PROGRAMME DESIGN DOCUMENT FORM FOR SMALL-SCALE CDM PROGRAMMES OF ACTIVITIES (F-CDM-SSC-PoA-DD) Version 02.0

PROGRAMME OF ACTIVITIES DESIGN DOCUMENT (PoA-DD)

PART I. Programme of activities (PoA)

SECTION A. General description of PoA

A.1. Title of the PoA

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Anaerobic Digestion and Renewable Energy Generation in South Africa.

Version: 4
Date: 10/06/2013

A.2. Purpose and general description of the PoA

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Policy/measure or stated goal of the PoA

The programme will involve methane emission avoidance through controlled anaerobic digestion and biogas-based renewable energy generation. Greenhouse gas emission reductions can occur from the following technology/measures:

- Project activities involving the replacement or modification of anaerobic animal manure management systems in livestock farms to achieve methane recovery and destruction by flaring/combustion or gainful use of the recovered methane. It also covers treatment of manure collected from several farms in a centralized plant.
- Biogas-based, renewable thermal energy production with or without electricity.

The further goal of this PoA is to ensure that all potential methane recovery/renewable energy projects will be able to take part in the CDM process which will help to make these projects viable.

The total annual GHG emission reductions of all component project activities (CPAs) expected to be included in the PoA are estimated at 200 000 tonnes of CO2e.

The programme fulfils the national sustainability development criteria[1] laid down by the Department of Energy of South Africa and contributes to sustainable development as follows:

Economic benefits:

- The programme provides the potential for new sources of revenue from renewable energy, raising the economic benefits from the agricultural industry.
- Taxable income from the project over the project lifespan.
- Employment of several tens of local people during the design and construction phase.
- Full-time employment of several management, operating and maintenance staff after commissioning. Staff from formerly disadvantaged communities will be targeted.
- Full time employment of support staff.

[1] Sustainable development criteria for approval of clean development mechanism projects by the designated national authority of the CDM, available under: http://www.energy.gov.za/files/esources/kyoto/kyoto_frame.html

Social benefits:

- Over and above the employment opportunities mentioned above, management, operational and maintenance staff will receive internal and external training on the project that will increase their skill base and allow effective management, operation and maintenance of the project.

Environment benefits:

- Effectively reducing methane emissions from animal waste management systems. The project activity consists of an advanced improvement to common practice of waste treatment, reducing methane emissions from wastes through anaerobic digesters with methane recovery and utilization.
- Renewable energy from renewable biomass further reduces GHG emissions to the atmosphere.
- Protecting the environment and human health. Improved waste management is critical to protect human health and the environment. The advanced waste management system to be employed will reduce the odour nuisance and pollution potential, leading to better environmental conditions and local quality of life.
- The land application of the stabilized sludge generated by the project activity provides an organic fertilizer for nearby crops.
- Establishing a positive model of waste management practice. The project activity will apply new, advanced and environmentally friendly technologies in treating waste, dramatically reducing related GHG emissions and pollution potential. The project further provide the potential for new sources of revenue from renewable energy, raising the economic benefits from the agricultural industry, and promoting utilization of agricultural waste, and hence building a circular economy.

Technological benefits:

- Improve technological transfer. The PoA aims to:
  - Share technology, knowledge and expertise with local communities.
  - Promote research on anaerobic digestion as well as the collection and pre-treatment of the feedstock and the processing of the digestate.
  - Provide technological support, thus ensuring safe conditions to adopt and operate anaerobic digesters, biomass collection systems and other related process equipment.

Income-generating capacity benefits

- One of the more important benefits of the PoA is that project implementers would obtains funds (where necessary) from the banks for development of projects, thus enabling small and medium rural producers to participate in the program.

Framework for the implementation of the proposed PoA

The programme of activities (PoA), Anaerobic Digestion and Renewable Energy Generation in South Africa, will be coordinated and managed by Farmsecure Carbon (Pty) Ltd.

The Farmsecure Group is an innovative service provider to the agricultural sector whose primary focus is to empower farmers with precision farming skills, agricultural knowledge, cost effective supply chain management and hands on support to assist them in achieving their maximum potential whilst creating above average Stakeholder wealth. The Farmsecure Group vision is to be a meaningful contributor to securing the world's food supply through the creation of sustainable and profitable farming enterprises whose produce is managed from the farm to the store shelf.

This focus inspired the Farmsecure Group to establish a subsidiary company, Farmsecure Carbon (Pty) Ltd (henceforth referred to as Farmsecure Carbon), with the mission to promote renewable energy projects and mitigate GHG emissions. This enables the Farmsecure Group to fulfil its wider purpose of promoting sustainable agriculture and to contribute to local development in the communities in which it operates.

Farmsecure Carbon is serving as CME of the PoA. Farmsecure Carbon will have overall responsibility for the PoA and the subsequent inclusion and monitoring of SSC-CPAs.

There are no mandatory policies or regulations in South Africa mandating the adoption of renewable energy and methane recovery measures. All of the key players consisting of the CME and the CPA implementer, are voluntarily participants in the PoA. The CME signed a confirmation that the PoA is a voluntary action by the CME, see confirmation letter (Ref.PoA.A.2.Confirmation).

A.3. CMEs and participants of PoA

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The Coordinating/managing entity for this PoA will be Farmsecure Carbon (Pty) Ltd. The CME will the entity which communicates with the Board. Farmsecure Carbon (Pty) Ltd will also be the project participant to the PoA.

A.4. Party(ies)

Name of Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
South Africa	Farmsecure Carbon (Pty) Ltd	No

A.5. Physical/ Geographical boundary of the PoA

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The boundary of the PoA is the Republic of South Africa.

A.6. Technologies/measures

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CPAs under the PoA involve methane emission avoidance through controlled anaerobic digestion and/or biogas-based renewable energy generation. A description of the anaerobic digestion technology and biogas-based renewable energy generation technology can be seen below. The following tables show the eligible measures/technologies and methodologies and specific Project scenarios under this PoA.

Description of applicable technologies/measures and methodologies chosen for this PoA

Project scenario	Technologies/measures	Methodology
A	• Project activities that digest animal manure where the manure would otherwise have been treated in an anaerobic treatment system without biogas recovery. • Recovered biogas will be utilized for thermal energy production with or without electricity, see different project energy scenarios in table below.	AMS-III.D AMS-I.C
B	• Project activities that digest animal manure where the manure would otherwise have been treated in an anaerobic treatment system without biogas recovery. • Technical measures shall be used to ensure that all biogas captured from the digester is flared.	AMS-III.D
C	• Project activities that recover and utilize biogas for power/heat production without claiming methane emission avoidance from manure. • Recovered biogas will be utilized for thermal energy production with or without electricity, see different project energy scenarios in table below.	AMS-I.C

Different options for utilizing biogas for renewable energy (energy scenarios)

Energy scenario	Project description	Methodology
1	Project activities that install biogas thermal energy plants that produce renewable thermal energy for on-site consumption or for consumption by other facilities and displace fossil fuel use.	AMS-I.C
2	Project activities that install biogas cogeneration plants that produce renewable electricity for supply to the grid and/or for captive use and renewable thermal energy for on-site consumption or for consumption by other facilities and displace fossil fuel use.	
3	Project activities that involve the addition of renewable energy units (thermal or cogeneration units) at an existing renewable energy production facility.	

Biomass under this PoA can be divided under the following two categories:

1. *Manure from different livestock types (LT):* Manure from AWMS that would otherwise have been left to decay anaerobically.
2. *Other biomass types (BT):* Other renewable biomass that does not involve methane emission avoidance. This biomass should comply with renewable biomass applicability conditions. Biomass will be assessed according the renewable biomass conditions in EB23 Annex 18 set out in section B.2, part II of the PoA-DD.

Description of the applicable biomass under each Project scenario

Project scenario	Biomass
A	1. Manure from different livestock types (LT) 2. Other biomass types (BT)
B	1. Manure from different livestock types (LT)
C	2. Other biomass types (BT)

The CPA implementer shall demonstrate that the performance of the equipment used in the proposed CPA comply with the following:

Technology eligibility criteria for PoA

a)	The national standard for the performance of the equipment type (CPA implementers shall identify the standard used)
b)	An international standard for the performance of the equipment type, such as International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) standards (CPA implementer shall identify the standard used) if the value specified in subparagraph (a) is not available;
c)	The manufacturer's specifications, provided that they are tested and certified by national or international certifiers, if the value specified in subparagraph (b) is not available;
d)	Performance data from test results conducted by an independent entity for equipment installed under the project activity if the value specified in subparagraph (c) is not available.

CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.

Technology description:

The eligible technology for this PoA is anaerobic digestion and biogas-based renewable energy generation, the process descriptions are outlined below.

Anaerobic digestion process:
Anaerobic digestion is a biological process in which microorganisms break down biodegradable material through a series of processes in the absence of oxygen.

Anaerobic Digestion consists of four key Biological and Chemical stages:

- Hydrolysis
- Acidogenesis
- Acetogenesis
- Methanogenesis

Biomass is mainly comprised of long organic polymer chains. In order for the bacteria in anaerobic digesters to access the energy potential of the material, these chains must first be broken down into their smaller constituent parts or monomers. The process of breaking the chains and dissolving the smaller molecules into solution is called hydrolysis. Therefore hydrolysis of these high molecular weight polymeric components is the necessary first step in anaerobic digestion. Through hydrolysis the complex organic molecules are broken down into simple sugars, amino acids, and fatty acids.

Acetate and hydrogen produced in the first stages can be used directly by methanogens. Other molecules such as volatile fatty acids (VFA's) with a chain length that is greater than acetate must first be catabolised into compounds that can be directly utilised by methanogens. The biological process of acidogenesis is where there is further breakdown of the remaining components by Acidogenic bacteria.

The third stage anaerobic digestion is Acetogenesis. Simple molecules created through the acidogenesis phase are further digested by acetogens to produce mainly acetic acid as well as carbon dioxide and hydrogen.

The final stage of anaerobic digestion is the biological process of Methanogenesis. Methanogens utilise the intermediate products of the preceding stages and convert them into methane, carbon dioxide and water. The biogas that is emitted is largely made up of these components. Methanogenesis is sensitive to both high and low pH and occurs between pH 6.5 and pH 8. The remaining, non-digestible material which the microbes cannot feed upon, along with any dead bacterial remains constitutes the digestate.

Anaerobic digestion technology options:
Several technology options may be adopted under the PoA. The most suitable technology will be selected for each SSC-CPA. The most common technologies are:

- *Covered Lagoon systems:*
  The covered lagoon consists of a lagoon that is covered by a flexible plastic membrane to contain the biogas produced by the digester while preventing outside air from leaking into it.
- *Mixed Reactor systems:*
  The mixed reactor blends manure to reach a homogenous concentration. Commonly used designs are a Completely Mixed Digester (Constantly Stirred Tank Reactor; CSTR) ; Anaerobic Sequencing Batch Reactor (ASBR) ; Up-flow Anaerobic Sludge Blanket Digester (UASB) ; Anaerobic Filter (Fixed Film Digester, Fix- Bed Anaerobic Reactor) ; Fluidized Bed Reactor (Expanded Bed Reactor, Moving Bed Bio-film Reactor).
- *Plug-Flow Reactor systems:*
  A plug-flow reactor is a long tank through which manure moves during processing. These reactors are typically made of concrete or plastic. Commonly used systems include tubular polyethylene and concrete digesters.
- *Dry fermentation reactor systems:*

The dry fermentation anaerobic digester can be operated in either the mesophilic or thermophilic mode and process biomass having 15 to 45% dry matter. In the horizontal format, it operates similar to the plug flow reactor except that it is equipped with rotating mixers operating at right angles to the flow of the biomass within the reactor and a bottom conveyor to remove sand, gravel and other residue to the discharge end. The vertical unit, termed the Upflow Anaerobic Solid State (UASS) Reactor feeds the biomass at the bottom of the reactor and relies on a fermented liquid and gravity to float the digested biomass upwards for removal at the top. Both systems offer the ability to anaerobically digest manure without dilution and very little use of external water.

Biogas recovery and combustion system:
Each SSC-CPA will include a system of collecting the biogas produced by the anaerobic reactor, treating it as required and combusting it, thus preventing its release to the atmosphere. The system used will depend upon the type of anaerobic digester used, quality of the biogas produced; and biogas engine or turbine that will be used to combust the gas and generate electricity. It will typically contain:

- A blower & piping system to collect & transfer the gas.
- Scrubbers to purify the gas prior to combustion as may be required.
- Cogeneration projects: biogas internal combustion engine(s) or micro gas turbine(s) to combust the biogas and generate electricity and thermal energy. In the case of biogas engine(s), thermal energy shall be utilized by decoupling the engine jacket water cooling circuit and circulating the engine block cooling water to heat the digester. Hot exhaust gas at ~400C can also be used for additional heating. The thermal energy will be carried over to heat water and this water will also be circulated along with the block cooling water to heat the digester. In the case of gas turbine(s), thermal energy can be utilized from the hot exhaust gases as a single point source of energy.
- Thermal energy projects: Where the objective is not power generation, the heat of combustion from methane in the biogas, can be utilized for thermal/heating applications. A typical application is the use of biogas as fossil fuel replacement for heating applications.
- An enclosed or open biogas flare to provide for auxiliary/standby combustion when the biogas has to be flared.

Digestate (effluent) management system:
The anaerobic digestion treatment system will produce a stabilized digestate, the quantity dependent on the type of reactor used and the amount of biomass digested. In all SSC-CPAs the sludge will be applied to soil in a manner that ensures aerobic conditions and avoids methane emissions.

Other components:
Depending on the SSC-CPA, additional components may be added to enhance treatment including a recycling system, nutrient recovery system, centrifuge for digestate thickening and polishing ponds after the anaerobic digester if further treatment is required of the effluent prior to application on land.

A.7. Public funding of PoA
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There no public funding involved at PoA level.

SECTION B. Demonstration of additionality and development of eligibility criteria
B.1. Demonstration of additionality for PoA
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The table below indicates the additionality criteria relative to each Project scenario applicable under this PoA. The different additionality approaches are discussed after the table.

Additionality criteria relative to each Project scenario

Project	Technology/measure	Methodologies	Additionality criteria

Scenario	Methane avoidance	Renewable technology	AMS-III.D	AMS-I.C	
A	✓	✓	✓	✓	Additionality may be based on approach 1 or approach 2. Where approach 1 is used, method a and b should be applied. Where approach 2 is used, barrier a or b should be applied.
B	✓		✓		Additionality may be based on approach 1 or approach 2. Where approach 1 is used, method b should be applied. Where approach 2 is used, barrier b should be applied.
C		✓		✓	Additionality may be based on approach 1 or approach 2. Where approach 1 is used, method a should be applied. Where approach 2 is used, barrier a or b should be applied.

For each CPA additonality shall be demonstrated in section B.5, part II of the CPA-DD, based on one of the following applicable approaches:

Approach 1: Demonstration of additionality for microscale project activities

Under this approach, additonality shall be demonstrated by using on one of the following two methods:

Method a:
Project activities up to five megawatts that employ renewable energy technology are additional if any one of the conditions in paragraph 2 in the "Guidelines for demonstrating additionality of microscale project activities" (Version 04.0) is satisfied.

Method b:
Type III project activities that aim to achieve emission reductions at a scale of no more than 20 ktCO2e per year, are additional if any one of the conditions in paragraph 4 in the "Guidelines for demonstrating additionality of microscale project activities" (Version 04.0) is satisfied.

Approach 2: Demonstration of additionality for project activities less than 15MW

According to the "Guidelines on the demonstration of additionality of small-scale project activities" (Version 09.0) the project participants shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers:
a) Investment barrier
b) Technological barrier
c) Barrier due to prevailing practice
d) Other barriers

Under this PoA, the CPA implementer shall provide an explanation to show that the project activity would not have occurred anyway due to one of the following barriers:
a) Investment barrier
b) Barrier due to prevailing practice

The Project scenarios applicable to apply the Investment barrier and the Barrier due to prevailing practice are described in the eligibility criteria of each barrier.

The following guidelines will be followed to prove the additionality:
- "Guidelines for objective demonstration and assessment of barriers" (Version 01.0)
- "Guidelines on the assessment of investment analysis" (Version 05.0)

- "Guidelines on additionality of first-of-its-kind project activities" (Version 02.0)
- "Non-binding best practice examples to demonstrate additionality for SSC project activities" (Version 01.0)
- "Guidelines on the demonstration of additionality of small-scale project activities" (Version 09.0)

a) INVESTMENT BARRIER

Eligibility criteria for the investment barrier

1.	Demonstrate that a financially more viable alternative to the project activity would have led to higher emissions.
2.	The Investment barrier is applicable for Project scenario A and C and for all three renewable energy scenarios under these Project scenarios. See justification below
3.	The benchmark analysis is the applicable financial analysis approach for all CPAs that choose to apply the Investment barrier. See justification below.
4.	All the applicable conditions in the "Guidelines on the assessment of investment analysis'" (Version 05.0) should be satisfied.

Justification for applying the Benchmark analysis

As indicated in the additionality criteria table above, CPAs that apply methodology AMS-I.C (Project scenario A and C) may choose to apply the Investment analysis for the demonstration of additionality. This section describes how the Benchmark analysis was determined as the applicable financial analysis approach for Project scenario A and C.

According to the "Tool for the demonstration and assessment of additionality" project activities that generate financial benefits other than CDM related income need to use the investment comparison analysis or the benchmark analysis. CPAs that apply methodology AMS-I.C (Project scenario A and C) generate financial income from the utilization of thermal energy production with or without electricity and therefore need apply the comparison analysis or the benchmark analysis.

According to this tool, Project scenario B, that generate no financial or economic benefits other than CDM related income, needs to apply the simple cost analysis and will therefore not be eligible to apply the Benchmark analysis. Project scenario B will need to apply the Barrier due to prevailing practice.

The benchmark analysis can be considered an applicable financial analysis approach for CPAs that apply methodology AMS-I.C (Project scenario A and C) under this PoA due to the following reasons. According to the "Guidelines on the assessment of investment analysis" (Version 05.0), the benchmark approach is suited to circumstances where the baseline does not require investment or is outside the direct control of the project developer and where the choice of the developer is to invest or not to invest.

For project activities that install an anaerobic digester for the gainful use the recovered methane for thermal energy generation, the baseline scenario is the fossil fuel consumption of the technologies that would have been used in the absence of the project activity. This baseline scenario does not require the investment in an anaerobic digester and the project participant can continue with the baseline scenario that uses fossil fuel technologies to supply thermal energy. Therefore, the baseline scenario does leave the project participant a choice to invest or not to invest and the benchmark approach can be considered applicable.

For project activities that install an anaerobic digester for the gainful use the recovered methane for electricity generation, the electricity baseline scenario is the supply of electricity from the grid, which is outside the direct control of the project developer and therefore the benchmark approach can be considered applicable.

The following table summarise the reasons why the benchmark analysis approach can be considered applicable for all three of renewable energy scenarios under Project scenario A and C.

Energy scenario	Project description	Benchmark analysis approach applicability
1	Project activities that install biogas thermal energy plants that produce renewable thermal energy for on-site consumption or for consumption by other facilities and displace fossil fuel use.	The thermal energy baseline does not require investment in an anaerobic digester for the gainful use of the recovered methane.
2	Project activities that install biogas cogeneration plants that produce renewable electricity for supply to the grid and/or for captive use and renewable thermal energy for on-site consumption or for consumption by other facilities and displace fossil fuel use.	The electricity baseline is outside the direct control of the project developer and the thermal energy baseline does not require investment in an anaerobic digester for the gainful use of the recovered methane.
3	Project activities that involve the addition of renewable energy units (thermal or cogeneration units) at an existing renewable energy production facility.	The electricity baseline is outside the direct control of the project developer and the thermal energy baseline does not require investment in an anaerobic digester for the gainful use of the recovered methane.

Benchmark analysis

The following steps will be followed:
1. Identify alternatives to the project activity
2. Determine the appropriate benchmark for the project
3. Calculate the appropriate benchmark for the project
4. Identify and calculate the financial indicator, most suitable for the project type
5. Compare the financial indicators
6. Conduct sensitivity analysis
7. Outcome of the benchmark analysis.

1. Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a: Define alternatives to the proposed CPA

The following alternatives to the project activity have been identified:
Alternative 1: The project activity is undertaken without being registered as a CPA
Alternative 2: The project participants continue with the identified energy baseline scenario

Sub-Step 1b: Consistency with mandatory applicable laws and regulation

All the alternatives to the proposed project activity are consistent with current laws and regulations.

2. Determine the appropriate benchmark for the project

The chosen benchmark shall be appropriate to the type of IRR calculated. Local commercial lending rates or weighted average costs of capital (WACC) are appropriate benchmarks for a project IRR. Required/expected returns on equity are appropriate benchmarks for an equity IRR. Benchmarks supplied by relevant national authorities are also appropriate if the DOE can validate that they are applicable to the project activity and the type of IRR calculation presented.

CPA implementer indicates the appropriate benchmark (calculated in PoA-DD) with a X:

Weighted average costs of capital (WACC)	
Local commercial lending rates	
Required/expected return on equity	
Benchmarks supplied by relevant national authorities	

3. Benchmark calculation

The benchmark for this PoA is based on parameters that are standard in the market, internal company benchmarks are not applicable. The CPA may chose to apply one of the following benchmark approaches:

Approach 1: WACC

Renewable energy projects in South Africa are typically financed using a combination of debt and equity finance. Hence, comparison of the investment analysis (IRR) with the weighted average cost of capital (WACC) represents a valid approach for many CPAs under the PoA. The WACC is determined on a pre-tax basis as follows:

$$WACC = CD \times Debt\% + CE \times Equity\%$$
$$= X \times X + X \times X$$
$$= X$$

Where:
CD = Cost of Debt
%Debt = Debt ratio compared to total investment
CE = Cost of Equity
%Equity = Equity ratio as compared to total investment

The following table indicates the benchmark calculation parameters and the type of supporting documentation to be supplied to the DOE. New CPAs to be included under the PoA will use parameter values and documents specific to that year. The parameters for each CPA will be indicated in Section D.5 of the CPA-DD.

Parameters for the calculation of the benchmark

Parameter	Value	Supporting documentation
a) *CD*	X	Confirmation letter from a commercial bank.
b) *EC*	X	Calculated from the table in the Appendix to EB 62, Annex5.
c) *Debt: Equity*	X:X	Confirmation letter from a commercial bank.

Approach 2: Local commercial lending rates

The local commercial lending rate is equal to the Cost of Debt explained above.

Approach 3: Required/expected returns on equity

The required/expected returns on equity is equal to the Cost of Equity explained above.

Approach 4: Benchmarks supplied by relevant national authorities

In the event that the CPA implementer chose benchmarks supplied by relevant national authorities, it should be described at CPA level.

4. Identify and calculate the financial indicator, most suitable for the project type

CPA implementer indicates the most suitable financial indicator for the project:

Equity IRR	
Project IRR	

The time period considered should be clearly defined and it should be consistent with the technical life of the project.

The CPA implementer shall supply the CME with a benchmark analysis spreadsheet and supporting documentation for the different parameters. The main parameters are listed below.

Parameters for the calculation of financial indicators (IRR)

Parameter	Unit	Value
1. Investment decision date	Date	
2. Project lifetime	Years	
3. Total Capex	ZAR	
4. Opex	ZAR	
5. Cost of sales	ZAR	
6. Net electricity generation	kWh	
7. Net thermal energy generation	TJ/yr	
8. Electricity price	ZAR/kWh	
9. Thermal energy price	ZAR/TJ	
10. CER price	EUR/ton	
11. Exchange Rate	ZAR:EUR	
12. Inflation rate	%	
13. Depreciation	%	
14. Salvage value	%	

5. Comparison of financial indicators

If the CPA has a less favourable indicator (IRR) than the benchmark, then the CPA cannot be considered as financially attractive and the CPA implementer may continue to the sensitivity analysis.

Comparison of financial indicators

Benchmark	
IRR (xx years) without CDM revenues	
IRR (xx years) with CDM revenues	

6. Sensitivity analysis

Variables that constitute more than 20% of either total project costs or total project revenues should be subjected to reasonable variation. The following parameters are considered in the financial sensitivity analysis:

Sensitivity analysis

Variation	Variation	IRR (xx years)
	±10%	

	±10%	
	±10%	
	±10%	

The following table indicate the values of variation where the benchmark will be reached.

Variation	Variation value where benchmark will be reached
	%
	%
	%
	%

The sensitivity analysis provides a valid argument in favour of additionality only if it consistently supports the conclusion that the project activity is unlikely to be financially attractive.

In cases where a scenario will result in the project activity passing the benchmark the CPA implementer shall provide an assessment of the probability of the occurrence of this scenario in comparison to the likelihood of the assumptions in the presented investment analysis, taking into consideration correlations between the variables as well as the specific socio-economic and policy context of the project activity.

7. Outcome of Benchmark analysis

The outcome of the benchmark analysis should demonstrate that the proposed CPA is unlikely to be financially attractive. Alternative 2, the continuation of the identified energy baseline scenario, is a more viable alternative to the project activity since continued operations do not require financial input from the project developer. The continued operations do however lead to higher emissions. Therefore, a financial more viable alternative to the CPA would have led to higher emissions

b) BARRIER DUE TO PREVAILING PRACTICE:

Eligibility criteria for the Barrier due to prevailing practice

1.	Best practice examples include but are not limited to, the demonstration that project is among the first of its kind in terms of technology, geography, sector, type of investment and investor, market etc.
2.	Demonstrate that the prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions by demonstrating the "Identification of a first-of-its-kind project activity" as in the "Guidelines on additionality of first-of-its-kind project activities: (Version 02.0) as follows: (a) The project is the first in the applicable geographical area that applies a technology that is different from technologies that are implemented by any other project, which are able to deliver the same output and have started commercial operation in the applicable geographical area before the project design document is published for global stakeholder consultation or before the start date of the proposed project activity, whichever is earlier; (b) The project implements one or more of the measures as described in the "Guidelines on additionality of first-of-its-kind project activities: (Version 02.0); (c) The project participants selected a crediting period for the project activity that is "a maximum of 10 years with no option of renewal".
3.	The Benchmark approach may be used for Project scenario A, B and C and for all three renewable energy scenarios under Project scenario A and C.
4.	All the guideline applicable conditions in the "Guidelines for objective demonstration and assessment of barriers" (Version 01.0) and "Guidelines on additionality of first-of-its-kind project activities" (Version 02.0) should be satisfied.

B.2. Eligibility criteria for inclusion of a CPA in the PoA

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The CME has developed the following eligibility criteria according to the "Standard for demonstration of additionality, development of eligibility criteria and application of multiple methodologies for programme of activities".

Eligibility criteria	
a)	The proposed CPA must be located in the geographical boundary of South Africa.
b)	The CME must implement precaution measures to avoid double counting of emission reductions.
c)	The proposed CPA must comply with performance specifications including compliance with certification. The CPA must involve the implementation of one of the technologies/measures described in section A.6, Part I in the PoA-DD.
d)	The starting date of the project activity must not be before the date of commencement of validation of the PoA.
e)	The proposed CPA must implement one of the eligible methodologies or methodology combinations for the PoA. Also, the proposed CPA must comply with the applicability conditions of the applicable methodology.
f)	The CPA must demonstrate additionality as per eligibility criteria.
g)	The CPA must comply with PoA conditions related to undertaking local stakeholder consultations and environmental impact analysis.
h)	The CPA must confirm that no Official Development Aid will be diverted.
i)	The PoA has no specific target group or distribution mechanism, therefore there is no eligibility criteria for target groups or distribution mechanisms
j)	All relevant parameters will be monitored for each CPA. However, only a statistically acceptable sample will be verified by the DOE.
k)	CPA in aggregate must meet the small-scale or micro-scale threshold criteria
l)	The proposed CPA must pass the de-bundling check.

B.3. Application of methodologies

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The following table shows the eligible measures/technologies and methodologies under this PoA.

Description of applicable technologies/measures and methodologies chosen for this PoA

Technologies/measures	Methodology
Measures involving the replacement or modification of anaerobic animal manure management systems in livestock farms to achieve methane recovery and destruction by flaring/combustion or gainful use of the recovered methane. It also covers treatment of manure collected from several farms in a centralized plant.	AMS-III.D
Biomass based renewable energy generation units (anaerobic digesters) that provide thermal energy that displaces fossil fuel. Biomass-based cogeneration systems are included.	AMS-I.C

Multiple methodology justification for the PoA

According to the "Standard for application of multiple CDM methodologies for a Programme of activities", combinations of approved methodologies contained in the "General guidelines to SSC CDM methodologies" can be applied without further assessment of cross effects. According to the "General guidelines to SSC CDM methodologies", the Board at its fifty-sixth meeting approved the combination of any one of the Type III methodologies where activities lead to generation of methane, with any one of the Type I methodologies for utilising the methane generated for generation of renewable energy.

The eligible technology/measures and methodologies for this PoA are indicated below:

Nr.	Technology/measure		Methodologies		Project activity description
	Methane avoidance	Renewable technology	AMS-III.D	AMS-I.C	
A	✓	✓	✓	✓	• Methane emission avoidance from AWMS. • Recovered methane will be used for energy generation.
B	✓		✓		• Methane emission avoidance from AWMS. • Recovered methane will be flared.
C		✓		✓	• No methane emission avoidance. • Recovered methane will be used for energy generation.

SECTION C. Management system

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The CME has developed a CME Quality manual according to the "Standard for demonstration of additionality, development of eligibility criteria and application of multiple methodologies for programme of activities" that includes the following.

a) A clear definition of roles and responsibilities of personnel involved in the process of inclusion of CPAs, including a review of their competencies
b) Records of arrangements for training and capacity development for personnel
c) Procedures for technical review of inclusion of CPAs
d) A procedure to avoid double counting
e) Records and documentation control process for each CPA under the PoA
f) Measures for continuous improvements of the PoA management system;

Please see the "CME Quality manual" document and Annexes.

SECTION D. Duration of PoA

D.1. Start date of PoA

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According to the EB70, Annex 7 (Glossary CDM terms, Version 07.0), the date of publication of the PoA-DD for global stakeholder consultation may be used as the start date of a CDM PoA. The date of publication of the PoA-DD for global stakeholder consultation was 09/09/2011 and is therefore the start date of the PoA.

D.2. Length of the PoA

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The duration of the proposed CDM PoA is 28 years, counting from the start date of the PoA.

The coordinating/managing entity shall renew the PoA every seven years counting from the date of its registration.

SECTION E. Environmental impacts

E.1. Level at which environmental analysis is undertaken

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There is no technical or administrative advantage of doing an environmental analysis at the PoA level as the impacts are confined to each project activity site and managed at that level.

E.2. Analysis of the environmental impacts

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Not applicable

SECTION F. Local stakeholder comments

F.1. Solicitation of comments from local stakeholders

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Local consultation is done at SSC-CPA level for each SSC-CPA to ensure full participation and consultation of local stakeholders.

F.2. Summary of comments received

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Not applicable

F.3. Report on consideration of comments received

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Not applicable

SECTION G. Approval and authorization

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The letter of approval was issued on the 08/02/2012 (Ref.PoA.G) and includes the CME authorization of its coordination of the PoA.

PART II. A Generic component project activity (CPA)

SECTION A. General description of a generic CPA

A.1. Purpose and general description of generic CPAs

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CPAs under this generic CPA-DD involve methane emission avoidance through controlled anaerobic digestion and biogas-based renewable energy generation. The following tables show the eligible measures/technologies and methodologies covered under Project scenario A.

Description of applicable technologies/measures and methodologies covered under Project scenario A

Project scenario	Technologies/measures	Methodology
A	• Project activities that digest animal manure where the manure would otherwise have been treated in an anaerobic treatment system without biogas recovery. • Recovered biogas will be utilized for thermal energy production with or without electricity, see different project energy scenarios in table below.	AMS-III.D AMS-I.C
	•	
	•	

Different options for utilizing biogas for renewable energy (energy scenarios)

Energy scenario	Project description	Methodology
1	Project activities that install biogas thermal energy plants that produce renewable thermal energy for on-site consumption or for consumption by other facilities and displace fossil fuel use.	AMS-I.C
2	Project activities that install biogas cogeneration plants that produce renewable electricity for supply to the grid and/or for captive use and renewable thermal energy for on-site consumption or for consumption by other facilities and displace fossil fuel use.	
3	Project activities that involve the addition of renewable energy units (thermal or cogeneration units) at an existing renewable energy production facility.	

Biomass applicable under Project Scenario A:

1. *Manure from different livestock types (LT):* Manure from AWMS that would otherwise have been left to decay anaerobically.
2. *Other biomass types (BT):* Other renewable biomass that does not involve methane emission avoidance. This biomass should comply with renewable biomass applicability conditions, see section B.2 below.

SECTION B. Application of a baseline and monitoring methodology

B.1. Reference of the approved baseline and monitoring methodology(ies) selected

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AMS-III.D "Methane recovery in animal manure management system" (Version 18)
AMS-I.C "Thermal energy production with or without electricity" (Version 19).

The following tools are applicable to the PoA, each CPA will apply the relevant tools:
"Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (Version 2)
"Tool to determine the baseline efficiency of thermal or electric energy generation systems" (Version 1)
"Tool to determine the remaining lifetime of equipment" (Version 1)
"Tool to calculate the emission factor for an electricity system" (Version 02.2.1)

"Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" (Version 5.1.0)
"Tool to determine project emissions from flaring gases containing methane" (Version 1)
"Tool for the identification of degraded or degrading lands for consideration in implementing CDM A/R project activities" (Version 1)

B.2. Application of methodology(ies)
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Type I, Type III and micro-scale threshold demonstration:

Demonstration that CPA meets the threshold criteria

Project type	Threshold criteria	PoA demonstration
Type I	Type I: Renewable energy project activities with a maximum output capacity of 15 MW (or an appropriate equivalent).	CPAs shall demonstrate that every CPA in aggregate meets the threshold criteria and remains within those thresholds throughout the crediting period of the CPA.
Microscale Type I	Type I: Project activities up to 5 MW that employ renewable energy as their primary technology.	
Type III	Type III: Other project activities not included in Type I or Type II that result in GHG emission reductions not exceeding 60 ktCO2e per year in any year of the crediting period.	

Methodology applicability conditions demonstration:

For a CPA to apply a specific methodology, it should comply with the methodology's applicability conditions. The tables below show the applicability conditions for the methodologies applicable to Project scenario A.

Applicability Conditions for methodology AMS-III.D

Applicability conditions	PoA confirmation
1. This methodology covers project activities involving the replacement or modification of anaerobic animal manure management systems in livestock farms to achieve methane recovery and destruction by flaring/combustion or gainful use of the recovered methane. It also covers treatment of manure collected from several farms in a centralized plant. This methodology is only applicable under the following conditions: (a) The livestock population in the farm is managed under confined conditions; (b) Manure or the streams obtained after treatment are not discharged into natural water resources (e.g. river or estuaries), otherwise AMS-III.H "Methane recovery in wastewater treatment" shall be applied; (c) The annual average temperature of baseline site where anaerobic manure treatment facility is located is higher than 5°C; (d) In the baseline scenario the retention time of manure waste in the anaerobic treatment system is greater than one month, and in case	CPAs that apply methodology AMS-III.D shall involve the replacement or modification of anaerobic animal manure management systems in livestock farms to achieve methane recovery and destruction by flaring/combustion or gainful use of the recovered methane. It also covers treatment of manure collected from several farms in a centralized plant. All CPAs that apply methodology AMS-III.D must comply with condition (a) to (e).

of anaerobic lagoons in the baseline, their depths are at least 1 m; (e) No methane recovery and destruction by flaring, combustion or gainful use takes place in the baseline scenario.	
2. The project activity shall satisfy the following conditions: (a) The residual waste from the animal manure management system shall be handled aerobically, otherwise the related emissions shall be taken into account as per relevant procedures of AMS-III.AO "Methane recovery through controlled anaerobic digestion". In case of soil application, proper conditions and procedures (not resulting in methane emissions) must be ensured; (b) Technical measures shall be used (including a flare for exigencies) to ensure that all biogas produced by the digester is used or flared; (c) 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. If the project proponent can demonstrate that the dry matter content of the manure when removed from the animal barns is larger than 20%, this time constraint will not apply.	For all CPAs residual waste from the animal manure management system shall be handled aerobically, otherwise the related emissions shall be taken into account as per relevant procedures of AMS-III.AO "Methane recovery through controlled anaerobic digestion". In case of soil application, proper conditions and procedures (not resulting in methane emissions) shall be ensured; All CPAs shall ensure that all biogas produced by the digester is used or flared. For all CPAs 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. If the CPA implementer can demonstrate that the dry matter content of the manure when removed from the animal barns is larger than 20%, this time constraint will not apply.
3. Projects that recover methane from landfills shall use AMS-III.G "Landfill methane recovery" and projects for wastewater treatment shall use AMS-III.H. Project for composting of animal manure shall use AMS-III.F "Avoidance of methane emissions through composting". .	These project activities are not applicable under this PoA.
4. Different options to utilise the recovered biogas as detailed in paragraph 3 of AMS-III.H are also eligible for use under this methodology. The respective procedures in AMS-III.H shall be followed in this regard.	Only activities under paragraph 3.a (direct thermal or electrical energy generation) are eligible under this PoA
5. 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".	CPAs that apply methodology AMS-III.D shall involve the replacement or modification of anaerobic AWMS in livestock farms to achieve methane recovery and destruction by flaring/combustion or gainful use of the recovered methane. No greenfield AWMS will be permissible, but all activities will occur on or associated with an existing AWMS activity. The methane capture may be a new component to the AWMS.
6. The requirements concerning demonstration of the remaining lifetime of the replaced equipment shall be met as described in the "General	Not applicable under this PoA, anaerobic digesters will not be replaced.

Guidelines to SSC CDM methodologies".	
7. Measures are limited to those that result in aggregate emission reductions of less than or equal to 60 kt CO_2 equivalent annually from all Type III components of the project activity.	CPAs are limited to those that result in emission reductions of less than or equal to 60 kt CO_2 equivalent annually from all Type III components of the project activity.

Applicability conditions for methodology AMS-I.C

Applicability conditions	PoA confirmation
1. This methodology comprises renewable energy technologies that supply users with thermal energy that displaces fossil fuel use. These units include technologies such as solar thermal water heaters and dryers, solar cookers, energy derived from renewable biomass and other technologies that provide thermal energy that displaces fossil fuel.	All CPAs shall comprise renewable biomass anaerobic digestion technology. CPAs that apply methodology AMS-I.C shall generate thermal energy or electricity and thermal energy through cogeneration.
2. Biomass-based cogeneration systems are included in this category. For the purpose of this methodology "cogeneration" shall mean the simultaneous generation of thermal energy and electrical energy in one process.	CPAs that apply cogeneration shall simultaneously generate thermal energy and electrical energy in one process. In the case of biogas engine(s), thermal energy shall be utilized by decoupling the engine jacket water cooling circuit and circulating the engine block cooling water to heat the digester. Hot exhaust gas at ~400C can also be used for additional heating. The thermal energy will be carried over to heat water and this water will also be circulated along with the block cooling water to heat the digester. In the case of gas turbine(s), thermal energy can be utilized from the hot exhaust gases as a single point source of energy.
3. Emission reductions from a biomass cogeneration system can accrue from one of the following activities: a) Electricity supply to a grid; b) Electricity and/or thermal energy (steam or heat) production for on-site consumption or for consumption by other facilities; c) Combination of (a) and (b).	CPAs that apply methodology AMS-I.C shall involve either: a) Electricity supply to a grid; b) Electricity and thermal energy (steam or heat) production for on-site consumption or for consumption by other facilities; c) Combination of (a) and (b).
4. The total installed/rated thermal energy generation capacity of the project equipment is equal to or less than 45 MW thermal (see paragraph 6 for the applicable limits for cogeneration project activities).	For CPAs that involve thermal energy generation, the capacity of the project equipment shall be equal to or less than 45MW thermal.
5. For co-fired systems, the total installed thermal energy generation capacity of the project equipment, when using both fossil and renewable fuel, shall not exceed 45 MW thermal (see paragraph 6 for the applicable limits for cogeneration project activities).	Not applicable to the PoA, the PoA does not involve co-fired systems.
6. The following capacity limits apply for biomass cogeneration units: (a) If the project activity includes emission reductions from both the thermal and	For CPAs where the emission reductions include both the thermal and electrical energy components,

electrical energy components, the total installed energy generation capacity (thermal and electrical) of the project equipment shall not exceed 45 MW thermal. For the purpose of calculating this capacity limit the conversion factor of 1:3 shall be used for converting electrical energy to thermal energy (i.e. for renewable energy project activities, the maximal limit of 15 MW(e) is equivalent to 45 MW thermal output of the equipment or the plant); (b) If the emission reductions of the cogeneration project activity are solely on account of thermal energy production (i.e. no emission reductions accrue from the electricity component), the total installed thermal energy production capacity of the project equipment of the cogeneration unit shall not exceed 45 MW thermal; (c) If the emission reductions of the cogeneration project activity are solely on account of electrical energy production (i.e. no emission reductions accrue from the thermal energy component), the total installed electrical energy generation capacity of the project equipment of the cogeneration unit shall not exceed 15 MW.	the total installed energy generation capacity (thermal and electrical) of the project equipment shall not exceed 45 MW thermal. For CPAs where the emission reductions of the cogeneration project activity are solely on account of thermal energy production, the total installed thermal energy production capacity of the project equipment of the cogeneration unit shall not exceed 45 MW thermal. For CPAs where the emission reductions of the cogeneration project activity are solely on account of electrical energy production, the total installed electrical energy generation capacity of the project equipment of the cogeneration unit shall not exceed 15 MW.
7. The capacity limits specified in the above paragraphs apply to both new facilities and retrofit projects. In the case of project activities that involve the addition of renewable energy units at an existing renewable energy facility, the total capacity of the units added by the project should comply with capacity limits in paragraphs 4 to 6, and should be physically distinct from the existing units.	The capacity limits specified in the above paragraphs apply to new plants. In the case of project activities that involve the addition of renewable energy units at an existing renewable energy facility, the total capacity of the units added by the project should comply with capacity limits in paragraphs 4 to 6, and should be physically distinct from the existing units.
8. Project activities that seek to retrofit or modify an existing facility for renewable energy generation are included in this category.	Not applicable to the PoA, the PoA does not involve CPAs that seek to retrofit an existing facility for renewable energy generation..
9. 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".	The requirements refer to national and/or sectoral policies and circumstances that shall be taken into account in the establishment of a baseline scenario. The national and/or sectoral policies in South Africa was introduced after 2009 and fall under E-policy and need not be taken into account in establishing a baseline scenario for projects under this PoA. See section B.4, Part II of this PoA-DD.
10. If solid biomass fuel (e.g. briquette) is used, it shall be demonstrated that it has been produced using solely renewable biomass and all project or leakage emissions associated with its production shall be taken into account in the	Not applicable to this PoA, anaerobic digesters does not use solid biomass as feedstock.

emissions reduction calculation.	
11. Where the project participant is not the producer of the processed solid biomass fuel, the project participant and the producer are bound by a contract that shall enable the project participant to monitor the source of the renewable biomass to account for any emissions associated with solid biomass fuel production. Such a contract shall also ensure that there is no double-counting of emission reductions.	Not applicable to this PoA, anaerobic digesters does not use processed solid biomass as feedstock.
12. If electricity and/or steam/heat produced by the project activity is delivered to a third party i.e. another facility or facilities within the project boundary, a contract between the supplier and consumer(s) of the energy will have to be entered into that ensures there is no double-counting of emission reductions.	CPAs that deliver electricity and/or steam/heat to a third party, a contract between the supplier and the consumer(s) shall be entered into to ensure there is no double-counting of emission reductions.
13. If the project activity recovers and utilizes biogas for power/heat production and applies this methodology on a stand alone basis i.e. without using a Type III component of a SSC methodology, any incremental emissions occurring due to the implementation of the project activity (e.g. physical leakage of the anaerobic digester, emissions due to inefficiency of the flaring), shall be taken into account either as project or leakage emissions.	CPAs that recovers and utilizes biogas for power/heat production and applies this methodology on a stand alone basis i.e. without using a Type III component of a SSC methodology, any incremental emissions occurring due to the implementation of the project activity, shall be taken into account either as project or leakage emissions.
14. Charcoal based biomass energy generation project activities are eligible to apply the methodology only if the charcoal is produced from renewable biomass sources provided:	Not applicable to this PoA, anaerobic digesters does not use charcoal as feedstock.
15. Project activity under a Programme of Activities must comply with stipulated conditions	All CPAs shall comply with the stipulated PoA conditions, see PoA applicability table below.

Applicability conditions for biomass project activities under a PoA

Applicability conditions	PoA confirmation
a) In the specific case of biomass project activities the applicability of the methodology is limited to either project activities that use biomass residues or processed biomass (e.g. briquette) only or biomass from dedicated plantations complying with the applicability conditions of methodology AM0042 or paragraph 5 in methodology AMS-III.AQ, see F-CDM-SSCwg ver 01 SSC_577.	All CPAs that use biomass residues shall comply with the stipulated conditions; see renewable biomass applicable conditions in table below. All CPAs that use biomass from dedicated plantations shall comply with stipulated conditions. First check compliance with renewable biomass applicable conditions and then check compliance with dedicated plantation applicable conditions in tables below. Solid biomass is not applicable under this PoA.
b) In the specific case of biomass project activities the determination of leakage shall be done following the general guidance for leakage in small-scale biomass project activities (attachment C of Appendix B of simplified modalities and procedures for small-scale clean development	For all CPAs the determination of leakage shall be done following the general guidance for leakage in small-scale biomass project activities (attachment C of Appendix B of simplified modalities and procedures for small-scale clean development mechanism project activities; decision 4/CMP.1)

mechanism project activities; decision 4/CMP.1) or following the procedures included in the leakage section of AM0042	Leakage emissions shall be calculated as in Section D.6.3 of each CPA-DD.
c) In case the project activity involves the replacement of equipment, and the leakage from the use of the replaced equipment in another activity is neglected, because the replaced equipment is scrapped, an independent monitoring of scrapping of replaced equipment needs to be implemented. The monitoring should include a check if the number of project activity equipment distributed by the project and the number of scrapped equipment correspond with each other. For this purpose scrapped equipment should be stored until such correspondence has been checked. The scrapping of replaced equipment should be documented and independently verified.	In case the project activity involves the replacement of equipment, an independent monitoring of scrapping of replaced equipment will be implemented.

Applicability conditions for renewable biomass

Applicability condition	PoA confirmation
1. The biomass is woody and non-biomass and originates from croplands and/or grasslands where: a) The land area remains cropland and/or grasslands or is reverted to forest; and b) Sustainable management practices are undertaken on these land areas to ensure in particular that the level of carbon stocks on these land areas does not systematically decrease over time (carbon stocks may temporarily decrease due to harvesting); and c) Any national or regional forestry, agriculture and nature conservation regulations are complied with. d) Biomass complies with the dedicated plantation applicability conditions described in Methodology AM0042 or Methodology AMS-III.AQ (see F-CDM-SSCwg ver 01 SSC_577). Applicability conditions are described in tables below.	All CPAs using biomass from dedicated plantations shall demonstrate that the CPA complies with conditions (a) to (d).
2. The biomass is a biomass residue, that means biomass by-products, residues and waste streams from agriculture, forestry and related industries. a) Where, the use of that biomass residue in the project activity does not involve a decrease of carbon pools, in particular dead wood, litter or soil organic carbon, on the land areas where the biomass residues are originating from	All CPAs using biomass residues shall demonstrate that the baseline (current practice) is one of the following: 1. The biomass residues are dumped or left to decay under mainly aerobic conditions. 2. The biomass residues are dumped or left to decay under clearly anaerobic conditions. 3. The biomass residues are burnt in an uncontrolled manner without utilizing them for energy purposes

	Where manure is applied as compost/fertilizer in the baseline, the residual waste from the digester should be applied as compost/fertilizer in the project activity. All CPAs using biomass residues shall demonstrate that the use of biomass residue in the project activity does not involve a decrease of carbon pools.

