CLEAN DEVELOPMENT MECHANISM
SMALL-SCALE PROGRAM ACTIVITY DESIGN DOCUMENT FORM (CDM-SSC-CPA-DD)
Version 01

CONTENTS

Annexes

NOTE:

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

(ii) The coordinating/managing entity shall prepare a CDM Small Scale Programme Activity Design Document (CDM-SSC-CPA-DD)[1,2] that is specified to the proposed PoA by using the provisions stated in the SSC PoA DD. At the time of requesting registration the SSC PoA DD must be accompanied by a CDM-SSC CPA-DD form that has been specified for the proposed SSC PoA, as well as by one completed CDM-SSC CPA-DD (using a real case). After the first CPA, every CPA that is added over time to the SSC PoA must submit a completed CDM-SSC CPA-DD.

[1] The latest version of the template form CDM-CPA-DD is available on the UNFCCC CDM web site in the reference/document section.

[2] At the time of requesting validation/registration, the coordinating managing entity is required to submit a completed CDM-POA-DD, the PoA specific CDM-CPA-DD, as well as one of such CDM-CPA-DD completed (using a real case).

SECTION A. General description of small scale CDM programme activity (CPA)

A.1. Title of the small-scale CPA:

CPA FSCAD001 – Under the PoA "Anaerobic Digestion and Renewable Energy in South Africa"

Version 1
Date:22 August 2011

A.2. Description of the small-scale CPA:

CPA FSCAD001 involve the installation of a anaerobic digester and a biogas cogeneration plant that produce renewable electricity for supply to the grid and thermal energy for on-site use by the project activity (emission reduction not eligible), thereby mitigating GHG emissions.

The project is a joint venture between Farmsecure Carbon (Pty) Ltd and the farm Manjoh Ranch (Pty) Ltd. Farmsecure Carbon is the majority shareholder who will develop, implement, operate and maintain the project and will therefore also act as the CPA implementer.

Manjoh Ranch, is projected to produce the following substrate streams for CPA FSCAD001:

- Manure from the cattle feedlot, consisting of 9500 cattle. This substrate is allocated to substrate stream "Manure from different livestock types" and will be referred to as $LT_{feedlot}$. Baseline methane emission for this substrate stream will be calculated.
- Potato waste from the potato packing facility, producing 32 tons of potato waste per day. This substrate is allocated to substrate stream "Different biomass types" and will be referred to as potato waste BT_{potato}. The current practise is to dump all the rejected potatoes on the manure stockpile, where it is left to decompose and later applied with the manure as compost. Baseline emissions for this substrate steam shall be accounted for as zero.

CPA FSCAD001 will need to apply a methane avoidance methodology, AMS-III.AO and the renewable energy methodology, AMS-I.C.

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

Anaerobic digestion technology:
The technology choice for the CPA FSCAD001 is a Continuously Stirred Tank Reactor (CSTR). A CSTR is the most common form of an anaerobic digester. A completely mixed reactor is known as a low rate digester technology and it is essentially a tank that is heated and mixed. The advantage of the CSTR is that it is a proven technology with many biogas plants in Europe and wastewater treatment facilities in the United States as reference. Another advantage is the ease of operation and its robustness towards solids loading rates and solids concentration in the feed. The CSTR is also more tolerant to variations in feed quality because the large hydraulic volume serves as a buffer for changes in feed pH and temperature. The disadvantages of the CSTR is the high capital cost requirement and cost of mixing, especially when inorganic materials such as sand, silt and floating materials have to be suspended throughout the digestion process.

The CSTR technology provider for CPA FSCAD001 is Highmark.

Biogas recovery and combustion system:
CPA FSCAD001 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. It will contain the following:

- 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 digestate treatment will include the following:

- A nutrient recovery system
- Centrifuge for solid and liquid separation.
    - The solid part will be treated in an aerobic manner through composting.
    - The liquid part will be recycled as makeup water for the digester. Where necessary, the liquid part will be irrigated.

A.3. Entity/individual responsible for the small-scale CPA:

The project is a joint venture between Farmsecure Carbon (Pty) Ltd and the farm Manjoh Ranch (Pty) Ltd. Farmsecure Carbon is the majority shareholder who will develop, implement, operate and maintain the project and will therefore also act as the CPA implementer.

Farmsecure Carbon is implementing an integrated approach to ensure the project proceeds smoothly. This approach includes careful specification and design of a complete technology solution, identification of appropriate technology/service providers and installation supervision. Farmsecure Carbon will ensure that all installed equipment is properly operated and maintained and will carefully monitor the data collection and recording process. Further, Farmsecure Carbon will ensure that the staff acquires appropriate expertise and resources to operate and monitor the system on an on-going basis.

CPA implementer contact information: see Annex 1.

A.4. Technical description of the small-scale CPA:

A.4.1. Identification of the small-scale CPA:

>>

A.4.1.1. Host Party:

Republic of South Africa

A.4.1.2. Geographic reference or other means of identification allowing the unique identification of the small-scale CPA (maximum one page):

Company/farm name: Manjoh Ranch (Pty) Ltd
SSC-CPA number: FSCAD001
GPS coordinates: 26°23'18,03"S 28°34'15,95"E

Figure A.1: Map and position of Gauteng province in South Africa

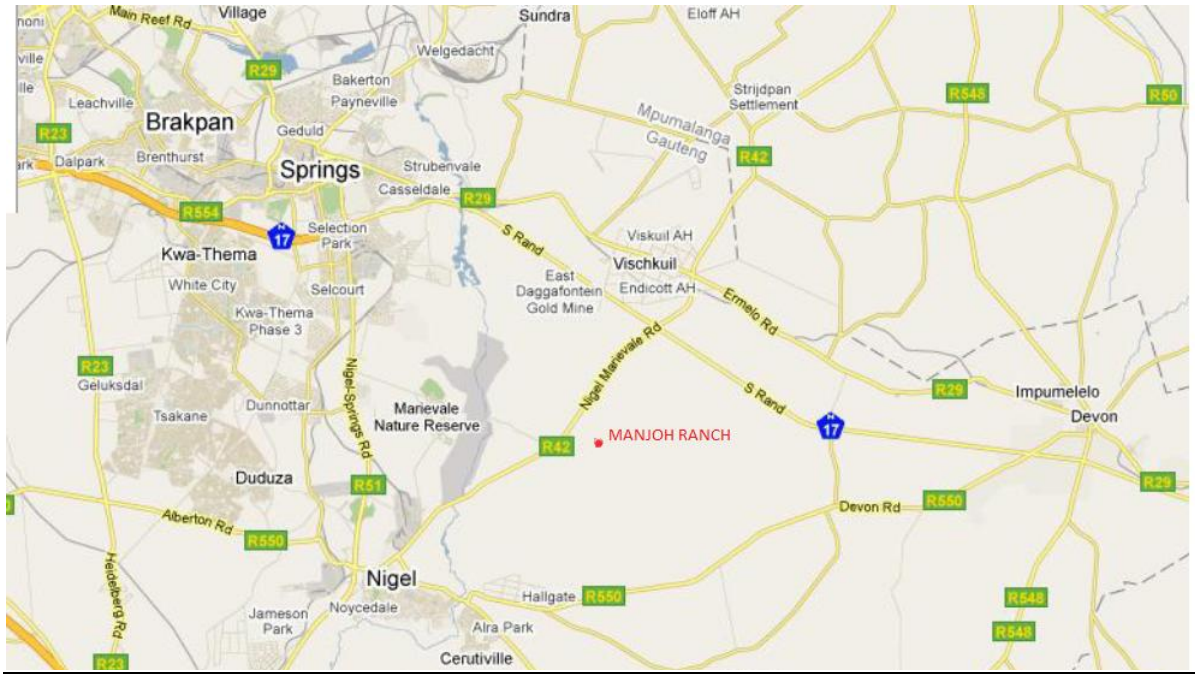

Figure A.2 Vicinity map of Manjoh Ranch

A.4.2. Duration of the small-scale CPA:

A.4.2.1. Starting date of the small-scale CPA:

01/01/2012

A.4.2.2. Expected operational lifetime of the small-scale CPA:

21 years

A.4.3. Choice of the crediting period and related information:

Renewable crediting period

A.4.3.1. Starting date of the crediting period:

The starting date of the crediting period is the registration date, estimated date: 01/09/2012

A.4.3.2. Length of the crediting period, first crediting period if the choice is renewable CP:

The length of the first crediting period is seven years and can be renewed for two more periods of seven years.

A.4.4. Estimated amount of emission reductions over the chosen crediting period:

>>

Emission reduction estimated for the first crediting period for CPA FSCAD001:

Year	Estimation of project activity emissions (tonnes of CO_2 e)	Estimation of baseline emissions (tonnes of CO_2 e)	Estimation of leakage (tonnes of CO_2 e)	Estimation of overall emission reductions (tonnes of CO_2 e)
2012	1 378	6 287	0	4 909
2013	1 378	6 287	0	4 909
2014	1 378	6 287	0	4 909
2015	1 378	6 287	0	4 909
2016	1 378	6 287	0	4 909
2017	1 378	6 287	0	4 909
2018	1 378	6 287	0	4 909
Total (tonnes of CO_2 e)	9 646	44 009	0	34 363

A.4.5. Public funding of the CPA:

There is no public funding involved in CPA FSCAD001.

A.4.6. Information to confirm that the proposed small-scale CPA is not a de-bundled component

According to paragraph 8 of Annex 13/EB54 "Guidance for determining the occurrence of debundeling 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.

A.4.7. Confirmation that small-scale CPA is neither registered as an individual CDM project activity or is part of another Registered PoA:

This is confirmed in an official letter from the project implementer.

SECTION B. Eligibility of small-scale CPA and Estimation of emissions reductions

B.1. Title and reference of the Registered PoA to which small-scale CPA is added:

Anaerobic Digestion and Renewable Energy in South Africa.

