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

# PROGRAMME OF ACTIVITIES DESIGN DOCUMENT (PoA-DD)

## PART I. Programme of activities (PoA)

## SECTION A. General description of PoA

### A.1. Title of the PoA

>>

a. The title of the proposed PoA is **Botswana Biogas Projects**
b. Version number of the PoA-DD: F CDM SSC PoA DD - Version 02.0
c. Date of completion: 25/06/2012

### A.2. Purpose and general description of the PoA

>>

The Botswana Biogas Project initiative (hereafter referred to as the "PoA") is a Small Scale CDM programme of Activity. The project is being developed by Bostrich Products International (BPI), who is the coordinating and managing entity (CME) and will reduce Green House Gas (GHG) Emission by using waste from capturing methane from Livestock Abattoir wastewater treatment processes, Cattle Feedlots, Chicken Farms, Cattle Abattoirs and Chicken Abattoirs.

Agriculture in Botswana is mostly dominated by beef production, which is spurred mostly by beef exports to the European Union. About 85% of the national herd is grazed on communal land and the rest in commercial farms in the form of feedlots. The manure generated in these feedlots is piled in heaps that produce methane. Manure generated from the livestock abattoirs is either stored in heaps close to the abattoirs where it is left to decompose and is disposed of at landfills. In all cases the manure generates methane.

In addition Botswana has a thriving poultry production industry valued at over P900million per year. Manure management at these farms is poor as some of the manure is heaped in piles from where part of it is sold but most of it is either incinerated or sent to landfills.

Botswana's electricity on the other hand is mostly from fossil fuels and less than 1% from renewable energies. The Government through its rural electrification policy is expanding the national grid to rural communities that were previously not connected to the grid. This coupled with economic development has led to increased demand for electricity at a time when supply is inadequate to meet Botswana and SADC electricity demand. Furthermore, the Government of Botswana in its National Energy Policy is seeking to increase the share of renewable energy based electricity in the national Energy Mix to 25% by 2016 from a current low of less than 1%. As a result there have been various energy sector reforms which include liberalization of the energy sector to include Independent Power Producers and a renewable energy feed in tariff.

The CDM project activity in this case will be to capture and destroy methane through flaring, heat production, electricity generation or bottling from livestock abattoir waste water treatment processes, using manure (or biodegradable waste) generated from livestock abattoirs, cattle feedlots and from chicken farms. The first CDM project activity of the Programme of Activity will be the 1MW biogas based electricity plant at Multispecies Ostrich Abattoir in Gaborone the capital City of Botswana.

Bostrich therefore seek to solve an environmental problem through the use of manure generated from feedlots and chicken runs to produce biogas electricity.

a. Policy/measure or stated goal that the PoA seeks to promote;
   The main aim of the PoA is to reduce GHG emission from Botswana enhance Botswana's profile as a net carbon sink. The project also aims to support the national policy on waste management which advocates reducing, reusing and recycling waste. The PoA will also help to increase the contribution of renewable energy to the national energy mix, which is currently less than 1%. Additional jobs will be created through the project activities that shall emanate from the CPAs that shall be implemented under this PoA.

b. Framework for the implementation of the proposed PoA.
   This PoA is a voluntary action by BPI as there are no national laws that compel potential project activities covered in this PoA to capture biogas. The PoA will however support the sustainable development policies and the national energy policy of Botswana.

**A.3. CMEs and participants of PoA**
>>

BPI will act as the coordinating and managing entity and is also a participant in the PoA. Other project participants may or may not be identified in one or more of the CPA related to the PoA.

**A.4. Party(ies)**

| Name of Party involved (host) indicates a host Party | Private and/or public entity(ies) project participants (as applicable) | Indicate if the Party involved wishes to be considered as project participant (Yes/No) |
|---|---|---|
| Botswana | Bostrich Products International (BPI)<br>Public entity A | No |
| Botswana | Biosys (Pty) Ltd<br>Public entity B | No |
| … | … | |

**A.5. Physical/ Geographical boundary of the PoA**

The geographical boundary of the PoA will be within the country of Botswana. The PoA will include all small scale CDM programme activities (SSC-CPAs) utilising the methodologies in the republic of Botswana as presented below.


**A.6. Technologies/measures**

>>

A typical CPA consist of either a cattle/chicken abattoir, cattle feedlot or chicken farm implementing a project activity by either installing a new waste handling and treatment facility that incorporates a biogas recovery system or modifying an existing facility to capture biogas currently being emitted into the atmosphere. The waste from these facilities will be treated under controlled conditions in an enclosed biodigester at the existing facility or at a centralised location. Each CPA is expected to install a digester which if efficient and reliable without limits to a specific technology. Due to variability of the circumstances of each possible site in the country, it is expected that several digester technologies will be considered by each CPA and each technology should capture biogas by one or more of the means stipulated in the methodologies listed below:-

- AMS III.H. “Methane recovery in wastewater treatment,” Version 16 or later
- AMS III.AO. “Methane recovery through controlled anaerobic digestion” Version 01 or later
- AMS III.D. “Methane recovery in animal manure management systems” Version 18 or later

The biogas captured by each CPA should be destroyed by either flaring in an open or enclosed flare or by utilising it for process heat production or electricity generation based on the circumstances of each CPA. The CPA project activities covered under this PoA will be limited to those that result in emission reductions of less than or equal to 60 kt $CO_2$ equivalent annually.

**A.7. Public funding of PoA**

>>

The project has obtained funding for the feasibility study through the Energy, Environment Partnership Program for Southern and East Africa (EEP-SEA) being financed by the Ministry of Foreign Affairs of Finland. This PoA has also been developed with financial assistance from the EU CDM project “Capacity Building related to Multilateral Environmental Agreements (MEA) in African, Caribbean and Pacific (ACP) Countries”. The project will however be seeking no further assistance form Annex 1 countries.

**SECTION B. Demonstration of additionality and development of eligibility criteria**
**B.1. Demonstration of additionality for PoA**
>>
The additionality of will be assessed and demonstrated at CPA level by using tools such as “Non-binding best practise examples to demonstrate additionality for SSC project activities” , “Guidelines for objective demonstration and assessment of barriers, ” and the “Tool for the demonstration and assessment of additionality ” the procedure of which is shown in figure 1.

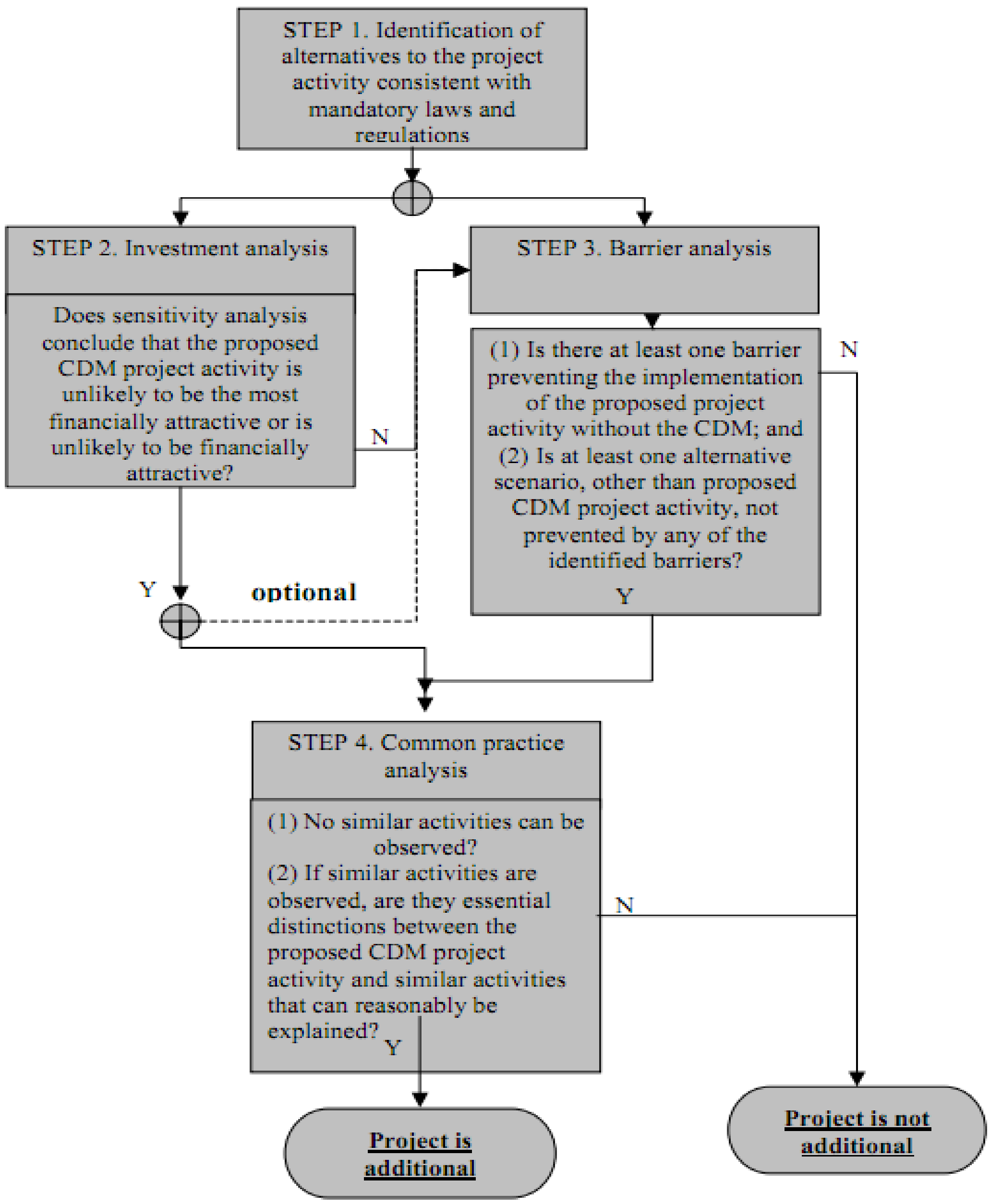


**Fig 1: Steps for proving Additionality**

Each CPA will demonstrate that the project activity would otherwise not be implemented due to the existence of one or more of the barriers listed below and that it is a voluntary action which would not have otherwise occurred without CDM.

1. Prevailing Practice
   Prevailing practice or existing regulatory or policy requirements in Botswana do not require the installation of the technologies proposed in this PoA but rather have led to the implementation of low cost practices, which result in high GHG emissions. Furthermore the CPA will demonstrate but not limited to the fact that the project is among the first of its kind technologically, geographically, in the sector etc.

2. Investment barrier
   The Government of Botswana does not provide financial incentives[1] for potential CPAs to invest in the types of technologies promoted in this CPA. There is also long-term return on investments from electricity generation and process heat derived from such small scale project activities. The CPA is expected to meet the upfront investment costs, which are high, compared to alternatives and cannot easily attract investment.

3. Access-to-finance barrier
   Financial institutions in Botswana are risk averse when it comes to investing in renewable energy projects and hence such as project will not easily get funding.

4. Technological barrier
   Biogas technologies are not common in Botswana and there is no local capacity to develop and operate commercial facilities in Botswana. CPA will have to demonstrate that biogas technology is not readily available in the country and the practice has not been widely adopted and need to be imported from South Africa and Annex 1 countries. Also due to lack of local capacity, there is limited understanding about the technology and therefore there is a high risk of failure. The proposed project activity will require special expertise with respect to design of the facility, operation, process control maintenance and repair. Project activity monitoring is also crucial and equipment will often need to be calibrated and local facilities are not well equipped to carry out such calibrations.
   CPAs are supposed to demonstrate that a less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty or low market share of the new technology adopted for the project activity and so would have led to higher emissions;

   Best practice examples include but are not limited to, the demonstration of non-availability of human capacity to operate and maintain the technology, lack of infrastructure to utilize the technology, unavailability of the technology and high level of technology risk.

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

>>

The eligibility criteria for inclusion of a CPA in the PoA shall include project activities that capture methane from either wastewater systems, animal manure management systems or through controlled anaerobic digestion which meet the following conditions as stipulated in the methodologies:

[1] Such as tax holiday, feed in tariffs have been established but not yet implemented.

1. Methodology AMS- III.H. Version 16: "Methane recovery in wastewater treatment."
   The CPA comprises measures that recover biogas from biogenic organic matter in wastewater by means of one, or a combination, of the following options:
   (a) Substitution of aerobic wastewater or sludge treatment systems with anaerobic systems with biogas recovery and combustion;
   (b) Introduction of anaerobic sludge treatment system with biogas recovery and combustion to a wastewater treatment plant without sludge treatment;
   (c) Introduction of biogas recovery and combustion to a sludge treatment system;
   (d) Introduction of biogas recovery and combustion to an anaerobic wastewater treatment system such as anaerobic reactor, lagoon, septic tank or an on-site industrial plant;
   (e) Introduction of anaerobic wastewater treatment with biogas recovery and combustion, with or without anaerobic sludge treatment, to an untreated wastewater stream;
   (f) Introduction of a sequential stage of wastewater treatment with biogas recovery and combustion, with or without sludge treatment, to an anaerobic wastewater treatment system without biogas recovery (e.g. introduction of treatment in an anaerobic reactor with biogas recovery as a sequential treatment step for the wastewater that is presently being treated in an anaerobic lagoon without methane recovery).

