CLEAN DEVELOPMENT MECHANISM
SMALL-SCALE PROGRAMME OF ACTIVITIES DESIGN DOCUMENT FORM
(CDM-SSC-PoA-DD) Version 01

CONTENTS

Annexes

NOTE:

(i) This form is for the submission of a CDM PoA whose CPAs apply a small scale approved methodology.

(ii) At the time of requesting registration this form must be accompanied by a CDM-SSC-CPA-DD form that has been specified for the proposed PoA, as well as by one completed CDM-SSC-CPA-DD (using a real case).

SECTION A. General description of small-scale programme of activities (PoA)

A.1 Title of the small-scale programme of activities (PoA):

Anaerobic Digestion and Renewable Energy Generation in South Africa.

Version 1
Date:22 August 2011

A.2. Description of the small-scale programme of activities (PoA):

1. General operating and implementing framework of PoA

The programme of activities, 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 fulfilling 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 soil to shelf.

This led 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 greenhouse gas (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 coordinating/managing entity (CME) of the PoA. Farmsecure Carbon will have overall responsibility for the PoA and the subsequent preparation and implementation of SSC-CPAs.

2. Policy/measure or stated goal of the PoA

The programme will involve renewable energy generation through anaerobic digestion and biogas-based energy generation. Greenhouse gas emission reductions can accrue from one of the following activities:

a) Project activities that install biomass thermal energy plants that produce renewable thermal energy for on-site consumption or for consumption by other facilities.
b) Project activities that install biomass cogeneration plants that produce electricity for supply to the grid or for captive use and/or thermal energy for on-site consumption or for consumption by other facilities.
c) Project activities that involve the addition of renewable energy units at an existing renewable energy production facility.

Some projects will also involve methane recovery from biomass that would otherwise have been left to decay anaerobically, thereby further mitigating GHG.

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 project will contribute to sustainable development in South Africa through supporting the development of renewable energy in the county and assisting South Africa to achieve the renewable energy target[1] of 10000 GWH of renewable energy contribution to the country's energy consumption by 2013.

The programme fulfils the national sustainability development criteria[2] 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.

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 waste management systems (animal waste management systems and solid waste disposal sites). 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:

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[1] White Paper on Renewable Energy, Republic of South Africa, November 2003, available under: http://www.energy.gov.za/files/policies_frame.html

[2] Sustainable development criteria for approval of clean development mechanism projects by the designated national authority of the CDM, 2004, Department of energy, p. 3, available under: http://www.dme.gov.za/dna/pdfs/sustainable_criteria.pdf

- 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.
- In addition the CME will be in charge of marketing the Certified Emission Reductions (CERs) created from the project and thus ensure that this process is managed optimally.

3. Confirmation that the proposed PoA is a voluntary action by the coordinating/managing entity.

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, the CPA implementer and the CPA participant, are voluntarily participants in the PoA.

A.3. Coordinating/managing entity and participants of SSC-POA:

The coordinating/managing entity for this PoA will be Farmsecure Carbon (Pty) Ltd.

The detail of the project participants are listed below:

Party involved	Private or public entity	Does the party involved want to be considered as a project participant (Yes/No)
Republic of South Africa	Farmsecure Carbon (Pty) Ltd (private entity)	No

A.4. Technical description of the small-scale programme of activities:

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A.4.1. Location of the programme of activities:

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A.4.1.1. Host Party(ies):

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Republic of South Africa.

A.4.1.2. Physical/ Geographical boundary:

All SSC-CPAs associated with this PoA will be implemented within the geographical boundary of South Africa.

A.4.2. Description of a typical small-scale CDM programme activity (CPA):

A.4.2.1. Technology or measures to be employed by the SSC-CPA:

The programme will involve renewable energy generation through anaerobic digestion and biogas-based energy generation. SSC-CPAs under the PoA will need to apply a methane avoidance methodology, AMS-III.AO or AMS-III.D, and the renewable energy methodology, AMS-I.C.

Methane avoidance methodology (AMS-III.AO or AMS-III.D):
All projects using anaerobic digestion technology (equipped with biogas recovery and combustion/flaring systems) need to apply a methane avoidance methodology for the purpose of calculating methane project emissions. Projects using biomass that would otherwise have been left to decay anaerobically in animal waste management systems (AWMS) and solid waste disposal sites (SWDS) may also use this methodology to claim methane emission reduction. One of the following methane avoidance methodologies should be applied to each SSC-CPA:

- Methodology AMS-III.D applies under the following condition:
  a) Digestion of manure from AWMS as a single source of substrate, where this organic matter would otherwise have been left to decay anaerobically.
- Methodology AMS-III.AO applies under the following conditions:
  a) Digestion of waste from SWDS as a single source of substrate, where this organic matter would otherwise have been left to decay anaerobically.
  b) Co-digestion of waste from SWDS and manure from AWMS, where this organic matter waste would otherwise have been left to decay anaerobically.
  c) Digestion of substrates for which it cannot be demonstrated that the biomass would otherwise been left to decay anaerobically. Baseline emissions related to such biomass shall be accounted for as zero, whereas project emissions shall be calculated for all substrates.

The above mentioned conditions result in the following distinct substrate streams that may be used as a single source or in combination:

1. *Different waste types (WT) from SWDS:* Waste from SWDS that would otherwise have been left to decay anaerobically. Baseline methane emission for this substrate stream will be calculated.
2. *Different biomass types (BT):* Other renewable biomass (conditions in Annex 18, EB23 must apply). Baseline emissions for this substrate steam shall be accounted for as zero.
3. *Manure from different livestock types (LT):* Manure from AWMS that would otherwise have been left to decay anaerobically. Baseline methane emission for this substrate stream will be calculated.

Renewable energy methodology (AMS-I.C)
Biogas will be use as a fuel in a renewable energy facility in order to achieve one of the following project activities, applying methodology AMS-I.C:

a) Project activities that install biomass thermal energy plants that produce renewable thermal energy for on-site consumption or for consumption by other facilities.
b) 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.
c) Project activities that involve the addition of renewable energy units at an existing renewable energy production facility.

The technology to be adopted by the project activity comprise the following basic components:

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
- biogas engine(s) or turbine to combust the biogas and generate electricity and thermal energy
- a enclosed 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 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.4.2.2. Eligibility criteria for inclusion of a SSC-CPA in the PoA:

The eligibility criteria for the inclusion of a SSC-CPA in a PoA are as follows:

1. All SSC-CPAs are located in the geographical boundary of South Africa.
2. All participants are voluntarily taking part in the programme and the agreement signing date with the SSC-CPA developer, is prior to the project activity implementation.
3. Each SSC-CPA shall be uniquely identified and defined in an unambiguous manner by providing geographic information, and the exact start and end date of the crediting period.
4. Each SSC-CPA will use a proven anaerobic digestion technology and energy generation technology.
5. Each SSC-CPA will involve a renewable energy project activity from renewable biomass and implement methodology AMS-I.C. Renewable biomass must comply to conditions in Annex 18, EB 23 and
6. Leakage will be calculated according to Attachment C to Appendix B.
7. The renewable energy project activity must be one of the following:
    a) Project activities that install a biomass thermal energy plant that produce renewable thermal energy for on-site consumption or for consumption by other facilities.

b) Project activities that install a biomass cogeneration plant that produce electricity for supply to the grid or for captive use and thermal energy for on-site consumption or for consumption by other facilities.
c) Project activities that involve the addition of renewable energy units at an existing renewable energy production facility.

8. Each SSC-CPA will implement methane avoidance methodology AMS-III.AO or AMS-III.D for the purpose of calculating methane project emissions.
9. SSC-CPAs that use biomass that would otherwise have been left to decay anaerobically in animal waste management systems (AWMS) and solid waste disposal sites (SWDS) may also use methodology AMS-III.D or methodology AMS-III.AO to claim methane emission reductions. Methane emission reductions from wastewater treatment systems (WWTS) do not form part of this PoA.
10. In each SSC-CPA the residual waste from the digestion shall be handled aerobically and therefore methodology AMS-III.H is not applicable to residual waste.
11. Each SSC-CPA must comply with the applicability conditions of the chosen methodologies, see section E.2.

A.4.3. Description of how the anthropogenic emissions of GHG by sources are reduced by a SSC-CPA below those that would have occurred in the absence of the registered PoA (assessment and demonstration of additionality):

There are no regulations in South Africa that require the implementation of renewable energy projects or methane recovery in AWMS and SWDS. All the key players, including the CME, the project implementers and the project participants, are voluntarily participants in the PoA.

Methane recovery and energy generation from biomass could not be successfully implemented in the past due to high investment cost compared the normal practice and the lack of technical skills to design and operate the systems. Without the PoA to provide additional financial incentives, and project implementers to provide the technical skills and financing (where necessary), the potential participants would not be interested in pursuing such projects.

Many of the potential participants in South Africa are too small to individually take part in the CDM process. The small quantity of potential Certified Emission Reductions (CER's) is not enough to justify the effort and cost associated with the standard small scale CDM process. Through the PoA, the CME hopes to reduce validation, registration and verification cost per SSC-CPA and in this way enable the inclusion of small to medium sized project in the CDM process.

A.4.4. Operational, management and monitoring plan for the programme of activities (PoA):

A.4.4.1. Operational and management plan:

(i) A record keeping system for each CPA under the PoA:

The CME of this program will be responsible for the required monitoring system and record keeping system for each SSC-CPA. The CME will write a monitoring manual, describing the operative procedures for measurements, handling, saving and storage of the data and back-ups. The CME will train the monitoring operators and verify the correct application of the operative procedures.

(ii) A system/procedure to avoid double accounting e.g. to avoid the case of including a new CPA that has been already registered either as a CDM project activity or as a CPA of another PoA:

Each SSC-CPA is identified with a unique identification number to ensure single counting in the PoA. In addition to the identification number, all of the SSC-CPAs will have a geographic location reference (latitude and longitude) stored in the system.

The CME is responsible for the baseline assessment and verification of each SSC-CPA's eligibility, hence, the CME is also responsible for verifying that a new SSC-CPA has not been already registered. The UNFCCC's website will be consulted prior to the inclusion of the SSC-CPA to confirm that the project has not been registered either as CDM project activity or as a SSC-CPA of another PoA.

(iii) The SSC-CPA included in the PoA is not a de-bundled component of another CDM programme activity (CPA) or CDM project activity:

According to paragraph 8 of Annex 13/EB54 "Guidance for determining the occurrence of debundling under a Programme of Activities", a proposed SSC-CPA of a PoA shall be deemed to be a de-bundled component of a large scale activity if there is already an activity, which satisfies both conditions (a) and (b) below:

a) Has the same activity implementer as the proposed SSC-CPA or has a coordinating or managing entity, which also manage a large scale PoA of the same technology/measure and;
b) The boundary is within 1 km of the boundary of the proposed SSC-CPA, at the closest point.

The CME will evaluate these conditions for each SSC-CPA and SSC-CPAs meeting any of these criteria will not be included in the PoA.

(iv) The provisions to ensure that those operating the CPA are aware of and have agreed that their activity is being subscribed to the PoA;

Prior to the inclusion of a SSC-CPA in the proposed PoA, agreements will be signed between the CME and the CPA participant.

A.4.4.2. Monitoring plan:

The sampling random method to be applied in verification by the DOE's is suggested as 10% in each round of verification.

A.4.5. Public funding of the programme of activities (PoA):

No public funding will be used for the implementation of the PoA.

SECTION B. Duration of the programme of activities (PoA)

B.1. Starting date of the programme of activities (PoA):

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Starting date is the projected PoA registration date: 01/08/2012

B.2. Length of the programme of activities (PoA):

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The length of the PoA is 28 years.

SECTION C. Environmental Analysis

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C.1. Please indicate the level at which environmental analysis as per requirements of the CDM modalities and procedures is undertaken. Justify the choice of level at which the environmental analysis is undertaken:

1. Environmental Analysis is done at PoA level ☐
2. Environmental Analysis is done at SSC-CPA level √

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.

C.2. Documentation on the analysis of the environmental impacts, including transboundary impacts:

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C.3. Please state whether in accordance with the host Party laws/regulations, an environmental impact assessment is required for a typical CPA, included in the programme of activities (PoA),:

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The host Party do require an environmental impact assessment for a typical SSC-CPA and these regulations require an analysis for each possible project. This is consistent with the Republic of South Africa's Environmental Impact Assessment EIA Regulations (Government Notice R.543 in Government Gazette 33306 of 18 June 2010)[3].

SECTION D. Stakeholders' comments

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D.1. Please indicate the level at which local stakeholder comments are invited. Justify the choice:

1. Local stakeholder consultation is done at PoA level ☐
2. Local stakeholder consultation is done at SSC-CPA level √

Local consultation is done at SSC-CPA level to ensure full participation and consultation of local stakeholders in the PoA. A local stakeholder consultation will be conducted for every SSC-CPA.

D.2. Brief description how comments by local stakeholders have been invited and compiled:

Local stakeholders will be invited at the SSC-CPA level to participate in a stakeholder meeting, and feedback will be solicited with the comments considered in the design and implementation of the project. Invitation will be through public notice in the local newspaper, posting of notice at and around the surrounding properties plus mailing to adjacent residents. Moreover we would also send written invitations to the municipal council of the nearby community and other interested parties and NGOs. These will be documented in each SSC-CPA.

[3]Government Notice R.543 in Government Gazette 33306 of 18 June1010, available under: http://www. environment.co.za/environmental-laws-and-legislation-in-south-africa

D.3. Summary of the comments received:

Comments received on the different SSC-CPAs are documented in the SSC-CPA-DD files.

D.4. Report on how due account was taken of any comments received:

Clarifications following comments received on the different SSC-CPA are documented in the SSC-CPA.

SECTION E. Application of a baseline and monitoring methodology

E.1. Title and reference of the approved SSC baseline and monitoring methodology applied to a SSC-CPA included in the PoA:

Each SSC-CPA will implement the methane avoidance methodology AMS-III.AO or AMS-III.D and the renewable energy methodology AMS-I.C.

Methodology AMS-III.AO: Methane recovery through controlled anaerobic digestion, version 1.
Methodology AMS-III.D: Methane recovery in animal manure management system, version 17.
Methodology 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 for the demonstration and assessment of additionality, version 5.2
Tool to calculate project or leakage CO2 emissions from fossil fuel combustion, version 2
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 to determine the baseline efficiency of thermal or electric energy generation systems, version 2.2.0.

E.2. Justification of the choice of the methodology and why it is applicable to a SSC-CPA:

Methodology AMS-III.AO and AMS-III.D:

All SSC-CPAs that introduce controlled biological treatment of biomass through anaerobic digestion in closed reactors equipped with biogas recovery and combustion/flaring system, need to apply a methane avoidance methodology for the purpose of calculating methane project emissions. Projects that use biomass that would otherwise have been left to decay anaerobically in animal waste management systems (AWMS) and solid waste disposal sites (SWDS) may also use this methodology to claim methane avoidance. One of the following methane avoidance methodologies may be applied to each SSC-CPA:

a) Methodology AMS-III.D applies to project activities treating waste from AWMS as single source substrate.
b) Methodology AMS-III.AO applies under the following conditions:
    a) Digestion of waste from SWDS as a single source of substrate, where this organic matter would otherwise have been left to decay anaerobically.
    b) Co-digestion of waste from AWMS and SWDS, where this organic matter waste would otherwise have been left to decay anaerobically.
    c) Digestion of substrates for which it cannot be demonstrated that the organic matter would otherwise been left to decay anaerobically. Baseline emissions related to such biomass shall be accounted for as zero, whereas project emissions shall be calculated for all substrates.

For project activities that claim methane avoidance, the baseline scenario would mean the ongoing use of the existing anaerobic waste management systems (AWMS and/or SWDS). In these systems, the biogas generated during the degradation process is released directly to the atmosphere. This biogas contains a large fraction of CH_4 which is a powerful GHG (21 times the global warming potential of CO_2). In the project scenario, the same fundamental biological anaerobic processes will be employed, albeit in a closed, digester configuration. In this system, the produced biogas can be easily collected and used for energy generation. This prevents the release of CH_4 to the atmosphere. The combustion of biogas converts CH_4 to CO_2. The CO_2 emitted from biogas combustion is considered to be of biogenic origin and thus is excluded from project emissions as this does not constitute a change in carbon stocks.

Methodology AMS-III.AO and AMS-III.D is applicable since SSC-CPAs will reduce anthropogenic emissions by sources, directly emit less than 15ktCO2e annually and result in emissions reduction lower than or equal to 60ktCO2e annually.

The project is eligible to use small-scale methodology AMS-III.AO or AMS-III.D if it meets all the applicability conditions. Each SSC-CPA will be evaluated against the stipulated applicability conditions described in Table E.2.a for methodology ASM-III.AO and Table E.2.b for methodology ASM-III.D.

Table E.2.a Applicability Conditions for AMS-III.AO

1. This methodology comprises measures to avoid the emissions of methane to the atmosphere from biomass or other organic matter that would have otherwise been left to decay anaerobically in a solid waste disposal site (SWDS), or in an animal waste management system (AWMS), or in a wastewater treatment system (WWTS). In the project activity, controlled biological treatment of biomass or other organic matters is introduced through anaerobic digestion in closed reactors equipped with biogas recovery and combustion/flaring system. The following conditions apply: (a) Digestion of biomass or other organic matter (excluding animal manure and sludge generated in the wastewater treatment works) as a single source of substrate is included; (b) Co-digestion of multiple sources of biomass substrates, e.g. MSW, organic waste, animal manure, wastewater, where those organic matters would otherwise have been treated in an anaerobic treatment system without biogas recovery is also eligible; (c) If for one or more sources of substrates, it cannot be demonstrated that the organic matter would otherwise been left to decay anaerobically, baseline emissions related to such organic matter shall be accounted for as zero, whereas project emissions shall be calculated according to the procedures presented in this methodology for all co-digested substrates; (d) Project participants shall apply the procedures related to the "competing use for the biomass" according to the latest "General guidance on leakage in biomass project activities"; (e) Project activities treating animal manure as single source substrate shall apply AMS-III.D "Methane recovery in animal manure management systems", similarly projects only treating wastewater and/or sludge generated in the wastewater treatment works shall apply AMS-III.H "Methane recovery in wastewater treatment"; (f) The project activity does not recover or combust landfill gas from the disposal site (unlike AMS-III.G "Landfill methane recovery"), and does not undertake controlled combustion of the waste that is not treated biologically in a first step (unlike AMS-III.E "Avoidance of methane production from decay of biomass through controlled combustion, gasification or mechanical/thermal treatment"). Project activities that recover biogas from wastewater treatment shall use methodology AMS-III.H.
2. Measures are limited to those that result in emission reductions of less than or equal to 60 kt CO_2 equivalent annually.
3. The location and characteristics of the disposal site of the biomass used for digestion in the baseline condition shall be known, in such a way as to allow the estimation of its methane emissions.

4. The project participants shall clearly define the geographical boundary of the region referred to in 3(b), and document it in the CDM-PDD. In defining the geographical boundary of the region, project participants should take into account the source of waste, i.e. if waste is transported up to 50 km, the region may cover a radius of 50 km around the project activity. In addition, it should also consider the distances to which the final product after digestion will be transported. In either case, the region should cover a reasonable radius around the project activity that can be justified with reference to the project circumstances but in no case it shall be more than 200 km. Once defined, the boundary should not be changed during the crediting period(s).
5. In case residual waste from the digestion is handled aerobically and submitted to soil application, the proper conditions and procedures (not resulting in methane emissions) for storage and transportation and soil application must be ensured.
6. In case residual waste from the digestion is treated thermally/mechanically, the provisions in AMS-III.E related to thermal/mechanical treatment shall be applied.
7. In case residual waste from the digestion is stored under anaerobic conditions and/or delivered to a landfill, emissions from the residual waste shall to be taken into account and calculated as per the latest version of the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site”.
8. In case the outflow from the digestion is discharged to a subsequent wastewater treatment system or to the natural water receiving body, relevant procedure in AMS-III.H shall be followed to estimate the resultant project emissions.
9. Technical measures shall be used to ensure that all biogas captured from the digester is combusted/flared.

Table E.2.b. Applicability conditions for AMS-III.D

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; (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.
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.
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". Project activities involving co-digestion of animal manure and other organic matters shall use the methodology AMS-III.AO "Methane recovery through controlled anaerobic digestion".
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.
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".
6. 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".
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.

<u>Methodology AMS-I.C:</u>

Methodology AMS-I.C is applicable to a SSC-CPA since the project activity will supply thermal energy with or without electricity derived from renewable biomass. The installed capacity of the energy plant will fall within the eligibility limit for small-scale CDM project activities.

The project is eligible to use small-scale methodology AMS-I.C if it meets all the applicability conditions. Each SSC-CPA will be evaluated against the stipulated applicability conditions described in Table E.2.c.

