CLEAN DEVELOPMENT MECHANISM

CDM-SSCWG39-A07

Draft Small-scale Methodology

AMS-III.D: Methane recovery in animal manure management systems

Version 19.0

Sectoral scope(s): 15

United Nations
Framework Convention on
Climate Change

COVER NOTE

1. Procedural background

1. Development of a small-scale methodology is one project in the SSC WG 2012 workplan that is project 130. It addresses the request from the clean development mechanism (CDM) Executive Board (hereinafter referred to as the Board) to develop top-down and to revise small-scale methodologies.

2. At EB 67, the Board opened a call for public input on "*AMS-III.D Methane recovery in animal manure management systems*", "*AMS-III.R Methane recovery in agricultural activities at household/small farm level"* and "*AMS-III.G Landfill methane recovery"* but no input was received on AMS-III.D. Taking into account inputs received in response to the call for public inputs, at its 38th meeting the SSC WG agreed to recommend that the Board approve the draft revised methodologies AMS-III.R and AMS-III.G and to continue working on the issue to strengthen the criteria imparting automatic additionality to manure methane recovery projects under AMS-III.D.

3. A final draft revised methodology has been prepared taking into account inputs provided from external experts, and is submitted to the Board at its seventieth meeting for adoption.

2. Purpose

4. The purpose of the proposed revision is to include simplified requirements for methane quantity determination and additionality demonstration.

3. Key issues and proposed solutions

5. For project activities utilizing recovered biogas for power generation, the destructed methane quantity can be determined based on the total electricity generated. Project activities applying AMS-III.D are imparted automatic additionality if it can be shown that there is no regulation in the host country that requires the collection and destruction of methane from livestock manure. Such a proposal is consistent with the approach approved by the Board in the context of standardized baseline and also supported by other researches as explained in the information note attached to this revised methodology.

4. Impacts

6. Alternative option for determining the methane quantity will reduce the monitoring cost, and the simplified requirement for additionality demonstration will streamline the development of this type of project.

7. So far 160 projects and 2 PoA have been registered applying this methodology. 342 project and 19 PoAs are currently listed as under validation applying this methodology.

5. Proposed work and timelines

8. The proposed draft revision of the methodology is recommended by the SSC WG to be considered by the Board at its seventieth meeting. No further work is envisaged.

6. Recommendations to the Board

9. The SSC WG recommends that the Board adopts the draft revised methodology.

TABLE OF CONTENTS **Page**

1. Introduction

1. The following table describes the key elements of the methodology:

Table 1. Methodology key elements

Typical projects	Replacement or modification of existing anaerobic manure management systems in livestock farms, or treatment of manure collected from several farms in a centralized plant to achieve methane recovery and destruction by flaring/combustion or energetic use of the recovered methane
Type of GHG emissions mitigation action	• GHG destruction GHG destruction and displacement of more- GHG -intensive service

2. Scope, applicability, and entry into force

2.1. Scope

2. 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.

2.2. Applicability

3. This methodology is only applicable under the following conditions:

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

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

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

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

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

4. The project activity shall satisfy the following conditions:

(a) The residual waste from the animal manure management system shall be handled aerobically, otherwise the related emissions shall be taken into account as per relevant procedures of "*AMS-III.AO Methane recovery through controlled anaerobic digestion"*. In the case of soil application, proper conditions and procedures (not resulting in methane emissions) must be ensured;

(b) Technical measures shall be used (including a flare for exigencies) to ensure that all biogas produced by the digester is used or flared;

(c) The storage time of the manure after removal from the animal barns, including transportation, should not exceed 45 days before being fed into the anaerobic digester. If the project proponent can demonstrate that the dry matter content of the manure when removed from the animal barns is larger than 20%, this time constraint will not apply.

5. 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"*.

6. Utilization of the recovered biogas in one of the options detailed in ~~in paragraph 3 of~~ AMS-III.H ~~(version 16)~~ is also eligible under this methodology. The respective procedures in AMS-III.H shall be followed in this regard. If the recovered biogas is used to power auxiliary equipment of the project activity, it should be taken into account accordingly, using zero as its emission factor; however, energy used for such purposes is not eligible as an SSC CDM Type I project component.