2. Methodology AMS- III.D./Version 18: "Methane recovery in animal manure management systems."
   The CPA project activities involve the replacement or modification of anaerobic animal manure management systems in livestock farms to achieve methane recovery and destruction by flaring/combustion or gainful use of the recovered methane. Project activities also covers treatment of manure collected from several farms to a centralized plant under the following conditions:
   (a) The livestock population in the farm is managed under confined conditions;
   (b) Manure or the streams obtained after treatment are not discharged into natural water resources (e.g. river or estuaries);
   (c) The annual average temperature of baseline site where anaerobic manure treatment facility is located is higher than 5°C;
   (d) In the baseline scenario the retention time of manure waste in the anaerobic treatment system is greater than one month, and in case of anaerobic lagoons in the baseline, their depths are at least 1m;
   (e) No methane recovery and destruction by flaring, combustion or gainful use takes place in the baseline scenario.

3. Methodology AMS- III.AO Version 01. "Methane recovery through controlled anaerobic digestion"

   CPA is implementing 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). The project activity involves controlled biological treatment of biomass or other organic matters through anaerobic digestion in closed reactors equipped with biogas recovery and combustion/flaring system with the following options:

   (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;

(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;

4. CPA project activities measures are limited to those that result in emission reductions of less than or equal to 60 kt $CO_2$ equivalent annually.
5. The CPA fulfils Botswana's national CDM sustainable development criteria
6. CPA must demonstrate the project's additionality by applying the criteria outlined in section B1;
7. The CPA is not already registered under a different PoA or as a CDM project.
8. The CPA has fulfilled or in the process of complying with Botswana's EIA requirements and stakeholder consultations under the Environmental Impact Assessment Act of 2005.
9. CPA is voluntary and there is no requirement or enforcement under existing national or local regulations to introduce or substitute the biogas recovery system.

**B.3. Application of methodologies**

>>

Application of Methodology AMS- III.H. / Version 16: Methane recovery in wastewater treatment

| **Requirement for applicability of the methodology** | **Compliance of CPA with the given requirement** | **Reference** |
|---|---|---|
| This methodology comprises measures that recover biogas from biogenic organic matter in wastewater by means of one, or a combination, of the following options:<br>(a) Substitution of aerobic wastewater or sludge treatment systems with anaerobic systems with biogas recovery and combustion;<br>(b) Introduction of anaerobic sludge treatment system with biogas recovery and combustion to a wastewater treatment plant without sludge treatment;<br>(c) Introduction of biogas recovery and combustion to a sludge treatment system;<br>(d) Introduction of biogas recovery and combustion to an anaerobic wastewater treatment system such as anaerobic reactor, lagoon, septic tank or an onsite industrial plant;<br>(e) Introduction of anaerobic wastewater treatment with biogas recovery and combustion, with or without anaerobic sludge treatment, to an untreated wastewater stream;<br>(f) Introduction of a sequential stage of wastewater treatment with biogas recovery and combustion, with or without sludge treatment, to an anaerobic wastewater treatment system without biogas recovery (e.g. introduction of treatment in an anaerobic reactor with biogas recovery as a sequential treatment step for the wastewater that is presently being treated in an anaerobic lagoon without methane recovery). | A potential CPA can be implemented under the PoA that recovers biogas from biogenic organic matter in Animal Abattoir wastewater by means of one, or a combination, of the six options mentioned in the methodology and will contribute to methane avoidance.<br><br>Some Animal Abattoirs in Botswana discharge untreated waste into the municipal waste system and this methodology will be applicable for such applications. | AMS- III.H./ Version 16 Paragraph 1 |

| | | |
|---|---|---|
| In cases where baseline system is anaerobic lagoon the methodology is applicable if:<br>(a) The lagoons are ponds with a depth greater than two meters, without aeration. The value for depth is obtained from engineering design documents, or through direct measurement, or by dividing the total volume by the surface area. If the lagoon filling level varies seasonally, the average of the highest and lowest levels may be taken;<br>(b) Ambient temperature above 15°C, at least during part of the year, on a monthly average basis;<br>(c) The minimum interval between two consecutive sludge removal events shall be30 days. | Anaerobic open lagoons are the most common treatment method used to treat wastewater at Cattle Abattoirs in Botswana as they are the least cost option. The average ambient temperature in Botswana is above 15°C for seven months of the year from September to march. The CME will ensure that CPA conforms to the design requirements stipulated in the methodology for anaerobic lagoons. | AMS- III.H./ Version 16 Paragraph 2 |
| The recovered biogas from the above measures may also be utilised for the following applications instead of combustion/flaring:<br>(a) Thermal or mechanical, electrical energy generation directly;<br>(b) Thermal or mechanical, electrical energy generation after bottling of upgraded biogas; or<br>(c) Thermal or mechanical, electrical energy generation after upgrading and distribution,<br>(iii) Upgrading and transportation of biogas to distribution points for end users.<br>(d) Hydrogen production;<br>(e) Use as fuel in transportation applications after upgrading. | The CPA will have the option to use the biogas generated through combustion or flaring, depending on the requirement at each specific.<br><br>Botswana has no natural gas pipe distribution network but LPG is distributed by local merchants mostly for thermal applications in cylinders. The biogas produced by CPA has the potential to be used as an LPG substitute for domestic or industrial thermal applications. It can also be used to power industrial vehicles such as forklifts that are currently using LPG. | AMS- III.H./ Version 16 Paragraph 3 |
| If the recovered biogas is used for project activities covered under paragraph 3 (a), that component of the project activity can use a corresponding methodology under Type I. | This is an option that CPAs are likely to consider and the CME will ensure that CPAs comply with the requirements for the required methodology | AMS- III.H./ Version 16 Paragraph 4 |
| For project activities covered under paragraph 3 (b), if bottles with upgraded biogas are sold outside the project boundary, the end-use of the biogas shall be ensured via a contract between the bottled biogas vendor and the end-user. No emission reductions may be claimed from the displacement of fuels from the end use of bottled biogas in such situations. If however the end use of the bottled biogas is included in the project boundary and is monitored during the crediting period $CO_2$ emissions avoided by the displacement of fossil fuel can be claimed under | This is an option that CPAs are likely to consider and the CME will ensure that CPAs comply with the requirements for the required methodology | AMS- III.H./ Version 16 Paragraph 5 |

| | | |
|---|---|---|
| the corresponding Type I methodology, e.g. AMS-I.C .Thermal energy production with or without electricity. | | |
| For project activities covered under paragraph 3 (c) (i), emission reductions from the displacement of the use of natural gas are eligible under this methodology, provided the geographical extent of the natural gas distribution grid is within the host country boundaries. | This is an option that CPAs are likely to consider and the CME will ensure that CPAs comply with the requirements in the methodology. However Botswana has no Natural Gas reserves no distribution network but has reserves for coal bed methane and a well-established distribution network of LPG merchants. | AMS- III.H./ Version 16 Paragraph 6 |
| For project activities covered under paragraph 3 (c) (ii), emission reductions for the displacement of the use of fuels can be claimed following the provision in the corresponding Type I methodology | This is an option that CPAs are likely to consider and the CME will ensure that CPAs comply with the requirements for the required methodology | AMS- III.H./ Version 16 Paragraph 7 |
| In particular, for the case of 3 (b) and (c) (iii), the physical leakage during storage and transportation of upgraded biogas, as well as the emissions from fossil fuel consumed by vehicles for transporting biogas shall be considered. Relevant procedures in paragraph 11 of Annex 1 of AMS-III.H “Methane recovery in wastewater treatment” shall be followed in this regard. | This is an option that CPAs are likely to consider and the CME will ensure that CPAs comply with the requirements for the required methodology | AMS- III.H./ Version 16 Paragraph 8 |
| For project activities covered under paragraph 3 (b) and (c), this methodology is applicable if the upgraded methane content of the biogas is in accordance with relevant national regulations (where these exist) or, in the absence of national regulations, a minimum of 96% (by volume). | This is an option that CPAs are likely to consider and the CME will ensure that CPAs comply with the requirements in the methodology since there are national regulations | AMS- III.H./ Version 16 Paragraph 9 |
| If the recovered biogas is utilized for the production of hydrogen (project activities covered under paragraph 3 (d)), that component of the project activity shall use the corresponding methodology AMS-III.O .Hydrogen production using methane extracted from biogas. | This is highly unlikely in Botswana, however should the CPA consider this option, the CME will ensure that CPAs comply with the requirements for the required methodology | AMS- III.H./ Version 16 Paragraph 10 |
| If the recovered biogas is used for project activities covered under paragraph 3 (e), that component of the project activity shall use corresponding methodology AMS-III.AQ .Introduction of Bio-CNG in road transportation. | This is highly unlikely in Botswana, however should the CPA consider this option, the CME will ensure that CPAs comply with the requirements for the required methodology | AMS- III.H./ Version 16 Paragraph 11 |
| New facilities (Greenfield projects) and project activities involving a change of equipment resulting in a capacity addition of the wastewater or sludge treatment system compared to the designed capacity of the | This is an eventuality which may occur to CPAs and the CME will ensure that CPAs comply with the requirements in the methodology. CPAs will | AMS- III.H./ Version 16 Paragraph 12 |

| | | |
|---|---|---|
| baseline treatment system are only eligible to apply this methodology if they comply with the relevant requirements in the "General guidelines to SSC CDM methodologies". In addition the requirements for demonstrating the remaining lifetime of the equipment replaced, as described in the general guidelines shall be followed. | also be required to describe the remaining life span of the replace equipment. | |
| The location of the wastewater treatment plant as well as the source generating the wastewater shall be uniquely defined and described in the PoA-PDD. | The CME will ensure that CPAs comply with the requirements in the methodology by identifying the location of the CPA using specific reference geographic coordinates, address, and map. The same will be done for the wastewater generating source and wastewater treatment plant and will be clearly described and shown in the baseline and project activity diagram. | AMS- III.H./ Version 16 Paragraph 13 |
| Measures are limited to those that result in aggregate emissions reductions of less than or equal to 60 kt $CO_2$ equivalent annually from all Type III components of the project activity. | The POA will only include CPAs that result in emission reduction less than or equal to 60 kt $CO_2$ equivalent annually from all Type III components of the project activity | AMS- III.H./ Version 16 Paragraph 14 |

Application of Methodology AMS- III.D./Version 18: Methane recovery in animal manure management systems

| **Requirement for applicability of the methodology** | **Compliance of CPA with the given requirement** | **Reference** |
|---|---|---|
| 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:<br>(a) The livestock population in the farm is managed under confined conditions;<br>(b) Manure or the streams obtained after treatment are not discharged into natural water resources (e.g. river or estuaries), otherwise AMS-III.H "Methane recovery in wastewater treatment" shall be applied;<br>(c) The annual average temperature of baseline site where anaerobic manure treatment facility is located is higher than 5°C; | Botswana has a number of livestock farms (e.g. cattle feedlots, Dairy Farms and chicken farms) that may be candidates for CPAs that can be implemented under this PoAs 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. In addition Botswana's average annual temperatures are above 5°C and the farms have conditions which match the conditions outlined in this methodology. | AMS-III.D./ Version 18 Paragraph 1 |

| | | |
|---|---|---|
| (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;<br>(e) No methane recovery and destruction by flaring, combustion or gainful use takes place in the baseline scenario. | | |
| The project activity shall satisfy the following conditions:<br>(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;<br>(b) Technical measures shall be used (including a flare for exigencies) to ensure that all biogas produced by the digester is used or flared;<br>(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. | The CPA will ensure compliance with the waste handling procedure in this clause and apply the prescribed methodology which ever applies. Furthermore the CPA will ensure that all the produced biogas is either used at the facility or flared. | AMS-III.D./ Version 18 Paragraph 2 |
| 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. | These are options that CPAs may be willing to consider and the CPAs should take steps to ensure compliance with the appropriate methodology. | AMS-III.D./ Version 18 Paragraph 3 |
| 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. | These are options CPAs may consider and therefore they should take steps to take in to account the respective procedures in AMS-III.H. | AMS-III.D./ Version 18 Paragraph 4 |
| New facilities (Greenfield projects) and project activities involving capacity additions compared to the baseline scenario are only eligible if they | CPAs falling in this category of project activities should enquire compliance with the | AMS-III.D./ Version 18 Paragraph 5 |

| | | |
|---|---|---|
| comply with the related and relevant requirements in the "General Guidelines to SSC CDM methodologies." | requirements in the "General Guidelines to SSC CDM methodologies." | |
| 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". | CPAs falling in this category of project activities should enquire compliance with the requirements in the "General Guidelines to SSC CDM methodologies." | AMS-III.D./ Version 18 Paragraph 6 |
| 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. | Only CPAs falling in this category of projects will apply this methodology and will be eligible for inclusion in this PoA. | AMS-III.D./ Version 18 Paragraph 7 |