Applicability conditions for dedicated plantations as in methodology AM0042

Applicability conditions	PoA confirmation
a) Biomass used by the project facility is not stored for more than one year; b) The dedicated plantation must be newly established as part of the project activity for the purpose of supplying biomass exclusively to the project; c) The biomass from the plantation is not chemically processed (e.g. esterification to produce biodiesel, production of alcohols from biomass, etc) prior to combustion in the project plant but it may be processed mechanically or be dried; d) The site preparation does not cause longer-term net emissions from soil carbon. Carbon stocks in soil organic matter, litter and deadwood can be expected to decrease more due to soil erosion and human intervention or increase less in the absence of the project activity; e) The land area of the dedicated plantation will be planted by direct planting and/or seeding; f) After harvest, regeneration will occur either by direct planting or natural sprouting; g) Grazing will not occur within the plantation; h) No irrigation is undertaken for the biomass plantations; i) The land area where the dedicated plantation will be established is, prior to project implementation, severely degraded and in absence of the project activity would have not been used for any other agricultural or forestry activity. The land degradation can be demonstrated using one or more of the following indicators: a) Vegetation degradation, e.g. ➢ Crown cover of pre-existing trees has decreased in the recent past for reasons other than sustainable harvesting activities; b) Soil degradation, e.g. ➢ Soil erosion has increased in the recent past; c) Anthropogenic influences, e.g. ➢ There is a recent history of loss of soil and vegetation due to anthropogenic actions; and ➢ Demonstration that there exist anthropogenic actions/activities that prevent possible occurrence of natural regeneration.	All CPAs using biomass from dedicated plantations shall demonstrate that the CPA complies with all the dedicated plantation applicability conditions in methodology AM0042.

Applicability conditions for dedicated plantations as in methodology ASM-III.AQ, paragraph 5 (see F-CDM-SSCwg ver 01 SSC_577)

Applicability conditions	Confirmation record
a) The project activity does not lead to a shift of pre-project activities outside the project boundary i.e. the land under the proposed project activity can continue to provide at least the same amount of goods and services as in the absence of the project;	All CPAs using biomass from dedicated plantations shall demonstrate that the

	project activity does not lead to a shift of pre-project activities outside of the project boundary.
b) The plantations are established on a land: i. Which was at the start of the project implementation, classified as degraded or degrading as per the "Tool for the identification of degraded or degrading lands for consideration in implementing CDM A/R project activities"; or ii. Area that is included in the project boundary of one or several registered A/R CDM project activities. iii. Plantations established on the peatlands are not eligible even if qualifying under condition (i) and (ii) above.	All CPAs using biomass from dedicated plantations shall demonstrate that the CPA complies with conditions (i) to (iii).

B.3. Sources and GHGs

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The project boundary is the physical, geographical site:

(a) Where the manure would have been disposed and the methane emission occurs in absence of the proposed project activity;

(b) Where the treatment of biomass or other organic matters through anaerobic digestion takes place;

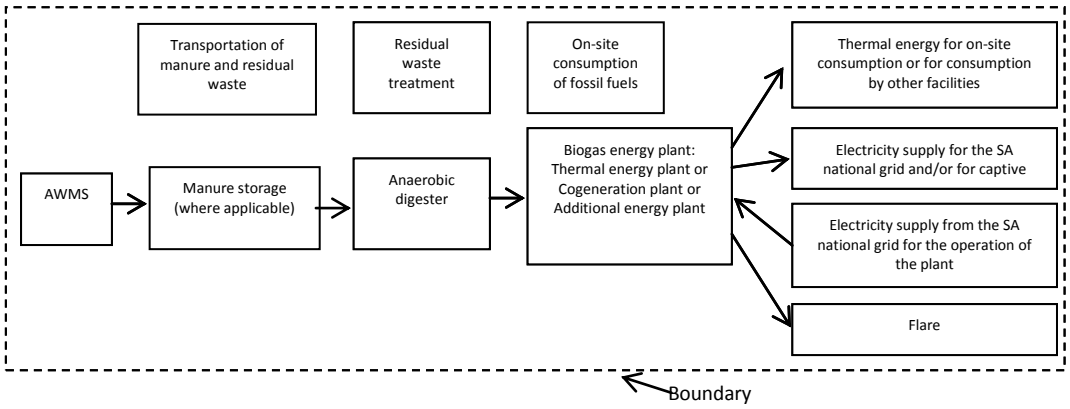
(c) Where the residual waste from biological treatment or products from those treatments, like slurry, are handled, disposed, submitted to soil application, or treated thermally/mechanically;

(d) And the itineraries between the above, where the transportation of manure or residual waste after digestion occurs.

(e) Where biogas is burned/flared or gainfully used, including the following:

- All plants generating power and/or heat located at the project site;
- All power plants connected physically to the electricity system (grid) that the project plant is connected to;
- Industrial, commercial or residential facility, or facilities, consuming energy generated by the system and the processes or equipment affected by the project activity;

The project boundary for Project scenario A is given below:



Project scenario A: Project activities that digest animal manure where the manure would otherwise have been treated in an anaerobic treatment system without biogas recovery. The recovered biogas will be utilized for thermal energy production with or without electricity. Methodology AMS-III.D and AMS-I.C are applicable.

The combination of the greenhouse gases and emission sources included in or excluded from the project boundary are shown in table below:

	Source	Gas		Justification / Explanation
Baseline	Emissions from decomposition of manure in AWMS	CO_2	Excluded	CO_2 emissions from the decomposition of manure are not accounted
		CH_4	Included	A potential major source of emissions where projects use manure that would otherwise have been left to decay anaerobically
		N_2O	Excluded	N_2O emissions are small compared to CH_4 emissions from AWMS. Exclusion is conservative
	Emissions from electricity consumption	CO_2	Included	A major source of emissions from power generation.
		CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small
	Emissions from thermal energy generation	CO_2	Included	A major source of emissions from thermal energy produced by fossil fuel
		CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small
Project Activity	Emissions from incremental transportation	CO_2	Included	May be an important emission source where manure is transported in the project activity.
		CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small
	Emissions from the use of electricity for the operation of the facilities	CO_2	Included	May be an important emission source where electricity is imported from the grid for the project activity. If electricity is generated from collected biogas, these emissions are not accounted for
		CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small
	Emissions from the use of fossil fuel for the operation of the facilities	CO_2	Included	May be an important emission source where fossil fuel is used in the project activity
		CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small
	Emissions from the storage of manure before being fed into the anaerobic digester	CO_2	Excluded	Excluded for simplification. This emission source is assumed to be very small
		CH_4	Included	May be an important emission source where manure is stored before being fed into the digester
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small

	Source	Gas		Justification / Explanation
	Methane emissions due to physical leakage of biogas	CO_2	Excluded	CO_2 emissions from the decomposition organic waste are not accounted
		CH_4	Included	Methane physical leakage from the anaerobic digester is a potential source of project emissions.
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small
	Methane emissions from biogas flaring	CO_2	Excluded	CO_2 emissions from the decomposition organic waste are not accounted
		CH_4	Included	Methane emissions from incomplete combustion in the flaring process are a potential source of project emissions.
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small
	Emissions from the disposal/ storage/treatment of residual waste	CO_2	Excluded	CO_2 emissions from the decomposition organic waste are not accounted
		CH_4	Included	May be an important emission source where the residual waste from the digestion is stored under anaerobic conditions and/or delivered to a SWDS
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small

B.4. Description of baseline scenario

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<u>BASELINE SCENARIO FOR AWMS (AMS-III.D)</u>

According to methodology AMS-III.D, the baseline scenario is the situation where, in the absence of the project activity, manure is left to decay within the project boundary and methane is emitted to the atmosphere. Therefore, the current manure management practice at each CPA will be the baseline scenario for that CPA.

Furthermore, according to methodology AMS-III.D, the methodology is only applicable under the conditions below. These conditions will be assessed in section D.4 of the CPA-DD.

(a) The livestock population in the farm is managed under confined conditions;

(b) Manure or the streams obtained after treatment are not discharged into natural water resources (e.g. river or estuaries), otherwise AMS-III.H "Methane recovery in wastewater treatment" shall be applied;

(c) The annual average temperature of baseline site where anaerobic manure treatment facility is located is higher than 5°C;

(d) In the baseline scenario the retention time of manure waste in the anaerobic treatment system is greater than one month, and in case of anaerobic lagoons in the baseline, their depths are at least 1 m;

(e) No methane recovery and destruction by flaring, combustion or gainful use takes place in the baseline scenario.

Only AWMS where manure is left to decay in an anaerobic treatment system will be applicable under this PoA. In South Africa, manure in piggeries and dairies are commonly left to decay in anaerobic treatment systems and therefore only these livestock will be applicable under this PoA. However, the current manure management practice for each CPA will be assessed and will form the baseline AWMS for the specific CPA.

The baseline AWMS system and manure characteristics will be identified as part of the development of each CPA through site inspections, measurements and documented accordingly. The applicable baseline information will be documented in a confirmation document to be signed by the baseline manager. The

baseline parameters for each CPA will also be documented in each CPA-DD in Section B.6.2. The confirmation letter must contain the following applicable information:

1. Description of the AWMS

A detailed description of the AWMS, with reference to different manure treatment phases where applicable. The parameters in the following table will be determined from the AWMS description, using IPCC values where necessary. The management and utilization of the manure in the baseline must also be described and include transport distances and the compost practise in the baseline.

Animal waste management system parameters

Parameter	Symbol	Unit
% manure handled in stage 1 of the AWMS	$MS\%_{BL1,j}$	%
% manure handled in stage 2 of the AWMS	$MS\%_{BL2,j}$	%
MCF for stage 1 of the AWMS	$MCF_{BL1,j}$	%
MCF for stage 2 of the AWMS	$MCF_{BL2,j}$	%
Reduction of Volatile solids in stage 1	RSV	%
Days per year that the AWMS was operational	ndy	day/yr

2. Animal population information

Animal population parameters for each livestock type of the CPA

Parameter	Symbol	Unit
Number of days animal is alive	$N_{da,y}$	Day
Number of animals produced annually	$N_{p,y}$	Head
Annual average number of animals	$N_{LT,y}$	nr of head
Average animal weight	W_{site}	Kg

3. Manure and feed information

There are two methods for calculating Volatile Solids (VS).

Volatile Solids calculated using default IPCC values

The confirmation letter must contain the following information:

- Documentation to proof that the genetic source of the production operations livestock originate from an Annex I Party.
- Formulated feed rations (FFR) for each livestock type.

Volatile Solids calculated using the enhanced characterisation method

The confirmation letter must contain the following information:

Manure and feed parameters for each livestock type of the CPA

Parameter	Symbol	Unit
Gross energy intake	GE_{LT}	MJ/hd/day
Digestibility of the feed	DE_{LT}	%
Urinary energy expressed as fraction of GE	UE	%
Ash content of the manure	ASH	%
Energy density of the feed	ED_{LT}	MJ/kg DM

<u>BASELINE SCENARIO – AMS-I.C</u>

The following table describe the baseline scenario for each Energy scenario under Project scenario A:

Energy scenario	Applicable technologies/measures and methodology	Description of the baseline scenario
1	Project activities that install biogas thermal energy plants that produce renewable thermal energy for on-site consumption or for consumption by other facilities and displace fossil fuel use.	The simplified baseline is the fuel consumption of the technologies that would have been used in the absence of the project activity, times an emission factor for the fossil fuel displaced. See below the "Criteria on determining the thermal energy baseline emissions".
2	Project activities that install biogas cogeneration plants that produce renewable electricity for supply to the grid and/or for captive use and/or renewable thermal energy for on-site consumption or for consumption by other facilities and displace fossil fuel use.	One of the following baseline scenarios should be applicable: • Electricity is imported from a grid and thermal energy (steam/heat) is produced using fossil fuel (project activity (a) in paragraph 19, methodology AMS-I.C). • Electricity is imported from a grid and thermal energy (steam/heat) is produced from biomass. Emission reduction from heat generation is not eligible (project activity (e) in paragraph 19, methodology AMS-I.C). For thermal energy, the simplified baseline is the fuel consumption of the technologies that would have been used in the absence of the project activity, times an emission factor for the fossil fuel displaced. See below the "Criteria on determining the thermal energy baseline emissions". For electricity, the baseline scenario is that the electricity displaced from the grid by the project activity would have otherwise been generated by the operation of grid connected power plants. The CO_2 emission factor for the South African national grid is calculated below.
3.	Project activities that involve the addition of renewable energy energy units (thermal energy or cogeneration units) at an existing renewable energy production facility.	For thermal energy, the simplified baseline is the fuel consumption of the technologies that would have been used in the absence of the project activity, times an emission factor for the fossil fuel displaced. See below the "Criteria on determining the thermal energy baseline emissions". For electricity, the baseline scenario is that the electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid connected power plants. The CO_2 emission factor for the South African national grid is calculated below.

<u>The grid emission factor calculation</u>

See Appendix 4.

Criteria on determining the thermal energy baseline emissions

Existing facilities are those that have been in operation for at least three years immediately prior to the start date of the project activity. For project activities implemented in existing facilities, baseline calculations shall be based on historical data on energy use (fossil fuel) and plant output (e.g. steam) in the baseline plant for at least three years prior to project implementation. For existing facilities with less than three years of operational data, all historical data shall be available (a minimum of one year data would be required). For existing facilities having no historical data/information on baseline parameters such as efficiency, energy consumption and output (e.g. the available data is not reliable due to various factors such as the use of imprecise or non-calibrated measuring equipment), the baseline parameters can be determined using a performance test/measurement campaign to be carried out prior to the implementation of the project activity. The project proponent may follow the relevant provisions from the "Tool to determine the baseline efficiency of thermal or electric energy generation systems". In the case of project activities that export to other facilities within the project boundary, historical data from the recipient plants is also required.

For project activities implemented in existing facilities where the additionality is demonstrated based on a baseline scenario that is not the continuation of the current practice (e.g. continued use of the fossil fuel that was used prior to the implementation of the project activity), the baseline emission factor is chosen as lower of the two: (a) the emission factor of the fossil fuel that would have been used in the identified baseline scenario; and (b) the emission factor of the fossil fuel that was used prior to the implementation of the project activity.

Efficiency of the baseline units (excluding cogeneration plants) shall be determined by adopting one of the following criteria (in preferential order):

(a) Highest measured operational efficiency over the full range of operating conditions of a unit with similar specifications, using baseline fuel. The efficiency tests shall be conducted following the guidance provided in relevant national/international standards;
(b) Highest of the efficiency values provided by two or more manufacturers for units with similar specifications, using the baseline fuel;
(c) Default efficiency of 100%.

For household or commercial applications/systems, whose maximum output capacity is less than 45 kW thermal and where it can be demonstrated that the metering of thermal energy output is not plausible, as in the case of cooking stoves, gasifiers, driers, water heaters etc., efficiency of the baseline units shall be determined by adopting one of the following criteria:

(a) Highest measured operational efficiency over the full range of operating conditions of a representative sample of units with similar specifications, using baseline fuel. The efficiency tests shall be conducted following the guidance provided in relevant national/international standards;
(b) Highest of the efficiency values provided by two or more manufacturers for units with similar specifications using the baseline fuel;
(c) Highest efficiency from referenced literature values or default efficiency of 100%.

National and/or sectoral policies

According to the CDM Project standard (Version 02.0), when establishing the baseline scenario, project participants shall take into account the following two types of national and/or sectoral policies:

a) National and/or sectoral policies or regulations that give comparative advantages to more emissions-intensive technologies or fuels over less emissions-intensive technologies or fuels (so called type E+);
b) National and/or sectoral policies or regulations that give comparative advantages to less emissions-intensive technologies over more emissions-intensive technologies (e.g. public

subsidies to promote the diffusion of renewable energy or to finance energy efficiency programs) (so called type E-).

Project participants shall address the two types of policies described in above above as follows:
(a) Only national and/or sectoral policies or regulations described in (a) above that have been implemented before adoption of the Kyoto Protocol by the Conference of the Parties (hereinafter referred to as the COP) (decision 1/CP.3, 11 December 1997) shall be taken into account when establishing a baseline scenario. If such national and/or sectoral policies were implemented since the adoption of the Kyoto Protocol, the baseline scenario should refer to a hypothetical situation without the national and/or sectoral policies or regulations being in place;
(b) National and/or sectoral policies or regulations described in (b) above that have been implemented since the adoption by the COP of the CDM M&P (decision 17/CP.7, 11 November 2001) need not be taken into account in establishing a baseline scenario (i.e. the baseline scenario could refer to a hypothetical situation without the national and/or sectoral policies or regulations being in place).

In South Africa, the National Electricity Regulator South Africa (NERSA SA) has effectively introduced the Renewable Energy Feed-In Tariff program (REFIT) in 2009. The Renewable Energy Independent Power Producer Program (REIPPP) under REFIT wherein Independent Power Producers (IPPs) must bid to provide power to Eskom at pricing below the maximum established cap was introduced in 2011. The REFIT was established due to national and/or sectorial policies that give comparative advantages to less emissions-intensive technologies over more emissions-intensive technologies.

The REFIT and REIPPP policy pursued by NERSA was introduced after 2009 and falls under E- policy and therefore need not be taken into account in establishing a baseline scenario. The baseline scenario could refer to a hypothetical situation without the national and/or sectoral policies or regulations being in place.

B.5. Demonstration of eligibility for a generic CPA

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Eligibility criteria for inclusion of a SSC-CPA in the PoA

Eligibility criteria	Possible means of verification
a) The proposed CPA must be located in the geographical boundary of South Africa.	Demonstrate that CPA is located in the geographical boundary of South Africa. See demonstration in Section A.7 of the CPA-DD.
b) The CME must implement precaution measures to avoid double counting of emission reductions.	The CME shall follow the procedure to avoid double counting in Section C (d) in the PoA-DD. Confirmation by the CPA implementer that the CPA is neither registered as an individual CDM project activity nor is part of another registered PoA. See confirmation in Section A.13 of the CPA-DD.
c) The proposed CPA must comply with performance specifications including compliance with certification. The CPA must involve the implementation of one of the technologies/measures described in section A.6, Part I in the PoA-DD.	Demonstration that the CPA will comply with the performance specifications set out in PoA-DD, Part I, Section A.6. See demonstration in Section A.5 of the CPA-DD. Feasibility study or other technical description, EIA report, supplier information or PPA proving that the CPA involves the implementation of a technology eligible for inclusion in the PoA.
d) The starting date of the project activity must not be before the date of commencement of validation of the PoA.	The staring date of the project activity means the earliest date at which either the implementation or construction or real action of a project activity

		begins. The CPA implementer will provide the CME with any significant purchase order, contract or payment evidence related to the construction of the project activity. See documentation in Section A.8.1 of the CPA-DD.
e)	The proposed CPA must implement one of the eligible methodologies or methodology combinations for the PoA. Also, the proposed CPA must comply with the applicability conditions of the applicable methodology.	Indicate that the CPA will apply one of the eligible methodologies or methodology combinations. Also, assess compliance with the specific methodology applicability conditions. See assessment in Section D.2 of the CPA-DD
f)	The CPA must demonstrate additionality as per eligibility criteria.	Assess additionality according to the eligibility criteria below. See assessment in Section D.5 of the CPA-DD
g)	The CPA must comply with PoA conditions related to undertaking local stakeholder consultations and environmental impact analysis.	Provide necessary environmental impact assessment and local stakeholder consultation information and documentation. See Section B and C of the CPA-DD.
h)	The CPA must confirm that no Official Development Aid will be diverted.	Provide information on sources of public funding from countries included in Annex I which shall affirm that such funding does not result in diversion of official development assistance. See affirmation Section A.11 of the CPA-DD.
i)	The PoA has no specific target group or distribution mechanism, therefore there is no eligibility criteria for target groups or distribution mechanisms	Not applicable
j)	All relevant parameters will be monitored for each CPA. However, only a statistically acceptable sample will be verified by the DOE.	Sampling must meet a confidence/precision limits of 90/10. All CPAs must be included as possible sites for DOE verification in the future.
k)	CPA in aggregate must meet the small-scale or micro-scale threshold criteria	Demonstration that the installed capacity of the small-scale or micro-scale CPA in aggregate will remain within the threshold criteria throughout the crediting period of the CPA See demonstration in Section D.2 of the CPA-DD
l)	The proposed CPA must pass the de-bundling check.	Demonstrate that the CPA is not a debundled component of a large scale activity by following the “Guidelines on assessment of debundling for SSC project activities”. See de-bundling check in Section A.12 of the CPA-DD

Compliance of the baseline system and project activity to the mandatory applicable legal and regulatory requirements/legislation will be confirmed through the Environmental authorization process of South Africa.

ADDITIONALITY OF THE GENERIC CPA

The table below indicates the additionality approaches applicable to Project scenario A. The CPA implementer will choose an approach and demonstrate additionality according to the applicable additionality eligibility criteria in section B.1, Part I of the PoA-DD.

Additionality approaches applicable to Project scenario A

Project Scenario	Additionality approach
A	Additionality may be based on approach 1 or approach 2. Where approach 1 is used, method a and b should be applied. Where approach 2 is used, barrier a or b should be applied.

B.6. Estimation of emission reductions of a generic CPA
B.6.1. Explanation of methodological choices

Baseline emission equation choices – AMS-III.D

Baseline emissions shall be calculated by using one of the following two options:

a) Based on the most recent IPCC tier 2 approach, using equation 1 from methodology AMS-III.D:

$$BE_y = GWP_{CH4} \times D_{CH4} \times UF_b \times \sum_{j,LT} MCF_j \times B_{0,LT} \times N_{LT,y} \times VS_{LT,y} \times MS\%_{Bl,j} \quad (1)$$

b) Based on direct measurement of the quantity of manure treated together with its specific volatile solids (*SVS*) content, using equation 4 from methodology AMS-III.D:

$$BE_y = GWP_{CH4} \times D_{CH4} * UF_b \times \sum_{j,LT} MCF_j \times B_{0,LT} \times Q_{manure,j,LT,y} \times SVS_{j,LT,y} \quad (4)$$

Baseline emission equation choices – AMS-I.C

Baseline emission equation choices for project energy scenarios 1 to 3, applying methodology AMS-I.C are as follow:

Energy scenario 1: Project activities that install biogas thermal energy plants that produce renewable thermal energy for on-site consumption or for consumption by other facilities and displace fossil fuel use. These project activities will use equation (2) from methodology AMS-I.C: $BE_{thermal,CO2,y} = (EG_{thermal,y}/\eta_{BL,thermal}) \times EF_{FF,CO2}$ (2)
Energy scenario 2: Project activities that install biogas cogeneration plants that produce renewable electricity for supply to the grid and/or for captive use and renewable thermal energy for on-site consumption or for consumption by other facilities and displace fossil fuel use. These project activities will use the equation (1) from methodology AMS-I.D for electricity baseline emission calculations and equation (2) from methodology AMS-I.C for thermal energy baseline emission calculations. $BE_{,y} = EG_{BL,,y} \times EF_{CO2,grid,y}$ (1) $BE_{thermal,CO2,y} = (EG_{thermal,y}/\eta_{BL,thermal}) \times EF_{FF,CO2}$ (2)
Energy scenario 3: Project activities that involve the addition of renewable energy units (thermal or cogeneration units) at an existing renewable energy production facility. Project activities that involve the addition of renewable thermal energy units will use equations (5), (6) and (7) from methodology AMS-I.C: $EG_{thermal,add,y} = EG_{thermal,PJ,y} - EG_{thermal,old,y}$ (5) $EG_{thermal,old,y} = MAX(EG_{thermal,actual,y}, EG_{thermal,estimated,y})$ (6)

$$EG_{thermal,old,y} = MAX(EG_{HY,thermal,retrofit,y}, EG_{estimated,thermal,y}) \text{ until } DATE_{BaselineRetrofit} \quad (7)$$

Project activities that involve the addition of cogeneration units will use the equations (5), (6) and (7) from methodology AMS-I.C as above and equations (8) and (9) from methodology ASM-I.D:

$$BE_{add,CO2,y} = (EG_{PJ,add,y} - EG_{BL,existing,y}) \times EF_{CO2,grid,y} \quad (8)$$

$$EG_{BL,existing,y} = MAX\ (EG_{actual,y}, EG_{estimated,y}) \text{ until } DATE_{BaselineRetrofit} \quad (9)$$

Grid emission factor choices

The grid emission factor ($EF_{CO2,grid,y}$) will be calculated as follows: A 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 grid emission factor will be calculated using the e*x ante* option: The emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required. For the calculations see Appendix 4.

CO_2 emission coefficient

The CO_2 emission coefficient ($COEF_{i,y}$) shall be calculated using Option B in the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion". In Option B $COEF_{i,y}$ is calculated based on net calorific value and CO_2 emission factor of the fuel type.

Project emissions due to physical leakage

Project emissions due to physical leakage of biogas from the animal manure management systems used to produce, collect and transport the biogas to the point of flaring or gainful use is estimated as: A default value of 0.05 m³ biogas leaked/m³ biogas produced

Approaches to rule out leakage choice

CPA implementers shall demonstrate that the use of the biomass residues does not result in increased use of fossil fuels or other GHG emissions elsewhere. For this purpose, CPA implementers shall assess as part of the monitoring the supply situation for each type of biomass residue *k* used in the project plant. The table below outlines the options (methodology AM0042) that may be used to demonstrate that the biomass residues used in the plant did not increase fossil fuel consumption or other GHG emissions elsewhere.

Approaches to rule out leakage according to methodology AM0042

L_1	Demonstrate that at the sites where the project activity is supplied from with biomass residues, the biomass residues have not been collected or utilized (e.g. as fuel, fertilizer or feedstock) but have been dumped and left to decay, land-filled or burnt without energy generation (e.g. field burning) prior to the implementation of the project activity. Demonstrate that this practice would continue in the absence of the CDM project activity, e.g. by showing that in the monitored period no market has emerged for the biomass residues considered or by showing that it would still not be feasible to utilize the biomass residues for any purposes (e.g. due to the remote location where the biomass residue is generated)
L_2	Demonstrate that there is an abundant surplus of the in the region of the project activity which is not utilized. For this purpose, demonstrate that the quantity of available biomass residues of type *k* in the region is at least 25% larger than the quantity of biomass residues of type *k* that are

	utilized (e.g. for energy generation or as feedstock), including the project plant.
L_3	Demonstrate that suppliers of the type of biomass residue in the region of the project activity are not able to sell all of their biomass residues. For this purpose, CPA implementers shall demonstrate that the ultimate supplier of the biomass residue (who supplies the project) and a representative sample of suppliers of the same type of biomass residue in the region had a surplus of biomass residues (e.g. at the end of the period during which biomass residues are sold), which they could not sell and which are not utilized
L_4	Identify the consumer that would use the biomass residue in the absence of the project activity (e.g. the former consumer). Demonstrate that this consumer has substituted the biomass residue diverted to the project with other types of biomass residues (and not with fossil fuels or other types of biomass than biomass residues) by showing that the former user only fires biomass residues for which leakage can be ruled out using approaches L_2 or L_3. Provide credible evidence and document the types and amounts of biomass residues used by the former user as replacement for the biomass residue fired in the project activity and apply approaches L_2 or L_3 to these types of biomass residues. Demonstrate that the substitution of the biomass residues used in the project activity with other types of biomass residues does not require a significant additional energy input except for the transportation of the biomass residues

B.6.2. Data and parameters that are to be reported ex-ante

Data / Parameter	GWP_{CH4}
Unit	tCO_2e/ tCH_4
Description	Global Warming Potential (GWP) of methane
Source of data	IPCC default, (a value of 21 is to be applied for the first commitment period of the Kyoto Protocol)
Value(s) applied	21
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline and project emissions
Additional comment	-

Data / Parameter	$B_{0,LT}$
Unit	m^3 CH_4/kg dm
Description	Maximum methane producing potential of the volatile solid generated for animal type "*LT*"
Source of data	IPCC default, Volume 4 chapter 10 table 10 A-4 to 10 A-9 The maximum methane-producing capacity of the manure (B_0) default IPCC values from 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 10 table 10 A-4 to 10 A-9 can be used provided the assessment of suitability of those data to the specific situation of the treatment site particularly with reference to feed intake levels.
Value(s) applied	Specific to AWMS
Choice of data or Measurement methods and procedures	
Purpose of data	Calculation of baseline emissions
Additional comment	

Data / Parameter	$MCF_{BL1,j}$
Unit	Fraction
Description	Annual methane conversion factor for the baseline animal waste management system *j*, stage 1
Source of data	IPCC default (Volume 4 chapter 10 table 10.17) and AWMS baseline formation
Value(s) applied	Specific to AWMS
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$MCF_{BL2,j}$
Unit	Fraction
Description	Annual methane conversion factor for the baseline animal waste management system *j*, stage 2
Source of data	IPCC default (Volume 4 chapter 10 table 10.17) and AWMS baseline information
Value(s) applied	Specific to AWMS
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$MS\%_{BL1,j}$
Unit	Fraction
Description	Fraction of manure handled in stage 1 of the baseline manure management system *j*
Source of data	AWMS baseline information
Value(s) applied	Specific to AWMS
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$MS\%_{BL\ 2,j}$
Unit	Fraction
Description	Fraction of manure handled in stage 2 of the baseline manure management system *j*
Source of data	AWMS baseline information
Value(s) applied	Specific to AWMS
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	D_{CH4}
Unit	ton/m^3
Description	Density of the methane
Source of data	IPCC value, specified in AMS-III.D
Value(s) applied	0.00067, default value at standard temperature (20°C) and pressure (1 atm).
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	UF_b
Unit	Fraction
Description	Model correction factor to account for model uncertainties.
Source of data	IPCC default value as per AMS III.D
Value(s) applied	0.94
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$W_{default}$
Unit	Kg
Description	Default average animal weight of a defined population
Source of data	IPCC default, Volume 4 chapter 10 table 10 A-4 to 10 A-9
Value(s) applied	Specific AWMS
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$VS_{default}$
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	IPCC default, Volume 4 chapter 10 table 10 A-4 to 10 A-9 Volatile solids (*VS*) IPCC default values from 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 10 table 10 A-4 to 10 A-9 can be used provided the assessment of suitability of those data to the specific situation of the treatment site particularly with reference to feed intake levels.
Value(s) applied	Specific to AWMS
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	*IC*
Unit	MW
Description	Installed capacity of the power plant
Source of data	Design capacity of the equipment installed
Value(s) applied	Specific to CPA
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	*CP*
Unit	MW
Description	Captive power
Source of data	Design capacity of the equipment installed
Value(s) applied	Specific to CPA
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	*TC*
Unit	MW
Description	Installed capacity of the thermal plant
Source of data	Design capacity of the equipment installed
Value(s) applied	Specific to CPA
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	*PA*
Unit	%
Description	Plant availability
Source of data	Manufacture's specifications
Value(s) applied	Specific to CPA
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EF_{CO2,grid,y}$
Unit	tCO_2e/MWh
Description	CO_2 emission factor of the grid in year *y*
Source of data	Calculated, see Appendix 4
Value(s) applied	0.9
Choice of data or Measurement methods and procedures	A 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"
Purpose of data	Calculation of baseline and project emissions
Additional comment	The emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required.

Data / Parameter	$EG_{estimated,y}$
Unit	MWh/yr
Description	Estimated net electrical energy that would have been produced by the existing units under the observed availability of the renewable resource in year *y*
Source of data	Estimation - Plant records / Manufacturer's specification
Value(s) applied	CPA specific value
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$DATE_{BaselineRetrofit}$
Unit	-
Description	Date at which the existing generation facility is likely to be replaced or retrofitted in the absence of the CDM project activity
Source of data	According to the "Tool to determine the remaining lifetime of equipment".
Value(s) applied	CPA specific
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EG_{thermal,estimated,y}$
Unit	TJ/yr
Description	The estimated thermal energy that would have been produced by the existing units under the observed availability of the renewable resource for year *y*
Source of data	Estimation - Plant records / Manufacturer's specification
Value(s) applied	CPA specific value
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EG_{HY,thermal,retrofit,y}$
Unit	TJ
Description	Average of historical thermal energy levels delivered by the existing facility, spanning all data from the most recent available year (or month, week or other time period) to the time at which the facility was constructed, retrofitted, or modified in a manner that significantly affected output (i.e. by 5% or more)
Source of data	Plant records
Value(s) applied	Specific to CPA
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EG_{estimated,thermal,y}$
Unit	TJ
Description	Estimated thermal energy that would have been produced by the existing units under the observed availability of renewable resources in year *y*
Source of data	Estimated
Value(s) applied	CPA specific
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of Baseline emissions
Additional comment	-

Data / Parameter	$\eta_{BL,thermal}$
Unit	%
Description	Efficiency of the plant using fossil fuel that would have been used in the absence of the project activity.
Source of data	Plant records / Manufacturer's specification
Value(s) applied	CPA specific value
Choice of data or Measurement methods and procedures	The value shall be calculated according to paragraph 28 – 31 in Methodology AMS-I.C (Version 19).
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EF_{FF,CO2}$
Unit	tCO_2e/TJ
Description	The CO_2 emission factor of the fossil fuel that would have been used in the baseline plant.
Source of data	The following data sources may be used if the relevant conditions apply:

Data source	Conditions for using the data source
a) Values provided by the fuel supplier in invoices	This is the preferred source
b) Measurements by the CPA implementers	If a) is not available
c) Regional or national default values	If a) is not available. These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances)
d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories	If a) is not available

Value(s) applied	CPA specific value
Choice of data or Measurement methods and procedures	For a) and b): Measurements should be undertaken in line with national or international fuel standards. For a) and b): The CO_2 emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated. For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	k
Unit	-
Description	Degradation rate constant (0.069)
Source of data	IPCC default, methodology AMS-III.D
Value(s) applied	0.069
Choice of data or Measurement methods and procedures	
Purpose of data	Calculation of project emissions
Additional comment	-

Data / Parameter	MCF_l
Unit	%
Description	Annual methane conversion factor for the project manure storage device *l*
Source of data	IPCC default and project design information
Value(s) applied	Specific to plant
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

Data / Parameter	φ
Unit	-
Description	Model correction factor to account for model uncertainties
Source of data	IPCC default from "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"
Value(s) applied	0.9
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

Data / Parameter	*OX*
Unit	Fraction
Description	Oxidation factor of the project SWDS (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data	IPCC default and project SWDS information
Value(s) applied	Use 0.1 for managed solid waste disposal sites that are covered with oxidizing material such as soil or compost. Use 0 for other types of solid waste disposal sites
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

Data / Parameter	*F*
Unit	Fraction
Description	Fraction of methane in the SWDS gas (volume fraction)
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	0.5
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comment	This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, under anaerobic conditions in the SWDS. A default value of 0.5 is recommended by IPCC

Data / Parameter	DOC_f
Unit	Fraction
Description	Fraction of degradable organic carbon (DOC) that can decompose
Source of data	IPCC default
Value(s) applied	0.5
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

Data / Parameter	*MCF*
Unit	Fraction
Description	Methane correction factor of the project SWDS
Source of data	Project SWDS information and IPCC 2006 Guidelines for National Greenhouse Gas Inventories.
Value(s) applied	Specific to the project SWDS Use the following values for MCF. • 1.0 for anaerobic managed solid waste disposal sites. These must have controlled placement of waste (i.e., waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires) and will include at least one of the following: (i) cover material; (ii) mechanical compacting; or (iii) leveling of the waste; • 0.5 for semi-aerobic managed solid waste disposal sites. These must have controlled placement of waste and will include all of the following structures for introducing air to waste layer: (i) permeable cover material; (ii) leachate drainage system; (iii) regulating pondage; and (iv) gas ventilation system;

	• 0.8 for unmanaged solid waste disposal sites – deep and/or with high water table. This comprises all SWDS not meeting the criteria of managed SWDS and which have depths of greater than or equal to 5 meters and/or high water table at near ground level. Latter situation corresponds to filling inland water, such as pond, river or wetland, by waste; • 0.4 for unmanaged-shallow solid waste disposal sites. This comprises all SWDS not meeting the criteria of managed SWDS and which have depths of less than 5 m
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comment	The methane correction factor (MCF) accounts for the fact that unmanaged SWDS produce less methane from a given amount of waste than managed SWDS, because a larger fraction of waste decomposes aerobically in the top layers of unmanaged SWDS

Data / Parameter	DOC_j
Unit	Fraction
Description	Fraction of degradable organic carbon (by weight) in the residual waste
Source of data	Project SWDS information and IPCC 2006 Guidelines for National Greenhouse Gas inventories (adapted from Volume 5, Tables 2.4 and 2.5)
Value(s) applied	In the case of industrial sludge, a value of 9% (% wet sludge) shall be used assuming an organic dry matter content of 35 percent. In the case of domestic sludge, a value of 5% (wet sludge) shall be used, assuming an organic dry matter content of 10 percent.
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comment	For industrial sludge, the value must be adjusted for other percentages of organic dry matter content as follows: DOC (% wet sludge) = 9 × (% organic dry matter content/35). For domestic sludge, the value must be adjusted for other percentages of organic dry matter content as follows: DOC (% wet sludge) = 5 × (% organic dry matter content/10).

Data / Parameter	k_j
Unit	-
Description	Decay rate for residual waste
Source of data	Project SWDS information and IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)
Value(s) applied	Apply the following default values for residual waste:

Waste type *j*		Boreal and Temperate (MAT≤20°C)		Tropical (MAT>20°C)	
		Dry MAP/PET <1	Wet (MAP/PET >1)	Dry (MAP< 1000mm)	Wet (MAP> 1000mm)
Rapidly degrading	Food, food waste, sewage sludge, beverages and tobacco	0.06	0.185	0.085	0.4

Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

Data / Parameter	GWP_{N2O}
Unit	($kgCO_2$/kg N_2O)
Description	Global Warming Potential for N_2O
Source of data	IPCC default = 310, valid for the first commitment period
Value(s) applied	310
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of leakage emissions
Additional comment	-

Data / Parameter	EF_1
Unit	ton N_2O-N/ton N input
Description	Emission Factor for emissions from N inputs
Source of data	IPCC 2006 Guidelines Table 11.1
Value(s) applied	1%
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of leakage emissions
Additional comment	-

Data / Parameter	MW_{N2O}
Unit	ton N_2O/ton N
Description	Ratio of molecular weights of N_2O and N
Source of data	Chemistry mass balance
Value(s) applied	44/28
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of leakage emissions
Additional comment	-

Data / Parameter	$Frac_{GASF}$
Unit	%
Description	Fraction that volatilises as NH_3 and NO_x for synthetic fertilizers
Source of data	2006 IPCC guidelines Table 11.3
Value(s) applied	10% volatilises as NO_x and 20% as NH_3
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of leakage emissions
Additional comment	-

Data / Parameter	$Frac_{GASM}$
Unit	%
Description	Fraction that volatilises as NH_3 and NO_x for organic fertilizers
Source of data	IPCC default
Value(s) applied	10% volatilises as NO_x and 20% as NH_3
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of leakage emissions
Additional comment	-

Data / Parameter	-
Unit	-
Description	Demonstration that the biomass residue type k from a specific source would continue not to be collected or utilized, e.g. by an assessment whether a market has emerged for that type of biomass residue (if yes, leakage is assumed not be ruled out) or by showing that it would still not be feasible to utilize the biomass residues for any purposes
Source of data	Information from the site where the biomass is generated
Value(s) applied	-
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of leakage emissions
Additional comments	Monitoring of this parameter is applicable if approach L_1 is used to rule out leakage

Data / Parameter	$BF_{available,k,y}$
Unit	ton/yr
Description	Quantity of available biomass residues of type *k* or *m* in the region
Source of data	Surveys or statistics from the defined geographical region
Value(s) applied	Specific to CPA
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of leakage emissions
Additional comments	Monitoring of this parameter is applicable if approach L_2 is used to rule out leakage or if approach L_4 is used in combination with approach L_2 to rule out leakage for the substituted biomass residue type *m*

Data / Parameter	$BF_{utilized,k,y}$
Unit	ton/yr
Description	Quantity of available biomass residues of type *k* or *m* that are utilized in the defined geographical region
Source of data	Surveys or statistics from the defined geographical region
Value(s) applied	Specific to CPA
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of leakage emissions
Additional comments	Monitoring of this parameter is applicable if approach L_2 is used to rule out leakage or if approach L_4 is used in combination with approach L_2 to rule out leakage for the substituted biomass residue type *m*

Data / Parameter	$EF_{CO2,LE}$
Unit	tCO_2/TJ
Description	CO_2 emission factor of the most carbon intensive fuel used in the country
Source of data	Identify the most carbon intensive fuel type from the national communication, other literature sources (e.g. IEA). Possibly consult with the national agency responsible for the national communication / GHG inventory. If available, use national default values for the CO_2 emission factor. Otherwise, IPCC default values may be used
Value(s) applied	Specific to CPA
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of leakage emissions
Additional comments	-

B.6.3. Ex-ante calculations of emission reductions

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Emission reductions shall be calculated *ex ante* as follows:

$$ER_y = BE_y - PE_y - LE_y$$

Where:

ER_y	Emission reductions in year *y* (tCO_2e/yr)
BE_y	Baseline emissions in year *y* (tCO_2e/yr)
PE_y	Project emissions in year *y* (tCO_2e/yr)
LE_y	Leakage emissions in year *y* (tCO_2e/yr)

<u>BASELINE EMISSIONS</u>

$$BE_y = BE_{AMS\text{-}III.D,y} + BE_{AMS\text{-}I.C,y}$$

Where:

$BE_{AMS\text{-}III.D,y}$ Baseline emissions from AWMS (tCO_2e/yr), calculated in section "Baseline emissions – AMS-III.D"

$BE_{AMS\text{-}I.C,y}$ Baseline emissions from renewable thermal energy with or without electricity (tCO_2e/yr), calculated in section "Baseline emissions – AMS-I.C".

Baseline emissions- AMS-III.D

The baseline scenario 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. Baseline emissions (BE_y) are calculated by using one of the following two options:

(a) Using the amount of the waste or raw material that would decay anaerobically in the absence of the project activity, with the most recent IPCC tier 2 approach

(b) Using the amount of manure that would decay anaerobically in the absence of the project activity based on direct measurement of the quantity of manure treated together with its specific volatile solids (*SVS*) content.

Baseline emissions calculated using option (a)

$$BE_{AMS\text{-}III.D,y} = BE_{stage\ 1,y} + BE_{stage\ 2,y}$$

Where:

$EB_{stage1,y}$ Baseline emissions for sequential treatment stages one (tCO_2e/yr)

$EB_{stage2,y}$ Baseline emissions for sequential treatment stages two (tCO_2e/yr)

***Stage 1:* The annual emissions in treatment stage one is determined as follows:**

$$BE_{stage\ 1,y} = GWP_{CH4} \times D_{CH4} \times UF_b \times \sum_{j,LT} MCF_{BL1,j} \times B_{0,LT} \times N_{LT,y} \times VS_{LT,y} \times RVS \times MS\%_{BL1,j}$$

Where:

GWP_{CH4} Global Warming Potential (GWP) of CH_4 (21)

$VS_{LT,y}$ Volatile solids for each livestock type (LT) entering the animal manure management system in year *y* (on a dry matter weight basis, kg dm/animal/year)

$N_{LT,y}$ Annual average number of animals of type "LT" in year *y* (numbers)

$B_{0,LT}$ Maximum methane producing potential of the VS generated for each animal type (m^3 CH_4/kg dm)

D_{CH4} CH_4 density (0.00067 t/m^3 at room temperature (20 ºC) and 1 atm pressure)

$MCF_{BL1,j}$ Annual methane conversion factor for stage 1 of the baseline animal manure management system *j*

$MS\%_{BL1,j}$ Fraction of manure handled in stage 1 of the baseline manure management system *j*

UF_b Model correction factor to account for model uncertainties (0.94)

RVS Relative reduction of Volatile solids in stage one

LT Index for all types of livestock

j Index for animal waste management system

***Stage 2:* The annual emissions in treatment stage two is determined as follows:**

In case of sequential treatment stages, the reduction of the volatile solids during a treatment stage is estimated based on referenced data for different treatment types. Emissions from the next treatment stage are then calculated following the approach outlined above in stage 1, but with volatile solids adjusted for the reduction from the previous treatment stages by multiplying by (1 - *RVS*), where *RVS* is the relative reduction of volatile solids from the previous stage. The relative reduction (*RVS*) of volatile solids

depends on the treatment technology and should be estimated in a conservative manner. Default values from annex1 in Methodology AMS-III.D may be used.

$$BE_{stage\ 2,y} = GWP_{CH4} \times D_{CH4} \times UF_b \times \sum_{j,LT} MCF_{BL2,j} \times B_{0,LT} \times N_{LT,y} \times VS_{LT,y} \times (1\text{-}RVS) \times MS\%_{BL2,j}$$

Where:

$MCF_{BL2,j}$ Annual methane conversion factor for stage 2 of the baseline animal manure management system *j*

$MS\%_{BL2,j}$ Fraction of manure handled in stage 2 of the baseline manure management system *j*

The annual average number of the livestock population ($N_{LT,y}$):

In the case of static animal populations, date will be obtain from the animal inventory. For a growing populations the following equation estimates the annual average of livestock population.

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

Where :

$N_{LT,y}$ Annual average number of animals in year *y* ($N_{LT,y}$)

$N_{da,y}$ Number of days animal is alive in the farm in year *y* (days)

$N_{p,y}$ Number of animals produced annually for the year *y* (numbers)

<u>Parameter description:</u>

Volatile solids (VS) from livestock:

There are two methods for calculating Volatile solids (VS) for different livestock types. The different methods may be used under the following conditions. Where it can be demonstrated that the genetic source of the livestock originates from an Annex I Party, both methods may be applied. Where it can not be demonstrated that the genetic source of the livestock originates from an Annex I Party, only the enhanced characterisation method may be applied. Calculated values from the enhanced characterisation method shall be compared with IPCC default values and any significant differences shall be explained.

$$VS_{LT,y} = VS_{LT\ IPCC,y}, \text{ or } VS_{LT\ feed,y}$$

Where:

$VS_{LT,y}$ Volatile solids for livestock "LT" entering the animal manure management system in year *y* (kg dm/animal/year)

$VS_{LT\ IPCC,y}$ Volatile solids for livestock "LT" entering the animal manure management system in year *y*, calculated using default IPCC values (kg dm/animal/year)

$VS_{LT\ feed,y}$ Volatile solids for livestock "LT" entering the animal manure management system in year *y*, calculated using the enhanced characterisation method (kg dm/animal/year)

Volatile solids calculated using default IPCC values:

Default IPCC values from 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 10 table 10 A-4 to 10 A-9 may be used. VS values applicable to developed countries can be used provided the following four conditions are satisfied:

Conditions
The genetic source of the production operations livestock originates from an Annex I Party
The farm uses formulated feed rations (FFR) which are optimized for the various animal(s), stage of

growth, category, weight gain/productivity and/or genetics
The use of FFR can be validated (through on-farm record keeping, feed supplier, etc.)
The project specific animal weights are more similar to developed country IPCC default values

Default IPCC volatile solid values are adjusted for a site-specific average animal weight with the following equation:

$$VS_{LT\,IPCC,y} = \left(\frac{W_{site}}{W_{default}}\right) \times VS_{default} \times nd_y$$

Where:

W_{site}	Average animal weight of a defined livestock population at the project site (kg)
$W_{default}$	Default average animal weight of a defined population, data sourced from IPCC 2006 (kg)
$VS_{default}$	Default value for the volatile solid excretion rate per day on a dry-matter basis for a defined livestock population (kg dm/animal/day)
nd_y	Number of days in year *y* that the treatment plant was operational

Volatile solids calculated using the enhanced characterisation method:

Country-specific volatile solid excretion rates can be estimated from feed intake levels, via the enhanced characterisation method described in section 10.2 in 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 10. The following equation shall then be used:

$$VS_{LT\,feed,y} = \left[GE_{LT} \times \left(1 - \frac{DE_{LT}}{100}\right) + (UE \times GE_{LT})\right] \times \left[\frac{1-ASH}{18.45}\right] \times nd_y$$

Where:

GE_{LT}	Gross energy intake (MJ/day).
DE_{LT}	Digestibility of the feed in percent, Table 10.2 2 in 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 10.
UE	Urinary energy expressed as fraction of GE. Typically 0.04 can be considered urinary energy excretion by most ruminants (reduce to 0.02 for ruminants fed with 85% or more grain in the diet or for swine).
ASH	Ash content of the manure in calculated as a fraction of the dry matter feed intake (e.g, 0.08 for cattle).
18.45	Energy density of the feed fed to livestock type LT (ED_{LT}). IPCC notes the energy density of feed is typically 18.45 MJ/kg DM, which is relatively constant across a wide variety of grain-based feeds
nd_y	Number of days in year *y* where the treatment plant was operational

Maximum methane-producing capacity of the manure (B_o)

Default values from tables 10 A-4 to 10 A-9 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10. B_0 values applicable to developed countries can be used provided the following four conditions are satisfied:

Conditions
The genetic source of the production operations livestock originates from an Annex I Party
The farm uses formulated feed rations (FFR) which are optimized for the various animal(s), stage of growth, category, weight gain/productivity and/or genetics
The use of FFR can be validated (through on-farm record keeping, feed supplier, etc.)
The project specific animal weights are more similar to developed country IPCC default values

Methane Conversion Factor (MCF)

IPCC default values provided in table 10.17 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Chapter 10 can be used.