Table E.2.c Applicability Conditions for AMS-I.C

1. This category 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.
2. Biomass-based co-generating systems that produce heat and electricity are included in this category. For the purpose of this methodology "Cogeneration" shall mean the simultaneous generation of thermal energy and electrical and/or mechanical energy in one process. For example the project activity that produces heat and power in separate element processes (for example, heat from a boiler and electricity from biogas engine) does not fit under the definition of co-generation project.
3. Emission reductions from a 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).
4. The total installed/rated thermal energy generation capacity of the project equipment is equal to or less than 45 MW 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.
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 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 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 thermal energy component), the total installed electrical energy generation capacity of the project equipment of the cogeneration unit shall not exceed 15 MW.
7. In case electricity and/or steam/heat produced by the project activity is delivered to 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 specifying that only the facility generating the energy can claim emission reductions from the energy displaced.
8. Project activities that seek to retrofit or modify an existing facility for renewable energy generation are included in this category.
9. 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 3 to 5 and should be physically distinct from the existing units.
10. Charcoal based biomass energy generation project activities are eligible to apply the methodology only if the charcoal is produced from renewable biomass sources provided: (a) Charcoal is produced in kilns equipped with methane recovery and destruction facility; or (b) If charcoal is produced in kilns not equipped with a methane recovery and destruction facility, methane emissions from the production of charcoal shall be considered. These emissions shall be calculated as per the procedures defined in the approved methodology AMS-III.K. Alternatively, conservative emission factor values from peer reviewed literature or from a registered CDM project activity can be used, provided that it can be demonstrated that the parameters from these are comparable e.g., source of biomass, characteristics of biomass such as moisture, carbon content, type of kiln, operating conditions such as ambient temperature.
11. 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 emissions reduction calculation.

E.3. Description of the sources and gases included in the SSC-CPA boundary

The project boundary is the physical, geographical site:

(a) Where the solid waste (including animal manure, where applicable) 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) Where biogas is burned/flared or gainfully used, including biogas sale points, if applicable, the boundary also extends to the industrial, commercial or residential facility, or facilities, consuming energy generated by the system and the processes or equipment that is affected by the project activity.

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

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 waste in SWDS and/or AWMS	CO_2	Excluded	CO_2 emissions from the decomposition of organic waste are not accounted
		CH_4	Included	A potential major source of emissions where projects use biomass that would otherwise have been left to decay anaerobically
		N_2O	Excluded	N_2O emissions are small compared to CH_4 emissions from SWDS/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 form 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 biomass 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	CO_2	Excluded	Excluded for simplification. This emission source is assumed to be very small

	Source	Gas		Justification / Explanation
	manure before being fed into the anaerobic digester	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 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

E.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

The latest version of "Tool for the demonstration and assessment of additionality (version 5.2), has been applied to identify the credible and realistic alternatives that are consistent with the current laws and regulations. Application of Step 1a and Step 1b and the conclusions are given below:

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

Sub-step 1a: Define alternatives to the project activity:

Alternatives to the Solid Waste Disposal Site project activity

To identify the most plausible Solid Waste Disposal Site (SWDS) baseline scenario, realistic and credible alternatives to the proposed CDM project activity must be identified, taking into account the following alternatives:

Alternative 1: The project activity (anaerobic digestion of waste) not implemented as a CDM project.
The project activity is not a financially viable option and faces various operational and technical barriers that have been detailed in Section E.5.1. Therefore, the project activity cannot be implemented without CDM funds and technical skills from the project implementer.

Alternative 2: Disposal of the waste at a landfill where landfill gas captured is flared.
The practice where landfill gas is captured and flared is not commonly implemented in South Africa. This is due to low penetration of the technology in the market and lack of available funds to explore the technology. Therefore this alternative is not a credible and realistic alternative for the project activity and hence not a plausible baseline scenario.

Alternative 3: Disposal of the waste on a landfill or stockpile without the capture of landfill gas.
In the absence of the project activity, waste would be disposed in a landfill sites or stockpile without capturing the gas. Continuation of the current practice does not violate any regulations in South Africa. This is also the current practice and therefore a plausible baseline scenario.

Alternatives to the Animal Waste Management System project activity

To identify the most plausible Animal Waste Management System (AWMS) baseline scenario, realistic and credible alternatives to the proposed CDM project activity must be identified, taking into account the complete set of possible manure management systems listed in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Chapter 10, Table 10.18). The possible AWMS is divided in a list of unlikely and plausible scenarios and from these the most plausible baseline scenario is identified.

The possible AWMS are:
- Pasture/Range/Paddock
- Daily spread
- Burned for fuel
- Solid Storage
- Dry Lot
- Liquid/Slurry
- Pit Storage below animal confinements
- Deep Bedding
- Composting
- Poultry manure with litter
- Aerobic Treatment
- Uncovered Anaerobic Lagoon
- Anaerobic Digester

The following livestock farms will be analysed:
- Piggeries and dairies (very similar AWMS practises)
- Cattle feedlot
- Poultry farms

Piggeries and dairies:
In South Africa, the waste from most piggeries and dairies has a low solid content due to the standard practice of washing and flushing the barns. This practise result in a high volume of waste with a low solid content.

Unlikely baseline scenarios for piggeries and dairies are:
- ***Pasture/range/paddock*:** Methodology AMS-III.D is only applicable where the livestock population on the farm is managed under confined conditions. Therefore, this system is not applicable.

- ***Daily spread***: It is highly labour intensive to remove the manure on a daily basis for a large piggery/dairy. Therefore, this system is unattractive from an economic viewpoint and therefore an unlikely baseline scenario.
- ***Burned for fuel***: It t is highly energy intensive to dry manure with a low solid content before using it as fuel. Therefore, this system is unattractive from an economic viewpoint and therefore an unlikely baseline scenario.
- ***Solid storage***: Not applicable for manure with a low solid content.
- ***Dry lot***: Not applicable for manure with a low solid content.
- ***Liquid/Slurry***: It is highly labour intensive to remove manure on a daily basis from a large piggery/dairy for storage in tanks or earthen ponds. Therefore, it is unrealistic to implement such a AWMS for this project.
- ***Deep Bedding***: Not applicable for manure with a low solid content.
- ***Composting***: These systems are not applicable for waste with a low solid content. For these reasons, it is excluded from the list of plausible scenarios.
- ***Aerobic treatment:*** It is considered uncommon AWMS because of high investment and operating costs . Therefore, this system is unattractive from an economic viewpoint and therefore an unlikely baseline scenario.
- ***Anaerobic digester***: This AWMS has clear economic barriers since it involves significant investment costs. It also has higher operation and maintenance costs and is more labour intensive than the current practice. The anaerobic digester system is not a financially attractive project without the income from the CDM due to its high costs. Therefore, it is not a realistic and credible alternative. Further details of the investment analysis are presented in section E.5.1.

Plausible baseline scenarios for piggeries and dairies:

- ***Uncovered anaerobic lagoon***: This is the current AWMS at most of the project sites. There are no investment or technological barriers related to this AWMS since continued operations are guaranteed without any modifications of the existing systems. There is also no regulation obligating the project participant to change to another practice, therefore the existing uncovered anaerobic lagoon is a very likely scenario.
- ***Pit storage below animal confinement:*** This system is usually combined with anaerobic lagoons. Manure is kept in the deep pit for some time and then flushed to the anaerobic lagoons. In this case the pit storage will be the treatment stage 1 and the anaerobic lagoons will be treatment stage 2.

As shown in this analysis, the most plausible scenario in absence of the project activity would be the uncovered anaerobic lagoons which may be combined with pit storage below animal confinement.

Cattle feedlots:
Unlikely baseline scenarios for cattle feedlots:

- ***Pasture/range/paddock***: Methodology AMS-III.D is only applicable where the livestock population on the farm is managed under confined conditions. Therefore, this system is not applicable.
- ***Daily spread:*** It is highly labour intensive to remove manure on a daily basis from a large cattle feedlot. Therefore, this system is unattractive from an economic viewpoint and therefore an unlikely baseline scenario.
- ***Burned for fuel:*** In the burning process the fertilizer value in manure is lost to the farmer due to the fact that all Nitrogen is volatilized and the final ash product containing Potassium and Phosphorus is unsuitable for field application. Therefore, this system is unattractive from an agronomic viewpoint and therefore an unlikely baseline scenario.

- ***Liquid/Slurry:*** It is highly labour intensive to remove manure on a daily basis from a large cattle feedlot for storage in tanks or earthen ponds. Therefore, it is unrealistic to implement such an AWMS for this project.
- ***Pit storage below animal confinement:*** This system is typically only applicable to piggeries and dairies under South African conditions. Therefore it is unrealistic to implement such an AWMS for this project.
- ***Deep Bedding:*** This system may be combined with a dry lot but is uncommon practice in South Africa.
- ***Composting:*** These systems need considerable land surface and are highly labour intensive. Therefore, this system is unattractive from an economic viewpoint and therefore an unlikely baseline scenario.
- ***Aerobic treatment:*** In South Africa it is uncommon practice to use washing and flushing systems in cattle feedlots. Therefore it is very unlikely that manure will be collected as a liquid and treated aerobically.
- ***Uncovered anaerobic lagoon:*** In South Africa it is uncommon practice to use washing and flushing systems in cattle feedlots. Therefore it is very unlikely that manure will be collected as a liquid and treated in anaerobic lagoons.
- ***Anaerobic digester*:** This AWMS has clear economic barriers since it involves significant investment costs. It also has higher operation and maintenance costs and is more labour intensive than the current practice. The anaerobic digester system is not a financially attractive project without the income from the CDM due to its high costs. Therefore, it is not a realistic and credible alternative. Further details of the investment analysis are presented in section E.5.1.

Plausible baseline scenarios for cattle feedlots:

- ***Dry lot and Solid storage:*** In this system, manure is left to accumulate in the Dry lot and periodically removed and put into Solid storage until it is used as fertilizer. This is the current AWMS at most of the project sites. There are no investments or technological barriers related to this AWMS since continued operations are guaranteed without any modifications of the existing systems. There is also no regulation obligating the project participant to change to another practice, therefore the existing AWMS is a very likely scenario.

As shown in this analysis, the most plausible scenario in absence of the project activity would be the Dry lot and Solid storage system. These systems do not emit large amounts of GHG’s but still need to be taken into account where the manure is used in renewable energy projects.

Poultry farms:
Unlikely baseline scenarios for poultry farms:

- *P**asture/range/paddock***: Methodology AMS-III.D is only applicable where the livestock population in the farm is managed under confined conditions. Therefore, this system is not applicable.
- ***Daily spread:*** It is highly labour intensive to remove manure on a daily basis from a large poultry farm. Therefore, this system is unattractive from an economic viewpoint and therefore an unlikely baseline scenario.
- ***Burned for fuel:*** In the burning process the fertilizer value in manure is lost to the farmer due to the fact that all Nitrogen is volatilized and the final ash product containing Potassium and Phosphorus is unsuitable for field application. Therefore, this system is unattractive from an agronomic viewpoint and therefore an unlikely baseline scenario.

- ***Liquid/Slurry:*** It is highly labour intensive to remove manure on a daily basis from a large poultry farm for storage in tanks or earthen ponds. Therefore, it is unrealistic to implement such an AWMS for this project.
- ***Pit storage below animal confinement:*** This system is typically only applicable to piggeries and dairies under South African conditions. Therefore it is unrealistic to implement such an AWMS for this project.
- ***Composting:*** These systems need considerable land surface and are highly labour intensive. Therefore, this system is unattractive from an economic viewpoint and therefore an unlikely baseline scenario.
- ***Aerobic treatment:*** In South Africa it is considered uncommon practice to use washing and flushing systems on poultry farms. Therefore it is very unlikely that manure will be collected as a liquid and treated aerobically.
- ***Uncovered anaerobic lagoon:*** In South Africa it is considered uncommon practice to use washing and flushing systems on poultry farms. Therefore it is very unlikely that manure will be collected as a liquid and treated in anaerobic lagoons.
- ***Anaerobic digester*:** This AWMS has clear economic barriers since it involves significant investment costs. It also has higher operation and maintenance costs and is more labour intensive than the current practice. The anaerobic digester system is not a financially attractive project without the income from the CDM due to its high costs. Therefore, it is not a realistic and credible alternative. Further details of the investment analysis are presented in section E.5.1.

Plausible baseline scenarios for poultry farms:

- ***Dry lot and Solid storage:*** This system is typically used for the production of eggs (layers). Manure is left to accumulate in the Dry lot and periodically removed and put into Solid storage until it is used as fertilizer. There are no investments or technological barriers related to this AWMS since continued operations are guaranteed without any modifications of the existing systems. There is also no regulation obligating the project participant to change to another practice, therefore this existing AWMS is a very likely baseline scenario.
- ***Poultry manure with litter:*** This system is typically used for all poultry breeder flocks and for the production of meat type chickens (broilers). There are no investments or technological barriers related to this AWMS since continued operations are guaranteed without any modifications of the existing systems. There is also no regulation obligating the project participant to change to another practice, therefore poultry manure with litter is a very likely baseline scenario.

As shown in this analysis, the most plausible scenario in absence of the project activity would be the “Dry lot and Solid storage system” or the “Poultry manure with litter system”, depending on type of poultry farm (layer or broiler). These systems do not emit large amounts of GHG’s but still need to be taken into account where the manure is used in renewable energy projects.

<u>Alternatives to energy generation</u>

For energy generation, the realistic and credible alternative(s) may include:

Alternative 1: Energy generation from renewable biomass, not undertaken as a CDM project activity;
Energy generation from the biogas collected from the anaerobic digestion of biogenic organic matter is a credible alternative. However, project involves high financial and technological risks and faces barriers in terms of technology, common practice. Thus, the project cannot be implemented without the CDM. This is not a credible and realistic alternative as well as not a plausible baseline scenario for power generation

Alternative 2: Existing or construction of a new on-site or off-site fossil fuel fired cogeneration plant;
A fossil fuel fired cogeneration plant will result in GHG emissions. Therefore the scenario is not applicable and hence not a credible and realistic baseline scenario and eliminated as a plausible baseline scenario.

Alternative 3: Existing grid-connected power plants and thermal energy generation using fossil fuel.
This meets all the legal and regulatory requirements and it is common practice in South Africa. Therefore this scenario is considered as a credible and realistic alternative to the project activity, and is the most likely baseline scenario.

Description of the identified energy baseline scenario:

The baseline scenarios for all the projects is the import of electricity from the grid and/or thermal energy production using fossil fuel.

In the following scenarios emission reduction from renewable thermal energy generation are not eligible:
- In the baseline scenario where thermal energy is produced from biomass.
- In the project activity where thermal energy is used to heat the digester.

Sub-step 1b: Consistency with mandatory laws and regulations:

There are no laws in South Africa compelling livestock farmers and solid waste disposal sites to treat waste in anaerobic digesters and to capture and destroy the methane produced. There are no regulations in South Africa that require the implementation or renewable energy projects. Consequently, the alternatives above and also the project activity are legally compliant and are realistic and credible alternatives.

E.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the SSC-CPA being included as registered PoA (assessment and demonstration of additionality of SSC-CPA): >>

E.5.1. Assessment and demonstration of additionality for a typical SSC-CPA:

This section is completed with reference to "Tool for the demonstration and assessment of additionality, version 05.2". The investment barrier and/or the barrier analysis should be completed. The investment barrier is described below in step 2 and the barrier analysis in step 3. The compulsory common practice analysis is described in step 4.

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

Sub-step 1a: Define alternatives to the project activity:

This step has been dealt with in Section E.4 of this PoA.

Sub-step 1b: Consistency with mandatory laws and regulations:

This step has been dealt with in Section E.4 of this PoA.

Step 2: Investment analysis

Sub-step 2a: Determine appropriate analysis method

The "Tool for the demonstration and assessment of additionality" suggests three analysis methods including simple cost analysis (option I), investment comparison analysis (option II) and benchmark analysis (option III). As the project activity generates financial benefits, the benchmark analysis (option III) is applied in this analysis.

The benchmark analysis is demonstrated for each CPA in their CDM-CPA-DD.

Step 3: Barrier analysis

Technological Barrier:
Anaerobic biological treatment of biomass to produce biogas is a new and relatively unknown technology in South Africa. The lack of available knowledge and confidence in the technology makes this type of development difficult to establish. As a result, this technology is viewed as risky and this risk is reflected in the fact that there are not many projects of this type in South Africa. In effect, there are only a few farms considering anaerobic digester technology and all of them intends to be CDM projects.

Moreover, many farmers are concerned that an anaerobic digester project is too complex to operate and maintain. The anaerobic digestion and biogas system that will be utilized in the program is quite different from the few previously installed in South Africa in relation to the anaerobic digester systems used with industrial and municipal wastewater treatment. The project activity represents a significantly more technologically advanced alternative to the business-as-usual scenario, and one that carries higher perceived risks.

Anaerobic digestion systems are perceived as relatively high risk, being based upon the function of a biological system that is not 100% performance-guaranteed. The biological system is at constant risk of chemical shocks that can wipe out the anaerobes and biological activity and subsequently the energy production regimes. Moreover, disease treatments are substances that can shock the bacterial cultures required to generate biogas, often killing the population during the period such materials are being used. Anaerobic digesters require constant on-going precise management of a variety of elements – water flows, pH levels, temperature, alkalinity and volatile fatty acid content, etc. Skills to manage such systems are not readily available in South Africa.

Furthermore, the maintenance of the high performance biogas engines will pose a very high technical barrier for the staff of the farms. New staff with a technical background would need to be recruited and present staff would need extensive technical training. Overall, the project scenario involves higher perceived risks due to more technology advanced process equipment for the SSC-CPA.

Investment barriers:
The continued use of the current open anaerobic technology is least-cost because:

1) it would require little to no capital investment (as it exists already and even if required upgrades or constructed from scratch would be lower cost than a system with methane capture); and,
2) has lower operation and maintenance costs over the project lifetime.

Without the incentive of the CDM, these higher costs would cause the farm owner to continue to operate the open lagoon system.

Other barriers:

Most projects will generate more energy than they can use in their own business, therefore the project needs to export electricity to the grid. In order to export electricity to the South African grid, a power purchase agreement (PPA) must be negotiated with ESKOM – the country's electricity supplier, or large industrial users. Often, most producers are not willing to enter into such complex, time consuming and costly negotiations. Moreover, they don't want to risk having to face major penalty charges for not meeting power quality and quantity as stipulated in the agreement.

Step 4: Common practice analysis

Anaerobic digester technology that will be utilized in the project activities is not common practice in South Africa (see letters industry organisations in annex 3) and, as previously discussed, represents a higher risk alternative to the business-as-usual scenario. There is little experience in utilizing anaerobic digestion technologies in South Africa and therefore, these are not considered a high management priority. In effect, there are only a few farms considering anaerobic digester technology and all of them intends to be CDM projects. There are only a few domestic scale projects where, for example, chicken manure is digested in polymer bladders.

The entry of Independent Power Producers in South Africa Power market is a recent phenomenon, with ESKOM still playing the dominant role in terms of generation capacity. Only a very small percentage of South Africa's generation capacity comes from non ESKOM sources. These are all either municipally owned plants or generators imbedded in large industrial operations supplying primarily for own internal use. There are therefore almost no privately owned power plants in South Africa apart from co-generation plants owned by large industry. In fact, only as of April 15, 2011, Eskom had signed up with three IPPs (IPSA, Tanget Mining and Sappi) to supply it with373 MW of power and it is expects to increase its purchase to 400 MW by the end of 2011. Given that Eskom has a net maximum capacity of 40,870 MW, the purchase from IPPs represents less than 1% of the total. IPPs however are stymied by Eskom's reluctance to purchase power from IPPs.

The renewable energy from biomass projects will be some of the first Independent Power Plants to be constructed in South Arica for the purpose of selling power commercially. The process is further complicated and prolonged by the application for an Independent Power Producers license from the National Electricity Regulator of South Africa (NERSA). In this case, under the government's integrated resource plan (IRP)[4] Eskom is looking to purchase 1,025 MW of power from Renewable energy sources by 2013.

E.5.2. Key criteria and data for assessing additionality of a SSC-CPA:

Key additionality criteria:

1. Identify realistic and credible alternative(s) to the project activity
2. Ensure that the proposed SSC-CPA is not the only alternative amongst those considered that is in compliance with mandatory regulations.
3. Apply a benchmark analysis to demonstrate that without CDM revenue the SSC-CPA is not a financially attractive option and/or
4. Conduct a barrier analysis to demonstrate that the project activity faces significant barriers that are overcome through the CDM.

[4] Integrated resource plan for electricity, available under: http://www.doe-irp.co.za/content/IRP2010_2030_ Final_Report_20110325.pdf)

5. Conduct a common practice analysis to demonstrate that the project activity (i) similar activities cannot be observed or (ii) similar activities are observed, but essential distinctions between the project activity and similar activities can reasonably be explained.

E.6. Estimation of Emission reductions of a CPA:

E.6.1. Explanation of methodological choices, provided in the approved baseline and monitoring methodology applied, selected for a typical SSC-CPA:

SSC-CPAs under the PoA will need to apply a methane avoidance methodology, AMS-III.AO or AMS-III.D, and the renewable energy methodology, AMS-I.C.

All projects using anaerobic digestion technology (equipped with biogas recovery and combustion/flaring systems) need to apply a methane avoidance methodology for the purpose of calculating methane project emissions. Projects using biomass that would otherwise have been left to decay anaerobically in animal waste management systems (AWMS) and solid waste disposal sites (SWDS) may also use this methodology to claim methane emission reduction. One of the following methane avoidance methodologies should be applied to each SSC-CPA:

- Methodology AMS-III.D applies under the following condition:
  a) Digestion of manure from AWMS as a single source of substrate, where this organic matter would otherwise have been left to decay anaerobically.
- Methodology AMS-III.AO applies under the following conditions:
  a) Digestion of waste from SWDS as a single source of substrate, where this organic matter would otherwise have been left to decay anaerobically.
  b) Co-digestion of waste from SWDS and manure from AWMS, where this organic matter waste would otherwise have been left to decay anaerobically.
  c) Digestion of substrates for which it cannot be demonstrated that the biomass would otherwise been left to decay anaerobically. Baseline emissions related to such biomass shall be accounted for as zero, whereas project emissions shall be calculated for all substrates.