Application of Methodology AMS- III.AO Version 01. Methane recovery through controlled anaerobic digestion

| **Requirement for applicability of the methodology** | **Compliance of CPA with the given requirement** | **Reference** |
|---|---|---|
| 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:<br>(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;<br>(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;<br>(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- | The legislation in Botswana stipulates waste such as chicken manure from chicken farms and other organic matter waste generated from all establishments (i.e. domestic, commercial, industrial etc) should be properly disposed of at Landfills. There are potential CPAs that may be implemented in this PoA with the waste classified in this methodology. The eligible CPAs will be assessed based on the 6 point criteria stipulated in this methodology. | AMS-III.AO./ Version 01 Paragraph 1 |

| | | |
|---|---|---|
| digested substrates;<br>(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;<br>(e) Project activities treating animal manure as single source substrate shall apply AMS-III.D .Methane recovery in animal manure management systems., similarly projects only treating wastewater and/or sludge generated in the wastewater treatment works shall apply AMS-III.H .Methane recovery in wastewater treatment.;<br>(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. | | |
| Measures are limited to those that result in emission reductions of less than or equal to 60 kt $CO_2$ equivalent annually. | Only CPAs falling in this category of projects will apply this methodology and will be eligible for inclusion in this PoA. | AMS-III.AO./ Version 01 Paragraph 2 |
| 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. Guidelines in AMS-III.G, AMS-III.D, AMS-III.E (concerning stockpiles) and AMS-III.H (as the case may be) shall be followed in this regard. Project activities for co-digestion of animal manure shall also meet the requirements under paragraphs 1 and 2(c) of AMS-III.D. The following requirement shall be checked ex ante at the beginning of each crediting period:<br>(a) Establish that identified landfill(s)/stockpile(s) can be expected to accommodate the waste to be used for the project activity for the duration of the crediting period; or<br>(b) Establish that it is common practice in the region to dispose of the waste in solid waste | The CPAs will take the necessary step to establish the baseline information required by the methodology. | AMS-III.AO./ Version 01 Paragraph 3 |

| | | |
|---|---|---|
| disposal site (landfill/stockpile). | | |
| 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). | Potential CPAs will define their geographical boundary based on the criteria outlined in this methodology | AMS-III.AO./ Version 01 Paragraph 4 |
| 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. | CPAs falling in this category will ensure compliances with the proper conditions and procedures for storage and transportation and soil application that do not result in methane emissions. | AMS-III.AO./ Version 01 Paragraph 5 |
| 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. | This may be an option CPAs may be willing to consider. The necessary methodology will apply. | AMS-III.AO./ Version 01 Paragraph 6 |
| 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". | This may be an option CPAs may be willing to consider. The "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site", will be used to calculate the residual emissions. | AMS-III.AO./ Version 01 Paragraph 7 |
| 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. | This may be an option CPAs may be willing to consider. The relevant procedure in AMS-III.H shall be followed to estimate the resultant project emissions. | AMS-III.AO./ Version 01 Paragraph 8 |
| Technical measures shall be used to ensure that all biogas captured from the digester is combusted/flared. | CPAs will use the captured biogas through means which involve the combustion or flaring and the necessary measures will be put in place to ensure that all biogas captured from the digester is combusted/flared. | AMS-III.AO./ Version 01 Paragraph 9 |

| | | |
|---|---|---|
| All the applications to utilise the recovered biogas detailed in paragraph 3 of AMS-III.H are eligible for use under this methodology. The relevant procedure in AMS-III.H shall be followed in this regard. | CPAs will consider the application stipulated in paragraph 3 of AMS-III.H and will follow the relevant procedure in AMS-III.H. | AMS-III.AO./ Version 01 Paragraph 10 |

**SECTION C. Management system**

>>

BPI will be the coordinating and management entity of the management and monitoring plan. The project developer and or the technology provider for each CPA, which may or may not include BPI, will develop the operation program.

**SECTION D. Duration of PoA**

**D.1. Start date of PoA**

>>

The start of the PoA will be the date on which the PoA is registered with the CDM Executive Board.

**D.2. Length of the PoA**

>>

The length of the PoA is 28 years.

**SECTION E. Environmental impacts**

**E.1. Level at which environmental analysis is undertaken**

>>

Environmental Analysis will be carried out at CPA level because each CPA constitutes a unique project, which is site specific. CPA will use different feedstock and will use a different technology approach and biogas utilisation based on the site requirements and utilisation and therefore will have different impacts. All CPAs will however conform to the Environmental Impact assessment (EIA) Act of Botswana, which requires all development projects to undertake an EIA. This will guarantee the environmental integrity of each CPA prior to inclusion in the PoA.

**E.2. Analysis of the environmental impacts**

>>

The production of biogas from cattle waste, chicken waste and abattoir waste has a net positive environmental impact. All biogas projects in Botswana are required by law to undertake an EIA prior to implementation to assess the positive and negative impacts that the projects may have on the environment. Currently the regulations stipulating the proper disposal of waste from the facilities earmarked for CPAs under this PoA do not stipulate to required treatment technologies. Rather the regulations allow for the disposal of the waste at designated landfills. The use of chicken waste in its raw form as natural fertiliser is prohibited under law. Furthermore there is no regulation on GHG emissions from waste generated at cattle feedlots, abattoirs and chicken farms.

The project will therefore have no negative impacts on the environment but will have the following positive impacts on the environment:-

- Reduction of methane emissions
- Reduction of underground water pollution
- Generation of green energy
- Reduction of dependence on fossil fuels
- Odour reduction
- Production of organic fertiliser
- Reduced dependants on inorganic fertiliser
- Reduced demand for land for waste disposal

## SECTION F. Local stakeholder comments

### F.1. Solicitation of comments from local stakeholders

>>

Consultations will be carried out at SSC-CPA level so as to reach a wider audience due to the geographical dispersion of the CPAs the diversity of interested and affected parties for each CPA. The EIA Act also stipulated that all interested and affected parties to the CPA will need to be consulted during the drafting of the EIA through local stakeholder meetings.

### F.2. Summary of comments received

>>

This will be addressed at CPA-PDD level

### F.3. Report on consideration of comments received

>>

This will be addressed at CPA-PDD level

## SECTION G. Approval and authorization

>>

This will be addressed at CPA-PDD level

## PART II. Generic component project activity (CPA)

### SECTION A. General description of a generic CPA

### A.1. Purpose and general description of generic CPAs

>>

Botswana has two main cattle Abattoirs in Lobatse and Francistown. The Lobatse abattoir uses open lagoons to treat wastewater to acceptable standards before being discharged to the municipal sewage system. A typical CPA will therefore seek to capture the methane generated from the open lagoons using the project activities stipulated in AMS- III.H. /: "Methane recovery in wastewater treatment" (Version 16). The capture methane can be destroyed by processes which include flaring, burning for process heat or electricity generation or upgrading for cooking bottling.

### SECTION B. Application of a baseline and monitoring methodology

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

>>

Typical CPAs for possible inclusion under this PoA include small scale project activities where the following methodologies are applicable:-

1. Project activities stipulated in AMS- III.H. /: "Methane recovery in wastewater treatment" (Version 16). The baseline and monitoring methodology in AMS- III.H will be used for such a CPA. The methodology has four tools that can be used with this methodology i.e.
    a. "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"
        i. The tool provides a procedure to calculate the baseline, project and/or leakage emissions from electricity consumption.
    b. "Tool to calculate project or leakage $CO_2$ emissions from fossil fuel combustion"
        i. The tool provides that methodology to calculate the CO2 emissions from fossil fuel consumption based on the type quantity and properties of fuel used.
    c. "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"
        i. The tool is used to calculate the emissions of the waste that would have been disposed of at a landfill in the absence of the project activities in the CPA.
    d. "Tool to determine project emissions from flaring gases containing methane"
        i. The tool will be used to calculate the project emissions from the flaring of biogas produced through the project activities.

### B.2. Application of methodology(ies)

>>

1. The CPA falling under the category of projects where the methodology AMS- III.H is applicable will typically be a livestock[2] abattoir, which currently has a waste water management system that does not currently capture biogas. The CPA will include the following:-
    a. The substitution of an existing aerobic wastewater and sludge systems with anaerobic systems with biogas recovery and combustion;
    b. The introduction of anaerobic sludge treatment system with biogas recovery and combustion to a wastewater treatment plant without sludge treatment;

    The recovered biogas will be combusted through a cogeneration system to meet the electricity and thermal requirement of the Abattoir.

[2] The abattoir may be slaughtering cattle, goats, sheep, game, chicken etc.

**B.3. Sources and GHGs**

>>

The main sources and GHGs of the project are shown in the table below and the leakages from the CPA will be accounted for according to the baseline monitoring methodologies.

| | Source | GHG | Inclusion | Justification |
|---|---|---|---|---|
| Baseline | Emissions from Abattoir Waste | $CO_2$ | No | Because it is generated from organic matter |
| | | $CH_4$ | Yes | Main Source |
| | | $N_2O$ | No | Because it's negligible |
| | Emissions from Electricity Generation | $CO_2$ | Yes | Catered for in the grid emission factor |
| | | $CH_4$ | Yes | Catered for in the grid emission factor |
| | | $N_2O$ | Yes | Catered for in the grid emission factor |
| Project Activity | Biogas recovery system | $CO_2$ | No | Because it's negligible |
| | | $CH_4$ | Yes | Main Source |
| | | $N_2O$ | No | Excluded for simplicity |
| | Waste treatment system with biogas recovery | $CO_2$ | No | Because it's negligible |
| | | $CH_4$ | Yes | Main Source |
| | | $N_2O$ | No | Excluded for simplicity |
| | Emissions from Cogeneration plant | $CO_2$ | Yes | Main Source |
| | | $CH_4$ | No | Excluded for simplicity |
| | | $N_2O$ | No | Excluded for simplicity |

**B.4. Description of baseline scenario**

>>

The baseline scenario waste at Livestock Abattoirs in Botswana is currently subject to various treatment processes which do not capture methane, which include open lagoon treatment processes. The abattoirs use electricity or coal to supply their energy and process heat requirements. For the case of the abattoir which is the subject of this CPA, the abattoir generates both solid and liquid waste through the slaughter of livestock, which includes cattle, game and ostriches. The solid waste generated consists mostly of biodegradable offal material and its contents and rejected animal carcasses. This waste is discharged loaded into large bins and disposed of at the Gamodubu landfill site 40km from the abattoir. The wastewater, which includes blood, fat and cow dung is discharged into the municipal waste system and is not treated at site.

The baseline emissions will be calculated according to the following steps:-

1. Baseline emissions for the systems affected by the project activity may consist of:

    (i) Emissions on account of electricity or fossil fuel used ($BE_{power,y}$);

    (ii) Methane emissions from baseline wastewater treatment systems ($BE_{ww,treatment,y}$);

    (iii) Methane emissions from baseline sludge treatment systems ($BE_{s,treatment,y}$);

    (iv) Methane emissions on account of inefficiencies in the baseline wastewater treatment systems and presence of degradable organic carbon in the treated wastewater discharged into river/lake/sea ($BE_{ww,discharge,y}$);

(v) Methane emissions from the decay of the final sludge generated by the baseline treatment systems ($BE_{s,final,y}$).

1. $$BE_y = \{BE_{power,y} + BE_{ww,treatment,y} + BE_{s,treatment,y} + BE_{ww,discharge,y} + BE_{s,final,y}\} \quad \textbf{(1)}$$

Where:

| | |
|---|---|
| $BE_y$ | Baseline emissions in year $y$ ($tCO_2e$) |
| $BE_{power,y}$ | Baseline emissions from electricity or fuel consumption in year $y$ ($tCO_2e$) |
| $BE_{ww,treatment,y}$ | Baseline emissions of the wastewater treatment systems affected by the project activity in year $y$ ($tCO_2e$) |
| $BE_{s,treatment,y}$ | Baseline emissions of the sludge treatment systems affected by the project activity in year $y$ ($tCO_2e$) |
| $BE_{ww,discharge,y}$ | Baseline methane emissions from degradable organic carbon in treated wastewater discharged into sea/river/lake in year $y$ ($tCO_2e$). |
| $BE_{s,final,y}$ | Baseline methane emissions from anaerobic decay of the final sludge produced in year $y$ ($tCO_2e$). If the sludge is controlled combusted, disposed in a landfill with biogas recovery, or used for soil application in the baseline scenario, this term shall be neglected |

Tools for Baseline calculations

$BE_{power,y}$ will be determined as per the procedures described in the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption.

The grid emission factor ( $EF_{CO2,grid,y}$ ,) that will be used in this procedure has been calculated in a transparent and conservative manner as follows:

A combined margin (CM), consists of the combination of operating margin (OM) and build margin (BM) contributions according to the procedures prescribed in the “Tool to calculate the Emission Factor for an electricity system (version 2.2.1)”. Table 1 summarizes the OM, BM and CM values that were calculated for the SAPP grid to which Botswana belongs (UNEP study)[3]. The grid emission factor (GEF) has been validated by Carbon Check of South Africa and is on the UNFCCC website. The value to be adopted for this PoA is 0.9644$tCO_2$/MWh[4]. This SAPP GEF is conservative for Botswana that individually has a higher emission factor of 1.0824 $tCO_2$/MWh[5].

