPA are those derived only from gas use for electricity generation and/or flared. No credits shall be claimed for any other uses of the gas.	Emission reductions claimed under the CPA are those derived only from gas use for electricity generation and/or flared	Project design	Documented as per project design
	Environmental and Social Issues			
24	The project must have undertaken a stakeholder consultation.	Conduct of Environmental impact assessment and Stakeholder's consultation as per CDM project standard	Stakeholder consultation done at the CPA level	Yes—This was completed, see details in Section E.

Appendix 1. Contact information of CPA implementers

Organization name	Biotech Farms, Inc.
Country	Philippines
Address	**Street/P.O. Box** Aquino Street **Building** 2nd Floor, KCC Mall of Marbel **City** Koronadal City **State/Region** **Postcode** 9506
Telephone	+63 (83) 239-2615
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E-mail	reychiang@kccmalls.com
Website	
Contact person	Mr. Wilfredo Ilogan Chiang-Yococao

Appendix 2. Affirmation regarding public funding

There is no public funding involved in the project at Biotech Farms.

Appendix 3. Further background information on ex ante calculation of emission reductions

Calculation of Emission Factor from the Grid

The Tool to Calculate the Emission Factor for an Electricity System (Version 02) is applied to calculate the combined margin emission factor. This section describes how the national emission factor has been determined as a combined margin (CM) based on the instructions for calculating the emission factors of the operating margin (OM) and build margin (BM).

According to the tool the grid emission factor is calculated as per the following seven steps:
STEP 1: Identify the relevant electricity systems.
STEP 2: Choose whether to include off-grid power plants in the project electricity system (optional).
STEP 3: Select a method to determine the operating margin (OM).
STEP 4: Calculate the operating margin emission factor according to the selected method.
STEP 5: Identify the group of power units to be included in the build margin (BM).
STEP 6: Calculate the build margin emission factor.
STEP 7: Calculate the combined margin (CM) emissions factor.

STEP 1 - Identify the relevant electric power system

The relevant electric power system for the project is the Mindanao grid. The table below shows the net generation in MWh for the Mindanao grid.

Net Power Generation (MWh)

MINDANAO	2006	2007	2008	2009	2010	2011
Coal	431,237	1,409,947	1,330,344	1,392,560	1,550,014	1,458,429
Oil-based	1,529,058	1,340,815	1,138,715	1,496,635	1,901,881	1,261,799
Diesel	1,528,816	1,340,722	1,138,437	1,496,059	1,896,755	1,261,543
Oil Thermal	242	93	278	576	5,126	256
Geothermal	802,872	824,717	754,306	780,622	789,782	791,759
Hydro	4,411,766	3,964,210	4,393,438	4,187,063	3,744,438	4,799,089
Solar	1,376	1,309	1,304	1,252	1,254	1,190
Total Net Generation	7,176,309	7,540,998	7,618,107	7,858,132	7,987,369	8,312,266
% low-cost/must run resources	72.68	63.52	67.59	63.23	56.78	67.27

Source: Power Planning and Development Division Electric Power Industry Management Bureau,Department of Energy

STEP 2 - Choose whether to include off-grid power plants in the project electricity system
The calculation of the operating margin and build margin emission factor will use the option I of the tool: *Only grid power plants are included in the calculation*.

STEP 3 - Select a method to determine the operating margin (OM)
According to the Tool, calculating the Operating Margin Emission Factor $EF_{grid, OM,,y}$ can be based on one of the four available methods:
(a) Simple OM,
(b) Simple adjusted OM,
(c) Dispatch Data Analysis OM, or
(d) Average OM.

Any of the four methods above for calculating the operating margin emission factor can be used according to the tool. However, the Simple OM method (a) can only be used if low-cost/must-run resources constitute less than 50% of the total grid connection in: 1) average of the five most recent years, or 2) based on long-term average hydro-electric production.

Low-cost/must-run resources, consisting mostly of geothermal and hydro, have been responsible for more than 50% of generation in the Mindanao grid during the past 5 years **(refer to the table above)**.
Based on the fact that the applicability condition of low cost/must run resources constituting less than 50% of the total grid connection in average of the five most recent years is satisfied, method (a) Simple OM cannot be used. Hence, method (d) **Average OM** has been selected as the method for calculating the operating margin.