<u>Baseline emissions calculated using option (b)</u>

$$BE_y = GWP_{CH4} \times D_{CH4} \times UF_b \times \sum_{j,LT} MCF_j \times B_{0,LT} \times Q_{manure,j,LT,y} \times SVS_{j,LT,y}$$

Where:

$Q_{manure,j,LT,y}$	Quantity of manure treated from livestock type *LT* and animal manure management system *j* (ton/year, dry basis)
$SVS_{j,LT,y}$	Specific volatile solids content of animal manure from livestock type *LT* and animal manure management system *j* in year *y* (%, dry basis)

<u>BASELINE EMISSIONS - AMS-I.C</u>

Baseline emissions will be calculated for the applicable scenarios:

Scenario		Description
1	$BE_{thermal,CO2,y}$	Baseline emissions from project activities that install biomass thermal energy plants that produce renewable thermal energy for on-site consumption or for consumption by other facilities (tCO_2e/yr).
2	$BE_{cogen,y}$	Baseline emissions from project activities that install biomass cogeneration plants that produce renewable electricity for supply to the grid or for captive use and renewable thermal energy for on-site consumption or for consumption by other facilities (tCO_2e/yr).
3	$BE_{add,y}$	Baseline emissions from project activities that involve the addition of renewable thermal energy units at an existing renewable energy production facility (tCO_2e/yr).

Scenario 1: Project activities that install thermal energy plants that produce renewable thermal energy for on-site consumption or for consumption by other facilities.

Baseline emissions shall be calculated as follows:

$$BE_{thermal,CO2,y} = (EG_{thermal,y}/\eta_{BL,thermal}) \times EF_{FF,CO2}$$

Where:

$BE_{thermal,CO2,y}$	The baseline emissions from thermal energy displaced by the project activity during the year *y* (tCO_2)
$EG_{thermal,y}$	Net quantity of thermal energy supplied by the project activity during the year *y* (TJ/yr)
$\eta_{BL,thermal}$	Efficiency of the plant using fossil fuel that would have been used in the absence of the project activity (%).
$EF_{FF,CO2}$	The CO_2 emission factor of the fossil fuel that would have been used in the baseline plant obtained from reliable local or national data if available, alternatively, IPCC default emission factors can be used (tCO_2/TJ)

Where:

$$EG_{thermal,y} = TC \times (31\,536\,000 / 1000\,000) \times PA$$

Where:

TC	Thermal installed capacity (MW)

31 536 000 Conversion factor to convert MW to MJ/yr (60×60×24×365 seconds/year)
PA Plant Availability (%)

Scenario 2: Project activities that install cogeneration plants that produce renewable electricity for supply to the grid or for captive use and renewable thermal energy for on-site consumption or for consumption by other facilities.

Baseline emissions shall be calculated as follows:

$$BE_{cogen,y} = BE_{elec,y} + BE_{thermal,CO2,y}$$

Where:
$BE_{cogen,y}$ Baseline emissions from project activities that install biomass cogeneration plants that produce renewable electricity for supply to the grid or for captive use and renewable thermal energy for on-site consumption or for consumption by other facilities (tCO_2e/yr).
$BE_{thermal,CO2,y}$ The baseline emissions from thermal energy displaced by the project activity during the year *y* (tCO_2).
$BE_{elec,y}$ Baseline emissions from project activities that supply electricity to the grid or for captive use (tCO_2e/yr).

2.1 The baseline emissions from thermal energy displaced by the project activity during shall be calculated as follows:

Calculated as in Scenario 1

2.2 Baseline emissions from project activities that supply electricity to the grid or for captive use shall be calculated as follows:

$$BE_{elec,y} = EG_{BL,y} \times EF_{CO2,grid,y}$$

Where:
$BE_{elec,y}$ Baseline emissions from project activities that supply electricity to the grid or displace electricity from the grid (tCO_2e/yr).
$EG_{BL,y}$ The amount of net renewable electricity supplied to the grid or displaced from the grid as a result of the implementation of the CDM project activity in year *y* (MWh/yr)
$EF_{CO2,grid,y}$ CO_2 emission factor of the grid in year *y* (tCO_2e/MWh)

Where:
$$EG_{BL,y} = EG_{elec,gross,y} - EG_{elec,captive,y}$$

Where:
$EG_{elec,gross,y}$ The gross amount of renewable electricity generated from the project activity (MWh/yr)
$EG_{elec,captive,y}$ Captive electricity consumption (MWh/yr)

With:
$$EG_{elec,gross,y} = IC \times 8\,760 \times PA$$

Where:
IC Installed capacity (MW)
8 760 Conversion factor to convert MW to MWh (24 ×365 hours/yr)
PA Plant availability (%)

And:

$EG_{elec,captive,y} = CP \times 8\,760 \times PA$

Where:

CP	Captive power (MW)
8 760	Conversion factor to convert MW to MWh (24 ×365 hours/yr)
PA	Plant availability (%)

Scenario 3: Project activities that involve the addition of renewable energy units at an existing renewable energy production facility.

The units may be thermal energy units or cogeneration units.

$BE_{add,y} = BE_{thermal,add,y} + BE_{add,CO2,y}$

Where:

$BE_{add,y}$	Baseline emissions from project activities that involve the addition of renewable energy units at an existing renewable energy production facility (tCO_2e/yr).
$BE_{thermal,add,y}$	Baseline emissions from project activities that involve the addition of renewable thermal energy units at an existing renewable energy production facility (tCO_2e/yr).
$BE_{add,CO2,y}$	Baseline emissions from project activities that involve capacity addition to renewable electricity plants that supply electricity to the grid or displace electricity from the grid (tCO_2e/yr).

3.1 Baseline emissions from project activities that involve the addition of renewable thermal energy units at an existing renewable energy production facility shall be calculated as follows:

$BE_{thermal,add,y} = (EG_{thermal,add,y}/\eta_{BL,thermal}) \times EF_{FF,CO2}$

Where:

$BE_{thermal,add,y}$	Baseline emissions from project activities that involve the addition of renewable thermal energy units at an existing renewable energy production facility (tCO_2e/yr).
$EG_{thermal,add,y}$	Net increase in thermal energy generation at existing plant in year y that should be considered as energy baseline (TJ/yr)

Where

$EG_{thermal,add,y} = EG_{thermal,PJ,y} - EG_{thermal,old,y}$

Where:

$EG_{thermal,PJ,y}$	Total actual thermal energy produced in year *y* by all units, existing and new project units (TJ/yr).
$EG_{thermal,old,y}$	Estimated thermal energy that would have been produced by existing units (installed before the project activity) in year *y* in the absence of the project activity (TJ/yr)

The value $EG_{thermal,old,y}$ is given by:

$EG_{thermal,old,y} = MAX(EG_{thermal,actual,y}\,;\, EG_{thermal,estimated,y})$

Where:

$EG_{thermal,actual,y}$	The actual, measured thermal energy production of the existing units in year *y* (TJ/yr)
$EG_{thermal,estimated,y}$	The estimated thermal energy that would have been produced by the existing units under the observed availability of the renewable resource for year *y* (TJ/yr).

If the existing units shut down, are derated, or otherwise become limited in production, the project activity should not get credit for generating energy from the same renewable resources that would have otherwise been used by the existing units (or their replacements). Therefore, the equation for $EG_{thermal,old,y}$ still holds, and the value for $EG_{thermal,estimated,y}$ should continue to be estimated assuming the capacity and operating parameters are the same as that at the time of the start of the project activity.

If the existing units are subject to modifications or retrofits that increase production, then $EG_{thermal,old,y}$ can be estimated using the procedures described below.

$$EG_{thermal,old,y} = MAX\left(EG_{HY,thermal,retrofit,y}, EG_{estimated,thermal,y}\right) \quad until \quad DATE_{BaselineRretrofit}$$

Where:

$EG_{HY,thermal,retrofit,y}$	Average of historical thermal energy levels delivered by the existing facility, spanning all data from the most recent available year (or month, week or other time period) to the time at which the facility was constructed, retrofitted, or modified in a manner that significantly affected output (i.e. by 5% or more) (TJ)
$EG_{estimated,thermal,y}$	Estimated thermal energy that would have been produced by the existing units under the observed availability of renewable resources in year *y* (TJ)
$DATE_{BaselineRetrofit}$	Date at which the existing generation facility is likely to be replaced or retrofitted in the absence of the CDM project activity

3.2 Baseline emissions from project activities that involve capacity addition to renewable electricity plants that supply electricity to the grid or displace electricity from the grid

The baseline scenario is the existing facility that would continue to supply electricity to the grid at historical levels, until the time at which the generation facility would likely be replaced or retrofitted ($DATE_{BaselineRetrofit}$). From that point of time onwards, the baseline scenario is assumed to correspond to the project activity, and no emission reductions are assumed to occur. The energy baseline corresponds to the net increase in electricity production associated with the project should be calculated as follows:

$$BE_{add,CO2,y} = (EG_{PJ,add,y} - EG_{BL,existing,y}) \times EF_{CO2,grid,y}$$

Where:

$BE_{add,CO2,y}$	Baseline emissions from project activities that involve capacity addition to renewable electricity plants that supply electricity to the grid or displace electricity from the grid (tCO_2e/yr).
$EG_{PJ,add,y}$	The total net electrical energy supplied to a grid or displaced from the grid in year *y* by all units, existing and new project units (MWh/yr).
$EG_{BL,existing,y}$	The estimated net amount of electricity that would have been supplied to a grid or to a captive plant by existing units (installed before the project activity) in year *y* in the absence of the project activity (MWh/yr).

Where:

$$EG_{BL,existing,y} = MAX\ (EG_{actual,y}\ ;\ EG_{estimated,y})\ until\ DATE_{BaselineRetrofit}$$

and

$$EG_{BL,existing,y} = 0;\ \text{on/after}\ DATE_{BaselineRetrofit}$$

Where:

$EG_{actual,y}$	The actual, measured net electrical energy supplied to the grid or displaced from the grid by the existing units in year *y* (MWh/yr).

$EG_{estimated,y}$	Estimated net electrical energy that would have been produced by the existing units under the observed availability of the renewable resource in year *y* (MWh/yr).
$DATE_{BaselineRetrofit}$	Date at which the existing generation facility is likely to be replaced or retrofitted in the absence of the CDM project activity

If the existing units shut down, are derated, or otherwise become limited in production, the project activity should not get credit for generating electricity from the same renewable resources that would have otherwise been used by the existing units (or their replacements). Therefore, the equation for $EG_{elec,existing,y}$ still holds, and the value for $EG_{elec,estimated,y}$ should continue to be estimated assuming the capacity and operating parameters are the same as that at the time of the start of the project activity.

PROJECT EMISSIONS

Project activity emissions consist of:

$$PE_y = PE_{PL,y} + PE_{flare,y} + PE_{transp,y} + PE_{storage,y} + PE_{reswaste,y} + PE_{FC,i,j,y} + PE_{elec,y}$$

Where:

$PE_{,y}$	Project emissions in year *y* (tCO_2e/yr)
$PE_{PL,y}$	Emissions due to physical leakage of biogas in year *y* (tCO_2e/yr)
$PE_{flare,y}$	Emissions from biogas flaring the year *y* (tCO_2e/yr)
$PE_{transp,y}$	Emissions from incremental transportation in the year *y* (tCO_2e/yr)
$PE_{storage,y}$	Emissions from the storage of manure before being fed into the anaerobic digester (tCO_2e/yr)
$PE_{reswaste,y}$	In case residual wastes are subjected to anaerobic storage, or disposed in a landfill, methane emissions from storage/disposal of waste (tCO_2e/yr)
$PE_{FF,y}$	Emissions from the use of fossil fuel for the operation of the facilities in the year *y* (tCO_2e/yr)
$PE_{elec,y}$	Emissions from the use of electricity for the operation of the facilities in the year *y* (tCO_2e/yr)

a) Emissions from physical leakage:

Methane emissions due to physical leakages from the digester and recovery system shall be estimated using a default factor of 0.05 m³ biogas leaked/m³ biogas produced. For ***ex post*** calculations the effectively recovered biogas amount shall be used for the calculation.

For ***ex ante*** estimation the expected biogas production of the digester may be used and leakage shall be calculated as follows:

$$PE_{PL,y} = CH4_y \times 0.05 \times D_{CH4} \times GWP_{CH4}$$

Where:

$CH4_y$ =	Methane production in year y (Nm^3/yr)
$D_{CH4,n}$	Density of methane at normal conditions (0.716) (kg/m^3)

b) Emissions from flaring:

Emissions from flaring will be calculated ***ex ante***, for methane produced while the plant is of line, using a flare efficiency of 50% for open flares or 90% for enclosed flares.

$$PE_{flare} = CH4_y \times (1 - PA) \times (1 - EF) \times D_{CH4} \times GWP_{CH4}$$

Where:

$CH4_y$ Methane production in year y (Nm^3/yr)
PA Plant Availability (%)
FE Flare efficiency as 50% or 90%

Emissions from flaring will be calculated ***ex post*** *as follow:*

Emissions from flaring are calculated using the procedures described in the "Tool to determine project emissions from flaring gases containing methane". According to the tool, PE_{flare} is as follows:

$$PE_{flare,expost,y} = \sum_{h=1}^{8760} TM_{RG,h} \times (1 - \eta flare, h) \times \frac{GWP_{CH4}}{1000}$$

Where:

$PE_{flare,y}$ Project emissions from flaring in year y (tCO_2e/yr)
$TM_{RG,h}$ Mass flow rate of methane in the residual gas in the hour h
$\eta_{flare,h}$ Flare efficiency in hour h

Where:

$TM_{RG,h} = FV_{RG,h} \times w_{CH4,y} \times D_{CH4,n}$

$FV_{RG,h}$ Volumetric flow rate of the biogas at normal conditions in hour h (m^3/h)
$w_{CH4,y}$ Volumetric fraction of methane in the biogas basis in hour h (fraction), alternatively a default value of 60% methane content can be used
$D_{CH4,n}$ Density of methane at normal conditions (0.716) (kg/m^3)

In case of enclosed flares and use of the default value for the flare efficiency (90%), the flare efficiency in the hour h ($\eta_{flare,h}$) is:

- 0% if the temperature in the exhaust gas of the flare (T_{flare}) is below 500 °C for more than 20 minutes during the hour h .
- 50%, if the temperature in the exhaust gas of the flare ((T_{flare}) is above 500 °C for more than 40 minutes during the hour h, but the manufacturer's specifications on proper operation of the flare are not met at any point in time during the hour h.
- 90%, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500 °C for more than 40 minutes during the hour h and the manufacturers specifications on proper operation of the flare are met continuously during the hour h.

In case of open flares, the flare efficiency in the hour h ($\eta_{flare,h}$) is

- 0% if the flame is not detected for more than 20 minutes during the hour h.
- 50%, if the flare is detected for more than 20 minutes during the hour h.

c) Emissions from incremental transportation:

Where substrates are used for renewable energy generation only (BT), project emissions due to incremental transport distances are not applicable. Emissions associated with transportation of these substrates are accounted for as leakage emissions.

For project activities that involve methane avoidance, project emissions due to incremental transport distances $PE_{y,transp}$ are calculated based on the incremental distances between:

(i) The collection points of manure (LT) and the digestion site as compared to the baseline solid waste disposal site or manure treatment site;

(ii) Treatment sites and the sites for soil application, landfilling and further treatment of the residual waste.

$$PE_{y,transp} = (Q_{y,LT}/CT_{y,LT}) \times DAF_{LT} \times EF_{CO2/km} + (Q_{y,res\text{-}waste}/CT_{y,res\text{-}waste}) \times DAF_{res\text{-}waste} \times EF_{CO2/km}$$

Where:

$Q_{y,LT}$	Quantity of raw manure transported in the year *y* (ton)
$CT_{y,LT}$	Average truck capacity for manure transportation (ton/truck)
DAF_{LT}	Average incremental distance for manure transportation (km/truck)
$Q_{y,res\text{-}waste}$	Quantity of digester residual waste transported in year *y* (ton)
$CT_{y,res\text{-}waste}$	Average truck capacity for residual waste transportation (ton/truck)
$DAF_{res\text{-}waste}$	Average incremental distance for residual waste transportation (km/truck)
$EF_{CO2/km}$	CO_2 emission factor from fossil fuel used for transportation inside the project boundary (tCO_2e/km)

CO_2 emission factor from fossil fuel used for transportation

$$EF_{CO2/km} = VF_{cons} \times D_{fuel} \times NCV_{fuel,y} \times EF_{CO2,fuel}$$

Where:

VF_{cons}	Vehicle fuel consumption for transportation inside the project boundary (ℓ/km)
D_{fuel}	Fuel density for fuel used for transportation inside the project boundary (kg/ℓ)
$NCV_{fuel,y}$	Calorific value of the fuel used for transportation inside the project boundary (TJ/kg t)
$EF_{CO2,fuel}$	CO_2 emission factor of the fuel used for transportation inside the project boundary (tCO_2e/TJ)

d) Emissions from storage:

Where applicable, project emissions on account of storage of manure before being fed into the anaerobic digester shall be accounted for if both condition (a) and condition (b) below are satisfied:

(a) The storage time of the manure after removal from the animal barns, including transportation, exceeds 24 hours before being fed into the anaerobic digester; and

(b) The dry matter content of the manure when removed from the animal barns is less than 20%.

The following method shall be used to calculate project emissions from manure storage:

$$PE_{storage,y} = GWP_{CH_4} \times D_{CH_4} \times \sum_{LT,l}\left[\frac{365}{AI_l}\sum_{d=1}^{AI}(N_{LT,y} \times VS_{LT,d} \times MS\%_l \times (1-e^{-k\ (AI_l-d)}) \times MCF_l \times B_{0_{LT}})\right]$$

AI_l	Annual average interval between manure collection and delivery for treatment at a given storage
$MS\%_l$	Fraction of volatile solids (%) handled by storage device *l*
k	Degradation rate constant (0.069)
d	Days for which cumulative methane emissions are calculated; d can vary from 1 to 45 and to be run from 1 up to AI_l
MCF_l	Annual methane conversion factor for the project manure storage device *l* from Table 10.17, Chapter 10, Volume 4

e) Methane emissions from the disposal/storage/treatment of these residual waste

Where applicable, methane emissions from anaerobic storage and/or disposal in a landfill of the residual waste from the digestion ($PE_{reswaste,y}$) are calculated as per follows:

$$BE_{reswaste,y} = \varphi \cdot (1-f) \cdot GWP_{CH4} \cdot (1-OX) \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^{y} \sum_j W_{j,x} \cdot DOC_j \cdot e^{-k(y-x)} \cdot (1-e^{-kj})$$

Where:

φ	Model correction factor to account for model uncertainties (0.9)
f	Fraction of methane captured at the SWDS and flared, combusted or used in another manner
GWP_{CH4}	Global warming Potential of methane, valid for the relevant commitment period
OX	Oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste)
F	Fraction of methane in the SWDS gas (volume fraction) (0.5)
DOC_f	Fraction of degradable organic carbon (DOC) that can decompose (0.5)
MCF	Methane correction factor
$W_{j,x}$	Amount of organic waste type *j* prevented from disposal in the SWDS in the year *x* (tons)
DOC_j	Fraction of degradable organic carbon (by weight) in the waste type *j*
k_j	Decay rate for the waste type *j*
j	Waste type category (index)
x	Year during the crediting period: x runs from the first year of the firs crediting period (x=1) to the year y for which avoided emissions are calculated (x = y)
y	Year for which methane emissions are calculated

f) Emissions from fossil fuel:

Emissions from fossil fuel combustion in the project activity are calculated based on the quantity of fuels combusted and the CO_2 emission coefficient of those fuels, as follows:

$$PE_{FC,j,y} = FC_{i,j,,y} \times COEF_{i,y}$$

Where:

$FC_{i,j,y}$	Quantity of fossil fuel type *i* combusted in process *j* inside the project boundary in year *y* (ton/yr)
$COEF_{i,y}$	The CO_2 emission coefficient of fuel type i in year y (tCO_2/mass or volume unit)
i	Fossil fuel types combusted in process *j* inside the project boundary in year y

With:

$$COEF_{i,y} = NCV_{i,y} \times EF_{CO2,i,y}$$

Where:

$NCV_{i,y}$	Weighted average net calorific value of the fossil fuel type *i* combusted inside the project boundary in year *y* (TJ/ton)
$EF_{CO2,i,y}$	CO_2 emission factor of fossil fuel type *i* combusted inside the project boundary (tCO_2e/TJ)

g) Emissions from electricity use:

Project emissions from grid electricity consumption will be calculated as follows:

$$PE_{elec,y} = EC_{elec,y} \times EF_{CO2,grid,y}$$

Where:

$EC_{elec,y}$	Quantity of electricity consumed in the project boundary in year *y* (MWh/yr)
$EF_{CO2,grid,y}$	CO_2 emission factor of the grid in year *y* (tCO_2e/MWh)

LEAKAGE EMISSIONS

Leakage emissions from the renewable energy project activity consist of:

$$LE_y = LE_{FC,j,y} + LE_{transp,y} + LE_{renewable\ biomass,y}$$

Where:

$LE_{FC,j,y}$	Leakage emissions from collection/processing of biomass outside the project boundary during year *y* (tCO_2e/yr).
$LE_{transp,y}$	Leakage emissions from transportation of biomass outside the project boundary during year *y* (tCO_2e/yr).
$LE_{renewable\ biomass,y}$	Leakage emissions from project activities involving renewable biomass during year *y* (tCO_2e/yr).

Leakage emissions from collection/processing of biomass shall be calculated as follows:

Leakage emissions from fossil fuel combustion outside the project boundary are calculated based on the quantity of fuels combusted and the CO_2 emission coefficient of those fuels, as follows:

$$LE_{FC,j,y} = FC_{c,j,,y} \times COEF_{c,y}$$

Where:

$FC_{c,j,y}$	Quantity of fossil fuel type *c* combusted in process *j* outside the project boundary in year *y* (ton/yr)
$COEF_{c,y}$	The CO_2 emission coefficient of fuel type *c* in year y (tCO_2/mass or volume unit)
c	Fossil fuel types combusted in process *j* outside the project boundary in year y

With:

$$COEF_{c,y} = NCV_{c,y} \times EF_{CO2,c,y}$$

Where:

$NCV_{c,y}$	Weighted average net calorific value of the fossil fuel type *c* combusted outside the project boundary in year *y* (TJ/ton)
$EF_{CO2,c,y}$	CO_2 emission factor of fossil fuel type *c* combusted outside the project boundary (tCO_2e/TJ)

Leakage emissions from transportation shall be calculated as follows:

If the biomass is transported over a distance of more than 200 kilometres due to the implementation of the project activity then this leakage source attributed to transportation shall be considered, otherwise it can be neglected.

$$LE_{transp,y} = (Q_{LE,y}/CT_{LE,y}) \times DAF_{LE,w} \times EF_{LE,CO2/km}$$

Where:

$Q_{LE,y}$	Quantity of biomass transported outside project boundary in the year *y* (ton)
$CT_{LE,y}$	Average truck capacity for transportation outside the project boundary (ton/truck)
$DAF_{LE,w}$	Average incremental distance for biomass transportation outside project boundary (km/truck)
$EF_{LE,CO2/km}$	CO_2 emission factor from fossil fuel used for transportation outside boundary (tCO_2e/km)

CO_2 emission factor from fossil fuel use due to transportation

$EF_{LE,CO2/km} = VF_{LE,cons} \times D_{LE,fuel} \times NCV_{LE,fuel,y} \times EF_{LE,CO2,fuel}$

Where:

$VF_{LE,cons}$	Vehicle fuel consumption for transportation outside the project boundary (ℓ/km)
$D_{LE,fuel}$	Fuel density for fuel used for transportation outside the project boundary (kg/ℓ)
$NCV_{LE,fuel,y}$	Calorific value of the fuel used for transportation outside the project boundary (TJ/kg)
$EF_{LE,CO2,fuel}$	CO_2 emission factor of the fuel used for transportation outside the project boundary (tCO_2e/TJ)

Leakage emissions from project activities involving renewable biomass:

For small scale CDM project activities involving renewable biomass there are three types of emissions sources that are potentially significant (>10% of emission reductions) and attributable to the project activities.

$LE_{renewable\ biomass} = LE_{shift} + LE_{production} + LE_{competing}$

Where:

LE_{shift}	Leakage due to shifts of pre-project activities (tCO_2e/yr).
$LE_{production}$	Leakage due to emissions related to the production of the biomass (tCO_2e/yr).
$LE_{competing}$	Leakage due to competing uses for the biomass (tCO_2e/yr)

Leakage due to shifts of pre-project activities:

Demonstrate that the project activity does not lead to a shift of pre-project activities outside the project boundary i.e. the land under the proposed project activity can continue to provide at least the same amount of goods and services as in the absence of the project.

Therefore, $LE_{shift} = 0$

Leakage due to emissions related to the production of the biomass

Potentially significant emission sources from the production of renewable biomass can be:

(a) Emissions from application of fertilizer; and
(b) Project emissions from clearance of lands.

These emissions sources should respectively be included. All other emission sources are likely to be smaller than 10% (each) - including transportation of raw materials and biomass, fossil fuel consumption for the cultivation of plantations - and can therefore be neglected in the context of SSC project activities.

Potentially significant emission sources from the production of renewable biomass can be:

$LE_{production} = LE_{N2O} + LE_{clearance}$

Where:

LE_{N2O}	Direct N_2O emission as a result of nitrogen application (tCO_2e/yr)
$LE_{clearance}$	Emissions from clearance of lands (tCO_2e/yr)

(a) Emissions from application of fertilizer

The direct nitrous oxide emissions from nitrogen fertilization can be estimated using equations as follows:

$LE_{N2O} = (F_{SN,y} + F_{ON,y}) \times FE_1 \times MW_{N20} \times GWP_{N20}$

$F_{SN,y}$	Mass of synthetic fertilizer nitrogen applied adjusted for volatilization as NH_3 and NO_x (ton N/yr)
$F_{ON,y}$	Mass of organic fertilizer nitrogen applied adjusted for volatilization as NH_3 and NO_x (ton N/yr)
EF_1	Emission Factor for emissions from N inputs (ton N_2O-N/tN input)
MW_{N2O}	Ratio of molecular weights of N_2O and N (44/28) (ton N_2O/tN)
GWP_{N2O}	Global Warming Potential for N_2O ($kgCO_2$/kg N_2O) (IPCC default = 310, valid for the first commitment period)

Mass of fertilizer nitrogen applied shall be calculated as follows:

$$F_{SN,y} = \sum_i M_{SFi,y} \times NC_{SFi} \times (1 - Frac_{GASF})$$

$$F_{ON,y} = \sum_j M_{OFj,y} \times NC_{OFj} \times (1 - Frac_{GASM})$$

Where:

$M_{SFi,y}$	Mass of synthetic fertilizer type i applied (ton/yr)
$M_{OFj,y}$	Mass of organic fertilizer type j applied (ton/yr)
$Frac_{GASF}$	Fraction that volatilises as NH_3 and NO_x for synthetic fertilizers (%)
$Frac_{GASM}$	Fraction that volatilises as NH_3 and NO_x for organic fertilizers (%)
NC_{SFi}	Nitrogen content of synthetic fertilizer type i applied (gN/100 g fertilizer)
NC_{OFj}	Nitrogen content of organic fertilizer type j applied (gN/100 g fertilizer)

(b) Project emissions from clearance of lands

Demonstrate that the area where the biomass is grown is not a forest (as per DNA forest definition) and has not been deforested, according to the forest definition by the national DNA, during the last 10 years prior to the implementation of the project activity. In the absence of forest definition from the DNA, definitions provided by relevant international organisations (e.g., FAO) shall be used.

Therefore, $LE_{clearance} = 0$

Leakage due to competing uses for the biomass

An important potential source of leakage is an increase in emissions from fossil fuel combustion or other sources due to diversion of biomass residues from other uses to the project plant as a result of the project activity.

CPA implementers shall demonstrate that the use of the biomass residues does not result in increased use of fossil fuels or other GHG emissions elsewhere. For this purpose, CPA implementers shall assess, as part of the monitoring process, the supply situation for each type of biomass residue *k* used in the project plant. The table below outlines the options that may be used to demonstrate that the biomass residues used in the plant did not increase fossil fuel consumption or other GHG emissions elsewhere.

Which approach should be used depends on the most plausible baseline scenario for the use of the biomass residues. Where scenarios B1, B2 or B3 apply, use approaches L_1, L_2 and/or L_3. Where scenario B4 applies, use approaches L_2 or L_3. Where scenario B5 applies, use approach L_4.

Baseline scenarios:

B1: The biomass residues are dumped or left to decay under mainly aerobic conditions.

B2: The biomass residues are dumped or left to decay under clearly anaerobic conditions.
B3: The biomass residues are burnt in an uncontrolled manner without utilizing them for energy purposes
B4: The biomass residues are sold to other consumers in the market and the predominant use of the biomass residues in the region/country is for energy purposes (heat and/or power generation)
B5: The biomass residues are used as feedstock in a process (e.g. in the pulp and paper industry or fertilizer industry)

Approaches to rule out leakage

L_1	Demonstrate that at the sites where the project activity is supplied from with biomass residues, the biomass residues have not been collected or utilized (e.g. as fuel, fertilizer or feedstock) but have been dumped and left to decay, land-filled or burnt without energy generation (e.g. field burning) prior to the implementation of the project activity. Demonstrate that this practice would continue in the absence of the CDM project activity, e.g. by showing that in the monitored period no market has emerged for the biomass residues considered or by showing that it would still not be feasible to utilize the biomass residues for any purposes (e.g. due to the remote location where the biomass residue is generated)
L_2	Demonstrate that there is an abundant surplus of the in the region of the project activity which is not utilized. For this purpose, demonstrate that the quantity of available biomass residues of type *k* in the region is at least 25% larger than the quantity of biomass residues of type *k* that are utilized (e.g. for energy generation or as feedstock), including the project plant.
L_3	Demonstrate that suppliers of the type of biomass residue in the region of the project activity are not able to sell all of their biomass residues. For this purpose, CPA implementers shall demonstrate that the ultimate supplier of the biomass residue (who supplies the project) and a representative sample of suppliers of the same type of biomass residue in the region had a surplus of biomass residues (e.g. at the end of the period during which biomass residues are sold), which they could not sell and which are not utilized
L_4	Identify the consumer that would use the biomass residue in the absence of the project activity (e.g. the former consumer). Demonstrate that this consumer has substituted the biomass residue diverted to the project with other types of biomass residues (and not with fossil fuels or other types of biomass than biomass residues) by showing that the former user only fires biomass residues for which leakage can be ruled out using approaches L_2 or L_3. Provide credible evidence and document the types and amounts of biomass residues used by the former user as replacement for the biomass residue fired in the project activity and apply approaches L_2 or L_3 to these types of biomass residues. Demonstrate that the substitution of the biomass residues used in the project activity with other types of biomass residues does not require a significant additional energy input except for the transportation of the biomass residues

Where approaches L_2, L_3 or L_4 are used to assess leakage effects, the geographical boundary of the region shall be clearly defined and document. In defining the geographical boundary of the region, the usual distances for biomass transports will be taken into account. A biomass survey needs to be done for these approaches.

Below is the calculation for estimation of the surplus biomass type *k* in the region applicable to approach *L2*, *L3* and *L4*.

$$BF_{diff,k,y} = BF_{available,k,y} - (BF_{utilized,k,y} \times 1.25)$$

Where

$BF_{diff,k,y}$ Difference in quantity of biomass available and the required 25% larger than the quantity utilised (ton/yr)

$BF_{available,k,y}$ Quantity of available biomass residues of type *k* or *m* in the region (ton/yr)

$BF_{utilized,k,y}$ Quantity of available biomass residues of type *k* or *m* that are utilized in the defined geographical region (ton/yr)

In case $BF_{diff,k,y}$ is positive (+) leakage can be ruled out. However, if $BF_{diff,k,y}$ is negative (-), then leakage effects cannot be ruled out.

If for a certain biomass residue type *k* used in the project leakage effects cannot be ruled out with one of the approaches above, leakage effects for the year *y* shall be calculated as follows:

$$LE_{competing,y} = EF_{CO2,LE} \times \sum_n BF_{LE,n,y} \times NCV_n$$

Where:

$EF_{CO2,LE}$ CO_2 emission factor of the most carbon intensive fuel used in the country (tCO_2/TJ)

$BF_{LE,n,y}$ Quantity of biomass residue type *n* used for heat generation as a result of the project activity during the year *y* and for which leakage can not be ruled out using one of the approaches L_1, L_2, L_3 or L_4 (tons of dry matter or liter)

NCV_n Net calorific value of the biomass residue type *n* (GJ/ton of dry matter or TJ/liter)

n Biomass residue type *n* for which leakage can not be ruled out using one of the approaches L_1, L_2, L_3 or L_4

In case of approaches L_1, $BF_{LE,n,y}$ corresponds to the quantity of biomass residue type *n* that is obtained from the relevant source or sources.

In case of approaches L_2 or L_3, $BF_{LE,n,y}$ corresponds to the quantity of biomass residue type *k* used in the project plant as a result of the project activity during the year *y* ($BF_{LE,n,y} = B_{biomass,k,y}$, where $n=k$).

In case of approach L_4, ($BF_{LE,n,y} \times NCV_n$) corresponds to the lower value of

(a) The quantity of fuel types *m*, expressed in energy quantities, that are used by the former user of the biomass residue type *k* and for which leakage can not be ruled out because the fuels used are either (i) fuels types other than biomass residues (e.g. fossil fuels or biomass types other than biomass residues) or (ii) are biomass residues but leakage can not be ruled out for those types of biomass residues with approaches L_2 or L_3; as follows:

$$BF_{LE,n,y} \times NCV_n = \sum_m FC_{former\ user,m,y} \times NCV_m$$

$BF_{LE,n,y}$ Quantity of biomass residue type *n* used for heat generation as a result of the project activity during the year *y* and for which leakage can not be ruled out using approach L_4 (tons of dry matter or liter)

NCV_n Net calorific value of the biomass residue type *n* (GJ/ton of dry matter or GJ/liter)

n Biomass residue type n for which leakage can not be ruled out using approach L4

$FC_{former\ user,m,y}$ Quantity of fuel type *m* used by the former user of the biomass residue type *n* during the year *y* (mass or volume unit)

NCV_m Net calorific value of fuel type *m* (GJ/ton of dry matter or GJ/liter)

m Fuel type *m*, being either (i) a fuel type other than a biomass residue (e.g. fossil fuel or biomass other than biomass residues) or (ii) a biomass residues for which leakage can not be ruled out with approaches L_2 or L_3

(b) The quantity of biomass residue type *k*, expressed in energy quantities, used in the project plant during the year *y* ($BF_{LE,n,y} = B_{biomass,k,y}$, *where* $n=k$).

B.7. Application of the monitoring methodology and description of the monitoring plan
B.7.1. Data and parameters to be monitored by each generic CPA

Data / Parameter	nd_y
Unit	Days per year
Description	Number of days in year *y* that the treatment plant was operational
Source of data	CPA operational records
Value(s) applied	Specific to CPA
Measurement methods and procedures	If any farm has no operations on a given day it needs to be properly documented and taken into account for the calculation of $BE_{ex\text{-}post}$
Monitoring frequency	Annually, based on daily records and monthly aggregation
QA/QC procedures	Cross check with the mass balance from the plant.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$N_{LT,y}$
Unit	Numbers
Description	Annual average number of animals of type "*LT*" in year *y*
Source of data	Farm records
Value(s) applied	Specific to CPA
Measurement methods and procedures	Animal inlet/birth and sold-out dates are part of the production schedule. Therefore, this parameter can be calculated from farm records.
Monitoring frequency	Annually, based on monthly records
QA/QC procedures	The consistency between the value and indirect information (records of sales, records of food purchases) should be assessed.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$N_{da,y}$
Unit	Number
Description	Number of days animals are alive in the farm in the year *y*
Source of data	Farm records
Value(s) applied	Specific to CPA
Measurement methods and procedures	Animal inlet/birth and sold-out dates are part of the production schedule. Therefore, this parameter can be calculated from farm records.
Monitoring frequency	Annually, based on monthly records
QA/QC procedures	The consistency between the value and indirect information (records of sales, records of food purchases) should be assessed.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$N_{p,y}$
Unit	Number
Description	Number of animals produced/bought annually of type *LT* for the year *y*
Source of data	Farm records
Value(s) applied	Specific to CPA
Measurement methods and procedures	Animal numbers are part of the productions schedule. Therefore, this parameter can be calculated from farm records.
Monitoring frequency	Annually, based on monthly records
QA/QC procedures	The consistency between the value and indirect information (records of sales, records of food purchases) should be assessed.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	W_{site}
Unit	Kg
Description	Average animal weight of a defined livestock population at the project site.
Source of data	Farm records
Value(s) applied	Specific to CPA
Measurement methods and procedures	The weighing of animals populations is part of the production schedule, the CPA-DD will describe this procedure.
Monitoring frequency	Annually
QA/QC procedures	Check the value against historical values. If the values differ significantly, differences should be explained.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	GE_{LT}
Unit	MJ/day
Description	Daily average gross energy intake
Source of data	AWMS operational records
Value(s) applied	Specific to CPA
Measurement methods and procedures	Factual information from AWMS.
Monitoring frequency	Annually
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	DE_{LT}
Unit	%
Description	Digestible energy of the feed in present
Source of data	IPCC default value (Volume 4 chapter 10) or feed information from feed supplier
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Annually
QA/QC procedures	Values shall be compared with IPCC default values and any significant differences shall be explained.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	*UE*
Unit	Fraction of GE
Description	Urinary energy expressed as fraction of GE
Source of data	Typically 0.04GE can be considered urinary energy excretion by most ruminants (reduce to 0.02 for ruminants fed with 85% or more grain in the diet or for swine). Use country-specific values where available.
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Annually
QA/QC procedures	Values shall be compared with IPCC default values and any significant differences shall be explained.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	*ASH*
Unit	Fraction of the dry matter feed intake
Description	Ash content of the manure calculated as a fraction of the dry matter feed intake
Source of data	IPCC default value (Volume 4 chapter 10). Use country specific values where available.
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Annually
QA/QC procedures	Values shall be compared with IPCC default values and any significant differences shall be explained.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	ED_{LT}
Unit	MJ/kg DM
Description	Energy density of the feed in MJ/kg fed to livestock type LT
Source of data	IPCC notes the energy density of feed, ED, is typically 18.45 MJ/kg DM, which is relatively constant across a wide variety of grain-based feeds. The project proponent will record the composition of the feed to enable the DOE to verify the energy density of the feed.
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Annually
QA/QC procedures	Check the consistency of the energy density by comparing the supplier information with previous years. If the values differ significantly, differences should be explained..
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$Q_{manure,j,LT,y}$
Unit	ton/year, dry basis
Description	Quantity of manure treated from livestock type *LT* and animal manure management system *j* in year *y*
Source of data	Measured
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Use mass or volume based measurements. Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Annually, based on daily measurement and monthly aggregation
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$SVS_{j,LT,y}$
Unit	% (dry basis)
Description	Specific volatile solids content of animal manure from livestock type *LT* and animal manure management system *j* in year *y*
Source of data	Measured at accredited laboratories
Value(s) applied	Specific to CPA
Measurement methods and procedures	In case animal manure is treated in a centralized plant. Testing shall be performed according to the guideline in Annex 2 of AM0073. It can be on sample basis by following "Standard for sampling and surveys for CDM project activities and programme of activities", with a maximum margin of error of 10% at a 90% confidence level.
Monitoring frequency	Annually
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	*Genetic source*
Unit	-
Description	Genetic source of the production operations livestock originate from an Annex I Party
Source of data	Farm records
Value(s) applied	-
Measurement methods and procedures	-
Monitoring frequency	Annually
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	*FFR*
Unit	-
Description	Formulated feed rations (*FFR*) which are optimized for the various animal(s), stage of growth, category, weight gain/productivity and/or genetics
Source of data	Farm records
Value(s) applied	-
Measurement methods and procedures	
Monitoring frequency	Annually
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	*Soil application*
Unit	-
Description	Where applicable, the proper soil application (not resulting in methane emissions) of the residual waste shall be monitored.
Source of data	-
Value(s) applied	-
Measurement methods and procedures	Monitor the soil application of the final sludge and confirm proper application.
Monitoring frequency	Annually
QA/QC procedures	-
Purpose of data	Calculation of project emissions
Additional comments	-

Data / Parameter	*Site inspections*
Unit	-
Description	On site inspections for each individual farm included in the project boundary where the project activity is implemented for each verification period.
Source of data	-
Value(s) applied	-
Measurement methods and procedures	-
Monitoring frequency	Annually
QA/QC procedures	-
Purpose of data	-
Additional comments	-

Data / Parameter	$BG_{flare,y}$; $BG_{elec,y}$; $BG_{thermal,y}$
Unit	Nm^3/yr
Description	$BG_{flare,y}$: Biogas flow to the flare in year *y* $BG_{elec,y}$: Biogas flow to the electricity generation system in year *y* $BG_{thermal,y}$: Biogas flow to the thermal energy generation system in year *y*
Source of data	Measured - flow meters
Value(s) applied	Not applicable, measured *ex post* only
Measurement methods and procedures	Flow meters will measure continuously the volume of gas and will be added over a period of a year to get the annual measurement. Biogas Temperature and pressure will be measured simultaneously to normalize for the conditions of the gas combusted. The system will be built and operated to ensure that there is no air inflow into the biogas pipeline. Measurement method: Flow meter Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Annually, based on continuous flow measurement with accumulated volume recording (e.g. hourly/daily accumulated reading)
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	T_{biogas}
Unit	^{o}C
Description	Temperature of the biogas at the flow measurement site
Source of data	Data from temperature gauge
Value(s) applied	Not applicable, measured *ex post* only
Measurement methods and procedures	The temperature of the gas is required to determine the density of the methane combusted. If the biogas flow meter employed measures flow, pressure and temperature and displays or outputs the normalised flow of biogas, then there is no need for separate monitoring of pressure and temperature of the biogas. Temperature shall be measured at the same time when methane content in biogas (w_{CH4}) is measured. Measurement method: Temperature gauge Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recording.
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	P_{biogas}
Unit	kPa
Description	Pressure of the biogas at the flow measurement site
Source of data	Measured - pressure gauge
Value(s) applied	Not applicable, measured *ex post* only
Measurement methods and procedures	The pressure of the gas is required to determine the density of the methane combusted. If the biogas flow meter employed measures flow, pressure and temperature and displays or outputs the normalised flow of biogas, then there is no need for separate monitoring of pressure and temperature of the biogas. Pressure shall be measured at the same time when methane content in biogas (w_{CH4}) is measured. Measurement method: Pressure gauge Standards to be applied: Relevant national/international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recording.
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$w_{CH4,y}$
Unit	Mass fraction
Description	Fraction of Methane in the biogas in year *y*
Source of data	Measured - gas analyser. Alternatively a default value of 60% methane content can be used
Value(s) applied	Not applicable, measured *ex post* only
Measurement methods and procedures	The fraction of methane in the biogas should be measured with a continuous analyser (values are recorded with the same frequency as the flow) or alternatively a default value of 60% methane content can be used. Option chosen should be clearly specified in the CPA-DD . It shall be measured using equipment that can directly measure methane content in the biogas - the estimation of methane content of biogas based on measurement of other constituents of biogas such as CO_2 is not permitted. The methane content measurement shall be carried out close to a location in the system where a biogas flow measurement takes place, and on the same basis (wet or dry) Measurement method: Gas analyser Standards to be applied: National or international standard or manufacturer's specifications. Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recording.
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline and project emissions (flare)
Additional comments	-

Data / Parameter	$EG_{thermal,y}$
Unit	TJ/yr
Description	Net quantity of thermal energy supplied by the project activity during the year *y*
Source of data	Calculated as described in monitoring section of methodology AMS-I.C (version 19), paragraph 50 no. 7.
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuous monitoring, aggregated annually
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$EG_{thermal,PJ,y}$
Unit	TJ/yr
Description	Total actual thermal energy produced in year *y* by all units, existing and new project units
Source of data	Calculated as described in monitoring section of methodology AMS-I.C (version 19), paragraph 50 no. 7.
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuous monitoring, aggregated annually
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$EG_{thermal,actual,y}$
Unit	TJ/yr
Description	The actual, measured thermal energy production of the existing units in year *y*
Source of data	Calculated as described in monitoring section of methodology AMS-I.C (version 19), paragraph 50 no. 7.
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuous monitoring, aggregated annually
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$Q_{hot\ air}$
Unit	m^3/yr
Description	Quantity of hot air
Source of data	Measured - flow meters
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Flow meter Standards to be applied: Relevant national/international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA Where it is not feasible (e.g. because of too high temperature), spot measurements can be used through sampling with a 90% confidence level and a 10% precision
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recordings
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used. If applicable, measurement results shall be cross checked with records for sold/purchased electricity (e.g. invoices/receipts)
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	Q_{steam}
Unit	m^3/yr
Description	Quantity of steam
Source of data	Measured - flow meters
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Flow meter Standards to be applied: Relevant national/international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recording
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used. If applicable, measurement results shall be cross checked with records for sold/purchased electricity (e.g. invoices/receipts)
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	*T*
Unit	°C
Description	Temperature of the steam or hot fluid and/or gases generated by the heat generation equipment
Source of data	Measured
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Temperature gauge Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recording
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	*P*
Unit	kPa
Description	Pressure of the steam or hot fluid and/or gases generated by the heat generation equipment
Source of data	Measured - pressure gauge
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Pressure gauge Standards to be applied: Relevant national/international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recording
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$EG_{BL,y}$
Unit	MWh/yr
Description	The amount of net renewable electricity supplied to the grid or displaced from the grid as a result of the implementation of the CDM project activity in year *y*
Source of data	Measured – electricity gauge
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Electricity gauge Standards to be applied: Relevant national/international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recordings
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used. If applicable, measurement results shall be cross checked with records for sold/purchased electricity (e.g. invoices/receipts). If applicable, cross check net electricity supplied to a grid as gross energy generation in the project activity power plant minus the auxiliary/station electricity consumption, technical losses and electricity import from the grid to the project power plant measured at the grid interface/connection used for billing purposes
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$EG_{PJ,add,y}$
Unit	MWh/yr
Description	The total net electrical energy supplied to a grid or displaced from the grid in year *y* by all units, existing and new project units
Source of data	Measured – electricity gauge
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Electricity gauge Standards to be applied: Relevant national/international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recordings
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$EG_{actual,y}$
Unit	MWh/yr
Description	The actual, measured net electrical energy supplied to the grid or displaced from the grid by the existing units in year *y*
Source of data	Measured – electricity gauge
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Electricity gauge Standards to be applied: Relevant national/international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recordings
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	EC_y
Unit	MWh/yr
Description	Quantity of electricity consumed in the project boundary in year *y*
Source of data	Measured – electricity gauge
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Electricity gauge Standards to be applied: Relevant national/international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recordings
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of project emissions (electricity)
Additional comments	-

Data / Parameter	$B_{biomass,k,y}$
Unit	Mass or volume/yr
Description	Quantity of biomass type *k* consumed in year *y*
Source of data	Measured
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Use mass or volume based measurements. Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	The quantity of biomass shall be measured continuously or in batches.
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	*% water*
Unit	%
Description	Moisture content of the biomass type *k*
Source of data	Measured
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Standards to be applied: Relevant national or international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Quarterly. The weighted average should be calculated for each monitoring period and used in the calculations.
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$\%VS_{k,y}$
Unit	% (dry basis)
Description	Volatile solid content of the biomass type *k* consumed in year *y*
Source of data	Measured at accredited laboratories
Value(s) applied	Specific to CPA
Measurement methods and procedures	Testing shall be performed according to the guideline in Annex 2 of AM0073.
Monitoring frequency	Quarterly. The weighted average should be calculated for each monitoring period and used in the calculations.
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	T_{flare}
Unit	^{o}C
Description	Temperature in the exhaust gas of the flare
Source of data	Data from temperature gauge
Value(s) applied	Not applicable, measured *ex post* only
Measurement methods and procedures	Measure the temperature of the exhaust gas stream in the flare with a temperature gauge. To ensure 90% of combustion of the biogas in the enclosed flare system, the temperature needs to be between 500 ^{o}C and 700 ^{o}C. The control of the temperature is determined by the temperature gauge. Measurement method: Temperature gauge Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recording.
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of project emissions (flare)
Additional comments	An excessively high temperature at the sampling point (above 700 ºC) may be an indication that the flare is not being adequately operated or that its capacity is not adequate to the actual flow.