Renewable energy methodology (AMS-I.C)
Biogas will be used as a fuel in a renewable energy facility in order to achieve one of the following project activities, applying methodology AMS-I.C:

a) Project activities that install biomass thermal energy plants that produce renewable thermal energy for on-site consumption or for consumption by other facilities.
b) 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.
c) Project activities that involve the addition of renewable energy units at an existing renewable energy production facility.

E.6.2. Equations, including fixed parametric values, to be used for calculation of emission reductions of a SSC-CPA:

Emission reductions are calculated *ex ante* as follows:

$$ER_y = BE_y - PE_y - LE_y \qquad (1)$$

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

$$BE_y = (BE_{AMS\text{-}III.AO,y} \ \ or \ \ BE_{AMS\text{-}III.D,y}) + BE_{AMS\text{-}I.C,y} \quad (2)$$

Where:
$BE_{AMS\text{-}III.AO,y}$ Baseline emissions from SWDS and where applicable baseline emissions from AWMS (tCO_2e/yr). Baseline emissions from SWDS are calculated in section "Baseline emissions-AMS-III.AO" and baseline emissions from AWMS are calculated in section "baseline emissions – AMS-III.D"
$BE_{AMS\text{-}III.D,y}$ 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".

Decide according to methodology conditions, if methodology ASM-III.AO or methodology AMS-III.D is applicable to each SSC-CPA.

Baseline emissions - AMS-III.AO

The baseline scenario is the situation where, in the absence of the project activity, biomass and other organic matter (including manure where applicable) are left to decay within the project boundary and methane is emitted to the atmosphere. The baseline emissions are the amount of methane emitted from the decay of the degradable organic carbon in the biomass and other organic matter. Baseline emissions shall exclude emissions of methane that would have to be captured, fuelled or flared or gainfully used to comply with national or local safety requirement or legal regulations.

Baseline emissions shall be determined as follows:

$$BE_{AMS\text{-}III.AO,y} = BE_{SWDS,y} + BE_{manure,y} - MD_{reg,y} \times GWP_{CH4} \quad (3)$$

Where:
$BE_{SWDS,y}$ Methane emissions avoided during the year *y* from preventing waste disposal at the solid waste disposal site (SWDS) during the period from the start of the project activity to the end of the year y (tCO2e/yr).
$BE_{manure,y}$ Where applicable, baseline emissions from the manure co-digested by the project activities, calculated as per the relevant procedures of AMS-III.D (tCO_2e/yr). $BE_{manure,y} = BE_{AMS\text{-}III.D}$
$MD_{reg,y}$ Amount of methane that would have to be captured and combusted in the year *y* to comply with the prevailing regulations (ton).
GWP_{CH4} Global warming Potential of methane, valid for the relevant commitment period (21 tCO_2e/tCH_4)

Where:

$$BE_{SWDS,y} = \varphi \cdot (1-f) \cdot GWP_{CH4} \cdot (1-OX) \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^{y} \sum_j W_{j,x} \cdot DOC_j \cdot e^{-k(y-x)} \cdot (1-e^{-kj}) \quad (4)$$

Where:

$BE_{SWDS,y}$	Methane emissions avoided during the year *y* from preventing waste disposal at the solid waste disposal site (SWDS) during the period from the start of the project activity to the end of the year y (tCO_2e/yr).
	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 ($21tCO_2e/tCH_4$)
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
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

See Annex 3 for yearly decay model calculations.

Fraction of methane captured at the SWDS and flared, combusted or used in another manner (f)

Written information from the operator of the solid waste disposal site and/or site visits at the solid waste disposal site

Oxidation factor(OX)

IPCC default value from 2006 IPCC Guidelines for National Greenhouse Gas Inventories can be used. A oxidation factor of 0.1 will be used for managed solid waste disposal sites that are covered with oxidizing material such as soil or compost. A factor of 0 will be used for other types of solid waste disposal sites.

Fraction of methane in the SWDS gas (F)

A default value of 0.5 is recommended by IPCC.

Fraction of degradable organic carbon (DOC_f) that can decompose

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.

Methane conversion factor (MCF)

The following MCF values will be used:

- 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 metres

Fraction of degradable organic carbon (by weight) in the waste type j (DOC_j):

IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4 and 2.5)

Different *DOC* values for the different waste types *j*.

Waste type j	DOC_j % wet waste	DOC_j % dry waste
Wood and wood products	43	50
Pulp, paper and cardboard (other than sludge)	40	44
Food, food waste, beverages and tobacco (other than sludge)	15	38
Textiles	24	30
Garden, yard and park waste	20	49
Glass, plastic, metal, other inert waste	0	0

If a waste type, prevented from disposal by the proposed CDM project activity, cannot clearly be attributed to one of the waste types in the table above, project participants should choose, among the waste types that have similar characteristics, the waste type where the values of DOC_j and k_j result in a conservative estimate (lowest emissions), or request a revision of/deviation from this methodology.

In the case of empty fruit bunches (EFB), as their characteristics are similar to garden waste, the parameter value correspondent of garden shall be used. 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

Decay rate for the waste type j (k)

IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)

Different *k* values for the different waste types j.

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)
Slowly degrading	Pulp, paper, cardboard (other than sludge), textiles	0.04	0.06	0.045	0.07
Slowly degrading	Wood, wood products and straw	0.02	0.03	0.025	0.035
Moderately degrading	Other (non-food) organic putrescible garden and park waste	0.05	0.1	0.065	0.17
Rapidly degrading	Food, food waste, sewage sludge, beverages and tobacco	0.06	0.185	0.085	0.4

Amount of organic waste prevented from disposal in the SWDS:

Where different waste types *j* are prevented from disposal, determine the amount of different waste types ($W_{j,x}$) through sampling and calculated the mean from the samples, as follows:

(5)

$W_{j,x}$	Amount of organic waste type *j* prevented from disposal in the SWDS in the year *x* (tons)
W_x	Total amount of organic waste prevented from disposal in year *x* (tons)
$p_{n,j,x}$	Weight fraction of the waste type *j* in the sample n collected during the year *x*
z	Number of samples collected during the year *x*

Where applicable, baseline emission determination of digested waste that would otherwise have been disposed in stockpiles shall follow relevant procedures below.

In determining the amount of waste prevented from disposal in the SWDS ($W_{j,x}$) as input in equation 4, the percentage of the biomass that is combusted in the project activity and which would have been dumped in a stockpile in the baseline situation and also would have remained in the stockpile for a sufficient period of time to decay shall be determined. A quantitative analysis shall be carried out using the following options (in the order of priorities):

1. Project specific waste disposal data from at least 3 years prior to the implementation of the project activity;
2. A control group;
3. Official data sources.

The following two factors shall be quantified and $W_{j,x}$, shall be adjusted accordingly.

1. Parts of the biomass may be taken from the stockpile for various reasons. Examples are that the biomass: (a) may be used as a fuel; (b) incinerated to use the ashes as fertilizer; (c) directly applied to land as fertilizer (mulching); (d) composted; (e) or used as a raw material (e.g., panel board production). The various uses shall be analysed and quantified to show what percentage of biomass would have remained in the stockpile.
2. There may be restrictions for leaving the biomass in a stockpile indefinitely. Examples are restrictions concerning land surface used for stockpiling or height of the stockpile.

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 are calculated using the amount of the waste or raw material that would decay anaerobically in the absence of the project activity.

Baseline emissions are determined as follows:

$$BE_{AMS\text{-}III.D,y} = BE_{stage\ 1,y} + BE_{stage\ 2,y} \quad (6)$$

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)

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

$$BE_{stage\ 1,y} = GWP_{CH4} \times VS_{LT,y} \times N_{LT,y} \times B_{0,LT} \times D_{CH4} \times \Sigma\ MCF_{stage\ 1,j} \times MS\%_{stage\ 1,j} \times UF_b \times RVS \quad (7)$$

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)
$MCF_{stage\ 1,j}$	Annual methane conversion factor for stage 1 of the baseline animal manure management system *j*
$MS\%_{stage\ 1,j}$	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

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

$$BE_{stage\ 2,y} = GWP_{CH4} \times VS_{,LT,y} \times N_{LT,y} \times B_{0,LT} \times D_{CH4} \times \Sigma\ MCF_{stage\ 2,j} \times MS\%_{stage\ 2,j} \times UF_b \times (1\text{-}RVS) \quad (8)$$

Where:

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

$$N_{LT,y} = N_{da,y} \times (N_{p,y} / 365) \qquad (9)$$

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)

Volatile solids (VS) from livestock:

There are two methods for calculating Volatile solids (VS) for different livestock types, the lowest value will be used.

$$VS_{LT,y} = MIN\,(VS_{LT\ IPCC,y},\ VS_{LT\ feed,y}) \qquad (10)$$

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:

(11)

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* where 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:

(12)

Where:

GE	Gross energy intake (MJ/day), calculated below
DE	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	Conversion factor for dietary GE per kg dry matter (MJ/kg)
nd_y	Number of days in year *y* where the treatment plant was operational

Where:

$$GE = W_{site} \times \%_{body\ weight} \times DE_{MJ} \quad (13)$$

Where:

W_{site}	Average body weight of animal (kg)
$\%_{body\ weight}$	% of body weight (%)
DE_{MJ}	Digestible Energy, 18.45 MJ DE/kg

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.

Baseline emissions - AMS-I.C

For *ex ante* energy baseline calculations, the potential available volume of methane is required. In this section the methane volume is calculated and secondly the baseline emissions from the different project activities.

Total volume of methane produced:

The volume of methane produced through anaerobic digestion from the different substrate streams may be calculated *ex anta* as follows:

$$CH4_{total,y} = CH4_{WT,y} + CH4_{BT,y} + CH4_{LT,y} \quad (14)$$

Where:

$CH4_{total,y}$ Total methane production (Nm^3/yr)
$CH4_{WT,y}$ Calculated methane production from each waste type from SWDS *WT* (Nm^3/yr)
$CH4_{BT,y}$ Calculated methane production from each biomass type *BT* (Nm^3/yr)
$CH4_{LT,y}$ Calculated methane production from each livestock type *LT* (Nm^3/yr)

Methane production from waste from SWDS shall be calculated as follows:

$$CH4_{WT,y} = VS_{WT,y} \times MPF_{WT} \quad (15)$$

Where:

$VS_{WT,y}$ Net quantity Volatile solids from each waste type from the SWDS in year *y* (kg VS/yr)
MPF_{WT} Methane production factor of volatile solids from each waste type from the SWDS (Nm^3 CH_4/kg VS_{added})

Volatile solid from waste from SWDS

$$VS_{WT,y} = B_{WT,y} \times (1 - \%\ water) \times \%VS_{WT} \quad (16)$$

Where:

$B_{WT,y}$ Net quantity from each waste type from the SWDS in year *y* (kgWW/yr)
% water Moisture content from each waste type from the SWDS (%)
$\%VS_{WT}$ Percentage volatile solids in the total solids from each waste type from SWDS (%)

Methane production from biomass shall be calculated as follows:

$$CH4_{BT,y} = VS_{BT,y} \times MPF_{BT} \quad (17)$$

Where:

$VS_{BT,y}$ Net quantity of Volatile solids from each biomass type in year *y* (kg VS/yr)
MPF_{BT} Methane production factor of volatile solids from each biomass type (Nm^3 CH_4/kg VS_{added})

Volatile solid from biomass

$$VS_{BT,y} = B_{BT,y} \times (1 - \%\ water) \times \%VS_{BT} \quad (18)$$

Where:

$B_{BT,y}$	Net quantity of each biomass type in year *y* (kgWW/yr)
% water	Moisture content of each biomass type (%)
$\%VS_{BT}$	Percentage volatile solids in the total solids of each biomass type (%)

Methane production from livestock manure shall be calculated as follows:

$$CH4_{LT,y} = VS_{LT\ net,y} \times MPF_{LT} \quad (19)$$

Where:

$VS_{LT\ net,y}$	Net quantity volatile solids from each livestock manure type in year *y* (kg VS/yr)
MPF_{LT}	Methane production factor of volatile solids from each livestock manure type (m^3 CH_4/kg VS_{added})

Volatile solids from livestock manure

$$VS_{LT\ net,y} = VS_{LT,y} \times N_{LT,y} \times (1 - VS_{lost}) \quad (20)$$

Where:

$VS_{LT,y}$	Volatile solids per animal for each livestock type LT in year *y* (kg dm/year)
$N_{LT,y}$	Annual average number of animals of type LT in year *y* (numbers)
VS_{lost}	Percentage of VS lost before entering the digester (%)

<u>Eligible energy project activities:</u>

The following three project activities will be covered under the AMS-I.C methodology:

1. Project activities that install biomass thermal energy plants that produce renewable thermal energy for on-site consumption or for consumption by other facilities.
2. Project activities that install biomass cogeneration plants that produce electricity for supply to the grid or for captive use and thermal energy for on-site consumption or for consumption by other facilities.
3. Project activities that involve the addition of renewable energy units at an existing renewable energy production facility.

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

The baseline emissions from thermal energy displaced by the project activity are calculated as follows:

$$BE_{therma,y} = (HG_{thermal,y}/\eta_{BL,thermal}) \times EF_{BL,CO2} \quad (21)$$

Where:

$BE_{thermal,y}$	Baseline emissions from thermal energy displaced by the project activity during the year *y* (tCO_2e/yr)
$HG_{thermal,y}$	Net quantity of thermal energy supplied by the project activity during the year *y* (TJ)

$EF_{BL,CO2}$	The CO_2 emission factor of the fossil fuel that would have been used in the baseline plant (tCO_2e/TJ), obtained from reliable local or national data if available, otherwise, IPCC default emission factors are used
$\eta_{BL,thermal}$	Efficiency of the plant using fossil fuel that would have been used in the absence of the project activity (%). Efficiency shall be calculated as described in methodology AMS-I.C.

Quantity of thermal energy generated through methane combustion

$$HG_{thermal,y} = CH4_{total,y} \times LHV_{CH4} \times \eta_{thermal} \times UT_{thermal} \quad (22)$$

Where:

$CH4_{total,y}$	Total potential methane production in year y (Nm^3/yr), see equation 14
LHV_{CH4}	Methane lower heating value (MJ/Nm^3)
$\eta_{thermal}$	Thermal plant efficiency (%)
$UT_{thermal}$	Thermal plant uptime (%)

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

In the baseline scenario where electricity is imported from the grid and thermal energy (steam/heat) is produced using fossil fuel, the baseline emissions shall be calculated as the sum of emissions from the production of electricity and thermal energy, as follows:

$$BE_{cogen,y} = BE_{elec,y} + BE_{cogen,thermal,y} \quad (23)$$

Where:

$BE_{cogen,y}$	Baseline emissions from the cogeneration project activity in year *y* (tCO_2e/yr).
$BE_{elec,y}$	Baseline emissions from electricity supply to the grid in year *y* (tCO_2e/yr).
$BE_{cogen,thermal,y}$	Baseline emissions from thermal energy displaced by the project activity in year *y* (tCO_2e/yr)

In the following scenarios emission reduction from renewable thermal energy generation are not eligible:

- In the baseline scenario where thermal energy is produced from biomass
- In the project activity where thermal energy is used to heat the digester

Baseline emissions from co-generation are calculated in the following two sections, electricity in section 2.a. and thermal energy (waste heat energy) in section 2.b.

2.a Baseline emissions from the supply of electricity to the grid or for captive use shall be calculated as follows:

$$BE_{elec,y} = EG_{elec,y} \times EF_{CO2,grid,y} \quad (24)$$

Where:

$EG_{elec,y}$	Net electricity supplied to 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), see Annex 3

Ex ante calculation of the net electricity supplied to the grid

$$EG_{elec,y} = EG_{gross,y} - EG_{aux,y} - EG_{import,y} \quad (25)$$

Where:

$EG_{gross,y}$ Gross amount of electricity generated from biomass (MWh/yr)
$EG_{aux,y}$ Auxiliary electricity consumption (MWh/yr)
$EG_{import,y}$ Electricity import from the grid to the project power plant (MWh/yr)

Ex ante calculation of the gross amount of electricity generated

$$EG_{gross,y} = CH4_{tota,y} \times LHV_{CH4} \div 3600 \times \eta_{cogen} \times UT_{cogen} \quad (26)$$

Where:

$CH4_{total,y}$ Total potential methane production (Nm^3/yr), see equation 14
LHV_{CH4} Methane energy value (MJ/Nm^3)
3600 Conversion factor to convert MJ/yr to MWh/yr
η_{cogen} Co-generation electrical efficiency (%)
UT_{cogen} Co-generation plant uptime (%

Ex ante calculation of the auxiliary electricity consumption

$$EG_{aux,y} = EG_{gross,y} \times \%_{aux} \quad (27)$$

Where:

$\%_{aux}$ Percentage of electrical energy used by the auxiliary equipment for the cogeneration plant

Electricity import from the grid to the project power plant

The electricity imported from the grid will not be calculated *ex ante* but measured at the grid interface.

2.b The baseline emissions from thermal energy displaced by the cogeneration project activity are calculated as follows:

$$BE_{cogen,thermal,y} = (HG_{cogen,thermal,y} / \eta_{BL,thermal}) \times EF_{BL,CO2} \quad (28)$$

Where:

$BE_{cogen,thermal,,y}$ Baseline emissions from thermal energy displaced by the project activity in year *y* (tCO_2e/yr).
$HG_{cogen,thermal,y}$ Net quantity of cogeneration thermal energy supplied by the project activity during the year *y* (TJ/yr)
$EF_{BL,CO2}$ CO_2 emission factor of the fossil fuel that would have been used in the baseline plant (tCO_2e/TJ), obtained from reliable local or national data if available, otherwise, IPCC default emission factors are used
$\eta_{BL,thermal}$ Efficiency of the plant using fossil fuel that would have been used in the absence of the project activity (%). Efficiency shall be calculated as described in methodology AMS-I.C.

Net quantity of waste heat supplied by the project activity

$$HG_{cogen,thermal,y} = M_{exhaust\ gas} \times Cp_{exhaust\ gas} \times (T_{out} - T_{in}) + M_{mainwater\ cooling} \times Cp_{water} \times (T_H - T_C) \quad (29)$$

Where:

$M_{exhauste\ gas}$	Mass flow rate of the exhaust gas (kg/year)
$M_{mainwater\ cooling}$	Mass flow rate of the main water cooling (kg/year)
Cp_{water}	Water heat capacity (TJ/kg^{o}C)
$Cp_{exhange\ gas}$	Exhaust gas heat capacity (TJ/kg^{o}C)
T_{out}	Temperature out of generator (^{o}C)
T_{in}	Temperature of exhaust gas after recovery (^{o}C)
T_H	Hot water outlet temperature (^{o}C)
T_C	Return temp of water required to cool engine (^{o}C)

3. Project activities that involve the addition of renewable energy co-generation units at an existing renewable energy production facility.

Baseline emissions shall be calculated as follows:

$$BE_{cogen,add,y} = BE_{thermal,add,y} + BE_{elec,add,y} \quad (30)$$

$BE_{cogen,add,y}$	Baseline emissions from project activities that involve the addition of renewable co-generation units at an existing renewable energy production facility (tCO_2e/yr).
$BE_{thermal,add,y}$	Thermal baseline emissions from project activities that involve the addition to renewable co-generation units at an existing renewable energy production facility (tCO_2e/yr).
$BE_{elec,add,y}$	Electricity baseline emissions from project activities that involve the addition of renewable co-generation units at an existing renewable energy production facility (tCO2e/yr).

Thermal baseline emissions from project activities that involve the addition of renewable co-generation units shall be calculated as follows:

$$BE_{thermal,add,y} = (HG_{thermal,PJ,y} - HG_{thermal,old,y}) \times EF_{BL,CO2} \quad (31)$$

Where:

$HG_{thermal,PJ,y}$	Total actual thermal energy produced in year *y* by all units, existing and new project units (TJ/yr). Calculated the same as $HG_{thermal,y}$ in section 1, using in equation 22.
$HG_{thermal,old,y}$	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 $HG_{thermal,old,y}$ is given by:

$$HG_{thermal,old,y} = MAX(HG_{thermal,actual,y}, HG_{thermal,estimated,y}) \quad (32)$$

Where:

$HG_{thermal,actual,y}$	The actual, measured thermal energy production of the existing units in year *y* (TJ/yr)
$HG_{thermal,estimated,y}$	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). Calculated the same as $HG_{thermal,y}$ in section 1, using in equations 22.

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.

Electricity baseline emissions from project activities that involve the addition of renewable co-generation units shall be calculated as follows:

$$BE_{elec,add,y} = (EG_{elec,PJ,y} - EG_{elec,existing,y}) \times EF_{CO2,grid,y} \quad (33)$$

Where:

$EG_{elec,PJ,y}$ 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). Calculated the same as $EG_{elec,y}$ in section 2.a, using in equation 25-27.

$EG_{elec,existing,y}$ 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:

$$EG_{elec,existing,y} = MAX\,(EG_{elec,actual,y}, EG_{elec,estimated,y}) \quad (34)$$

Where:

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

$EG_{elec,estimated,y}$ 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). Calculated the same as $EG_{elec,y}$ in section 2.a, using in equation 25-27.