---

[3] **Calculation of the Emission Factor of the Electricity System of the Southern African Power Pool Version 1.5, 22nd February 2012**

[4] **CDM-EB73-A03**

[5] **UNEP Risoe Center Analysis on Grid Emission Factors for the Electricity Sector in Sub-Saharan Africa The Case of the Southern African Power Pool**

| **Table 1: Summary of the Regional SAPP GEF**[6] | | | |
|---|---|---|---|
| OM Emission Factor (in t-$CO_2$/MWh) | **0.9958** | | |
| BM Emission Factor (in t-$CO_2$/MWh) | **0.9331** | | |
| | Weight of the OM | Weight of the BM | CM Emission Factor (in t-CO2/MWh) |
| Wind and solar power generation project activities for the first crediting period and for subsequent crediting periods | 0.75 | 0.25 | **0.9801** |
| All other projects for the first crediting period | 0.5 | 0.5 | **0.9644** |
| All other projects for the second and third crediting period | 0.25 | 0.75 | **0.9488** |

[6] Grid Emission Factor still under consideration by the EB although all the SAPP DNAs have signed for it.

$$BE_{ww,treatment,y} = \sum_i (Q_{ww,i,y} * COD_{inflow,i,y} * \eta_{COD,BL,i} * MCF_{ww,treatment,BL,i}) * B_{o,ww} * UF_{BL} * GWP_{CH4} \quad \textbf{(2)}$$

Where:

| | |
|---|---|
| $Q_{ww,i,y}$ | Volume of wastewater treated in baseline wastewater treatment system *i* in year *y* ($m^3$). For *ex ante* estimation, forecasted wastewater generation volume or the designed capacity of the wastewater treatment facility can be used. However, the *ex post* emissions reduction calculation shall be based on the actual monitored volume of treated wastewater |
| $COD_{inflow,i,y}$ | Chemical oxygen demand of the wastewater inflow to the baseline treatment system *i* in year *y* ($t/m^3$). Average value may be used through sampling with the confidence/precision level 90/10 |
| $\eta_{COD,BL,i}$ | COD removal efficiency of the baseline treatment system *i*, determined as per the paragraphs 26, 27 or 28 in AMSIII.H. Version 16. |
| $MCF_{ww,treatment,BL,i}$ | Methane correction factor for baseline wastewater treatment systems *i* (*MCF* values as per Table III.H.1 in AMSIII.H. Version 16.) |
| $i$ | Index for baseline wastewater treatment system |
| $B_{o,ww}$ | Methane producing capacity of the wastewater (IPCC value of 0.25 kg $CH_4$/kg COD)[7] |
| $UF_{BL}$ | Model correction factor to account for model uncertainties (0.89)[8] |
| $GWP_{CH4}$ | Global Warming Potential for methane (value of 21) |

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

$$BE_{treatment,s,y} = \sum_j S_{j,BL,y} * MCF_{s,treatment,BL,j} * DOC_s * UF_{BL} * DOC_F * F * 16/12 * GWP_{CH4} \quad \textbf{(3)}$$

Where:

| | |
|---|---|
| $S_{j,BL,y}$ | Amount of dry matter in the sludge that would have been treated by the sludge treatment system *j* in the baseline scenario (t). For *ex ante* estimation, forecasted sludge generation volume or the designed capacity of the sludge treatment facility can be used. However, the *ex post* emissions reduction calculation shall be based on the actual monitored volume of treated sludge |
| $j$ | Index for baseline sludge treatment system |
| $DOC_s$ | Degradable organic content of the untreated sludge generated in the year *y* (fraction, dry basis). Default values of 0.5 for domestic sludge and 0.257 for industrial sludge[9] shall be used |

---

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

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

[9] The IPCC default values of 0.05 for domestic sludge (wet basis, considering a default dry matter content of 10%) or 0.09 for industrial sludge (wet basis, assuming dry matter content of 35%), were corrected for dry basis.

| | |
|---|---|
| $MCF_{s,treatment,BL,j}$ | Methane correction factor for the baseline sludge treatment system *j* (*MCF* values as per Table III.H.1 in AMS III.H./Version 16) |
| $UF_{BL}$ | Model correction factor to account for model uncertainties (0.89) |
| $DOC_F$ | Fraction of DOC dissimilated to biogas (IPCC default value of 0.5) |
| $F$ | Fraction of $CH_4$ in biogas (IPCC default of 0.5) |

$$BE_{s,treatment,y} = \sum_j S_{j,BL,y} * EF_{composting} * GWP_{CH4} \quad \textbf{(4)}$$

Where:

| | |
|---|---|
| $EF_{composting}$ | Emission factor for composting organic waste (t $CH_4$/t waste treated). Emission factors can be based on facility/site-specific measurements, country specific values or IPCC default values (Table 4.1, chapter 4, Volume 5, 2006 IPCC Guidelines for National Greenhouse Gas Inventories). IPCC default value is 0.01 t $CH_4$/ t sludge treated on a dry weight basis |

If the baseline wastewater treatment system is different from the treatment system in the project scenario, the sludge generation rate (amount of sludge generated per unit of COD removed) in the baseline may differ significantly from that of the project scenario. For example, it is known that the amount of sludge generated in aerobic wastewater systems is larger than in anaerobic systems, for the same COD removal efficiency. Therefore, for these cases, the monitored values of the amount of sludge generated during the crediting period will be used to estimate the amount of sludge generated in the baseline, as follows:

$$S_{j,BL,y} = S_{l,PJ,y} * \frac{SGR_{BL}}{SGR_{PJ}} \quad \textbf{(5)}$$

Where:

| | |
|---|---|
| $S_{l,PJ,y}$ | Amount of dry matter in the sludge treated by the sludge treatment system *l* in year *y* in the project scenario (t) |
| $SGR_{BL}$ | Sludge generation ratio of the wastewater treatment plant in the baseline scenario (tonne of dry matter in sludge/t COD removed). This ratio will be determined as per paragraphs 26, 27 or 28 in AMS III.H Version 16. |
| $SGR_{PJ}$ | Sludge generation ratio of the wastewater treatment plant in the project scenario (tonne of dry matter in sludge/t COD removed). Calculated using the monitored values of COD removal (i.e. $COD_{inflow,i}$ minus $COD_{outflow,i}$) and sludge generation in the project scenario |

$$BE_{ww,discharge,y} = Q_{ww,y} * GWP_{CH4} * B_{o,ww} * UF_{BL} * COD_{ww,discharge,BL,y} * MCF_{ww,BL,discharge} \quad \textbf{(6)}$$

Where:

| | |
|---|---|
| $Q_{ww,y}$ | Volume of treated wastewater discharged in year *y* ($m^3$) |
| $UF_{BL}$ | Model correction factor to account for model uncertainties (0.89) |
| $COD_{ww,discharge,BL,y}$ | Chemical oxygen demand of the treated wastewater discharged into sea, river or lake in the baseline situation in the year *y* ($t/m^3$). If the baseline scenario is the discharge of untreated wastewater, the COD of untreated wastewater shall be used |
| $MCF_{ww,BL,discharge}$ | Methane correction factor based on discharge pathway in the baseline situation (e.g. into sea, river or lake) of the wastewater (fraction) (*MCF* values as per Table |

III.H.1 in AMS III.H./Version 16)

To determine $COD_{ww,discharge,BL,y}$: if the baseline treatment system(s) is different from the treatment system(s) in the project scenario, the monitored values of the COD inflow during crediting period will be used to calculate the baseline emissions *ex post*.

$$BE_{s,final,y} = S_{final,BL,y} * DOC_s * UF_{BL} * MCF_{s,BL,final} * DOC_F * F * 16/12 * GWP_{CH4} \quad \textbf{(7)}$$

Where:

| | |
|---|---|
| $S_{final,BL,y}$ | Amount of dry matter in the final sludge generated by the baseline wastewater treatment systems in the year *y* (t). If the baseline wastewater treatment system is different from the project system, it will be estimated using the monitored amount of dry matter in the final sludge generated by the project activity ($S_{final,PJ,y}$) corrected for the sludge generation ratios of the project and baseline systems as per equation 5 above |
| $MCF_{s,BL,final}$ | Methane correction factor of the disposal site that receives the final sludge in the baseline situation, estimated using the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site” |
| $UF_{BL}$ | Model correction factor to account for model uncertainties (0.89) |

**B.5. Demonstration of eligibility for a generic CPA**

>>

A potential CPA can be implemented under the PoA that recovers biogas from biogenic organic matter in Animal Abattoir wastewater by means of one, or a combination, of the six options mentioned in the methodology and will contribute to methane avoidance.

Some Animal Abattoirs in Botswana discharge untreated waste into the municipal waste system and this methodology will be applicable for the project activities covered in AMSIII.H. Version 16. The treatment processes in Botswana will have lagoons ponds with a depth greater than two meters, without aeration and are situated in areas with ambient temperature above 15$^o$C, at least during most parts of the year on a monthly average basis.

**B.6. Estimation of emission reductions of a generic CPA**

**B.6.1. Explanation of methodological choices**

>>

In determining the Emission Reductions of the CPA project activities the following steps will be followed:-

Project activity emissions from the systems affected by the project activity are:

(i) $CO_2$ emissions from electricity and fuel used by the project facilities ($PE_{power,y}$);

(ii) Methane emissions from wastewater treatment systems affected by the project activity, and not equipped with biogas recovery in the project scenario ($PE_{ww,treatment,y}$);

(iii) Methane emissions from sludge treatment systems affected by the project activity, and not equipped with biogas recovery in the project situation ($PE_{s,treatment,y}$);

(iv) Methane emissions on account of inefficiency of the project activity wastewater treatment systems and presence of degradable organic carbon in treated wastewater ($PE_{ww,discharge,y}$);

(v) Methane emissions from the decay of the final sludge generated by the project activity treatment systems ( $PE_{s,final,y}$ );

(vi) Methane fugitive emissions due to inefficiencies in capture systems ( $PE_{fugitive,y}$ );

(vii) Methane emissions due to incomplete flaring ( $PE_{flaring,y}$ );

(viii) Methane emissions from biomass stored under anaerobic conditions which would not have occurred in the baseline situation ($PE_{biomass,y}$).

$$PE_y = \left\{ \begin{array}{l} PE_{power,y} + PE_{ww,treatment,y} + PE_{s,treatment,y} + PE_{ww,discharge,y} + PE_{s,final,y} + \\ PE_{fugitive,y} + PE_{biomass,y} + PE_{flaring,y} \end{array} \right\} \quad \textbf{(8)}$$

Where:

$PE_y$ — Project activity emissions in the year $y$ ($tCO_2e$)

$PE_{power,y}$ — Emissions from electricity or fuel consumption in the year $y$ ($tCO_2e$).

$PE_{ww,treatment,y}$ — Methane emissions from wastewater treatment systems affected by the project activity, and not equipped with biogas recovery, in year $y$ ($tCO_2e$). Emissions calculated as per equation 2, using an uncertainty factor of 1.12 and data applicable to the project situation ($MCF_{ww,treatment,PJ,k}$ and $\eta_{,PJ,k,y}$) and with the following changed definition of parameters:

- $MCF_{ww,treatment,PJ,k}$ — Methane correction factor for project wastewater treatment system $k$ (*MCF* values as per Table III.H.1)
- $\eta_{,PJ,k,}$ — Chemical oxygen demand removal efficiency of the project wastewater treatment system $k$ in year $y$ ($t/m^3$), measured based on inflow COD and outflow COD in system $k$

$PE_{s,treatment,y}$ — Methane emissions from sludge treatment systems affected by the project activity, and not equipped with biogas recovery, in year $y$ ($tCO_2e$). Emissions calculated as per equations 3 and 4, using an uncertainty factor of 1.12 and data applicable to the project situation ($S_{l,PJ,y}$, $MCF_{s,treatment,l}$) and with the following changed definition of parameters:

- $S_{l,PJ,y}$ — Amount of dry matter in the sludge treated by the sludge treatment system $l$ in the project scenario in year $y$ (t)
- $MCF_{s,treatment,l}$ — Methane correction factor for the project sludge treatment system l (*MCF* values as per Table III.H.1)

$PE_{ww,discharge,y}$ — Methane emissions from degradable organic carbon in treated wastewater in year $y$ ($tCO_2e$).

- $COD_{ww,discharge,PJ,y}$ — Chemical oxygen demand of the treated wastewater discharged into the sea, river or lake in the project scenario in year $y$ ($t/m^3$)
- $MCF_{ww,PJ,discharge}$ — Methane correction factor based on the discharge pathway of the wastewater in the project scenario (e.g. into sea, river or lake) (*MCF* values as per Table III.H.1)

$PE_{s,final,y}$ — Methane emissions from anaerobic decay of the final sludge produced in year *y* ($tCO_2e$). Emissions calculated as per equation 7, using an uncertainty factor of 1.12 and data applicable to the project conditions ($MCF_{s,PJ,final}$, $S_{final,PJ,y}$). If the sludge is controlled combusted, disposed in a landfill with biogas recovery, or used for soil application in aerobic conditions in the project activity, this term shall be neglected, and the sludge treatment and/or use and/or final disposal shall be monitored during the crediting period with the following revised definition of the parameters:

- $MCF_{s,PJ,final}$ — Methane correction factor of the disposal site that receives the final sludge in the project situation, estimated using the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"
- $S_{final,PJ,y}$ — Amount of dry matter in final sludge generated by the project wastewater treatment systems in the year *y* (t)

$PE_{fugitive,y}$ — Methane emissions from biogas release in capture systems in year *y*, ($tCO_2e$)

$PE_{flaring,y}$ — Methane emissions due to incomplete flaring in year *y* ($tCO_2e$). For *ex ante* estimation, baseline emission calculation for wastewater and/or sludge treatment (i.e. equation 2 and/or equation 3) can be used but without the consideration of GWP for $CH_4$. *Ex post* emission reduction shall be calculated using the "Tool to determine project emissions from flaring gases containing methane" by using actual monitored data

$PE_{biomass,y}$ — Methane emissions from biomass stored under anaerobic conditions. If storage of biomass under anaerobic conditions takes place in the project and does not occur in the baseline , methane emissions due to anaerobic decay of this biomass shall be considered and be determined using the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" ($tCO_2e$)

Project activity emissions from methane release in capture systems are determined as follows:

(a) Based on the methane emission potential of wastewater and/or sludge:

$$PE_{fugitive,y} = PE_{fugitive,ww,y} + PE_{fugitive,s,y} \quad \textbf{(9)}$$

Where:

$PE_{fugitive,ww,y}$ — Fugitive emissions through capture inefficiencies in the anaerobic wastewater treatment systems in the year *y* ($tCO_2e$)

$PE_{fugitive,s,y}$ — Fugitive emissions through capture inefficiencies in the anaerobic sludge treatment systems in the year *y* ($tCO_2e$)

$$PE_{fugitive,ww,y} = (1 - CFE_{ww}) * MEP_{ww,treatment,y} * GWP_{CH4} \quad \textbf{(10)}$$

Where:

$CFE_{ww}$ — Capture efficiency of the biogas recovery equipment in the wastewater treatment systems (a default value of 0.9 shall be used)