Data / Parameter	$FV_{RG,h}$
Unit	m^3/h
Description	Volumetric flow rate of the residual gas in dry basis at normal conditions in hour h
Source of data	Measured - flow meters
Value(s) applied	Not applicable, measured *ex post* only
Measurement methods and procedures	Flow meters will measure continuously the volume of gas. Biogas Temperature and pressure will be measured simultaneously. The system will be built and operated to ensure that there is no air inflow into the biogas pipeline. Measurement method: Flow meter Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recording.
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of project emissions (flare)
Additional comments	-

Data / Parameter	$\eta_{flare,h}$
Unit	Fraction
Description	Flare efficiency in hour *h*
Source of data	Default of 50% will be used for open flares and 90% will be used for enclosed flares, except in circumstances where it does not operate in accordance with manufacturers specifications for enclosed flare
Value(s) applied	In case of enclosed flares and use of the default value for the flare efficiency (90%), the flare efficiency in the hour h ($\eta_{flare,h}$) is: ● 0% if the temperature in the exhaust gas of the flare (T_{flare}) is below 500 °C for more than 20 minutes during the hour *h* . ● 50%, if the temperature in the exhaust gas of the flare ((T_{flare}) is above 500 °C for more than 40 minutes during the hour *h*, but the manufacturer's specifications on proper operation of the flare are not met at any point in time during the hour *h*. ● 90%, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500 °C for more than 40 minutes during the hour *h* and the manufacturers specifications on proper operation of the flare are met continuously during the hour *h*. In case of open flares, the flare efficiency in the hour h ($\eta_{flare,h}$) is ● 0% if the flame is not detected for more than 20 minutes during the hour h. ● 50%, if the flare is detected for more than 20 minutes during the hour h.
Measurement methods and procedures	Based on exhaust gas temperature recorded by T_{flare} and monitored compliance with manufacturers specifications.
Monitoring frequency	-
QA/QC procedures	Continuous check of compliance with the manufacturer's specifications of the flare device
Purpose of data	Calculation of project emissions (flare)
Additional comments	

Data / Parameter	$Q_{y,LT}$; $Q_{y,res\text{-}waste}$
Unit	ton/yr or m^3/yr
Description	$Q_{y,LT}$: Quantity of raw manure transported in the year *y* $Q_{y,res\text{-}waste}$: Quantity of digester residual waste transported in year *y*
Source of data	CPA operational records
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Use mass or volume based measurements. Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA.
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used. The quantity monitored should be cross checked with the mass balance from the plant.
Purpose of data	Calculation of project emissions (transport)
Additional comments	-

Data / Parameter	$CT_{y,LT}$; $CT_{y,res\text{-}waste}$
Unit	ton or m^3/truk
Description	$CT_{y,LT}$: Average truck capacity for manure transportation in year *y* $CT_{y,res\text{-}waste}$: Average truck capacity for residual waste transportation in year *y*
Source of data	CPA operational records e.g. logbooks
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	-
Purpose of data	Calculation of project emissions (transport)
Additional comments	-

Data / Parameter	DAF_{LT}; $DAF_{res\text{-}waste}$
Unit	km/truck
Description	$DAF_{w,LT}$: Incremental distance for manure transportation in year *y* $DAF_{res\text{-}waste}$: Incremental distance for residual waste transportation in year *y*
Source of data	CPA operational records, e.g. logbooks
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	-
Purpose of data	Calculation of project emissions (transport)
Additional comments	-

Data / Parameter	VF_{cons}
Unit	ℓ/km
Description	Vehicle fuel consumption in litres per kilometre
Source of data	Records (e.g. logbooks) or standard fuel consumption for type of truck or IPCC values
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	-
Purpose of data	Calculation of project emissions (transport)
Additional comments	-

Data / Parameter	D_{fuel}
Unit	kg/ℓ
Description	Fuel density
Source of data	Oil company data for fuel type used
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	-
Purpose of data	Calculation of project emissions (transport)
Additional comments	-

Data / Parameter	$NCV_{fuel,y}$
Unit	TJ/kg or other unit
Description	Net calorific value of the fuel used for transport inside the project boundary in year *y*
Source of data	The following data sources may be used if the relevant conditions apply: Data source / Conditions for using the data source a) Values provided by the fuel supplier in invoices / This is the preferred source if the carbon fraction of the fuel is not provided (Option A) b) Measurements by the CPA implementers / If a) is not available c) Regional or national default values / If a) is not available. These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances). d) IPCC default values at the upper 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 / If a) is not available
Value(s) applied	Specific to CPA
Measurement methods and procedures	For a) and b): Measurements should be undertaken in line with national or international fuel standards
Monitoring frequency	For a) and b): The NCV should be obtained for each fuel delivery, from which weighted average annual values should be calculated For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures	Verify if the values under a), b) and c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards.
Purpose of data	Calculation of project emissions (transport)
Additional comments	-

Data / Parameter	$EF_{CO2,fuel}$
Unit	tCO_2e/TJ
Description	CO_2 emission factor of the fuel used for transportation inside the project boundary in year *y*.
Source of data	The following data sources may be used if the relevant conditions apply:

Data source	Conditions for using the data source
a) Values provided by the fuel supplier in invoices	This is the preferred source
b) Measurements by the CPA implementers	If a) is not available
c) Regional or national default values	If a) is not available. These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances)
d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories	If a) is not available

Value(s) applied	Specific to CPA
Measurement methods and procedures	For a) and b): Measurements should be undertaken in line with national or international fuel standards
Monitoring frequency	For a) and b): The CO2 emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated. For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures	-
Purpose of data	Calculation of project emissions (transport)
Additional comments	For a): If the fuel supplier does provide the NCV value and the CO_2 emission factor on the invoice and these two values are based on measurements for this specific fuel, this CO_2 factor should be used. If another source for the CO_2 emission factor is used or no CO_2 emission factor is provided, Options b), c) or d) should be used.

Data / Parameter	$MS\%_l$
Unit	%
Description	Fraction of volatile solids handled by storage device *l*
Source of data	CPA operational records
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Use mass or volume based measurements. Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA.
Monitoring frequency	Annually, based on daily records an aggregated monthly
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of project emissions (storage)
Additional comments	-

Data / Parameter	AI_l
Unit	Days
Description	Annual average interval between manure collection and delivery for treatment at a given storage
Source of data	CPA operational records
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Annually, based on daily records an aggregated monthly
QA/QC procedures	The days monitored should be cross checked with the time balance from the plant.
Purpose of data	Calculation of project emissions (storage)
Additional comments	-

Data / Parameter	f
Unit	
Description	Fraction of methane captured at the project SWDS and flared, combusted or used in another manner
Source of data	Written information from the operator of the solid waste disposal site and/or site visits at the solid waste disposal site
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Annually
QA/QC procedures	Check the value against projection schedule. If the values differ significantly, differences should be explained.
Purpose of data	Calculation of project emissions (residual waste)
Additional comments	-

Data / Parameter	$W_{j,x}$
Unit	Ton
Description	Total amount of residual disposed of in SWDS in year x
Source of data	CPA operational records
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Use mass or volume based measurements. Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA.
Monitoring frequency	Annually, based on daily records and monthly aggregation.
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used. The quantity monitored should be cross checked with the mass balance from the plant.
Purpose of data	Calculation of project emissions (residual waste)
Additional comments	-

Data / Parameter	$FC_{i,j,y}$
Unit	ton/yr or m^3/yr
Description	Quantity of fossil fuel type *i* combusted in process *j* inside the project boundary in year *y*
Source of data	Onsite measurements
Value(s) applied	Specific to CPA
Measurement methods and procedures	• Use either mass or volume meters. In cases where fuel is supplied from small daily tanks, rulers can be used to determine mass or volume of the fuel consumed, with the following conditions: The ruler gauge must be part of the daily tank and calibrated at least once a year and have a book of control for recording the measurements (on a daily basis or per shift); • Accessories such as transducers, sonar and piezoelectronic devices are accepted if they are properly calibrated with the ruler gauge and receiving a reasonable maintenance; • In case of daily tanks with pre-heaters for heavy oil, the calibration will be made with the system at typical operational conditions.
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used. The consistency of metered fuel consumption quantities should be cross-checked by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records.
Purpose of data	Calculation of project emissions (fossil fuel)
Additional comments	-

Data / Parameter	$NCV_{i,y}$
Unit	TJ/ton
Description	Weighted average net calorific value of the fossil fuel type *i* combusted inside the project boundary in year *y*
Source of data	The following data sources may be used if the relevant conditions apply:

Data source	Conditions for using the data source
a) Values provided by the fuel supplier in invoices	This is the preferred source if the carbon fraction of the fuel is not provided (Option A)
b) Measurements by the CPA implementers	If a) is not available
c) Regional or national default values	If a) is not available. These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances).
d) IPCC default values at the upper 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	If a) is not available

Value(s) applied	Specific to CPA
Measurement methods and procedures	For a) and b): Measurements should be undertaken in line with national or international fuel standards
Monitoring frequency	For a) and b): The NCV should be obtained for each fuel delivery, from which weighted average annual values should be calculated For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures	Verify if the values under a), b) and c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards.
Purpose of data	Calculation of project emissions (fossil fuel)
Additional comments	-

Data / Parameter	$EF_{CO2,i,y}$
Unit	tCO_2/TJ
Description	CO_2emission factor of fossil fuel type *i* combusted inside the project boundary in year y
Source of data	The following data sources may be used if the relevant conditions apply:

Data source	Conditions for using the data source
a) Values provided by the fuel supplier in invoices	This is the preferred source
b) Measurements by the CPA implementers	If a) is not available
c) Regional or national default values	If a) is not available. These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances)
d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories	If a) is not available

Value(s) applied	Specific to CPA
Measurement methods and procedures	For a) and b): Measurements should be undertaken in line with national or international fuel standards
Monitoring frequency	For a) and b): The CO2 emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated. For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures	-
Purpose of data	Calculation of project emissions (fossil fuel)
Additional comments	For a): If the fuel supplier does provide the NCV value and the CO_2 emission factor on the invoice and these two values are based on measurements for this specific fuel, this CO_2 factor should be used. If another source for the CO_2 emission factor is used or no CO_2 emission factor is provided, Options b), c) or d) should be used.

Data / Parameter	$FC_{c,j,y}$
Unit	ton/yr or m^3/yr
Description	Quantity of fossil fuel type *c* combusted in process *j* outside the project boundary in year *y*
Source of data	Measured
Value(s) applied	Specific to CPA
Measurement methods and procedures	• Use either mass or volume meters. In cases where fuel is supplied from small daily tanks, rulers can be used to determine mass or volume of the fuel consumed, with the following conditions: The ruler gauge must be part of the daily tank and calibrated at least once a year and have a book of control for recording the measurements (on a daily basis or per shift); • Accessories such as transducers, sonar and piezoelectronic devices are accepted if they are properly calibrated with the ruler gauge and receiving a reasonable maintenance; • In case of daily tanks with pre-heaters for heavy oil, the calibration will be made with the system at typical operational conditions.
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used. The consistency of metered fuel consumption quantities should be cross-checked by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records.
Purpose of data	Calculation of leakage (fossil fuel)
Additional comments	-

Data / Parameter	$NCV_{c,y}$
Unit	TJ/ton
Description	Weighted average net calorific value of the fossil fuel type *c* combusted outside the project boundary in year *y*
Source of data	The following data sources may be used if the relevant conditions apply:

Data source	Conditions for using the data source
a) Values provided by the fuel supplier in invoices	This is the preferred source if the carbon fraction of the fuel is not provided (Option A)
b) Measurements by the CPA implementers	If a) is not available
c) Regional or national default values	If a) is not available. These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances).
d) IPCC default values at the upper 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	If a) is not available

Value(s) applied	Specific to CPA
Measurement methods and procedures	For a) and b): Measurements should be undertaken in line with national or international fuel standards
Monitoring frequency	For a) and b): The NCV should be obtained for each fuel delivery, from which weighted average annual values should be calculated For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures	Verify if the values under a), b) and c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards.
Purpose of data	Calculation of leakage emissions (fossil fuel)
Additional comments	-

Data / Parameter	$EF_{CO2,c,y}$
Unit	tCO_2e/TJ
Description	CO_2emission factor of fossil fuel type *c* combusted outside the project boundary in year *y*
Source of data	The following data sources may be used if the relevant conditions apply: Data source / Conditions for using the data source a) Values provided by the fuel supplier in invoices / This is the preferred source b) Measurements by the CPA implementers / If a) is not available c) Regional or national default values / If a) is not available. These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances) d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories / If a) is not available
Value(s) applied	Specific to CPA
Measurement methods and procedures	For a) and b): Measurements should be undertaken in line with national or international fuel standards
Monitoring frequency	For a) and b): The CO2 emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated. For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions (fossil fuel)
Additional comments	For a): If the fuel supplier does provide the NCV value and the CO_2 emission factor on the invoice and these two values are based on measurements for this specific fuel, this CO_2 factor should be used. If another source for the CO_2 emission factor is used or no CO_2 emission factor is provided, Options b), c) or d) should be used.

Data / Parameter	$Q_{LE,y}$
Unit	ton/yr or m^3/yr
Description	Quantity of biomass transported outside the project boundary in the year *y*
Source of data	Measured
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Use mass or volume based measurements. Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA.
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of leakage emissions (transport)
Additional comments	-

Data / Parameter	$CT_{LE,y}$
Unit	ton/truck
Description	Average truck capacity for transportation outside the project boundary in year *y*
Source of data	Records, e.g. logbooks
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions (transport)
Additional comments	-

Data / Parameter	$DAF_{LE,y}$
Unit	km/truck
Description	Average incremental distance for biomass transportation outside the project boundary in year *y*
Source of data	Records, e.g. logbooks
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions (transport)
Additional comments	-

Data / Parameter	$VF_{LE,cons}$
Unit	ℓ/km
Description	Vehicle fuel consumption in litres per kilometre
Source of data	Records (e.g. logbooks) or standard fuel consumption for type of truck or IPCC values
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions (transport)
Additional comments	-

Data / Parameter	$D_{LE,fuel}$
Unit	kg/ℓ
Description	Fuel density
Source of data	Oil company data for fuel type used
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions (transport)
Additional comments	-

<table>
<tr><td>Data / Parameter</td><td>$NCV_{LE,fuel,y}$</td></tr>
<tr><td>Unit</td><td>TJ/kg or other unit</td></tr>
<tr><td>Description</td><td>Net calorific value of the fuel used for transport outside the project boundary in year y</td></tr>
<tr><td>Source of data</td><td>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>a) Values provided by the fuel supplier in invoices</td><td>This is the preferred source if the carbon fraction of the fuel is not provided (Option A)</td></tr>
<tr><td>b) Measurements by the CPA implementers</td><td>If a) is not available</td></tr>
<tr><td>c) Regional or national default values</td><td>If a) is not available. These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances).</td></tr>
<tr><td>d) IPCC default values at the upper 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</td><td>If a) is not available</td></tr>
</table></td></tr>
<tr><td>Value(s) applied</td><td>Specific to CPA</td></tr>
<tr><td>Measurement methods and procedures</td><td>For a) and b): Measurements should be undertaken in line with national or international fuel standards</td></tr>
<tr><td>Monitoring frequency</td><td>For a) and b): The NCV should be obtained for each fuel delivery, from which weighted average annual values should be calculated
For c): Review appropriateness of the values annually
For d): Any future revision of the IPCC Guidelines should be taken into account</td></tr>
<tr><td>QA/QC procedures</td><td>Verify if the values under a), b) and c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards.</td></tr>
<tr><td>Purpose of data</td><td>Calculation of leakage emissions (transport)</td></tr>
<tr><td>Additional comments</td><td>-</td></tr>
</table>

Data / Parameter	$EF_{LE,CO2,fuel}$
Unit	tCO_2e/TJ
Description	CO_2 emission factor of the fuel used for transportation outside the project boundary in year *y*
Source of data	The following data sources may be used if the relevant conditions apply: Data source / Conditions for using the data source a) Values provided by the fuel supplier in invoices / This is the preferred source b) Measurements by the CPA implementers / If a) is not available c) Regional or national default values / If a) is not available. These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances) d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories / If a) is not available
Value(s) applied	Specific to CPA
Measurement methods and procedures	For a) and b): Measurements should be undertaken in line with national or international fuel standards
Monitoring frequency	For a) and b): The CO2 emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated. For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions (transport)
Additional comments	For a): If the fuel supplier does provide the NCV value and the CO_2 emission factor on the invoice and these two values are based on measurements for this specific fuel, this CO_2 factor should be used. If another source for the CO_2 emission factor is used or no CO_2 emission factor is provided, Options b), c) or d) should be used.

Data / Parameter	$M_{SFi,y}$
Unit	ton/yr
Description	Mass of synthetic fertilizer type *i* applied
Source of data	On-site records
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions
Additional comments	-

Data / Parameter	$M_{OFj,y}$
Unit	ton/yr
Description	Mass of organic fertilizer type *j* applied
Source of data	On-site records
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions
Additional comments	-

Data / Parameter	NC_{SFi}
Unit	gN/100 g fertilizer
Description	Nitrogen content of synthetic fertilizer type *i* applied
Source of data	Supplier information
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Monthly
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions
Additional comments	-

Data / Parameter	NC_{OFj}
Unit	gN/100 g fertilizer
Description	Nitrogen content of organic fertilizer type *j* applied
Source of data	Supplier information
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Monthly
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions
Additional comments	-

B.7.2. Description of the monitoring plan for a generic CPA

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1. Management of parameters to be monitored

The Tables below show all the possible parameters to be monitored for the different Project scenarios under the PoA. From these tables, the CME will compile a list of relevant parameters for each CPA in section D.7.2 of the CPA-DD. Further information on the source of date, details on the measurement methods and procedures and QA/QC procedures will be as describe in section D.7.1 of the CPA-DD

The CME will ensure that a representative from each CPA is suitable trained on monitoring and operations & maintenance of monitoring equipment.

CPAs shall monitor 100% of the relevant parameters included in Section D.7.1. of each CPA-DD. Monitoring reports will be prepared separately for all CPAs, however only a sample will be verified by the DOE. See the sampling procedure proposed for verification below in “Reporting and verification”.

The following tables show all the parameters to be monitored under the PoA:

Table 1.a Baseline emission parameters related to methane avoidance from AWMS
Table 1.b Methane captured and destroyed or used gainfully by the project activity
Table 1.c Baseline emission parameters related to thermal energy generation
Table 1.d Baseline emission parameters related to electricity generation
Table 1.e Baseline emission parameters for each energy project scenario under the PoA
Table 2 Project emission parameters under the PoA
Table 3. Leakage emission parameters and demonstrations under the PoA

Baseline emissions

Table 1.a. Baseline emission parameters related to methane avoidance from AWMS

Parameter	Description
$N_{LT,y}$	Annual average number of animals of type “LT” in year *y* (numbers)
$N_{da,y}$	Number of days animal is alive in the farm in year *y* (days)
$N_{p,y}$	Number of animals produced annually for the year *y* (numbers)
W_{site}	Average animal weight of a defined livestock population at the project site (kg)
nd_y	Number of days in year *y* that the treatment plant was operational
GE_{LT}	Gross energy intake (MJ/day)

DE_{LT}	Digestibility of the feed in percent, Table 10.2 2 in 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 10.
UE	Urinary energy expressed as fraction of GE. Typically 0.04 can be considered urinary energy excretion by most ruminants (reduce to 0.02 for ruminants fed with 85% or more grain in the diet or for swine)
ASH	Ash content of the manure in calculated as a fraction of the dry matter feed intake (e.g, 0.08 for cattle)
ED_{LT}	Energy density of the feed in MJ/kg fed to livestock type LT (MJ/kg DM)
$Q_{manure,j,LT,y}$	Quantity of manure treated from livestock type *LT* and animal manure management system *j* (ton/year, dry basis)
$SVS_{j,LT,y}$	Specific volatile solids content of animal manure from livestock type *LT* and animal manure management system *j* in year *y* (%, dry basis)
Genetic source	Genetic source of the production operations livestock originate from an Annex I Party
FFR	Formulated feed rations (*FFR*) which are optimized for the various animal(s), stage of growth, category, weight gain/productivity and/or genetics
Soil application	Where applicable, the proper soil application (not resulting in methane emissions) of the residual waste shall be monitored.
Site inspection	On-site inspections for each individual farm included in the project boundary where the project activity is implemented for each verification period.

Table 1.b. Methane captured and destroyed or used gainfully by the project activity

Parameter	Description
$BG_{flare,y}$	Biogas flow to the fare (Nm^3/yr)
$BG_{elec,y}$	Biogas flow to the electricity generation system (Nm^3/yr)
$BG_{thermal,y}$	Biogas flow to the thermal energy generation system (Nm^3/yr)
T_{biogas}	Temperature of the biogas at the flow measurement site (^oC)
P_{biogas}	Pressure of the biogas at the flow measurement site (kPa)
$w_{CH4,y}$	Fraction of methane in the biogas (fraction)

Table 1.c. Baseline emission parameters for thermal energy generation

Parameter	Description
$EG_{thermal,y}$	Net quantity of thermal energy supplied by the project activity during the year *y* (TJ/yr)
$Q_{hot\ air}$	Quantity of hot air (m^3/yr)
Q_{steam}	Quantity of steam (m^3/yr)
T	Temperature of the steam or hot fluid and/or gases generated by the heat generation equipment (°C)
P	Pressure of the steam or hot fluid and/or gases generated by the heat generation equipment (kg/cm)
Parameters for biomass that does not apply methodology AMS-III.D:	
$B_{biomass,k,y}$	Quantity of biomass type *k* consumed in year *y* (ton/yr)
$\%VS_{k,y}$	Volatile solid content of the biomass type *k* consumed in year *y* (%, dry basis)
% water	Moisture content of the biomass type *k* (%)

Table 1.d. Baseline emission parameters for electricity generation

Parameter	Description
$EG_{BL,y}$	The amount of net renewable electricity supplied to the grid or displaced from the grid as a result of the CDM project activity in year *y* (MWh/yr)
Parameters for biomass that does not apply methodology AMS-III.D:	
$B_{biomass,k,y}$	Quantity of biomass type *k* consumed in year *y* (ton/yr)
$\%VS_{k,y}$	Volatile solid content of the biomass type *k* consumed in year *y* (%, dry basis)

% water	Moisture content of the biomass type *k* (%)

Table 1.e. Baseline emission parameters for each Energy scenario

Energy scenario	Parameters	Description
1	Table 1.c	
2.1 2.2	Table 1.c Table 1.d	
3.1	Table 1.c + $EG_{thermal,PJ,y}$ $EG_{thermal,actual,y}$	 Total actual thermal energy produced in year *y* by all units, existing and new project units (TJ/yr). The actual, measured thermal energy production of the existing units in year *y* (TJ/yr)
3.2	Table 1.d + $EG_{PJ,add,y}$ $EG_{actual,y}$	 The total net electrical energy supplied to a grid or displaced from the grid in year *y* by all units, existing and new project units (MWh/yr). The actual, measured net electrical energy supplied to the grid or displaced from the grid by the existing units in year *y* (MWh/yr).

Project emissions

Table 2.1. Project emission parameters for flaring

Parameter	Description
$FV_{RG,h}$	Volumetric flow rate of the residual gas in dry basis at normal conditions in hour *h* (m^3/h)
T_{flare}	Temperature in the exhaust gas of the flare (^oC)

Table 2.2. Project emission parameters for transportation

Parameter	Description
$Q_{y,LT}$	Quantity of raw manure transported in the year *y* (ton)
$Q_{y,res\text{-}waste}$	Quantity of digester residual waste transported in year *y* (ton)
$CT_{y,LT}$	Average truck capacity for manure transportation (ton/truck)
$CT_{y,res\text{-}waste}$	Average truck capacity for residual waste transportation (ton/truck)
DAF_{LT}	Average incremental distance for manure transportation (km/truck)
$DAF_{res\text{-}waste}$	Average incremental distance for residual waste transportation (km/truck)
VF_{cons}	Vehicle fuel consumption for transportation inside the project boundary (ℓ/km)
D_{fuel}	Fuel density for fuel used for transportation inside the project boundary (kg/ℓ)
$NCV_{fuel,y}$	Calorific value of the fuel used for transportation inside the project boundary (TJ/ton)
$EF_{CO2,fuel}$	CO_2 emission factor of the fuel used for transportation inside the project boundary (tCO_2e/TJ)

Table 2.3. Project emission parameters for storage of manure

Parameter	Description
AI_l	Annual average interval between manure collection and delivery for treatment at a given storage
$MS\%_l$	Fraction of volatile solids (%) handled by storage device *l*

Table 2.4. Project emission parameters for residual waste

Parameter	Description
f	Fraction of methane captured at the project SWDS and flared, combusted or used in another manner
$W_{j,x}$	Amount of residual waste disposed of in the SWDS in the year *x* (tons)

Table 2.5. Project emission parameters for fossil fuel and electricity use

Parameter	Description
$FC_{i,j,y}$	Quantity of fossil fuel type *i* combusted in process *j* inside the project boundary in year *y* (ton/yr)
$NCV_{i,y}$	Weighted average net calorific value of the fossil fuel type *i* combusted inside the project boundary in year *y* (TJ/ton)
$EF_{CO2,i,y}$	CO_2 emission factor of fossil fuel type *i* combusted inside the project boundary (tCO_2e/TJ)
EC_y	Quantity of electricity consumed in the project boundary in year *y* (MWh/yr)

Leakage emissions

Table 3.1. Leakage emission parameters for collection and processing of biomass

Parameter	Description
$FC_{c,j,y}$	Quantity of fossil fuel type *c* combusted in process *j* outside the project boundary in year *y* (ton/yr)
$NCV_{c,y}$	Weighted average net calorific value of the fossil fuel type *c* combusted outside the project boundary in year *y* (TJ/ton)
$EF_{CO2,c,y}$	CO_2 emission factor of fossil fuel type *c* combusted outside the project boundary (tCO_2e/TJ)

Table 3.2. Leakage emission parameters for transportation

Parameter	Description
$Q_{LE,y}$	Quantity of biomass transported outside project boundary in the year *y* (ton)
$CT_{LE,y}$	Average truck capacity for transportation outside the project boundary (ton/truck)
$DAF_{LE,w}$	Average incremental distance for biomass transportation outside project boundary (km/truck)
$VF_{LE,cons}$	Vehicle fuel consumption for transportation outside the project boundary (ℓ/km)
$D_{LE,fuel}$	Fuel density for fuel used for transportation outside the project boundary (kg/ℓ)
$NCV_{LE,fuel,y}$	Calorific value of the fuel used for transportation outside the project boundary (TJ/kg)
$EF_{LE,CO2,fuel}$	CO_2 emission factor of the fuel used for transportation outside the project boundary (tCO_2e/TJ)

Table 3.3. Leakage emission parameters for the application of fertilizer

Parameter	Description
$M_{SFi,y}$	Mass of synthetic fertilizer type i applied (ton/yr)
$M_{OFj,y}$	Mass of organic fertilizer type j applied (ton/yr)
NC_{SFi}	Nitrogen content of synthetic fertilizer type i applied (gN/100 g fertilizer)
NC_{OFj}	Nitrogen content of organic fertilizer type j applied (gN/100 g fertilizer)

2. Data management

- The CME will ensure that a representative from each CPA will be suitable trained on the applications of data management.
- The CPA implementer will be responsible for measurement, record-keeping and storage of all data to be monitored. All data will be electronically archived on the CPA's data control system for the entire crediting period plus two years beyond the crediting period.
- The CPA implementer will be responsible for coordinating the monitoring of AWMS parameters with the AWMS manager.
- The CME will manage a central database with all the monitoring information from the different CPAs and also store the information for the whole crediting period plus two years beyond the crediting period.

- The CME will conduct an inspection of each CPA every six months to ensure that all the relevant data is collected and stored adequately for verification
- Data management between the CPA implementer and the CME will work as follows:

Parameter		Measurement method	Data management
AWMS	$N_{LT,y}$; $N_{da,y}$; $N_{p,y}$ W_{site} GE_{LT}; DE_{LT}; UE;ASH; ED_{LT} *Genetic source* *FFR*	Farm records	CPA implementers shall gather information and supporting documentations from the AWMS manager or farmer and supply it to the CME on an annual basis.
	nd_y AI_l	Operational records	Data will be manually recorded by the operational staff at the project site. Data will be transferred to a spreadsheet, aggregated monthly and sent to the CME.
	$MS\%_{i,y}$	Mass or volume measurements	
	CPA implementer shall monitor the soil application of the final sludge and confirm proper application.		CPA implementer shall annually send report and confirmation to CME.
	CPA implementers shall conduct on-site inspections for each farm and for each verification period		CPA implementer shall annually send report to the CME.
Biomass	$\%VS_{k,y}$; $SVS_{j,LT,y}$ *% water*	Accredited laboratories	CPA implementer will do measurements quarterly and send data to CME.
	$B_{biomass,k,y}$; $Q_{manure,j,LT,y}$ $W_{j,x}$	Mass or volume measurements	Data will be manually recorded by the operational staff at the project site. Data will be transferred to a spreadsheet, aggregated monthly and sent to the CME.
Biogas	$BG_{flare,y}$ $BG_{elec,y}$ $BG_{thermal,y}$	Flow meter	The metering instruments will be connected to a monitoring system for computation and automatic data acquisition on a continuous basis. This data is logged in the plant distributed control system for history collection. This data is transferred monthly to the CME and archived.
	T_{biogas}	Temperature gauge	
	P_{biogas}	Pressure gauge	
	$w_{CH4,y}$	Gas analyser	
Electricity	$EG_{BL,y}$ $EG_{PJ,add,y}$ $EG_{actual,y}$ EC_y	Electricity meters	
Flare	$FV_{RG,h}$	Flow meter	
	T_{flare}	Temperature gauge	
Thermal energy	$Q_{hot\ air}$; Q_{steam}	Flow meter	
	T	Temperature gauge	
	P	Pressure gauge	
	$EG_{thermal,y}$ $EG_{thermal,PJ,y}$ $EG_{thermal,actual,y}$	Steam tables will be used to calculate the enthalpy and standard thermodynamic equations will be used to calculate the quantity of thermal energy.	
Transport	$Q_{y,LT}$; $Q_{y,res\text{-}waste}$ $CT_{y,LT}$; $CT_{y,res\text{-}waste}$ DAF_{LT}; $DAF_{res\text{-}waste}$ VF_{cons}; $VF_{LE,cons}$ $Q_{LE,y}$; $CT_{LE,y}$; DAF_{LE}	Log book	Data will be manually recorded by the operational/administrational staff at the project site. Data will be transferred to a spreadsheet, aggregated monthly and sent to the CME.
	D_{fuel};$D_{LE,fuel}$	Suppliers information	
Fossil fuel	$FC_{i,j,y}$; $FC_{c,j,y}$ $NCV_{i,y}$. $NCV_{c,y}$; $NCV_{fuel,y}$; $NCV_{LE,fuel,y}$	According to "Tool to calculate CO_2 emissions from fossil	

	$EF_{CO2,i,y}$; $EF_{CO2,c,y}$; $EF_{CO2,fuel}$; $EF_{LE,CO2,fuel}$	fuel"	
Fertilizer	$M_{SFi,y}$; $M_{OFj,y}$ NC_{SFi}; NC_{OFj}	Farm records	
Residual waste	f	SWDS records	CPA implementers shall gather information and supporting documentations from the SWDS manager and supply it to the CME on an annual basis.

3. Reporting and verification

- The CME will process data received from the CPA implementer and calculated emission reductions.
- The CME will compile the monitoring reports from all CPAs into one summary report
- The CME QC Manager will review the CPAs' monitoring reports.
- The DOE performs a desk review on the CPAs'monitoring reports.
- The CME provides an updated monitoring report in light of the DOE desk review findings.
- The DOE approves the final monitoring report
- For on-site assessment of CPAs, the DOE will implement the sampling procedure as described below:

Sampling plan:
All CPAs included in the PoA shall monitor 100% of the relevant parameters included in Section D.7.1. of the CPA-DD unless otherwise noted. Monitoring reports will be prepared separately for all CPAs, however only a statistically acceptable sample will be verified by the DOE.

The proposed sampling method is based on the multi-stage sampling approach. In multi-stage sampling, the population is divided into units, referred to as primary sampling units. The population in the primary units is again divided into smaller sub-units, referred to as secondary sampling units. Each CPA can be assigned to only one sample unit.

For this PoA, the primary sampling units will be the CPAs under a specific CPA implementer and the secondary sample units will be the different project scenarios. For each secondary sample unit a sample will be determined that will be subject to on-site verification.

For each secondary sample unit the size of the randomly selected samples will be defined to meet the 90/10 confidence interval level. In order to ensure transparency and representativeness of the sample chosen, the CPAs to be included in a sample will be chosen randomly by the DOE for each verification period. Since the number of CPAs included in the proposed PoA will evolve during the crediting period, the sampling selection process is to be recalculated for at each verification. All CPAs included in a sampling group will be subject to on-site verification.

4. Procedures for corrective actions in order to provide more accurate future monitoring

- The CME shall update the monitoring system to the necessary improvements/updates and include them in a new version of the PoA-DD and CPA-DD.
- The DOE validate the new monitoring system and submit it to the CDM Board for approval.
- Once changes have been approved by the Board, the monitoring of all new CPAs and existing CPAs shall be based on the updated monitoring system.

5. Emergency procedures for unintended methane emissions

- In the event where methane cannot be combusted in the engine due to engine failure or grid connection faults, all methane will be flared.
- All pressure relief valves will lead to the flare.
- The maintenance plan will include inspections for physical leakages.

6. Monitoring of data concerning environmental, social and economic impacts.

- According to the South African DNA, there is no formal agreement for monitoring data concerning sustainability development criteria, see correspondence from the DNA, (Ref.PoA.E.7).

PART II. B Generic component project activity (CPA)

SECTION A. General description of a generic CPA

A.1. Purpose and general description of generic CPAs

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CPAs under this generic CPA-DD involve methane emission avoidance through controlled anaerobic digestion and methane destruction by flaring. The following tables show the eligible measures/technologies and methodologies covered under Project scenario B.

Description of applicable technologies/measures and methodologies covered under Project scenario B

Project scenario	Technologies/measures	Methodology
B	• Project activities that digest animal manure where the manure would otherwise have been treated in an anaerobic treatment system without biogas recovery. • Technical measures shall be used to ensure that all biogas captured from the digester is flared.	AMS-III.D

Biomass applicable under Project scenario B:

1. *Manure from different livestock types (LT):* Manure from AWMS that would otherwise have been left to decay anaerobically.

SECTION B. Application of a baseline and monitoring methodology

B.1. Reference of the approved baseline and monitoring methodology(ies) selected

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AMS-III.D "Methane recovery in animal manure management system" (Version 18)

The following tools are applicable to the PoA, each CPA will apply the relevant tools:
"Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (Version 2)
"Tool to calculate the emission factor for an electricity system" (Version 02.2.1)
"Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" (Version 5.1.0)
"Tool to determine project emissions from flaring gases containing methane" (Version 1)

B.2. Application of methodology(ies)

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<u>Type I, Type III and micro-scale threshold demonstration:</u>

Demonstration that CPA meets the threshold criteria

Project type	Threshold criteria	PoA demonstration
Type I	Type I: Renewable energy project activities with a maximum output capacity of 15 MW (or an appropriate equivalent).	CPAs shall demonstrate that every CPA in aggregate meets the threshold criteria and remains within those thresholds throughout the crediting period of the CPA.
Microscale Type I	Type I: Project activities up to 5 MW that employ renewable energy as their primary technology.	
Type III	Type III: Other project activities not included in Type I or Type II that result in GHG emission reductions not exceeding 60 ktCO2e per year in any year of the crediting period.	

<u>Methodology applicability conditions demonstration:</u>

For a CPA to apply a specific methodology, it should comply with the methodology's applicability conditions. The tables below show the applicability conditions for the methodologies applicable to Project scenario B.

Applicability Conditions for methodology AMS-III.D

Applicability conditions	PoA confirmation
1. This methodology covers project activities involving the replacement or modification of anaerobic animal manure management systems in livestock farms to achieve methane recovery and destruction by flaring/combustion or gainful use of the recovered methane. It also covers treatment of manure collected from several farms in a centralized plant. This methodology is only applicable under the following conditions: (a) The livestock population in the farm is managed under confined conditions; (b) Manure or the streams obtained after treatment are not discharged into natural water resources (e.g. river or estuaries), otherwise AMS-III.H "Methane recovery in wastewater treatment" shall be applied; (c) The annual average temperature of baseline site where anaerobic manure treatment facility is located is higher than 5°C; (d) In the baseline scenario the retention time of manure waste in the anaerobic treatment system is greater than one month, and in case of anaerobic lagoons in the baseline, their depths are at least 1 m; (e) No methane recovery and destruction by flaring, combustion or gainful use takes place in the baseline scenario.	CPAs that apply methodology AMS-III.D shall involve the replacement or modification of anaerobic animal manure management systems in livestock farms to achieve methane recovery and destruction by flaring/combustion or gainful use of the recovered methane. It also covers treatment of manure collected from several farms in a centralized plant. All CPAs that apply methodology AMS-III.D must comply with condition (a) to (e).
3. The project activity shall satisfy the following conditions: (a) The residual waste from the animal manure management system shall be handled aerobically, otherwise the related emissions shall be taken into account as per relevant procedures of AMS-III.AO "Methane recovery through controlled anaerobic digestion". In case of soil application, proper conditions and procedures (not resulting in methane emissions) must be ensured; (b) Technical measures shall be used (including a flare for exigencies) to ensure that all biogas produced by the digester is used or flared; (c) The storage time of the manure after removal from the animal barns,	For all CPAs residual waste from the animal manure management system shall be handled aerobically, otherwise the related emissions shall be taken into account as per relevant procedures of AMS-III.AO "Methane recovery through controlled anaerobic digestion". In case of soil application, proper conditions and procedures (not resulting in methane emissions) shall be ensured; All CPAs shall ensure that all biogas produced by the digester is used or flared. For all CPAs the storage time of the manure after removal from the animal barns, including

including transportation, should not exceed 45 days before being fed into the anaerobic digester. If the project proponent can demonstrate that the dry matter content of the manure when removed from the animal barns is larger than 20%, this time constraint will not apply.	transportation, should not exceed 45 days before being fed into the anaerobic digester. If the CPA implementer can demonstrate that the dry matter content of the manure when removed from the animal barns is larger than 20%, this time constraint will not apply.
4. Projects that recover methane from landfills shall use AMS-III.G "Landfill methane recovery" and projects for wastewater treatment shall use AMS-III.H. Project for composting of animal manure shall use AMS-III.F "Avoidance of methane emissions through composting". .	These project activities are not applicable under this PoA.
5. Different options to utilise the recovered biogas as detailed in paragraph 3 of AMS-III.H are also eligible for use under this methodology. The respective procedures in AMS-III.H shall be followed in this regard.	Only activities under paragraph 3.a (direct thermal or electrical energy generation) are eligible under this PoA
6. 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".	CPAs that apply methodology AMS-III.D shall involve the replacement or modification of anaerobic AWMS in livestock farms to achieve methane recovery and destruction by flaring/combustion or gainful use of the recovered methane. No greenfield AWMS will be permissible, but all activities will occur on or associated with an existing AWMS activity. The methane capture may be a new component to the AWMS.
7. 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".	Not applicable under this PoA, anaerobic digesters will not be replaced.
8. Measures are limited to those that result in aggregate emission reductions of less than or equal to 60 kt CO_2 equivalent annually from all Type III components of the project activity.	CPAs are limited to those that result in emission reductions of less than or equal to 60 kt CO_2 equivalent annually from all Type III components of the project activity.

B.3. Sources and GHGs

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The project boundary is the physical, geographical site:

(a) Where the manure would have been disposed and the methane emission occurs in absence of the proposed project activity;

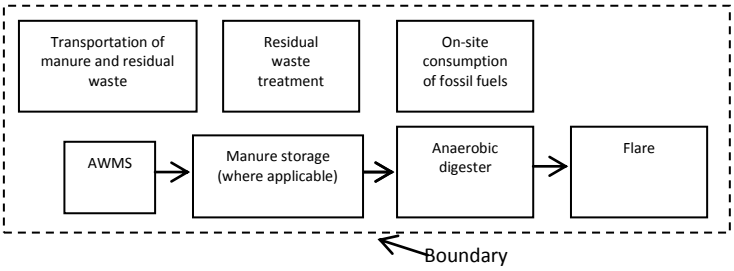
(b) Where the treatment of biomass or other organic matters through anaerobic digestion takes place;

(c) Where the residual waste from biological treatment or products from those treatments, like slurry, are handled, disposed, submitted to soil application, or treated thermally/mechanically;

(d) And the itineraries between the above, where the transportation of manure or residual waste after digestion occurs.

(e) Where biogas is flared.

The project boundary for Project scenario B is given below:



Project scenario B: Project activities that digest animal manure where the manure would otherwise have been treated in an anaerobic treatment system without biogas recovery. Technical measures shall be used to ensure that all biogas captured from the digester is flared. Only methodology AMS-III.D is applicable.

The combination of the greenhouse gases and emission sources included in or excluded from the project boundary are shown in table below:

	Source	Gas		Justification / Explanation
Baseline	Emissions from decomposition of manure in AWMS	CO_2	Excluded	CO_2 emissions from the decomposition of manure are not accounted
		CH_4	Included	A potential major source of emissions where projects use manure that would otherwise have been left to decay anaerobically
		N_2O	Excluded	N_2O emissions are small compared to CH_4 emissions from AWMS. Exclusion is conservative
Project Activity	Emissions from incremental transportation	CO_2	Included	May be an important emission source where manure is transported in the project activity.
		CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small
	Emissions from the use of electricity for the operation of the facilities	CO_2	Included	May be an important emission source where electricity is imported from the grid for the project activity. If electricity is generated from collected biogas, these emissions are not accounted for
		CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small
	Emissions from the use of fossil fuel for the operation of the facilities	CO_2	Included	May be an important emission source where fossil fuel is used in the project activity
		CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small
	Emissions from the storage of manure before being fed into the anaerobic digester	CO_2	Excluded	Excluded for simplification. This emission source is assumed to be very small
		CH_4	Included	May be an important emission source where manure is stored before being fed into the digester
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small
	Methane emissions due to	CO_2	Excluded	CO_2 emissions from the decomposition organic waste are not accounted

	Source	Gas		Justification / Explanation
	physical leakage of biogas	CH_4	Included	Methane physical leakage from the anaerobic digester is a potential source of project emissions.
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small
	Methane emissions from biogas flaring	CO_2	Excluded	CO_2 emissions from the decomposition organic waste are not accounted
		CH_4	Included	Methane emissions from incomplete combustion in the flaring process are a potential source of project emissions.
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small
	Emissions from the disposal/ storage/treatment of residual waste	CO_2	Excluded	CO_2 emissions from the decomposition organic waste are not accounted
		CH_4	Included	May be an important emission source where the residual waste from the digestion is stored under anaerobic conditions and/or delivered to a SWDS
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small

B.4. Description of baseline scenario

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According to methodology AMS-III.D, the baseline scenario is the situation where, in the absence of the project activity, manure are left to decay within the project boundary and methane is emitted to the atmosphere. Therefore, the current manure management practice at each CPA will be the baseline scenario for that CPA.

Furthermore, according to methodology AMS-III.D, the methodology is only applicable under the conditions below. These conditions will be assessed in section D.4 of the CPA-DD.

(a) The livestock population in the farm is managed under confined conditions;

(b) Manure or the streams obtained after treatment are not discharged into natural water resources (e.g. river or estuaries), otherwise AMS-III.H "Methane recovery in wastewater treatment" shall be applied;

(c) The annual average temperature of baseline site where anaerobic manure treatment facility is located is higher than 5°C;

(d) In the baseline scenario the retention time of manure waste in the anaerobic treatment system is greater than one month, and in case of anaerobic lagoons in the baseline, their depths are at least 1 m;

(e) No methane recovery and destruction by flaring, combustion or gainful use takes place in the baseline scenario.

Only AWMS where manure is left to decay in an anaerobic treatment system will be applicable under this PoA. In South Africa, manure in piggeries and dairies are commonly left to decay in anaerobic treatment systems and therefore only these livestock will be applicable under this PoA. However, the current manure management practice for each CPA will be assessed and will form the baseline AWMS for the specific CPA.

The baseline AWMS system and manure characteristics will be identified as part of the development of each CPA through site inspections, measurements and documented accordingly. The applicable baseline information will be documented in a confirmation document to be signed by the baseline manager. The baseline parameters for each CPA will also be documented in each CPA-DD in Section B.6.2. The confirmation letter must contain the following applicable information:

1. Description of the AWMS

A detailed description of the AWMS, with reference to different manure treatment phases where applicable. The parameters in the following table will be determined from the AWMS description, using IPCC values where necessary. The management and utilization of the manure in the baseline must also be described and include transport distances and the compost practise in the baseline.

Animal waste management system parameters

Parameter	Symbol	Unit
% manure handled in stage 1 of the AWMS	$MS\%_{BL1,j}$	%
% manure handled in stage 2 of the AWMS	$MS\%_{BL2,j}$	%
MCF for stage 1 of the AWMS	$MCF_{BL1,j}$	%
MCF for stage 2 of the AWMS	$MCF_{BL2,j}$	%
Reduction of Volatile solids in stage 1	RSV	%
Days per year that the AWMS was operational	ndy	day/yr

2. Animal population information

Animal population parameters for each livestock type of the CPA

Parameter	Symbol	Unit
Number of days animal is alive	$N_{da,y}$	Day
Number of animals produced annually	$N_{p,y}$	Head
Annual average number of animals	$N_{LT,y}$	nr of head
Average animal weight	W_{site}	Kg

3. Manure and feed information

There are two methods for calculating Volatile Solids (VS).

Volatile Solids calculated using default IPCC values

The confirmation letter must contain the following information:

- Documentation to proof that the genetic source of the production operations livestock originate from an Annex I Party.
- Formulated feed rations (FFR) for each livestock type.

Volatile Solids calculated using the enhanced characterisation method

The confirmation letter must contain the following information:

Manure and feed parameters for each livestock type of the CPA

Parameter	Symbol	Unit
Gross energy intake	GE_{LT}	MJ/hd/day
Digestibility of the feed	DE_{LT}	%
Urinary energy expressed as fraction of GE	UE	%
Ash content of the manure	ASH	%
Energy density of the feed	ED_{LT}	MJ/kg DM

B.5. Demonstration of eligibility for a generic CPA

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Eligibility criteria for inclusion of a SSC-CPA in the PoA

Eligibility criteria	Possible means of verification
a) The proposed CPA must be located in the	Demonstrate that CPA is located in the

	geographical boundary of South Africa.	geographical boundary of South Africa. See demonstration in Section A.7 of the CPA-DD.
b)	The CME must implement precaution measures to avoid double counting of emission reductions.	The CME shall follow the procedure to avoid double counting in Section C (d) in the PoA-DD. Confirmation by the CPA implementer that the CPA is neither registered as an individual CDM project activity nor is part of another registered PoA. See confirmation in Section A.13 of the CPA-DD.
c)	The proposed CPA must comply with performance specifications including compliance with certification. The CPA must involve the implementation of one of the technologies/measures described in section A.6, Part I in the PoA-DD.	Demonstration that the CPA will comply with the performance specifications set out in PoA-DD, Part I, Section A.6. See demonstration in Section A.5 of the CPA-DD. Feasibility study or other technical description, EIA report, supplier information or PPA proving that the CPA involves the implementation of a technology eligible for inclusion in the PoA.
d)	The starting date of the project activity must not be before the date of commencement of validation of the PoA.	The staring date of the project activity means the earliest date at which either the implementation or construction or real action of a project activity begins. The CPA implementer will provide the CME with any significant purchase order, contract or payment evidence related to the construction of the project activity. See documentation in Section A.8.1 of the CPA-DD.
e)	The proposed CPA must implement one of the eligible methodologies or methodology combinations for the PoA. Also, the proposed CPA must comply with the applicability conditions of the applicable methodology.	Indicate that the CPA will apply one of the eligible methodologies or methodology combinations. Also, assess compliance with the specific methodology applicability conditions. See assessment in Section D.2 of the CPA-DD
f)	The CPA must demonstrate additionality as per eligibility criteria.	Assess additionality according to the eligibility criteria below. See assessment in Section D.5 of the CPA-DD
g)	The CPA must comply with PoA conditions related to undertaking local stakeholder consultations and environmental impact analysis.	Provide necessary environmental impact assessment and local stakeholder consultation information and documentation. See Section B and C of the CPA-DD.
h)	The CPA must confirm that no Official Development Aid will be diverted.	Provide information on sources of public funding from countries included in Annex I which shall affirm that such funding does not result in diversion of official development assistance. See affirmation Section A.11 of the CPA-DD.
i)	The PoA has no specific target group or distribution mechanism, therefore there is no eligibility criteria for target groups or distribution mechanisms	Not applicable
j)	All relevant parameters will be monitored for each CPA. However, only a statistically acceptable sample will be verified by the DOE.	Sampling must meet a confidence/precision limits of 90/10. All CPAs must be included as possible sites for DOE verification in the future.
k)	CPA in aggregate must meet the small-scale or micro-scale threshold criteria	Demonstration that the installed capacity of the small-scale or micro-scale CPA in aggregate will

	remain within the threshold criteria throughout the crediting period of the CPA See demonstration in Section D.2 of the CPA-DD
l) The proposed CPA must pass the de-bundling check.	Demonstrate that the CPA is not a debundled component of a large scale activity by following the "Guidelines on assessment of debundling for SSC project activities". See de-bundling check in Section A.12 of the CPA-DD

Compliance of the baseline system and project activity to the mandatory applicable legal and regulatory requirements/legislation will be confirmed through the Environmental authorization process of South Africa.