<u>**PROJECT ACTIVITY EMISSIONS**</u>

Project activity emissions consist of:

$$PE_y = PE_{PL,y} + PE_{flare,y} + PE_{transp,y} + PE_{storage,y} + PE_{reswaste,y} + PE_{FF,y} + PE_{elec,y} \quad (35)$$

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 ante* estimation the expected biogas production of the digester may be used, for *ex post* calculations the effectively recovered biogas amount shall be used for the calculation. *Ex ante* calculation for physical leakage shall be calculated as follows:

$$PE_{PL,y} = CH4_{total,y} \times 5\% \times D_{CH4} \times GWP_{CH4} \quad (36)$$

Where:
$CH4_{total}$ Calculated total methane production (Nm^3/yr), see equation 14.

b) Emissions from flaring:

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

——— (37)

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:

$$TM_{RG,h} = FV_{RG,h} \times w_{CH4,y} \times D_{CH4} \quad (38)$$

$FV_{RG,h}$ Volumetric flow rate of the residual gas in dry basis at normal conditions in hour *h* (m^3/h)
$w_{CH4,y}$ Volumetric fraction of methane in the residual gas on dry basis in hour *h* (fraction)
$D_{CH4,n}$ Density of methane at normal conditions (0.716) (kg/m^3)

All SSC-CPAs will use enclosed flares and the default flare efficiency value of 90% will be used, 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*.

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

$$PE_{flare} = CH4_{total,y} \times (1 - UT) \times (1\text{-}EF) \times D_{CH4} \times GWP_{CH4} \quad (39)$$

Where:
$CH4_{total,y}$ Calculated total methane production, see equation 14 (Nm^3/yr)
UT Plant time (%)
FE Flare efficiency as 90%

c) Emissions from incremental transportation:

Project emissions due to incremental (additional) transport distances $PE_{y,transp}$ are calculated based on the incremental distances between:

(i) The collection points of waste and the anaerobic digester as compared to the baseline waste treatment site;
(ii) The collection point of biomass and the anaerobic digester;
(iii) The collection points of manure and the anaerobic digester as compared to the baseline manure treatment site;
(iv) Treatment sites and the sites for soil application of the produced digester sludge.

$$PE_{y,transp} = (Q_{y,WT}/CT_{y,WT}) \times DAF_{w,WT} \times EF_{CO2/km} + (Q_{y,BT}/CT_{y,BT}) \times DAF_{w,BT} \times EF_{CO2/km} + (Q_{y,LT}/CT_{y,LT}) \times DAF_{w,LT} \times EF_{CO2/km} + (Q_{y,sludge}/CT_{y,sludge}) \times DAF_{sludge} \times EF_{CO2/km} \quad (40)$$

Where:

$Q_{y,WT}$	Quantity of waste transported in the year *y* (ton)
$CT_{y,WT}$	Average truck capacity for waste transportation from SWDS (ton/truck)
$DAF_{w,WT}$	Average incremental distance for waste transportation from SWDS (km/truck)
$Q_{y,BT}$	Quantity of biomass transported in the year *y* (ton)
$CT_{y,BT}$	Average truck capacity for biomass transportation (ton/truck)
$DAF_{w,BT}$	Average incremental distance for biomass transportation (km/truck)
$Q_{y,LT}$	Quantity of raw manure transported in the year *y* (ton)
$CT_{y,LT}$	Average truck capacity for manure transportation (ton/truck)
$DAF_{w,LT}$	Average incremental distance for manure transportation (km/truck)
$Q_{y,sludge}$	Quantity of digester sludge transported in year *y* (ton)
$CT_{y,sludge}$	Average truck capacity for sludge transportation (ton/truck)
DAF_{sludge}	Average incremental distance for sludge 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 use due to transportation

$$EF_{CO2/km} = VF_{cons} \times D_{fuel} \times NCV_{fuel,y} \times EF_{CO2,fuel} \quad (41)$$

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:

$$PE_{storage,y} = GWP_{CH_4} \times D_{CH_4} \times \sum_{LT,l} \left[\frac{365}{AI_l} \sum_{d=1}^{AI} (N_{LT,y} \times VS_{LT,d} \times MS\%_l \times (1 - e^{-k\ (AI_l - d)}) \times MCF_l \times B_{0_{LT}}) \right] \quad (42)$$

$PE_{storage,y}$	Project emissions on account of manure storage in year *y* (tCO_2e)
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:

$$PE_{reswaste,y} = \varphi \cdot (1 - f_{RW}) \cdot GWP_{CH4} \cdot (1 - OX_{RW}) \cdot \frac{16}{12} \cdot F \cdot DOC_{RW,f} \cdot MCF_{RW} \cdot \sum_{x=1}^{y} \sum_j W_{RW,j,x} \cdot DOC_{RW,j} \cdot e^{-k(y-x)} \cdot (1 - e^{-kj}) \quad (43)$$

Where:

$PE_{reswaste,y}$	Project methane emissions during the year *y*, during the period from the start of the project activity to the end of the year *y* (tCO_2e/yr).
	Model correction factor to account for model uncertainties (0.9)
f_{RW}	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_{RW}	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)
$DOC_{RW,f}$	Fraction of degradable organic carbon (DOC) that can decompose
MCF_{RW}	Methane correction factor
$W_{RW,j,x}$	Amount of organic waste type *j* prevented from disposal in the SWDS in the year *x* (tons)
$DOC_{RW,j}$	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:

CO_2 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:

$$PE_{FF,y} = FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i} \quad (44)$$

Where:

$PE_{FF,y}$	Emissions from fossil fuel combustion inside the project boundary in year y (tCO_2e/yr)
$FC_{i,y}$	Quantity of fossil fuel type *i* combusted inside the project boundary in year y (kg/yr)
$NCV_{i,y}$	Net calorific value of the fossil fuel type *i* combusted inside the project boundary (TJ/kg)
$EF_{CO2,i}$	CO_2 emission factor of fossil fuel type *i* combusted inside the project boundary (tCO_2e/TJ)
i	Fossil fuel types combusted in year y

g) Emissions from electricity use:

Emissions from electricity use are included in net electricity calculation as "electricity imported from the grid to the project power plant", see section: Baseline emissions – AMS-I.C. Therefore, it is not necessary to calculate it under project activity emissions.

LEAKAGE EMISSIONS

According to methodology AMS-III.AO and AMS-III.D, no leakage calculation is required for the methane avoidance project activity

Leakage emissions from the renewable energy project activity consist of:

$$LE_y = LE_{collect/process/transp,y} + LE_{renewable\ biomass,y} \quad (45)$$

Where:

$LE_{collect/process/transp,y}$	Leakage emissions from collection/processing/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/transportation of biomass outside project boundary:

In case collection/processing/transportation of biomass is outside the project boundary, leakage emissions from collection/processing/transportation of biomass to the project site, shall be calculated as follows:

$$LE_{collect/process/transp,y} = LE_{collect/process,y} + LE_{transp,y} \quad (46)$$

Where:

$LE_{collect/process,y}$	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).

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

$$LE_{collect/process,y} = FC_{c,y} \times NCV_{c,y} \times EF_{CO2,c} \quad (47)$$

Where:

$FC_{c,y}$	Quantity of fossil fuel type *c* combusted outside the project boundary in year y (kg/yr)

$NCV_{c,y}$	Net calorific value of the fossil fuel type *c* combusted outside the project boundary in year y(TJ/kg)
$EF_{CO2,c}$	CO_2 emission factor of fossil fuel type *c* combusted outside the project boundary (tCO_2e/TJ)
c	Fossil fuel types combusted in year y

Leakage emissions from incremental transportation shall be calculated as follows:

If biomass are 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.

$$LE_{transp,y} = (Q_{LE,y} / CT_{LE,y}) \times DAF_{LE,w} \times EF_{LE,CO2/km} \quad (48)$$

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

$$EF_{LE,CO2/km} = VF_{LE,cons} \times D_{LE,fuel} \times NCV_{LE,fuel,y} \times EF_{LE,CO2,fuel} \quad (49)$$

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, as in the renewable energy project activities in this PoA, there are three types of emissions sources that are potentially significant (>10% of emission reductions) and attributable to the project activities.

$$LE_{renewable\ biomass,y} = LE_{shift,y} + LE_{production,y} + LE_{competing,y} \quad (50)$$

Where:

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

Leakage due to shifts of pre-project activities:

Applicable biomass is biomass from croplands or grasslands (non-woody) where in the absence of the project the land would be used as cropland/wetland.

Deforestation on other land areas as a result of shifts of pre-project activities might be the most important potential leakage source. For the assessment of whether a project activity results in deforestation elsewhere, it is necessary to evaluate whether there is significant land pressure in the area.

The possibility of leakage from the displacement of activities or people should be assessed considering the following indicators:

- Percentage of families/households of the community involved in or affected by the project activity displaced (from within to out of the project boundary) due to the project activity;
- Percentage of total production of the main produce (e.g., meat, corn) within the project boundary displaced due to the generation of renewable biomass.

If the value of these two indicators is lower than 10%, then leakage from this source is assumed to be zero. If the value of any of these two indicators is higher than 10% and less than or equal to 50%, then leakage shall be equal to 15% of the difference between baseline emissions and project emissions. If the value of any of these two indicators is larger than 50%, then this project is not eligible under this methodology.

Leakage due to emissions related to the production of the biomass

Applicable biomass is biomass from croplands or grasslands (non-woody) where in the absence of the project the land would be used as cropland/wetland and where in the absence of the project the land would be abandoned. Potentially significant emission sources from the production of renewable biomass can be:

$$LE_{production,y} = LE_{N2O,y} + LE_{clearance,y} \quad (51)$$

Where:

$LE_{production,y}$ Leakage due to emissions related to the production of the biomass (tCO_2e/yr)
$LE_{N2O,y}$ Direct N_2O emission as a result of nitrogen application (tCO_2e/yr)
$LE_{clearance,y}$ 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:

$$LE_{N2O,y} = (F_{SN,y} + F_{ON,y}) \times FE_1 \times MW_{N20} \times GWP_{N20} \quad (52)$$

$F_{SN,y}$ 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/ton N input)
MW_{N2O} Ratio of molecular weights of N_2O and N (44/28) (ton N_2O/ton N)
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:

(53)

(54)

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

Where the project activity involves the use of a type of renewable biomass that is not a biomass residues or waste, it should be demonstrated 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.

Leakage due to competing uses for the biomass

Applicable biomass is biomass residues or waste.

As per the guidance on leakage, if it is demonstrated at the beginning of each crediting period that the quantity of available biomass in the region (e.g., 50 km radius), is at least 25% larger than the quantity of biomass that is utilised including the project activity, then this source of leakage can be neglected otherwise this leakage shall be estimated and deducted from the emission reductions.

Below is the calculation for estimation of the excess biomass in the region and the leakage emission calculation if the biomass availability is less than 1.25 times the total biomass requirement.

$$FC_{BiomassDiff,y} = FC_{BiomassTotal,y} - (FC_{BiomassProject,y} + FC_{BiomassOther,y}) \times 1.25 \quad (55)$$

Where:

$FC_{BiomassDiff,y}$	Difference in quantity of total biomass and the required 25% larger than the combined usage (ton/yr)
$FC_{BiomassTotal,y}$	Total biomass quantity available in the region in year y (ton/yr)
$FC_{BiomassProject,y}$	Biomass quantity utilized by project activity in year y (ton/yr)
$FC_{BiomassOther,y}$	Biomass quantity utilized by other users in year y (ton/yr)

In case $FC_{BiomassDiff,y}$ is positive (+) then there would be no leakage, hence leakage will be zero. However, if $FC_{BiomassDiff,y}$ is negative (-), then leakage would be due to the use of an equivalent amount of fossil fuel in the region and the same shall be calculated using the following equation:

$$LE_{competing,y} = FC_{BiomassDiff} \times NCV_n \times EF_{CO2} \quad (56)$$

Where:

$LE_{competing,y}$	Leakage emissions during the year *y* (tCO_2e/yr)
$FC_{BiomassDiff,y}$	Quantity of biomass residue *n* used in the project activity during the year *y* for which leakage cannot be ruled out (ton/yr)

NCV_n	Net calorific value of the biomass residue type *n* for which leakage cannot be ruled out (TJ/ton)
EF_{CO2}	CO_2 emission factor of the most carbon intensive fuel used in the country (tCO_2e/TJ)
n	Biomass residue type *n* for which leakage cannot be ruled out

E.6.3. Data and parameters that are to be reported in CDM-SSC-CPA-DD form:

Data / Parameter:	ER_y
Data unit:	tCO_2e/yr
Description:	Emission reductions in year *y*
Source of data used:	Calculated, see equation 1
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	BE_y
Data unit:	tCO_2e/yr
Description:	Baseline emissions in year *y*
Source of data used:	Calculated, see equation 2
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Baseline emission parameters for AMS-III.AO

Data / Parameter:	$BE_{AMS-III.AO,y}$
Data unit:	tCO_2e/yr
Description:	Baseline emissions from SWDS and where applicable baseline emissions from AWMS
Source of data used:	Calculated, see equation 3
Value applied:	Calculated value
Justification of the choice of data or description of	-

measurement methods and procedures actually applied :	
Any comment:	-

Data / Parameter:	$BE_{SWDS,y}$
Data unit:	tCO_2e/yr
Description:	Methane emissions avoided during the year *y* from preventing waste disposal at the solid waste disposal site (SWDS) during the period from the start of the project activity to the end of the year *y*
Source of data used:	Calculated, see equation 4
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$BE_{manure,y}$
Data unit:	tCO_2e/yr
Description:	Baseline emissions from the manure co-digested by the project activities
Source of data used:	Calculated as per the relevant procedures of AMS-III.D. $BE_{manure,y} = BE_{AMS\text{-}III.D}$
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$MD_{reg,y}$
Data unit:	ton
Description:	Amount of methane that would have to be captured and combusted in the year *y* to comply with the prevailing regulations
Source of data used:	Applicable regulations
Value applied:	Country specific
Justification of the choice of data or description of measurement	-

methods and procedures actually applied :	
Any comment:	-

Data / Parameter:	□
Data unit:	-
Description:	Model correction factor to account for model uncertainties
Source of data used:	From "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"
Value applied:	0.9
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	*f*
Data unit:	
Description:	Fraction of methane captured at the SWDS and flared, combusted or used in another manner
Source of data used:	Written information from the operator of the solid waste disposal site and/or site visits at the solid waste disposal site
Value applied:	SWDS specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	GWP_{CH4}
Data unit:	tCO_2e/ tCH_4
Description:	Global Warming Potential (GWP) of methane, valid for the relevant commitment period
Source of data used:	Decisions under UNFCCC and the Kyoto Protocol (a value of 21 is to be applied for the first commitment period of the Kyoto Protocol)
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually	-

applied :	
Any comment:	-

Data / Parameter:	*OX*
Data unit:	Fraction
Description:	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data used:	Conduct a site visit at the solid waste disposal site in order to assess the type of cover of the solid waste disposal site. Use the IPCC 2006 Guidelines for National Greenhouse Gas Inventories for the choice of the value to be applied
Value 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
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	*F*
Data unit:	-
Description:	Fraction of methane in the SWDS gas (volume fraction)
Source of data used:	IPCC default
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	DOC_f
Data unit:	Fraction
Description:	Fraction of degradable organic carbon (DOC) that can decompose
Source of data used:	IPCC default
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually	-

applied :	
Any 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:	*MCF*
Data unit:	Fraction
Description:	Methane correction factor
Source of data used:	Default IPCC MCF values: • 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
Value applied:	SWDS specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any 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:	*DOCj*
Data unit:	Fraction
Description:	Fraction of degradable organic carbon (by weight) in the waste type *j*
Source of data used:	IPCC default (adapted from Volume 5, Tables 2.4 and 2.5) Apply the following values for the different waste types *j*:

Waste type j	DOC_j %wet waste	DOC_j % dry waste

	Wood and wood products	43	50
	Pulp, paper and cardboard (not sludge)	40	44
	Food, food waste, beverages and tobacco (not sludge)	15	38
	Textiles	24	30
	Garden, yard and park waste	20	49
	Glass, plastic, metal, other inert waste	0	0

Value applied:	Waste type specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	k_j
Data unit:	-
Description:	Decay rate for the waste type *j*
Source of data used:	IPCC default (adapted from Volume 5, Table 3.3) Apply the following default values for the different waste types *j*

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)
Slowly degrading	Pulp, paper, cardboard (other than sludge), textiles	0.04	0.06	0.045	0.07
Slowly degrading	Wood, wood products and straw	0.02	0.03	0.025	0.035
Moderately degrading	Other (non-food) organic putrescible garden and park waste	0.05	0.1	0.065	0.17
Rapidly degrading	Food, food waste, sewage sludge, beverages and tobacco	0.06	0.185	0.085	0.4

Value applied:	Waste type and climate specific
Justification of the choice of data or	-

description of measurement methods and procedures actually applied :	
Any comment:	-

Data / Parameter:	$W_{j,x}$
Data unit:	Ton
Description:	Total amount of organic waste prevented from disposal in year x (tons)
Source of data used:	Information from SWDS operator.
Value applied:	SWDS specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Baseline emission parameters for AMS-III.D

Data / Parameter:	$BE_{AMS\text{-}III.D,y}$
Data unit:	tCO_2e/yr
Description:	Baseline emissions from AWMS
Source of data used:	Calculated, see equation 6
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$BE_{stage\ 1,y}$
Data unit:	tCO_2e/yr
Description:	Baseline emissions from treatment stage 1 in year *y*
Source of data used:	Calculated, see equation 7
Value applied:	Calculated value
Justification of the choice of data or description of measurement	-

methods and procedures actually applied :	
Any comment:	-

Data / Parameter:	$BE_{stage\ 2,y}$
Data unit:	tCO_2e/yr
Description:	Baseline emissions from treatment stage 2 in year *y*
Source of data used:	Calculated, see equation 8
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$N_{LT,y}$
Data unit:	Numbers
Description:	Annual average number of animals of type "*LT*" in year *y*
Source of data used:	Calculated, see equation 9
Value applied:	Animal population specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$N_{da,y}$
Data unit:	Days
Description:	Number of days animals are alive in the farm in the year *y*
Source of data used:	Farm records. The number of days animals are alive on the farm is part of the production schedule.
Value applied:	Animal population specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$N_{p,y}$
Data unit:	Number
Description:	Number of animals produced/bought annually of type *LT* for the year *y*
Source of data used:	Farm records. The counting of animals populations is part of the production schedule. The responsibility of monitoring this parameter relies on each pen/barn's operator. The consistency between the value and indirect information (records of sales, records of food purchases) should be assessed.
Value applied:	Animal population specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$VS_{LT,y}$
Data unit:	Kg dm/animal/year
Description:	Volatile solids for livestock "LT" entering the animal manure management system in year *y* (on a dry matter weight basis, kg dm/animal/year)
Source of data used:	Calculated in equation 10
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$VS_{LT\ IPCC,y}$
Data unit:	Kg dm/animal/year
Description:	Volatile solids for livestock "LT" entering the animal manure management system in year *y* (on a dry matter weight basis, kg dm/animal/year). Default IPCC values used
Source of data used:	Calculated in equation 11
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-

Any comment:	-

Data / Parameter:	$VS_{default}$
Data unit:	Kg dm/animal/year
Description:	Volatile solids for livestock "LT" entering the animal manure management system in year *y* (on a dry matter weight basis, kg dm/animal/year)
Source of data used:	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. B_0 and VS values applicable to developed countries can be used provided the following four conditions are satisfied: • 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. Adjustment for animal weight: The chosen default values can be adjusted for animal weight based on site specific animal weights in accordance with the formula from AMS. III. D.
Value applied:	Animal specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	W_{site}
Data unit:	Kg
Description:	Average animal weight of a defined livestock population at the project site.
Source of data used:	Weighing of the animals is part of the production schedule.
Value applied:	Animal population specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-

Any comment:	-

Data / Parameter:	$W_{default}$
Data unit:	Kg
Description:	Default average animal weight of a defined population
Source of data used:	IPCC default, Volume 4 chapter 10 table 10 A-4 to 10 A-9
Value applied:	Animal population specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	nd_y
Data unit:	Days per year
Description:	The number of days that the animal manure management system capturing methane and flaring/combusting using methane was operational.
Source of data used:	Farm records
Value applied:	Plant specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$VS_{LT\ feed,y}$
Data unit:	Kg dm/animal/year
Description:	Volatile solids for livestock “LT” entering the animal manure management system in year *y* (on a dry matter weight basis, kg dm/animal/year)
Source of data used:	Calculated from feed intake levels using the enhanced characterisation method described section 10.2 in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 10. Calculated in equation 12
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	*DE_{LT}*
Data unit:	%
Description:	Digestible energy of the feed in percent
Source of data used:	IPCC default, Volume 4 chapter 10 table 10.2
Value applied:	Livestock specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	*UE*
Data unit:	Fraction of GE
Description:	Urinary energy expressed as fraction of GE
Source of data used:	IPCC default, Volume 4 chapter 10
Value applied:	Livestock specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	*ASH*
Data 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 used:	IPCC default, Volume 4 chapter 10
Value applied:	Livestock specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	*GE*
Data unit:	MJ/day
Description:	Gross energy intake

Source of data used:	Calculated in equation 13
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	DE_{MJ}
Data unit:	MJ DE/kg
Description:	Digestible Energy in feed per kg total digestible nutrition
Source of data used:	IPCC default, Volume 4 chapter 10
Value applied:	18.45
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	*% Body weight*
Data unit:	%
Description:	Recommended % of body weight for calculation
Source of data used:	IPCC default, Volume 4 chapter 10
Value applied:	Farm specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$B_{0,LT}$
Data unit:	m^3 CH_4/kg dm
Description:	Maximum methane producing potential of the volatile solid generated for animal type "*LT*"
Source of data used:	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. B_0 and VS values applicable to developed countries can be used provided the following four conditions are satisfied: • 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.
Value applied:	Animal specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	D_{CH4}
Data unit:	ton/m^3
Description:	Density of the methane
Source of data used:	Specified in AMS-III.D
Value applied:	0.00067, default value at standard temperature (20^{o}C) and pressure (1 atm).
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$MCF_{stage\ 1}$
Data unit:	Fraction
Description:	Annual methane conversion factor (MCF) for the baseline animal waste management system *j*
Source of data used:	IPCC default, Volume 4 chapter 10 table 10.17
Value applied:	Specific to manure management system en temperature
Justification of the choice of data or	-

description of measurement methods and procedures actually applied :	
Any comment:	-