According to the "*Tool to calculate the emission factor for an electricity system*", the Simple OM emission factor can be calculated using either of the two following data vintages:
 Ex ante option: A 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation, without requirement to monitor and recalculate the emissions factor during the crediting period, or
 Ex post option: The year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring. If the data required to calculate the emission factor for year *y* is usually only available later than six months after the end of year *y* then the emission factor of the previous year (*y-1*) may be used. If the data is usually only available 18 months after the end of year y, the emission factor of the year proceeding, the previous year (*y-2*) may be used. The same data vintage (*y, y-1, or y-2*) should be used throughout all crediting periods.

"**Ex ante option: A 3-year generation - weighted average**" has been selected for the purpose of emission reductions calculation for the proposed project.

STEP 4 - Calculate the operating margin emission factor according to the selected method
The Average OM emission factor has been calculated based on a 3-year vintage (2009-2011). The OM is calculated as the generation-weighted emissions per electricity unit of all generating units serving the system, including low-cost and must-run power plants
The OM is calculated as follows (Option A1), using a 3-year average.

Under this option, the Average OM emission factor is calculated based on average efficiency and electricity generation of each plant, including low-cost/must run resources and the fuel type(s) and total fuel consumption of the project electricity system, as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_m EG_{m,y} \bullet EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

Where:

$EF_{grid,OM,simple,y}$ Simple operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EG_{m,y}$ Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
$EF_{EL,m,y}$ CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
m All power units serving the grid in year *y* including low-cost / must-run power units
y The relevant year of the chosen vintage data in Step 3 (i.e. 2009,2010,2011)

To determine $EF_{EL,m,y}$, Option A2 is applied given that the data on fuel consumption is NOT available. The emission factor then is determined based on the CO_2 emission factor of the fuel type used and the efficiency of the power unit, as follows:

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \bullet 3.6}{\eta_{m,y}}$$

Where:

$EF_{EL,m,y}$ CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
$EF_{CO2,m,i,y}$ Average CO_2 emission factor of fuel type i used in power unit m in year *y* (tCO_2/GJ)
$\eta_{m,y}$ Average net energy conversion efficiency of power unit m in year y (ratio)
m All power units serving the grid in year *y* except low-cost/must-run power units
y The relevant year of the chosen vintage data in Step 3 (i.e. 2006,2007,2008)

The calculation of Operating Margin is illustrated in the following table.

Net Power Generation for MINDANAO grid (MWh)

	2009	2010	2011	Default CEF (tCO_2/GJ)	$\eta_{m,y}$	EF_{EL} (tCO_2/MWh)
Coal	1,392,560	1,550,014	1,458,429	0.0873	39%	0.805846154
Oil-based	1,496,635	1,901,881	1,261,799			
Diesel	1,496,059	1,896,755	1,261,543	0.0726	39.5%	0.661670886
Oil Thermal	576	5,126	256	0.0755	39.5%	0.688101266
Geothermal	780,622	789,782	791,759	-		-
Hydro	4,187,063	3,744,438	4,799,089	-		-
Solar	1,252	1,254	1,190	-		-
Total Net Generation	7,858,132	7,987,369	8,312,266			

When calculating the Operation Margin, the Gross generation data for year 2009, 2010, and 2011 have been employed to ensure the conservativeness of the results.

Therefore, the Average operating margin emission factor for the Mindanao grid is 0.2779 tCO_2/MWh

« Operating Margin » (OM)	EF in tCO_2/MWh
2009	0.2688
2010	0.3139
2011	0.2418
OM	**0.2779**

STEP 5 - Identify the group of power units to be included in the build margin (BM).
According to the tool, the sample group of power units m used to calculate the build margin consists of either:
(a) Calculate the build margin emission factor based the set of five power units that have been built most recently; or
(b) Consider the set of power capacity additions in the electricity system that comprises 20% of the system generation (in MWh) and that have been built most recently.
From the above two options, the set of power units that comprises the larger annual generation is to be used. For the Mindanao grid, the most recent capacity additions constituting 20 % of the system represent a larger annual generation than the 5 most recently added power units, and is therefore chosen as the sample group for the build margin. The most recently built plants have generated 1,663,198 MWh electricity representing 20.01 % of the overall electricity generated by all power plants in the Mindanao grid in year 2011.
For the Mindanao grid, the most recent capacity additions representing 20% of the system comprise larger annual generation than the 5 most recent plants, and are therefore the chosen as the build margin sample group:

Build Margin Plants[4]

Plant Name	Installed Cap (MW)	Plant Type
Sibulan Hydro	42	Hydro
Mindanao Coal	210	Coal
Bubunawan	7	Hydro
Mt Apo II	54	Geothermal
Tolomo	3.7	Hydro
Gen. Santos (SPPC)	56	Oil Based
Western Mindanao Power Corp.	113	Oil Based
Mt Apo I	54	Geothermal

Note: **Sibulan Hydro has been registered as a CDM project on June 6, 2008 and therefore excluded from the BM calculation.