ADDITIONALITY OF THE GENERIC CPA

The table below indicates the additionality approaches applicable to Project scenario B. The CPA implementer will choose an approach and demonstrate additionality according to the applicable additionality eligibility criteria in section B.1, Part I of the PoA-DD.

Additionality approaches applicable to Project scenario B

Project scenario	Additionality approach
B	Additionality may be based on approach 1 or approach 2. Where approach 1 is used, method b should be applied. Where approach 2 is used, barrier b should be applied.

B.6. Estimation of emission reductions of a generic CPA
B.6.1. Explanation of methodological choices

Baseline emission equation choices – AMS-III.D

Baseline emissions shall be calculated by using one of the following two options:

a) Based on the most recent IPCC tier 2 approach, using equation 1 from methodology AMS-III.D:

$$BE_y = GWP_{CH4} \times D_{CH4} \times UF_b \times \sum_{j,LT} MCF_j \times B_{0,LT} \times N_{LT,y} \times VS_{LT,y} \times MS\%_{Bl,j} \quad (1)$$

b) Based on direct measurement of the quantity of manure treated together with its specific volatile solids (*SVS*) content, using equation 4 from methodology AMS-III.D:

$$BE_y = GWP_{CH4} \times D_{CH4} * UF_b \times \sum_{j,LT} MCF_j \times B_{0,LT} \times Q_{manure,j,LT,y} \times SVS_{j,LT,y} \quad (4)$$

Grid emission factor choices

The grid emission factor ($EF_{CO2,grid,y}$) will be calculated as follows: A 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 grid emission factor will be calculated using the *ex ante* option: The emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required. For the calculations see Appendix 4.

CO_2 emission coefficient

The CO_2 emission coefficient ($COEF_{i,y}$) shall be calculated using Option B in the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion". In Option B $COEF_{i,y}$ is calculated based on net calorific value and CO_2 emission factor of the fuel type.

Project emissions due to physical leakage

Project emissions due to physical leakage of biogas from the animal manure management systems used to produce, collect and transport the biogas to the point of flaring or gainful use is estimated as: A default value of 0.05 m³ biogas leaked/m³ biogas produced

Approaches to rule out leakage choice

CPA implementers shall demonstrate that the use of the biomass residues does not result in increased use of fossil fuels or other GHG emissions elsewhere. For this purpose, CPA implementers shall assess as part of the monitoring the supply situation for each type of biomass residue *k* used in the project plant. The table below outlines the options (methodology AM0042) that may be used to demonstrate that the biomass residues used in the plant did not increase fossil fuel consumption or other GHG emissions elsewhere.

Approaches to rule out leakage according to methodology AM0042

L_1	Demonstrate that at the sites where the project activity is supplied from with biomass residues, the biomass residues have not been collected or utilized (e.g. as fuel, fertilizer or feedstock) but have been dumped and left to decay, land-filled or burnt without energy generation (e.g. field burning) prior to the implementation of the project activity. Demonstrate that this practice would continue in the absence of the CDM project activity, e.g. by showing that in the monitored period no market has emerged for the biomass residues considered or by showing that it would still not be feasible to utilize the biomass residues for any purposes (e.g. due to the remote location where the biomass residue is generated)
L_2	Demonstrate that there is an abundant surplus of the in the region of the project activity which is not utilized. For this purpose, demonstrate that the quantity of available biomass residues of type *k* in the region is at least 25% larger than the quantity of biomass residues of type *k* that are utilized (e.g. for energy generation or as feedstock), including the project plant.
L_3	Demonstrate that suppliers of the type of biomass residue in the region of the project activity are not able to sell all of their biomass residues. For this purpose, CPA implementers shall demonstrate that the ultimate supplier of the biomass residue (who supplies the project) and a representative sample of suppliers of the same type of biomass residue in the region had a surplus of biomass residues (e.g. at the end of the period during which biomass residues are sold), which they could not sell and which are not utilized
L_4	Identify the consumer that would use the biomass residue in the absence of the project activity (e.g. the former consumer). Demonstrate that this consumer has substituted the biomass residue diverted to the project with other types of biomass residues (and not with fossil fuels or other types of biomass than biomass residues) by showing that the former user only fires biomass residues for which leakage can be ruled out using approaches L_2 or L_3. Provide credible evidence and document the types and amounts of biomass residues used by the former user as replacement for the biomass residue fired in the project activity and apply approaches L_2 or L_3 to these types of biomass residues. Demonstrate that the substitution of the biomass residues used in the project activity with other types of biomass residues does not require a significant additional energy input except for the transportation of the biomass residues

B.6.2. Data and parameters that are to be reported ex-ante

Data / Parameter	GWP_{CH4}
Unit	tCO_2e/ tCH_4
Description	Global Warming Potential (GWP) of methane
Source of data	IPCC default, (a value of 21 is to be applied for the first commitment period of the Kyoto Protocol)
Value(s) applied	21
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$B_{0,LT}$
Unit	m^3 CH_4/kg dm
Description	Maximum methane producing potential of the volatile solid generated for animal type "*LT*"
Source of data	IPCC default, Volume 4 chapter 10 table 10 A-4 to 10 A-9 The maximum methane-producing capacity of the manure (B_0) default IPCC values from 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 10 table 10 A-4 to 10 A-9 can be used provided the assessment of suitability of those data to the specific situation of the treatment site particularly with reference to feed intake levels.
Value(s) applied	Specific to AWMS
Choice of data or Measurement methods and procedures	
Purpose of data	Calculation of baseline emissions
Additional comment	

Data / Parameter	$MCF_{BL1,j}$
Unit	Fraction
Description	Annual methane conversion factor for the baseline animal waste management system *j*, stage 1
Source of data	IPCC default (Volume 4 chapter 10 table 10.17) and AWMS baseline formation
Value(s) applied	Specific to AWMS
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$MCF_{BL2,j}$
Unit	Fraction
Description	Annual methane conversion factor for the baseline animal waste management system *j*, stage 2
Source of data	IPCC default (Volume 4 chapter 10 table 10.17) and AWMS baseline information
Value(s) applied	Specific to AWMS
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$MS\%_{BL1,j}$
Unit	Fraction
Description	Fraction of manure handled in stage 1 of the baseline manure management system *j*
Source of data	AWMS baseline information
Value(s) applied	Specific to AWMS
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$MS\%_{BL\ 2,j}$
Unit	Fraction
Description	Fraction of manure handled in stage 2 of the baseline manure management system *j*
Source of data	AWMS baseline information
Value(s) applied	Specific to AWMS
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	D_{CH4}
Unit	ton/m^3
Description	Density of the methane
Source of data	IPCC value, specified in AMS-III.D
Value(s) applied	0.00067, default value at standard temperature (20°C) and pressure (1 atm).
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	UF_b
Unit	Fraction
Description	Model correction factor to account for model uncertainties.
Source of data	IPCC default value as per AMS III.D
Value(s) applied	0.94
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$W_{default}$
Unit	Kg
Description	Default average animal weight of a defined population
Source of data	IPCC default, Volume 4 chapter 10 table 10 A-4 to 10 A-9
Value(s) applied	Specific AWMS
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$VS_{default}$
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	IPCC default, Volume 4 chapter 10 table 10 A-4 to 10 A-9 Volatile solids (*VS*) IPCC default values from 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 10 table 10 A-4 to 10 A-9 can be used provided the assessment of suitability of those data to the specific situation of the treatment site particularly with reference to feed intake levels.
Value(s) applied	Specific to AWMS
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EF_{CO2,grid,y}$
Unit	tCO_2e/MWh
Description	CO_2 emission factor of the grid in year *y*
Source of data	Calculated, see Appendix 4
Value(s) applied	0.9
Choice of data or Measurement methods and procedures	A 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"
Purpose of data	Calculation of baseline emissions
Additional comment	The emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required.

Data / Parameter	*k*
Unit	-
Description	Degradation rate constant (0.069)
Source of data	IPCC default, methodology AMS-III.D
Value(s) applied	0.069
Choice of data or Measurement methods and procedures	
Purpose of data	Calculation of project emissions
Additional comment	-

Data / Parameter	MCF_l
Unit	%
Description	Annual methane conversion factor for the project manure storage device *l*
Source of data	IPCC default and project design information
Value(s) applied	Specific to plant
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

Data / Parameter	φ
Unit	-
Description	Model correction factor to account for model uncertainties
Source of data	IPCC default from "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"
Value(s) applied	0.9
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

Data / Parameter	*OX*
Unit	Fraction
Description	Oxidation factor of the project SWDS (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data	IPCC default and project SWDS information
Value(s) applied	Use 0.1 for managed solid waste disposal sites that are covered with oxidizing material such as soil or compost. Use 0 for other types of solid waste disposal sites
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

Data / Parameter	*F*
Unit	Fraction
Description	Fraction of methane in the SWDS gas (volume fraction)
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	0.5
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comment	This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, under anaerobic conditions in the SWDS. A default value of 0.5 is recommended by IPCC

Data / Parameter	DOC_f
Unit	Fraction
Description	Fraction of degradable organic carbon (DOC) that can decompose
Source of data	IPCC default
Value(s) applied	0.5
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

Data / Parameter	*MCF*
Unit	Fraction
Description	Methane correction factor of the project SWDS
Source of data	Project SWDS information and IPCC 2006 Guidelines for National Greenhouse Gas Inventories.
Value(s) applied	Specific to the project SWDS Use the following values for MCF. • 1.0 for anaerobic managed solid waste disposal sites. These must have controlled placement of waste (i.e., waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires) and will include at least one of the following: (i) cover material; (ii) mechanical compacting; or (iii) leveling of the waste; • 0.5 for semi-aerobic managed solid waste disposal sites. These must have controlled placement of waste and will include all of the following structures for introducing air to waste layer: (i) permeable cover material; (ii) leachate drainage system; (iii) regulating pondage; and (iv) gas ventilation system;

	• 0.8 for unmanaged solid waste disposal sites – deep and/or with high water table. This comprises all SWDS not meeting the criteria of managed SWDS and which have depths of greater than or equal to 5 meters and/or high water table at near ground level. Latter situation corresponds to filling inland water, such as pond, river or wetland, by waste; • 0.4 for unmanaged-shallow solid waste disposal sites. This comprises all SWDS not meeting the criteria of managed SWDS and which have depths of less than 5 m
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comment	The methane correction factor (MCF) accounts for the fact that unmanaged SWDS produce less methane from a given amount of waste than managed SWDS, because a larger fraction of waste decomposes aerobically in the top layers of unmanaged SWDS

Data / Parameter	DOC_j
Unit	Fraction
Description	Fraction of degradable organic carbon (by weight) in the residual waste
Source of data	Project SWDS information and IPCC 2006 Guidelines for National Greenhouse Gas inventories (adapted from Volume 5, Tables 2.4 and 2.5)
Value(s) applied	In the case of industrial sludge, a value of 9% (% wet sludge) shall be used assuming an organic dry matter content of 35 percent. In the case of domestic sludge, a value of 5% (wet sludge) shall be used, assuming an organic dry matter content of 10 percent.
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comment	For industrial sludge, the value must be adjusted for other percentages of organic dry matter content as follows: DOC (% wet sludge) = 9 × (% organic dry matter content/35). For domestic sludge, the value must be adjusted for other percentages of organic dry matter content as follows: DOC (% wet sludge) = 5 × (% organic dry matter content/10).

Data / Parameter	k_j
Unit	-
Description	Decay rate for residual waste
Source of data	Project SWDS information and IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)
Value(s) applied	Apply the following default values for residual waste:

Waste type *j*		Boreal and Temperate (MAT≤20°C)		Tropical (MAT>20°C)	
		Dry MAP/PET <1	Wet (MAP/PET >1)	Dry (MAP< 1000mm)	Wet (MAP> 1000mm)
Rapidly degrading	Food, food waste, sewage sludge, beverages and tobacco	0.06	0.185	0.085	0.4

Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

B.6.3. Ex-ante calculations of emission reductions

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Emission reductions shall be calculated *ex ante* as follows:

$$ER_y = BE_y - PE_y - LE_y$$

Where:

ER_y Emission reductions in year *y* (tCO_2e/yr)
BE_y Baseline emissions in year *y* (tCO_2e/yr)
PE_y Project emissions in year *y* (tCO_2e/yr)
LE_y Leakage emissions in year *y* (tCO_2e/yr)

<u>BASELINE EMISSIONS</u>

$$BE_y = BE_{AMS\text{-}III.D,y}$$

Where:

$BE_{AMS\text{-}III.D,y}$ Baseline emissions from AWMS (tCO_2e/yr), calculated in section "Baseline emissions – AMS-III.D"

<u>Baseline emissions- AMS-III.D</u>

The baseline scenario 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. Baseline emissions (BE_y) are calculated by using one of the following two options:

(a) Using the amount of the waste or raw material that would decay anaerobically in the absence of the project activity, with the most recent IPCC tier 2 approach

(b) Using the amount of manure that would decay anaerobically in the absence of the project activity based on direct measurement of the quantity of manure treated together with its specific volatile solids (*SVS*) content.

Baseline emissions calculated using option (a)

$$BE_{AMS\text{-}III.D,y} = BE_{stage\ 1,y} + BE_{stage\ 2,y}$$

Where:

$EB_{stage1,y}$	Baseline emissions for sequential treatment stages one (tCO_2e/yr)
$EB_{stage2,y}$	Baseline emissions for sequential treatment stages two (tCO_2e/yr)

***Stage 1:* The annual emissions in treatment stage one is determined as follows:**

$$BE_{stage\ 1,y} = GWP_{CH4} \times D_{CH4} \times UF_b \times \sum_{j,LT} MCF_{BL1,j} \times B_{0,LT} \times N_{LT,y} \times VS_{LT,y} \times RVS \times MS\%_{BL1,j}$$

Where:

GWP_{CH4}	Global Warming Potential (GWP) of CH_4 (21)
$VS_{LT,y}$	Volatile solids for each livestock type (LT) entering the animal manure management system in year *y* (on a dry matter weight basis, kg dm/animal/year)
$N_{LT,y}$	Annual average number of animals of type "LT" in year *y* (numbers)
$B_{0,LT}$	Maximum methane producing potential of the VS generated for each animal type (m^3 CH_4/kg dm)
D_{CH4}	CH_4 density (0.00067 t/m^3 at room temperature (20 ºC) and 1 atm pressure)
$MCF_{BL1,j}$	Annual methane conversion factor for stage 1 of the baseline animal manure management system *j*
$MS\%_{BL1,j}$	Fraction of manure handled in stage 1 of the baseline manure management system *j*
UF_b	Model correction factor to account for model uncertainties (0.94)
^2RVS	Relative reduction of Volatile solids in stage one
LT	Index for all types of livestock
j	Index for animal waste management system

***Stage 2:* The annual emissions in treatment stage two is determined as follows:**

In case of sequential treatment stages, the reduction of the volatile solids during a treatment stage is estimated based on referenced data for different treatment types. Emissions from the next treatment stage are then calculated following the approach outlined above in stage 1, but with volatile solids adjusted for the reduction from the previous treatment stages by multiplying by (1 - *RVS*), where *RVS* is the relative reduction of volatile solids from the previous stage. The relative reduction (*RVS*) of volatile solids depends on the treatment technology and should be estimated in a conservative manner. Default values from annex1 in Methodology AMS-III.D may be used.

$$BE_{stage\ 2,y} = GWP_{CH4} \times D_{CH4} \times UF_b \times \sum_{j,LT} MCF_{BL2,j} \times B_{0,LT} \times N_{LT,y} \times VS_{LT,y} \times (1\text{-}RVS) \times MS\%_{BL2,j}$$

Where:

$MCF_{BL2,j}$	Annual methane conversion factor for stage 2 of the baseline animal manure management system *j*
$MS\%_{BL2,j}$	Fraction of manure handled in stage 2 of the baseline manure management system *j*

The annual average number of the livestock population ($N_{LT,y}$):

In the case of static animal populations, date will be obtain from the animal inventory. For a growing populations the following equation estimates the annual average of livestock population.

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

Where :

$N_{LT,y}$ Annual average number of animals in year y ($N_{LT,y}$)

$N_{da,y}$ Number of days animal is alive in the farm in year y (days)

$N_{p,y}$ Number of animals produced annually for the year y (numbers)

<u>Parameter description:</u>

Volatile solids (VS) from livestock:

There are two methods for calculating Volatile solids (VS) for different livestock types. The different methods may be used under the following conditions. Where it can be demonstrated that the genetic source of the livestock originates from an Annex I Party, both methods may be applied. Where it can not be demonstrated that the genetic source of the livestock originates from an Annex I Party, only the enhanced characterisation method may be applied. Calculated values from the enhanced characterisation method shall be compared with IPCC default values and any significant differences shall be explained.

$$VS_{LT,y} = VS_{LT\,IPCC,y}, \text{ or } VS_{LT\,feed,y}$$

Where:

$VS_{LT,y}$ Volatile solids for livestock "LT" entering the animal manure management system in year y (kg dm/animal/year)

$VS_{LT\,IPCC,y}$ Volatile solids for livestock "LT" entering the animal manure management system in year y, calculated using default IPCC values (kg dm/animal/year)

$VS_{LT\,feed,y}$ Volatile solids for livestock "LT" entering the animal manure management system in year y, calculated using the enhanced characterisation method (kg dm/animal/year)

Volatile solids calculated using default IPCC values:

Default IPCC values from 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 10 table 10 A-4 to 10 A-9 may be used. VS values applicable to developed countries can be used provided the following four conditions are satisfied:

Conditions
The genetic source of the production operations livestock originates from an Annex I Party
The farm uses formulated feed rations (FFR) which are optimized for the various animal(s), stage of growth, category, weight gain/productivity and/or genetics
The use of FFR can be validated (through on-farm record keeping, feed supplier, etc.)
The project specific animal weights are more similar to developed country IPCC default values

Default IPCC volatile solid values are adjusted for a site-specific average animal weight with the following equation:

$$VS_{LT\,IPCC,y} = \left(\frac{W_{site}}{W_{default}}\right) \times VS_{default} \times nd_y$$

Where:

W_{site} Average animal weight of a defined livestock population at the project site (kg)

$W_{default}$ Default average animal weight of a defined population, data sourced from IPCC 2006 (kg)
$VS_{default}$ Default value for the volatile solid excretion rate per day on a dry-matter basis for a defined livestock population (kg dm/animal/day)
nd_y Number of days in year *y* that the treatment plant was operational

Volatile solids calculated using the enhanced characterisation method:

Country-specific volatile solid excretion rates can be estimated from feed intake levels, via the enhanced characterisation method described in section 10.2 in 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 10. The following equation shall then be used:

$$VS_{LT\,feed,y} = \left[GE_{LT} \times \left(1 - \frac{DE_{LT}}{100}\right) + (UE \times GE_{LT})\right] \times \left[\frac{1-ASH}{18.45}\right] \times nd_y$$

Where:
GE_{LT} Gross energy intake (MJ/day).
DE_{LT} Digestibility of the feed in percent, Table 10.2 2 in 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 10.
UE Urinary energy expressed as fraction of GE. Typically 0.04 can be considered urinary energy excretion by most ruminants (reduce to 0.02 for ruminants fed with 85% or more grain in the diet or for swine).
ASH Ash content of the manure in calculated as a fraction of the dry matter feed intake (e.g, 0.08 for cattle).
18.45 Energy density of the feed fed to livestock type LT (ED_{LT}). IPCC notes the energy density of feed is typically 18.45 MJ/kg DM, which is relatively constant across a wide variety of grain-based feeds
nd_y Number of days in year *y* where the treatment plant was operational

Maximum methane-producing capacity of the manure (B_o)

Default values from tables 10 A-4 to 10 A-9 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10. B_0 values applicable to developed countries can be used provided the following four conditions are satisfied:

Conditions
The genetic source of the production operations livestock originates from an Annex I Party
The farm uses formulated feed rations (FFR) which are optimized for the various animal(s), stage of growth, category, weight gain/productivity and/or genetics
The use of FFR can be validated (through on-farm record keeping, feed supplier, etc.)
The project specific animal weights are more similar to developed country IPCC default values

Methane Conversion Factor (MCF)

IPCC default values provided in table 10.17 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Chapter 10 can be used.

<u>Baseline emissions calculated using option (b)</u>

$$BE_y = GWP_{CH4} \times D_{CH4} \times UF_b \times \sum_{j,LT} MCF_j \times B_{0,LT} \times Q_{manure,j,LT,y} \times SVS_{j,LT,y}$$

Where:
$Q_{manure,j,LT,y}$ Quantity of manure treated from livestock type *LT* and animal manure management system *j* (ton/year, dry basis)

$SVS_{j,LT,y}$ Specific volatile solids content of animal manure from livestock type *LT* and animal manure management system *j* in year *y* (%, dry basis)

PROJECT EMISSIONS

Project activity emissions consist of:

$$PE_y = PE_{PL,y} + PE_{flare,y} + PE_{transp,y} + PE_{storage,y} + PE_{reswaste,y} + PE_{FC,i,j,y} + PE_{elec,y}$$

Where:

$PE_{,y}$	Project emissions in year *y* (tCO_2e/yr)
$PE_{PL,y}$	Emissions due to physical leakage of biogas in year *y* (tCO_2e/yr)
$PE_{flare,y}$	Emissions from biogas flaring the year *y* (tCO_2e/yr)
$PE_{transp,y}$	Emissions from incremental transportation in the year *y* (tCO_2e/yr)
$PE_{storage,y}$	Emissions from the storage of manure before being fed into the anaerobic digester (tCO_2e/yr)
$PE_{reswaste,y}$	In case residual wastes are subjected to anaerobic storage, or disposed in a landfill, methane emissions from storage/disposal of waste (tCO_2e/yr)
$PE_{FF,y}$	Emissions from the use of fossil fuel for the operation of the facilities in the year *y* (tCO_2e/yr)
$PE_{elec,y}$	Emissions from the use of electricity for the operation of the facilities in the year *y* (tCO_2e/yr)

a) Emissions from physical leakage:

Methane emissions due to physical leakages from the digester and recovery system shall be estimated using a default factor of 0.05 m³ biogas leaked/m³ biogas produced. For ***ex post*** calculations the effectively recovered biogas amount shall be used for the calculation.

For ***ex ante*** estimation the expected biogas production of the digester may be used and leakage shall be calculated as follows:

$$PE_{PL,y} = CH4_y \times 0.05 \times D_{CH4} \times GWP_{CH4}$$

Where:

$CH4_y$ = Methane production in year y (Nm^3/yr)

$D_{CH4,n}$ Density of methane at normal conditions (0.716) (kg/m^3)

b) Emissions from flaring:

Emissions from flaring will be calculated ***ex ante***, for methane produced while the plant is of line, using a flare efficiency of 50% for open flares or 90% for enclosed flares.

$$PE_{flare} = CH4_y \times (1 - PA) \times (1 - EF) \times D_{CH4} \times GWP_{CH4}$$

Where:

$CH4_y$	Methane production in year y (Nm^3/yr)
PA	Plant Availability (%)
FE	Flare efficiency as 50% or 90%

Emissions from flaring will be calculated ***ex post*** *as follow:*

Emissions from flaring are calculated using the procedures described in the "Tool to determine project emissions from flaring gases containing methane". According to the tool, PE_{flare} is as follows:

$$PE_{flare,expost,y} = \sum_{h=1}^{8760} TM_{RG,h} \times (1 - \eta flare, h) \times \frac{GWP_{CH4}}{1000}$$

Where:

$PE_{flare,y}$	Project emissions from flaring in year *y* (tCO_2e/yr)
$TM_{RG,h}$	Mass flow rate of methane in the residual gas in the hour *h*
$\eta_{flare,h}$	Flare efficiency in hour *h*

Where:

$TM_{RG,h} = FV_{RG,h} \times w_{CH4,y} \times D_{CH4,n}$

$FV_{RG,h}$	Volumetric flow rate of the biogas at normal conditions in hour *h* (m^3/h)
$w_{CH4,y}$	Volumetric fraction of methane in the biogas basis in hour *h* (fraction), alternatively a default value of 60% methane content can be used
$D_{CH4,n}$	Density of methane at normal conditions (0.716) (kg/m^3)

In case of enclosed flares and use of the default value for the flare efficiency (90%), the flare efficiency in the hour h ($\eta_{flare,h}$) is:

- 0% if the temperature in the exhaust gas of the flare (T_{flare}) is below 500 °C for more than 20 minutes during the hour *h* .
- 50%, if the temperature in the exhaust gas of the flare ((T_{flare}) is above 500 °C for more than 40 minutes during the hour *h*, but the manufacturer's specifications on proper operation of the flare are not met at any point in time during the hour *h*.
- 90%, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500 °C for more than 40 minutes during the hour *h* and the manufacturers specifications on proper operation of the flare are met continuously during the hour *h*.

In case of open flares, the flare efficiency in the hour h ($\eta_{flare,h}$) is

- 0% if the flame is not detected for more than 20 minutes during the hour h.
- 50%, if the flare is detected for more than 20 minutes during the hour h.

c) Emissions from incremental transportation:

Where substrates are used for renewable energy generation only (*BT*), project emissions due to incremental transport distances are not applicable. Emissions associated with transportation of these substrates are accounted for as leakage emissions.

For project activities that involve methane avoidance, project emissions due to incremental transport distances $PE_{y,transp}$ are calculated based on the incremental distances between:

(i) The collection points of manure (*LT*) and the digestion site as compared to the baseline solid waste disposal site or manure treatment site;

(ii) Treatment sites and the sites for soil application, landfilling and further treatment of the residual waste.

$$PE_{y,transp} = (Q_{y,LT}/CT_{y,LT}) \times DAF_{LT} \times EF_{CO2/km} + (Q_{y,res\text{-}waste}/CT_{y,res\text{-}waste}) \times DAF_{res\text{-}waste} \times EF_{CO2/km}$$

Where:

$Q_{y,LT}$	Quantity of raw manure transported in the year *y* (ton)

$CT_{y,LT}$	Average truck capacity for manure transportation (ton/truck)
DAF_{LT}	Average incremental distance for manure transportation (km/truck)
$Q_{y,res\text{-}waste}$	Quantity of digester residual waste transported in year *y* (ton)
$CT_{y,res\text{-}waste}$	Average truck capacity for residual waste transportation (ton/truck)
$DAF_{res\text{-}waste}$	Average incremental distance for residual waste transportation (km/truck)
$EF_{CO2/km}$	CO_2 emission factor from fossil fuel used for transportation inside the project boundary (tCO_2e/km)

CO_2 emission factor from fossil fuel used for transportation

$$EF_{CO2/km} = VF_{cons} \times D_{fuel} \times NCV_{fuel,y} \times EF_{CO2,fuel}$$

Where:

VF_{cons}	Vehicle fuel consumption for transportation inside the project boundary (ℓ/km)
D_{fuel}	Fuel density for fuel used for transportation inside the project boundary (kg/ℓ)
$NCV_{fuel,y}$	Calorific value of the fuel used for transportation inside the project boundary (TJ/kg t)
$EF_{CO2,fuel}$	CO_2 emission factor of the fuel used for transportation inside the project boundary (tCO_2e/TJ)

d) Emissions from storage:

Where applicable, project emissions on account of storage of manure before being fed into the anaerobic digester shall be accounted for if both condition (a) and condition (b) below are satisfied:

(c) The storage time of the manure after removal from the animal barns, including transportation, exceeds 24 hours before being fed into the anaerobic digester; and

(d) The dry matter content of the manure when removed from the animal barns is less than 20%.

The following method shall be used to calculate project emissions from manure storage:

$$PE_{storage,y} = GWP_{CH_4} \times D_{CH_4} \times \sum_{LT,l}\left[\frac{365}{AI_l}\sum_{d=1}^{AI}(N_{LT,y} \times VS_{LT,d} \times MS\%_l \times (1-e^{-k\ (AI_l-d)}) \times MCF_l \times B_{0_{LT}})\right]$$

AI_l	Annual average interval between manure collection and delivery for treatment at a given storage
$MS\%_l$	Fraction of volatile solids (%) handled by storage device *l*
k	Degradation rate constant (0.069)
d	Days for which cumulative methane emissions are calculated; d can vary from 1 to 45 and to be run from 1 up to AI_l
MCF_l	Annual methane conversion factor for the project manure storage device *l* from Table 10.17, Chapter 10, Volume 4

e) Methane emissions from the disposal/storage/treatment of these residual waste

Where applicable, methane emissions from anaerobic storage and/or disposal in a landfill of the residual waste from the digestion ($PE_{reswaste,y}$) are calculated as per follows:

$$BE_{reswaste,y} = \varphi \cdot (1-f) \cdot GWP_{CH4} \cdot (1-OX) \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^{y}\sum_j W_{j,x} \cdot DOC_j \cdot e^{-k(y-x)} \cdot (1-e^{-kj})$$

Where:

φ	Model correction factor to account for model uncertainties (0.9)

f	Fraction of methane captured at the SWDS and flared, combusted or used in another manner
GWP_{CH4}	Global warming Potential of methane, valid for the relevant commitment period
OX	Oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste)
F	Fraction of methane in the SWDS gas (volume fraction) (0.5)
DOC_f	Fraction of degradable organic carbon (DOC) that can decompose (0.5)
MCF	Methane correction factor
$W_{j,x}$	Amount of organic waste type *j* prevented from disposal in the SWDS in the year *x* (tons)
DOC_j	Fraction of degradable organic carbon (by weight) in the waste type *j*
k_j	Decay rate for the waste type *j*
j	Waste type category (index)
x	Year during the crediting period: x runs from the first year of the firs crediting period (x=1) to the year y for which avoided emissions are calculated (x = y)
y	Year for which methane emissions are calculated

f) Emissions from fossil fuel:

Emissions from fossil fuel combustion in the project activity are calculated based on the quantity of fuels combusted and the CO_2 emission coefficient of those fuels, as follows:

$$PE_{FC,j,y} = FC_{i,j,,y} \times COEF_{i,y}$$

Where:

$FC_{i,j,y}$	Quantity of fossil fuel type *i* combusted in process *j* inside the project boundary in year *y* (ton/yr)
$COEF_{i,y}$	The CO_2 emission coefficient of fuel type i in year y (tCO_2/mass or volume unit)
i	Fossil fuel types combusted in process *j* inside the project boundary in year y

With:

$$COEF_{i,y} = NCV_{i,y} \times EF_{CO2,i,y}$$

Where:

$NCV_{i,y}$	Weighted average net calorific value of the fossil fuel type *i* combusted inside the project boundary in year *y* (TJ/ton)
$EF_{CO2,i,y}$	CO_2 emission factor of fossil fuel type *i* combusted inside the project boundary (tCO_2e/TJ)

g) Emissions from electricity use:

Project emissions from grid electricity consumption will be calculated as follows:

$$PE_{elec,y} = EC_{elec,y} \times EF_{CO2,grid,y}$$

Where:

$EC_{elec,y}$	Quantity of electricity consumed in the project boundary in year *y* (MWh/yr)
$EF_{CO2,grid,y}$	CO_2 emission factor of the grid in year *y* (tCO_2e/MWh)

<u>LEAKAGE EMISSIONS</u>

According to Methodology ASM-III.D (Version 18) paragraph 16, no leakage calculation is required.

B.7. Application of the monitoring methodology and description of the monitoring plan
B.7.1. Data and parameters to be monitored by each generic CPA

Data / Parameter	nd_y
Unit	Days per year
Description	Number of days in year *y* that the treatment plant was operational
Source of data	CPA operational records
Value(s) applied	Specific to CPA
Measurement methods and procedures	If any farm has no operations on a given day it needs to be properly documented and taken into account for the calculation of $BE_{ex\text{-}post}$
Monitoring frequency	Annually, based on daily records and monthly aggregation
QA/QC procedures	Cross check with the mass balance from the plant.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$N_{LT,y}$
Unit	Numbers
Description	Annual average number of animals of type "*LT*" in year *y*
Source of data	Farm records
Value(s) applied	Specific to CPA
Measurement methods and procedures	Animal inlet/birth and sold-out dates are part of the production schedule. Therefore, this parameter can be calculated from farm records.
Monitoring frequency	Annually, based on monthly records
QA/QC procedures	The consistency between the value and indirect information (records of sales, records of food purchases) should be assessed.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$N_{da,y}$
Unit	Number
Description	Number of days animals are alive in the farm in the year *y*
Source of data	Farm records
Value(s) applied	Specific to CPA
Measurement methods and procedures	Animal inlet/birth and sold-out dates are part of the production schedule. Therefore, this parameter can be calculated from farm records.
Monitoring frequency	Annually, based on monthly records
QA/QC procedures	The consistency between the value and indirect information (records of sales, records of food purchases) should be assessed.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$N_{p,y}$
Unit	Number
Description	Number of animals produced/bought annually of type *LT* for the year *y*
Source of data	Farm records
Value(s) applied	Specific to CPA
Measurement methods and procedures	Animal numbers are part of the productions schedule. Therefore, this parameter can be calculated from farm records.
Monitoring frequency	Annually, based on monthly records
QA/QC procedures	The consistency between the value and indirect information (records of sales, records of food purchases) should be assessed.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	W_{site}
Unit	Kg
Description	Average animal weight of a defined livestock population at the project site.
Source of data	Farm records
Value(s) applied	Specific to CPA
Measurement methods and procedures	The weighing of animals populations is part of the production schedule, the CPA-DD will describe this procedure.
Monitoring frequency	Annually
QA/QC procedures	Check the value against historical values. If the values differ significantly, differences should be explained.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	GE_{LT}
Unit	MJ/day
Description	Daily average gross energy intake
Source of data	AWMS operational records
Value(s) applied	Specific to CPA
Measurement methods and procedures	Factual information from AWMS.
Monitoring frequency	Annually
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	DE_{LT}
Unit	%
Description	Digestible energy of the feed in present
Source of data	IPCC default value (Volume 4 chapter 10) or feed information from feed supplier
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Annually
QA/QC procedures	Values shall be compared with IPCC default values and any significant differences shall be explained.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	*UE*
Unit	Fraction of GE
Description	Urinary energy expressed as fraction of GE
Source of data	Typically 0.04GE can be considered urinary energy excretion by most ruminants (reduce to 0.02 for ruminants fed with 85% or more grain in the diet or for swine). Use country-specific values where available.
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Annually
QA/QC procedures	Values shall be compared with IPCC default values and any significant differences shall be explained.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	*ASH*
Unit	Fraction of the dry matter feed intake
Description	Ash content of the manure calculated as a fraction of the dry matter feed intake
Source of data	IPCC default value (Volume 4 chapter 10). Use country specific values where available.
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Annually
QA/QC procedures	Values shall be compared with IPCC default values and any significant differences shall be explained.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	ED_{LT}
Unit	MJ/kg DM
Description	Energy density of the feed in MJ/kg fed to livestock type LT
Source of data	IPCC notes the energy density of feed, ED, is typically 18.45 MJ/kg DM, which is relatively constant across a wide variety of grain-based feeds. The project proponent will record the composition of the feed to enable the DOE to verify the energy density of the feed.
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Annually
QA/QC procedures	Check the consistency of the energy density by comparing the supplier information with previous years. If the values differ significantly, differences should be explained..
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$Q_{manure,j,LT,y}$
Unit	ton/year, dry basis
Description	Quantity of manure treated from livestock type *LT* and animal manure management system *j* in year *y*
Source of data	Measured
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Use mass or volume based measurements. Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Annually, based on daily measurement and monthly aggregation
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$SVS_{j,LT,y}$
Unit	% (dry basis)
Description	Specific volatile solids content of animal manure from livestock type *LT* and animal manure management system *j* in year *y*
Source of data	Measured at accredited laboratories
Value(s) applied	Specific to CPA
Measurement methods and procedures	In case animal manure is treated in a centralized plant. Testing shall be performed according to the guideline in Annex 2 of AM0073. It can be on sample basis by following "Standard for sampling and surveys for CDM project activities and programme of activities", with a maximum margin of error of 10% at a 90% confidence level.
Monitoring frequency	Annually
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	*Genetic source*
Unit	-
Description	Genetic source of the production operations livestock originate from an Annex I Party
Source of data	Farm records
Value(s) applied	-
Measurement methods and procedures	-
Monitoring frequency	Annually
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	*FFR*
Unit	-
Description	Formulated feed rations (*FFR*) which are optimized for the various animal(s), stage of growth, category, weight gain/productivity and/or genetics
Source of data	Farm records
Value(s) applied	-
Measurement methods and procedures	
Monitoring frequency	Annually
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	*Soil application*
Unit	-
Description	Where applicable, the proper soil application (not resulting in methane emissions) of the residual waste shall be monitored.
Source of data	-
Value(s) applied	-
Measurement methods and procedures	Monitor the soil application of the final sludge and confirm proper application.
Monitoring frequency	Annually
QA/QC procedures	-
Purpose of data	Calculation of project emissions
Additional comments	-

Data / Parameter	*Site inspections*
Unit	-
Description	On-site inspections for each individual farm included in the project boundary where the project activity is implemented for each verification period.
Source of data	-
Value(s) applied	-
Measurement methods and procedures	-
Monitoring frequency	Annually
QA/QC procedures	-
Purpose of data	-
Additional comments	-

Data / Parameter	$BG_{flare,y}$; $BG_{elec,y}$; $BG_{thermal,y}$
Unit	Nm^3/yr
Description	$BG_{flare,y}$: Biogas flow to the flare in year *y* $BG_{elec,y}$: Biogas flow to the electricity generation system in year *y* $BG_{thermal,y}$: Biogas flow to the thermal energy generation system in year *y*
Source of data	Measured - flow meters
Value(s) applied	Not applicable, measured *ex post* only
Measurement methods and procedures	Flow meters will measure continuously the volume of gas and will be added over a period of a year to get the annual measurement. Biogas Temperature and pressure will be measured simultaneously to normalize for the conditions of the gas combusted. The system will be built and operated to ensure that there is no air inflow into the biogas pipeline. Measurement method: Flow meter Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Annually, based on continuous flow measurement with accumulated volume recording (e.g. hourly/daily accumulated reading)
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	T_{biogas}
Unit	^{o}C
Description	Temperature of the biogas at the flow measurement site
Source of data	Data from temperature gauge
Value(s) applied	Not applicable, measured *ex post* only
Measurement methods and procedures	The temperature of the gas is required to determine the density of the methane combusted. If the biogas flow meter employed measures flow, pressure and temperature and displays or outputs the normalised flow of biogas, then there is no need for separate monitoring of pressure and temperature of the biogas. Temperature shall be measured at the same time when methane content in biogas (w_{CH4}) is measured. Measurement method: Temperature gauge Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recording.
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	P_{biogas}
Unit	kPa
Description	Pressure of the biogas at the flow measurement site
Source of data	Measured - pressure gauge
Value(s) applied	Not applicable, measured *ex post* only
Measurement methods and procedures	The pressure of the gas is required to determine the density of the methane combusted. If the biogas flow meter employed measures flow, pressure and temperature and displays or outputs the normalised flow of biogas, then there is no need for separate monitoring of pressure and temperature of the biogas. Pressure shall be measured at the same time when methane content in biogas (w_{CH4}) is measured. Measurement method: Pressure gauge Standards to be applied: Relevant national/international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recording.
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$w_{CH4,y}$
Unit	Mass fraction
Description	Fraction of Methane in the biogas in year *y*
Source of data	Measured - gas analyser. Alternatively a default value of 60% methane content can be used
Value(s) applied	Not applicable, measured *ex post* only
Measurement methods and procedures	The fraction of methane in the biogas should be measured with a continuous analyser (values are recorded with the same frequency as the flow) or alternatively a default value of 60% methane content can be used. Option chosen should be clearly specified in the CPA-DD . It shall be measured using equipment that can directly measure methane content in the biogas - the estimation of methane content of biogas based on measurement of other constituents of biogas such as CO_2 is not permitted. The methane content measurement shall be carried out close to a location in the system where a biogas flow measurement takes place, and on the same basis (wet or dry) Measurement method: Gas analyser Standards to be applied: National or international standard or manufacturer's specifications. Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recording.
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of project emissions (flare)
Additional comments	-

Data / Parameter	T_{flare}
Unit	^{o}C
Description	Temperature in the exhaust gas of the flare
Source of data	Data from temperature gauge
Value(s) applied	Not applicable, measured *ex post* only
Measurement methods and procedures	Measure the temperature of the exhaust gas stream in the flare with a temperature gauge. To ensure 90% of combustion of the biogas in the enclosed flare system, the temperature needs to be between 500 ^{o}C and 700 ^{o}C. The control of the temperature is determined by the temperature gauge. Measurement method: Temperature gauge Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recording.
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of project emissions (flare)
Additional comments	An excessively high temperature at the sampling point (above 700 ºC) may be an indication that the flare is not being adequately operated or that its capacity is not adequate to the actual flow.

Data / Parameter	$FV_{RG,h}$
Unit	m^3/h
Description	Volumetric flow rate of the residual gas in dry basis at normal conditions in hour h
Source of data	Measured - flow meters
Value(s) applied	Not applicable, measured *ex post* only
Measurement methods and procedures	Flow meters will measure continuously the volume of gas. Biogas Temperature and pressure will be measured simultaneously. The system will be built and operated to ensure that there is no air inflow into the biogas pipeline. Measurement method: Flow meter Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recording.
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of project emissions (flare)
Additional comments	-

Data / Parameter	$\eta_{flare,h}$
Unit	Fraction
Description	Flare efficiency in hour *h*
Source of data	Default of 50% will be used for open flares and 90% will be used for enclosed flares, except in circumstances where it does not operate in accordance with manufacturers specifications for enclosed flare
Value(s) applied	In case of enclosed flares and use of the default value for the flare efficiency (90%), the flare efficiency in the hour h ($\eta_{flare,h}$) is: ● 0% if the temperature in the exhaust gas of the flare (T_{flare}) is below 500 °C for more than 20 minutes during the hour *h* . ● 50%, if the temperature in the exhaust gas of the flare ((T_{flare}) is above 500 °C for more than 40 minutes during the hour *h*, but the manufacturer's specifications on proper operation of the flare are not met at any point in time during the hour *h*. ● 90%, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500 °C for more than 40 minutes during the hour *h* and the manufacturers specifications on proper operation of the flare are met continuously during the hour *h*. In case of open flares, the flare efficiency in the hour h ($\eta_{flare,h}$) is ● 0% if the flame is not detected for more than 20 minutes during the hour h. ● 50%, if the flare is detected for more than 20 minutes during the hour h.
Measurement methods and procedures	Based on exhaust gas temperature recorded by T_{flare} and monitored compliance with manufacturers specifications.
Monitoring frequency	-
QA/QC procedures	Continuous check of compliance with the manufacturer's specifications of the flare device
Purpose of data	Calculation of project emissions (flare)
Additional comments	

Data / Parameter	$Q_{y,LT}$; $Q_{y,res\text{-}waste}$
Unit	ton/yr or m^3/yr
Description	$Q_{y,LT}$: Quantity of raw manure transported in the year *y* $Q_{y,res\text{-}waste}$: Quantity of digester residual waste transported in year *y*
Source of data	CPA operational records
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Use mass or volume based measurements. Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA.
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used. The quantity monitored should be cross checked with the mass balance from the plant.
Purpose of data	Calculation of project emissions (transport)
Additional comments	-

Data / Parameter	$CT_{y,LT}$; $CT_{y,res\text{-}waste}$
Unit	ton or m^3/truk
Description	$CT_{y,LT}$: Average truck capacity for manure transportation in year *y* $CT_{y,res\text{-}waste}$: Average truck capacity for residual waste transportation in year *y*
Source of data	CPA operational records e.g. logbooks
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	-
Purpose of data	Calculation of project emissions (transport)
Additional comments	-

Data / Parameter	DAF_{LT}; $DAF_{res\text{-}waste}$
Unit	km/truck
Description	$DAF_{w,LT}$: Incremental distance for manure transportation in year *y* $DAF_{res\text{-}waste}$: Incremental distance for residual waste transportation in year *y*
Source of data	CPA operational records, e.g. logbooks
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	-
Purpose of data	Calculation of project emissions (transport)
Additional comments	-

Data / Parameter	VF_{cons}
Unit	ℓ/km
Description	Vehicle fuel consumption in litres per kilometre
Source of data	Records (e.g. logbooks) or standard fuel consumption for type of truck or IPCC values
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	-
Purpose of data	Calculation of project emissions (transport)
Additional comments	-

Data / Parameter	D_{fuel}
Unit	kg/ℓ
Description	Fuel density
Source of data	Oil company data for fuel type used
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	-
Purpose of data	Calculation of project emissions (transport)
Additional comments	-

Data / Parameter	$NCV_{fuel,y}$
Unit	TJ/kg or other unit
Description	Net calorific value of the fuel used for transport inside the project boundary in year *y*
Source of data	The following data sources may be used if the relevant conditions apply:

Data source	Conditions for using the data source
a) Values provided by the fuel supplier in invoices	This is the preferred source if the carbon fraction of the fuel is not provided (Option A)
b) Measurements by the CPA implementers	If a) is not available
c) Regional or national default values	If a) is not available. These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances).
d) IPCC default values at the upper 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	If a) is not available

Value(s) applied	Specific to CPA
Measurement methods and procedures	For a) and b): Measurements should be undertaken in line with national or international fuel standards
Monitoring frequency	For a) and b): The NCV should be obtained for each fuel delivery, from which weighted average annual values should be calculated For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures	Verify if the values under a), b) and c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards.
Purpose of data	Calculation of project emissions (transport)
Additional comments	-

Data / Parameter	$EF_{CO2,fuel}$
Unit	tCO_2e/TJ
Description	CO_2 emission factor of the fuel used for transportation inside the project boundary in year *y*.
Source of data	The following data sources may be used if the relevant conditions apply:

Data source	Conditions for using the data source
a) Values provided by the fuel supplier in invoices	This is the preferred source
b) Measurements by the CPA implementers	If a) is not available
c) Regional or national default values	If a) is not available. These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances)
d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories	If a) is not available

Value(s) applied	Specific to CPA
Measurement methods and procedures	For a) and b): Measurements should be undertaken in line with national or international fuel standards
Monitoring frequency	For a) and b): The CO2 emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated. For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures	-
Purpose of data	Calculation of project emissions (transport)
Additional comments	For a): If the fuel supplier does provide the NCV value and the CO_2 emission factor on the invoice and these two values are based on measurements for this specific fuel, this CO_2 factor should be used. If another source for the CO_2 emission factor is used or no CO_2 emission factor is provided, Options b), c) or d) should be used.