Data / Parameter:	MCF_j
Data unit:	Fraction
Description:	Annual methane conversion factor (MCF) for the baseline animal waste management system *j*
Source of data used:	IPCC default, Volume 4 chapter 10 table 10.17
Value applied:	Specific to manure management system en temperature
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$MS\%_{stage\ 1,j}$
Data unit:	Fraction
Description:	Fraction of manure handled in stage 1 of the baseline manure management system *j*
Source of data used:	Farm records
Value applied:	Specific to animal manure management system
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$MS\%_{stage\ 2,j}$
Data unit:	Fraction
Description:	Fraction of manure handled in stage 2 of the baseline manure management system *j*
Source of data used:	Farm records
Value applied:	Specific to animal manure management system
Justification of the choice of data or description of	-

measurement methods and procedures actually applied :	
Any comment:	-

Data / Parameter:	UF_b
Data unit:	Fraction
Description:	Model correction factor to account for model uncertainties.
Source of data used:	Default value as per AMS III.D
Value applied:	0.94
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	*RVS*
Data unit:	%
Description:	Relative reduction of volatile solids from the previous treatment stage
Source of data used:	Conservative assumptions or defaults provided in AMSIII.D.
Value applied:	Specific to animal manure management system
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	GWP_{CH4}
Data unit:	tCO_2e/tCH_4
Description:	Global warming potential for CH4
Source of data used:	IPCC default
Value applied:	21 for the first commitment period. Shall be updated according to any future COP/MOP decisions.
Justification of the choice of data or description of measurement methods and procedures actually	-

applied :	
Any comment:	-

Baseline emission parameters for AMS-I.C

Data / Parameter:	$CH4_{total,y}$
Data unit:	Nm^3/yr
Description:	Total methane production in year *y*
Source of data used:	Calculated in equation 14
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$CH4_{WT,y}$; $CH_{BT,y}$; $CH4_{LT,y}$
Data unit:	Nm^3/yr
Description:	$CH4_{WT}$: Calculated methane production from each waste type from SWDS, *WT* $CH4_{BT}$: Calculated methane production from each biomass type, *BT* $CH4_{LT}$: Calculated methane production from each livestock type, *LT*
Source of data used:	$CH4_{WT}$: Calculated in equation 15 $CH4_{BT}$: Calculated in equation 17 $CH4_{LT}$: Calculated in equation 19
Value applied:	$CH4_{WT}$: Calculated value $CH4_{BT}$: Calculated value $CH4_{LT}$: Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	VS_{WT}; VS_{BT}; VS_{LT}
Data unit:	$m^3CH_4/kg\ VS_{added}$
Description:	VS_{WT}: Net quantity Volatile solids from each waste type from the SWDS in yr *y* VS_{BT}: Net quantity of Volatile solids from each biomass type in yr *y* VS_{LT}: Net quantity Volatile solids from each livestock type in yr *y*
Source of data used:	VS_{WT}: Calculated in equation 16 VS_{BT}: Calculated in equation 18

	VS_{LT}: Calculated in equation 20
Value applied:	VS_{WT}: Calculated value VS_{BT}: Calculated value VS_{LT}: Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	MPF_{WT}; MPF_{BT}; MPF_{LT}
Data unit:	m^3CH_4/kg VS_{added}
Description:	MPF_{WT}: CH4 production factor of volatile solids from each *WT* from SWDS MPF_{BT}: CH4 production factor of volatile solids from each biomass type MPF_{LT}: CH4 production factor of volatile solids from each livestock type
Source of data used:	Literature review and mass and energy balance
Value applied:	MPF_{WT}: Waste specific MPF_{BT}: Biomass specific $MPF_{LT:}$ Manure specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$B_{WT,y}$; $B_{BT,y}$
Data unit:	kgWW/yr
Description:	$B_{WT,y}$: Net quantity from each waste type from the SWDS in year *y* $B_{BT,y}$: Net quantity of each biomass type in year *y*
Source of data used:	Information from CPA participant
Value applied:	$B_{WT,y}$: CPA specific $B_{BT,y}$: CPA specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$\%water_{WT}$; $\%water_{BT}$
Data unit:	%
Description:	$\%water_{WT}$: Moisture content from each waste type from the SWDS $\%water_{BT}$: Moisture content of each biomass type
Source of data used:	Laboratory measurement.
Value applied:	$\%water_{WT}$: Waste type specific $\%water_{BT}$: Biomass type specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$\%VS_{WT}$; $\%VS_{BT}$
Data unit:	%
Description:	$\%VS_{WT}$: % volatile solids in the total solids from each waste type from SWDS $\%VS_{BT}$: % volatile solids in the total solids of each biomass type
Source of data used:	Laboratory measurement.
Value applied:	$\%VS_{WT}$: Waste type specific $\%VS_{BT}$: Biomass specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	VS_{lost}
Data unit:	%
Description:	Estimated percentage of VS lost before entering the digester
Source of data used:	Estimated in the mass and energy balance
Value applied:	Estimated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Baseline emission parameters for AMS-I.C. For project activities that install biomass thermal energy plants that produce renewable thermal energy for on-site consumption or for consumption by other facilities.

Data / Parameter:	$BE_{thermal\ CO2,y}$
Data unit:	tCO_2e/yr
Description:	The baseline emissions from thermal energy displaced by the project activity during the year *y*
Source of data used:	Calculated in equation 21
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$HG_{thermal,y}$
Data unit:	TJ/yr
Description:	Net quantity of thermal energy supplied by the project activity during the year *y*
Source of data used:	Calculated in equation 22
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$\eta_{BL,thermal}$
Data unit:	%
Description:	The efficiency of the plant using fossil fuel that would have been used in the absence of the project activity
Source of data used:	Baseline information, obtained as described in methodology AMS-I.C.
Value applied:	Baseline specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-

Any comment:	-

Data / Parameter:	$EF_{BL,CO2}$
Data 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 used:	Obtained from reliable local or national data if available; otherwise, IPCC default emission factors are used
Value applied:	Fuel specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$CH4_{total}$
Data unit:	Nm^3/yr
Description:	Total potential methane production in year *y*
Source of data used:	Calculated in equation 14
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	LHV_{CH4}
Data unit:	MJ/Nm^3
Description:	Methane lower heating value
Source of data used:	Literature. This value is used for emission reduction estimations by calculations, in the future the electricity/thermal energy will be monitored.
Value applied:	36
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$\eta_{thermal}$

Data unit:	%
Description:	Plant thermal efficiency
Source of data used:	Supplier information, the value for the specific generation installed will be used.
Value applied:	Plant specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$UT_{thermal}$
Data unit:	%
Description:	Thermal plant uptime
Source of data used:	Basic engineering package. This value is used for emission reduction estimations by calculations, in the future the electricity/thermal energy will be monitored.
Value applied:	Plant specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Baseline emission parameters for AMS-I.C. For project activities that install biomass cogeneration plants that produce electricity for supply to the grid or for captive use and/or thermal energy for on-site consumption or for consumption by other facilities.

Data / Parameter:	$BE_{cogen,y}$
Data unit:	tCO_2e/yr
Description:	Baseline emissions from the cogeneration project activity in year *y*
Source of data used:	Calculated in equation 23
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$BE_{elec,y}$
Data unit:	tCO_2e/yr
Description:	Baseline emissions from electricity supply to the grid in year *y*
Source of data used:	Calculated in equation 24
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$EG_{elec,y}$
Data unit:	MWh/yr
Description:	Net electricity supplied to the grid as a result of the implementation of the CDM project activity in year y
Source of data used:	Calculated in equation 25
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$EF_{CO2,grid,y}$
Data unit:	tCO_2e/MWh
Description:	CO_2 emission factor of the grid in year *y*
Source of data used:	Calculations was done according to “Tool to calculate the Emission Factor for an electricity system.”, see Annex 3.
Value applied:	1.04
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$EG_{gross,y}$
Data unit:	MWh/yr
Description:	Gross amount of electricity generated from biomass

Source of data used:	Calculated in equation 26
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	UT_{cogen}
Data unit:	%
Description:	Co-generation plant uptime (%)
Source of data used:	Basic engineering package. In the future the uptime will be monitored.
Value applied:	Plant specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	η_{cogen}
Data unit:	%
Description:	Co-generation electrical efficiency (%)
Source of data used:	Supplier information, the value for the specific generation installed will be used.
Value applied:	Plant specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$EG_{aux,y}$
Data unit:	MWh/yr
Description:	Auxiliary electricity consumption
Source of data used:	Calculated in equation 27
Value applied:	Calculated value
Justification of the	-

choice of data or description of measurement methods and procedures actually applied :	
Any comment:	-

Data / Parameter:	$\%_{aux}$
Data unit:	%
Description:	Percentage of electrical energy used by the auxiliary equipment for the cogeneration plant
Source of data used:	Basic engineering package. In the future the auxiliary electricity consumed will be monitored.
Value applied:	Plant specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$BE_{cogen\ thermal,,y}$
Data unit:	tCO_2e/yr
Description:	Baseline emissions from thermal energy displaced by the project activity in year *y*
Source of data used:	Calculated in equation 28
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$HG_{cogen,thermal,y}$
Data unit:	TJ/yr
Description:	Net quantity of cogeneration thermal energy supplied by the project activity during the year *y*
Source of data used:	Calculated in equation 29
Value applied:	Calculated value
Justification of the choice of data or	-

description of measurement methods and procedures actually applied :	
Any comment:	-

Data / Parameter:	$M_{exhauste\ gas}$
Data unit:	kg/year
Description:	Mass flow rate of the exhaust gas
Source of data used:	Basic engineering package
Value applied:	Plant specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$M_{mainwater\ cooling}$
Data unit:	kg/year
Description:	Mass flow rate of the main water cooling
Source of data used:	Basic engineering package
Value applied:	Plant specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	Cp_{water}
Data unit:	TJ/kg^{o}C
Description:	Water heat capacity
Source of data used:	Basic engineering package
Value applied:	Plant specific
Justification of the choice of data or description of measurement methods and procedures actually	-

applied :	
Any comment:	-

Data / Parameter:	$Cp_{exhange\ gas}$
Data unit:	TJ/kg^{o}C
Description:	Exhaust gas heat capacity
Source of data used:	Basic engineering package
Value applied:	Plant specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	T_{out}
Data unit:	^{o}C
Description:	Temperature out of generator
Source of data used:	Basic engineering package
Value applied:	Plant specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	T_{in}
Data unit:	^{o}C
Description:	Temperature of exhaust gas after recovery
Source of data used:	Basic engineering package
Value applied:	Plant specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	T_H

Data unit:	^{o}C
Description:	Hot water outlet temperature
Source of data used:	Basic engineering package
Value applied:	Plant specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	T_C
Data unit:	^{o}C
Description:	Return temp of water required to cool engin
Source of data used:	Basic engineering package
Value applied:	CPA specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Baseline emission parameters for AMS-I.C. For project activities that involve the addition of renewable energy units at an existing renewable energy production facility.

Data / Parameter:	$BE_{cogen,add,y}$
Data unit:	tCO_2e/yr
Description:	Baseline emissions from project activities that involve the addition of renewable co-generation units at an existing renewable energy production facility
Source of data used:	Calculated in equation 30
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$BE_{thermal,add,y}$

Data unit:	tCO_2e/yr
Description:	Thermal baseline emissions from project activities that involve the addition to renewable co-generation units at an existing renewable energy production facility
Source of data used:	Calculated in equation 31
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$HG_{thermal,PJ,y}$
Data unit:	TJ/yr
Description:	Total actual thermal energy produced in year *y* by all units, existing and new project units
Source of data used:	Calculated the same as $HG_{thermal,y}$ in section 1, using in equation 22. This value is used for emission reduction estimations by calculations, in the future the thermal energy will be monitored.
Value applied:	Plant specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$HG_{thermal,old,y}$
Data unit:	TJ/yr
Description:	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
Source of data used:	Calculated in equation 32
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$HG_{thermal,estimated,y}$
Data 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 used:	Calculated the same as $HG_{thermal,y}$ in section 1, using in equations 22.
Value applied:	Plant specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$BE_{elec,add,y}$
Data unit:	tCO_2e/yr
Description:	Electricity baseline emissions from project activities that involve the addition of renewable co-generation units at an existing renewable energy production facility
Source of data used:	Calculated in equation 33
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$EG_{elec,PJ,y}$
Data 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 used:	Calculated the same as $EG_{elec,y}$ in section 2.a, using in equation 25-27. This value is used for emission reduction estimations by calculations, in the future the electricity will be monitored.
Value applied:	Plant specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$EG_{elec,existing,y}$
Data unit:	MWh/yr
Description:	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
Source of data used:	Calculated in equation 34
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$EG_{elec,estimated,y}$
Data 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 used:	Calculated the same as $EG_{elec,y}$ in section 2.a, using in equation 25-27.
Value applied:	Plant specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Project emission parameters

Data / Parameter:	PE_y
Data unit:	tCO_2e/yr
Description:	Project emissions in year *y*
Source of data used:	Calculated in equation 32
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$PE_{PL,y}$
Data unit:	tCO_2e/yr
Description:	Emissions due to physical leakage of biogas in year *y*
Source of data used:	Calculated in equation 36
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	PE_{flare}
Data unit:	tCO_2e/yr
Description:	Emissions from biogas flaring the year *y*
Source of data used:	Calculated in equation 39
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$PE_{transp,y}$
Data unit:	tCO_2e/yr
Description:	Emissions from incremental transportation in the year *y*
Source of data used:	Calculated in equation 40
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$DAF_{w,WT}$; $DAF_{w,BL}$; $DAF_{w,LT}$; $DAF_{w,sludge}$
Data unit:	km/truck
Description:	$DAF_{w,WT}$: Average incremental distance for waste transportation from SWDS

	$DAF_{w,BT}$: Average incremental distance for biomass transportation $DAF_{w,LT}$: Average incremental distance for manure transportation DAF_{sludge}: Average incremental distance for sludge transportation
Source of data used:	Logbook from CPA participant
Value applied:	$DAF_{w,WT}$: CPA specific $DAF_{w,BT}$: CPA specific $DAF_{w,LT}$: CPA specific DAF_{sludge}: CPA specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$Q_{y,WT}$; $Q_{y,BL}$; $Q_{y,LT}$; $Q_{y,sludge}$
Data unit:	ton or m^3
Description:	$Q_{y,WT}$: Quantity of waste transported in the year y $Q_{y,BT}$: Quantity of biomass transported in the year y $Q_{y,LT}$: Quantity of raw manure transported in the year y $Q_{y,sludge}$: Quantity of digester sludge transported in year y
Source of data used:	Measurements by CPA participants
Value applied:	$Q_{y,WT}$: CPA specific $Q_{y,BT}$: CPA specific $Q_{y,LT}$: CPA specific $Q_{y,sludge}$: CPA specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$CT_{y,WT}$; $CT_{y,BT}$; $CT_{y,LT}$; $CT_{y,sludge}$
Data unit:	ton or m^3/truk
Description:	$CT_{y,WT}$: Average truck capacity for waste transportation from SWDS $CT_{y,BT}$: Average truck capacity for biomass transportation $CT_{y,LT}$: Average truck capacity for manure transportation $CT_{y,sludge}$: Average truck capacity for sludge transportation
Source of data used:	Information from CPA participant
Value applied:	$CT_{y,WT}$: CPA specific $CT_{y,BT}$: CPA specific

	$CT_{y,LT}$: CPA specific $CT_{y,sludge}$: CPA specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$EF_{CO2/km}$
Data unit:	tCO_2e/km
Description:	CO_2 emission factor from fossil fuel use due to transportation
Source of data used:	Calculated in equation 41
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	VF_{cons}
Data unit:	ℓ/km
Description:	Vehicle fuel consumption for transportation inside the project boundary
Source of data used:	Information from CPA participant
Value applied:	CPA specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$NCV_{fuel,y}$
Data unit:	TJ/kg or other unit
Description:	Calorific value of the fuel used for transportation inside the project boundary
Source of data used:	IPCC default
Value applied:	Fuel specific
Justification of the choice of data or	-

description of measurement methods and procedures actually applied :	
Any comment:	-

Data / Parameter:	D_{fuel}
Data unit:	kg/ℓ
Description:	Fuel density for fuel used for transportation inside the project boundary
Source of data used:	Literature
Value applied:	Fuel specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$EF_{CO2,fuel}$
Data unit:	tCO_2e/yr
Description:	CO_2 emission factor of the fossil fuel used for transport outside the project boundary
Source of data used:	IPCC default
Value applied:	Fuel specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$PE_{storage,y}$
Data unit:	tCO_2e/yr
Description:	Emissions from the storage of manure before being fed into the anaerobic digester
Source of data used:	Calculated in equation 42
Value applied:	Calculated value
Justification of the choice of data or description of measurement	-

methods and procedures actually applied :	
Any comment:	-

Data / Parameter:	*MS%*$_l$
Data unit:	%
Description:	Fraction of volatile solids handled by storage device *l*
Source of data used:	Basic engineering package
Value applied:	CPA specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	MCF_l
Data unit:	%
Description:	Annual methane conversion factor for the project manure storage device *l*
Source of data used:	IPCC default, Table 10.17, Chapter 10, Volume 4
Value applied:	CPA specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	AI_l
Data unit:	Days
Description:	Annual average interval between manure collection and delivery for treatment at a given storage
Source of data used:	Basic engineering package
Value applied:	Plant specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-

Any comment:	-

Data / Parameter:	k
Data unit:	-
Description:	Degradation rate constant (0.069)
Source of data used:	IPCC default, AMS-III.D
Value applied:	0.069
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$PE_{reswaste,y}$
Data unit:	tCO_2e/yr
Description:	In case residual wastes are subjected to anaerobic storage, or disposed in a landfill, methane emissions from storage/disposal of waste (tCO_2e)
Source of data used:	Calculated in equation 40
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	□
Data unit:	-
Description:	Model correction factor to account for model uncertainties
Source of data used:	From "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"
Value applied:	0.9
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	f_{RW}

Data unit:	%
Description:	Fraction of methane captured at the SWDS and flared, combusted or used in another manner
Source of data used:	Written information from the operator of the solid waste disposal site and/or site visits at the solid waste disposal site
Value applied:	SWDS specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	GWP_{CH4}
Data unit:	tCO_2/tCH_4
Description:	Global Warming Potential (GWP) of methane, valid for the relevant commitment period
Source of data used:	Decisions under UNFCCC and the Kyoto Protocol (a value of 21 is to be applied for the first commitment period of the Kyoto Protocol)
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	OX_{RW}
Data unit:	Fraction
Description:	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data used:	Conduct a site visit at the solid waste disposal site in order to assess the type of cover of the solid waste disposal site. Use the IPCC 2006 Guidelines for National Greenhouse Gas Inventories for the choice of the value to be applied
Value 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
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	*F*
Data unit:	-
Description:	Fraction of methane in the SWDS gas (volume fraction)
Source of data used:	IPCC default
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$DOC_{RW,f}$
Data unit:	Fraction
Description:	Fraction of degradable organic carbon (DOC) that can decompose
Source of data used:	IPCC default
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any 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:	MCF_{RW}
Data unit:	Fraction
Description:	Methane correction factor
Source of data used:	IPCC default
Value applied:	SWDS specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any 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:	$DOC_{RW,j}$
Data unit:	Fraction
Description:	Fraction of degradable organic carbon (by weight) in the waste type *j*
Source of data used:	IPCC default (adapted from Volume 5, Tables 2.4 and 2.5)
Value applied:	Waste specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	k_j
Data unit:	-
Description:	Decay rate for the waste type *j*
Source of data used:	IPCC default (adapted from Volume 5, Table 3.3)
Value applied:	Waste specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	Document in the CDM-PDD the climatic conditions at the SWDS site (temperature, precipitation and, where applicable, evapotranspiration). Use long-term averages based on statistical data, where available. Provide references

Data / Parameter:	$W_{RW,j,x}$
Data unit:	Tons
Description:	Total amount of sludge disposed in SWDS in year x (tons)
Source of data used:	Information from CPA participant
Value applied:	CPA specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$PE_{FF,y}$
Data unit:	tCO_2e/yr
Description:	Emissions from fossil fuel combustion in the project activity in year *y*
Source of data used:	Calculated in equation 44
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$FC_{i,y}$
Data unit:	Mass or volume unit/yr
Description:	Quantity of fossil fuel type *i* combusted in the project boundary in year *y*
Source of data used:	Information from CPA participant
Value applied:	CPA specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$NCV_{i,y}$
Data unit:	TJ/kg or other unit
Description:	Net calorific value of the fossil fuel type *i* combusted in the project activity
Source of data used:	IPCC default
Value applied:	Fuel specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$EF_{CO2,i}$
Data unit:	tCO_2/TJ
Description:	CO_2 emission factor of the fossil fuel type *i* used inside the project boundary
Source of data	Obtained from reliable local or national data if available, otherwise, IPCC default

used:	emission factors are used
Value applied:	Fuel specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Leakage emission parameters