B.2. Justification of the why the small-scale CPA is eligible to be included in the Registered PoA:

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

	Eligibility criteria	**FSCAD001**
1.	All SSC-CPAs are located in the geographical boundary of South Africa.	Yes
2.	All participants are voluntarily taking part in the programme and the agreement signing date with the CPA developer, is prior to the project activity implementation.	Yes
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.	Yes
4.	Each SSC-CPA will use a proven anaerobic digestion technology and energy generation technology.	Yes
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 leakage will be calculated according to Attachment C to Appendix B.	Yes
6.	The renewable energy project activity must be one of the following: a) Project activities that install a biomass thermal energy plant that produce	Yes, project activity (b)

	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.	
7.	Each SSC-CPA will implement methane avoidance methodology AMS-III.AO or AMS-III.D for the purpose of calculating methane project emissions.	Yes, AMS-III.AO. Due to co-generation condition.
8.	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.	Methane emission reductions claimed
9.	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.	Yes
10.	Each SSC-CPA must comply with the applicability conditions of the chosen methodologies below.	See below

Applicability Conditions for AMS-III.AO		**FSCAD001**
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;	Not relevant
(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;	Yes
(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;	Yes
(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";	Yes
(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	Not relevant

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.	Not relevant
2. Measures are limited to those that result in emission reductions of less than or equal to 60 kt CO_2 equivalent annually.	Yes
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.	Not relevant
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).	Not relevant
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.	Yes
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.	Not relevant
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".	Yes
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.	Not relevant
9. Technical measures shall be used to ensure that all biogas captured from the digester is combusted/flared.	Yes

Applicability Conditions for AMS-III.D	**FSCAD001**
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;	Yes
(b) Manure or the streams obtained after treatment are not discharged into natural water resources (e.g. river or estuaries;	Yes

(c) The annual average temperature of baseline site where anaerobic manure treatment facility is located is higher than 5°C;	Yes
(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;	Not relevant
(e) No methane recovery and destruction by flaring, combustion or gainful use takes place in the baseline scenario.	Yes
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;	Yes
(b) Technical measures shall be used (including a flare for exigencies) to ensure that all biogas produced by the digester is used or flared;	Yes
(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.	Yes
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".	Yes
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.	Not relevant
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".	Yes
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".	Yes
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.	Yes

Applicability Conditions for AMS-I.C	**FSCAD001**
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.	Yes, renewable biomass
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	Yes

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).	 Yes Yes Yes
4. The total installed/rated thermal energy generation capacity of the project equipment is equal to or less than 45 MW thermal	Yes
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.	Not relevant
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.	 Not relevant Not relevant Yes
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.	Not relevant
8. Project activities that seek to retrofit or modify an existing facility for renewable energy generation are included in this category.	Not relevant
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.	Not relevant
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	 Not relevant Not relevant

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.	Not relevant

B.3. Assessment and demonstration of additionality of the small-scale CPA , as per eligibility criteria listed in the Registered PoA:

Key additionality criteria:

1. Identify realistic and credible alternative(s) to the project activity.

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

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.

Alternatives to energy generation

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 are 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.

2. Ensure that the proposed SSC-CPA is not the only alternative amongst those considered that is in compliance with mandatory regulations.

There are no laws in South Africa compelling livestock farmer 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.

3. Apply a benchmark analysis to demonstrate that without CDM revenue the SSC-CPA is not a financially attractive option.

Sub-step 2b: Option III. Apply benchmark analysis:

The project required rate of return on total investment (IRR) has been chosen as the financial indicator, in order to judge the financial viability of the project. The IRR analysis has been prepared for a period of 12 years with a salvage value of 20%. According to the guidelines laid down in the "Tool for demonstration and assessment of additionality", the benchmark shall be derived from government bond rates, increased by a suitable risk premium to reflect private investment and/or project type. In view of this guidance, government bond rate of 8%, increased by a suitable risk premium of 7.2% to reflect private investment has been considered as an appropriate benchmark for the project activity. The benchmark for the project activity is thus derived at 15.2%.

Sub-step 2c: Calculation and comparison of financial indicators

Project IRR is calculated using the following parameters and assumptions (Table E.5.a), as per feasibility study report.

Table E.5.a. Basic parameters for IRR calculations

Parameter	Value	Source
Total investment	R 23 216 000	See attached Financial Calculations
Equity investment	R 6 964 800	See attached Financial Calculations
Loan	R 16 251 200	See attached Financial Calculations
Prime lending rate	9%	http://www.resbank.co.za/Pages/default.aspx
Government bond rate	8%	https://secure.rsaretailbonds.gov.za/
Benchmark	15.2%	Calculated as follows: 70% project finance @ prime + 2% (11%) = 7.7% 30% equity finance @ 25% return on equity = 7.5% 7.7% + 7.5% = 15.2%
Risk premium	7.2%	Calculated as follows: Risk premium = Benchmark - Government bond rate Risk premium = 15.2% - 8% = 7.2%
ZAR: € exchange rate	10.5	http://www.resbank.co.za/Pages/default.aspx
CER price	13 €/tCO_2e	http://www.pointcarbon.com/
Loan duration	5 year	Loan term sheet
Inflation	6%	http://www.statssa.gov.za/keyindicators/CPI/CPIHistory
Tariffs	R0.96/kWh	Based on the feed-in tariff stipulated by the National Electricity Regulator of South Africa (NERSA). In 2011 there will be a 25.1% increase and in 2012 a 25.9% increase, which will bring the electricity price to R0.96/kWh in 2013 (Eskom Integrated Report 2010, p91).

In accordance with the benchmark analysis, if the financial indicator (IRR) of the project are lower than the benchmark, the project is considered as financially unattractive.

Table E.5.b. Financial indicators of the project activity

Scenario	IRR (Benchmark=15.2%)
Without CDM revenues	12.8%
With CDM revenues	16.34%

According to Table E.5.b, the project IRR is 12.8% which is below the benchmark and this indicate the need for CDM revenues for the implementation of the project. When CDM revenues are taken into account with a price of 13€/tCO_2e, the IRR increases to 16.34%.

Sub-step 2d: Sensitivity analysis

The objective of sensitivity analysis is to show whether the conclusion regarding the financial attractiveness is robust to reasonable variation in the critical assumptions. The investment analysis provides a valid argument in favour of additionality only if it consistently supports the conclusion that the project activity is unlikely to be the financially attractive.

The following parameters are considered in the sensitivity analysis of financial attractiveness:
(1) Total investment, (2) Operating cost, (3) Electricity tariff (4) Biomass substrate cost (not applicable.

Table E.5.c. Sensitivity analysis of the IRR of the project activity without CDM

Variation	+10%	-10%
Total investment	11.17	14.71
Operating cost	12.24	13.36
Electricity tariff	15.03	10.46

With all the parameters the IRR stay consistently below the benchmark IRR of 15.2% and therefore supports the conclusion that the project activity is unlikely to be the financially attractive.

4. Conduct a barrier analysis to demonstrate that the project activity faces significant barriers that are overcome through the CDM.

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.

5. Conduct a 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)[3] Eskom is looking to purchase 1,025 MW of power from Renewable energy sources by 2013.

B.4. Description of the sources and gases included in the project boundary and proof that the small-scale CPA is located within the geographical boundary of the registered PoA.

The project boundary encompasses the physical and geographical site of the methane recovery facility and of the renewable generation unit. The combination of the greenhouse gases and emission sources included in or excluded from the project boundary are shown in table below:

Overview on emission sources included in or excluded from the project boundary

[3] Integrated resource plan for electricity, available under: http://www.doe-irp.co.za/content/IRP2010_2030_Final_Report_20110325.pdf)

	Source	Gas		Justification / Explanation
Baseline	Emissions from decomposition of waste in 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
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 manure before being fed into the anaerobic digester	CO_2	Excluded	Excluded for simplification. This emission source is assumed to be very small
		CH_4	Included	May be an important emission source where manure is stored before being fed into the digester
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small
	Methane emissions due to 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	CO_2	Excluded	CO_2 emissions from the decomposition organic waste are not accounted

	Source	Gas		Justification / Explanation
	biogas flaring	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

The geographical boundary of the CPA is within South Africa, therefore within the geographical boundary of the registered PoA.

B.5. Emission reductions:

B.5.1. Data and parameters that are available at validation:

Data / Parameter:	ER_y
Data unit:	tCO_2e/yr
Description:	Emission reductions in year *y*
Source of data:	Calculated, see equation 1
Value applied:	4 909
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated
Any comment:	-

Data / Parameter:	BE_y
Data unit:	tCO_2e/yr
Description:	Baseline emissions in year *y*
Source of data:	Calculated, see equation 2
Value applied:	6 287
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated

Any comment:	-

Baseline emission parameters for AMS-III.AO

Data / Parameter:	$BE_{AMS\text{-}III.AO,y}$
Data unit:	tCO_2e/yr
Description:	Baseline emissions from SWDS and where applicable baseline emissions from AWMS
Source of data:	Calculated, see equation 3
Value applied:	390
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated
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:	Calculated, see equation 4
Value applied:	Not relevant to FSCAD001, project activity does not use biomass from a SWDS that would otherwise have been left to decay anaerobically.
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:	Calculated as per the relevant procedures of AMS-III.D. $BE_{manure,y} = BE_{AMS\text{-}III.D}$
Value applied:	390
Justification of the choice of data or description of measurement methods and procedures actually	Calculated

applied :	
Any comment:	-

Data / Parameter:	$MD_{req,y}$
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:	Applicable regulations
Value applied:	Not relevant to FSCAD001, project activity does not use biomass from a SWDS that would otherwise have been left to decay anaerobically.
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:	From "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"
Value applied:	Not relevant to FSCAD001, project activity does not use biomass from a SWDS that would otherwise have been left to decay anaerobically.
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:	Written information from the operator of the solid waste disposal site and/or site visits at the solid waste disposal site
Value applied:	Not relevant to FSCAD001, project activity does not use biomass from a SWDS that would otherwise have been left to decay anaerobically.
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:	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:	Not relevant to FSCAD001, project activity does not use biomass from a SWDS that would otherwise have been left to decay anaerobically.
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:	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:	Not relevant to FSCAD001, project activity does not use biomass from a SWDS that would otherwise have been left to decay anaerobically.
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:	IPCC default
Value applied:	Not relevant to FSCAD001, project activity does not use biomass from a SWDS that would otherwise have been left to decay anaerobically.
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:	IPCC default
Value applied:	Not relevant to FSCAD001, project activity does not use biomass from a SWDS that would otherwise have been left to decay anaerobically.
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:	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:	Not relevant to FSCAD001, project activity does not use biomass from a SWDS

	that would otherwise have been left to decay anaerobically.
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:	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:	Not relevant to FSCAD001, project activity does not use biomass from a SWDS that would otherwise have been left to decay anaerobically.
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:	IPCC default (adapted from Volume 5, Table 3.3) Apply the following default values for the different waste types *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
		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:	Not relevant to FSCAD001, project activity does not use biomass from a SWDS that would otherwise have been left to decay anaerobically.					
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:	Information from SWDS operator.
Value applied:	Not relevant to FSCAD001, project activity does not use biomass from a SWDS that would otherwise have been left to decay anaerobically.
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:	Calculated, see equation 6
Value applied:	390
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated
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:	Calculated, see equation 7
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	Stage one of the MWMS is not prevented in the project activity, therefore it does not form part of the baseline emissions.
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:	Calculated, see equation 8
Value applied:	390
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated
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:	Calculated, see equation 9
Value applied:	9 500

Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated
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:	Farm records. The number of days animals are alive on the farm is part of the production schedule.
Value applied:	120
Justification of the choice of data or description of measurement methods and procedures actually applied :	The number of days animals are alive on the farm is part of the production schedule.
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:	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:	28 896
Justification of the choice of data or description of measurement methods and procedures actually applied :	The counting of animals populations is part of the production schedule.
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:	Calculated in equation 10
Value applied:	813

Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated
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:	Calculated in equation 11
Value applied:	813
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated
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:	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. <u>Adjustment for animal weight:</u> 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:	2.6 (Western Europe)
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC values is only used to compare against the value calculated using the enhanced characterisation method. The value from Western Europe is very similar to the calculated value.
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:	Weighing of the animals is part of the production schedule.
Value applied:	360
Justification of the choice of data or description of measurement methods and procedures actually applied :	Weighing of the animals is part of the production schedule.
Any comment:	-

Data / Parameter:	$W_{default}$
Data unit:	Kg
Description:	Default average animal weight of a defined population
Source of data:	IPCC default, Volume 4 chapter 10 table 10 A-4 to 10 A-9
Value applied:	420 (Western Europe)
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC values is only used to compare against the value calculated using the enhanced characterisation method. The value from Western Europe is very similar to the calculated value.
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:	Farm records
Value applied:	365
Justification of the choice of data or	All the manure produced will be treated in the anaerobic digester.

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:	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:	816
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated
Any comment:	-

Data / Parameter:	DE_{LT}
Data unit:	%
Description:	Digestible energy of the feed in percent
Source of data:	IPCC default, Volume 4 chapter 10 table 10.2
Value applied:	75%
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC default values
Any comment:	-

Data / Parameter:	*UE*
Data unit:	Fraction of GE
Description:	Urinary energy expressed as fraction of GE
Source of data:	IPCC default, Volume 4 chapter 10
Value applied:	2%
Justification of the choice of data or description of measurement	IPCC default values

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:	IPCC default, Volume 4 chapter 10
Value applied:	8%
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC default values
Any comment:	-

Data / Parameter:	*GE*
Data unit:	MJ/day
Description:	Gross energy intake
Source of data:	Calculated in equation 13
Value applied:	166
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated
Any comment:	-

Data / Parameter:	DE_{MJ}
Data unit:	MJ DE/kg
Description:	Digestible Energy per kg total digestible nutrition
Source of data:	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 :	IPCC default values
Any comment:	-

Data / Parameter:	*% Body weight*
Data unit:	%
Description:	Recommended % of body weight for calculation
Source of data:	IPCC default, Volume 4 chapter 10
Value applied:	2.5%
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC default values
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:	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:	0.18 (Western Europe)
Justification of the choice of data or description of measurement methods and procedures actually applied :	Considering that the VS feed calculation is very similar to Western Europe IPCC values, we are of the opinion that that the Western Europe B_0 values are also applicable
Any comment:	-

Data / Parameter:	D_{CH4}
Data unit:	ton/m^3

Description:	Density of the methane
Source of data:	Specified in AMS-III.D
Value applied:	0.00067, default value at standard temperature (20°C) and pressure (1 atm).
Justification of the choice of data or description of measurement methods and procedures actually applied :	Specified in AMS-III.D
Any comment:	-

Data / Parameter:	$MCF_{stage\ 1,j}$
Data unit:	Fraction
Description:	Annual methane conversion factor for the stage 1 baseline animal waste management system *j*
Source of data:	IPCC default, Volume 4 chapter 10 table 10.17
Value applied:	1.5%
Justification of the choice of data or description of measurement methods and procedures actually applied :	Stage 1 of the AWMS resembles the 'Dry lot' IPCC description in chapter 10 table 10.17, Volume 4. However, the dry lot stage of the MWMS is not prevented in the project activity, therefore it does not form part of the baseline emissions.
Any comment:	-

Data / Parameter:	$MCF_{stage\ 2,j}$
Data unit:	Fraction
Description:	Annual methane conversion factor for the stage 2 baseline animal waste management system *j*
Source of data:	IPCC default, Volume 4 chapter 10 table 10.17
Value applied:	4%
Justification of the choice of data or description of measurement methods and procedures actually applied :	Stage 2 of the AWMS resembles the 'Dry lot' IPCC description in chapter 10 table 10.17, Volume 4.
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:	Farm records

Value applied:	100%
Justification of the choice of data or description of measurement methods and procedures actually applied :	All manure is handled in the same MWMS
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:	Farm records
Value applied:	100%
Justification of the choice of data or description of measurement methods and procedures actually applied :	All manure is handled in the same MWMS
Any comment:	-

Data / Parameter:	UF_b
Data unit:	Fraction
Description:	Model correction factor to account for model uncertainties.
Source of data:	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 :	Default value as per AMS III.D
Any comment:	-

Data / Parameter:	*RVS*
Data unit:	%
Description:	Relative reduction of volatile solids from the previous treatment stage
Source of data:	Conservative assumptions or defaults provided in AMSIII.D.
Value applied:	47%
Justification of the choice of data or description of	It is calculated in the mass and energy balance that the relative reduction of volatile solids in stage one is 47%.

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:	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 :	IPCC default
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:	Calculated in equation 14
Value applied:	1 717 840
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated
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:	$CH4_{WT}$: Calculated in equation 15 $CH4_{BT}$: Calculated in equation 17 $CH4_{LT}$: Calculated in equation 19
Value applied:	$CH4_{WT}$: Substrate type not relevant to FSCAD001 $CH4_{BT}$: 671 927

	$CH4_{LT}$: 1 045 913
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated
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:	VS_{WT}: Calculated in equation 16 VS_{BT}: Calculated in equation 18 VS_{LT}: Calculated in equation 20
Value applied:	VS_{WT}: Substrate type not relevant to FSCAD001 VS_{BT}: 1 866 464 VS_{LT}: 1 045 913
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated
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:	Literature review and mass and energy balance
Value applied:	MPF_{WT}: Substrate type not relevant to FSCAD001 MPF_{BT}: 0.36 MPF_{LT}: 0.26
Justification of the choice of data or description of measurement methods and procedures actually applied :	Methane production values for different substrates was taken from the literature and further refined in the mass and energy model.
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:	Information from CPA participant
Value applied:	$B_{WT,y}$: Substrate type not relevant to FSCAD001 $B_{BT,y}$: 11 680 000
Justification of the choice of data or description of measurement methods and procedures actually applied :	The potato packing facility produce an average of 32 000 kg of waste per day = 11 680 000 kg per year.
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:	Laboratory measurement.
Value applied:	$\%water_{WT}$: Substrate type not relevant to FSCAD001 $\%water_{BT}$: 83%
Justification of the choice of data or description of measurement methods and procedures actually applied :	Laboratory measurement.
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:	Laboratory measurement.
Value applied:	$\%VS_{WT}$: Substrate type not relevant to FSCAD001 $\%VS_{BT}$: 94%
Justification of the choice of data or description of measurement methods and procedures actually applied :	Laboratory measurement.

Any comment:	-

Data / Parameter:	VS_{lost}
Data unit:	%
Description:	Estimated percentage of VS lost before entering the digester
Source of data:	Estimated in the mass and energy balance
Value applied:	47%
Justification of the choice of data or description of measurement methods and procedures actually applied :	It is calculated in the mass and energy balance that 47% of volatile solids is lost before entering the digester.
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:	Calculated in equation 21
Value applied:	Not relevant to FSCAD001. The project activities does not install a biomass thermal energy plant but a co-generation plant
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:	Calculated in equation 22
Value applied:	Not relevant to FSCAD001. The project activities does not install a biomass thermal energy plant but a co-generation plant
Justification of the choice of data or description of measurement methods and	-

procedures actually applied :	
Any comment:	-

Data / Parameter:	$n_{BL,thermal}$
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:	Baseline information, obtained as described in methodology AMS-I.C.
Value applied:	Not relevant to FSCAD001. The project activities does not install a biomass thermal energy plant but a co-generation plant
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:	Obtained from reliable local or national data if available; otherwise, IPCC default emission factors are used
Value applied:	Not relevant to FSCAD001. The project activities does not install a biomass thermal energy plant but a co-generation plant
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:	Calculated in equation 14
Value applied:	Not relevant to FSCAD001. The project activities does not install a biomass thermal energy plant but a co-generation plant
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:	Literature. This value is used for emission reduction estimations by calculations, in the future the electricity/thermal energy will be monitored.
Value applied:	Not relevant to FSCAD001. The project activities does not install a biomass thermal energy plant but a co-generation plant
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:	Supplier information, the value for the specific generation installed will be used.
Value applied:	Not relevant to FSCAD001. The project activities does not install a biomass thermal energy plant but a co-generation plant
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:	Basic engineering package. This value is used for emission reduction estimations; in the future the electricity/thermal energy will be monitored.
Value applied:	Not relevant to FSCAD001. The project activities does not install a biomass thermal energy plant but a co-generation plant
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:	Calculated in equation 23
Value applied:	5 897
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated
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:	Calculated in equation 24
Value applied:	5 897
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated
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:	Calculated in equation 25
Value applied:	5 671
Justification of the choice of data or description of measurement	Calculated