Data / Parameter	$MS\%_l$
Unit	%
Description	Fraction of volatile solids handled by storage device *l*
Source of data	CPA operational records
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Use mass or volume based measurements. Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA.
Monitoring frequency	Annually, based on daily records an aggregated monthly
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of project emissions (storage)
Additional comments	-

Data / Parameter	AI_l
Unit	Days
Description	Annual average interval between manure collection and delivery for treatment at a given storage
Source of data	CPA operational records
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Annually, based on daily records an aggregated monthly
QA/QC procedures	The days monitored should be cross checked with the time balance from the plant.
Purpose of data	Calculation of project emissions (storage)
Additional comments	-

Data / Parameter	f
Unit	
Description	Fraction of methane captured at the project SWDS and flared, combusted or used in another manner
Source of data	Written information from the operator of the solid waste disposal site and/or site visits at the solid waste disposal site
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Annually
QA/QC procedures	Check the value against projection schedule. If the values differ significantly, differences should be explained.
Purpose of data	Calculation of project emissions (residual waste)
Additional comments	-

Data / Parameter	$W_{j,x}$
Unit	Ton
Description	Total amount of residual disposed of in SWDS in year x
Source of data	CPA operational records
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Use mass or volume based measurements. Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA.
Monitoring frequency	Annually, based on daily records and monthly aggregation.
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used. The quantity monitored should be cross checked with the mass balance from the plant.
Purpose of data	Calculation of project emissions (residual waste)
Additional comments	-

Data / Parameter	$FC_{i,j,y}$
Unit	ton/yr or m^3/yr
Description	Quantity of fossil fuel type *i* combusted in process *j* inside the project boundary in year *y*
Source of data	Onsite measurements
Value(s) applied	Specific to CPA
Measurement methods and procedures	• Use either mass or volume meters. In cases where fuel is supplied from small daily tanks, rulers can be used to determine mass or volume of the fuel consumed, with the following conditions: The ruler gauge must be part of the daily tank and calibrated at least once a year and have a book of control for recording the measurements (on a daily basis or per shift); • Accessories such as transducers, sonar and piezoelectronic devices are accepted if they are properly calibrated with the ruler gauge and receiving a reasonable maintenance; • In case of daily tanks with pre-heaters for heavy oil, the calibration will be made with the system at typical operational conditions.
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used. The consistency of metered fuel consumption quantities should be cross-checked by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records.
Purpose of data	Calculation of project emissions (fossil fuel)
Additional comments	-

Data / Parameter	$NCV_{i,y}$
Unit	TJ/ton
Description	Weighted average net calorific value of the fossil fuel type *i* combusted inside the project boundary in year *y*
Source of data	The following data sources may be used if the relevant conditions apply: Data source: Conditions for using the data source a) Values provided by the fuel supplier in invoices: This is the preferred source if the carbon fraction of the fuel is not provided (Option A) b) Measurements by the CPA implementers: If a) is not available c) Regional or national default values: If a) is not available. These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances). d) IPCC default values at the upper 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: If a) is not available
Value(s) applied	Specific to CPA
Measurement methods and procedures	For a) and b): Measurements should be undertaken in line with national or international fuel standards
Monitoring frequency	For a) and b): The NCV should be obtained for each fuel delivery, from which weighted average annual values should be calculated For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures	Verify if the values under a), b) and c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards.
Purpose of data	Calculation of project emissions (fossil fuel)
Additional comments	-

Data / Parameter	$EF_{CO2,i,y}$
Unit	tCO_2/TJ
Description	CO_2emission factor of fossil fuel type *i* combusted inside the project boundary in year y
Source of data	The following data sources may be used if the relevant conditions apply:

Data source	Conditions for using the data source
a) Values provided by the fuel supplier in invoices	This is the preferred source
b) Measurements by the CPA implementers	If a) is not available
c) Regional or national default values	If a) is not available. These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances)
d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories	If a) is not available

Value(s) applied	Specific to CPA
Measurement methods and procedures	For a) and b): Measurements should be undertaken in line with national or international fuel standards
Monitoring frequency	For a) and b): The CO2 emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated. For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures	-
Purpose of data	Calculation of project emissions (fossil fuel)
Additional comments	For a): If the fuel supplier does provide the NCV value and the CO_2 emission factor on the invoice and these two values are based on measurements for this specific fuel, this CO_2 factor should be used. If another source for the CO_2 emission factor is used or no CO_2 emission factor is provided, Options b), c) or d) should be used.

Data / Parameter	EC_y
Unit	MWh/yr
Description	Quantity of electricity consumed in the project boundary in year *y*
Source of data	Measured – electricity gauge
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Electricity gauge Standards to be applied: Relevant national/international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recordings
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of project emissions (electricity)
Additional comments	-

B.7.2. Description of the monitoring plan for a generic CPA

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1. Management of parameters to be monitored

The Tables below show all the possible parameters to be monitored for the different Project scenarios under the PoA. From these tables, the CME will compile a list of relevant parameters for each CPA in section D.7.2 of the CPA-DD. Further information on the source of date, details on the measurement methods and procedures and QA/QC procedures will be as describe in section D.7.1 of the CPA-DD

The CME will ensure that a representative from each CPA is suitable trained on monitoring and operations & maintenance of monitoring equipment.

CPAs shall monitor 100% of the relevant parameters included in Section D.7.1. of each CPA-DD. Monitoring reports will be prepared separately for all CPAs, however only a sample will be verified by the DOE. See the sampling procedure proposed for verification below in "Reporting and verification".

The following tables show all the parameters to be monitored under the PoA:

Table 1.a Baseline emission parameters related to methane avoidance from AWMS
Table 1.b Methane captured and destroyed or used gainfully by the project activity
Table 2 Project emission parameters under the PoA
Table 3 Leakage emission parameters and demonstrations under the PoA

Baseline emissions

Table 1.a. Baseline emission parameters related to methane avoidance from AWMS

Parameter	Description
$N_{LT,y}$	Annual average number of animals of type "LT" in year *y* (numbers)
$N_{da,y}$	Number of days animal is alive in the farm in year *y* (days)
$N_{p,y}$	Number of animals produced annually for the year *y* (numbers)

W_{site}	Average animal weight of a defined livestock population at the project site (kg)
nd_y	Number of days in year *y* that the treatment plant was operational
GE_{LT}	Gross energy intake (MJ/day)
DE_{LT}	Digestibility of the feed in percent, Table 10.2 2 in 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 10.
UE	Urinary energy expressed as fraction of GE. Typically 0.04 can be considered urinary energy excretion by most ruminants (reduce to 0.02 for ruminants fed with 85% or more grain in the diet or for swine)
ASH	Ash content of the manure in calculated as a fraction of the dry matter feed intake (e.g, 0.08 for cattle)
ED_{LT}	Energy density of the feed in MJ/kg fed to livestock type LT (MJ/kg DM)
$Q_{manure,j,LT,y}$	Quantity of manure treated from livestock type *LT* and animal manure management system *j* (ton/year, dry basis)
$SVS_{j,LT,y}$	Specific volatile solids content of animal manure from livestock type *LT* and animal manure management system *j* in year *y* (%, dry basis)
Genetic source	Genetic source of the production operations livestock originate from an Annex I Party
FFR	Formulated feed rations (*FFR*) which are optimized for the various animal(s), stage of growth, category, weight gain/productivity and/or genetics
Soil application	Where applicable, the proper soil application (not resulting in methane emissions) of the residual waste shall be monitored.
Site inspection	On-site inspections for each individual farm included in the project boundary where the project activity is implemented for each verification period.

Table 1.b. Methane captured and destroyed or used gainfully by the project activity

Parameter	Description
$BG_{flare,y}$	Biogas flow to the fare (Nm^3/yr)
$BG_{elec,y}$	Biogas flow to the electricity generation system (Nm^3/yr)
$BG_{thermal,y}$	Biogas flow to the thermal energy generation system (Nm^3/yr)
T_{biogas}	Temperature of the biogas at the flow measurement site (^oC)
P_{biogas}	Pressure of the biogas at the flow measurement site (kPa)
$w_{CH4,y}$	Fraction of methane in the biogas (fraction)

Project emissions

Table 2.1. Project emission parameters for flaring

Parameter	Description
$FV_{RG,h}$	Volumetric flow rate of the residual gas in dry basis at normal conditions in hour *h* (m^3/h)
T_{flare}	Temperature in the exhaust gas of the flare (^oC)

Table 2.2. Leakage emission parameters for transportation

Parameter	Description
$Q_{y,LT}$	Quantity of raw manure transported in the year *y* (ton)
$Q_{y,res\text{-}waste}$	Quantity of digester residual waste transported in year *y* (ton)
$CT_{y,LT}$	Average truck capacity for manure transportation (ton/truck)
$CT_{y,res\text{-}waste}$	Average truck capacity for residual waste transportation (ton/truck)
DAF_{LT}	Average incremental distance for manure transportation (km/truck)
$DAF_{res\text{-}waste}$	Average incremental distance for residual waste transportation (km/truck)
VF_{cons}	Vehicle fuel consumption for transportation inside the project boundary (ℓ/km)
D_{fuel}	Fuel density for fuel used for transportation inside the project boundary (kg/ℓ)
$NCV_{fuel,y}$	Calorific value of the fuel used for transportation inside the project boundary (TJ/ton)

$EF_{CO2,fuel}$	CO_2 emission factor of the fuel used for transportation inside the project boundary (tCO_2e/TJ)

Table 2.3. Leakage emission parameters for storage of manure

Parameter	Description
AI_l	Annual average interval between manure collection and delivery for treatment at a given storage
$MS\%_l$	Fraction of volatile solids (%) handled by storage device *l*

Table 2.4. Project emission parameters for residual waste

Parameter	Description
f	Fraction of methane captured at the project SWDS and flared, combusted or used in another manner
$W_{j,x}$	Amount of residual waste disposed of in the SWDS in the year *x* (tons)

Table 2.5. Project emission parameters for fossil fuel and electricity use

Parameter	Description
$FC_{i,j,y}$	Quantity of fossil fuel type *i* combusted in process *j* inside the project boundary in year *y* (ton/yr)
$NCV_{i,y}$	Weighted average net calorific value of the fossil fuel type *i* combusted inside the project boundary in year *y* (TJ/ton)
$EF_{CO2,i,y}$	CO_2 emission factor of fossil fuel type *i* combusted inside the project boundary (tCO_2e/TJ)
EC_y	Quantity of electricity consumed in the project boundary in year *y* (MWh/yr)

2. Data management

- The CME will ensure that a representative from each CPA will be suitable trained on the applications of data management.
- The CPA implementer will be responsible for measurement, record-keeping and storage of all data to be monitored. All data will be electronically archived on the CPA's data control system for the entire crediting period plus two years beyond the crediting period.
- The CPA implementer will be responsible for coordinating the monitoring of AWMS parameters with the AWMS manager.
- The CME will manage a central database with all the monitoring information from the different CPAs and also store the information for the whole crediting period plus two years beyond the crediting period.
- The CME will conduct an inspection of each CPA every six months to ensure that all the relevant data is collected and stored adequately for verification
- Data management between the CPA implementer and the CME will work as follows:

Parameter		Measurement method	Data management
AWMS	$N_{LT,y}$; $N_{da,y}$; $N_{p,y}$ W_{site} GE_{LT}; DE_{LT}; UE;ASH; ED_{LT} *Genetic source* *FFR*	Farm records	CPA implementers shall gather information and supporting documentations from the AWMS manager or farmer and supply it to the CME on an annual basis.
	nd_y AI_l	Operational records	Data will be manually recorded by the operational staff at the project site. Data will be transferred to a spreadsheet, aggregated monthly and sent to the CME.
	$MS\%_{i,y}$	Mass or volume measurements	
	CPA implementer shall monitor the soil application of the final sludge and confirm proper application.		CPA implementer shall annually send report and confirmation to CME.

	CPA implementers shall conduct on-site inspections for each farm and for each verification period		CPA implementer shall annually send report to the CME.
Biomass	$SVS_{j,LT,y}$	Accredited laboratories	CPA implementer will do measurements quarterly and send data to CME.
	$Q_{manure,j,LT,y}$ $W_{j,x}$	Mass or volume measurements	Data will be manually recorded by the operational staff at the project site. Data will be transferred to a spreadsheet, aggregated monthly and sent to the CME.
Biogas	$BG_{flare,y}$ $BG_{elec,y}$ $BG_{thermal,y}$	Flow meter	The metering instruments will be connected to a monitoring system for computation and automatic data acquisition on a continuous basis. This data is logged in the plant distributed control system for history collection . This data is transferred monthly to the CME and archived.
	T_{biogas}	Temperature gauge	
	P_{biogas}	Pressure gauge	
	$w_{CH4,y}$	Gas analyser	
Electricity	EC_y	Electricity meters	
Flare	$FV_{RG,h}$	Flow meter	
	T_{flare}	Temperature gauge	
Transport	$Q_{y,LT}$; $Q_{y,res\text{-}waste}$ $CT_{y,LT}$; $CT_{y,res\text{-}waste}$ DAF_{LT}; $DAF_{res\text{-}waste}$ VF_{cons}	Log book	Data will be manually recorded by the operational/administrational staff at the project site. Data will be transferred to a spreadsheet, aggregated monthly and sent to the CME.
	D_{fuel}	Suppliers information	
Fossil fuel	$FC_{i,j,y}$ $NCV_{i,y}$ $NCV_{fuel,y}$ $EF_{CO2,i,y}$ $EF_{CO2,fuel}$	According to "Tool to calculate CO_2 emissions from fossil fuel"	
Residual waste	f	SWDS records	CPA implementers shall gather information and supporting documentations from the SWDS manager and supply it to the CME on an annual basis.

3. Reporting and verification

- The CME will process data received from the CPA implementer and calculated emission reductions.
- The CME will compile the monitoring reports from all CPAs into one summary report
- The CME QC Manager will review the CPAs' monitoring reports.
- The DOE performs a desk review on the CPAs'monitoring reports.
- The CME provides an updated monitoring report in light of the DOE desk review findings.
- The DOE approves the final monitoring report
- For on-site assessment of CPAs, the DOE will implement the sampling procedure as described below:

Sampling plan:
All CPAs included in the PoA shall monitor 100% of the relevant parameters included in Section D.7.1. of the CPA-DD unless otherwise noted. Monitoring reports will be prepared separately for all CPAs, however only a statistically acceptable sample will be verified by the DOE.

The proposed sampling method is based on the multi-stage sampling approach. In multi-stage sampling, the population is divided into units, referred to as primary sampling units. The population in the primary units is again divided into smaller sub-units, referred to as secondary sampling units. Each CPA can be assigned to only one sample unit.

For this PoA, the primary sampling units will be the CPAs under a specific CPA implementer and the secondary sample units will be the different project scenarios. For each secondary sample unit a sample will be determined that will be subject to on-site verification.

For each secondary sample unit the size of the randomly selected samples will be defined to meet the 90/10 confidence interval level. In order to ensure transparency and representativeness of the sample chosen, the CPAs to be included in a sample will be chosen randomly by the DOE for each verification period. Since the number of CPAs included in the proposed PoA will evolve during the crediting period, the sampling selection process is to be recalculated for at each verification. All CPAs included in a sampling group will be subject to on-site verification.

4. Procedures for corrective actions in order to provide more accurate future monitoring

- The CME shall update the monitoring system to the necessary improvements/updates and include them in a new version of the PoA-DD and CPA-DD.
- The DOE validate the new monitoring system and submit it to the CDM Board for approval.
- Once changes have been approved by the Board, the monitoring of all new CPAs and existing CPAs shall be based on the updated monitoring system.

5. Emergency procedures for unintended methane emissions

- In the event where methane cannot be combusted in the engine due to engine failure or grid connection faults, all methane will be flared.
- All pressure relief valves will lead to the flare.
- The maintenance plan will include inspections for physical leakages.

6. Monitoring of data concerning environmental, social and economic impacts.

- According to the South African DNA, there is no formal agreement for monitoring data concerning sustainability development criteria, see correspondence from the DNA, (Ref.PoA.E.7).

PART II. C Generic component project activity (CPA)

SECTION A. General description of a generic CPA

A.1. Purpose and general description of generic CPAs

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CPAs under this generic CPA-DD involve biogas-based renewable energy generation. The following tables show the eligible measures/technologies and methodologies covered under Project scenario C.

Description of applicable technologies/measures and methodologies covered under Project scenario C

Project scenario	Technologies/measures	Methodology
C	• Project activities that recover and utilize biogas for power/heat production without claiming methane emission avoidance from manure. • Recovered biogas will be utilized for thermal energy production with or without electricity, see different project energy scenarios in table below.	AMS-I.C

Different options for utilizing biogas for renewable energy (energy scenarios)

Energy scenario	Project description	Methodology
1	Project activities that install biogas thermal energy plants that produce renewable thermal energy for on-site consumption or for consumption by other facilities and displace fossil fuel use.	AMS-I.C
2	Project activities that install biogas cogeneration plants that produce renewable electricity for supply to the grid and/or for captive use and renewable thermal energy for on-site consumption or for consumption by other facilities and displace fossil fuel use.	
3	Project activities that involve the addition of renewable energy units (thermal or cogeneration units) at an existing renewable energy production facility.	

Biomass applicable under Project scenario C:

2. *Other biomass types (BT):* Other renewable biomass that does not involve methane emission avoidance. This biomass should comply with renewable biomass applicability conditions, see section B.2 below.

SECTION B. Application of a baseline and monitoring methodology

B.1. Reference of the approved baseline and monitoring methodology(ies) selected

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AMS-I.C "Thermal energy production with or without electricity" (Version 19).

The following tools are applicable to the PoA, each CPA will apply the relevant tools:

"Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (Version 2)
"Tool to determine the baseline efficiency of thermal or electric energy generation systems" (Version 1)
"Tool to determine the remaining lifetime of equipment" (Version 1)
"Tool to calculate the emission factor for an electricity system" (Version 02.2.1)
"Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" (Version 5.1.0)
"Tool to determine project emissions from flaring gases containing methane" (Version 1)
"Tool for the identification of degraded or degrading lands for consideration in implementing CDM A/R project activities" (Version 1)

B.2. Application of methodology(ies)

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Type I, Type III and micro-scale threshold demonstration:

Demonstration that CPA meets the threshold criteria

Project type	Threshold criteria	PoA demonstration
Type I	Type I: Renewable energy project activities with a maximum output capacity of 15 MW (or an appropriate equivalent).	CPAs shall demonstrate that every CPA in aggregate meets the threshold criteria and remains within those thresholds throughout the crediting period of the CPA.
Microscale Type I	Type I: Project activities up to 5 MW that employ renewable energy as their primary technology.	
Type III	Type III: Other project activities not included in Type I or Type II that result in GHG emission reductions not exceeding 60 ktCO2e per year in any year of the crediting period.	

Methodology applicability conditions demonstration:

For a CPA to apply a specific methodology, it should comply with the methodology's applicability conditions. The tables below show the applicability conditions for the methodologies applicable to Project scenario C.

Applicability conditions for methodology AMS-I.C

Applicability conditions	PoA confirmation
1. This methodology comprises renewable energy technologies that supply users with thermal energy that displaces fossil fuel use. These units include technologies such as solar thermal water heaters and dryers, solar cookers, energy derived from renewable biomass and other technologies that provide thermal energy that displaces fossil fuel.	All CPAs shall comprise renewable biomass anaerobic digestion technology. CPAs that apply methodology AMS-I.C shall generate thermal energy or electricity and thermal energy through cogeneration. CPAs that apply cogeneration shall simultaneously generate thermal energy and electrical energy in one process. In the case of biogas engine(s), thermal energy shall be utilized by decoupling the engine jacket water cooling circuit and circulating the engine block cooling water to heat the digester. Hot exhaust gas at ~400C can also be used for additional heating. The thermal energy will be carried over to heat water and this water will also be circulated along with the block cooling water to heat the digester. In the case of gas turbine(s), thermal energy can be utilized from the hot exhaust gases as a single point source of energy.
2. Biomass-based cogeneration systems are included in this category. For the purpose of this methodology "cogeneration" shall mean the simultaneous generation of thermal energy and electrical energy in one process.	
3. Emission reductions from a biomass cogeneration system can accrue from one of the following activities: a) Electricity supply to a grid; b) Electricity and/or thermal energy (steam or heat) production for on-site consumption or for consumption by other facilities; c) Combination of (a) and (b).	CPAs that apply methodology AMS-I.C shall involve either: a) Electricity supply to a grid; b) Electricity and thermal energy (steam or heat) production for on-site consumption or for consumption by other facilities; c) Combination of (a) and (b).
4. The total installed/rated thermal energy	For CPAs that involve thermal energy generation,

generation capacity of the project equipment is equal to or less than 45 MW thermal (see paragraph 6 for the applicable limits for cogeneration project activities).	the capacity of the project equipment shall be equal to or less than 45MW thermal.
5. For co-fired systems, the total installed thermal energy generation capacity of the project equipment, when using both fossil and renewable fuel, shall not exceed 45 MW thermal (see paragraph 6 for the applicable limits for cogeneration project activities).	Not applicable to the PoA, the PoA does not involve co-fired systems.
6. The following capacity limits apply for biomass cogeneration units: (a) If the project activity includes emission reductions from both the thermal and electrical energy components, the total installed energy generation capacity (thermal and electrical) of the project equipment shall not exceed 45 MW thermal. For the purpose of calculating this capacity limit the conversion factor of 1:3 shall be used for converting electrical energy to thermal energy (i.e. for renewable energy project activities, the maximal limit of 15 MW(e) is equivalent to 45 MW thermal output of the equipment or the plant); (b) If the emission reductions of the cogeneration project activity are solely on account of thermal energy production (i.e. no emission reductions accrue from the electricity component), the total installed thermal energy production capacity of the project equipment of the cogeneration unit shall not exceed 45 MW thermal; (c) If the emission reductions of the cogeneration project activity are solely on account of electrical energy production (i.e. no emission reductions accrue from the thermal energy component), the total installed electrical energy generation capacity of the project equipment of the cogeneration unit shall not exceed 15 MW.	For CPAs where the emission reductions include both the thermal and electrical energy components, the total installed energy generation capacity (thermal and electrical) of the project equipment shall not exceed 45 MW thermal. For CPAs where the emission reductions of the cogeneration project activity are solely on account of thermal energy production, the total installed thermal energy production capacity of the project equipment of the cogeneration unit shall not exceed 45 MW thermal. For CPAs where the emission reductions of the cogeneration project activity are solely on account of electrical energy production, the total installed electrical energy generation capacity of the project equipment of the cogeneration unit shall not exceed 15 MW.
7. The capacity limits specified in the above paragraphs apply to both new facilities and retrofit projects. In the case of project activities that involve the addition of renewable energy units at an existing renewable energy facility, the total capacity of the units added by the project should comply with capacity limits in paragraphs 4 to 6, and should be physically distinct from the existing units.	The capacity limits specified in the above paragraphs apply to new plants. In the case of project activities that involve the addition of renewable energy units at an existing renewable energy facility, the total capacity of the units added by the project should comply with capacity limits in paragraphs 4 to 6, and should be physically distinct from the existing units.
8. Project activities that seek to retrofit or modify an existing facility for renewable energy generation are included in this category.	Not applicable to the PoA, the PoA does not involve CPAs that seek to retrofit an existing facility for renewable energy generation..

9. 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".	The requirements refer to national and/or sectoral policies and circumstances that shall be taken into account in the establishment of a baseline scenario. The national and/or sectoral policies in South Africa was introduced after 2009 and fall under E-policy and need not be taken into account in establishing a baseline scenario for projects under this PoA. See section B.4, Part II of this PoA-DD.
10. If solid biomass fuel (e.g. briquette) is used, it shall be demonstrated that it has been produced using solely renewable biomass and all project or leakage emissions associated with its production shall be taken into account in the emissions reduction calculation.	Not applicable to this PoA, anaerobic digesters does not use solid biomass as feedstock.
11. Where the project participant is not the producer of the processed solid biomass fuel, the project participant and the producer are bound by a contract that shall enable the project participant to monitor the source of the renewable biomass to account for any emissions associated with solid biomass fuel production. Such a contract shall also ensure that there is no double-counting of emission reductions.	Not applicable to this PoA, anaerobic digesters does not use processed solid biomass as feedstock.
12. If electricity and/or steam/heat produced by the project activity is delivered to a third party i.e. another facility or facilities within the project boundary, a contract between the supplier and consumer(s) of the energy will have to be entered into that ensures there is no double-counting of emission reductions.	CPAs that deliver electricity and/or steam/heat to a third party, a contract between the supplier and the consumer(s) shall be entered into to ensure there is no double-counting of emission reductions.
14. If the project activity recovers and utilizes biogas for power/heat production and applies this methodology on a stand alone basis i.e. without using a Type III component of a SSC methodology, any incremental emissions occurring due to the implementation of the project activity (e.g. physical leakage of the anaerobic digester, emissions due to inefficiency of the flaring), shall be taken into account either as project or leakage emissions.	CPAs that recovers and utilizes biogas for power/heat production and applies this methodology on a stand alone basis i.e. without using a Type III component of a SSC methodology, any incremental emissions occurring due to the implementation of the project activity, shall be taken into account either as project or leakage emissions.
15. Charcoal based biomass energy generation project activities are eligible to apply the methodology only if the charcoal is produced from renewable biomass sources provided:	Not applicable to this PoA, anaerobic digesters does not use charcoal as feedstock.
16. Project activity under a Programme of Activities must comply with stipulated conditions	All CPAs shall comply with the stipulated PoA conditions, see PoA applicability table below.

Applicability conditions for biomass project activities under a PoA

Applicability conditions	PoA confirmation
a) In the specific case of biomass project activities the applicability of the methodology is limited to either project activities that use biomass residues or processed biomass (e.g. briquette) only or biomass	All CPAs that use biomass residues shall comply with the stipulated conditions; see renewable biomass applicable conditions in table below.

from dedicated plantations complying with the applicability conditions of methdology AM0042 or paragraph 5 in methodology AMS-III.AQ, see F-CDM-SSCwg ver 01 SSC_577.	All CPAs that use biomass from dedicated plantations shall comply with stipulated conditions. First check compliance with renewable biomass applicable conditions and then check compliance with dedicated plantation applicable conditions in tables below. Solid biomass is not applicable under this PoA.
b) In the specific case of biomass project activities the determination of leakage shall be done following the general guidance for leakage in small-scale biomass project activities (attachment C of Appendix B of simplified modalities and procedures for small-scale clean development mechanism project activities; decision 4/CMP.1) or following the procedures included in the leakage section of AM0042	For all CPAs the determination of leakage shall be done following the general guidance for leakage in small-scale biomass project activities (attachment C of Appendix B of simplified modalities and procedures for small-scale clean development mechanism project activities; decision 4/CMP.1) Leakage emissions shall be calculated as in Section D.6.3 of each CPA-DD.
c) In case the project activity involves the replacement of equipment, and the leakage from the use of the replaced equipment in another activity is neglected, because the replaced equipment is scrapped, an independent monitoring of scrapping of replaced equipment needs to be implemented. The monitoring should include a check if the number of project activity equipment distributed by the project and the number of scrapped equipment correspond with each other. For this purpose scrapped equipment should be stored until such correspondence has been checked. The scrapping of replaced equipment should be documented and independently verified.	In case the project activity involves the replacement of equipment, an independent monitoring of scrapping of replaced equipment will be implemented.

Applicability conditions for renewable biomass

Applicability condition	PoA confirmation
1. The biomass is woody and non-biomass and originates from croplands and/or grasslands where: a) The land area remains cropland and/or grasslands or is reverted to forest; and b) Sustainable management practices are undertaken on these land areas to ensure in particular that the level of carbon stocks on these land areas does not systematically decrease over time (carbon stocks may temporarily decrease due to harvesting); and c) Any national or regional forestry, agriculture and nature conservation regulations are complied with. d) Biomass complies with the dedicated plantation applicability conditions described in Methodology AM0042 or	All CPAs using biomass from dedicated plantations shall demonstrate that the CPA complies with conditions (a) to (d).

Methodology AMS-III.AQ (see F-CDM-SSCwg ver 01 SSC_577). Applicability conditions are described in tables below.	
3. The biomass is a biomass residue, that means biomass by-products, residues and waste streams from agriculture, forestry and related industries. a) Where, the use of that biomass residue in the project activity does not involve a decrease of carbon pools, in particular dead wood, litter or soil organic carbon, on the land areas where the biomass residues are originating from	All CPAs using biomass residues shall demonstrate that the baseline (current practice) is one of the following: 1. The biomass residues are dumped or left to decay under mainly aerobic conditions. 2. The biomass residues are dumped or left to decay under clearly anaerobic conditions. 3. The biomass residues are burnt in an uncontrolled manner without utilizing them for energy purposes Where manure is applied as compost/fertilizer in the baseline, the residual waste from the digester should be applied as compost/fertilizer in the project activity. All CPAs using biomass residues shall demonstrate that the use of biomass residue in the project activity does not involve a decrease of carbon pools.

Applicability conditions for dedicated plantations as in methodology AM0042

Applicability conditions	PoA confirmation
a) Biomass used by the project facility is not stored for more than one year; b) The dedicated plantation must be newly established as part of the project activity for the purpose of supplying biomass exclusively to the project; c) The biomass from the plantation is not chemically processed (e.g. esterification to produce biodiesel, production of alcohols from biomass, etc) prior to combustion in the project plant but it may be processed mechanically or be dried; d) The site preparation does not cause longer-term net emissions from soil carbon. Carbon stocks in soil organic matter, litter and deadwood can be expected to decrease more due to soil erosion and human intervention or increase less in the absence of the project activity; e) The land area of the dedicated plantation will be planted by direct planting and/or seeding; f) After harvest, regeneration will occur either by direct planting or natural sprouting; g) Grazing will not occur within the plantation; h) No irrigation is undertaken for the biomass plantations; i) The land area where the dedicated plantation will be established is, prior to project implementation, severely degraded and in absence of the project activity would have not been used for any other agricultural or forestry activity. The land degradation can be demonstrated using one or more of the following indicators: a) Vegetation degradation, e.g. ➢ Crown cover of pre-existing trees has decreased in the recent past for reasons other than sustainable harvesting activities; b) Soil degradation, e.g.	All CPAs using biomass from dedicated plantations shall demonstrate that the CPA complies with all the dedicated plantation applicability conditions in methodology AM0042.

➢ Soil erosion has increased in the recent past; c) Anthropogenic influences, e.g. ➢ There is a recent history of loss of soil and vegetation due to anthropogenic actions; and ➢ Demonstration that there exist anthropogenic actions/activities that prevent possible occurrence of natural regeneration.	

Applicability conditions for dedicated plantations as in methodology ASM-III.AQ, paragraph 5 (see F-CDM-SSCwg ver 01 SSC_577)

Applicability conditions	Confirmation record
a) The project activity does not lead to a shift of pre-project activities outside the project boundary i.e. the land under the proposed project activity can continue to provide at least the same amount of goods and services as in the absence of the project;	All CPAs using biomass from dedicated plantations shall demonstrate that the project activity does not lead to a shift of pre-project activities outside of the project boundary.
b) The plantations are established on a land: i. Which was at the start of the project implementation, classified as degraded or degrading as per the "Tool for the identification of degraded or degrading lands for consideration in implementing CDM A/R project activities"; or ii. Area that is included in the project boundary of one or several registered A/R CDM project activities. iii. Plantations established on the peatlands are not eligible even if qualifying under condition (i) and (ii) above.	All CPAs using biomass from dedicated plantations shall demonstrate that the CPA complies with conditions (i) to (iii).

B.3. Sources and GHGs

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The project boundary is the physical, geographical site:

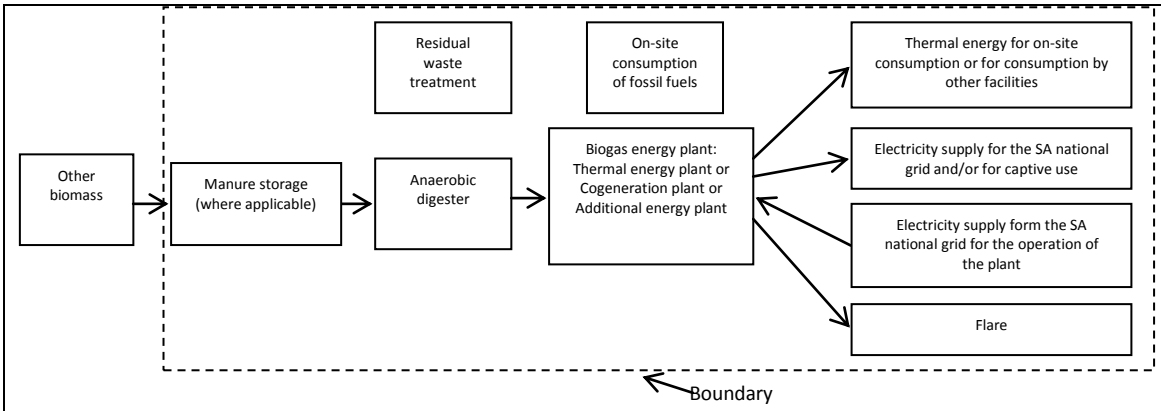
(a) Where the treatment of biomass or other organic matters through anaerobic digestion takes place;

(b) Where the residual waste from biological treatment or products from those treatments, like slurry, are handled, disposed, submitted to soil application, or treated thermally/mechanically;

(c) Where biogas is burned/flared or gainfully used, including the following:

- All plants generating power and/or heat located at the project site;
- All power plants connected physically to the electricity system (grid) that the project plant is connected to;
- Industrial, commercial or residential facility, or facilities, consuming energy generated by the system and the processes or equipment affected by the project activity;

The project boundary for Project scenario C is given below:



Project scenario C: Project activities that recovers and utilizes biogas for thermal energy production with or without electricity, without measures to avoid emission of methane from biomass. Only methodology AMS-I.C is applicable.

The combination of the greenhouse gases and emission sources included in or excluded from the project boundary are shown in table below:

	Source	Gas		Justification / Explanation
Baseline	Emissions from electricity consumption	CO_2	Included	A major source of emissions from power generation.
		CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small
	Emissions from thermal energy generation	CO_2	Included	A major source of emissions from thermal energy produced by fossil fuel
		CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small
Project activity	Emissions from the use of electricity for the operation of the facilities	CO_2	Included	May be an important emission source where electricity is imported from the grid for the project activity. If electricity is generated from collected biogas, these emissions are not accounted for
		CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small
	Emissions from the use of fossil fuel for the operation of the facilities	CO_2	Included	May be an important emission source where fossil fuel is used in the project activity
		CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small
	Emissions from the storage of manure before being fed into the anaerobic digester	CO_2	Excluded	Excluded for simplification. This emission source is assumed to be very small
		CH_4	Included	May be an important emission source where manure is stored before being fed into the digester
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small

	Source	Gas		Justification / Explanation
	Methane emissions due to physical leakage of biogas	CO_2	Excluded	CO_2 emissions from the decomposition organic waste are not accounted
		CH_4	Included	Methane physical leakage from the anaerobic digester is a potential source of project emissions.
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small
	Methane emissions from biogas flaring	CO_2	Excluded	CO_2 emissions from the decomposition organic waste are not accounted
		CH_4	Included	Methane emissions from incomplete combustion in the flaring process are a potential source of project emissions.
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small
	Emissions from the disposal/ storage/treatment of residual waste	CO_2	Excluded	CO_2 emissions from the decomposition organic waste are not accounted
		CH_4	Included	May be an important emission source where the residual waste from the digestion is stored under anaerobic conditions and/or delivered to a SWDS
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small

B.4. Description of baseline scenario

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The following table describe the baseline scenario for each Energy scenario under Project scenario C:

Energy scenario	Applicable technologies/measures and methodology	Description of the baseline scenario
1	Project activities that install biogas thermal energy plants that produce renewable thermal energy for on-site consumption or for consumption by other facilities and displace fossil fuel use.	The simplified baseline is the fuel consumption of the technologies that would have been used in the absence of the project activity, times an emission factor for the fossil fuel displaced. See below the "Criteria on determining the thermal energy baseline emissions".
2	Project activities that install biogas cogeneration plants that produce renewable electricity for supply to the grid and/or for captive use and/or renewable thermal energy for on-site consumption or for consumption by other facilities and displace fossil fuel use.	One of the following baseline scenarios should be applicable: • Electricity is imported from a grid and thermal energy (steam/heat) is produced using fossil fuel (project activity (a) in paragraph 19, methodology AMS-I.C). • Electricity is imported from a grid and thermal energy (steam/heat) is produced from biomass. Emission reduction from heat generation are not eligible (project activity (e) in paragraph 19, methodology AMS-I.C). For thermal energy, the simplified baseline is the fuel consumption of the technologies that would have been used in the absence of the project activity, times an emission factor for the fossil fuel displaced. See below the "Criteria on determining the thermal energy baseline emissions".

		For electricity, the baseline scenario is that the electricity displaced from the grid by the project activity would have otherwise been generated by the operation of grid connected power plants. The CO_2 emission factor for the South African national grid is calculated below.
3.	Project activities that involve the addition of renewable energy energy units (thermal energy or cogeneration units) at an existing renewable energy production facility.	For thermal energy, the simplified baseline is the fuel consumption of the technologies that would have been used in the absence of the project activity, times an emission factor for the fossil fuel displaced. See below the "Criteria on determining the thermal energy baseline emissions". For electricity, the baseline scenario is that the electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid connected power plants. The CO_2 emission factor for the South African national grid is calculated below.

The grid emission factor calculation

See Appendix 4.

Criteria on determining the thermal energy baseline emissions

Existing facilities are those that have been in operation for at least three years immediately prior to the start date of the project activity. For project activities implemented in existing facilities, baseline calculations shall be based on historical data on energy use (fossil fuel) and plant output (e.g. steam) in the baseline plant for at least three years prior to project implementation. For existing facilities with less than three years of operational data, all historical data shall be available (a minimum of one year data would be required). For existing facilities having no historical data/information on baseline parameters such as efficiency, energy consumption and output (e.g. the available data is not reliable due to various factors such as the use of imprecise or non-calibrated measuring equipment), the baseline parameters can be determined using a performance test/measurement campaign to be carried out prior to the implementation of the project activity. The project proponent may follow the relevant provisions from the "Tool to determine the baseline efficiency of thermal or electric energy generation systems". In the case of project activities that export to other facilities within the project boundary, historical data from the recipient plants is also required.

For project activities implemented in existing facilities where the additionality is demonstrated based on a baseline scenario that is not the continuation of the current practice (e.g. continued use of the fossil fuel that was used prior to the implementation of the project activity), the baseline emission factor is chosen as lower of the two: (a) the emission factor of the fossil fuel that would have been used in the identified baseline scenario; and (b) the emission factor of the fossil fuel that was used prior to the implementation of the project activity.

Efficiency of the baseline units (excluding cogeneration plants) shall be determined by adopting one of the following criteria (in preferential order):

(a) Highest measured operational efficiency over the full range of operating conditions of a unit with similar specifications, using baseline fuel. The efficiency tests shall be conducted following the guidance provided in relevant national/international standards;

(b) Highest of the efficiency values provided by two or more manufacturers for units with similar specifications, using the baseline fuel;

(c) Default efficiency of 100%.

For household or commercial applications/systems, whose maximum output capacity is less than 45 kW thermal and where it can be demonstrated that the metering of thermal energy output is not plausible, as in the case of cooking stoves, gasifiers, driers, water heaters etc., efficiency of the baseline units shall be determined by adopting one of the following criteria:

(a) Highest measured operational efficiency over the full range of operating conditions of a representative sample of units with similar specifications, using baseline fuel. The efficiency tests shall be conducted following the guidance provided in relevant national/international standards;
(b) Highest of the efficiency values provided by two or more manufacturers for units with similar specifications using the baseline fuel;
(c) Highest efficiency from referenced literature values or default efficiency of 100%.

National and/or sectoral policies

According to the CDM Project standard (Version 02.0), when establishing the baseline scenario, project participants shall take into account the following two types of national and/or sectoral policies:

a) National and/or sectoral policies or regulations that give comparative advantages to more emissions-intensive technologies or fuels over less emissions-intensive technologies or fuels (so called type E+);
b) National and/or sectoral policies or regulations that give comparative advantages to less emissions-intensive technologies over more emissions-intensive technologies (e.g. public subsidies to promote the diffusion of renewable energy or to finance energy efficiency programs) (so called type E-).

Project participants shall address the two types of policies described in above above as follows:
(a) Only national and/or sectoral policies or regulations described in (a) above that have been implemented before adoption of the Kyoto Protocol by the Conference of the Parties (hereinafter referred to as the COP) (decision 1/CP.3, 11 December 1997) shall be taken into account when establishing a baseline scenario. If such national and/or sectoral policies were implemented since the adoption of the Kyoto Protocol, the baseline scenario should refer to a hypothetical situation without the national and/or sectoral policies or regulations being in place;
(b) National and/or sectoral policies or regulations described in (b) above that have been implemented since the adoption by the COP of the CDM M&P (decision 17/CP.7, 11 November 2001) need not be taken into account in establishing a baseline scenario (i.e. the baseline scenario could refer to a hypothetical situation without the national and/or sectoral policies or regulations being in place).

In South Africa, the National Electricity Regulator South Africa (NERSA SA) has effectively introduced the Renewable Energy Feed-In Tariff program (REFIT) in 2009. The Renewable Energy Independent Power Producer Program (REIPPP) under REFIT wherein Independent Power Producers (IPPs) must bid to provide power to Eskom at pricing below the maximum established cap was introduced in 2011. The REFIT was established due to national and/or sectorial policies that give comparative advantages to less emissions-intensive technologies over more emissions-intensive technologies.

The REFIT and REIPPP policy pursued by NERSA was introduced after 2009 and falls under E- policy and therefore need not be taken into account in establishing a baseline scenario. The baseline scenario could refer to a hypothetical situation without the national and/or sectoral policies or regulations being in place.

B.5. Demonstration of eligibility for a generic CPA

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Eligibility criteria for inclusion of a SSC-CPA in the PoA

Eligibility criteria	Possible means of verification
a) The proposed CPA must be located in the geographical boundary of South Africa.	Demonstrate that CPA is located in the geographical boundary of South Africa. See demonstration in Section A.7 of the CPA-DD.
b) The CME must implement precaution measures to avoid double counting of emission reductions.	The CME shall follow the procedure to avoid double counting in Section C (d) in the PoA-DD. Confirmation by the CPA implementer that the CPA is neither registered as an individual CDM project activity nor is part of another registered PoA. See confirmation in Section A.13 of the CPA-DD.
c) The proposed CPA must comply with performance specifications including compliance with certification. The CPA must involve the implementation of one of the technologies/measures described in section A.6, Part I in the PoA-DD.	Demonstration that the CPA will comply with the performance specifications set out in PoA-DD, Part I, Section A.6. See demonstration in Section A.5 of the CPA-DD. Feasibility study or other technical description, EIA report, supplier information or PPA proving that the CPA involves the implementation of a technology eligible for inclusion in the PoA.
d) The starting date of the project activity must not be before the date of commencement of validation of the PoA.	The staring date of the project activity means the earliest date at which either the implementation or construction or real action of a project activity begins. The CPA implementer will provide the CME with any significant purchase order, contract or payment evidence related to the construction of the project activity. See documentation in Section A.8.1 of the CPA-DD.
e) The proposed CPA must implement one of the eligible methodologies or methodology combinations for the PoA. Also, the proposed CPA must comply with the applicability conditions of the applicable methodology.	Indicate that the CPA will apply one of the eligible methodologies or methodology combinations. Also, assess compliance with the specific methodology applicability conditions. See assessment in Section D.2 of the CPA-DD
f) The CPA must demonstrate additionality as per eligibility criteria.	Assess additionality according to the eligibility criteria below. See assessment in Section D.5 of the CPA-DD
g) The CPA must comply with PoA conditions related to undertaking local stakeholder consultations and environmental impact analysis.	Provide necessary environmental impact assessment and local stakeholder consultation information and documentation. See Section B and C of the CPA-DD.
h) The CPA must confirm that no Official Development Aid will be diverted.	Provide information on sources of public funding from countries included in Annex I which shall affirm that such funding does not result in diversion of official development assistance. See affirmation Section A.11 of the CPA-DD.
i) The PoA has no specific target group or distribution mechanism, therefore there is no eligibility criteria for target groups or distribution mechanisms	Not applicable
j) All relevant parameters will be monitored for each CPA. However, only a statistically	Sampling must meet a confidence/precision limits of 90/10. All CPAs must be included as possible

acceptable sample will be verified by the DOE.	sites for DOE verification in the future.
k) CPA in aggregate must meet the small-scale or micro-scale threshold criteria	Demonstration that the installed capacity of the small-scale or micro-scale CPA in aggregate will remain within the threshold criteria throughout the crediting period of the CPA See demonstration in Section D.2 of the CPA-DD
l) The proposed CPA must pass the de-bundling check.	Demonstrate that the CPA is not a debundled component of a large scale activity by following the "Guidelines on assessment of debundling for SSC project activities". See de-bundling check in Section A.12 of the CPA-DD

Compliance of the baseline system and project activity to the mandatory applicable legal and regulatory requirements/legislation will be confirmed through the Environmental authorization process of South Africa.

ADDITIONALITY OF THE GENERIC CPA

The table below indicates the additionality approaches applicable to Project scenario C. The CPA implementer will choose an approach and demonstrate additionality according to the applicable additionality eligibility criteria in section B.1, Part I of the PoA-DD.

Additionality approaches applicable to Project scenario C

Project scenario	Additionality approach
C	Additionality may be based on approach 1 or approach 2. Where approach 1 is used, method a should be applied. Where approach 2 is used, barrier a or b should be applied.

B.6. Estimation of emission reductions of a generic CPA
B.6.1. Explanation of methodological choices

Baseline emission equation choices – AMS-I.C

Baseline emission equation choices for project energy scenarios 1 to 3, applying methodology AMS-I.C are as follow:

Energy scenario 1: Project activities that install biogas thermal energy plants that produce renewable thermal energy for on-site consumption or for consumption by other facilities and displace fossil fuel use. These project activities will use equation (2) from methodology AMS-I.C: $BE_{thermal,CO2,y} = (EG_{thermal,y}/\eta_{BL,thermal}) \times EF_{FF,CO2}$ (2)
Energy scenario 2: Project activities that install biogas cogeneration plants that produce renewable electricity for supply to the grid and/or for captive use and renewable thermal energy for on-site consumption or for consumption by other facilities and displace fossil fuel use. These project activities will use the equation (1) from methodology AMS-I.D for electricity baseline emission calculations and equation (2) from methodology AMS-I.C for thermal energy baseline emission calculations. $BE_{,y} = EG_{BL,,y} \times EF_{CO2,grid,y}$ (1) $BE_{thermal,CO2,y} = (EG_{thermal,y}/\eta_{BL,thermal}) \times EF_{FF,CO2}$ (2)

Energy scenario 3: Project activities that involve the addition of renewable energy units (thermal or cogeneration units) at an existing renewable energy production facility. Project activities that involve the addition of renewable thermal energy units will use equations (5), (6) and (7) from methodology AMS-I.C:

$$EG_{thermal,add,y} = EG_{thermal,PJ,y} - EG_{thermal,old,y} \quad (5)$$

$$EG_{thermal,old,y} = MAX(EG_{thermal,actual,y}, EG_{thermal,estimated,y}) \quad (6)$$

$$EG_{thermal,old,y} = MAX(EG_{HY,thermal,retrofit,y}, EG_{estimated,thermal,y}) \text{ until } DATE_{BaselineRetrofit} \quad (7)$$

Project activities that involve the addition of cogeneration units will use the equations (5), (6) and (7) from methodology AMS-I.C as above and equations (8) and (9) from methodology ASM-I.D:

$$BE_{add,CO2,y} = (EG_{PJ,add,y} - EG_{BL,existing,y}) \times EF_{CO2,grid,y} \quad (8)$$

$$EG_{BL,existing,y} = MAX\ (EG_{actual,y}, EG_{estimated,y}) \text{ until } DATE_{BaselineRetrofit} \quad (9)$$

Grid emission factor choices

The grid emission factor ($EF_{CO2,grid,y}$) will be calculated as follows: A 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 grid emission factor will be calculated using the e*x ante* option: The emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required. For the calculations see Appendix 4.

CO_2 emission coefficient

The CO_2 emission coefficient ($COEF_{i,y}$) shall be calculated using Option B in the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion". In Option B $COEF_{i,y}$ is calculated based on net calorific value and CO_2 emission factor of the fuel type.

Project emissions due to physical leakage

Project emissions due to physical leakage of biogas from the animal manure management systems used to produce, collect and transport the biogas to the point of flaring or gainful use is estimated as: A default value of 0.05 m³ biogas leaked/m³ biogas produced

Approaches to rule out leakage choice

CPA implementers shall demonstrate that the use of the biomass residues does not result in increased use of fossil fuels or other GHG emissions elsewhere. For this purpose, CPA implementers shall assess as part of the monitoring the supply situation for each type of biomass residue *k* used in the project plant. The table below outlines the options (methodology AM0042) that may be used to demonstrate that the biomass residues used in the plant did not increase fossil fuel consumption or other GHG emissions elsewhere.