Data / Parameter:	LE_y
Data unit:	tCO_2e/yr
Description:	Leakage emissions in year y
Source of data used:	Calculated with equation 42
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$LE_{collect/process/transp,y}$
Data unit:	tCO_2e/yr
Description:	Leakage emissions from collection/processing/transportation of biomass outside the project boundary during year *y*
Source of data used:	Calculated with equation 43
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$LE_{collect/process,y}$
Data unit:	tCO_2e/yr
Description:	Leakage emissions from collection/processing of biomass outside the project boundary during year *y*
Source of data	Calculated with equation 44

used:	
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$FC_{c,y}$
Data unit:	kg (or other unit)/yr
Description:	Quantity of fossil fuel type *c* combusted outside the project boundary in year *y*
Source of data used:	Information from CPA participant
Value applied:	Fuel specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$NCV_{c,y}$
Data unit:	TJ/kg
Description:	Net calorific value of the fossil fuel type *c* combusted outside project boundary
Source of data used:	IPCC default
Value applied:	Fuel specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$EF_{CO2,c}$
Data unit:	tCO_2e/TJ
Description:	CO_2 emission factor of the fossil fuel type *c* used outside project boundary
Source of data used:	Obtained from reliable local or national data if available, otherwise, IPCC default emission factors are used
Value applied:	Fuel specific
Justification of the choice of data or	-

description of measurement methods and procedures actually applied :	
Any comment:	-

Data / Parameter:	$LE_{transp,y}$
Data unit:	tCO_2e/yr
Description:	Leakage emissions from transportation of biomass outside the project boundary during year *y*.
Source of data used:	Calculated with equation 45
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$DAF_{LE,w}$
Data unit:	km/truck
Description:	Average incremental distance for biomass transportation outside project boundary
Source of data used:	Information from CPA participant
Value applied:	CPA specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$Q_{LE,y}$
Data unit:	ton or m^3
Description:	Quantity of biomass transported outside project boundary in the year *y* (ton)
Source of data used:	Information from CPA participant
Value applied:	CPA specific
Justification of the choice of data or description of measurement	-

methods and procedures actually applied :	
Any comment:	-

Data / Parameter:	$CT_{LE,y}$
Data unit:	ton or m^3/truck
Description:	Average truck capacity for transportation outside the project boundary
Source of data used:	Information from CPA participant
Value applied:	CPA specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$EF_{LE,CO2/km}$
Data unit:	tCO_2e/km
Description:	CO_2 emission factor from fossil fuel used for transportation outside boundary
Source of data used:	Calculated in equation 38
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	VF_{cons}
Data unit:	ℓ/km
Description:	Vehicle fuel consumption for transportation inside the project boundary
Source of data used:	Information from CPA participant
Value applied:	CPA specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$NCV_{fuel,y}$
Data unit:	TJ/kg or other unit
Description:	Calorific value of the fuel used for transportation inside the project boundary
Source of data used:	IPCC default
Value applied:	Fuel specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	D_{fuel}
Data unit:	kg/ℓ
Description:	Fuel density for fuel used for transportation inside the project boundary
Source of data used:	Literature
Value applied:	Fuel specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$EF_{CO2,fuel}$
Data unit:	tCO_2e/TJ
Description:	CO_2 emission factor of the fossil fuel used for transport outside project boundary
Source of data used:	IPCC default
Value applied:	Fuel specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$LE_{renewable\ biomass,y}$
Data unit:	tCO_2e/yr
Description:	Leakage emissions from project activities involving renewable biomass in yr *y*

Source of data used:	Calculated with equation 47
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	Land pressure
Data unit:	Level of pressure - high, medium, low
Description:	Evaluate whether there is significant land pressure in the area
Source of data used:	Information from CPA participant
Value applied:	CPA specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$\%_{households\ displaced}$
Data unit:	%
Description:	Percentage of families/households of the community involved in or affected by the project activity displaced (from within to out of the project boundary) due to the project activity
Source of data used:	Information from CPA participant
Value applied:	CPA specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$\%_{production\ displaced}$
Data unit:	%
Description:	Percentage of total production of the main produce (e.g., meat, corn) within the project boundary displaced due to the generation of renewable biomass.
Source of data	Information from CPA participant

used:	
Value applied:	CPA specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	LE_{shift}
Data unit:	tCO_2e/yr
Description:	Leakage shall be equal to 15% of the difference between baseline emissions and project emissions
Source of data used:	Information from CPA participant
Value applied:	CPA specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$LE_{production,y}$
Data unit:	tCO_2e/yr
Description:	Leakage due to emissions related to the production of the biomass
Source of data used:	Calculated with equation 48
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$LE_{N20,y}$
Data unit:	tCO_2e/yr
Description:	Direct N_2O emission as a result of nitrogen application within the project boundary
Source of data used:	Calculated with equation 49
Value applied:	Calculated value

Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$F_{SN,y}$
Data unit:	tonN/yr
Description:	Mass of synthetic fertilizer N applied adjusted for volatilization as NH_3 and NO_x
Source of data used:	Calculated with equation 50
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$F_{ON,y}$
Data unit:	tonN/yr
Description:	Mass of organic fertilizer N applied adjusted for volatilization as NH_3 and NO_x
Source of data used:	Calculated with equation 51
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	EF_1
Data unit:	ton N_2O-N/ton N input
Description:	Emission Factor for emissions from N inputs
Source of data used:	IPCC 2006 Guidelines Table 11.1
Value applied:	1%
Justification of the choice of data or description of measurement	-

methods and procedures actually applied :	
Any comment:	-

Data / Parameter:	MW_{N2O}
Data unit:	$tonN_2O$/ton N
Description:	Ratio of molecular weights of N_2O and N
Source of data used:	Chemistry
Value applied:	44/28
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	GWP_{N2O}
Data unit:	kg CO_2e/kgN_20
Description:	Global Warming Potential for N_2O
Source of data used:	IPCC default
Value applied:	310, valid for the first commitment period
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$M_{SFi,y}$
Data unit:	ton/yr
Description:	Mass of synthetic fertilizer type *i* applied in year *y*
Source of data used:	Information from CPA participant
Value applied:	CPA specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$M_{OFj,y}$
Data unit:	ton/yr
Description:	Mass of organic fertilizer type *j* applied in year *y*
Source of data used:	Information from CPA participant
Value applied:	CPA specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$Frac_{GASF}$
Data unit:	%
Description:	Fraction that volatilises as NH_3 and NO_x for synthetic fertilizers
Source of data used:	2006 IPCC guidelines Table 11.3
Value applied:	10% volatilises as NO_x and 20% as NH_3
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$Frac_{GASM}$
Data unit:	%
Description:	Fraction that volatilises as NH_3 and NO_x for organic fertilizers
Source of data used:	IPCC default
Value applied:	10% volatilises as NO_x and 20% as NH_3
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	NC_{SFi}
Data unit:	gN/100g fertilizer
Description:	Nitrogen content of synthetic fertilizer type *i* applied

Source of data used:	Producers of synthetic fertilizer purchased and used
Value applied:	Product specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	If producers do not provide data of nitrogen content, the nitrogen content should be determined by qualified lab

Data / Parameter:	NC_{OFj}
Data unit:	gN/100g fertilizer
Description:	Nitrogen content of organic fertilizer type *j* applied
Source of data used:	Producers of synthetic fertilizer purchased and used
Value applied:	Product specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	If producers do not provide data of nitrogen content, the nitrogen content should be determined by qualified lab

Data / Parameter:	*Demonstrate that the area where the biomass is grown is not a forest*
Data unit:	-
Description:	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.
Source of data used:	DNA forest definition
Value applied:	CPA specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$FC_{BiomassDiff,y}$
Data unit:	ton/yr

Description:	Difference in quantity of total biomass and the required 25% larger than the combined usage
Source of data used:	Calculated with equation 52
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$FC_{BiomassTotal,y}$
Data unit:	ton/yr
Description:	Total biomass quantity available in the region
Source of data used:	Information from CPA participant
Value applied:	CPA specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$FC_{BiomassProject,y}$
Data unit:	ton/yr
Description:	Biomass quantity utilized by project activity
Source of data used:	Information from CPA participant
Value applied:	CPA specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$FC_{BiomassOther,y}$
Data unit:	ton/yr
Description:	Biomass quantity utilized by other users
Source of data used:	Information from CPA participant

Value applied:	CPA specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$LE_{competing,y}$
Data unit:	tCO_2e/yr
Description:	Leakage emissions during the year *y*
Source of data used:	Calculated with equation 53
Value applied:	Calculated value
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	$EF_{CO2,n}$
Data unit:	tCO_2e/TJ
Description:	CO2 emission factor of the most carbon intensive fuel used in the country
Source of data used:	Information from CPA participant
Value applied:	Fuel specific
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

Data / Parameter:	NCV_n
Data unit:	TJ/kg
Description:	Net calorific value of the biomass residue type *n*
Source of data used:	Laboratory measurements
Value applied:	Biomass specific
Justification of the choice of data or description of	-

measurement methods and procedures actually applied :	
Any comment:	-

E.7. Application of the monitoring methodology and description of the monitoring plan:

E.7.1. Data and parameters to be monitored by each SSC-CPA:

Data / Parameter:	f
Data unit:	-
Description:	Fraction of methane captured at the SWDS and flared, combusted or used in another manner
Source of data to be used:	Written information from the operator of the solid waste disposal site and/or site visits at the solid waste disposal site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Measured value
Description of measurement methods and procedures to be applied:	Annually
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	W_x
Data unit:	ton
Description:	Total amount of organic waste prevented from disposal in year x (tons)
Source of data to be used:	Measurements by CPA participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Measured value
Description of measurement methods and procedures to be applied:	Logbook. Data will be transferred to a spreadsheet on a monthly basis
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	$p_{n,j,x}$
Data unit:	%

Description:	Weight fraction of the waste type *j* in the sample n collected during the year *x*
Source of data to be used:	Sample measurements by CPA participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Measured value
Description of measurement methods and procedures to be applied:	Sample the waste prevented from disposal, using the waste categories j, as provided in the table for DOCj and kj, and weigh each waste fraction. The size and frequency of sampling should be statistically significant with a maximum uncertainty range of 20% at a 95% confidence level. As a minimum, sampling should be undertaken four times per year.
QA/QC procedures to be applied:	-
Any comment:	This parameter only needs to be monitored if the waste prevented from disposal includes several waste categories j, as categorized in the tables for DOCj and kj

Data / Parameter:	*z*
Data unit:	Number
Description:	Number of samples collected during the year x
Source of data to be used:	CPA participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Measured value
Description of measurement methods and procedures to be applied:	Continuously, aggregated annually
QA/QC procedures to be applied:	-
Any comment:	This parameter only needs to be monitored if the waste prevented from disposal includes several waste categories j, as categorized in the tables for DOCj and kj

Baseline emission parameters for AMS-III.D

Data / Parameter:	W_{site}
Data unit:	Kg
Description:	Average animal weight of a defined livestock population at the project site.
Source of data to be used:	Measurements by CPA participants
Value of data applied for the purpose of	Measured value

calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	The weighing of animals populations is part of the production schedule. The responsibility of monitoring this parameter relies on each pen/barn's operator. Monitored monthly, archive electronically.
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	nd_y
Data unit:	Days per year
Description:	The number of days that the animal manure management system capturing methane and flaring/combusting using methane was operational.
Source of data to be used:	Recorded by CPA participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Recorded value
Description of measurement methods and procedures to be applied:	Logbook. Data will be transferred to a spreadsheet on a monthly basis
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	$N_{da,y}$
Data unit:	Days
Description:	Number of days animals are alive in the farm in the year *y*
Source of data to be used:	Recorded by CPA participants.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Recorded value
Description of measurement methods and procedures to be applied:	The animal stock and inlet program of animals (net inlet considering mortality) are recorded and archived electronically.
QA/QC procedures to be applied:	The counting of days is part of the production schedule. The responsibility of monitoring this parameter relies on each pen/barn's operator.
Any comment:	-

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

Data unit:	Number
Description:	Number of animals produced/bought annually of type *LT* for the year *y*
Source of data to be used:	Recorded by CPA participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Recorded value
Description of measurement methods and procedures to be applied:	The animal stock and inlet program of animals (net inlet considering mortality) are recorded and archived electronically.
QA/QC procedures to be applied:	The counting of animals populations is part of the production schedule. The responsibility of monitoring this parameter relies on each pen/barn's operator. The consistency between the value and indirect information (records of sales, records of food purchases) should be assessed.
Any comment:	-

Data / Parameter:	$MS\%_{i,y}$
Data unit:	Fraction
Description:	Fraction of manure handled in baseline animal manure management system *j*
Source of data to be used:	Measurements by CPA participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Measured value
Description of measurement methods and procedures to be applied:	Logbook. Data will be transferred to a spreadsheet on a monthly basis
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	*Soil application of the compost or slurry in agriculture or related activities.*
Data unit:	-
Description:	-
Source of data to be used:	Documentation of the sales or delivery of the compost final product/slurry. It shall also include an in situ verification of the proper soil application of the compost/slurry to ensure aerobic conditions for further decay.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-

Description of measurement methods and procedures to be applied:	Verification shall be done at representative sample of user sites. The conditions for proper soil application ensuring aerobic conditions can be established by a local expert taking into account the soil conditions, crop types grown and weather conditions.
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	$BG_{flare,y}$; $BG_{elec,y}$; $BG_{heat,y}$
Data unit:	Nm^3/yr
Description:	$BG_{flare,y}$: Biogas flow to the flare $BG_{elec,y:}$ Biogas flow to the electricity generation system $BG_{heat,y:}$ Biogas flow to the thermal energy generation system
Source of data to be used:	Data from flow meter
Value of data applied for the purpose of calculating expected emission reductions in section B.5	$BG_{flare,y}$: Measured value $BG_{elec,y:}$ Measured value $BG_{heat,y:}$ Measured value
Description of measurement methods and procedures to be applied:	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. The continuously monitored data will be downloaded and aggregated monthly and archived electronically.
QA/QC procedures to be applied:	Flow meters shall be subject to regular maintenance, testing and calibration according to manufacturer specifications.
Any comment:	-

Data / Parameter:	T_{biogas}
Data unit:	^oC
Description:	Temperature of the biogas
Source of data to be used:	Data from Thermocouple meter
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Measured value
Description of measurement methods and procedures to be applied:	Measure the temperature of the biogas when w_{CH4} is measured. Temperature will be used along with pressure to determine the density of the methane combusted. The continuously monitored data will be aggregated monthly, and archived electronically during the project activity.
QA/QC procedures to be applied:	Thermocouple meters shall be subject to regular maintenance, testing and calibration according to manufacturer specifications.
Any comment:	-

Data / Parameter:	P_{biogas}
Data unit:	kPa
Description:	Biogas pressure
Source of data to be used:	Pressure gauge
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Measured value
Description of measurement methods and procedures to be applied:	Measure the pressure of the biogas when w_{CH4} is measured. Pressure will be used along with temperature to determine the density of the methane combusted. The continuously monitored data will be aggregated monthly, and archived electronically during the project activity
QA/QC procedures to be applied:	Pressure gauges shall be subject to regular maintenance, testing and calibration according to manufacturer specifications.
Any comment:	-

Baseline emission parameters for AMS-I.C

Data / Parameter:	$B_{WT,y}$; $B_{BT,y}$
Data unit:	kgWW/yr
Description:	$B_{WT,y}$: Net quantity from each waste type from the SWDS in year *y* $B_{BT,y}$: Net quantity of each biomass type in year *y*
Source of data to be used:	From SWDS and biomass supplier
Value of data applied for the purpose of calculating expected emission reductions in section B.5	$B_{WT,y}$: Measured value $B_{BT,y}$: Measured value
Description of measurement methods and procedures to be applied:	Use mass or volume based measurements. Adjust for the moisture content in order to determine the quantity of dry biomass. And/or perform an annual energy/mass balance that is based on received quantities and stock. If more than one type of biomass is consumed, each shall be monitored separately. Continuously or estimate using annual mass/ energy balance.
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	$\%water_{WT}$; $\%water_{BT}$
Data unit:	%
Description:	$\%water_{WT}$: Moisture content from each waste type from the SWDS $\%water_{BT}$: Moisture content of each biomass type
Source of data to be used:	Laboratory measurements
Value of data applied for the purpose of calculating expected	$\%water_{WT}$: Measured value $\%water_{BT}$: Measured value

emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	Measurement in laboratories according to relevant national/international standards. The moisture content of biomass of homogeneous quality shall be monitored at least on a monthly basis. The weighted average should be calculated for each monitoring period and used in the calculations
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	$\%VS_{WT}$; $\%VS_{BT}$
Data unit:	%
Description:	$\%VS_{WT}$: % Volatile solids in the total solids from each waste type $\%VS_{BT}$: % Volatile solids in the total solids of each biomass type
Source of data to be used:	Laboratory measurements
Value of data applied for the purpose of calculating expected emission reductions in section B.5	$\%VS_{WT}$: Measured value $\%VS_{BT}$: Measured value
Description of measurement methods and procedures to be applied:	Measurement in laboratories according to relevant national/international standards. Measure the VS% based on dry biomass. Annual measurements.
QA/QC procedures to be applied:	Check the consistency of the measurements by comparing the measurement results with measurements from previous years, relevant data sources (e.g. values in the literature). If the measurement results differ significantly from previous measurements or other relevant data sources, conduct additional measurements.
Any comment:	-

Data / Parameter:	$EG_{gross,y}$; $EG_{aux,y}$; $EG_{import,y}$; $EG_{elec,PJ,y}$; $EG_{elec,actual,y}$
Data unit:	MWh/yr
Description:	$EG_{gross,y}$: Gross amount of electricity generated from biomass $EG_{aux,y}$: Auxiliary electricity consumption $EG_{import,y}$: Electricity import from the grid to the project power plant $EG_{elec,PJ,y}$: The total net electrical energy supplied to a grid or displaced from the grid in year y by all units, existing and new $EG_{elec,actual,y}$: 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 to be used:	Data from electricity power meter
Value of data applied for the purpose of calculating expected emission reductions in	$EG_{gross,y}$: Measured value $EG_{aux,y}$: Measured value $EG_{import,y}$: Measured value $EG_{elec,PJ,y}$: Measured value

section B.5	$EG_{elec,actual,y}$: Measured value
Description of measurement methods and procedures to be applied:	Electricity power meter. The continuously monitored data will be downloaded and aggregated monthly and archived electronically.
QA/QC procedures to be applied:	Electricity meters shall be subject to regular maintenance, testing and calibration according to manufacturer specifications.
Any comment:	-

Data / Parameter:	$HG_{thermal,y}$; $HG_{cogen,thermal,y}$; $HG_{thermal,PJ,y}$; $HG_{thermal,actual,y}$
Data unit:	TJ/yr
Description:	$HG_{thermal,y}$: Net quantity of thermal energy supplied by the project activity during the year *y* $HG_{cogen,thermal,y}$: Net quantity of cogeneration thermal energy supplied by the project activity during the year *y* $HG_{thermal,PJ,y}$: Total actual thermal energy produced in year *y* by all units, existing and new project units $HG_{thermal,actual,y}$: The actual, measured thermal energy production of the existing units in year *y*
Source of data to be used:	Heat generation is determined as the difference of the enthalpy of the steam or hot fluid and/or gases generated by the heat generation equipment and the sum of the enthalpies of the feed-fluid and/or gases blow-down and any condensate returns.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	$HG_{thermal,y}$: Measured value $HG_{cogen,thermal,y}$: Measured value $HG_{thermal,PJ,y}$: Measured value $HG_{thermal,actual,y}$: Measured value
Description of measurement methods and procedures to be applied:	The respective enthalpies should be determined based on the mass (or volume) flows, the temperatures and, in case of superheated steam, the pressure. Steam tables or appropriate thermodynamic equations may be used to calculate the enthalpy as a function of temperature and pressure. In case of equipment that produces hot water/oil this is expressed as difference in the enthalpy between the hot water/oil supplied to and returned by the plant. In case of equipment that produces hot gases or combustion gases, this is expressed as difference in the enthalpy between the hot gas produced and all streams supplied to the plant. The enthalpy of all relevant streams shall be determined based on the monitored mass flow, temperature, pressure, density and specific heat of the gas. In case the project activity is exporting heat to other facilities, the metering shall be carried out at the recipient's end and measurement results shall be cross checked with records for sold/purchased thermal energy (e.g. invoices/receipts). Continuous monitoring, aggregated annually
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	*M*
Data unit:	kg/hr or Nm^3/hr

Description:	Mass or volume flows of all relevant streams (hot air and/or hot steam)
Source of data to be used:	Data from flow meter
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Measured values
Description of measurement methods and procedures to be applied:	Flow meters. The continuously monitored data will be downloaded and aggregated monthly and archived electronically.
QA/QC procedures to be applied:	Flow meters will be calibrated as manufacturer specifications, or replaced when necessary. 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
Any comment:	-

Data / Parameter:	T
Data unit:	°C
Description:	Temperature of all relevant streams
Source of data to be used:	Data from thermocouple meter
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Measured values
Description of measurement methods and procedures to be applied:	Measure the temperature of the relevant streams by a thermocouple. The temperature will be used along with pressure to determine the density of the gas combusted. The continuously monitored data will be aggregated monthly, and archived electronically during the project activity.
QA/QC procedures to be applied:	Thermocouple meters shall be subject to regular maintenance, testing and calibration according to manufacturer specifications.
Any comment:	-

Data / Parameter:	P_{steam}
Data unit:	kPa
Description:	Steam pressure
Source of data to be used:	Data from pressure gauge
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Measured data
Description of measurement methods and procedures to be	Pressure gauge. The continuously monitored data will be aggregated monthly, and archived electronically during the project activity

applied:	
	Pressure gauges shall be subject to regular maintenance, testing and calibration according to manufacturer specifications.
Any comment:	-