The build margin emission factor is determined by applying *ex-ante* option based on the most recent information available.

STEP 6- Calculate the build margin emission factor

The Build Margin emissions factor (BM) is calculated as the generation-weighted average emission factor of the most recently built plants, using the following formula:

$$EF_{grid,BM,y} = \frac{\sum_{i,m} EG_{m,y} . EF_{EL,m,y}}{\sum_{m} EG_{m,y}}$$

Where:
$EF_{grid,BM,y}$ Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EG_{m,y}$ Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EF_{EL,m,y}$ CO_2 emission factor of power unit m in year y (tCO_2/MWh)
m Power units included in the build margin
y Most recent historical year for which power generation data is available

The calculation method for BM is as same as the one for OM (refer to the table below)

[4] Data are available via email by Philippines DOE

Plant Name	Power generation in 2011 (GWh)	Plant Type	Default CEF (tCO_2/GJ)	$\eta_{m,y}$	EF_{EL} (tCO_2/MWh)	tCO_2
Mindanao Coal	1,458.43	Coal	0.0873	0.39	0.80585	1,175,269.40
Total	1,458.43					1,175,269.40
					BM	**0.8058**

The build margin emission factor is therefore 0.8058 tCO2/MWh.

STEP 7- Calculate the combined margin (CM) emissions factor
The final step in applying the tool is to calculate the combined margin emissions factor. This has been calculated as the weighted average of the emissions factor of the OM and the BM. The formula that has been used to calculate this weighted average emission factor is as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$$

Where
$EF_{grid,BM,y}$ Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid,OM,y}$ Operating margin CO_2 emission factor in year y (tCO_2/MWh)
w_{OM} Weighting of operating margin emissions factor (%)
w_{BM} Weighting of build margin emissions factor (%)

Therefore, $EF_{grid,CM,y}$ = 0.5 * 0.2779 + 0.5 * 0.8058 = **0.5418 tCO_2/MWh**

As recommended by the tool for projects other than wind and solar projects, the default values of weighted factors w_{OM} = 0.5 & w_{BM} = 0.5 are used.

The latest default values recommended in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories for the fuels emissions factors and Default efficiency factors for power plants in Annex 1 of the "Tool to calculate the emission factor for an electricity system-version 2" are used to derive the OM and the BM emission factors of the grid.

Grid emission factors computation

Designation	EF in tCO2/MWh
« Operating Margin » (OM)	
2009	0.2688
2010	0.3139
2011	0.2418
Average OM	**0.2779**
« Build Margin » (BM)	0.8058
Combined Margin (weighted average OM and BM)	**0.5418**

Appendix 4. Further background information on monitoring plan

Please refer to section B.5.3.

Appendix 5. Summary report of comments received from local stakeholders

Please refer to section E.2.

Appendix 6. Summary of post-registration changes

PRC requested for this CPA:

Corrections
- Editorial corrections including typo mistakes, incorrect sentences and inconsistencies
- Corrected value and dates of fixed parameter EG_y in section B.4.2

Permanent Changes to the project design :
-Decrease in capacity of the anaerobic digestion system from 60,000 m3[5] to 8 x 4,805 m3 (total=38,440 m3) by using enclosed anaerobic biodigester tanks and components as described in section A.3. There is a plan in the future to add 4 x 4,805 =19,220 m3 units of digester tanks for a total volume of 57,660 m3.
-Phased addition of available capacity of the engines without exceeding the threshold for the corresponding small-scale project type I (15 MW) from 1000 kW to 8,834 kW (seven units of gas engines/microturbines) completed by 15/07/2019. Generator sets will be operated alternately at a maximum operating capacity of 2,858 kW. The rest of the gensets will be on stand-by/back-up. In the approved CPA-DD version 6, it was mentioned that "The biogas recovery system might be modified during the crediting period".
- Change in flare with flare capacity (enclosed) of 1500 m^3/hr
-The farm has extended the design to combine manure from the poultry farm (which can be considered negligible, i.e. << 5% contribution to baseline and GHG emissions, and thus not considered in the ER calculation) with the manure influent from the piggery farm to the anaerobic digestion system. Ex-post calculations will consider a 1% discount on $BG_{burnt,y}$ (Biogas flared or combusted in year y) for the poultry manure added.