$MEP_{ww,treatment,y}$ — Methane emission potential of wastewater treatment systems equipped with biogas recovery system in year *y* (t)

$$MEP_{ww,treatment,y} = Q_{ww,y} * B_{o,ww} * UF_{PJ} * \sum_k COD_{removed,PJ,k,y} * MCF_{ww,treatment,PJ,k} \quad \textbf{(11)}$$

Where:

| | |
|---|---|
| $COD_{removed,PJ,k,y}$ | The chemical oxygen demand removed[10] by the treatment system *k* of the project activity equipped with biogas recovery in the year *y* (t/m$^3$) |
| $MCF_{ww,treatment,PJ,k}$ | Methane correction factor for the project wastewater treatment system *k* equipped with biogas recovery equipment |
| $UF_{PJ}$ | Model correction factor to account for model uncertainties (1.12) |

$$PE_{fugitive,s,y} = (1 - CFE_s) * MEP_{s,treatment,y} * GWP_{CH4} \quad \textbf{(7)}$$

Where:

| | |
|---|---|
| $CFE_s$ | Capture efficiency of the biogas recovery equipment in the sludge treatment systems (a default value of 0.9 shall be used) |
| $MEP_{s,treatment,y}$ | Methane emission potential of the sludge treatment systems equipped with a biogas recovery system in year *y* (t) |

$$MEP_{s,treatment,y} = \sum_{l} (S_{l,PJ,y} * MCF_{s,treatment,PJ,l}) * DOC_s * UF_{PJ} * DOC_F * F * 16/12 \quad \textbf{(12)}$$

Where:

| | |
|---|---|
| $S_{l,PJ,y}$ | Amount of sludge treated in the project sludge treatment system *l* equipped with a biogas recovery system (on a dry basis) in year *y* (t) |
| $MCF_{s,treatment,PJ,l}$ | Methane correction factor for the sludge treatment system equipped with biogas recovery equipment (*MCF* values as per Table III.H.1) |
| $UF_{PJ}$ | Model correction factor to account for model uncertainties (1.12) |

(b) Optionally a default value of 0.05 m³ biogas leaked/m³ biogas produced may be used as an alternative to calculations per equation 9 to 13.

**Leakage**

In case the project activity involves the replacement of equipment, and the leakage effect of the use of the replaced equipment in another activity is neglected, because the replaced equipment is scrapped, an independent monitoring of scrapping of replaced equipment needs to be implemented. The monitoring should include a check if the number of project activity equipment distributed by the project and the number of scrapped equipment correspond with each other. For this purpose scrapped equipment should be stored until such correspondence has been checked. The scrapping of replaced equipment should be documented and independently verified.

**Emission Reduction**

For all scenarios in paragraph 1 in AMS III.H Version 16, i.e. 1 (a) to 1 (f),[11] emission reductions shall be estimated *ex ante* in the PDD using the equations provided in the baseline, project and leakage emissions sections above. Emission reductions shall be estimated *ex ante* as follows:

$$ER_{y,ex\,ante} = BE_{y,ex\,ante} - (PE_{y,ex\,ante} + LE_{y,ex\,ante}) \quad \textbf{(13)}$$

Where:

| | |
|---|---|
| $ER_{y,ex\,ante}$ | *Ex ante* emission reduction in year *y* ($tCO_2e$) |

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

[11] AMS-III.H./Version 16

| | |
|---|---|
| $LE_{y,ex\,ante}$ | *Ex ante* leakage emissions in year *y* ($tCO_2e$) |
| $PE_{y,ex\,ante}$ | *Ex ante* project emissions in year *y* calculated as paragraph 29 in AMS III.H Version 16 ($tCO_2e$) |
| $BE_{y,ex\,ante}$ | *Ex ante* baseline emissions in year *y* calculated as per paragraph 18 in AMS III.H Version 16 ($tCO_2e$) |

*Ex post* emission reductions shall be determined for case 1 (a) and 1 (e) using equation 16. For cases 1 (b), 1 (c), 1 (d) and 1 (f), *ex post* emission reductions shall be based on the lowest value of the following, using equation (15):

1. The amount of biogas recovered and fuelled or flared ($MD_y$) during the crediting period, that is monitored *ex post*;
2. *Ex post* calculated baseline, project and leakage emissions based on actual monitored data for the project activity.

For cases 1 (b), 1 (c), 1 (d) and 1 (f): it is possible that the project activity involves wastewater and sludge treatment systems with higher methane conversion factors (*MCF*) or with higher efficiency than the treatment systems used in the baseline situation. Therefore the emission reductions achieved by the project activity is limited to the *ex post* calculated baseline emissions minus project emissions using the actual monitored data for the project activity. The emission reductions achieved in any year are the lowest value of the following:

$$ER_{y,ex\,post} = \min((BE_{y,ex\,post} - PE_{y,ex\,post} - LE_{y,ex\,post}), (MD_y - PE_{power,y} - PE_{biomass,y} - LE_{y,ex\,post})) \quad \textbf{(14)}$$

Where:

| | |
|---|---|
| $ER_{y,ex\,post}$ | Emission reductions achieved by the project activity based on monitored values for year *y* ($tCO_2e$) |
| $BE_{y,ex\,post}$ | Baseline emissions calculated as per paragraph 18 in AMS III.H Version 16 using *ex post* monitored values |
| $PE_{y,ex\,post}$ | Project emissions calculated as per paragraph 29 in AMS III.H Version 16 using *ex post* monitored values |
| $MD_y$ | Methane captured and destroyed/gainfully used by the project activity in the year *y* ($tCO_2e$) |

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

$$MD_y = BG_{burnt,y} * w_{CH4,y} * D_{CH4} * FE * GWP_{CH4} \quad \textbf{(15)}$$

Where:

| | |
|---|---|
| $BG_{burnt,y}$ | Biogas[12] flared/combusted in year *y* ($m^3$) |
| $w_{CH4,y}$ | Methane content[13] of the biogas in the year *y* (volume fraction) |
| $D_{CH4}$ | Density of methane at the temperature and pressure of the biogas in the year *y* ($t/m^3$) |
| $FE$ | Flare efficiency in year *y* (fraction). If the biogas is combusted for gainful purposes, e.g. fed to an engine, an efficiency of 100% may be applied |

[12] Biogas volume and methane content measurements shall be on the same basis (wet or dry).

For the cases listed in paragraph 1 in AMS III.H. Version 16 such as:

a. Substitution of an aerobic wastewater or sludge treatment system with an anaerobic treatment system with methane recovery and combustion; and

b. Introduction of an anaerobic wastewater treatment system with methane recovery and combustion to an untreated wastewater stream.

The emission reduction achieved by the project activity (*ex post*) will be the difference between the baseline emissions and the sum of the project emissions and leakage.

$$ER_y = BE_{y,ex\ post} - \left(PE_{y,ex\ post} + LE_{y,ex\ post}\right) \qquad \textbf{(16)}$$

The historical records of electricity and fuel consumption, the COD content of untreated and treated wastewater, and the quantity of sludge produced by the replaced units will be used for the baseline calculation.

In case (a), if the volumetric flow and the characteristic properties (e.g. COD) of the inflow and outflow of the wastewater are equivalent in the project and the baseline scenarios (i.e. the project and baseline systems have the same efficiency for COD removal for wastewater treatment), then the higher energy consumption and sludge generation in the baseline scenario are the only significant differences contributing to emissions reductions in the project case. In this case, the emission reductions can be calculated as the difference between the historical energy consumption of the replaced unit and the recorded energy consumption of the new system, plus the difference in emissions from sludge treatment and/or disposal. Project emissions from fugitive emissions and incomplete flaring ($PE_{fugitive,y}$, $PE_{flaring,y}$) shall also be considered in the calculation of the emission reductions, however the emissions from the wastewater outflow and sludge ($PE_{ww,discharge,y}$, $PE_{s,final,y}$) may be disregarded, if they are equivalent in the baseline and project scenarios.

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

*(Copy this table for each data and parameter.)*

| **Data / Parameter** | $Q_{ww,i,y}$ |
|---|---|
| **Unit** | m³/month |
| **Description** | The flow of wastewater |
| **Source of data** | Historical Data and measurement campaign<br>For Greenfield Plants:-<br>1. Values can be obtained from a measurement campaign in a comparable existing wastewater treatment plant<br>2. Value provided by the manufacturer/designer of a Greenfield wastewater treatment plant using the same technology, demonstrated to be conservative, |
| **Value(s) applied** | To be determined by each CPA |
| **Choice of data or Measurement methods and procedures** | Measurements are undertaken using flow meters |
| **Purpose of data** | Used in calculations in equations (2) and (11) |
| **Additional comment** | |

| | |
|---|---|
| **Data / Parameter** | $COD_{\inf low,i,y}$ |
| **Unit** | t/m$^3$ |
| **Description** | Chemical oxygen demand of the wastewater inflow to the baseline treatment system *i* in year *y* |
| **Source of data** | Historical Data and measurement campaign<br>For Greenfield Plants:-<br>1. Values can be obtained from a measurement campaign in a comparable existing wastewater treatment plant<br>2. Value provided by the manufacturer/designer of a Greenfield wastewater treatment plant using the same technology, demonstrated to be conservative, |
| **Value(s) applied** | To be determined by each CPA |
| **Choice of data or Measurement methods and procedures** | The COD to be measured according to national or international standards through representative sampling |
| **Purpose of data** | Used to calculate baseline emission factor |
| **Additional comment** | Average value may be used through sampling with the confidence/precision level 90/10 |

| | |
|---|---|
| **Data / Parameter** | $h_{COD,BL,i}$ |
| **Unit** | Fraction |
| **Description** | COD removal efficiency of the baseline treatment system *i* |
| **Source of data** | |
| **Value(s) applied** | |
| **Choice of data or Measurement methods and procedures** | Historical Data and measurement campaign<br>For Greenfield Plants:-<br>1. Values can be obtained from a measurement campaign in a comparable existing wastewater treatment plant<br>2. Value provided by the manufacturer/designer of a Greenfield wastewater treatment plant using the same technology, demonstrated to be conservative, |
| **Purpose of data** | A measure of COD removal in baseline treatment system |
| **Additional comment** | |

| Data / Parameter | $MCF_{ww,treatment,BL,i}$ |
|---|---|
| Unit | Fraction |
| Description | Methane correction factor for baseline wastewater treatment systems *i* |
| Source of data | Table III.H.1 in AMS III.H./Version 16 |
| Value(s) applied | To be determined by each CPA |
| Choice of data or Measurement methods and procedures | Will depend on CPA and will be selected from the figures recommended in Table III.H.1 in AMS III.H./Version 16. |
| Purpose of data | Used for calculating Baseline emissions |
| Additional comment | |

| Data / Parameter | $B_{o,ww}$ |
|---|---|
| Unit | kg $CH_4$/kg COD |
| Description | Methane producing capacity of the wastewater |
| Source of data | IPCC value in AMS III.H./Version 16 |
| Value(s) applied | 0.25 |
| Choice of data or Measurement methods and procedures | Based on IPCC value in AMS III.H./Version 16 |
| Purpose of data | Used to calculate baseline emissions |
| Additional comment | Project activities may use the default value of 0.6 kg $CH_4$/kg BOD, if the parameter $BOD_{5,20}$ is used to determine the organic content of the wastewater. In this case, baseline and project emissions calculations shall use BOD instead of COD in the equations, and the monitoring of the project activity shall be based in direct measurements of $BOD_{5,20}$, i.e. the estimation of BOD values based on COD measurements is not allowed. |

| Data / Parameter | $UF_{BL}$ |
|---|---|
| Unit | Fraction |
| Description | Model correction factor to account for model uncertainties |
| Source of data | IPCC value in AMS III.H./Version 16 |
| Value(s) applied | 0.89 |
| Choice of data or Measurement methods and procedures | Based on IPCC value in AMS III.H./Version 16 |
| Purpose of data | Used to account for uncertainty associated with calculation model |
| Additional comment | Parameter to remain constant for entire crediting period |

| Data / Parameter | $GWP_{CH4}$ |
|---|---|
| Unit | Fraction |
| Description | Global Warming Potential for methane |
| Source of data | IPCC value in AMS III.H./Version 16 |
| Value(s) applied | 21 |
| Choice of data or Measurement methods and procedures | Based on IPCC value in AMS III.H./Version 16 |
| Purpose of data | Value used to calculate global warming potential of methane |
| Additional comment | |

| Data / Parameter | $S_{j,BL,y}$ |
|---|---|
| Unit | t |
| Description | Amount of dry matter in the sludge that would have been treated by the sludge treatment system *j* in the baseline scenario |
| Source of data | 1. For *ex ante* estimation, forecasted sludge generation volume or the designed capacity of the sludge treatment facility can be used.<br>2. *ex post* emissions reduction calculation shall be based on the actual monitored volume of treated sludge |
| Value(s) applied | To be determined by each CPA |
| Choice of data or Measurement methods and procedures | To be measured according to international best practice |
| Purpose of data | Used for calculating Baseline emissions |
| Additional comment | |

| Data / Parameter | $MCF_{s,treatment,BL,j}$ |
|---|---|
| Unit | Fraction |
| Description | Methane correction factor for the baseline sludge treatment system *j* |
| Source of data | Table III.H.1 in AMS III.H./Version 16 |
| Value(s) applied | To be determined by each CPA |
| Choice of data or Measurement methods and procedures | Will be depend on CPA and will be selected from the figures recommended in Table III.H.1 in AMS III.H./Version 16. |
| Purpose of data | Used for calculating Baseline emissions |
| Additional comment | |