Approaches to rule out leakage according to methodology AM0042

L_1	Demonstrate that at the sites where the project activity is supplied from with biomass residues, the biomass residues have not been collected or utilized (e.g. as fuel, fertilizer or feedstock) but have

	been dumped and left to decay, land-filled or burnt without energy generation (e.g. field burning) prior to the implementation of the project activity. Demonstrate that this practice would continue in the absence of the CDM project activity, e.g. by showing that in the monitored period no market has emerged for the biomass residues considered or by showing that it would still not be feasible to utilize the biomass residues for any purposes (e.g. due to the remote location where the biomass residue is generated)
L_2	Demonstrate that there is an abundant surplus of the in the region of the project activity which is not utilized. For this purpose, demonstrate that the quantity of available biomass residues of type *k* in the region is at least 25% larger than the quantity of biomass residues of type *k* that are utilized (e.g. for energy generation or as feedstock), including the project plant.
L_3	Demonstrate that suppliers of the type of biomass residue in the region of the project activity are not able to sell all of their biomass residues. For this purpose, CPA implementers shall demonstrate that the ultimate supplier of the biomass residue (who supplies the project) and a representative sample of suppliers of the same type of biomass residue in the region had a surplus of biomass residues (e.g. at the end of the period during which biomass residues are sold), which they could not sell and which are not utilized
L_4	Identify the consumer that would use the biomass residue in the absence of the project activity (e.g. the former consumer). Demonstrate that this consumer has substituted the biomass residue diverted to the project with other types of biomass residues (and not with fossil fuels or other types of biomass than biomass residues) by showing that the former user only fires biomass residues for which leakage can be ruled out using approaches L_2 or L_3. Provide credible evidence and document the types and amounts of biomass residues used by the former user as replacement for the biomass residue fired in the project activity and apply approaches L_2 or L_3 to these types of biomass residues. Demonstrate that the substitution of the biomass residues used in the project activity with other types of biomass residues does not require a significant additional energy input except for the transportation of the biomass residues

B.6.2. Data and parameters that are to be reported ex-ante

Data / Parameter	*IC*
Unit	MW
Description	Installed capacity of the power plant
Source of data	Design capacity of the equipment installed
Value(s) applied	Specific to CPA
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	*CP*
Unit	MW
Description	Captive power
Source of data	Design capacity of the equipment installed
Value(s) applied	Specific to CPA
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	*TC*
Unit	MW
Description	Installed capacity of the thermal plant
Source of data	Design capacity of the equipment installed
Value(s) applied	Specific to CPA
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	*PA*
Unit	%
Description	Plant availability
Source of data	Manufacture's specifications
Value(s) applied	Specific to CPA
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EF_{CO2,grid,y}$
Unit	tCO_2e/MWh
Description	CO_2 emission factor of the grid in year *y*
Source of data	Calculated, see Appendix 4
Value(s) applied	0.9
Choice of data or Measurement methods and procedures	A 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"
Purpose of data	Calculation of baseline emissions
Additional comment	The emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required.

Data / Parameter	$EG_{estimated,y}$
Unit	MWh/yr
Description	Estimated net electrical energy that would have been produced by the existing units under the observed availability of the renewable resource in year *y*
Source of data	Estimation - Plant records / Manufacturer's specification
Value(s) applied	CPA specific value
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$DATE_{BaselineRetrofit}$
Unit	-
Description	Date at which the existing generation facility is likely to be replaced or retrofitted in the absence of the CDM project activity
Source of data	According to the "Tool to determine the remaining lifetime of equipment".
Value(s) applied	CPA specific
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EG_{thermal,estimated,y}$
Unit	TJ/yr
Description	The estimated thermal energy that would have been produced by the existing units under the observed availability of the renewable resource for year *y*
Source of data	Estimation - Plant records / Manufacturer's specification
Value(s) applied	CPA specific value
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EG_{HY,thermal,retrofit,y}$
Unit	TJ
Description	Average of historical thermal energy levels delivered by the existing facility, spanning all data from the most recent available year (or month, week or other time period) to the time at which the facility was constructed, retrofitted, or modified in a manner that significantly affected output (i.e. by 5% or more)
Source of data	Plant records
Value(s) applied	Specific to CPA
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EG_{estimated,thermal,y}$
Unit	TJ
Description	Estimated thermal energy that would have been produced by the existing units under the observed availability of renewable resources in year *y*
Source of data	Estimated
Value(s) applied	CPA specific
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of Baseline emissions
Additional comment	-

Data / Parameter	$\eta_{BL,thermal}$
Unit	%
Description	Efficiency of the plant using fossil fuel that would have been used in the absence of the project activity.
Source of data	Plant records / Manufacturer's specification
Value(s) applied	CPA specific value
Choice of data or Measurement methods and procedures	The value shall be calculated according to paragraph 28 – 31 in Methodology AMS-I.C (Version 19).
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EF_{FF,CO2}$
Unit	tCO_2e/TJ
Description	The CO_2 emission factor of the fossil fuel that would have been used in the baseline plant.
Source of data	The following data sources may be used if the relevant conditions apply:

Data source	Conditions for using the data source
a) Values provided by the fuel supplier in invoices	This is the preferred source
b) Measurements by the CPA implementers	If a) is not available
c) Regional or national default values	If a) is not available. These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances)
d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories	If a) is not available

Value(s) applied	CPA specific value
Choice of data or Measurement methods and procedures	For a) and b): Measurements should be undertaken in line with national or international fuel standards. For a) and b): The CO_2 emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated. For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	k
Unit	-
Description	Degradation rate constant (0.069)
Source of data	IPCC default, methodology AMS-III.D
Value(s) applied	0.069
Choice of data or Measurement methods and procedures	
Purpose of data	Calculation of project emissions
Additional comment	-

Data / Parameter	MCF_l
Unit	%
Description	Annual methane conversion factor for the project manure storage device *l*
Source of data	IPCC default and project design information
Value(s) applied	Specific to plant
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

Data / Parameter	φ
Unit	-
Description	Model correction factor to account for model uncertainties
Source of data	IPCC default from "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"
Value(s) applied	0.9
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

Data / Parameter	GWP_{CH4}
Unit	tCO_2e/ tCH_4
Description	Global Warming Potential (GWP) of methane
Source of data	IPCC default, (a value of 21 is to be applied for the first commitment period of the Kyoto Protocol)
Value(s) applied	21
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

Data / Parameter	*OX*
Unit	Fraction
Description	Oxidation factor of the project SWDS (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data	IPCC default and project SWDS information
Value(s) applied	Use 0.1 for managed solid waste disposal sites that are covered with oxidizing material such as soil or compost. Use 0 for other types of solid waste disposal sites
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

Data / Parameter	*F*
Unit	Fraction
Description	Fraction of methane in the SWDS gas (volume fraction)
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	0.5
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comment	This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, under anaerobic conditions in the SWDS. A default value of 0.5 is recommended by IPCC

Data / Parameter	DOC_f
Unit	Fraction
Description	Fraction of degradable organic carbon (DOC) that can decompose
Source of data	IPCC default
Value(s) applied	0.5
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

Data / Parameter	*MCF*
Unit	Fraction
Description	Methane correction factor of the project SWDS
Source of data	Project SWDS information and IPCC 2006 Guidelines for National Greenhouse Gas Inventories.
Value(s) applied	Specific to the project SWDS Use the following values for MCF. • 1.0 for anaerobic managed solid waste disposal sites. These must have controlled placement of waste (i.e., waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires) and will include at least one of the following: (i) cover material; (ii) mechanical compacting; or (iii) leveling of the waste; • 0.5 for semi-aerobic managed solid waste disposal sites. These must have controlled placement of waste and will include all of the following structures for introducing air to waste layer: (i) permeable cover material; (ii) leachate drainage system; (iii) regulating pondage; and (iv) gas ventilation system; • 0.8 for unmanaged solid waste disposal sites – deep and/or with high water table. This comprises all SWDS not meeting the criteria of managed SWDS and which have depths of greater than or equal to 5 meters and/or high water table at near ground level. Latter situation corresponds to filling inland water, such as pond, river or wetland, by waste; • 0.4 for unmanaged-shallow solid waste disposal sites. This comprises all SWDS not meeting the criteria of managed SWDS and which have depths of less than 5 m
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comment	The methane correction factor (MCF) accounts for the fact that unmanaged SWDS produce less methane from a given amount of waste than managed SWDS, because a larger fraction of waste decomposes aerobically in the top layers of unmanaged SWDS

Data / Parameter	DOC_j
Unit	Fraction
Description	Fraction of degradable organic carbon (by weight) in the residual waste
Source of data	Project SWDS information and IPCC 2006 Guidelines for National Greenhouse Gas inventories (adapted from Volume 5, Tables 2.4 and 2.5)
Value(s) applied	In the case of industrial sludge, a value of 9% (% wet sludge) shall be used assuming an organic dry matter content of 35 percent. In the case of domestic sludge, a value of 5% (wet sludge) shall be used, assuming an organic dry matter content of 10 percent.
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comment	For industrial sludge, the value must be adjusted for other percentages of organic dry matter content as follows: DOC (% wet sludge) = 9 × (% organic dry matter content/35). For domestic sludge, the value must be adjusted for other percentages of organic dry matter content as follows: DOC (% wet sludge) = 5 × (% organic dry matter content/10).

Data / Parameter	k_j
Unit	-
Description	Decay rate for residual waste
Source of data	Project SWDS information and IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)
Value(s) applied	Apply the following default values for residual waste:

Waste type *j*		Boreal and Temperate (MAT≤20°C)		Tropical (MAT>20°C)	
		Dry MAP/PET <1	Wet (MAP/PET >1)	Dry (MAP< 1000mm)	Wet (MAP> 1000mm)
Rapidly degrading	Food, food waste, sewage sludge, beverages and tobacco	0.06	0.185	0.085	0.4

Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

Data / Parameter	GWP_{N2O}
Unit	($kgCO_2$/kg N_2O)
Description	Global Warming Potential for N_2O
Source of data	IPCC default = 310, valid for the first commitment period
Value(s) applied	310
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of leakage emissions
Additional comment	-

Data / Parameter	EF_1
Unit	ton N_2O-N/ton N input
Description	Emission Factor for emissions from N inputs
Source of data	IPCC 2006 Guidelines Table 11.1
Value(s) applied	1%
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of leakage emissions
Additional comment	-

Data / Parameter	MW_{N2O}
Unit	ton N_2O/ton N
Description	Ratio of molecular weights of N_2O and N
Source of data	Chemistry mass balance
Value(s) applied	44/28
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of leakage emissions
Additional comment	-

Data / Parameter	$Frac_{GASF}$
Unit	%
Description	Fraction that volatilises as NH_3 and NO_x for synthetic fertilizers
Source of data	2006 IPCC guidelines Table 11.3
Value(s) applied	10% volatilises as NO_x and 20% as NH_3
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of leakage emissions
Additional comment	-

Data / Parameter	$Frac_{GASM}$
Unit	%
Description	Fraction that volatilises as NH_3 and NO_x for organic fertilizers
Source of data	IPCC default
Value(s) applied	10% volatilises as NO_x and 20% as NH_3
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of leakage emissions
Additional comment	-

Data / Parameter	-
Unit	-
Description	Demonstration that the biomass residue type k from a specific source would continue not to be collected or utilized, e.g. by an assessment whether a market has emerged for that type of biomass residue (if yes, leakage is assumed not be ruled out) or by showing that it would still not be feasible to utilize the biomass residues for any purposes
Source of data	Information from the site where the biomass is generated
Value(s) applied	-
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of leakage emissions
Additional comments	Monitoring of this parameter is applicable if approach L_1 is used to rule out leakage

Data / Parameter	$BF_{available,k,y}$
Unit	ton/yr
Description	Quantity of available biomass residues of type *k* or *m* in the region
Source of data	Surveys or statistics from the defined geographical region
Value(s) applied	Specific to CPA
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of leakage emissions
Additional comments	Monitoring of this parameter is applicable if approach L_2 is used to rule out leakage or if approach L_4 is used in combination with approach L_2 to rule out leakage for the substituted biomass residue type *m*

Data / Parameter	$BF_{utilized,k,y}$
Unit	ton/yr
Description	Quantity of available biomass residues of type *k* or *m* that are utilized in the defined geographical region
Source of data	Surveys or statistics from the defined geographical region
Value(s) applied	Specific to CPA
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of leakage emissions
Additional comments	Monitoring of this parameter is applicable if approach L_2 is used to rule out leakage or if approach L_4 is used in combination with approach L_2 to rule out leakage for the substituted biomass residue type *m*

Data / Parameter	$EF_{CO2,LE}$
Unit	tCO_2/TJ
Description	CO_2 emission factor of the most carbon intensive fuel used in the country
Source of data	Identify the most carbon intensive fuel type from the national communication, other literature sources (e.g. IEA). Possibly consult with the national agency responsible for the national communication / GHG inventory. If available, use national default values for the CO_2 emission factor. Otherwise, IPCC default values may be used
Value(s) applied	Specific to CPA
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of leakage emissions
Additional comments	-

B.6.3. Ex-ante calculations of emission reductions

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Emission reductions shall be calculated *ex ante* as follows:

$$ER_y = BE_y - PE_y - LE_y$$

Where:

ER_y	Emission reductions in year *y* (tCO_2e/yr)
BE_y	Baseline emissions in year *y* (tCO_2e/yr)
PE_y	Project emissions in year *y* (tCO_2e/yr)
LE_y	Leakage emissions in year *y* (tCO_2e/yr)

BASELINE EMISSIONS

$$BE_y = BE_{AMS\text{-}I.C,y}$$

Where:

$BE_{AMS\text{-}I.C,y}$	Baseline emissions from renewable thermal energy with or without electricity (tCO_2e/yr), calculated in section "Baseline emissions – AMS-I.C".

BASELINE EMISSIONS - AMS-I.C

Baseline emissions will be calculated for the applicable scenarios:

Scenario		Description
1	$BE_{thermal,CO2,y}$	Baseline emissions from project activities that install biomass thermal energy plants that produce renewable thermal energy for on-site consumption or for consumption by other facilities (tCO_2e/yr).
2	$BE_{cogen,y}$	Baseline emissions from project activities that install biomass cogeneration plants that produce renewable electricity for supply to the grid or for captive use and renewable thermal energy for on-site consumption or for consumption by other facilities (tCO_2e/yr).
3	$BE_{add,y}$	Baseline emissions from project activities that involve the addition of renewable thermal energy units at an existing renewable energy production facility (tCO_2e/yr).

Scenario 1: Project activities that install thermal energy plants that produce renewable thermal energy for on-site consumption or for consumption by other facilities.

Baseline emissions shall be calculated as follows:

$$BE_{thermal,CO2,y} = (EG_{thermal,y}/\eta_{BL,thermal}) \times EF_{FF,CO2}$$

Where:

$BE_{thermal,CO2,y}$	The baseline emissions from thermal energy displaced by the project activity during the year *y* (tCO_2)
$EG_{thermal,y}$	Net quantity of thermal energy supplied by the project activity during the year *y* (TJ/yr)
$\eta_{BL,thermal}$	Efficiency of the plant using fossil fuel that would have been used in the absence of the project activity (%).
$EF_{FF,CO2}$	The CO_2 emission factor of the fossil fuel that would have been used in the baseline plant obtained from reliable local or national data if available, alternatively, IPCC default emission factors can be used (tCO_2/TJ)

Where:

$EG_{thermal,y} = TC \times (31\ 536\ 000 / 1000\ 000) \times PA$

Where:

TC	Thermal installed capacity (MW)
31 536 000	Conversion factor to convert MW to MJ/yr (60×60×24×365 seconds/year)
PA	Plant Availability (%)

Scenario 2: Project activities that install cogeneration plants that produce renewable electricity for supply to the grid or for captive use and renewable thermal energy for on-site consumption or for consumption by other facilities.

Baseline emissions shall be calculated as follows:

$BE_{cogen,y} = BE_{elec,y} + BE_{thermal,CO2,y}$

Where:

$BE_{cogen,y}$	Baseline emissions from project activities that install biomass cogeneration plants that produce renewable electricity for supply to the grid or for captive use and renewable thermal energy for on-site consumption or for consumption by other facilities (tCO_2e/yr).
$BE_{thermal,CO2,y}$	The baseline emissions from thermal energy displaced by the project activity during the year *y* (tCO_2).
$BE_{elec,y}$	Baseline emissions from project activities that supply electricity to the grid or for captive use (tCO_2e/yr).

2.1 The baseline emissions from thermal energy displaced by the project activity during shall be calculated as follows:

Calculated as in Scenario 1

2.2 Baseline emissions from project activities that supply electricity to the grid or for captive use shall be calculated as follows:

$BE_{elec,y} = EG_{BL,y} \times EF_{CO2,grid,y}$

Where:

$BE_{elec,y}$	Baseline emissions from project activities that supply electricity to the grid or displace electricity from the grid (tCO_2e/yr).
$EG_{BL,y}$	The amount of net renewable electricity supplied to the grid or displaced from the grid as a result of the implementation of the CDM project activity in year *y* (MWh/yr)
$EF_{CO2,grid,y}$	CO_2 emission factor of the grid in year *y* (tCO_2e/MWh)

Where:

$EG_{BL,y} = EG_{elec,gross,y} - EG_{elec,captive,y}$

Where:

$EG_{elec,gross,y}$	The gross amount of renewable electricity generated from the project activity (MWh/yr)
$EG_{elec,captive,y}$	Captive electricity consumption (MWh/yr)

With:

$EG_{elec,gross,y} = IC \times 8\ 760 \times PA$

Where:

IC	Installed capacity (MW)
8 760	Conversion factor to convert MW to MWh (24 ×365 hours/yr)
PA	Plant availability (%)

And:

$$EG_{elec,captive,y} = CP \times 8\,760 \times PA$$

Where:

CP	Captive power (MW)
8 760	Conversion factor to convert MW to MWh (24 ×365 hours/yr)
PA	Plant availability (%)

Scenario 3: Project activities that involve the addition of renewable energy units at an existing renewable energy production facility.

The units may be thermal energy units or cogeneration units.

$$BE_{add,y} = BE_{thermal,add,y} + BE_{add,CO2,y}$$

Where:

$BE_{add,y}$	Baseline emissions from project activities that involve the addition of renewable energy units at an existing renewable energy production facility (tCO_2e/yr).
$BE_{thermal,add,y}$	Baseline emissions from project activities that involve the addition of renewable thermal energy units at an existing renewable energy production facility (tCO_2e/yr).
$BE_{add,CO2,y}$	Baseline emissions from project activities that involve capacity addition to renewable electricity plants that supply electricity to the grid or displace electricity from the grid (tCO_2e/yr).

3.1 Baseline emissions from project activities that involve the addition of renewable thermal energy units at an existing renewable energy production facility shall be calculated as follows:

$$BE_{thermal,add,y} = (EG_{thermal,add,y}/\eta_{BL,thermal}) \times EF_{FF,CO2}$$

Where:

$BE_{thermal,add,y}$	Baseline emissions from project activities that involve the addition of renewable thermal energy units at an existing renewable energy production facility (tCO_2e/yr).
$EG_{thermal,add,y}$	Net increase in thermal energy generation at existing plant in year y that should be considered as energy baseline (TJ/yr)

Where

$$EG_{thermal,add,y} = EG_{thermal,PJ,y} - EG_{thermal,old,y}$$

Where:

$EG_{thermal,PJ,y}$	Total actual thermal energy produced in year *y* by all units, existing and new project units (TJ/yr).
$EG_{thermal,old,y}$	Estimated thermal energy that would have been produced by existing units (installed before the project activity) in year *y* in the absence of the project activity (TJ/yr)

The value $EG_{thermal,old,y}$ is given by:

$$EG_{thermal,old,y} = MAX(EG_{thermal,actual,y} ; EG_{thermal,estimated,y})$$

Where:

$EG_{thermal,actual,y}$	The actual, measured thermal energy production of the existing units in year *y* (TJ/yr)
$EG_{thermal,estimated,y}$	The estimated thermal energy that would have been produced by the existing units under the observed availability of the renewable resource for year *y* (TJ/yr).

If the existing units shut down, are derated, or otherwise become limited in production, the project activity should not get credit for generating energy from the same renewable resources that would have otherwise been used by the existing units (or their replacements). Therefore, the equation for $EG_{thermal,old,y}$ still holds, and the value for $EG_{thermal,estimated,y}$ should continue to be estimated assuming the capacity and operating parameters are the same as that at the time of the start of the project activity.

If the existing units are subject to modifications or retrofits that increase production, then $EG_{thermal,old,y}$ can be estimated using the procedures described below.

$$EG_{thermal,old,y} = MAX\left(EG_{HY,thermal,retrofit,y}, EG_{estimated,thermal,y}\right) \quad until \quad DATE_{BaselineRretrofit}$$

Where:

$EG_{HY,thermal,retrofit,y}$	Average of historical thermal energy levels delivered by the existing facility, spanning all data from the most recent available year (or month, week or other time period) to the time at which the facility was constructed, retrofitted, or modified in a manner that significantly affected output (i.e. by 5% or more) (TJ)
$EG_{estimated,thermal,y}$	Estimated thermal energy that would have been produced by the existing units under the observed availability of renewable resources in year *y* (TJ)
$DATE_{BaselineRetrofit}$	Date at which the existing generation facility is likely to be replaced or retrofitted in the absence of the CDM project activity

3.2 Baseline emissions from project activities that involve capacity addition to renewable electricity plants that supply electricity to the grid or displace electricity from the grid

The baseline scenario is the existing facility that would continue to supply electricity to the grid at historical levels, until the time at which the generation facility would likely be replaced or retrofitted ($DATE_{BaselineRetrofit}$). From that point of time onwards, the baseline scenario is assumed to correspond to the project activity, and no emission reductions are assumed to occur. The energy baseline corresponds to the net increase in electricity production associated with the project should be calculated as follows:

$$BE_{add,CO2,y} = (EG_{PJ,add,y} - EG_{BL,existing,y}) \times EF_{CO2,grid,y}$$

Where:

$BE_{add,CO2,y}$	Baseline emissions from project activities that involve capacity addition to renewable electricity plants that supply electricity to the grid or displace electricity from the grid (tCO_2e/yr).
$EG_{PJ,add,y}$	The total net electrical energy supplied to a grid or displaced from the grid in year *y* by all units, existing and new project units (MWh/yr).
$EG_{BL,existing,y}$	The estimated net amount of electricity that would have been supplied to a grid or to a captive plant by existing units (installed before the project activity) in year *y* in the absence of the project activity (MWh/yr).

Where:

$$EG_{BL,existing,y} = MAX\ (EG_{actual,y}\ ;\ EG_{estimated,y})\ until\ DATE_{BaselineRetrofit}$$

and

$$EG_{BL,existing,y} = 0;\ \text{on/after}\ DATE_{BaselineRetrofit}$$

Where:

$EG_{actual,y}$	The actual, measured net electrical energy supplied to the grid or displaced from the grid by the existing units in year *y* (MWh/yr).
$EG_{estimated,y}$	Estimated net electrical energy that would have been produced by the existing units under the observed availability of the renewable resource in year *y* (MWh/yr).
$DATE_{BaselineRetrofit}$	Date at which the existing generation facility is likely to be replaced or retrofitted in the absence of the CDM project activity

If the existing units shut down, are derated, or otherwise become limited in production, the project activity should not get credit for generating electricity from the same renewable resources that would have otherwise been used by the existing units (or their replacements). Therefore, the equation for $EG_{elec,existing,y}$ still holds, and the value for $EG_{elec,estimated,y}$ should continue to be estimated assuming the capacity and operating parameters are the same as that at the time of the start of the project activity.

PROJECT EMISSIONS

Project activity emissions consist of:

$$PE_y = PE_{PL,y} + PE_{flare,y} + PE_{transp,y} + PE_{storage,y} + PE_{reswaste,y} + PE_{FC,i,j,y} + PE_{elec,y}$$

Where:

$PE_{,y}$	Project emissions in year *y* (tCO_2e/yr)
$PE_{PL,y}$	Emissions due to physical leakage of biogas in year *y* (tCO_2e/yr)
$PE_{flare,y}$	Emissions from biogas flaring the year *y* (tCO_2e/yr)
$PE_{transp,y}$	Emissions from incremental transportation in the year *y* (tCO_2e/yr)
$PE_{storage,y}$	Emissions from the storage of manure before being fed into the anaerobic digester (tCO_2e/yr)
$PE_{reswaste,y}$	In case residual wastes are subjected to anaerobic storage, or disposed in a landfill, methane emissions from storage/disposal of waste (tCO_2e/yr)
$PE_{FF,y}$	Emissions from the use of fossil fuel for the operation of the facilities in the year *y* (tCO_2e/yr)
$PE_{elec,y}$	Emissions from the use of electricity for the operation of the facilities in the year *y* (tCO_2e/yr)

a) Emissions from physical leakage:

Methane emissions due to physical leakages from the digester and recovery system shall be estimated using a default factor of 0.05 m^3 biogas leaked/m^3 biogas produced. For ***ex post*** calculations the effectively recovered biogas amount shall be used for the calculation.

For ***ex ante*** estimation the expected biogas production of the digester may be used and leakage shall be calculated as follows:

$$PE_{PL,y} = CH4_y \times 0.05 \times D_{CH4} \times GWP_{CH4}$$

Where:

$CH4_y$ = Methane production in year y (Nm^3/yr)

$D_{CH4,n}$ Density of methane at normal conditions (0.716) (kg/m^3)

b) Emissions from flaring:

Emissions from flaring will be calculated ***ex ante***, for methane produced while the plant is of line, using a flare efficiency of 50% for open flares or 90% for enclosed flares.

$PE_{flare} = CH4_y \times (1 - PA) \times (1 - EF) \times D_{CH4} \times GWP_{CH4}$

Where:

$CH4_y$	Methane production in year y (Nm^3/yr)
PA	Plant Availability (%)
FE	Flare efficiency as 50% or 90%

*Emissions from flaring will be calculated **ex post** as follow:*

Emissions from flaring are calculated using the procedures described in the "Tool to determine project emissions from flaring gases containing methane". According to the tool, PE_{flare} is as follows:

$$PE_{flare,expost,y} = \sum_{h=1}^{8760} TM_{RG,h} \times (1 - \eta flare, h) \times \frac{GWP_{CH4}}{1000}$$

Where:

$PE_{flare,y}$	Project emissions from flaring in year *y* (tCO_2e/yr)
$TM_{RG,h}$	Mass flow rate of methane in the residual gas in the hour *h*
$\eta_{flare,h}$	Flare efficiency in hour *h*

Where:

$TM_{RG,h} = FV_{RG,h} \times w_{CH4,y} \times D_{CH4,n}$

$FV_{RG,h}$	Volumetric flow rate of the biogas at normal conditions in hour *h* (m^3/h)
$w_{CH4,y}$	Volumetric fraction of methane in the biogas basis in hour *h* (fraction), alternatively a default value of 60% methane content can be used
$D_{CH4,n}$	Density of methane at normal conditions (0.716) (kg/m^3)

In case of enclosed flares and use of the default value for the flare efficiency (90%), the flare efficiency in the hour h ($\eta_{flare,h}$) is:

- 0% if the temperature in the exhaust gas of the flare (T_{flare}) is below 500 °C for more than 20 minutes during the hour *h* .
- 50%, if the temperature in the exhaust gas of the flare ((T_{flare}) is above 500 °C for more than 40 minutes during the hour *h*, but the manufacturer's specifications on proper operation of the flare are not met at any point in time during the hour *h*.
- 90%, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500 °C for more than 40 minutes during the hour *h* and the manufacturers specifications on proper operation of the flare are met continuously during the hour *h*.

In case of open flares, the flare efficiency in the hour h ($\eta_{flare,h}$) is

- 0% if the flame is not detected for more than 20 minutes during the hour h.
- 50%, if the flare is detected for more than 20 minutes during the hour h.

c) Emissions from incremental transportation:

Where substrates are used for renewable energy generation only (*BT*), project emissions due to incremental transport distances are not applicable. Emissions associated with transportation of these substrates are accounted for as leakage emissions.

d) Emissions from storage:

Where applicable, project emissions on account of storage of manure before being fed into the anaerobic digester shall be accounted for if both condition (a) and condition (b) below are satisfied:

(a) The storage time of the manure after removal from the animal barns, including transportation, exceeds 24 hours before being fed into the anaerobic digester; and

(b) The dry matter content of the manure when removed from the animal barns is less than 20%.

The following method shall be used to calculate project emissions from manure storage:

$$PE_{storage,y} = GWP_{CH_4} \times D_{CH_4} \times \sum_{LT,l} \left[\frac{365}{AI_l} \sum_{d=1}^{AI} (N_{LT,y} \times VS_{LT,d} \times MS\%_l \times (1 - e^{-k\ (AI_l - d)}) \times MCF_l \times B_{0_{LT}}) \right]$$

AI_l	Annual average interval between manure collection and delivery for treatment at a given storage
$MS\%_l$	Fraction of volatile solids (%) handled by storage device *l*
k	Degradation rate constant (0.069)
d	Days for which cumulative methane emissions are calculated; d can vary from 1 to 45 and to be run from 1 up to AI_l
MCF_l	Annual methane conversion factor for the project manure storage device *l* from Table 10.17, Chapter 10, Volume 4

e) Methane emissions from the disposal/storage/treatment of the residual waste

Where applicable, methane emissions from anaerobic storage and/or disposal in a landfill of the residual waste from the digestion ($PE_{reswaste,y}$) are calculated as per follows:

$$BE_{reswaste,y} = \varphi \cdot (1 - f) \cdot GWP_{CH4} \cdot (1 - OX) \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^{y} \sum_j W_{j,x} \cdot DOC_j \cdot e^{-k(y-x)} \cdot (1 - e^{-kj})$$

Where:

φ	Model correction factor to account for model uncertainties (0.9)
f	Fraction of methane captured at the SWDS and flared, combusted or used in another manner
GWP_{CH4}	Global warming Potential of methane, valid for the relevant commitment period
OX	Oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste)
F	Fraction of methane in the SWDS gas (volume fraction) (0.5)
DOC_f	Fraction of degradable organic carbon (DOC) that can decompose (0.5)
MCF	Methane correction factor
$W_{j,x}$	Amount of organic waste type *j* prevented from disposal in the SWDS in the year *x* (tons)
DOC_j	Fraction of degradable organic carbon (by weight) in the waste type *j*
k_j	Decay rate for the waste type *j*
j	Waste type category (index)
x	Year during the crediting period: x runs from the first year of the firs crediting period (x=1) to the year y for which avoided emissions are calculated (x = y)
y	Year for which methane emissions are calculated

f) Emissions from fossil fuel:

Emissions from fossil fuel combustion in the project activity are calculated based on the quantity of fuels combusted and the CO_2 emission coefficient of those fuels, as follows:

$$PE_{FC,j,y} = FC_{i,j,,y} \times COEF_{i,y}$$

Where:

$FC_{i,j,y}$	Quantity of fossil fuel type *i* combusted in process *j* inside the project boundary in year *y* (ton/yr)
$COEF_{i,y}$	The CO_2 emission coefficient of fuel type i in year y (tCO_2/mass or volume unit)
i	Fossil fuel types combusted in process *j* inside the project boundary in year y

With:

$$COEF_{i,y} = NCV_{i,y} \times EF_{CO2,i,y}$$

Where:

$NCV_{i,y}$	Weighted average net calorific value of the fossil fuel type *i* combusted inside the project boundary in year *y* (TJ/ton)
$EF_{CO2,i,y}$	CO_2 emission factor of fossil fuel type *i* combusted inside the project boundary (tCO_2e/TJ)

g) Emissions from electricity use:

Project emissions from grid electricity consumption will be calculated as follows:

$$PE_{elec,y} = EC_{elec,y} \times EF_{CO2,grid,y}$$

Where:

$EC_{elec,y}$	Quantity of electricity consumed in the project boundary in year *y* (MWh/yr)
$EF_{CO2,grid,y}$	CO_2 emission factor of the grid in year *y* (tCO_2e/MWh)

<u>LEAKAGE EMISSIONS</u>

Leakage emissions from the renewable energy project activity consist of:

$$LE_y = LE_{FC,j,y} + LE_{transp,y} + LE_{renewable\ biomass,y}$$

Where:

$LE_{FC,j,y}$	Leakage emissions from collection/processing of biomass outside the project boundary during year *y* (tCO_2e/yr).
$LE_{transp,y}$	Leakage emissions from transportation of biomass outside the project boundary during year *y* (tCO_2e/yr).
$LE_{renewable\ biomass,y}$	Leakage emissions from project activities involving renewable biomass during year *y* (tCO_2e/yr).

Leakage emissions from collection/processing of biomass shall be calculated as follows:

Leakage emissions from fossil fuel combustion outside the project boundary are calculated based on the quantity of fuels combusted and the CO_2 emission coefficient of those fuels, as follows:

$$LE_{FC,j,y} = FC_{c,j,,y} \times COEF_{c,y}$$

Where:

$FC_{c,j,y}$	Quantity of fossil fuel type *c* combusted in process *j* outside the project boundary in year *y* (ton/yr)
$COEF_{c,y}$	The CO_2 emission coefficient of fuel type *c* in year y (tCO_2/mass or volume unit)
c	Fossil fuel types combusted in process *j* outside the project boundary in year y

With:

$$COEF_{c,y} = NCV_{c,y} \times EF_{CO2,c,y}$$

Where:

$NCV_{c,y}$	Weighted average net calorific value of the fossil fuel type *c* combusted outside the project boundary in year *y* (TJ/ton)
$EF_{CO2,c,y}$	CO_2 emission factor of fossil fuel type *c* combusted outside the project boundary (tCO_2e/TJ)

Leakage emissions from transportation shall be calculated as follows:

If the biomass is transported over a distance of more than 200 kilometres due to the implementation of the project activity then this leakage source attributed to transportation shall be considered, otherwise it can be neglected.

$$LE_{transp,y} = (Q_{LE,y} / CT_{LE,y}) \times DAF_{LE,w} \times EF_{LE,CO2/km}$$

Where:

$Q_{LE,y}$	Quantity of biomass transported outside project boundary in the year *y* (ton)
$CT_{LE,y}$	Average truck capacity for transportation outside the project boundary (ton/truck)
$DAF_{LE,w}$	Average incremental distance for biomass transportation outside project boundary (km/truck)
$EF_{LE,CO2/km}$	CO_2 emission factor from fossil fuel used for transportation outside boundary (tCO_2e/km)

CO_2 emission factor from fossil fuel use due to transportation

$$EF_{LE,CO2/km} = VF_{LE,cons} \times D_{LE,fuel} \times NCV_{LE,fuel,y} \times EF_{LE,CO2,fuel}$$

Where:

$VF_{LE,cons}$	Vehicle fuel consumption for transportation outside the project boundary (ℓ/km)
$D_{LE,fuel}$	Fuel density for fuel used for transportation outside the project boundary (kg/ℓ)
$NCV_{LE,fuel,y}$	Calorific value of the fuel used for transportation outside the project boundary (TJ/kg)
$EF_{LE,CO2,fuel}$	CO_2 emission factor of the fuel used for transportation outside the project boundary (tCO_2e/TJ)

Leakage emissions from project activities involving renewable biomass:

For small scale CDM project activities involving renewable biomass there are three types of emissions sources that are potentially significant (>10% of emission reductions) and attributable to the project activities.

$$LE_{renewable\ biomass} = LE_{shift} + LE_{production} + LE_{competing}$$

Where:

LE_{shift}	Leakage due to shifts of pre-project activities (tCO_2e/yr).
$LE_{production}$	Leakage due to emissions related to the production of the biomass (tCO_2e/yr).
$LE_{competing}$	Leakage due to competing uses for the biomass (tCO_2e/yr)

Leakage due to shifts of pre-project activities:

Demonstrate that the project activity does not lead to a shift of pre-project activities outside the project boundary i.e. the land under the proposed project activity can continue to provide at least the same amount of goods and services as in the absence of the project.

Therefore, $LE_{shift} = 0$

Leakage due to emissions related to the production of the biomass

Potentially significant emission sources from the production of renewable biomass can be:

(a) Emissions from application of fertilizer; and
(b) Project emissions from clearance of lands.

These emissions sources should respectively be included. All other emission sources are likely to be smaller than 10% (each) - including transportation of raw materials and biomass, fossil fuel consumption for the cultivation of plantations - and can therefore be neglected in the context of SSC project activities.

Potentially significant emission sources from the production of renewable biomass can be:

$$LE_{production} = LE_{N2O} + LE_{clearance}$$

Where:

LE_{N2O}	Direct N_2O emission as a result of nitrogen application (tCO_2e/yr)
$LE_{clearance}$	Emissions from clearance of lands (tCO_2e/yr)

(a) Emissions from application of fertilizer

The direct nitrous oxide emissions from nitrogen fertilization can be estimated using equations as follows:

$$LE_{N2O} = (F_{SN,y} + F_{ON,y}) \times FE_1 \times MW_{N20} \times GWP_{N20}$$

$F_{SN,y}$	Mass of synthetic fertilizer nitrogen applied adjusted for volatilization as NH_3 and NO_x (ton N/yr)
$F_{ON,y}$	Mass of organic fertilizer nitrogen applied adjusted for volatilization as NH_3 and NO_x (ton N/yr)
EF_1	Emission Factor for emissions from N inputs (ton N_2O-N/tN input)
MW_{N2O}	Ratio of molecular weights of N_2O and N (44/28) (ton N_2O/tN)
GWP_{N2O}	Global Warming Potential for N_2O ($kgCO_2/kg\ N_2O$) (IPCC default = 310, valid for the first commitment period)

Mass of fertilizer nitrogen applied shall be calculated as follows:

$$F_{SN,y} = \sum_i M_{SFi,y} \times NC_{SFi} \times (1 - Frac_{GASF})$$

$$F_{ON,y} = \sum_j M_{OFj,y} \times NC_{OFj} \times (1 - Frac_{GASM})$$

Where:

$M_{SFi,y}$	Mass of synthetic fertilizer type i applied (ton/yr)
$M_{OFj,y}$	Mass of organic fertilizer type j applied (ton/yr)
$Frac_{GASF}$	Fraction that volatilises as NH_3 and NO_x for synthetic fertilizers (%)
$Frac_{GASM}$	Fraction that volatilises as NH_3 and NO_x for organic fertilizers (%)

NC_{SFi} Nitrogen content of synthetic fertilizer type i applied (gN/100 g fertilizer)
NC_{OFj} Nitrogen content of organic fertilizer type j applied (gN/100 g fertilizer)

(b) Project emissions from clearance of lands

Demonstrate that the area where the biomass is grown is not a forest (as per DNA forest definition) and has not been deforested, according to the forest definition by the national DNA, during the last 10 years prior to the implementation of the project activity. In the absence of forest definition from the DNA, definitions provided by relevant international organisations (e.g., FAO) shall be used.

Therefore, $LE_{clearance} = 0$

Leakage due to competing uses for the biomass

An important potential source of leakage is an increase in emissions from fossil fuel combustion or other sources due to diversion of biomass residues from other uses to the project plant as a result of the project activity.

CPA implementers shall demonstrate that the use of the biomass residues does not result in increased use of fossil fuels or other GHG emissions elsewhere. For this purpose, CPA implementers shall assess, as part of the monitoring process, the supply situation for each type of biomass residue *k* used in the project plant. The table below outlines the options that may be used to demonstrate that the biomass residues used in the plant did not increase fossil fuel consumption or other GHG emissions elsewhere.

Which approach should be used depends on the most plausible baseline scenario for the use of the biomass residues. Where scenarios B1, B2 or B3 apply, use approaches L_1, L_2 and/or L_3. Where scenario B4 applies, use approaches L_2 or L_3. Where scenario B5 applies, use approach L_4.

Baseline scenarios:
B1: The biomass residues are dumped or left to decay under mainly aerobic conditions.
B2: The biomass residues are dumped or left to decay under clearly anaerobic conditions.
B3: The biomass residues are burnt in an uncontrolled manner without utilizing them for energy purposes
B4: The biomass residues are sold to other consumers in the market and the predominant use of the biomass residues in the region/country is for energy purposes (heat and/or power generation)
B5: The biomass residues are used as feedstock in a process (e.g. in the pulp and paper industry or fertilizer industry)

Approaches to rule out leakage

L_1	Demonstrate that at the sites where the project activity is supplied from with biomass residues, the biomass residues have not been collected or utilized (e.g. as fuel, fertilizer or feedstock) but have been dumped and left to decay, land-filled or burnt without energy generation (e.g. field burning) prior to the implementation of the project activity. Demonstrate that this practice would continue in the absence of the CDM project activity, e.g. by showing that in the monitored period no market has emerged for the biomass residues considered or by showing that it would still not be feasible to utilize the biomass residues for any purposes (e.g. due to the remote location where the biomass residue is generated)
L_2	Demonstrate that there is an abundant surplus of the in the region of the project activity which is not utilized. For this purpose, demonstrate that the quantity of available biomass residues of type *k* in the region is at least 25% larger than the quantity of biomass residues of type *k* that are utilized (e.g. for energy generation or as feedstock), including the project plant.
L_3	Demonstrate that suppliers of the type of biomass residue in the region of the project activity are not able to sell all of their biomass residues. For this purpose, CPA implementers shall

	demonstrate that the ultimate supplier of the biomass residue (who supplies the project) and a representative sample of suppliers of the same type of biomass residue in the region had a surplus of biomass residues (e.g. at the end of the period during which biomass residues are sold), which they could not sell and which are not utilized
L_4	Identify the consumer that would use the biomass residue in the absence of the project activity (e.g. the former consumer). Demonstrate that this consumer has substituted the biomass residue diverted to the project with other types of biomass residues (and not with fossil fuels or other types of biomass than biomass residues) by showing that the former user only fires biomass residues for which leakage can be ruled out using approaches L_2 or L_3. Provide credible evidence and document the types and amounts of biomass residues used by the former user as replacement for the biomass residue fired in the project activity and apply approaches L_2 or L_3 to these types of biomass residues. Demonstrate that the substitution of the biomass residues used in the project activity with other types of biomass residues does not require a significant additional energy input except for the transportation of the biomass residues

Where approaches L_2, L_3 or L_4 are used to assess leakage effects, the geographical boundary of the region shall be clearly defined and document. In defining the geographical boundary of the region, the usual distances for biomass transports will be taken into account. A biomass survey needs to be done for these approaches.

Below is the calculation for estimation of the surplus biomass type *k* in the region applicable to approach *L2, L3* and *L4*.

$$BF_{diff,k,y} = BF_{available,k,y} - (BF_{utilized,k,y} \times 1.25)$$

Where

$BF_{diff,k,y}$	Difference in quantity of biomass available and the required 25% larger than the quantity utilised (ton/yr)
$BF_{available,k,y}$	Quantity of available biomass residues of type *k* or *m* in the region (ton/yr)
$BF_{utilized,k,y}$	Quantity of available biomass residues of type *k* or *m* that are utilized in the defined geographical region (ton/yr)

In case $BF_{diff,k,y}$ is positive (+) leakage can be ruled out. However, if $BF_{diff,k,y}$ is negative (-), then leakage effects cannot be ruled out.

If for a certain biomass residue type *k* used in the project leakage effects cannot be ruled out with one of the approaches above, leakage effects for the year *y* shall be calculated as follows:

$$LE_{competing,y} = EF_{CO2,LE} \times \sum_n BF_{LE,n,y} \times NCV_n$$

Where:

$EF_{CO2,LE}$	CO_2 emission factor of the most carbon intensive fuel used in the country (tCO_2/TJ)
$BF_{LE,n,y}$	Quantity of biomass residue type *n* used for heat generation as a result of the project activity during the year *y* and for which leakage can not be ruled out using one of the approaches L_1, L_2, L_3 or L_4 (tons of dry matter or liter)
NCV_n	Net calorific value of the biomass residue type *n* (GJ/ton of dry matter or TJ/liter)
n	Biomass residue type *n* for which leakage can not be ruled out using one of the approaches L_1, L_2, L_3 or L_4

In case of approaches L_1, $BF_{LE,n,y}$ corresponds to the quantity of biomass residue type *n* that is obtained from the relevant source or sources.

In case of approaches L_2 or L_3, $BF_{LE,n,y}$ corresponds to the quantity of biomass residue type *k* used in the project plant as a result of the project activity during the year *y* ($BF_{LE,n,y} = B_{biomass,k,y}$, where $n=k$).

In case of approach L_4, ($BF_{LE,n,y} \times NCV_n$) corresponds to the lower value of

(a) The quantity of fuel types *m*, expressed in energy quantities, that are used by the former user of the biomass residue type *k* and for which leakage can not be ruled out because the fuels used are either (i) fuels types other than biomass residues (e.g. fossil fuels or biomass types other than biomass residues) or (ii) are biomass residues but leakage can not be ruled out for those types of biomass residues with approaches L_2 or L_3; as follows:

$$BF_{LE,n,y} \times NCV_n = \sum_m FC_{former\ user,m,y} \times NCV_m$$

$BF_{LE,n,y}$	Quantity of biomass residue type *n* used for heat generation as a result of the project activity during the year *y* and for which leakage can not be ruled out using approach L_4 (tons of dry matter or liter)
NCV_n	Net calorific value of the biomass residue type *n* (GJ/ton of dry matter or GJ/liter)
n	Biomass residue type n for which leakage can not be ruled out using approach L4
$FC_{former\ user,m,y}$	Quantity of fuel type *m* used by the former user of the biomass residue type *n* during the year *y* (mass or volume unit)
NCV_m	Net calorific value of fuel type *m* (GJ/ton of dry matter or GJ/liter)
m	Fuel type *m*, being either (i) a fuel type other than a biomass residue (e.g. fossil fuel or biomass other than biomass residues) or (ii) a biomass residues for which leakage can not be ruled out with approaches L_2 or L_3

(b) The quantity of biomass residue type *k*, expressed in energy quantities, used in the project plant during the year *y* ($BF_{LE,n,y} = B_{biomass,k,y}$, *where* $n=k$).