Post registration changes approved on 14/08/2017 (5979-P1-0002-CP1: CPA-DD version 6):

Corrections
-Editorial corrections including typo mistakes, incorrect sentences and inconsistencies.

Permanent changes from the registered monitoring plan or applied methodology:

-An alternative has been included for the monitoring of MD_y, where continuous monitoring of flow (and related temperature and pressure) is not necessary. When the CPA utilizes the recovered methane for power generation, MD_y may be calculated based on the amount of monitored electricity generation, without monitoring methane flow and concentration grid electricity consumption, following the provision on paragraph 29 of the methodology AMS-III.D version 20.1.

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[5] Verification report-PoA 5979 for first Monitoring period dated 06/04/2016 by Bureau Veritas Certification Holdings SAS (BVCH)

Post registration changes approved on 29/06/2015 (5979-P1-0002-CP1: CPA-DD version 5):

Corrections

- Calculation formula for of ex-ante project emissions from flaring has been clarified to use the default flare efficiency of 0.9.

- Nomenclature of parameters between sections has been corrected for consistency

- It has been clarified that if the recovered biogas is combusted for electrical energy production or for other gainful use, the methane destruction efficiency can be considered as 100%, as long as the energy generated by the project is being monitored.

- Parameter GWP_{CH4} has been clarified to include the value to be used in the second commitment period of the Kyoto Protocol.

Permanent changes from the registered monitoring plan or applied methodology:

- Measurement methods have been added to parameter $BG_{burnt,y}$

- Parameters T and P, temperature and pressure of the biogas, have been added

- The flare Efficiency parameter name has been corrected for consistency within the document and text has been added to comply with the “Tool to determine project emissions from flaring gases containing methane”.

- References to specific equipment have been deleted in parameter T_{flare}.

- Text has been clarified for parameter “other flare operation parameters”.

- Parameter EG_y has been clarified following that in version 19 of AMS III.D

- An alternative has been included for the monitoring of grid electricity consumption, following the provision on paragraph 26 of the methodology (AMS III.D version 17), to monitor the farms electricity consumption when there is no separate electricity meter.
- Possible use of sampling methods and procedures for parameter W_{site} has been added.

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Document information

Version	Date	Description
09.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the “CDM project standard for programmes of activities” (CDM-EB93-A07-STAN); • Make editorial improvements.
08.1	20 October 2017	Editorial revision to remove appendix “Applicability of methodologies and standardized baselines” from the main part of the form which had been mistakenly kept in the previous version.
08.0	28 June 2017	Revision to: • Remove appendix “Applicability of methodologies and standardized baselines” as the appendix is not relevant at the CPA level; • Make editorial improvement.
07.0	7 June 2017	Revision to: • Improve consistency with the “CDM project standard for programmes of activities” and with the PDD and PoA-DD forms; • Make editorial improvement.
06.0	24 May 2017	Revision to: • Ensure consistency with the “Standard: CDM project standard for programme of activities” (CDM-EB93-A07-STAN) (version 01.0); • Incorporate the “Component project activity design document form for small-scale component project activities” (CDM-SSC-CPA-DD-FORM); • Make editorial improvement.
05.0	15 April 2016	Revision to ensure consistency with the “Standard: Applicability of sectoral scopes” (CDM-EB88-A04-STAN) (version 01.0).
04.0	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.
03.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the component project activity design document form for CDM component project activities (these instructions supersede the "Guidelines for completing the component project activity design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a CPA implementer and/or responsible person/ entity for completing the CDM-CPA-DD-

Version	Date	Description
		FORM in A.13. and Appendix 1; • Add general instructions on post-registration changes in paragraph 4 and 5 of general instructions and Appendix 6; • Change the reference number from F-CDM-CPA-DD to CDM-CPA-DD-FORM; • Make editorial improvement.
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the component project activity design document form" (EB 66, Annex 16).
01.0	27 July 2007	EB 33, Annex 42 Initial adoption.

Decision Class: Regulatory
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Business Function: Registration
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