| | |
|---|---|
| **Data / Parameter** | $DOC_F$ |
| **Unit** | Fraction |
| **Description** | Fraction of DOC dissimilated to biogas |
| **Source of data** | IPCC default value in AMS III.H./Version 16 |
| **Value(s) applied** | 0.5 |
| **Choice of data or Measurement methods and procedures** | Default value recommended by IPCC |
| **Purpose of data** | Used for calculating Baseline emissions |
| **Additional comment** | |

| | |
|---|---|
| **Data / Parameter** | $F$ |
| **Unit** | Fraction |
| **Description** | Fraction of $CH_4$ in biogas |
| **Source of data** | IPCC default value in AMS III.H./Version 16 |
| **Value(s) applied** | 0.5 |
| **Choice of data or Measurement methods and procedures** | Default value recommended by IPCC |
| **Purpose of data** | Used for calculating Baseline emissions |
| **Additional comment** | |

| | |
|---|---|
| **Data / Parameter** | $EF_{composting}$ |
| **Unit** | t $CH_4$/t waste treated |
| **Description** | Emission factor for composting organic waste. |
| **Source of data** | Emission factors can be based on facility/site-specific measurements, country specific values or IPCC default values (Table 4.1, chapter 4, Volume 5, 2006 IPCC Guidelines for National Greenhouse Gas Inventories). |
| **Value(s) applied** | IPCC default value is 0.01 t $CH_4$/ t sludge treated on a dry weight basis. But will depend on CPA |
| **Choice of data or Measurement methods and procedures** | To be based on IPCC default values in Table 4.1, chapter 4, Volume 5, 2006 IPCC Guidelines for National Greenhouse Gas Inventories. |
| **Purpose of data** | Used to calculate baseline emissions if the sludge is composted |
| **Additional comment** | |

| **Data / Parameter** | $Q_{ww,y}$ |
|---|---|
| **Unit** | m³ |
| **Description** | Volume of treated wastewater discharged in year *y* |
| **Source of data** | Historical Data and measurement campaign<br>For Greenfield Plants:-<br>1. Values can be obtained from a measurement campaign in a comparable existing wastewater treatment plant<br>2. Value provided by the manufacturer/designer of a Greenfield wastewater treatment plant using the same technology, demonstrated to be conservative, |
| **Value(s) applied** | To be determined by each CPA |
| **Choice of data or Measurement methods and procedures** | Measurements are undertaken using flow meters |
| **Purpose of data** | Used in calculations in equations (6) |
| **Additional comment** | |

| **Data / Parameter** | $COD_{ww,discharge,BL,y}$ |
|---|---|
| **Unit** | t/m³ |
| **Description** | Chemical oxygen demand of the treated wastewater discharged into sea, river or lake in the baseline situation in the year *y* |
| **Source of data** | Historical Data and measurement campaign<br>For Greenfield Plants:-<br>1. Values can be obtained from a measurement campaign in a comparable existing wastewater treatment plant<br>2. Value provided by the manufacturer/designer of a Greenfield wastewater treatment plant using the same technology, demonstrated to be conservative, |
| **Value(s) applied** | To be determined by each CPA |
| **Choice of data or Measurement methods and procedures** | The COD to be measured according to national or international standards through representative sampling |
| **Purpose of data** | Used to calculate baseline emissions of effluent discharged into natural rivers. |
| **Additional comment** | If the baseline scenario is the discharge of untreated wastewater, the COD of untreated wastewater shall be used |

| Data / Parameter | $MCF_{ww,BL,discharge}$ |
|---|---|
| Unit | Fraction |
| Description | Methane correction factor based on discharge pathway in the baseline situation (e.g. into sea, river or lake) of the wastewater (fraction) |
| Source of data | Table III.H.1 in AMS III.H./Version 16 |
| Value(s) applied | To be determined by each CPA |
| Choice of data or Measurement methods and procedures | Will be depend on CPA and will be selected from the figures recommended in Table III.H.1 in AMS III.H./Version 16. |
| Purpose of data | Used for calculating Baseline emissions of wastewater discharged into natural rivers |
| Additional comment | |

| Data / Parameter | $S_{final,BL,y}$ |
|---|---|
| Unit | t |
| Description | Amount of dry matter in the final sludge generated by the baseline wastewater treatment systems in the year *y* |
| Source of data | If the baseline wastewater treatment system is different from the project system, it will be estimated using the monitored amount of dry matter in the final sludge generated by the project activity ($S_{final,PJ,y}$) corrected for the sludge generation ratios of the project and baseline systems as per equation 5 |
| Value(s) applied | To be determined by each CPA |
| Choice of data or Measurement methods and procedures | To be measured according to international best practice |
| Purpose of data | Used for calculating final baseline emissions |
| Additional comment | |

| Data / Parameter | $MCF_{s,BL,final}$ |
|---|---|
| Unit | Fraction |
| Description | Methane correction factor of the disposal site that receives the final sludge in the baseline situation |
| Source of data | Estimated using the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site” |
| Value(s) applied | To be determined by each CPA |
| Choice of data or Measurement methods and procedures | Will be depend on CPA and will be results of the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site” |
| Purpose of data | Used for calculating Baseline emissions anaerobic decay of final sludge |
| Additional comment | |

| | |
|---|---|
| **Data / Parameter** | $COD_{ww,untreated,y}$, |
| **Unit** | t COD/m³ |
| **Description** | The chemical oxygen demand of the wastewater before the treatment system affected by the project activity |
| **Source of data** | Historical Data and measurement campaign<br>For Greenfield Plants:-<br>1. Values can be obtained from a measurement campaign in a comparable existing wastewater treatment plant<br>2. Value provided by the manufacturer/designer of a Greenfield wastewater treatment plant using the same technology, demonstrated to be conservative, |
| **Value(s) applied** | To be determined by each CPA |
| **Choice of data or Measurement methods and procedures** | The COD to be measured according to national or international standards through representative sampling |
| **Purpose of data** | Used to calculate the plant COD removal efficiency |
| **Additional comment** | |

| | |
|---|---|
| **Data / Parameter** | $COD_{ww,treated,y}$, |
| **Unit** | t COD/m³ |
| **Description** | The chemical oxygen demand of the wastewater after the treatment system affected by the project activity |
| **Source of data** | Historical Data and measurement campaign<br>For Greenfield Plants:-<br>1. Values can be obtained from a measurement campaign in a comparable existing wastewater treatment plant<br>2. Value provided by the manufacturer/designer of a Greenfield wastewater treatment plant using the same technology, demonstrated to be conservative, |
| **Value(s) applied** | To be determined by each CPA |
| **Choice of data or Measurement methods and procedures** | The COD to be measured according to national or international standards through representative sampling |
| **Purpose of data** | Used to calculate the plant COD removal efficiency |
| **Additional comment** | |

| Data / Parameter | $COD_{ww,discharge,PJ,y}$ |
|---|---|
| Unit | t COD/m³ |
| Description | The chemical oxygen demand of the wastewater after the treatment system affected by the project activity |
| Source of data | Historical Data and measurement campaign<br>For Greenfield Plants:-<br>3. Values can obtained from a measurement campaign in a comparable existing wastewater treatment plant<br>4. Value provided by the manufacturer/designer of a Greenfield wastewater treatment plant using the same technology, demonstrated to be conservative, |
| Value(s) applied | To be determined by each CPA |
| Choice of data or Measurement methods and procedures | The COD to be measured according to national or international standards through representative sampling |
| Purpose of data | Used to calculate the plant COD removal efficiency |
| Additional comment | |

| Data / Parameter | $S_{l,PJ,y}$ |
|---|---|
| Unit | t |
| Description | Amount of dry matter in the sludge |
| Source of data | Historical Data and measurement campaign<br>For Greenfield Plants:-<br>1. Values can be obtained from a measurement campaign in a comparable existing wastewater treatment plant<br>2. Value provided by the manufacturer/designer of a Greenfield wastewater treatment plant using the same technology, demonstrated to be conservative, |
| Value(s) applied | To be determined by each CPA |
| Choice of data or Measurement methods and procedures | Measure the total quantity of sludge on a wet basis. The volume ($m^3$) and density or direct weighing may be used to determine the sludge amount (wet basis). Representative samples are taken to determine the moisture content to calculate the total sludge amount on dry basis.<br>If the methane emissions from anaerobic decay of the final sludge are to be neglected because the sludge is controlled combusted, disposed of in a landfill with methane recovery, or used for soil application, then the end-use of the final sludge will be monitored during the crediting period.<br>If the baseline emissions include the anaerobic decay of final sludge generated by the baseline treatment systems in a landfill without methane recovery, the baseline disposal site shall be clearly defined, and verified by the DOE |
| Purpose of data | Used for calculating methane generated in by sludge |
| Additional comment | |

| | |
|---|---|
| **Data / Parameter** | $S_{final,PJ,y,}$ |
| **Unit** | t |
| **Description** | Amount of dry matter in the sludge |
| **Source of data** | Historical Data and measurement campaign<br>For Greenfield Plants:-<br>1. Values can be obtained from a measurement campaign in a comparable existing wastewater treatment plant<br>2. Value provided by the manufacturer/designer of a Greenfield wastewater treatment plant using the same technology, demonstrated to be conservative, |
| **Value(s) applied** | To be determined by each CPA |
| **Choice of data or Measurement methods and procedures** | Measure the total quantity of sludge on a wet basis. The volume ($m^3$) and density or direct weighing may be used to determine the sludge amount (wet basis). Representative samples are taken to determine the moisture content to calculate the total sludge amount on dry basis.<br>If the methane emissions from anaerobic decay of the final sludge are to be neglected because the sludge is controlled combusted, disposed of in a landfill with methane recovery, or used for soil application, then the end-use of the final sludge will be monitored during the crediting period.<br>If the baseline emissions include the anaerobic decay of final sludge generated by the baseline treatment systems in a landfill without methane recovery, the baseline disposal site shall be clearly defined, and verified by the DOE |
| **Purpose of data** | Used for calculating methane generated in by sludge |
| **Additional comment** | |

| | |
|---|---|
| **Data / Parameter** | $BG_{burnt,y}$ |
| **Unit** | $m^3$ |
| **Description** | Biogas volume in year *y* |
| **Source of data** | Historical Data and measurement campaign<br>For Greenfield Plants:-<br>1. Values can obtained from a measurement campaign in a comparable existing wastewater treatment plant<br>2. Value provided by the manufacturer/designer of a Greenfield wastewater treatment plant using the same technology, demonstrated to be conservative, |
| **Value(s) applied** | To be determined by each CPA |
| **Choice of data or Measurement methods and procedures** | In all cases, the amount of biogas recovered, fuelled, flared or otherwise utilized shall be monitored *ex post*, using continuous flow meters. If the biogas streams flared and fuelled (or utilized) are monitored separately, the two fractions can be added together to determine the total biogas recovered, without the need to monitor the recovered biogas before the separation. The methane content measurement shall be carried out close to a location in the system where a biogas flow measurement takes place. |
| **Purpose of data** | Used to determine Methane Captured and destroyed |
| **Additional comment** | |

| | |
|---|---|
| **Data / Parameter** | $w_{CH4,y}$ |
| **Unit** | % |
| **Description** | Methane content in biogas in the year *y* |
| **Source of data** | Historical Data and measurement campaign |
| **Value(s) applied** | To be determined by each CPA |
| **Choice of data or Measurement methods and procedures** | The fraction of methane in the gas should be measured with a continuous analyser or, alternatively, with periodical measurements at a 90/10 confidence/precision level. It shall be measured using equipment that can directly measure methane content in the biogas - the estimation of methane content of biogas based on measurement of other constituents of biogas such as $CO_2$ is not permitted. The methane content measurement shall be carried out close to a location in the system where a biogas flow measurement takes place |
| **Purpose of data** | Used to determine Methane Captured and destroyed |
| **Additional comment** | |

| | |
|---|---|
| **Data / Parameter** | *T* |
| **Unit** | $^{o}C$ |
| **Description** | Temperature of the biogas |
| **Source of data** | Measurement campaign |
| **Value(s) applied** | To be determined by each CPA |
| **Choice of data or Measurement methods and procedures** | If the biogas flow meter employed measures flow, pressure and temperature and displays or outputs the normalised flow of biogas, then there is no need for separate monitoring of pressure and temperature of the biogas |
| **Purpose of data** | The temperature of the gas is required to determine the density of the methane combusted. |
| **Additional comment** | |

| | |
|---|---|
| **Data / Parameter** | *P* |
| **Unit** | Pa |
| **Description** | Pressure of the biogas |
| **Source of data** | Measurement campaign |
| **Value(s) applied** | To be determined by each CPA |
| **Choice of data or Measurement methods and procedures** | If the biogas flow meter employed measures flow, pressure and temperature and displays or outputs the normalised flow of biogas, then there is no need for separate monitoring of pressure and temperature of the biogas |
| **Purpose of data** | The pressure of the gas is required to determine the density of the methane combusted. |
| **Additional comment** | |