B.7. Application of the monitoring methodology and description of the monitoring plan
B.7.1. Data and parameters to be monitored by each generic CPA

Data / Parameter	$BG_{flare,y}$; $BG_{elec,y}$; $BG_{thermal,y}$
Unit	Nm^3/yr
Description	$BG_{flare,y}$: Biogas flow to the flare in year *y* $BG_{elec,y}$: Biogas flow to the electricity generation system in year *y* $BG_{thermal,y}$: Biogas flow to the thermal energy generation system in year *y*
Source of data	Measured - flow meters
Value(s) applied	Not applicable, measured *ex post* only
Measurement methods and procedures	Flow meters will measure continuously the volume of gas and will be added over a period of a year to get the annual measurement. Biogas Temperature and pressure will be measured simultaneously to normalize for the conditions of the gas combusted. The system will be built and operated to ensure that there is no air inflow into the biogas pipeline. Measurement method: Flow meter Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Annually, based on continuous flow measurement with accumulated volume recording (e.g. hourly/daily accumulated reading)
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	T_{biogas}
Unit	^{o}C
Description	Temperature of the biogas at the flow measurement site
Source of data	Data from temperature gauge
Value(s) applied	Not applicable, measured *ex post* only
Measurement methods and procedures	The temperature of the gas is required to determine the density of the methane combusted. If the biogas flow meter employed measures flow, pressure and temperature and displays or outputs the normalised flow of biogas, then there is no need for separate monitoring of pressure and temperature of the biogas. Temperature shall be measured at the same time when methane content in biogas (w_{CH4}) is measured. Measurement method: Temperature gauge Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recording.
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	P_{biogas}
Unit	kPa
Description	Pressure of the biogas at the flow measurement site
Source of data	Measured - pressure gauge
Value(s) applied	Not applicable, measured *ex post* only
Measurement methods and procedures	The pressure of the gas is required to determine the density of the methane combusted. If the biogas flow meter employed measures flow, pressure and temperature and displays or outputs the normalised flow of biogas, then there is no need for separate monitoring of pressure and temperature of the biogas. Pressure shall be measured at the same time when methane content in biogas (w_{CH4}) is measured. Measurement method: Pressure gauge Standards to be applied: Relevant national/international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recording.
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$w_{CH4,y}$
Unit	Mass fraction
Description	Fraction of Methane in the biogas in year *y*
Source of data	Measured - gas analyser. Alternatively a default value of 60% methane content can be used
Value(s) applied	Not applicable, measured *ex post* only
Measurement methods and procedures	The fraction of methane in the biogas should be measured with a continuous analyser (values are recorded with the same frequency as the flow) or alternatively a default value of 60% methane content can be used. Option chosen should be clearly specified in the CPA-DD . It shall be measured using equipment that can directly measure methane content in the biogas - the estimation of methane content of biogas based on measurement of other constituents of biogas such as CO_2 is not permitted. The methane content measurement shall be carried out close to a location in the system where a biogas flow measurement takes place, and on the same basis (wet or dry) Measurement method: Gas analyser Standards to be applied: National or international standard or manufacturer's specifications. Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recording.
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline and project emissions (flare)
Additional comments	-

Data / Parameter	$EG_{thermal,y}$
Unit	TJ/yr
Description	Net quantity of thermal energy supplied by the project activity during the year *y*
Source of data	Calculated as described in monitoring section of methodology AMS-I.C (version 19), paragraph 50 no. 7.
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuous monitoring, aggregated annually
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$EG_{thermal,PJ,y}$
Unit	TJ/yr
Description	Total actual thermal energy produced in year *y* by all units, existing and new project units
Source of data	Calculated as described in monitoring section of methodology AMS-I.C (version 19), paragraph 50 no. 7.
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuous monitoring, aggregated annually
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$EG_{thermal,actual,y}$
Unit	TJ/yr
Description	The actual, measured thermal energy production of the existing units in year *y*
Source of data	Calculated as described in monitoring section of methodology AMS-I.C (version 19), paragraph 50 no. 7.
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuous monitoring, aggregated annually
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$Q_{hot\ air}$
Unit	m^3/yr
Description	Quantity of hot air
Source of data	Measured - flow meters
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Flow meter Standards to be applied: Relevant national/international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA Where it is not feasible (e.g. because of too high temperature), spot measurements can be used through sampling with a 90% confidence level and a 10% precision
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recordings
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used. If applicable, measurement results shall be cross checked with records for sold/purchased electricity (e.g. invoices/receipts)
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	Q_{steam}
Unit	m^3/yr
Description	Quantity of steam
Source of data	Measured - flow meters
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Flow meter Standards to be applied: Relevant national/international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recording
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used. If applicable, measurement results shall be cross checked with records for sold/purchased electricity (e.g. invoices/receipts)
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	*T*
Unit	°C
Description	Temperature of the steam or hot fluid and/or gases generated by the heat generation equipment
Source of data	Measured
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Temperature gauge Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recording
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	*P*
Unit	kPa
Description	Pressure of the steam or hot fluid and/or gases generated by the heat generation equipment
Source of data	Measured - pressure gauge
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Pressure gauge Standards to be applied: Relevant national/international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recording
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$EG_{BL,y}$
Unit	MWh/yr
Description	The amount of net renewable electricity supplied to the grid or displaced from the grid as a result of the implementation of the CDM project activity in year *y*
Source of data	Measured – electricity gauge
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Electricity gauge Standards to be applied: Relevant national/international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recordings
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used. If applicable, measurement results shall be cross checked with records for sold/purchased electricity (e.g. invoices/receipts). If applicable, cross check net electricity supplied to a grid as gross energy generation in the project activity power plant minus the auxiliary/station electricity consumption, technical losses and electricity import from the grid to the project power plant measured at the grid interface/connection used for billing purposes
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$EG_{PJ,add,y}$
Unit	MWh/yr
Description	The total net electrical energy supplied to a grid or displaced from the grid in year *y* by all units, existing and new project units
Source of data	Measured – electricity gauge
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Electricity gauge Standards to be applied: Relevant national/international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recordings
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$EG_{actual,y}$
Unit	MWh/yr
Description	The actual, measured net electrical energy supplied to the grid or displaced from the grid by the existing units in year *y*
Source of data	Measured – electricity gauge
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Electricity gauge Standards to be applied: Relevant national/international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recordings
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	EC_y
Unit	MWh/yr
Description	Quantity of electricity consumed in the project boundary in year *y*
Source of data	Measured – electricity gauge
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Electricity gauge Standards to be applied: Relevant national/international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recordings
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of project emissions (electricity)
Additional comments	-

Data / Parameter	$B_{biomass,k,y}$
Unit	Mass or volume/yr
Description	Quantity of biomass type *k* consumed in year *y*
Source of data	Measured
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Use mass or volume based measurements. Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	The quantity of biomass shall be measured continuously or in batches.
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	*% water*
Unit	%
Description	Moisture content of the biomass type *k*
Source of data	Measured
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Standards to be applied: Relevant national or international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Quarterly. The weighted average should be calculated for each monitoring period and used in the calculations.
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$\%VS_{k,y}$
Unit	% (dry basis)
Description	Volatile solid content of the biomass type *k* consumed in year *y*
Source of data	Measured at accredited laboratories
Value(s) applied	Specific to CPA
Measurement methods and procedures	Testing shall be performed according to the guideline in Annex 2 of AM0073.
Monitoring frequency	Quarterly. The weighted average should be calculated for each monitoring period and used in the calculations.
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	T_{flare}
Unit	^{o}C
Description	Temperature in the exhaust gas of the flare
Source of data	Data from temperature gauge
Value(s) applied	Not applicable, measured *ex post* only
Measurement methods and procedures	Measure the temperature of the exhaust gas stream in the flare with a temperature gauge. To ensure 90% of combustion of the biogas in the enclosed flare system, the temperature needs to be between 500 ^{o}C and 700 ^{o}C. The control of the temperature is determined by the temperature gauge. Measurement method: Temperature gauge Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recording.
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of project emissions (flare)
Additional comments	An excessively high temperature at the sampling point (above 700 ºC) may be an indication that the flare is not being adequately operated or that its capacity is not adequate to the actual flow.

Data / Parameter	$FV_{RG,h}$
Unit	m^3/h
Description	Volumetric flow rate of the residual gas in dry basis at normal conditions in hour h
Source of data	Measured - flow meters
Value(s) applied	Not applicable, measured *ex post* only
Measurement methods and procedures	Flow meters will measure continuously the volume of gas. Biogas Temperature and pressure will be measured simultaneously. The system will be built and operated to ensure that there is no air inflow into the biogas pipeline. Measurement method: Flow meter Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recording.
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of project emissions (flare)
Additional comments	-

Data / Parameter	$\eta_{flare,h}$
Unit	Fraction
Description	Flare efficiency in hour *h*
Source of data	Default of 50% will be used for open flares and 90% will be used for enclosed flares, except in circumstances where it does not operate in accordance with manufacturers specifications for enclosed flare
Value(s) applied	In case of enclosed flares and use of the default value for the flare efficiency (90%), the flare efficiency in the hour h ($\eta_{flare,h}$) is: ● 0% if the temperature in the exhaust gas of the flare (T_{flare}) is below 500 °C for more than 20 minutes during the hour *h* . ● 50%, if the temperature in the exhaust gas of the flare ((T_{flare}) is above 500 °C for more than 40 minutes during the hour *h*, but the manufacturer's specifications on proper operation of the flare are not met at any point in time during the hour *h*. ● 90%, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500 °C for more than 40 minutes during the hour *h* and the manufacturers specifications on proper operation of the flare are met continuously during the hour *h*. In case of open flares, the flare efficiency in the hour h ($\eta_{flare,h}$) is ● 0% if the flame is not detected for more than 20 minutes during the hour h. ● 50%, if the flare is detected for more than 20 minutes during the hour h.
Measurement methods and procedures	Based on exhaust gas temperature recorded by T_{flare} and monitored compliance with manufacturers specifications.
Monitoring frequency	-
QA/QC procedures	Continuous check of compliance with the manufacturer's specifications of the flare device
Purpose of data	Calculation of project emissions (flare)
Additional comments	

Data / Parameter	$MS\%_l$
Unit	%
Description	Fraction of volatile solids handled by storage device *l*
Source of data	CPA operational records
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Use mass or volume based measurements. Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA.
Monitoring frequency	Annually, based on daily records an aggregated monthly
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of project emissions (storage)
Additional comments	-

Data / Parameter	AI_l
Unit	Days
Description	Annual average interval between manure collection and delivery for treatment at a given storage
Source of data	CPA operational records
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Annually, based on daily records an aggregated monthly
QA/QC procedures	The days monitored should be cross checked with the time balance from the plant.
Purpose of data	Calculation of project emissions (storage)
Additional comments	-

Data / Parameter	f
Unit	
Description	Fraction of methane captured at the project SWDS and flared, combusted or used in another manner
Source of data	Written information from the operator of the solid waste disposal site and/or site visits at the solid waste disposal site
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Annually
QA/QC procedures	Check the value against projection schedule. If the values differ significantly, differences should be explained.
Purpose of data	Calculation of project emissions (residual waste)
Additional comments	-

Data / Parameter	$W_{j,x}$
Unit	Ton
Description	Total amount of residual disposed of in SWDS in year x
Source of data	CPA operational records
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Use mass or volume based measurements. Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA.
Monitoring frequency	Annually, based on daily records and monthly aggregation.
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used. The quantity monitored should be cross checked with the mass balance from the plant.
Purpose of data	Calculation of project emissions (residual waste)
Additional comments	-

Data / Parameter	*Soil application*
Unit	-
Description	Where applicable, the proper soil application (not resulting in methane emissions) of the residual waste shall be monitored.
Source of data	-
Value(s) applied	-
Measurement methods and procedures	Monitor the soil application of the final sludge and confirm proper application.
Monitoring frequency	Annually
QA/QC procedures	-
Purpose of data	Calculation of project emissions
Additional comments	-

Data / Parameter	$FC_{i,j,y}$
Unit	ton/yr or m^3/yr
Description	Quantity of fossil fuel type *i* combusted in process *j* inside the project boundary in year *y*
Source of data	Onsite measurements
Value(s) applied	Specific to CPA
Measurement methods and procedures	• Use either mass or volume meters. In cases where fuel is supplied from small daily tanks, rulers can be used to determine mass or volume of the fuel consumed, with the following conditions: The ruler gauge must be part of the daily tank and calibrated at least once a year and have a book of control for recording the measurements (on a daily basis or per shift); • Accessories such as transducers, sonar and piezoelectronic devices are accepted if they are properly calibrated with the ruler gauge and receiving a reasonable maintenance; • In case of daily tanks with pre-heaters for heavy oil, the calibration will be made with the system at typical operational conditions.
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used. The consistency of metered fuel consumption quantities should be cross-checked by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records.
Purpose of data	Calculation of project emissions (fossil fuel)
Additional comments	-

Data / Parameter	$NCV_{i,y}$
Unit	TJ/ton
Description	Weighted average net calorific value of the fossil fuel type *i* combusted inside the project boundary in year *y*
Source of data	The following data sources may be used if the relevant conditions apply:

Data source	Conditions for using the data source
a) Values provided by the fuel supplier in invoices	This is the preferred source if the carbon fraction of the fuel is not provided (Option A)
b) Measurements by the CPA implementers	If a) is not available
c) Regional or national default values	If a) is not available. These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances).
d) IPCC default values at the upper 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	If a) is not available

Value(s) applied	Specific to CPA
Measurement methods and procedures	For a) and b): Measurements should be undertaken in line with national or international fuel standards
Monitoring frequency	For a) and b): The NCV should be obtained for each fuel delivery, from which weighted average annual values should be calculated For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures	Verify if the values under a), b) and c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards.
Purpose of data	Calculation of project emissions (fossil fuel)
Additional comments	-

Data / Parameter	$EF_{CO2,i,y}$
Unit	tCO_2/TJ
Description	CO_2emission factor of fossil fuel type *i* combusted inside the project boundary in year y
Source of data	The following data sources may be used if the relevant conditions apply: Data source / Conditions for using the data source a) Values provided by the fuel supplier in invoices / This is the preferred source b) Measurements by the CPA implementers / If a) is not available c) Regional or national default values / If a) is not available. These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances) d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories / If a) is not available
Value(s) applied	Specific to CPA
Measurement methods and procedures	For a) and b): Measurements should be undertaken in line with national or international fuel standards
Monitoring frequency	For a) and b): The CO2 emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated. For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures	-
Purpose of data	Calculation of project emissions (fossil fuel)
Additional comments	For a): If the fuel supplier does provide the NCV value and the CO_2 emission factor on the invoice and these two values are based on measurements for this specific fuel, this CO_2 factor should be used. If another source for the CO_2 emission factor is used or no CO_2 emission factor is provided, Options b), c) or d) should be used.

Data / Parameter	$FC_{c,j,y}$
Unit	ton/yr or m^3/yr
Description	Quantity of fossil fuel type *c* combusted in process *j* outside the project boundary in year *y*
Source of data	Measured
Value(s) applied	Specific to CPA
Measurement methods and procedures	• Use either mass or volume meters. In cases where fuel is supplied from small daily tanks, rulers can be used to determine mass or volume of the fuel consumed, with the following conditions: The ruler gauge must be part of the daily tank and calibrated at least once a year and have a book of control for recording the measurements (on a daily basis or per shift); • Accessories such as transducers, sonar and piezoelectronic devices are accepted if they are properly calibrated with the ruler gauge and receiving a reasonable maintenance; • In case of daily tanks with pre-heaters for heavy oil, the calibration will be made with the system at typical operational conditions.
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used. The consistency of metered fuel consumption quantities should be cross-checked by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records.
Purpose of data	Calculation of leakage (fossil fuel)
Additional comments	-

Data / Parameter	$NCV_{c,y}$
Unit	TJ/ton
Description	Weighted average net calorific value of the fossil fuel type *c* combusted outside the project boundary in year *y*
Source of data	The following data sources may be used if the relevant conditions apply:

Data source	Conditions for using the data source
a) Values provided by the fuel supplier in invoices	This is the preferred source if the carbon fraction of the fuel is not provided (Option A)
b) Measurements by the CPA implementers	If a) is not available
c) Regional or national default values	If a) is not available. These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances).
d) IPCC default values at the upper 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	If a) is not available

Value(s) applied	Specific to CPA
Measurement methods and procedures	For a) and b): Measurements should be undertaken in line with national or international fuel standards
Monitoring frequency	For a) and b): The NCV should be obtained for each fuel delivery, from which weighted average annual values should be calculated For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures	Verify if the values under a), b) and c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards.
Purpose of data	Calculation of leakage emissions (fossil fuel)
Additional comments	-

Data / Parameter	$EF_{CO2,c,y}$
Unit	tCO_2e/TJ
Description	CO_2emission factor of fossil fuel type *c* combusted outside the project boundary in year *y*
Source of data	The following data sources may be used if the relevant conditions apply: Data source / Conditions for using the data source a) Values provided by the fuel supplier in invoices / This is the preferred source b) Measurements by the CPA implementers / If a) is not available c) Regional or national default values / If a) is not available. These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances) d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories / If a) is not available
Value(s) applied	Specific to CPA
Measurement methods and procedures	For a) and b): Measurements should be undertaken in line with national or international fuel standards
Monitoring frequency	For a) and b): The CO2 emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated. For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions (fossil fuel)
Additional comments	For a): If the fuel supplier does provide the NCV value and the CO_2 emission factor on the invoice and these two values are based on measurements for this specific fuel, this CO_2 factor should be used. If another source for the CO_2 emission factor is used or no CO_2 emission factor is provided, Options b), c) or d) should be used.

Data / Parameter	$Q_{LE,y}$
Unit	ton/yr or m^3/yr
Description	Quantity of biomass transported outside the project boundary in the year *y*
Source of data	Measured
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Use mass or volume based measurements. Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA.
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of leakage emissions (transport)
Additional comments	-

Data / Parameter	$CT_{LE,y}$
Unit	ton/truck
Description	Average truck capacity for transportation outside the project boundary in year *y*
Source of data	Records, e.g. logbooks
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions (transport)
Additional comments	-

Data / Parameter	$DAF_{LE,y}$
Unit	km/truck
Description	Average incremental distance for biomass transportation outside the project boundary in year *y*
Source of data	Records, e.g. logbooks
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions (transport)
Additional comments	-

Data / Parameter	$VF_{LE,cons}$
Unit	ℓ/km
Description	Vehicle fuel consumption in litres per kilometre
Source of data	Records (e.g. logbooks) or standard fuel consumption for type of truck or IPCC values
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions (transport)
Additional comments	-

Data / Parameter	$D_{LE,fuel}$
Unit	kg/ℓ
Description	Fuel density
Source of data	Oil company data for fuel type used
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions (transport)
Additional comments	-

Data / Parameter	$NCV_{LE,fuel,y}$
Unit	TJ/kg or other unit
Description	Net calorific value of the fuel used for transport outside the project boundary in year *y*
Source of data	The following data sources may be used if the relevant conditions apply: Data source / Conditions for using the data source a) Values provided by the fuel supplier in invoices / This is the preferred source if the carbon fraction of the fuel is not provided (Option A) b) Measurements by the CPA implementers / If a) is not available c) Regional or national default values / If a) is not available. These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances). d) IPCC default values at the upper 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 / If a) is not available
Value(s) applied	Specific to CPA
Measurement methods and procedures	For a) and b): Measurements should be undertaken in line with national or international fuel standards
Monitoring frequency	For a) and b): The NCV should be obtained for each fuel delivery, from which weighted average annual values should be calculated For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures	Verify if the values under a), b) and c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards.
Purpose of data	Calculation of leakage emissions (transport)
Additional comments	-

Data / Parameter	$EF_{LE,CO2,fuel}$
Unit	tCO_2e/TJ
Description	CO_2 emission factor of the fuel used for transportation outside the project boundary in year *y*
Source of data	The following data sources may be used if the relevant conditions apply:

Data source	Conditions for using the data source
a) Values provided by the fuel supplier in invoices	This is the preferred source
b) Measurements by the CPA implementers	If a) is not available
c) Regional or national default values	If a) is not available. These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances)
d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories	If a) is not available

Value(s) applied	Specific to CPA
Measurement methods and procedures	For a) and b): Measurements should be undertaken in line with national or international fuel standards
Monitoring frequency	For a) and b): The CO2 emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated. For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions (transport)
Additional comments	For a): If the fuel supplier does provide the NCV value and the CO_2 emission factor on the invoice and these two values are based on measurements for this specific fuel, this CO_2 factor should be used. If another source for the CO_2 emission factor is used or no CO_2 emission factor is provided, Options b), c) or d) should be used.

Data / Parameter	$M_{SFi,y}$
Unit	ton/yr
Description	Mass of synthetic fertilizer type *i* applied
Source of data	On-site records
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions
Additional comments	-

Data / Parameter	$M_{OFj,y}$
Unit	ton/yr
Description	Mass of organic fertilizer type *j* applied
Source of data	On-site records
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions
Additional comments	-

Data / Parameter	NC_{SFi}
Unit	gN/100 g fertilizer
Description	Nitrogen content of synthetic fertilizer type *i* applied
Source of data	Supplier information
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Monthly
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions
Additional comments	-

Data / Parameter	NC_{OFj}
Unit	gN/100 g fertilizer
Description	Nitrogen content of organic fertilizer type *j* applied
Source of data	Supplier information
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Monthly
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions
Additional comments	-

B.7.2. Description of the monitoring plan for a generic CPA

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1. Management of parameters to be monitored

The Tables below show all the possible parameters to be monitored for the different Project scenarios under the PoA. From these tables, the CME will compile a list of relevant parameters for each CPA in section D.7.2 of the CPA-DD. Further information on the source of date, details on the measurement methods and procedures and QA/QC procedures will be as describe in section D.7.1 of the CPA-DD

The CME will ensure that a representative from each CPA is suitable trained on monitoring and operations & maintenance of monitoring equipment.

CPAs shall monitor 100% of the relevant parameters included in Section D.7.1. of each CPA-DD. Monitoring reports will be prepared separately for all CPAs, however only a sample will be verified by the DOE. See the sampling procedure proposed for verification below in “Reporting and verification”.

The following tables show all the parameters to be monitored under the PoA:

Table 1.a Baseline emission parameters related to methane avoidance from AWMS
Table 1.b Methane captured and destroyed or used gainfully by the project activity
Table 1.c Baseline emission parameters related to thermal energy generation
Table 1.d Baseline emission parameters related to electricity generation
Table 1.e Baseline emission parameters for each energy project scenario under the PoA
Table 2 Project emission parameters under the PoA
Table 3. Leakage emission parameters and demonstrations under the PoA

Baseline emissions

Table 1.a. Baseline emission parameters related to methane avoidance from AWMS
Not applicable to this generic CPA-DD.

Table 1.b. Methane captured and destroyed or used gainfully by the project activity

Parameter	Description
$BG_{flare,y}$	Biogas flow to the fare (Nm^3/yr)
$BG_{elec,y}$	Biogas flow to the electricity generation system (Nm^3/yr)
$BG_{thermal,y}$	Biogas flow to the thermal energy generation system (Nm^3/yr)

T_{biogas}	Temperature of the biogas at the flow measurement site (°C)
P_{biogas}	Pressure of the biogas at the flow measurement site (kPa)
$w_{CH4,y}$	Fraction of methane in the biogas (fraction)

Table 1.c. Baseline emission parameters for thermal energy generation

Parameter	Description
$EG_{thermal,y}$	Net quantity of thermal energy supplied by the project activity during the year *y* (TJ/yr)
$Q_{hot\ air}$	Quantity of hot air (m^3/yr)
Q_{steam}	Quantity of steam (m^3/yr)
T	Temperature of the steam or hot fluid and/or gases generated by the heat generation equipment (°C)
P	Pressure of the steam or hot fluid and/or gases generated by the heat generation equipment (kg/cm)
Parameters for biomass that does not apply methodology AMS-III.D:	
$B_{biomass,k,y}$	Quantity of biomass type *k* consumed in year *y* (ton/yr)
$\%VS_{k,y}$	Volatile solid content of the biomass type *k* consumed in year *y* (%, dry basis)
% water	Moisture content of the biomass type *k* (%)

Table 1.d. Baseline emission parameters for electricity generation

Parameter	Description
$EG_{BL,y}$	The amount of net renewable electricity supplied to the grid or displaced from the grid as a result of the CDM project activity in year *y* (MWh/yr)
Parameters for biomass that does not apply methodology AMS-III.D:	
$B_{biomass,k,y}$	Quantity of biomass type *k* consumed in year *y* (ton/yr)
$\%VS_{k,y}$	Volatile solid content of the biomass type *k* consumed in year *y* (%, dry basis)
% water	Moisture content of the biomass type *k* (%)

Table 1.e. Baseline emission parameters for each Energy scenario

Energy scenario	Parameters	Description
1	Table 1.c	
2.1 2.2	Table 1.c Table 1.d	
3.1	Table 1.c + $EG_{thermal,PJ,y}$ $EG_{thermal,actual,y}$	 Total actual thermal energy produced in year *y* by all units, existing and new project units (TJ/yr). The actual, measured thermal energy production of the existing units in year *y* (TJ/yr)
3.2	Table 1.d + $EG_{PJ,add,y}$ $EG_{actual,y}$	 The total net electrical energy supplied to a grid or displaced from the grid in year *y* by all units, existing and new project units (MWh/yr). The actual, measured net electrical energy supplied to the grid or displaced from the grid by the existing units in year *y* (MWh/yr).

Project emissions

Table 2.1. Project emission parameters for flaring

Parameter	Description
$FV_{RG,h}$	Volumetric flow rate of the residual gas in dry basis at normal conditions in hour *h* (m^3/h)
T_{flare}	Temperature in the exhaust gas of the flare (°C)

Table 2.2. Project emission parameters for transportation

Not applicable to this generic CPA-DD.

Table 2.3. Project emission parameters for storage of manure

Parameter	Description
AI_l	Annual average interval between manure collection and delivery for treatment at a given storage
$MS\%_l$	Fraction of volatile solids (%) handled by storage device *l*

Table 2.4. Project emission parameters for residual waste

Parameter	Description
f	Fraction of methane captured at the project SWDS and flared, combusted or used in another manner
$W_{j,x}$	Amount of residual waste disposed of in the SWDS in the year *x* (tons)
Soil application	Where applicable, the proper soil application (not resulting in methane emissions) of the residual waste shall be monitored.

Table 2.5. Project emission parameters for fossil fuel and electricity use

Parameter	Description
$FC_{i,j,y}$	Quantity of fossil fuel type *i* combusted in process *j* inside the project boundary in year *y* (ton/yr)
$NCV_{i,y}$	Weighted average net calorific value of the fossil fuel type *i* combusted inside the project boundary in year *y* (TJ/ton)
$EF_{CO2,i,y}$	CO_2 emission factor of fossil fuel type *i* combusted inside the project boundary (tCO_2e/TJ)
EC_y	Quantity of electricity consumed in the project boundary in year *y* (MWh/yr)

Leakage emissions

Table 3.1. Leakage emission parameters for collection and processing of biomass

Parameter	Description
$FC_{c,j,y}$	Quantity of fossil fuel type *c* combusted in process *j* outside the project boundary in year *y* (ton/yr)
$NCV_{c,y}$	Weighted average net calorific value of the fossil fuel type *c* combusted outside the project boundary in year *y* (TJ/ton)
$EF_{CO2,c,y}$	CO_2 emission factor of fossil fuel type *c* combusted outside the project boundary (tCO_2e/TJ)

Table 3.2. Leakage emission parameters for transportation

Parameter	Description
$Q_{LE,y}$	Quantity of biomass transported outside project boundary in the year *y* (ton)
$CT_{LE,y}$	Average truck capacity for transportation outside the project boundary (ton/truck)
$DAF_{LE,w}$	Average incremental distance for biomass transportation outside project boundary (km/truck)
$VF_{LE,cons}$	Vehicle fuel consumption for transportation outside the project boundary (ℓ/km)
$D_{LE,fuel}$	Fuel density for fuel used for transportation outside the project boundary (kg/ℓ)
$NCV_{LE,fuel,y}$	Calorific value of the fuel used for transportation outside the project boundary (TJ/kg)
$EF_{LE,CO2,fuel}$	CO_2 emission factor of the fuel used for transportation outside the project boundary (tCO_2e/TJ)

Table 3.3. Leakage emission parameters for the application of fertilizer

Parameter	Description
$M_{SFi,y}$	Mass of synthetic fertilizer type i applied (ton/yr)
$M_{OFj,y}$	Mass of organic fertilizer type j applied (ton/yr)

NC_{SFi}	Nitrogen content of synthetic fertilizer type i applied (gN/100 g fertilizer)
NC_{OFj}	Nitrogen content of organic fertilizer type j applied (gN/100 g fertilizer)

2. Data management

- The CME will ensure that a representative from each CPA will be suitable trained on the applications of data management.
- The CPA implementer will be responsible for measurement, record-keeping and storage of all data to be monitored. All data will be electronically archived on the CPA's data control system for the entire crediting period plus two years beyond the crediting period.
- The CPA implementer will be responsible for coordinating the monitoring of AWMS parameters with the AWMS manager.
- The CME will manage a central database with all the monitoring information from the different CPAs and also store the information for the whole crediting period plus two years beyond the crediting period.
- The CME will conduct an inspection of each CPA every six months to ensure that all the relevant data is collected and stored adequately for verification
- Data management between the CPA implementer and the CME will work as follows:

Parameter		Measurement method	Data management
AWMS	CPA implementer shall monitor the soil application of the final sludge and confirm proper application.		CPA implementer shall annually send report and confirmation to CME.
Biomass	$\%VS_{k,y}$ $\%\ water$	Accredited laboratories	CPA implementer will do measurements quarterly and send data to CME.
	$B_{biomass,k,y}$	Mass or volume measurements	Data will be manually recorded by the operational staff at the project site. Data will be transferred to a spreadsheet, aggregated monthly and sent to the CME.
Biogas	$BG_{flare,y}$ $BG_{elec,y}$ $BG_{thermal,y}$	Flow meter	The metering instruments will be connected to a monitoring system for computation and automatic data acquisition on a continuous basis. This data is logged in the plant distributed control system for history collection. This data is transferred monthly to the CME and archived.
	T_{biogas}	Temperature gauge	
	P_{biogas}	Pressure gauge	
	$w_{CH4,y}$	Gas analyser	
Electricity	$EG_{BL,y}$ $EG_{PJ,add,y}$ $EG_{actual,y}$ EC_y	Electricity meters	
Flare	$FV_{RG,h}$	Flow meter	
	T_{flare}	Temperature gauge	
Thermal energy	$Q_{hot\ air}$; Q_{steam}	Flow meter	
	T	Temperature gauge	
	P	Pressure gauge	
	$EG_{thermal,y}$ $EG_{thermal,PJ,y}$ $EG_{thermal,actual,y}$	Steam tables will be used to calculate the enthalpy and standard thermodynamic equations will be used to calculate the quantity of thermal energy.	
Transport	$VF_{LE,cons}$ $Q_{LE,y}$; $CT_{LE,y}$; DAF_{LE}	Log book	Data will be manually recorded by the operational/administrational staff at the project site. Data will be transferred to a
	$D_{LE,fuel}$	Suppliers information	

Fossil fuel	$NCV_{LE,fuel,y}$ $EF_{LE,CO2,fuel}$	According to "Tool to calculate CO_2 emissions from fossil fuel"	spreadsheet, aggregated monthly and sent to the CME.
Fertilizer	$M_{SFi,y}$; $M_{OFj,y}$ NC_{SFi}; NC_{OFj}	Farm records	
Residual waste	f	SWDS records	CPA implementers shall gather information and supporting documentations from the SWDS manager and supply it to the CME on an annual basis.

3. Reporting and verification

- The CME will process data received from the CPA implementer and calculated emission reductions.
- The CME will compile the monitoring reports from all CPAs into one summary report
- The CME QC Manager will review the CPAs' monitoring reports.
- The DOE performs a desk review on the CPAs'monitoring reports.
- The CME provides an updated monitoring report in light of the DOE desk review findings.
- The DOE approves the final monitoring report
- For on-site assessment of CPAs, the DOE will implement the sampling procedure as described below:

Sampling plan:
All CPAs included in the PoA shall monitor 100% of the relevant parameters included in Section D.7.1. of the CPA-DD unless otherwise noted. Monitoring reports will be prepared separately for all CPAs, however only a statistically acceptable sample will be verified by the DOE.

The proposed sampling method is based on the multi-stage sampling approach. In multi-stage sampling, the population is divided into units, referred to as primary sampling units. The population in the primary units is again divided into smaller sub-units, referred to as secondary sampling units. Each CPA can be assigned to only one sample unit.

For this PoA, the primary sampling units will be the CPAs under a specific CPA implementer and the secondary sample units will be the different project scenarios. For each secondary sample unit a sample will be determined that will be subject to on-site verification.

For each secondary sample unit the size of the randomly selected samples will be defined to meet the 90/10 confidence interval level. In order to ensure transparency and representativeness of the sample chosen, the CPAs to be included in a sample will be chosen randomly by the DOE for each verification period. Since the number of CPAs included in the proposed PoA will evolve during the crediting period, the sampling selection process is to be recalculated for at each verification. All CPAs included in a sampling group will be subject to on-site verification.

4. Procedures for corrective actions in order to provide more accurate future monitoring

- The CME shall update the monitoring system to the necessary improvements/updates and include them in a new version of the PoA-DD and CPA-DD.
- The DOE validate the new monitoring system and submit it to the CDM Board for approval.
- Once changes have been approved by the Board, the monitoring of all new CPAs and existing CPAs shall be based on the updated monitoring system.

5. Emergency procedures for unintended methane emissions

- In the event where methane cannot be combusted in the engine due to engine failure or grid connection faults, all methane will be flared.
- All pressure relief valves will lead to the flare.
- The maintenance plan will include inspections for physical leakages.

6. Monitoring of data concerning environmental, social and economic impacts.

- According to the South African DNA, there is no formal agreement for monitoring data concerning sustainability development criteria, see correspondence from the DNA, (Ref.PoA.E.7).

Appendix 1: Contact information on entity/individual responsible for the PoA

Organization	Farmsecure Carbon (Pty) Ltd
Street/P.O. Box	350 Farm Wonderfontein, Minaar Street, Sasolburg, 1947 P.O. Box 1033, Vanderbijlpark, 1900, RSA
Building	-
City	Sasolburg
State/Region	=
Postcode	1947
Country	South Africa
Telephone	+27 (0) 16 970 8900/1/2
Fax	+27 (0) 16 970 8920
E-mail	isabelle.barnard@farmsecure.co.za
Website	www.fsenergy.co.za
Contact person	Isabelle Barnard
Title	Mrs
Salutation	-
Last name	Barnard
Middle name	-
First name	Isabelle
Department	-
Mobile	+27 (0) 83 657 8973
Direct fax	+27 (0) 86 677 1462
Direct tel.	-
Personal e-mail	-

B.

Appendix 2: Affirmation regarding public funding

Not applicable

Appendix 3: Application of methodology(ies)

Not applicable

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

The grid emission factor calculation

Application of the UNFCCC methodological tool: "Tool to calculate the emission factor for an electricity system" (UNFCCC tool version 02.2.1)

Step 1: Identify the relevant electricity systems
Step 2: Chose whether to include off-grid power plants in the project electricity system
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: Calculate the build margin (BM) Emission Factor
Step 6: Calculate the combined margin (CM) emission factor

Step 1: Identify the relevant electricity systems

This tool will serve project activities that will displace grid electricity in South Africa.

The **project electricity system** is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity and that can be displaced without significant transmission constraints.

Similarly, a **connected electricity system**, e.g. national or international, is defined as an electricity system that is connected by transmission lines to the project electricity system. Power plants within the connected electricity system can be dispatched without significant transmission constraints, but transmission to the project electricity system has significant transmission constraints.

The DNA of South Africa has not published a delineation of the project electricity system and connected electricity systems. Also, the application of the criteria with regards to determining significant transmission constraints does not result in a clear grid boundary due to a lack of sufficient data. For these reasons the following was chosen for the reference system of this project:

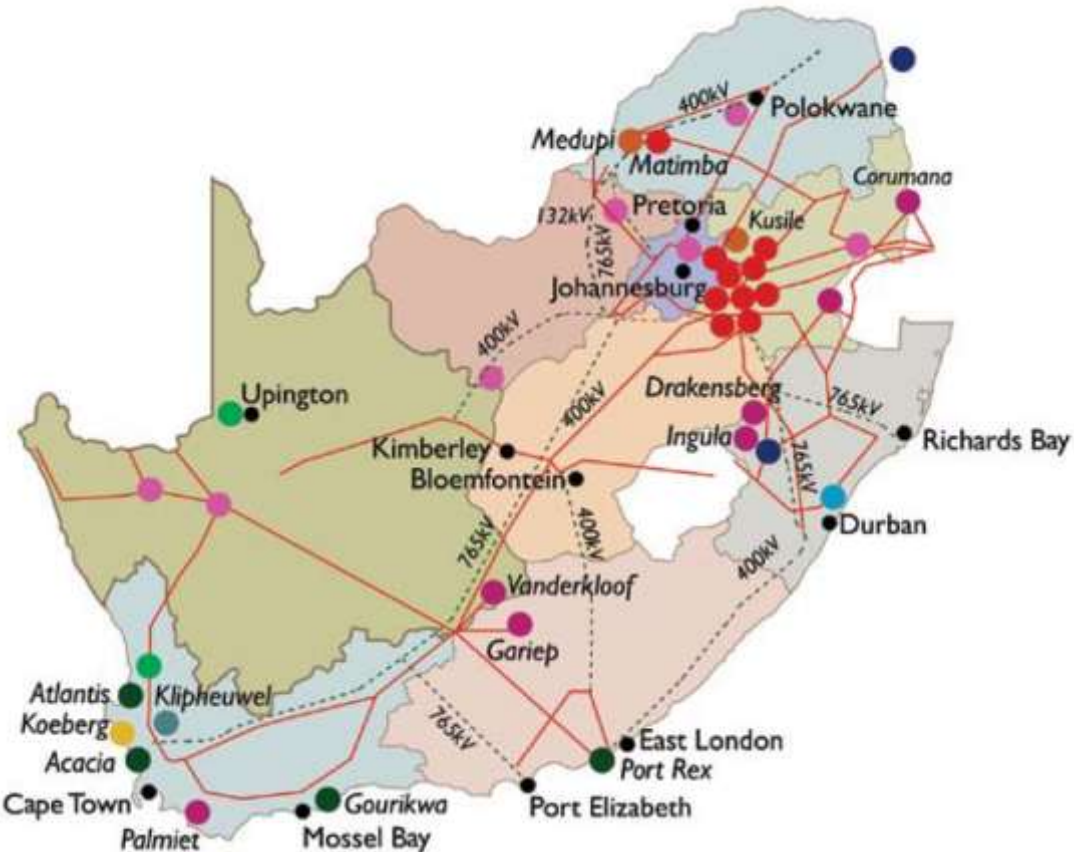
- The **project electricity system** entails all the Eskom power plants in the South African electricity grid.
- Due to a lack of data available in the public domain (in order to evaluate significant transmission constraints), all other power stations (non-Eskom) and countries with power grids connected to South Africa, are treated as **connected electricity systems**, and emission factors for imports from these systems are conservatively assumed to be 0 tCO_2/MWh.

All electricity generated by the Eskom power stations is taken into consideration when calculating the grid emission factor; exports are not subtracted.

All the data for the Eskom power stations are obtained from the Eskom website, where they have a specific webpage dedicated to CDM grid emission factor related data[2]. This data includes commissioning dates, electricity generated, and fuel consumed.

Data for the imported electricity are obtained from the Eskom annual report, where "*Total purchased for the Eskom system (GWh)*" is shown in the "*Statistical overview*" table on pg. 324 of the report[3].

[2] Eskom Holdings SOC Limited . (2011). *CDM Calculations*. Retrieved October 06, 2011, from Eskom: http://www.eskom.co.za/c/article/236/cdm-calculations/



Step 2: Chose whether to include off-grid power plants in the project electricity system

This step is optional according to the tool. The grid emission factor is calculated from only grid power plants (**Option I**). Off-grid power plants are not included in the calculations.

Step 3: Select a method to determine the operating margin (OM)

The OM is calculated using the **simple OM method (Option a)**. The simple OM method can be used provided that the low-cost/must-run resources constitute less than 50% of the total grid generation in average of the five most recent years.

The average percentage of low-cost/must-run resources amount to 0.00% of the total grid generation for this project electricity system. Therefore, Option (a) is applicable.

In terms of data vintages, the *ex ante* option were chosen to calculate the simple OM. In this option a 3 year generation-weighted average are used for the grid power plants. Using this option also means that the emission factor is determined only once at the validation stage, thus no monitoring and recalculation is required during the crediting period.

The data used in OM calculations are for the 3 year period of 1 April 2008 – 31 March 2011 (Eskom financial year runs from 1 April – 31 March). This is the latest available data.

Step 4: Calculate the operating margin emission factor according to the selected method

[3] Eskom Holdings SOC Limited. (2011). *Annual Report 2011.*

The simple OM emission factor ($EF_{grid,OMsimple,y}$) is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units. Hence, the hydro and nuclear power plants are excluded from the calculation of the OM.

Option A is used for calculating the simple OM. The calculations in this option are based on the total net electricity generation and a CO2 emission factor of each power plant.

Option A – Calculation based on average efficiency and electricity generation of each plant

Under this option, the simple OM emission factor is calculated based on the net electricity generation of each power plant and an emission factor of each power plant, as follows:

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

Where:

$EF_{grid,\ OMsimple,y}$	= 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 the 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 except low-cost/must-run power units
y	= The relevant year as per data vintage chosen in Step 3

Determination of $EF_{EL,m,y}$

The emission factor for each power plant *m* were determined as follows (**Option A1**):

$$EF_{grid,OMsimple,y} = \frac{\sum_i \left(FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y}\right)}{EG_y} \qquad \textbf{(6)}$$

Where:

$EF_{grid,\ OMsimple,y}$	= Simple operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
$FC_{i,y}$	= Amount of fossil fuel type *i* consumed in the project electricity system in year *y* (mass or volume unit)
$NCV_{i,y}$	= Net calorific value (energy content) fossil fuel type *i* in year *y* (GJ/mass or volume unit)
$EF_{CO2,i,y}$	= CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/GJ)
EG_y	= Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/must-run power plants/units, in year *y* (MWh)
i	= All fossil fuel types combusted in power sources in the project electricity system in year *y*
y	= The relevant year as per data vintage chosen in Step 3.

Electricity imports are treated as one power plant, as per the tool guidance.

The parameters used in calculations appear in Table 1.

Table 1: Constants used in calculations

Constants		
$NCV_{other\ bituminous\ coal,\ 2009}$ [4]	19.10	GJ/T
$NCV_{other\ bituminous\ coal,\ 2010}$ [5]	19.22	GJ/T
$NCV_{other\ bituminous\ coal,\ 2011}$ [6]	19.45	GJ/T
$NCV_{other\ kerosene}$ [7]	42.4	GJ/T
$EF_{CO2other\ bituminous\ coal}$ [8]	0.0895	tCO_2/GJ
$EF_{CO2,other\ kerosene}$ [9]	0.0708	tCO_2/GJ

The fuel used for coal power stations is other bituminous coal. In *"Eskom Fact Sheet – Formation of Coal"*[10] it is stated that coal in South Africa is "mostly classified as 'bituminous' coals". The article *"What is the carbon emission factor for the South African electricity grid? (Spaldin-Fecher, 2011)"*[11] also specifies the use of "other bituminous coal" as the fuel used in the Eskom power stations.

The fuel used for Acacia and Port Rex power stations is kerosene. This is stated in *"Eskom Fact Sheet – Port Rex and Acacia Power Stations"*[12]. Also, in the source data for electricity generation and fuel consumption the fuel consumption for these two power stations are specified in units of "liters kerosene/year"[13].

Using equation 6, the OM is calculated as **0.92** tCO_2e/MWh.

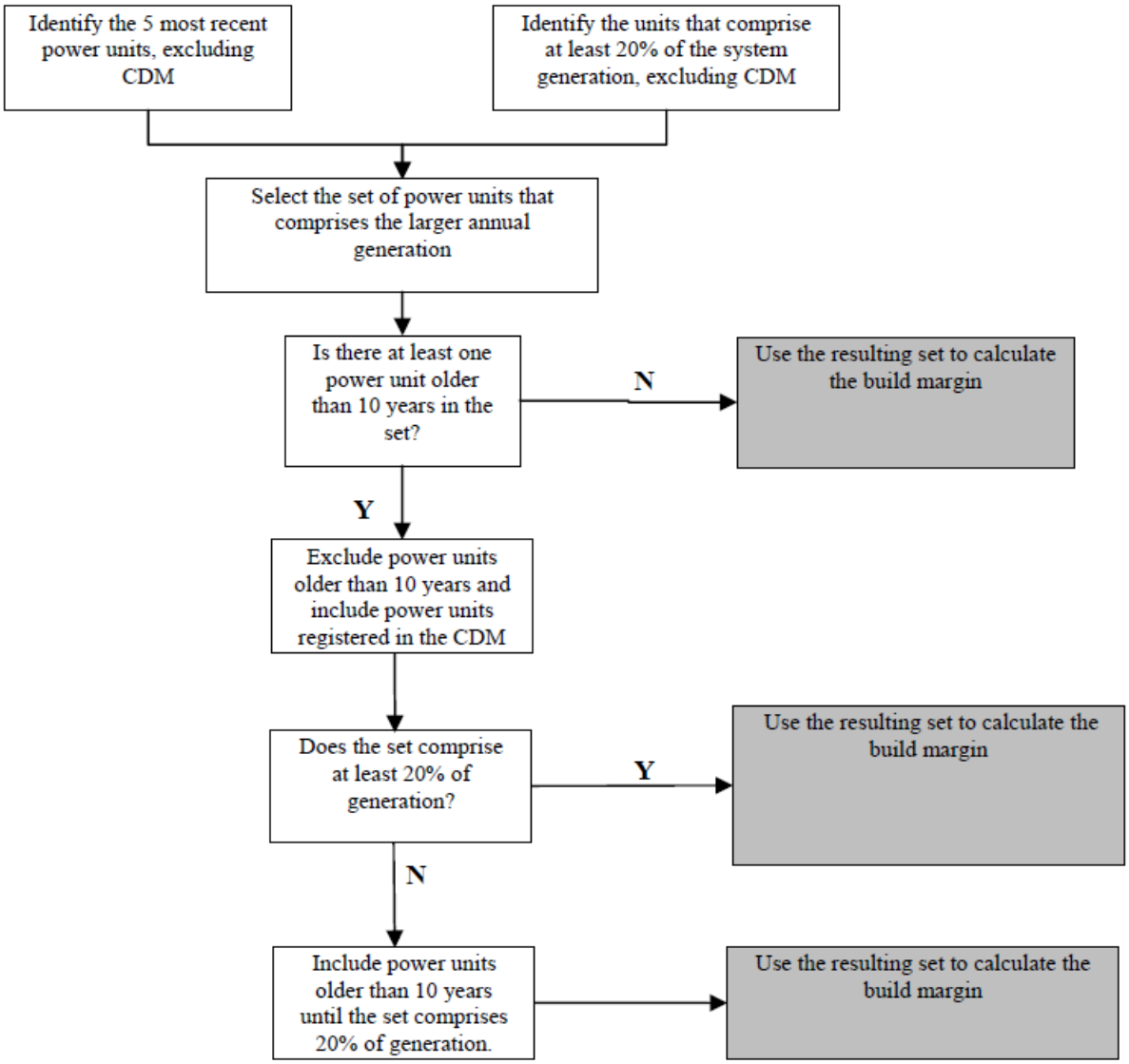
Step 5: Calculate the build margin (BM) Emission Factor

In terms of vintage of data, one **Option 1** was selected: For the first crediting period, calculate the build margin emission factor *ex ante* based on the most recent information available on units already built for sample group *m* at the time of CDM-PDD submission to the DOE for validation.

The sample group of power units *m* used to calculate the build margin were determined as per the procedure delineated in the tool, consistent with the data vintages selected.

The following diagram summarizes the procedure of identifying the sample group:

[4] Eskom Holdings SOC Limited. (2011). *Annual Report 2011.*
[5] Eskom Holdings SOC Limited. (2011). *Annual Report 2011.*
[6] Eskom Holdings SOC Limited. (2011). *Annual Report 2011.*
[7] IPCC, 2006
[8] IPCC, 2006
[9] IPCC, 2006
[10] http://recruitment.eskom.co/live/content.php?Category_ID=60
[11] Supplied to validators.
[12] http://www.eskom.co.za/content/GS_0001GasTurbAcaciaPortRexRev6~1~1.pdf
[13] Eskom Holdings SOC Limited . (2011). *CDM Calculations*. Retrieved October 06, 2011, from Eskom: http://www.eskom.co.za/c/article/236/cdm-calculations/



According to the above diagram, the only two power stations that are included in the build margin are Majuba (1996) and Kendal (1988). There is no power generation data available for power units registered in the CDM, therefore these could not be included. Majuba and Kendal comprises 23% of generation.

The sample group of power units m used to calculate the build margin is the resulting set **SETsample-CDM->10yrs**.

The build margin emissions factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units *m* during the most recent year *y* for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \qquad \textbf{(13)}$$

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/GJ)
m = Power units included in the build margin
y = Most recent historical year for which power generation data is available.

According to the tool: *If the power units included in the build margin m correspond to the sample group **SETsample-CDM->10yrs**, then, as a conservative approach, only option A2 from guidance in Step 4 (a) can be used and the default values provided in Annex 1 shall be used to determine the parameter* $\eta_{m,y}$. The CO_2 emission factor of each power unit m ($EL_{EL,m,y}$) should be determined as per the guidance in Step 4 (a) for the simple OM, using **Option A2**:

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \times 3.6}{\eta_{m,y}} \quad \textbf{(3)}$$

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 CO2 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 plants/units serving the grid in year y except low-cost/must-run power plants/units
i = All fossil fuel types combusted in power plant/unit m in year y
y = The relevant year as per data vintage chosen in Step 3.

The default value for $\eta_{m,y}$ for the coal power stations in the BM were obtained from Annex 1 of the tool. The value used is 37%.

Using equation 13, the BM is calculated as **0.87** tCO_2e/MWh.

Step 6: Calculate the combined margin (CM) emission factor

The combined margin factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM} \quad \textbf{(14)}$$

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 (%)

The emission factors for the final combined margin appear in Table 8.

Table 1: CM emission factor

	w_{OM}	w_{BM}	**Combined Margin Emission Factor**
Wind and solar power generation project activities for the first crediting period and for subsequent crediting periods.	0.75	0.25	**0.91**

All other projects for the first crediting period.	0.5	0.5	**0.90**
All other projects for the second and third crediting period.	0.25	0.75	**0.88**

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Eskom Holdings SOC Limited . (2011). *CDM Calculations*. Retrieved October 06, 2011, from Eskom: http://www.eskom.co.za/c/article/236/cdm-calculations

Eskom Holdings SOC Limited. (2011). *Annual Report 2011*

Appendix 5: Further background information on the monitoring plan

Not applicable

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History of the document

Version	Date	Nature of revision(s)
02.0	EB 66 13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the programme design document form for small-scale CDM programmes of activities" (EB 66, Annex 13).
01	EB33, Annex43 27 July 2007	Initial adoption.
Decision Class: Regulatory **Document Type:** Form **Business Function:** Registration		