7. New facilities (Greenfield projects) and project activities involving capacity additions compared to the baseline scenario are only eligible if they comply with the related and relevant requirements in the *"General guidelines for SSC CDM methodologies"*.

8. The requirements concerning demonstration of the remaining lifetime of the replaced equipment shall be met as described in the *"General guidelines for SSC CDM methodologies"*.

9. 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.

2.3. Entry into force

10. The date of entry into force of the revision is 14 days after the date of the publication of the EB 70 meeting report on 7 December 2012.

3. Normative references

11. Project participants shall take into account the *General guidelines for SSC CDM methodologies* and the "*Guidelines on the demonstration of additionality of small-scale project activities*"~~information on additionality~~ (*Attachment A to Appendix B*) provided at: <http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html>
mutatis *mutandis.*

4. Baseline methodology

4.1. Project boundary

12. The project boundary includes the physical, geographical site(s) of:

    (a) The livestock;

    (b) Animal manure management systems (including centralised manure treatment plant where applicable);

    (c) Facilities which recover and flare/combust or use methane.

4.2. Additionality

13. Project activities may demonstrate the additionality by showing that there is no regulation in the host country, applicable to the project site, that requires the collection and destruction of methane from livestock manure. If so, it is not required to apply the *"Guidelines on the demonstration of additionality of small-scale project activities"*.

14. This additionality condition also applies to Greenfield project activities. Furthermore, for project activities applying this methodology in combination with a Type I methodology, that has an energy component whose installed capacity is less than 5 MW, this procedure for additionality demonstration also applies to that component.

4.3. Baseline emissions

15. The baseline scenario is the situation where, in the absence of the project activity, animal manure is left to decay anaerobically within the project boundary and methane is emitted to the atmosphere. Baseline emissions (BE_y) are calculated by using one of the following two options:

    (a) Using the amount of the waste or raw material that would decay anaerobically in the absence of the project activity, with the most recent IPCC Tier 2 approach (please refer to the chapter 'Emissions from Livestock and Manure Management' under the volume 'Agriculture, Forestry and other Land use' of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories). For this calculation, information about the characteristics of the manure and of the management systems in the baseline is required. Manure characteristics include the amount of volatile solids (*VS*) produced by the livestock and the maximum amount of methane that can be potentially produced from that manure (B_o);

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

16. If option in paragraph 14(a) is chosen, baseline emissions are determined as follows:

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

Where:

BE_y	=	Baseline emissions in year *y* (t CO_2e)
GWP_{CH4}	=	Global Warming Potential (GWP) of CH_4 applicable to the crediting period (t CO_2e/t CH_4) ~~(21)~~
D_{CH4}	=	CH_4 density (0.00067 t/m^3 at room temperature (20 ºC) and 1 atm pressure)
LT	=	Index for all types of livestock
j	=	Index for animal manure management system
MCF_j	=	Annual methane conversion factor (*MCF*) for the baseline animal manure management system j
$B_{0,LT}$	=	Maximum methane producing potential of the volatile solid generated for animal type *LT* (m^3 CH_4/kg dm)
$N_{LT,y}$	=	Annual average number of animals of type *LT* in year *y* (numbers)
$VS_{LT,y}$	=	Volatile solids production/excretion per animal of ~~for~~ livestock *LT* ~~entering the animal manure management system~~ in year *y* (on a dry matter weight basis, kg dm/animal/year
$MS\%_{Bl,j}$	=	Fraction of manure handled in baseline animal manure management system *j*
UF_b	=	Model correction factor to account for model uncertainties (0.94)[1]

(a) The maximum methane-producing capacity of the manure (B_o) varies by species and diet. The preferred method to obtain B_o measurement values is to use data from country-specific published sources, measured with a standardised method (B_o shall be based on total as-excreted *VS*). These values shall be compared to IPCC default values and any significant differences shall be explained. If country specific B_o values are not available, default values from tables 10 A-4 to 10 A-9 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10 can be used, provided that the project participants assess the suitability of those data to the specific situation of the treatment site;