**B.6.3. Ex-ante calculations of emission reductions**
>>

| **Data / Parameter** | $MCF_{ww,treatment,PJ,k}$ |
|---|---|
| **Unit** | Fraction |
| **Description** | Methane correction factor for project wastewater treatment system *k* |
| **Source of data** | Based on *MCF* values in per Table III.H.1 found in AMS III.H. version 16 |
| **Value(s) applied** | To be determined by each CPA |
| **Choice of data or Measurement methods and procedures** | To be selected from Table III.H.1 found in AMS III.H. version 16 |
| **Purpose of data** | Used for calculating Methane emissions from wastewater treatment systems affected by the project activity, and not equipped with biogas recovery |
| **Additional comment** | |

| **Data / Parameter** | $\eta_{,PJ,k,}$ |
|---|---|
| **Unit** | $t/m^3$ |
| **Description** | Chemical oxygen demand removal efficiency of the project wastewater treatment system *k* in year *y* |
| **Source of data** | measured based on inflow COD and outflow COD in system *k* |
| **Value(s) applied** | |
| **Choice of data or Measurement methods and procedures** | Measurement campaign |
| **Purpose of data** | Used for calculating Methane emissions from wastewater treatment systems affected by the project activity, and not equipped with biogas recovery |
| **Additional comment** | |

| Data / Parameter | $S_{l,PJ,y}$ |
|---|---|
| Unit | t |
| Description | Amount of dry matter in the sludge treated by the sludge treatment system *l* in the project scenario in year *y* |
| Source of data | Measurement campaign |
| Value(s) applied | To be determined by each CPA |
| Choice of data or Measurement methods and procedures | Measure the total quantity of sludge on a wet basis. The volume ($m^3$) and density or direct weighing may be used to determine the sludge amount (wet basis). Representative samples are taken to determine the moisture content to calculate the total sludge amount on dry basis.<br>If the methane emissions from anaerobic decay of the final sludge are to be neglected because the sludge is controlled combusted, disposed of in a landfill with methane recovery, or used for soil application, then the end-use of the final sludge will be monitored during the crediting period. |
| Purpose of data | Used for calculating methane emissions from sludge treatment systems affected by the project activity, and not equipped with biogas recovery |
| Additional comment | |

| Data / Parameter | $MCF_{s,treatment,l}$ |
|---|---|
| Unit | Fraction |
| Description | Methane correction factor for project wastewater treatment system *l* |
| Source of data | Based on *MCF* values in per Table III.H.1 found in AMS III.H. version 16 |
| Value(s) applied | To be determined by each CPA |
| Choice of data or Measurement methods and procedures | To be selected from Table III.H.1 found in AMS III.H. version 16 |
| Purpose of data | Used for calculating Methane emissions from sludge treatment systems affected by the project activity, and not equipped with biogas recovery |
| Additional comment | |

| **Data / Parameter** | $COD_{ww,discharge,PJ,y}$ |
|---|---|
| **Unit** | t COD/m³ |
| **Description** | The chemical oxygen demand of the wastewater after the treatment system affected by the project activity |
| **Source of data** | Historical Data and measurement campaign<br>For Greenfield Plants:-<br>1. Values can be obtained from a measurement campaign in a comparable existing wastewater treatment plant<br>2. Value provided by the manufacturer/designer of a Greenfield wastewater treatment plant using the same technology, demonstrated to be conservative, |
| **Value(s) applied** | To be determined by each CPA |
| **Choice of data or Measurement methods and procedures** | The COD to be measured according to national or international standards through representative sampling |
| **Purpose of data** | Used to calculate the plant COD removal efficiency |
| **Additional comment** | |

| **Data / Parameter** | $MCF_{ww,PJ,discharge}$ |
|---|---|
| **Unit** | Fraction |
| **Description** | Methane correction factor based on the discharge pathway of the wastewater in the project scenario (e.g. into sea, river or lake) |
| **Source of data** | Based on *MCF* values in per Table III.H.1 found in AMS III.H. version 16 |
| **Value(s) applied** | To be determined by each CPA |
| **Choice of data or Measurement methods and procedures** | To be selected from Table III.H.1 found in AMS III.H. version 16 |
| **Purpose of data** | Used for calculating Methane emissions from degradable organic carbon in treated wastewater in year *y* |
| **Additional comment** | |

| Data / Parameter | $MCF_{s,PJ,final}$ |
|---|---|
| Unit | Fraction |
| Description | Methane correction factor of the disposal site that receives the final sludge in the project situation |
| Source of data | Estimated using the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" |
| Value(s) applied | To be determined by each CPA |
| Choice of data or Measurement methods and procedures | Estimated using the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" |
| Purpose of data | Used for calculating Methane emissions from anaerobic decay of the final sludge produced in year *y* |
| Additional comment | |

| Data / Parameter | $S_{final,PJ,y}$ |
|---|---|
| Unit | t |
| Description | Amount of dry matter in final sludge generated by the project wastewater treatment systems in the year *y* |
| Source of data | Measurement campaign |
| Value(s) applied | To be determined by each CPA |
| Choice of data or Measurement methods and procedures | Measure the total quantity of sludge on a wet basis. The volume ($m^3$) and density or direct weighing may be used to determine the sludge amount (wet basis). Representative samples are taken to determine the moisture content to calculate the total sludge amount on dry basis.<br>If the methane emissions from anaerobic decay of the final sludge are to be neglected because the sludge is controlled combusted, disposed of in a landfill with methane recovery, or used for soil application, then the end-use of the final sludge will be monitored during the crediting period. |
| Purpose of data | Used for calculating Methane emissions from anaerobic decay of the final sludge produced in year *y* |
| Additional comment | |

| | |
|---|---|
| **Data / Parameter** | $CFE_{ww}$ |
| **Unit** | Fraction |
| **Description** | Capture efficiency of the biogas recovery equipment in the wastewater treatment systems |
| **Source of data** | IPCC default value in AMS III.H/Version 16 |
| **Value(s) applied** | 0.9 |
| **Choice of data or Measurement methods and procedures** | IPCC Default Value in line with methodology requirements |
| **Purpose of data** | Used for calculating Methane emissions from anaerobic decay of the final sludge produced in year *y* |
| **Additional comment** | |

| | |
|---|---|
| **Data / Parameter** | $MEP_{ww,treatment,y}$ |
| **Unit** | t |
| **Description** | Methane emission potential of wastewater treatment systems equipped with biogas recovery system in year *y* |
| **Source of data** | Calculated according to equation 6 |
| **Value(s) applied** | To be determined by CPA. |
| **Choice of data or Measurement methods and procedures** | Calculated based on baseline methodology |
| **Purpose of data** | Used for calculating Fugitive emissions through capture inefficiencies in the anaerobic sludge treatment systems in the year *y* |
| **Additional comment** | |

| Data / Parameter | $COD_{removed,PJ,k,y}$ |
|---|---|
| Unit | t COD/m³ |
| Description | The chemical oxygen demand removed by the treatment system *k* of the project activity equipped with biogas recovery in the year *y* |
| Source of data | Measurement campaign |
| Value(s) applied | To be determined by each CPA |
| Choice of data or Measurement methods and procedures | The COD to be measured according to national or international standards through representative sampling |
| Purpose of data | Used to calculate the Methane emission potential of wastewater treatment systems equipped with biogas recovery system |
| Additional comment | |

| Data / Parameter | $MCF_{ww,treatment,PJ,k}$ |
|---|---|
| Unit | Fraction |
| Description | Methane correction factor for the project wastewater treatment system *k* equipped with biogas recovery equipment |
| Source of data | Based on *MCF* values in per Table III.H.1 found in AMS III.H. version 16 |
| Value(s) applied | To be determined by each CPA |
| Choice of data or Measurement methods and procedures | To be selected from Table III.H.1 found in AMS III.H. version 16 |
| Purpose of data | Used for calculating Methane emission potential of wastewater treatment systems equipped with biogas recovery system |
| Additional comment | |

| Data / Parameter | $UF_{PJ}$ |
|---|---|
| Unit | Fraction |
| Description | Model correction factor to account for model uncertainties |
| Source of data | IPCC value in AMS III.H./Version 16 |
| Value(s) applied | 1.12 |
| Choice of data or Measurement methods and procedures | Based on IPCC value in AMS III.H./Version 16 |
| Purpose of data | Used to account for uncertainty associated with calculation model |
| Additional comment | Parameter to remain constant for entire crediting period |

| Data / Parameter | $CFE_s$ |
|---|---|
| Unit | Fraction |
| Description | Capture efficiency of the biogas recovery equipment in the wastewater treatment systems |
| Source of data | IPCC default value in AMS III.H/Version 16 |
| Value(s) applied | 0.9 |
| Choice of data or Measurement methods and procedures | IPCC Default Value in line with methodology requirements |
| Purpose of data | Used for calculating project fugitive emissions |
| Additional comment | |

| Data / Parameter | $MCF_{s,treatment,PJ,l}$ |
|---|---|
| Unit | Fraction |
| Description | Methane correction factor for the sludge treatment system equipped with biogas recovery equipment |
| Source of data | *MCF* values based on Table III.H.1 in AMS III.H/Version 16 |
| Value(s) applied | To be determined by each CPA |
| Choice of data or Measurement methods and procedures | Based values from Table III.H.1 in AMS III.H/Version 16 |
| Purpose of data | |
| Additional comment | |

| Data / Parameter | $BG_{burnt,y}$ |
|---|---|
| Unit | $m^3$ |
| Description | Biogas volume in year *y* |
| Source of data | Historical Data and measurement campaign |
| Value(s) applied | To be determined by each CPA |
| Choice of data or Measurement methods and procedures | In all cases, the amount of biogas recovered, fuelled, flared or otherwise utilized shall be monitored *ex post*, using continuous flow meters. If the biogas streams flared and fuelled (or utilized) are monitored separately, the two fractions can be added together to determine the total biogas recovered, without the need to monitor the recovered biogas before the separation. The methane content measurement shall be carried out close to a location in the system where a biogas flow measurement takes place. |
| Purpose of data | Used to determine Methane Captured and destroyed |
| Additional comment | |

| | |
|---|---|
| **Data / Parameter** | $w_{CH4,y}$ |
| **Unit** | % |
| **Description** | Methane content in biogas in the year *y* |
| **Source of data** | Historical Data and measurement campaign |
| **Value(s) applied** | To be determined by each CPA |
| **Choice of data or Measurement methods and procedures** | The fraction of methane in the gas should be measured with a continuous analyser or, alternatively, with periodical measurements at a 90/10 confidence/precision level. It shall be measured using equipment that can directly measure methane content in the biogas - the estimation of methane content of biogas based on measurement of other constituents of biogas such as $CO_2$ is not permitted. The methane content measurement shall be carried out close to a location in the system where a biogas flow measurement takes place |
| **Purpose of data** | Used to determine Methane Captured and destroyed |
| **Additional comment** | |

| | |
|---|---|
| **Data / Parameter** | $D_{CH4}$ |
| **Unit** | $t/m^3$ |
| **Description** | Density of methane at the temperature and pressure of the biogas in the year *y* |
| **Source of data** | Calculated based on temperature and pressure of biogas |
| **Value(s) applied** | To be determined by each CPA |
| **Choice of data or Measurement methods and procedures** | If the biogas flow meter employed measures flow, pressure and temperature and displays or outputs the normalised flow of biogas, then there is no need for separate monitoring of pressure and temperature of the biogas |
| **Purpose of data** | Used to calculate the Methane captured and destroyed/gainfully used by the project activity in the year *y* |
| **Additional comment** | |

| | |
|---|---|
| **Data / Parameter** | *FE* |
| **Unit** | fraction |
| **Description** | Flare efficiency in year *y* |
| **Source of data** | If the biogas is combusted for gainful purposes, e.g. fed to an engine, an efficiency of 100% may be applied |
| **Value(s) applied** | To be determined by CPA |
| **Choice of data or Measurement methods and procedures** | |
| **Purpose of data** | |
| **Additional comment** | |

| **Data / Parameter** | *T* |
|---|---|
| **Unit** | $^oC$ |
| **Description** | Temperature of the biogas |
| **Source of data** | Measurement campaign |
| **Value(s) applied** | To be determined by each CPA |
| **Choice of data or Measurement methods and procedures** | If the biogas flow meter employed measures flow, pressure and temperature and displays or outputs the normalised flow of biogas, then there is no need for separate monitoring of pressure and temperature of the biogas |
| **Purpose of data** | The temperature of the gas is required to determine the density of the methane combusted $D_{CH4}$. |
| **Additional comment** | |

| **Data / Parameter** | *P* |
|---|---|
| **Unit** | Pa |
| **Description** | Pressure of the biogas |
| **Source of data** | Measurement campaign |
| **Value(s) applied** | To be determined by each CPA |
| **Choice of data or Measurement methods and procedures** | If the biogas flow meter employed measures flow, pressure and temperature and displays or outputs the normalised flow of biogas, then there is no need for separate monitoring of pressure and temperature of the biogas |
| **Purpose of data** | The pressure of the gas is required to determine the density of the methane combusted $D_{CH4}$. |
| **Additional comment** | |

For an adopted fixed period of 10 years, the table below would present the estimated annual emission reductions for each CPA.

| | Year | Emission Reductions |
|---|---|---|
| 1 | 20xx | XX XXX |
| 2 | 20xx | XX XXX |
| 3 | 20xx | XX XXX |
| 4 | 20xx | XX XXX |
| 5 | 20xx | XX XXX |
| 6 | 20xx | XX XXX |
| 7 | 20xx | XX XXX |
| 8 | 20xx | XX XXX |
| 9 | 20xx | XX XXX |
| 10 | 20xx | XX XXX |
| Total estimated Reductions (tonnes CO2)e | | XXX XXX |
| Total number of Crediting years | | 10 |
| Annual average of the estimated reductions over the crediting period | | XX XXX |