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:	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 :	According to UNFCCC tool.
Any comment:	-

Data / Parameter:	$EG_{gross,y}$
Data unit:	MWh/yr
Description:	Gross amount of electricity generated from biomass
Source of data:	Calculated in equation 26
Value applied:	6 202
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated
Any comment:	-

Data / Parameter:	UT_{cogen}
Data unit:	%
Description:	Co-generation plant uptime (%)
Source of data:	Basic engineering package. In the future the uptime will be monitored.
Value applied:	93%
Justification of the choice of data or description of measurement methods and procedures actually applied :	The basic engineering package is used to estimate the plant uptime.
Any comment:	-

Data / Parameter:	η_{cogen}
Data unit:	%
Description:	Co-generation electrical efficiency (%)
Source of data:	Supplier information, the value for the specific generation installed will be used.
Value applied:	39%
Justification of the choice of data or description of measurement methods and procedures actually applied :	The basic engineering package is used to estimate the plant electrical efficiency.
Any comment:	-

Data / Parameter:	$EG_{aux,y}$
Data unit:	MWh/yr
Description:	Auxiliary electricity consumption
Source of data:	Calculated in equation 27
Value applied:	531
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated
Any comment:	-

Data / Parameter:	$\%_{aux}$
Data unit:	%
Description:	Percentage of electrical energy used by the auxiliary equipment for the cogeneration plant
Source of data:	Basic engineering package. In the future the auxiliary electricity consumed will be monitored.
Value applied:	8.57%
Justification of the choice of data or description of measurement methods and procedures actually applied :	The basic engineering package is used to estimate the auxiliary electricity consumed.
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:	Calculated in equation 28
Value applied:	Not relevant to FSCAD001. Thermal energy is only used to heat the digester in the project activity, emission reductions not eligible.
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:	Calculated in equation 29
Value applied:	Not relevant to FSCAD001. Thermal energy is only used to heat the digester in the project activity, emission reductions not eligible.
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:	Basic engineering package
Value applied:	Parameter not relevant to this CPA. Thermal energy is only used to heat the digester in the project activity, emission reductions eligible.
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:	Basic engineering package
Value applied:	Not relevant to FSCAD001. Thermal energy is only used to heat the digester in the project activity, emission reductions not eligible.
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:	Basic engineering package
Value applied:	Not relevant to FSCAD001. Thermal energy is only used to heat the digester in the project activity, emission reductions not eligible.
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:	Basic engineering package
Value applied:	Not relevant to FSCAD001. Thermal energy is only used to heat the digester in the project activity, emission reductions not eligible.
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:	Basic engineering package

Value applied:	Not relevant to FSCAD001. Thermal energy is only used to heat the digester in the project activity, emission reductions not eligible.
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:	Basic engineering package
Value applied:	Not relevant to FSCAD001. Thermal energy is only used to heat the digester in the project activity, emission reductions not eligible.
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:	Basic engineering package
Value applied:	Not relevant to FSCAD001. Thermal energy is only used to heat the digester in the project activity, emission reductions not eligible.
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:	Basic engineering package
Value applied:	Not relevant to FSCAD001. Thermal energy is only used to heat the digester in the project activity, emission reductions not eligible.

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:	Calculated in equation 30
Value applied:	Not relevant to FSCAD001, project activity does not involve capacity addition.
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:	Calculated in equation 31
Value applied:	Not relevant to FSCAD001, project activity does not involve capacity addition.
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:	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:	Not relevant to FSCAD001, project activity does not involve capacity addition.
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:	Calculated in equation 32
Value applied:	Not relevant to FSCAD001, project activity does not involve capacity addition.
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:	Calculated the same as $HG_{thermal,y}$ in section 1, using in equations 22.
Value applied:	Not relevant to FSCAD001, project activity does not involve capacity addition.
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:	Calculated in equation 33
Value applied:	Not relevant to FSCAD001, project activity does not involve capacity addition.
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:	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:	Not relevant to FSCAD001, project activity does not involve capacity addition.
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:	Calculated in equation 34
Value applied:	Not relevant to FSCAD001, project activity does not involve capacity addition.
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:	Calculated the same as $EG_{elec,y}$ in section 2.a, using in equation 25-27.
Value applied:	Not relevant to FSCAD001, project activity does not involve capacity addition.
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:	Calculated in equation 32
Value applied:	1 378
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated
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:	Calculated in equation 36
Value applied:	1 209
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated
Any comment:	-

Data / Parameter:	PE_{flare}
Data unit:	tCO_2e/yr
Description:	Emissions from biogas flaring the year *y*
Source of data:	Calculated in equation 39
Value applied:	169

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

Data / Parameter:	$PE_{transp,y}$
Data unit:	tCO_2e/yr
Description:	Emissions from incremental transportation in the year *y*
Source of data:	Calculated in equation 40
Value applied:	0, no incremental transport increase in the CPA
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated
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:	Logbook from CPA participant
Value applied:	$DAF_{w,WT}$: Substrate stream not relevant to CPA $DAF_{w,BT}$: 0, no incremental transport increase, the distance between the potato packing facility and the digester in the project activity (1.2 km) is very similar to the distance between the packing facility and the compost site in the baseline scenario (1.2 km) $DAF_{w,LT}$: 0, no incremental transport increase, the distance between the feedlot and the digester in the project activity is shorter (1.6 km) than the distance between the feedlot and the compost facility in the baseline (1 km) DAF_{sludge}: 0, no incremental transport increase, the compost application practice in the project activity is similar to the baseline scenario.
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:	Measurements by CPA participants
Value applied:	$Q_{y,WT}$: substrate stream not relevant to CPA $Q_{y,BT}$: not relevant, no incremental transport increase, see $DAF_{w,BT}$ $Q_{y,LT}$: not relevant, no incremental transport increase, see $DAF_{w,LT}$ $Q_{y,sludge}$: not relevant, no incremental transport increase, see $DAF_{w,sludge}$
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:	Information from CPA participant
Value applied:	$CT_{y,WT}$: substrate stream not relevant to CPA $CT_{y,BT}$: not relevant, no incremental transport increase, see $DAF_{w,BT}$ $CT_{y,LT}$: not relevant, no incremental transport increase, see $DAF_{w,LT}$ $CT_{y,sludge}$: not relevant, no incremental transport increase, see $DAF_{w,sludge}$
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:	Calculated in equation 41
Value applied:	Not relevant to FSCAD001, no incremental transport increase
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:	Information from CPA participant
Value applied:	Not relevant to FSCAD001, no incremental transport increase
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:	IPCC default
Value applied:	Not relevant to FSCAD001, no incremental transport increase
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:	Literature
Value applied:	Not relevant to FSCAD001, no incremental transport increase
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:	IPCC default
Value applied:	Not relevant to FSCAD001, no incremental transport increase
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:	Calculated in equation 42
Value applied:	Not relevant to FSCAD001, project activity does not involve storage.
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:	Basic engineering package
Value applied:	Not relevant to FSCAD001, project activity does not involve storage.
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:	IPCC default, Table 10.17, Chapter 10, Volume 4
Value applied:	Not relevant to FSCAD001, project activity does not involve storage.
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:	Basic engineering package
Value applied:	Not relevant to FSCAD001, project activity does not involve storage.
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:	IPCC dfault, AMS-III.D
Value applied:	Not relevant to FSCAD001, project activity does not involve storage.
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:	Calculated in equation 40
Value applied:	Not relevant to FSCAD001, project activity does not involve anaerobic storage of res waste.
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:	From "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"
Value applied:	Not relevant to FSCAD001, project activity does not involve anaerobic storage of res waste.
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:	Written information from the operator of the solid waste disposal site and/or site visits at the solid waste disposal site
Value applied:	Not relevant to FSCAD001, project activity does not involve anaerobic storage of res waste.
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:	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:	Not relevant to FSCAD001, project activity does not involve anaerobic storage of res waste.
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:	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:	Not relevant to FSCAD001, project activity does not involve anaerobic storage of res waste.
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:	IPCC default
Value applied:	Not relevant to FSCAD001, project activity does not involve anaerobic storage of res waste.
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:	IPCC default
Value applied:	Not relevant to FSCAD001, project activity does not involve anaerobic storage of res waste.
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:	IPCC default
Value applied:	Not relevant to FSCAD001, project activity does not involve anaerobic storage of res waste.
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:	IPCC default (adapted from Volume 5, Tables 2.4 and 2.5)
Value applied:	Not relevant to FSCAD001, project activity does not involve anaerobic storage of res waste.
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:	IPCC default (adapted from Volume 5, Table 3.3)
Value applied:	Not relevant to FSCAD001, project activity does not involve anaerobic storage of res waste.
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:	Information from CPA participant
Value applied:	Not relevant to FSCAD001, project activity does not involve anaerobic storage of res waste.
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:	Calculated in equation 44
Value applied:	Not relevant to FSCAD001, no fossil fuel used in the project activity.
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:	Information from CPA participant
Value applied:	Not relevant to FSCAD001, no fossil fuel used in the project activity.
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:	IPCC default
Value applied:	Not relevant to FSCAD001, no fossil fuel used in the project activity.
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 emission factors are used
Value applied:	Not relevant to FSCAD001, no fossil fuel used in the project activity.
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:	Calculated with equation 42
Value applied:	Not relevant to FSCAD001, no leakage emissions.
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:	Calculated with equation 43
Value applied:	Not relevant to FSCAD001, no leakage emissions from collection/processing/transportation of biomass outside the project boundary during year *y*
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
Value applied:	Not relevant to FSCAD001, no leakage emissions from collection/processing of biomass outside the project boundary during year *y*
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:	Information from CPA participant
Value applied:	Not relevant to FSCAD001, no leakage emissions from collection/processing of biomass outside the project boundary during year *y*
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:	IPCC default
Value applied:	Not relevant to FSCAD001, no leakage emissions from collection/processing of biomass outside the project boundary during year *y*
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:	Obtained from reliable local or national data if available, otherwise, IPCC default emission factors are used
Value applied:	Not relevant to FSCAD001, no leakage emissions from collection/processing of biomass outside the project boundary during year *y*
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:	Calculated with equation 45
Value applied:	Not relevant to FSCAD001, no leakage emissions from transportaiton of biomass outside the project boundary during year *y*
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:	Information from CPA participant
Value applied:	Not relevant to FSCAD001, no incremental distance increase for biomass transportation outside project boundary
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:	Information from CPA participant
Value applied:	Not relevant to FSCAD001, no incremental distance increase for biomass transportation outside project boundary
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:	Information from CPA participant
Value applied:	Not relevant to FSCAD001, no incremental distance increase for biomass transportation outside project boundary
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:	Calculated in equation 38
Value applied:	Not relevant to FSCAD001, no incremental distance increase for biomass transportation outside project boundary
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:	Information from CPA participant
Value applied:	Not relevant to FSCAD001, no incremental distance increase for biomass transportation outside project boundary
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:	IPCC default
Value applied:	Not relevant to FSCAD001, no incremental distance increase for biomass transportation outside project boundary
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:	Literature
Value applied:	Not relevant to FSCAD001, no incremental distance increase for biomass transportation outside project boundary
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:	IPCC default
Value applied:	Not relevant to FSCAD001, no incremental distance increase for biomass transportation outside project boundary
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:	Calculated with equation 47
Value applied:	Not relevant to FSCAD001, no leakage emissions from project activities involving renewable biomass during yr *y*
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:	Information from CPA participant
Value applied:	Not relevant to FSCAD001, none of the substrate is from croplands of grasslands where, in the absence of the project the land would be used as cropland/wetland.
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:	Information from CPA participant
Value applied:	Not relevant to FSCAD001, none of the substrate is from croplands of grasslands where, in the absence of the project the land would be used as cropland/wetland.
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
Value applied:	Not relevant to FSCAD001, none of the substrate is from croplands of grasslands where, in the absence of the project the land would be used as cropland/wetland.
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:	Information from CPA participant
Value applied:	Not relevant to FSCAD001, none of the substrate is from croplands of grasslands where, in the absence of the project the land would be used as cropland/wetland.
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:	Calculated with equation 48
Value applied:	Not relevant to FSCAD001, no leakage emissions due to emissions related to the production of the biomass
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:	Calculated with equation 49
Value applied:	Not relevant to FSCAD001, no fertilzer used in the project activity.
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:	Calculated with equation 50
Value applied:	Not relevant to FSCAD001, no fertilizer used in the project activity.
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:	Calculated with equation 51
Value applied:	Not relevant to FSCAD001, no fertilizer used in the project activity.
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:	IPCC 2006 Guidelines Table 11.1