Project emission and leakage emission parameters

Data / Parameter:	T_{flare}
Data unit:	^{o}C
Description:	Temperature in the exhaust gas of the flare
Source of data to be used:	Data from Thermocouple meter
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Measured value
Description of measurement methods and procedures to be applied:	Measure the temperature of the exhaust gas stream in the flare by a thermocouple. 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 meter. The continuously monitored data will be aggregated monthly, and archived electronically during the project activity.
QA/QC procedures to be applied:	Thermocouple meters shall be subject to regular maintenance, testing and calibration according to manufacturer specifications.
Any comment:	-

Data / Parameter:	P_{flare}
Data unit:	kPa
Description:	Pressure in the exhaust gas of the flare
Source of data to be used:	Pressure gauge
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Measured value
Description of measurement methods and procedures to be applied:	Measure the pressure of the exhaust gas stream in the flare when w_{CH4} is measured. Pressure will be used along with temperature to determine the density of the methane combusted. The continuously monitored data will be aggregated monthly, and archived electronically during the project activity
QA/QC procedures to be applied:	Pressure gauges shall be subject to regular maintenance, testing and calibration according to manufacturer specifications.
Any comment:	-

Data / Parameter:	w_{CH4}
Data unit:	Mass fraction
Description:	Methane content in the biogas
Source of data to be	Data from gas analyser

used:	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Measured value
Description of measurement methods and procedures to be applied:	The fraction of methane in the biogas will be measured with a continuous gas analyser. The gas analyzer work by absorption of the gas in a chemical reagent. Measurements can be on a wet or dry basis but done consistently and on the same basis as the biogas flow rate. Temperature and pressure will be measured simultaneously. The continuously monitored data will be aggregated monthly, and archived electronically during the project activity
QA/QC procedures to be applied:	Analyzers will be calibrated according to manufacturing specifications.
Any comment:	-

Data / Parameter:	$\eta_{flare,h}$
Data unit:	Fraction
Description:	Flare efficiency in hour *h*
Source of data to be used:	Default of 90% will be used except in circumstances where it does not operate in accordance with manufacturers specifications for enclosed flare
Value of data applied for the purpose of calculating expected emission reductions in section B.5	• 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*.
Description of measurement methods and procedures to be applied:	Based on exhaust gas temperature recorded by T_{flare} and monitored compliance with manufacturers specifications. The continuously monitored data will be aggregated hourly and archived electronically during the project activity.
QA/QC procedures to be applied:	Continuous check of compliance with the manufacturer's specifications of the flare device
Any comment:	-

Data / Parameter:	$FV_{RG,h}$
Data unit:	m^3/h
Description:	Volumetric flow rate of the residual gas in dry basis at normal conditions in hour h
Source of data to be used:	Data from flow meters
Value of data applied for the purpose of calculating expected	Measured value

emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	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. The continuously monitored data will be downloaded and aggregated hourly and archived electronically.
QA/QC procedures to be applied:	Flow meters shall be subject to regular maintenance, testing and calibration according to manufacturer specifications.
Any comment:	-

Data / Parameter:	$MS\%_l$
Data unit:	%
Description:	Fraction of volatile solids handled by storage device *l*
Source of data to be used:	Measurements by CPA participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Measured value
Description of measurement methods and procedures to be applied:	Logbook. Data will be transferred to a spreadsheet on a monthly basis
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	AI_l
Data unit:	days
Description:	Annual average interval between manure collection and delivery for treatment at a given storage
Source of data to be used:	Measurements by CPA participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Measured value
Description of measurement methods and procedures to be applied:	Logbook. Data will be transferred to a spreadsheet on a monthly basis
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	f_{RW}

Data unit:	
Description:	Fraction of methane captured at the SWDS and flared, combusted or used in another manner
Source of data to be used:	Written information from the operator of the solid waste disposal site and/or site visits at the solid waste disposal site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Measured value
Description of measurement methods and procedures to be applied:	Annual measurements
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	$W_{RW,j,x}$
Data unit:	ton
Description:	Total amount of sludge disposed in SWDS in year x
Source of data to be used:	Measurements by CPA participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Measured value
Description of measurement methods and procedures to be applied:	Logbook. Data will be transferred to a spreadsheet on a monthly basis
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	$Q_{y,WT}$; $Q_{y,BL}$; $Q_{y,LT}$; $Q_{y,sludge}$; $Q_{LE,y}$
Data unit:	ton or m^3
Description:	$Q_{y,WT}$: Quantity of waste transported in the year y $Q_{y,BT}$: Quantity of biomass transported in the year y $Q_{y,LT}$: Quantity of raw manure transported in the year y $Q_{y,sludge}$: Quantity of digester sludge transported in year y $Q_{LE,y}$: Quantity of biomass transported outside project boundary in yr y
Source of data to be used:	Measurements by CPA participants
Value of data applied for the purpose of calculating expected emission reductions in	$Q_{y,WT}$: Measured value $Q_{y,BT}$: Measured value $Q_{y,LT}$: Measured value $Q_{y,sludge}$: Measured value

section B.5	$Q_{LE,y}$: Measured value
Description of measurement methods and procedures to be applied:	Logbook. Data will be transferred to a spreadsheet on a monthly basis
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	$CT_{y,WT}$; $CT_{y,BT}$; $CT_{y,LT}$; $CT_{y,sludge}$; $CT_{LE,y}$
Data unit:	ton or m^3/truk
Description:	$CT_{y,WT}$: Average truck capacity for waste transportation from SWDS $CT_{y,BT}$: Average truck capacity for biomass transportation $CT_{y,LT}$: Average truck capacity for manure transportation $CT_{y,sludge}$: Average truck capacity for sludge transportation $CT_{LE,y}$: Average truck capacity for biomass transported outside boundary
Source of data to be used:	Measurements by CPA participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	$CT_{y,WT}$: Measured value $CT_{y,BT}$: Measured value $CT_{y,LT}$: Measured value $CT_{y,sludge}$: Measured value $CT_{LE,y}$: Measured value
Description of measurement methods and procedures to be applied:	Logbook. Data will be transferred to a spreadsheet on a monthly basis
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	$DAF_{w,WT}$; $DAF_{w,BT}$; $DAF_{w,LT}$; $DAF_{w,sludge}$; $DAF_{LE,w}$
Data unit:	km/truck
Description:	$DAF_{w,WT}$: Incremental distance for waste transportation from SWDS $DAF_{w,BT}$: Incremental distance for biomass transportation $DAF_{w,LT}$: Incremental distance for manure transportation DAF_{sludge}: Incremental distance for sludge transportation $DAF_{LE,w}$: Incremental distance for biomass transportation outside boundary
Source of data to be used:	Measurements by CPA participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	$DAF_{w,WT}$: Measured value $DAF_{w,BT}$: Measured value $DAF_{w,LT}$: Measured value DAF_{sludge}: Measured value $DAF_{LE,w}$: Measured value
Description of measurement methods and procedures to be applied:	Logbook. Data will be transferred to a spreadsheet on a monthly basis

QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	VF_{cons}: $VF_{LE,cons}$
Data unit:	ℓ/km
Description:	$VF_{LE,cons}$: Vehicle fuel consumption for transportation inside boundary $VF_{LE,cons}$: Vehicle fuel consumption for transportation outside boundary
Source of data to be used:	Measurements by CPA participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	$VF_{LE,cons}$: Measured value $VF_{LE,cons}$: Measured value
Description of measurement methods and procedures to be applied:	Logbook. Data will be transferred to a spreadsheet on a monthly basis
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	$NCV_{i,y}$; $NCV_{c,y}$; $NCV_{fuel,y}$; $NCV_{LE,fuel,y}$
Data unit:	TJ/kg or other unit
Description:	$NCV_{i,y}$: Net calorific value of the fossil fuel type *i* combusted in the project activity in year y $NCV_{c,y}$: Net calorific value of the fossil fuel type *c* combusted outside the project boundary in year y $NCV_{fuel,y}$: Netc calorific value of the fuel used for project activity transportation in year y $NCV_{LE,fuel,y}$: Net calorific value of the fuel used for transport outside the project boundary in year y
Source of data to be used:	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 project participants	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%	If a) is not available

	<table><tr><td>confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines</td><td></td></tr></table>
Value of data applied for the purpose of calculating expected emission reductions in section B.5	$NCV_{i,y}$: Monitored value $NCV_{c,y}$: Monitored value $NCV_{fuel,y}$: Monitored value $NCV_{LE,fuel,y}$: Monitored value
Description of measurement methods and procedures to be applied:	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 to be applied:	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.
Any comment:	-

Data / Parameter:	$EF_{CO2,i}$; $EF_{CO2,c}$; $EF_{CO2,fuel}$; $EF_{LE,CO2,fuel}$
Data unit:	tCO_2e/TJ
Description:	$EF_{CO2,i}$: CO_2 emission factor of the fossil fuel type *i* used inside the project boundary $EF_{CO2,c}$: CO_2 emission factor of the fossil fuel type *c* used outside project boundary $EF_{CO2,fuel}$: CO_2 emission factor of the fossil fuel used for transport inside the project boundary $EF_{LE,CO2,fuel}$: CO_2 emission factor of the fossil fuel used for transport outside the project boundary
Source of data to be used:	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</td></tr><tr><td>b) Measurements by the project participants</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</td><td>If a) is not available</td></tr></table>

	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
Value of data applied for the purpose of calculating expected emission reductions in section B.5	$EF_{CO2,i}$: Measured value $EF_{CO2,c}$: Measured value $EF_{CO2,fuel}$: Measured value $EF_{LE,CO2,fuel}$: Measured value
`Description of measurement methods and procedures to be applied:	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 to be applied:	-
Any comment:	-

Data / Parameter:	$FC_{i,y}$; $FC_{c,y}$
Data unit:	Mass or volume unit/yr
Description:	$FC_{i,y}$: Quantity of fossil fuel type *i* combusted in the project boundary $FC_{c,y}$: Quantity of fossil fuel type *c* combusted outside project boundary
Source of data to be used:	Onsite measurements
Value of data applied for the purpose of calculating expected emission reductions in section B.5	$FC_{i,y}$: Measured value $FC_{c,y}$: Measured value
Description of measurement methods and procedures to be applied:	• 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.
QA/QC procedures to be applied:	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.
Any comment:	-

Data / Parameter:	$M_{SFi,y}$
Data unit:	ton/yr
Description:	Mass of synthetic fertilizer type *i* applied in year *y*
Source of data to be used:	Record of synthetic fertilizer purchased and used
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Measured value
Description of measurement methods and procedures to be applied:	Keep record of quantities purchased and used
QA/QC procedures to be applied:	Cross check with synthetic fertilizer purchased and quantity used and total area applied.
Any comment:	-

Data / Parameter:	$M_{OFj,y}$
Data unit:	ton/yr
Description:	Mass of organic fertilizer type *j* applied in year *y*
Source of data to be used:	Record of synthetic fertilizer purchased and used
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Measured value
Description of measurement methods and procedures to be applied:	Keep record of quantities purchased and used
QA/QC procedures to be applied:	Cross check with synthetic fertilizer purchased and quantity used and total area applied.
Any comment:	-

Data / Parameter:	NC_{SFi}
Data unit:	gN/100g fertilizer
Description:	Nitrogen content of synthetic fertilizer type *i* applied
Source of data to be used:	Producers of synthetic fertilizer purchased and used
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Recorded values

Description of measurement methods and procedures to be applied:	Keep record of nitrogen content from producers
QA/QC procedures to be applied:	-
Any comment:	If producers do not provide data of nitrogen content, the nitrogen content should be determined by qualified lab

Data / Parameter:	NC_{OFj}
Data unit:	gN/100g fertilizer
Description:	Nitrogen content of organic fertilizer type *j* applied
Source of data to be used:	Producers of synthetic fertilizer purchased and used
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Recorded values
Description of measurement methods and procedures to be applied:	Keep record of nitrogen content from producers
QA/QC procedures to be applied:	-
Any comment:	If producers do not provide data of nitrogen content, the nitrogen content should be determined by qualified lab

E.7.2. Description of the monitoring plan for a SSC-CPA:

Each of the SSC-CPA activities will develop an operations plan that defines a standard against which the project performance will be measured in terms of its emission reductions and conformance with all standards and criteria under the PoA. It assists the project operator in establishing a credible, transparent, and adequate data measurement, collection, recording and management system to coordinate all the monitoring requirements for generating certified emission reductions from their project and for ensuring compliance of the SSC-CPA with the CME obligations under the PoA. The SSC-CPA Operations Plan outlines the following plan:

a) Monitoring:

Parameters to be monitored are those described in section E.7.1. These parameters to be included in an individual SSC-CPA will be based on the situation of the SSC-CPA.

Data variables that are most directly related to the emission reductions will be measured continuously. Data elements that are generally constant and indirectly related to the emission reductions will be measured or calculated at least once in an year. All data will be electronically archive on SCAPA (Supervisory control and Data Acquisition) as part of monitoring for a period of two years from the end of the crediting period.

b) Quality Assurance and Quality Control:

The proponent will have a quality assurance and quality control plan in order to ensure that monitoring is done accurately and with properly calibrated instruments. The basic requirements are outlined in section E.7.1.

c) Calculation of emissions reductions:

Based on the monitoring data the emission reductions will be calculated *ex-post* using the following approach:

Emission reduction determined ex post for AMS-III.AO or AMS-III.D:

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

$$ER_{y,ex\ post} = \min\left[BE_{y,ex\ post} - PE_{y,ex\ post}),\ (MD_y - PE_{y,ex\ post})\right]$$

$ER_{y,expost}$	Emission reductions achieved by the project activity based on monitored values for year *y* (tCO_2e)
$BE_{y,expost}$	Baseline emissions calculated using *ex post* monitored values for year y (tCO_2e)
$PE_{y,expost}$	Project emissions calculated using *ex post* monitored values for year y (tCO_2e)
MD_y	Methane captured and destroyed or used gainfully by the project activity in year *y* (tCO_2e)

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

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

Where:

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

Emission reduction determined ex post for AMS-I.C:

Electricity en thermal energy will be measured and monitored *ex post*, using calibrated meters.

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

>>
15/06/2011
Isabelle Barnard, Farmsecure Carbon (Pty) Ltd

Annex 1

CONTACT INFORMATION ON COORDINATING/MANAGING ENTITY and PARTICIPANTS IN THE PROGRAMME of ACTIVITIES

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Direct tel:	
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding was used in this PoA and related CPA's.

Annex 3

BASELINE INFORMATION

Application of the "Tool to calculate the emission factor for an electricity system" Version 02.2.0

The methodological tool to calculate the emission factor for an electricity system determines the CO_2 emission factor for the displacement of electricity generated by power plants in an electricity system, by calculating the "operating margin" (OM) and "build margin" (BM) as well as the "combined margin" (CM). The operating margin refers to existing power plants whose electricity generation would be affected by the proposed CDM project activity. The build margin reflect the power units whose construction would be affected by the proposed CDM project activity. The tool follows six steps in order to calculate the operating margin, build margin and the combined margin:

Step 1: Identify the relevant electric power system
Step 2: Select an operating margin method
Step 3: Calculation of the operating margin emission factor
Step 4: Identify the cohort of power units to be included in the build margin
Step 5: Calculate the build margin emission factor
Step 6: Calculate the combined margin emission factor

STEP 1: IDENTIFY THE RELEVANT ELECTRICITY SYSTEMS

This tool will serve project activities that prospect displace grid electricity in countries that form part of the Southern African Power pool.

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.

None of the DNAs of Southern African countries have published delineations of their project electricity systems or connected electricity systems. There is however information available on the countries that is part of the SAPP grid[5]; generated and exported electricity[6], as well as connected transmission lines between countries and the maximum ratings[7].

The countries that are *physically connected* in the SAPP are (excluding countries that are part of SAPP, but not connected) (connected utilities indicated in brackets):

- Namibia (NamPower);

[5] The Southern African Power Pool, 2007, *SAPP Grid*, http://www.sapp.co.zw/viewinfo.cfm?id=7&linkid12&siteid=1
[6] The Southern African Power Pool, *Annual Reports*, http://www.sapp.co.zw/viewinfo.cfm?id=71&linkid=2&siteid=1
[7] The Southern African Power Pool, 2007, *Interconnector limits*, http://www.sapp.co.zw/viewinfo.cfm?id=74&linkid=12&siteid=1

- South Africa (Eskom and non-Eskom stations);
- Zimbabwe (ZESA);
- Zambia (ZESCO);
- Mozambique (EDM);
- Botswana (BPC);
- Democratic Republic of Congo (SNEL);
- Lesotho (LEC);
- Swaziland (SEB).

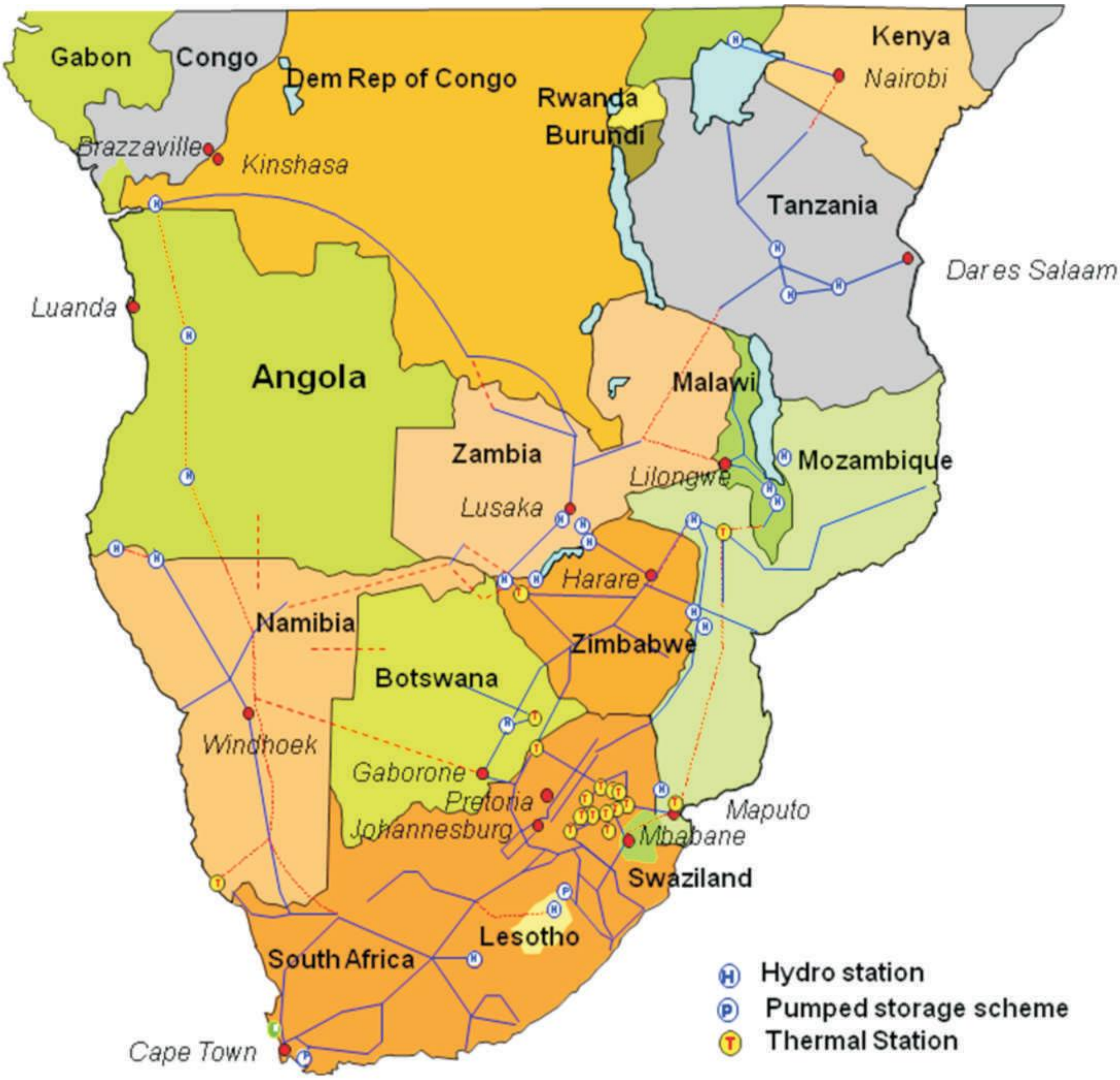

Figure 1: The SAPP Grid.