**B.7. Application of the monitoring methodology and description of the monitoring plan**

**B.7.1. Data and parameters to be monitored by each generic CPA**

*(Copy this table for each data and parameter)*

| **Data / Parameter** | $Q_{ww,i,y}$ |
|---|---|
| **Unit** | m³/month |
| **Description** | The flow of wastewater |
| **Source of data** | Historical Data and measurement campaign<br>For Greenfield Plants:-<br>1. Values can obtained from a measurement campaign in a comparable existing wastewater treatment plant<br>Value provided by the manufacturer/designer of a Greenfield wastewater treatment plant using the same technology, demonstrated to be conservative, |
| **Value(s) applied** | To be determined by each CPA |
| **Measurement methods and procedures** | Measurements are undertaken using flow meters |
| **Monitoring frequency** | Monitored continuously (at least hourly measurements are undertaken, if less, confidence/precision level of 90/10 shall be attained) |
| **QA/QC procedures** | Flow meters to be calibrated according to manufacturer's recommendations |
| **Purpose of data** | |
| **Additional comments** | |

| **Data / Parameter** | $COD_{ww,untreated,y}$, |
|---|---|
| **Unit** | t COD/m³ |
| **Description** | The chemical oxygen demand of the wastewater before the treatment system affected by the project activity |
| **Source of data** | Historical Data and measurement campaign<br>For Greenfield Plants:-<br>1. Values can obtained from a measurement campaign in a comparable existing wastewater treatment plant<br>Value provided by the manufacturer/designer of a Greenfield wastewater treatment plant using the same technology, demonstrated to be conservative, |
| **Value(s) applied** | To be determined by each CPA |
| **Measurement methods and procedures** | The COD to be measured according to national or international standards through representative sampling |
| **Monitoring frequency** | Frequency measurement according to national regulations |
| **QA/QC procedures** | Samples and measurements shall ensure a 90/10 confidence/precision level |
| **Purpose of data** | Used to calculate the plant COD removal efficiency |
| **Additional comments** | |

| Data / Parameter | $COD_{ww,treated,y}$, |
|---|---|
| Unit | t COD/m³ |
| Description | The chemical oxygen demand of the wastewater after the treatment system affected by the project activity |
| Source of data | Historical Data and measurement campaign<br>For Greenfield Plants:-<br>1. Values can obtained from a measurement campaign in a comparable existing wastewater treatment plant<br>Value provided by the manufacturer/designer of a Greenfield wastewater treatment plant using the same technology, demonstrated to be conservative, |
| Value(s) applied | To be determined by each CPA |
| Measurement methods and procedures | The COD to be measured according to national or international standards through representative sampling |
| Monitoring frequency | Frequency measurement according to national regulations |
| QA/QC procedures | Samples and measurements shall ensure a 90/10 confidence/precision level |
| Purpose of data | Used to calculate the plant COD removal efficiency |
| Additional comments | |

| Data / Parameter | $COD_{ww,discharge,PJ,y}$ |
|---|---|
| Unit | t COD/m³ |
| Description | The chemical oxygen demand of the wastewater after the treatment system affected by the project activity |
| Source of data | Historical Data and measurement campaign<br>For Greenfield Plants:-<br>1. Values can be obtained from a measurement campaign in a comparable existing wastewater treatment plant<br>Value provided by the manufacturer/designer of a Greenfield wastewater treatment plant using the same technology, demonstrated to be conservative, |
| Value(s) applied | To be determined by each CPA |
| Measurement methods and procedures | The COD to be measured according to national or international standards through representative sampling |
| Monitoring frequency | Frequency measurement according to national regulations |
| QA/QC procedures | Samples and measurements shall ensure a 90/10 confidence/precision level |
| Purpose of data | Used to calculate the plant COD removal efficiency |
| Additional comments | |

| **Data / Parameter** | $S_{l,PJ,y}$ ; $S_{final,PJ,y,}$ |
|---|---|
| **Unit** | t |
| **Description** | Amount of dry matter in the sludge |
| **Source of data** | Historical Data and measurement campaign<br>For Greenfield Plants:-<br>1. Values can be obtained from a measurement campaign in a comparable existing wastewater treatment plant<br>Value provided by the manufacturer/designer of a Greenfield wastewater treatment plant using the same technology, demonstrated to be conservative, |
| **Value(s) applied** | To be determined by each CPA |
| **Measurement methods and procedures** | Measure the total quantity of sludge on a wet basis. The volume ($m^3$) and density or direct weighing may be used to determine the sludge amount (wet basis). Representative samples are taken to determine the moisture content to calculate the total sludge amount on dry basis.<br><br>If the methane emissions from anaerobic decay of the final sludge are to be neglected because the sludge is controlled combusted, disposed of in a landfill with methane recovery, or used for soil application, then the end-use of the final sludge will be monitored during the crediting period.<br><br>If the baseline emissions include the anaerobic decay of final sludge generated by the baseline treatment systems in a landfill without methane recovery, the baseline disposal site shall be clearly defined, and verified by the DOE |
| **Monitoring frequency** | Monitoring of 100% of the sludge amount through continuous or batch measurements and moisture content through representative sampling to ensure the 90/10 confidence/precision level |
| **QA/QC procedures** | |
| **Purpose of data** | Used for calculating methane generated in by sludge |
| **Additional comments** | |

| Data / Parameter | $BG_{burnt,y}$ |
|---|---|
| Unit | $m^3$ |
| Description | Biogas volume in year *y* |
| Source of data | Historical Data and measurement campaign<br>For Greenfield Plants:-<br>1. Values can be obtained from a measurement campaign in a comparable existing wastewater treatment plant<br>2. Value provided by the manufacturer/designer of a Greenfield wastewater treatment plant using the same technology, demonstrated to be conservative, |
| Value(s) applied | To be determined by each CPA |
| Measurement methods and procedures | In all cases, the amount of biogas recovered, fuelled, flared or otherwise utilized shall be monitored *ex post*, using continuous flow meters. If the biogas streams flared and fuelled (or utilized) are monitored separately, the two fractions can be added together to determine the total biogas recovered, without the need to monitor the recovered biogas before the separation. The methane content measurement shall be carried out close to a location in the system where a biogas flow measurement takes place. |
| Monitoring frequency | Monitored continuously (at least hourly measurements are undertaken, if less, confidence/precision level of 90/10 shall be attained) |
| QA/QC procedures | Instruments calibrated by according to manufacturer recommendations. |
| Purpose of data | Used to determine Methane Captured and destroyed |
| Additional comments | |

| Data / Parameter | $w_{CH4,y}$ |
|---|---|
| Unit | % |
| Description | Methane content in biogas in the year *y* |
| Source of data | Historical Data and measurement campaign |
| Value(s) applied | To be determined by each CPA |
| Measurement methods and procedures | The fraction of methane in the gas should be measured with a continuous analyser or, alternatively, with periodical measurements at a 90/10 confidence/precision level. It shall be measured using equipment that can directly measure methane content in the biogas - the estimation of methane content of biogas based on measurement of other constituents of biogas such as $CO_2$ is not permitted. The methane content measurement shall be carried out close to a location in the system where a biogas flow measurement takes place |
| Monitoring frequency | The fraction of methane in the gas should be measured with a continuous analyser or, alternatively, with periodical measurements at a 90/10 confidence/precision level. |
| QA/QC procedures | |
| Purpose of data | Used to determine Methane Captured and destroyed |
| Additional comments | |

| | |
|---|---|
| **Data / Parameter** | *T* |
| **Unit** | $^{o}C$ |
| **Description** | Temperature of the biogas |
| **Source of data** | Measurement campaign |
| **Value(s) applied** | To be determined by each CPA |
| **Measurement methods and procedures** | If the biogas flow meter employed measures flow, pressure and temperature and displays or outputs the normalised flow of biogas, then there is no need for separate monitoring of pressure and temperature of the biogas |
| **Monitoring frequency** | Shall be measured at the same time when methane content in biogas ( $w_{CH4,y}$ ) is measured |
| **QA/QC procedures** | |
| **Purpose of data** | The temperature of the gas is required to determine the density of the methane combusted. |
| **Additional comments** | |

| | |
|---|---|
| **Data / Parameter** | *P* |
| **Unit** | Pa |
| **Description** | Pressure of the biogas |
| **Source of data** | Measurement campaign |
| **Value(s) applied** | To be determined by each CPA |
| **Measurement methods and procedures** | If the biogas flow meter employed measures flow, pressure and temperature and displays or outputs the normalised flow of biogas, then there is no need for separate monitoring of pressure and temperature of the biogas |
| **Monitoring frequency** | Shall be measured at the same time when methane content in biogas ( $w_{CH4,y}$ ) is measured |
| **QA/QC procedures** | |
| **Purpose of data** | The pressure of the gas is required to determine the density of the methane combusted. |
| **Additional comments** | |

| **Data / Parameter** | $h_{flare,h}$ |
|---|---|
| **Unit** | % |
| **Description** | The flare efficiency |
| **Source of data** | As per the “Tool to determine project emissions from flaring gases containing Methane”. |
| **Value(s) applied** | To be determined by each CPA |
| **Measurement methods and procedures** | As per the “Tool to determine project emissions from flaring gases containing Methane”. |
| **Monitoring frequency** | |
| **QA/QC procedures** | Regular maintenance shall be carried out to ensure optimal operation of flares |
| **Purpose of data** | Used to calculate project activity emissions |
| **Additional comments** | |

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

>>

This Monitoring Plan (MP) provides a standard monitoring plan for all the CPAs covered under this PoA. The managing entity, BPI, will manage the monitoring done by each CPA to ensure its compliance with data collection, processing and reporting required in this PoA. The MP shall comply with all the relevant rules and regulations of the CDM. CPAs shall make reference to this MP to facilitate accurate and consistent monitoring of the PoA’s Certified Emission Reductions. This MP shall be followed during the project duration and be used for project verification in quantifying the CERs achieved by each CPA and aims to achieve the following:

- Establishing and maintaining a suitable monitoring system,
- Establishing and maintaining a reliable and accurate monitoring system,
- Guide the implementation of necessary measurement and management operations,
- Guide for meeting CDM requirements for verification and certification.

All the CPAs will be assigned a unique identification number and GPS coordinates of project location for verification and as reference to ensure single counting of the PoA or CPAs.

**Monitoring Obligations**

To facilitate the accurate determination of CERs, each CPA will need to fulfil certain operation and data collection obligations. A CDM Operations and Monitoring Manual will be prepared before the start of the first crediting period. The objective of the manual is to ensure the accurate and transparent calculation and monitoring of CERs for each CPA. The necessary data for baseline and emission reduction determination shall be stipulated in each CPA-DD.

The management entity, BPI, will maintain all monitoring reports for the CPAs in accordance to the records keeping system and shall ensure that monitoring reports are available upon request by the DOE for verification purposes.

**Management and Operational Systems**

Each CPA shall have a well-defined management and operational system that meets the specific requirements of the project activities. The system should ensure successful execution of CPA and the credibility and verifiability of the CERs achieved and should include the following:-

Data Handling

- Each CPA will develop, implement and maintain a transparent system for the collection, computation and storage of data, which includes adequate records keeping and data monitoring system fit for independent monitoring auditing and verification.
- BPI as the management entity will oversee and ensure that each CPA will maintain standard records documentation and keep the monitored data in a secure data for the crediting period and up to two years after the crediting period for each CPA.
- Data (soft and hard copy) will be transmitted to BPI who is responsible for the compilation of the monitoring reports and BPI will conduct a data audit and compliance review with the MP at least bi-annually for each CPA.

Quality Control

- Key quality assurance personnel will be assigned for overall project management, operation, monitoring and reporting required by the project activity
- A competent manager responsible and accountable for the generation of CERs including monitoring, records keeping, computation of ERs, audits and verification. The manager will sign off on all GHG Emission worksheets.
- Well defined quality control procedures will be encouraged to enhance data archiving and integrity of ERs.

Training

- Training for new staff will be done to enable them to implement the requirements of this MP. Initial training will be done for all staff involved in the implementation of the MP before the start of the project and generation of CERs.
- Environment, health and safety issues will also be given priority.

The CPA will inform the management entity about the need for any corrective and enhancement measures.

- - - - -

**Appendix 1: Contact information on entity/individual responsible for the PoA**

| | |
|---|---|
| **Organization** | Bostrich Products International |
| **Street/P.O. Box** | Unit C3; Plot 61128-61130, Block 8 |
| **Building** | BEDIA Factory Shells |
| **City** | Gaborone |
| **State/Region** | |
| **Postcode** | |
| **Country** | Botswana |
| **Telephone** | |
| **Fax** | |
| **E-mail** | bostrich2@gmail.com |
| **Website** | |
| **Contact person** | Carlie de Bruyn |
| **Title** | Mr |
| **Salutation** | Mr |
| **Last name** | de Bruyn |
| **Middle name** | |
| **First name** | Carlie |
| **Department** | |
| **Mobile** | +267-72333155 |
| **Direct fax** | |
| **Direct tel.** | |
| **Personal e-mail** | bostrich2@gmail.com |

**Appendix 2: Affirmation regarding public funding**

The project has obtained funding for the feasibility study through the Energy, Environment Partnership Program for Southern and East Africa (EEP-SEA) being financed by the Ministry of Foreign Affairs of Finland. This PoA has also been developed with financial assistance from UNEP-RISOE. The project will however be seeking no further assistance form Annex 1 countries.

**Appendix 3: Application of methodology(ies)**

No additional information

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

No additional information

**Appendix 5: Further background information on the monitoring plan**

No additional information

- - - - -

**History of the document**

| Version | Date | Nature of revision(s) |
|---|---|---|
| 02.0 | EB 66<br>13 March 2012 | Revision required to ensure consistency with the "Guidelines for completing the programme design document form for small-scale CDM programmes of activities" (EB 66, Annex 13). |
| 01 | EB33, Annex43<br>27 July 2007 | Initial adoption. |
| **Decision Class:** Regulatory<br>**Document Type:** Form<br>**Business Function:** Registration | | |