Value applied:	Not relevant to FSCAD001, no fertilizer used in the project activity.
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:	Chemistry
Value applied:	Not relevant to FSCAD001, no fertilizer used in the project activity.
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:	IPCC default
Value applied:	Not relevant to FSCAD001, no fertilizer used in the project activity.
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:	Information from CPA participant
Value applied:	Not relevant to FSCAD001, no fertilizer used in the project activity.
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:	Information from CPA participant
Value applied:	Not relevant to FSCAD001, no fertilizer used in the project activity.
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:	2006 IPCC guidelines Table 11.3
Value applied:	Not relevant to FSCAD001, no fertilizer used in the project activity.
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:	IPCC default
Value applied:	Not relevant to FSCAD001, no fertilizer used in the project activity.
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:	Producers of synthetic fertilizer purchased and used
Value applied:	Not relevant to FSCAD001, no fertilizer used in the project activity.
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:	Producers of synthetic fertilizer purchased and used
Value applied:	Not relevant to FSCAD001, no fertilizer used in the project activity.
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:	DNA forest definition
Value applied:	Not relevant to FSCAD001, no production of biomass in project activity
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:	Calculated with equation 52
Value applied:	Not relevant to FSCAD001, manure and potato waste will still be used for the same purpose as in the baseline, for making compost. No leakage calculations necessary.
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:	Information from CPA participant
Value applied:	Not relevant to FSCAD001, manure and potato waste will still be used for the same purpose as in the baseline, for making compost. No leakage calculations necessary.
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:	Information from CPA participant
Value applied:	Not relevant to FSCAD001, manure and potato waste will still be used for the same purpose as in the baseline, for making compost. No leakage calculations necessary.
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:	Information from CPA participant
Value applied:	Not relevant to FSCAD001, manure and potato waste will still be used for the same purpose as in the baseline, for making compost. No leakage calculations necessary.
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:	Calculated with equation 53
Value applied:	Not relevant to FSCAD001, manure and potato waste will still be used for the same purpose as in the baseline, for making compost. No leakage calculations necessary.
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:	Information from CPA participant
Value applied:	Not relevant to FSCAD001, manure and potato waste will still be used for the same purpose as in the baseline, for making compost. No leakage calculations necessary.
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:	Laboratory measurements
Value applied:	Not relevant to FSCAD001, manure and potato waste will still be used for the same purpose as in the baseline, for making compost. No leakage calculations necessary.
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	-

B.5.2. Ex-ante calculation of emission reductions:

Emission reductions are calculated *ex ante* as follows:

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

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)

Parameter	Unit	Value	Comment
BE_y	tCO2e/yr	6 287	Calculated below
PE_y	tCO2e/yr	1 378	Calculated below
LE_y	tCO2e/yr	0	Calculated below
ER_y	tCO2e/yr	4 909	Calculated, see equation 1

BASELINE EMISSIONS

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

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".

Co-digestion of multiple sources of biomass substrates, e.g. animal manure and potato waste is eligible under methodology AMS-III.AO.

Parameter	Unit	Value	Comment
$BE_{AMS\text{-}III.AO,y}$	tCO_2e/yr	390	Calculated below
$BE_{AMS\text{-}III.D,y}$	tCO_2e/yr	0	Not relevant to FSCAD001
$BE_{AMS\text{-}I.C,y}$	tCO_2e/yr	5 897	Calculated below
BE_y	tCO_2e/yr	6 287	Calculated, see equation 2

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:

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

Where:

$BE_{SWDS,y}$ Methane emissions avoided during the year *y* from preventing waste disposal at the solid waste disposal site (SWDS) (tCO2e/yr). Not relevant to CPA FSCAD001.

$BE_{manure,y}$ 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)

Parameter	Unit	Waste type	Comment
$BE_{SWDS,y}$	tCO_2e/yr	0	Not relevant to FSCAD001
$BE_{manure,y}$	tCO_2e/yr	390	See AMS-III.D section
$MD_{reg,y}$	ton	0	Not relevant to FSCAD001
GWP_{CH4}	tCO_2e/tCH_4	21	IPCC default
$BE_{AMS\text{-}III.AO,y}$	tCO_2e/yr	390	Calculated, see equation 3

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 animal waste management system (AWMS) at the Manjoh Ranch feedlot consists of the following two stages.

Stage 1: Dry lot - a unpaved open confinement area without any significant vegetative cover where accumulating manure is removed periodically.
Stage 2: Solid storage - manure is stored for a period of several months in unconfined piles

Stage one of the MWMS is not prevented in the project activity, therefore it does not for part of the baseline emissions and shall be accounted for as zero. It is however calculated in the mass and energy balance that the relative reduction of volatile solids in stage one is 47%.

Parameter	Unit	$LT_{feedlot}$	Comment
$BE_{stage\ 1,y}$	tCO_2e/yr	0	Stage one of MWMS is not prevented
$BE_{stage\ 2,y}$	tCO_2e/yr	390	Calculated below
$BE_{AMS\text{-}III.D,y}$	tCO_2e/yr	390	Calculated, see equation 6

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:

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)
$MCF_{stage\ 2,j}$ 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*
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

Parameter	Unit	$LT_{feedlot}$	Comment
$VS_{LT,y}$	kg/hd/day	813	Calculated below
$N_{LT,y}$	number	9500	Calculated below
$B_{0,LT}$	m^3CH_4/kg VS	0.18	IPCC, animal type specific
$MCF_{stage\ 2,j}$	%	4%	IPCC default for solid storage
$MS\%_{stage\ 2,j}$	%	100%	100% of remaining manure is treated in MWMS
(1 - RSV)	%	53%	Mass and energy balance
D_{CH4}	t/m^3	0.00067	IPCC default
GWP_{CH4}	tCO_2e/CH_4	21	IPCC default
UF_b		0.94	IPCC default
$BE_{stage\ 2,y}$	kg CH_4/hd/yr	390	Calculated, see equation 8

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 population the following equation estimates the annual average of livestock population.