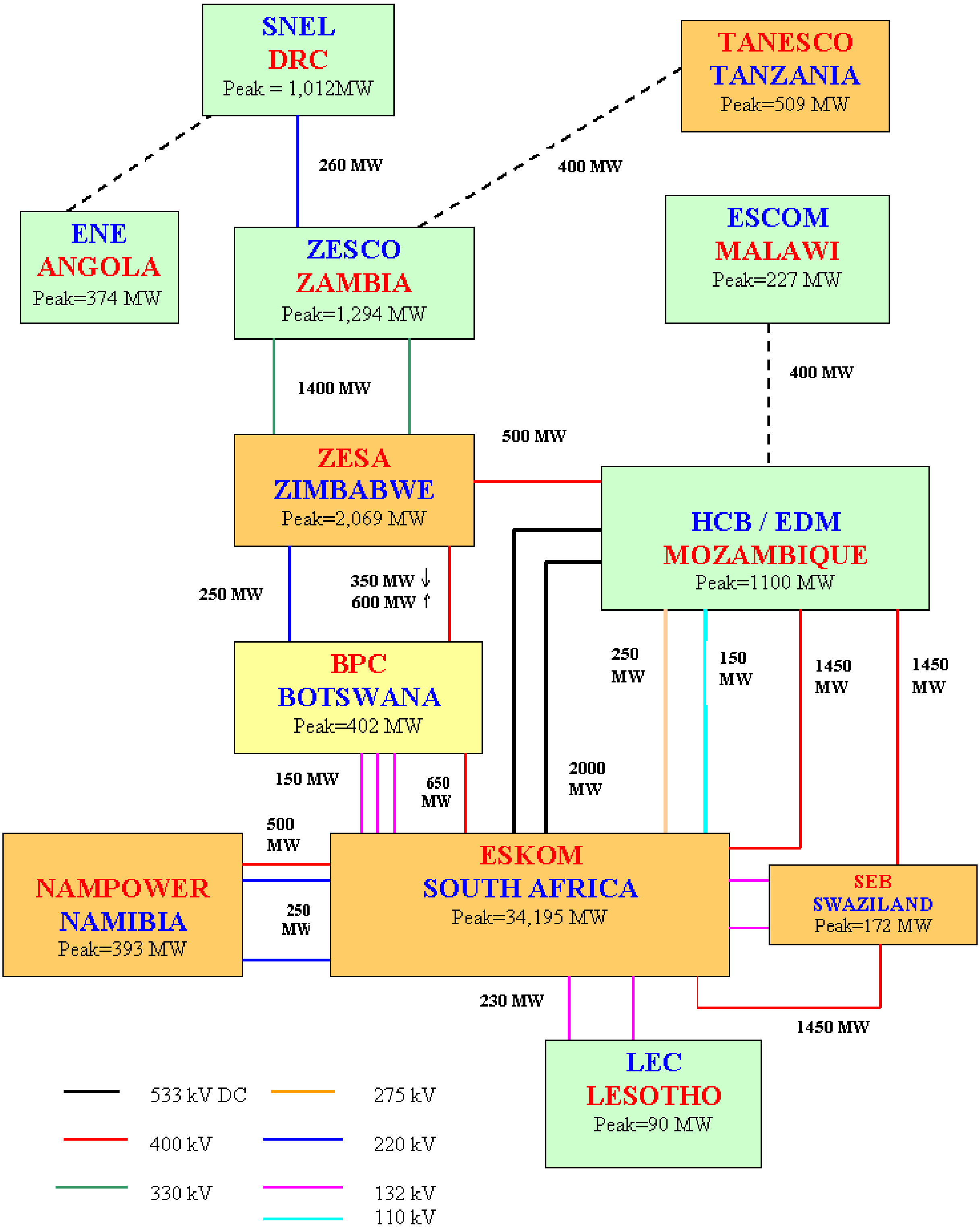

Figure 2: SAPP interconnector limits.

The Caprivi link is an interconnector (not indicated in Figure 1) that is currently under construction between Zimbabwe and Namibia. It will supply 150 megawatts (MW) of electricity from Hwange power station to Namibia. The Caprivi Link is part of the ZIZABONA project and the power line from Hwange in Zimbabwe to Livingstone in Zambia is expected to be completed by December 2010[8]. This link will not be considered in calculations.

To determine which of the connected utilities are part of the **project electricity system** and which are **connected electricity systems**, the existence of significant transmission constraints between utilities has to be determined.

The existence of significant transmission constrains from the connected electricity system to the project electricity system are determined by the following criteria:

- In case of electricity systems with spot markets for electricity: there are differences in electricity prices (without transmission and distribution costs) of more than 5 percent between the systems during 60 percent or more of the hours of the year
- The transmission line operates at 90% or more of its rated capacity during 90% percent or more of the hours of the year.

Spot markets are not applicable for this electricity system. The SAPP does have a Short Term Energy Market (STEM). STEM is designed to be a day-ahead market and compliments the bilateral market through the provision of another technique for the pricing of electrical energy. A day-ahead market is a physical market where prices and amounts are based on supply and demand. SAPP said in 2004: "*The ambition of SAPP is to establish a regional spot market where electricity would be traded in real time and provide the necessary basis for the development of subsequent financial markets*"[9]. This has not been implemented to date as the STEM "Book of Rules" currently in use is still the 2003 version[10]

A 3-year average (2007-2009 financial years; 1 April – 31 March) for each utility's electricity combined imports and exports are obtained from the SAPP annual reports. This is used, together with 90% of the rated interconnector limits (illustrated in Figure 2) to calculate the percentage of hours in a year operated at 90% of rated capacity.

It was found that there is no significant transmission constrains between any of the connected SAPP countries, and thus no **connected electricity systems**. Therefore, all the suppliers listed on pg. 1 comprise the **project electricity system**, from which the project activity sources electricity.

STEP 2: CHOSE WHETHER TO INCLUDE OFF-GRID POWER PLANTS IN THE PROJECT ELECTRICITY SYSTEM (OPTIONAL)

The grid emission factor is calculated from only grid power plants (Option I). Off-grid power plants are not included in the calculations.

[8] Informante, *Simasiku on Caprivi link project and Hwange*, Administrator, 14 January 2010, http://www.informante.web.na/index.php?option=com_content&task=view&id=5570&Itemid=108&PHPSESSID=b4dcfee218fc205d8efdeb7968b06910

[9] Dr. L. Musaba, P. Naidoo, W. Balet and A. Chikova, Developing a competitive market for regional electricity cross border trading: The case for the Southern African Power Pool, http://www.sapp.co.zw/documents/P12%20-%20SAPP%20Publication%20for%20IEE%20-%20JAN%202004.pdf as accessed on 2 June 2010

[10] http://www.sapp.co.zw/docs/STEM%20Book%20of%20Rules%20-%20%20APRIL%202003.pdf as accessed on 2 June 2010

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 total generated electricity for the different utilities were obtained from the SAPP annual reports, but data for the electricity resources and generation capacities were not readily available in the public domain. The source and type of data that were used to establish the low-cost/must-run resources of each utility can be found in Table 1 (actual values used are shown in Table 4).

Table 1: Utility power generation resources

Country (Utility)	Data description	Source
Namibia (NamPower)	General fractions for different electricity production resources	Developing Renewables, *Country Energy Information, Namibia*, 2006, http://www.energyrecipes.org/reports/genericData/Africa/061129%20RECIPES%20country%20info%20Namibia.pdf
South Africa (Eskom)	Actual generation (GWh) for 2006-2008.	Eskom Holdings Limited, 2009, *Eskom Annual Report 2009*, http://www.eskom.co.za/annreport09/
Zimbabwe (ZESA)	Generation capacity (MW) of different resources.	Stuart Doran, 2009, *Zimbabwe's economy*, http://www.thebrenthurstfoundation.org/Files/Brenthurst_Commisioned_Reports/BD0908-Zimbabwe.pdf
Zambia (ZESCO)	General fractions for different electricity production resources	ZESCO official website, http://www.zesco.co.zm/index.php?option=com_content&task=view&id=1&Itemid=
Mozambique (EDM)	Actual generation (GWh) for 2000-2004 (average taken).	*Brief analysis of energy sector in Mozambique*, EDM Annual Statistical Reports 2000-2004, http://www.mozergy.com/articles/MozambiqueEnergyOverview.pdf
Botswana (BPC)	General fractions for different electricity production resources	Nationmaster website, http://www.nationmaster.com/country/bc-botswana/ene-energy
Democratic Republic of Congo (SNEL)	General fractions for different electricity production resources	Geni website and SAPP, http://www.geni.org/globalenergy/library/national_energy_grid/democratic-republic-of-the-congo/demrepubliccongonationalelectricitygrid.shtml
Lesotho (LEC)	General fractions for different electricity production resources	The Southern African Power Pool, 2007, *SAPP Grid*, http://www.sapp.co.zw/viewinfo.cfm?id=7&linkid12&siteid=1

The average percentage of low-cost/must-run resources, for the entire SAPP grid, amount to 15.79% of the total grid generation. Therefore, Option (a) is applicable to the SAPP grid emission factor calculations.
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 2006 – 31 March 2009 (SAPP 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

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 B is used for calculating the simple OM. The calculations in this option are based on the total net electricity generation of all power plants serving the system and the fuel types and fuel consumption of the project electricity system. Option B is used seeing that:

a) The necessary data for Option A (electricity generation and emission factor for each power unit) is not available; and
b) Only nuclear and renewable power generation are considered as low-cost/must-run power sources and the quantity of electricity supplied to the grid by these sources is know; and
c) Off-grid power plants are not included in the calculation.

In addition to data and sources already provided in this report, Table 2 depicts data descriptions and sources that were used in the calculation of the simple OM (actual values used can be found in Tables 3 and 4).

Table 2: Other data used in calculations

Country (Utility)	Data description	Source
Namibia (NamPower)	Fuel efficiencies for Paratus and Van Eck power stations.	Republikein, *Namibia's power is in your hands; Use it wisely*, April 2008, www.republikein.com.na/fileadmin/pdf/2008/nampower.pdf
South Africa (Eskom)	Coal-fired stations fuel efficiency (average for all stations).	Eskom Holdings Limited, 2009, *Eskom Annual Report 2009*, http://www.eskom.co.za/annreport09/
South Africa (Eskom)	Gas turbine stations fuel efficiency (average for all stations).	Eskom Website (data used for 2005; latest available), http://www.eskom.co.za/live/content.php?Item_ID=4226&Revision=en%2F0
Zimbabwe (ZESA)	Fuel efficiency of Hwange coal-fired station.	UNFCCC website (data used from previous project), http://unfccc.int/kyoto_mechanisms/aij/activities_implemented_jointly/items/1886.php
Zimbabwe (ZESA)	Net calorific value (NCV) and emission factor (EF) for Zimbabwean coal.	UNFCCC website (data used from previous project), http://unfccc.int/kyoto_mechanisms/aij/activities_implemented_jointly/items/1886.php
General	NCV and EF for sub-bituminous coal and heavy fuel oil (HFO) (residual fuel oil values used from IPCC).	*2006 IPCC Guidelines for National Greenhouse Gas Inventories*

Equation 7 (in the methodological tool) is used to calculate the average OM:

$$EF_{grid,OMsimple,y} = \frac{\sum_i (FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y})}{EG_y} \quad (7)$$

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.

The constants used in calculations appear in Table 3, while all the values and final calculated operating margin emission factor can be seen in Table 4.

Table 3: Constants used in calculations (refer to Table 2 for references)

Constants		
$NCV_{sub\text{-}bituminous\ coal}$	18.9	GJ/T
$NCV_{HFO\ (Residual\ Fuel\ Oil)}$	40.4	GJ/T
$NCV_{kerosene}$	43.8	GJ/T
$EF_{CO2,\ sub\text{-}bituminous\ coal}$	0.0961	tCO_2/GJ
$EF_{CO2,HFO\ (Residual\ Fuel\ Oil)}$	0.0774	tCO_2/GJ
$EF_{CO2,kerosene}$	0.0719	tCO_2/GJ
$Density_{HFO\ (Residual\ Fuel\ Oil)}$	930	kg/m^3
$NCV_{coal,\ Zimbabwean}$	25.75	GJ/T
$EF_{CO2,coal,\ Zimbabwean}$	0.0946	tCO_2/GJ

Table 4: Electricity generation, fuel consumption, and calculated OM

Supplier	3 yr avg. (GWh)	Fuel Efficiency (T/GWh)	Fuel Consumed (T)	$EF_{grid,OMsimple}$ (tCO2/MWh)
Namibia (NamPower)	1,584.67	-	-	**1.04**
Hydro (Ruacana)	1,537.13	-	-	
Heavy Fuel Oil (Paratus)	47.54	260.40	12,379.42	
Coal (van Eck)	-	570.00	-	
South Africa (Eskom)	230,011.67	-	-	
Coal Fired	213,459.10	552.70	117,979,150.89	

Hydroelectric	1,361.91	-	-	
Pumped-storage	1,935.18	-	-	
Gas turbine (kerosene)	404.07	365.50	147,688.57	
Nuclear power	7,522.33	-	-	
Zimbabwe (ZESA)	7,781.00	-	-	
Coal (Hwange)	1,897.80	505.00	958,391.46	
Hydro (Kariba)	5,883.20	-	-	
Zambia (ZESCO)	9,771.00	-	-	
Hydro	9,761.23	-	-	
Diesel	9.77	No Data	No Data	
Mozambique (EDM)	261.67	-	-	
Hydro	223.90	-	-	
Diesel	37.77	No Data	No Data	
Botswana (BPC)	728.00	-	-	
Coal Fired	696.84	No Data	No Data	
Oil	31.16	No Data	No Data	
DRC (SNEL)	7,345.33	-	-	
Hydro	7,345.33	-	-	
Lesotho (LEC)	479.33	-	-	
Hydro	479.33	-	-	
Swaziland (SEB)	137.30	-	-	

STEP 5: IDENTIFY THE GROUP OF POWER UNITS TO BE INCLUDED IN THE BUILD MARGIN (BM)

The build margin must consist of either:

a) The set of five power plants most recently built; or
b) The set of power capacity additions in the electricity system that comprise 20% of the system generation and that have been most recently built.
c)

The set of power plants that comprise the larger annual generation should be used.

Only data from NamPower, Eskom, and ZESA are available in the public domain, therefore Option (a) is used.

In order to determine the vintage of data, one of the following options must be selected:

Option 1: For the first crediting period, calculate the build margin emission factor *ex ante* based on the most recent information available at the time of CDM-PDD submission to the DOE for validation.

Option 2: For the first crediting period, the build margin emission factor shall be updated annually, *ex post*, including those units built up to the year of registration of the project activity.

Option 1 is used for this project due to the lack consistent data from the same vintage for the NamPower, Eskom, and ZESA power plants.

The commissioning dates for the Eskom and power plants appear in on the Eskom website[11]. NamPower and ZESA power plants are listed in Table 5 with their commissioning dates.

Table 5: Supplementary commissioning dates

Power Plant	Commissioning Date	Reference
Ruacana	1977	NamPower, *http://www.nampower.com.na/pages/ruacana.asp*
Paratus	1976	NamPower, *http://www.nampower.com.na/pages/paratus.asp*
Van Eck	1979	NamPower, http://www.nampower.com.na/pages/van-eck.asp
Hwange	1984	Power plants around the world, *Coal-fired power plants in Africa*, November 2009, *http://www.industcards.com/st-coal-africa.htm*

The five most recently built power plants and their emission factors appear in Table 6. Generation and fuel consumption data for Eskom power stations were obtained from the Eskom website (for the financial year ending 31 March 2010[12]). This is the latest available data.

Table 6: Power plants included in the BM

Station	On-Line Year	Generation (MWh)	Fuel Consumption (Tons)	$EF_{EL,m,y}$
Kendal (Eskom)	1988	23,307,031.00	13,866,514.00	1.08
Lethabo (Eskom)	1985	25,522,698.00	18,170,227.00	1.29
Majuba (Eskom)	1996	22,340,081.00	12,261,833.00	1.00
Matimba (Eskom)	1987	27,964,141.00	14,637,481.00	0.95
Tuktuka (Eskom)	1985	19,847,894.00	10,602,839.00	0.97

STEP 6: CALCULATE THE BUILD MARGIN EMISSION FACTOR

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:

[11] Eskom Holdings Limited, 2010, *CDM Calculations, General Information*, *http://www.eskom.co.za/live/content.php?Item_ID=4226&Revision=en/0 [Accessed 1November 2010]*

[12] Eskom Holdings Limited, 2010, *CDM Calculations, General Information*, *http://www.eskom.co.za/live/content.php?Item_ID=4226&Revision=en/0 [Accessed 1 November 2010]*

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad \textbf{(13)}$$

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.

The CO_2 emission factor of each power unit m ($EL_{EL,m,y}$) should be determined as per the guidance in Step 3 (a) for the simple OM, using option A1 using for *y* the most recent historical year for which power generation data is available, and using for *m* the power units included in the build margin.

If for a power unit *m* data on fuel consumption and electricity generation is available the emission factor ($EF_{EL,m,y}$) should be determined as follows:

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{\sum_m EG_{m,y}} \quad \textbf{(2)}$$

Where:

$EF_{EL,m,y}$ = CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
$FC_{i,m,y}$ = Amount of fossil fuel type *i* consumed by power unit *m* 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)
$EF_{CO2,i,y}$ = CO_2 emission factor of fossil fuel type *i* in year y (tCO_2/GJ)
$EG_{m,y}$ = Net electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
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.*

Emission factors for individual power plants appear in Table 7.

Using equation 13, the BM is calculated as **1.06** tCO_2e/MWh.

STEP 7: 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 CO2 emission factor in year y (tCO_2/MWh)
$EF_{grid,OM,y}$ = Operating margin CO2 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 operating margin, the build margin, and the final combined margin appear in Table 8.

Table 7: CM emission factor

$EF_{grid,OM,y}$	1.01
$EF_{grid,BM,y}$	1.06
w_{OM}	0.5
w_{BM}	0.5
$EF_{grid,CM,y}$	**1.04**

Letter from the dairy industry regarding the common practise of waste management

MELKPRODUSENTE-ORGANISASIE
MILK PRODUCERS' ORGANISATION

SATEMENT ON PREVAILING WASTE MANAGEMENT PRACTICE IN THE DAIRY INDUSTRY IN SOUTH AFRICA

I, Nico Schutte, have been approached by Farmsecure Carbon (PTY) LTD to provide an expert report on the application of anaerobic digesters in the dairy industry in South Africa.

I am presently the CEO of the Centre for Producer Development. of the Milk Producers' Organisation (MPO) and have been in the position for more than six years. I have an intimate knowledge of the dairy industry in South Africa. I respectfully submit that I am in the position to give an opinion on the matters dealt with in this document.

Since taking over the former Milk Board's functions on 1 January 1998, the Milk Producers' Organisation (MPO) has grown into South Africa's foremost industry organisation. The MPO represents and empowers milk producers by rendering a variety of innovative services to and on behalf of milk producers. The MPO is continuously adapting in order to meet the changing needs of milk producers in a dynamic agricultural environment. The MPO consists of able and skilled staff, who are all specialists in their own fields. The democratically elected board of directors plays an important role in the strategic focus of the MPO, as representatives of milk producers.

Prevailing waste management practise in the dairy industry:

Anaerobic digester technology is not a common practice in the dairy industry in South Africa.
There are no laws or regulations forcing dairy farms to capture and destroy methane.

Signed on the 4th day of July 2011 at Pretoria.

Nico Schutte

Letter from the pork industry regarding the common practise of waste management

SA Varkvleisprodusente-organisasie
SA Pork Producers' Organisation

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4th Floor 318 The Hillside Lynnwood 0082
Posbus 36207 Menlopark 0102 P O Box 36207 Menlo Park 0102
Tel: (012) 361-3920 Faks / Fax: (012) 361-4069
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STATEMENT ON PREVAILING WASTE MANAGEMENT PRACTICE IN THE PORK INDUSTRY IN SOUTH AFRICA

I, James Jenkinson, have been approached by Farmsecure Carbon (PTY) LTD to provide an expert report on the prevailing waste management practice in the pork industry in South Africa.

I am presently the chairman of The South African Pork Producers' Organisation (SAPPO) and have been in position for 2 years. I have an intimate knowledge of the pork industry in South Africa. I respectfully submit that I am in the position to give an opinion on the matters dealt with in this document.

The South African Pork Producers' Organisation is the mouthpiece of commercial pork producers in South Africa. The organisation serves the South African pork producer by co-operating within the organised agricultural fraternity and by liaising with various sectoral organisations, role-players within the supply chain of the meat industry, the government and international interest groups. SAPPO is a broad-based and dynamic service provider and facilitator, representing and supporting all South Africa's pig farmers in their quest for profitability and sustainability.

Prevailing waste management practise in the pork industry:

Currently the prevailing manure management practise in the pork industry in South Africa is open-air anaerobic lagoons, where all emitted GHG goes directly to the atmosphere. The proposed CDM project activities involve the replacement or modification of these anaerobic manure management systems by anaerobic digester technology and thereby achieving methane recovery and destruction by flaring/combustion or gainful use of the recovered methane.

Anaerobic digester technology is not a common practice in the pork industry in South Africa. There is little experience in utilizing this technology and are therefore not considered a high management priority. In effect, there are only a few pork farms considering anaerobic digester technology and all of them intent to be CDM projects.

There are no laws or regulations forcing pig farmers to capture and destroy methane.

Signed on the 24th day of June 2011 at Pretoria.

James Jenkinson

SAPPO Chairman

Letter from the feedlot industry regarding the common practise of waste management

SOUTH AFRICAN FEEDLOT ASSOCIATION
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5 August 2011.

STATEMENT ON PREVAILING WASTE MANAGEMENT PRACTICE IN THE CATTLE FEEDLOT INDUSTRY IN SOUTH AFRICA

I, DAVE FORD, have been approached by Farmsecure Carbon (Pty) Ltd to provide an opinion on the prevailing waste management practice in the cattle feedlot industry in South Africa.

I am presently the Executive Director of the South African Feedlot Association and have been in the position for more than 16 years. I have an intimate knowledge of the feedlot industry in South Africa. I respectfully submit that I am in the position to give an opinion on the issue of anaerobic digestion in SA Feedlots as dealt with in this document.

The SA Feedlot Association is an umbrella organization that addresses collective interests of the South African Feedlot industry which markets close to 80% of the total annual cattle slaughtered in South Africa.

Prevailing waste management practice in the cattle feedlot industry in South Africa:

Anaerobic digester technology is not a common practice in the cattle feedlot industry in South Africa. There are no laws or regulations requiring SA Feedlots to remove or utilize methane.

Signed on the 4 th day of August 2011 in Pretoria

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Executive Director

Annex 4

MONITORING INFORMATION

Described in section E.7.