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

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)

Parameter	Unit	$LT_{feedlot}$	Comment
$N_{da,y}$	day	120	CPA specific, to be monitored
$N_{p,y}$	head	28 896	CPA specific, to be monitored
$N_{LT,y}$	nr of head	9 500	Calculated, see equation 9

Volatile solids (VS) from livestock:

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

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

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)

Parameter	Unit	$LT_{feedlot}$	Comment
$VS_{LT\,IPCC,y}$	kg dm/hd/yr	813	Calculated below
$VS_{LT\,feed,y}$	kg dm/hd/yr	816	Calculated below
$VS_{LT,y}$	kg dm/hd/yr	813	Calculated, see equation 10

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	CPA FSCAD001
The genetic source of the production operations livestock originates from an Annex I Party	No, therefore the enhanced characterisation method is used, see below. This value is compared to the default IPCC value of Western Europe.
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	Yes
The use of FFR can be validated (through on-farm record keeping, feed supplier, etc.)	Yes
The project specific animal weights are more similar to developed country IPCC default values	Yes

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

Parameter	Unit	$LT_{feedlot}$	Comment
W_{site}	kg	360	CPA specific, to be monitored
$W_{default}$	kg	420	IPCC default
$VS_{default}$	kg dm/hd/day	2.60	IPCC default
nd_y	day/yr	365	CPA specific, to be monitored
$VS_{LT\,IPCC,y}$	kg dm/hd/yr	813	Calculated, see equation 11

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

Parameter	Unit	$LT_{feedlot}$	Comment
GE	MJ DE/hd/day	166	Calculated below
DE	%	75%	IPCC default
UE	%	2%	IPCC default
ASH	%	8%	IPCC default
Conversion factor	MJ/kg	18.45	Constant
nd_y	day/yr	365	CPA specific, to be monitored
$VS_{LT\,feed,y}$	kg dm/hd/yr	816	Calculated, see equation 12

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, 45 MJ DE/kg

Parameter	Unit	$LT_{feedlot}$	Comment
$\%_{body\ weight}$	%	2.5%	CPA specific
W_{site}	kg	360	CPA specific, to be monitored
DE_{MJ}	MJ DE/kg	18.45	IPCC default
GE	MJ DE/hd/day	166	Calculated, see equation 13

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	CPA FSCAD001
The genetic source of the production operations livestock originates from an Annex I Party	No. However, considering that the VS_{feed} and the Western Europe IPCC value are very similar, we are of the opinion that that the Western Europe B_0 values are also applicable
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	Yes
The use of FFR can be validated (through on-farm record keeping, feed supplier, etc.)	Yes
The project specific animal weights are more similar to developed country IPCC default values	Yes

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)

Parameter	Unit	Value	Comment
$CH4_{WT,y}$	Nm^3/yr	0	Substrate not relevant to FSCAD001
$CH4_{BT,y}$	Nm^3/yr	671 927	Calculated below
$CH4_{LT,y}$	Nm^3/yr	1 045 913	Calculated below
$CH4_{total,y}$	Nm^3/yr	1 717 840	Calculated, see equation 14

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})

Parameter	Unit	BT_{potato}	Comment
$VS_{BT,y}$	kg VS/yr	1 866 464	Calculated below
MPF_{BT}	m^3CH_4/kg VS_{added}	0.36	Literature research
$CH4_{BT,y}$	Nm^3/yr	671 927	Calculated, see equation 17

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 (%)

Parameter	Unit	BT_{potato}	Comment
$B_{BT,y}$	kg	11 680 000	CPA specific, to be monitored
% water	%	83%	Analysis, to be monitored
$\%VS_{BT}$	%	94%	Analysis, to be monitored
$VS_{BT,y}$	kg VS/yr	1 866 464	Calculated, see equation 18

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})

Parameter	Unit	$LT_{feedlot}$	Comment
$VS_{LT\ net,y}$	kg VS/yr	4 078 999	Calculated below
MPF_{LT}	m^3CH_4/kg VS_{added}	0.26	Literature research
$CH4_{LT,y}$	Nm^3/yr	1 045 913	Calculated, see equation 19

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 (%)

Parameter	Unit	$LT_{feedlot}$	Comment
$VS_{LT,y}$	kg VS/yr	813	Calculated under AMS-III.D
$N_{LT,y}$	numbers	9 500	Calculated under AMS-III.D
VS_{lost}	%	47%	CPA specific
$VS_{LT\,net,y}$	kg VS/yr	4 078 999	Calculated, see equation 20

Eligible energy project activities:

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.

This SSC-CPA involve the following project activity:
The project activity is the installation of a biomass cogeneration plant that produces electricity for supply to the grid and thermal energy for on-site consumption. Thermal energy is only used to heat the digester in the project activity, therefore, emission reductions from heat generation are not eligible. Emission reduction will be calculated according to PoA project activity (2) 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)

Parameter	Unit	Value	Comment
$BE_{elec,y}$	tCO_2e/yr	5 897	Calculated below
$BE_{cogen,thermal,y}$	tCO_2e/yr	0	Not relavanat to FSCAD001
$BE_{cogen,y}$	tCO_2e/yr	5 897	Calculated, see equation 23

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

Parameter	Unit	Value	Comment
$EG_{elec,y}$	MWh/yr	5 671	Calculated below
$EF_{CO2,grid,y}$	tCO_2/MWh	1.04	Calculated, see Annex 3
$BE_{elec,y}$	tCO_2e/yr	5 897	Calculated, see equation 24

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)

Parameter	Unit	Value	Comment
$EG_{gross,y}$	MWh/yr	6 202	Calculated below, to be monitored
$EG_{aux,y}$	MWh/yr	531	Calculated below, to be monitored
$EG_{import,y}$	MWh/yr	0	Monitored at grid interface
$EG_{elec,y}$	MWh/yr	5 671	Calculated, see equation 25

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 (%

Parameter	Unit	Value	Comment
$CH4_{total,y}$	Nm^3/yr	1 717 840	Calculated in equation 14
LHV_{CH4}	MJ/Nm^3	36	Constant
η_{cogen}	%	39%	Basic engineering package
Conversion factor	3600	3 600	Constant
UT_{cogen}	%	93%	Basic engineering package
$EG_{gross,y}$	MWh/yr	6 202	Calculated, see equation 26

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

Parameter	Unit	Value	Comment
$EG_{gross,y}$	MWh/yr	6 202	Calculated above
$\%_{aux}$	%	8.57%	Basic engineering package
$EG_{aux,y}$	MWh/yr	531	Calculated, see equation 27

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:

Thermal energy is only used to heat the digester in the project activity, therefore, emission reductions from heat generation are not eligible.

PROJECT ACTIVITY EMISSIONS

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)

Parameter	Unit	Value	Comment
$PE_{PL,y}$	tCO_2e/yr	1209	Calculated below
$PE_{flare,y}$	tCO_2e/yr	169	Calculated below
$PE_{transp,y}$	tCO_2e/yr	0	Calculated below
$PE_{storage,y}$	tCO_2e/yr	0	Calculated below
$PE_{reswaste,y}$	tCO_2e/yr	0	Calculated below
$PE_{FF,y}$	tCO_2e/yr	0	Calculated below
PE_y	tCO_2e/yr	1378	Calculated, see equation 35

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.

Parameter	Unit	Value	Comment
$CH4_{total,y}$	Nm^3/yr	1 717 840	See equation 14
GWP_{CH4}	tCO_2e/CH_4	21	IPCC default
D_{CH4}	ton/m^3	0.00067	IPCC default
5%	%	5%	IPCC default
$PE_{PL,y}$	tCO_2e/yr	1209	Calculated, see equation 36

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%

Parameter	Unit	Value	Comment
$CH4_{total,y}$	Nm^3/yr	1 717 840	See equation 14
EF	%	90%	*Ex ante* value, to be monitored
UT	%	93%	Basic engineering package
GWP_{CH4}	tCO_2e/CH_4	21	IPCC default
D_{CH4}	ton/m^3	0.00067	IPCC default
$PE_{flare,y}$	tCO_2e/yr	169	Calculated, see equation 39

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)

Parameter	Unit	Value	Comment
$Q_{y,WT}$	ton		Not relevant to FSCAD001
$CT_{y,WT}$	ton/truk	-	Not relevant to FSCAD001
$DAF_{w,WT}$	km/truck	-	Not relevant to FSCAD001
$Q_{y,BT}$	ton	0	Biomass not transported, to be monitored
$CT_{y,BT}$	ton/truk	-	Biomass not transported, to be monitored
$DAF_{w,BT}$	km/truck	-	Biomass not transported, to be monitored
$Q_{y,LT}$	ton	0	Biomass not transported, to be monitored
$CT_{y,LT}$	ton/truk	-	Biomass not transported, to be monitored
$DAF_{w,LT}$	km/truck	-	Biomass not transported, to be monitored
$Q_{y,sludge}$	ton	0	Biomass not transported, to be monitored
$CT_{y,sludge}$	ton/truk	-	Biomass not transported, to be monitored
$DAF_{w,sludge}$	km/truck	-	Biomass not transported, to be monitored
$EF_{CO2/km}$	tCO_2e/km	-	Calculated below
$PE_{y,transp}$	tCO_2e/yr	0	Calculated, see equation 40

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)

Parameter	Unit	Value	Comment
VF_{cons}	ℓ/km	-	Biomass not transported, to be monitored
D_{fuel}	kg/ℓ	-	Fuel specific
$NCV_{fuel,y}$	TJ/kg	-	IPCC default, to be monitored
$EF_{CO2,fuel}$	tCO_2e/TJ	-	IPCC default, to be monitored
$EF_{CO2/km}$	tCO_2e/km	-	Calculated, see equation 41

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

Parameter	Unit	Value	Comment
GWP_{CH4}	tCO_2e/CH_4	21	IPCC default
D_{CH4}	ton/m^3	0.00067	IPCC default
$N_{LT,y}$	number	9 500	Calculated under AMS-III.D
$VS_{LT,y}$	kg/hd/day	2.23	Calculated under AMS-III.D
$MS\%_l$	%	0%	No storage, to be monitored
MCF_l	%	-	IPCC values, CPA specific
$B_{0,LT}$	m^3CH_4/kg VS	-	IPCC values, animal specific
AI_l	days	0	No storage, to be monitored
k	constant	0.069	IPCC default
$PE_{storage,y}$	tCO_2e/yr	0	Calculated, see equation 42

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

Parameter	Unit	Value	Comment
φ		0.9	IPCC default
f_{RW}	%	0	CPA specific, to be monitored
GWP_{CH4}	tCO_2e/CH_4	21	IPCC default
OX_{RW}	%	0	IPCC default, SWDS spesific
F	%	50%	IPCC default
$DOC_{RW,f}$	%	50%	IPCC default
MCF_{RW}	%	-	IPCC default, SWDS specific
$W_{RW,j,x}$	ton/yr	0	No res waste, to be monitored
$DOC_{RW,j}$	%	-	IPCC default, waste specific
k_j	-	-	IPCC default, waste specific
$BE_{reswaste,y}$	tCO_2e/yr	0	Calculated, see equation 43

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*

Parameter	Unit	Value	Comment
$FC_{i,y}$	ton/yr	0	No fossil fuel used, to be monitored
$NCV_{i,y}$	TJ/ton	-	IPCC default, to be monitored
$EF_{CO2,i}$	tCO_2e/TJ	-	IPCC default, to be monitored
$PE_{FF,y}$	tCO_2e/yr	0	Calculated, see equation 44

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)

Parameter	Unit	Value	Comment
$LE_{collect/process/transp,y}$	tCO_2e/yr	0	Not relevant to FSCAD001, no activities outside boundary
$LE_{renewable\ biomass,y}$	tCO_2e/yr	0	Calculated below
LE_y	tCO_2e/yr	0	Calculated, see equation 45

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).

Parameter	Unit	Value	Comment
$LE_{collect/process,y}$	tCO_2e/yr	0	Not relevant to FSCAD001, no activities outside boundary
$LE_{transp,y}$	tCO_2e/yr	0	Not relevant to FSCAD001, no activities outside boundary
$LE_{collect/process/transp,y}$	tCO_2e/yr	0	Calculated, see equation 46

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).

Parameter	Unit	Value	Comment
$LE_{shift,y}$	tCO_2e/yr	0	Not relevant to this FSCAD001. There is no shift in pre-project activities.
$LE_{production,y}$	tCO_2e/yr	0	Not relevant to FSCAD001. None of the biomass are generated/cultivated specifically for the project.
$LE_{competing,y}$	tCO_2e/yr	0	No competing use leakage. Manure and potato waste will still be used for the same purpose as in the baselien, as
$LE_{renewable\ biomass,y}$	tCO_2e/yr	0	Calculated, see equation 50

B.5.3. Summary of the ex-ante estimation of emission reductions:

Year	Estimation of project activity emissions (tonnes of CO_2 e)	Estimation of baseline emissions (tonnes of CO_2 e)	Estimation of leakage (tonnes of CO_2 e)	Estimation of overall emission reductions (tonnes of CO_2 e)
2012	1 378	6 287	0	4 909
2013	1 378	6 287	0	4 909
2014	1 378	6 287	0	4 909
2015	1 378	6 287	0	4 909
2016	1 378	6 287	0	4 909

2017	1 378	6 287	0	4 909
2018	1 378	6 287	0	4 909
Total (tonnes of CO_2 e)	9 646	44 009	0	34 363

B.6. Application of the monitoring methodology and description of the monitoring plan:

B.6.1. Description of the monitoring plan:

>>

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 below in section (d). 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 below in section (d).

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:

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

$ER_{y,expost}$ 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/yr)

$PE_{y,expost}$ Project emissions calculated using *ex post* monitored values for year *y* (tCO_2e/yr)

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

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.

d) Data and parameters to be monitored for CPA FSCAD001:

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	Not relevant to FSCAD001, project activity does not use biomass from a SWDS that would otherwise have been left to decay anaerobically.
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	Not relevant to FSCAD001, project activity does not use biomass from a SWDS that would otherwise have been left to decay anaerobically.

emission reductions in section B.5	
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	Not relevant to FSCAD001, project activity does not use biomass from a SWDS that would otherwise have been left to decay anaerobically.
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	Not relevant to FSCAD001, project activity does not use biomass from a SWDS that would otherwise have been left to decay anaerobically.
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 calculating expected emission reductions in section B.5	Measured value
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	Recorded by CPA participants

used:	
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	Logbook. Data will be transferred to a spreadsheet on a monthly basis

applied:	
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 $BG_{heat,y:}$ Not relevant to FSCAD001
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:	^{o}C
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	$B_{WT,y}$: Not relevant to FSCAD001 $B_{BT,y}$: Measured value

section B.5	
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 emission reductions in section B.5	$\%water_{WT}$: Not relevant to FSCAD001 $\%water_{BT}$: Measured value
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	$\%VS_{WT}$: Not relevant to FSCAD001 $\%VS_{BT}$: 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 section B.5	$EG_{gross,y}$: Measured value $EG_{aux,y}$: Measured value $EG_{import,y}$: Measured value $EG_{elec,PJ,y}$: Not relevant to FSCAD001 $EG_{elec,actual,y}$: Not relevant to FSCAD001
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	$HG_{thermal,y}$: Not relevant to FSCAD001 $HG_{cogen,thermal,y}$: Not relevant to FSCAD001 $HG_{thermal,PJ,y}$: Not relevant to FSCAD001 $HG_{thermal,actual,y}$: Not relevant to FSCAD001

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	Not relevant to FSCAD001. Thermal energy used for heating the digester is not eligible.
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	Not relevant to FSCAD001. Thermal energy used for heating the digester is not eligible.

section B.5	
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	Not relevant to FSCAD001. Thermal energy used for heating the digester is not eligible.
Description of measurement methods and procedures to be applied:	Pressure gauge. The continuously monitored data will be aggregated monthly, and archived electronically during the project activity
	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 used:	Data from gas analyser
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 analyser 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:	Analysers 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	• 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* .

calculating expected emission reductions in section B.5	• 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 emission reductions in section B.5	Measured value
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	Logbook. Data will be transferred to a spreadsheet on a monthly basis

measurement methods and procedures to be applied:	
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	Not relevant to FSCAD001, residual waste not subjected to anaerobic storage.
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	Not relevant to FSCAD001, residual waste not subjected to anaerobic storage.
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 section B.5	$Q_{y,WT}$: Substrate stream not relevant to FSCAD001 $Q_{y,BT}$: Measured value $Q_{y,LT}$: Measured value $Q_{y,sludge}$: Measured value $Q_{y,WT}$: Substrate stream not relevant to FSCAD001
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	$CT_{y,WT}$: Substrate stream not relevant to FSCAD001 $CT_{y,BT}$: Measured value $CT_{y,LT}$: Measured value $CT_{y,sludge}$: Measured value $CT_{LE,y}$: Substrate stream not relevant to FSCAD001
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	$DAF_{w,WT}$: Substrate stream not relevant to FSCAD001 $DAF_{w,BT}$: Measured value $DAF_{w,LT}$: Measured value DAF_{sludge}: Measured value $DAF_{LE,w}$: Substrate stream not relevant to FSCAD001
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 $VF_{LE,cons}$: Not relevant to FSCAD001
Description of	Logbook. Data will be transferred to a spreadsheet on a monthly basis

measurement methods and procedures to be applied:	
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 $NCV_{fuel,y}$: Net 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% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines	If a) is not available

Value of data applied for the purpose of calculating expected emission reductions in section B.5	$NCV_{i,y}$: Not relevant to FSCAD001 $NCV_{c,y}$: Not relevant to FSCAD001 $NCV_{fuel,y}$: Monitored value $NCV_{LE,fuel,y}$: Not relevant to FSCAD001
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:

Data source	Conditions for using the data source
a) Values provided by the fuel supplier in invoices	This is the preferred source
b) Measurements by the 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% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories	If a) is not available

Value of data applied for the purpose of calculating expected emission reductions in section B.5	$EF_{CO2,i}$: Not relevant to FSCAD001 $EF_{CO2,c}$: Not relevant to FSCAD001 $EF_{CO2,fuel}$: Measured value $EF_{LE,CO2,fuel}$: Not relevant to FSCAD001
Description of	For a) and b): Measurements should be undertaken in line with national or

measurement methods and procedures to be applied:	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	$FC_{i,y}$: Not relevant to FSCAD001 $FC_{c,y}$: Not relevant to FSCAD001
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	Not relevant to FSCAD001, no fertilizer applications

calculating expected emission reductions in section B.5	
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	Not relevant to FSCAD001, no fertilizer applications
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	Not relevant to FSCAD001, no fertilizer applications
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	Not relevant to FSCAD001, no fertilizer applications
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

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:

☐ Please tick if this information is provided at the PoA level. In this case sections C.2. and C.3. need not be completed in this form.

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

Unfortunately this process has not been completed, we will supply you with the documents as soon as possible.

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

An environmental impact assessment is required for a typical SSC-CPA included in the PoA.

SECTION D. Stakeholders' comments

>>

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

☐ Please tick if this information is provided at the PoA level. In this case sections D.2. to D.4. need not be completed in this form.

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

- A Background Information Document (BID) was released on 17/08/2011 for a 30-day public comment period in order to provide interested and affected parties (I & AP) an opportunity to comment on the proposed project. I & AP were invited to comment in writing during this period.

- An open day was held at Manjoh Ranch on portion 2 of the farm Holgatfontein 326IR in Nigel on 17/08/2011. The open day provided the public with an opportunity to get more information regarding the proposed project, and to provide inputs on the proposed project and basic assessment process. All I & APs were invited to attend the open day.

- Public participation notifications:
  - Newspaper advertisements: Heidelberg/Nigel Heraut on 17/08/2011
  - 3 on-site notices
  - 9 letters of notifications with the BID attached and an invitation to attend the open day

D.3. Summary of the comments received:

Attendees were encouraged to verbally comment about the proposed project at the open day. The following questions were received:

Question: How far can waste be stored from a natural watercourse?
Answer: 100m. The project easily meets this requirement.

Question: How much carbon will be eliminated in the process?
Answer: 4 909 ton CO_2e/year

Question: How many jobs will be created by the project?
Answer: During the design and construction phase, employment will be provided to approximately 100 people. During the operation of the project, two operators, one millwright, and one supervisor will be employed.

Question: What are the capital and operating costs for the project?
Answer: Capital: R 23 216 00
Operating cost: R 1 396 352 (first year)

Question: Will the project produce odours?
Answer: Odour emanating from existing waste management practices will almost entirely be eliminated. Putrescible material in the raw waste will be removed by the digestion process and converted to methane and carbon dioxide. Sulphur containing compounds generated in the processes are converted to non-odorous compounds biologically.

Question: Is there a danger of explosions and how will it be handled?

Answer: Methane is a flammable gas, however, precautions will be taken to prevent explosions. These include the installation of flame arrestors, monitoring and control equipment, as well as all stipulated safety signage.

Question: What are the environmental advantages of the project?
Answer: A slide with the following advantages was shown:

- Methane in the biogas is converted to carbon dioxide in the electricity generation process.
- Greenhouse gas emissions from the raw manure are thus significantly reduced by the process.
- Potential water contamination by the raw wastes that are currently applied on land will be significantly reduced since the raw waste is stabilized during the process.
- Solid material from the process (that has been stabilised) will be registered as a fertilizer, will be stored on concrete surfaces and will be applied to land as a fertilizer.
- Liquid material from the process will registered as a fertilizer, will be stored in lined dams for land application as a fertilizer
- The process removed >90% of the pathogens present in the raw waste, thus improving current microbial contamination.

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

Since no negative comments were received, there was no need to make adjustments on the design, construction, or operation of the proposed project

Annex 1

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

Organization:	Farmsecure Carbon (Pty) Ltd
Street/P.O.Box:	350 Farm Wonderfontein / P.O. Box 1033, Vanderbijlpark, 1900, RSA
Building:	Minaar Steet
City:	Sasolburg, 1947
State/Region:	Gauteng
Postfix/ZIP:	1900
Country:	South Africa
Telephone:	+27 (0) 16 970 8900/1/2
FAX:	+27 (0) 16 970 8920
E-Mail:	isabelle.barnard@farmsecure.co.za
URL:	www.farmsecure.co.za
Represented by:	Isabelle Barnard
Title:	Mrs
Salutation:	
Last Name:	Barnard
Middle Name:	-
First Name:	Isabelle
Department:	
Mobile:	+27 (0) 83 657 8973
Direct FAX:	+27 (0) 86 677 1462
Direct tel:	
Personal E-Mail:	-

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[4]; generated and exported electricity[5], as well as connected transmission lines between countries and the maximum ratings[6].

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):

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

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

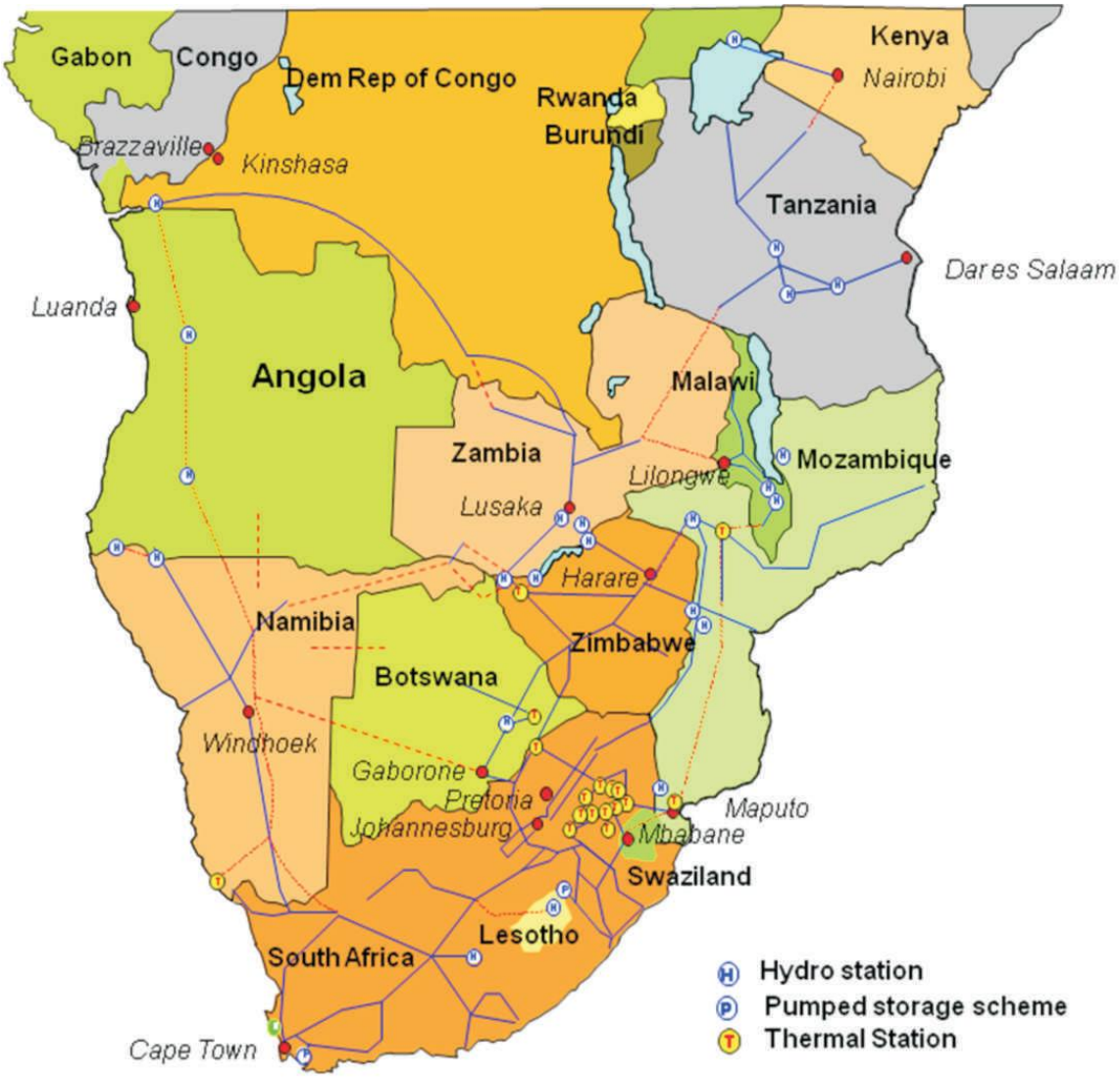

Figure 1: The SAPP Grid.

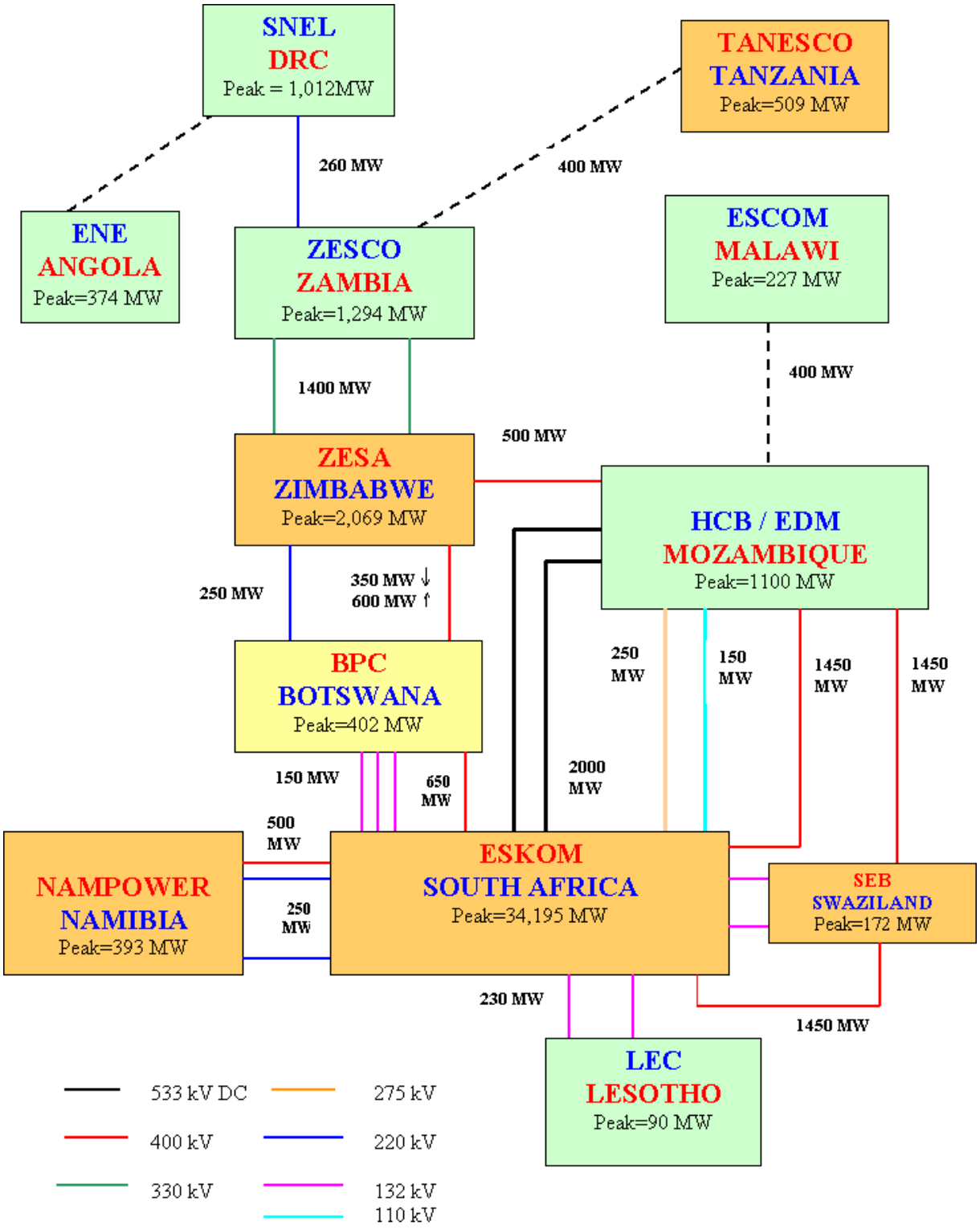

Figure 2: SAPP interconnector limits.

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[7]. 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*"[8]. This has not been implemented to date as the STEM "Book of Rules" currently in use is still the 2003 version[9]

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.

[7] 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

[8] 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

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

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.

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:

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

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[10]. 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[11]). 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

[10] 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]*
[11] 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]*

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:

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

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
$\boldsymbol{EF_{grid,CM,y}}$	**1.04**

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

SOUTH AFRICAN FEEDLOT ASSOCIATION
SUID AFRIKAANSE VOERKRAALVERENIGING

76 JEAN AVENUE
DORINGKLOOF
CENTURION 0157
TEL : 012 667 1189
FAX : 012 667 1246

PO BOX 16021
LYTTELTON
0140
URL : www.safeedlot.co.za
E-MAIL : safa@safeedlot.co.za

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

Executive Director

Annex 4

MONITORING INFORMATION

Described in section E.7.