(b) Volatile solids (*VS*) are the organic material in livestock manure and consist of both biodegradable and non-biodegradable fractions. For the calculations the total *VS* excreted by each animal species is required. The preferred method to obtain *VS* is to use data from nationally published sources. These values shall

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

be compared with IPCC default values and any significant differences shall be explained. If data from nationally published sources are not available, country-specific *VS* excretion rates can be estimated from feed intake levels, via the enhanced characterisation method (tier 2) described in section 10.2 in 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 10. If country specific VS values are not available IPCC default values from 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 10 table 10 A-4 to 10 A-9 can be used provided that the project participants assess the suitability of those data to the specific situation of the treatment site particularly with reference to feed intake levels;

(c) Project participants may adjust ~~In case~~ default IPCC values for *VS* ~~are adjusted~~ for a site-specific average animal weight. If so, it shall be well explained and documented. The following equation shall be used:

$$VS_{LT,y} = \left(\frac{W_{site}}{W_{default}} \right) \times VS_{default} \times nd_y \qquad \text{Equation (2)}$$

Where:

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

$W_{default}$ = Default average animal weight of a defined population, this data is sourced from IPCC 2006 (kg)

$VS_{default}$ = Default value for the volatile solid excretion rate per day on a dry-matter basis for a defined livestock population (kg dm/animal/day)

nd_y = Number of days in year *y* where the animal manure management system is operational

(d) B_o or *VS* values applicable to developed countries can be used provided the following four conditions are satisfied:

(i) The genetic source of the livestock originates from an Annex I Party;

(ii) The farm uses formulated feed rations (*FFR*) which are optimized for the various animal(s), stage of growth, category, weight gain/productivity and/or genetics;

(iii) The use of *FFR* can be validated (through on-farm record keeping, feed supplier, etc.);

(iv) The project specific animal weights are more similar to developed country IPCC default values.

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

RVS is the relative reduction of volatile solids from the previous stage. The relative reduction of volatile solids (*RVS*) depends on the treatment technology and should be estimated in a conservative manner. Default values for different treatment technologies can be found in the table in ~~annex~~ Appendix 1;

(f) Methane Conversion Factors (*MCF*) values are determined for a specific manure management system and represent the degree to which B_o is achieved. Where available country-specific *MCF* values that reflect the specific management systems used in particular countries or regions shall be used. Alternatively, the IPCC default values provided in table 10.17 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Chapter 10 can be used. The site annual average temperature is taken from official data at the nearest meteorological station, or from data available from historical on site observations;

(g) The annual average number of animals ($N_{LT,y}$) is determined as follows:

$$N_{LT,y} = N_{da,y} \times \left(\frac{N_{p,y}}{365} \right) \quad \text{Equation (3)}$$

Where:

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

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

17. If option in paragraph 14(b) is chosen, baseline emissions are determined based on directly measured quantity of manure and its specific volatile solids content, as follows:

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

Where:

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

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

MCF_j = Annual methane conversion factor (MCF) for the baseline animal manure management system *j*, as per paragraph 15 above

$B_{0,LT}$ = Maximum methane producing potential of the volatile solid generated for animal type *LT* (m^3 CH_4/kg dm), as per paragraph 15 above

4.4. Project activity emissions

18. Project activity emissions consist of:

(a) Physical leakage of biogas in the manure management systems which includes production, collection and transport of biogas to the point of flaring/combustion or gainful use ($PE_{PL,y}$);

(b) Emissions from flaring or combustion of the gas stream ($PE_{flare,y}$);

(c) CO_2 emissions from use of fossil fuels or electricity for the operation of all the installed facilities ($PE_{power,y}$);

(d) CO_2 emissions from incremental transportation distances;

(e) Emissions from the storage of manure before being fed into the anaerobic digester ($PE_{storage,y}$).

$$PE_y = PE_{PL,y} + PE_{flare,y} + PE_{power,y} + PE_{transp,y} + PE_{storage,y} \quad \text{Equation (5)}$$

Where:

PE_y = Project emissions in year *y* (t CO_2e)

$PE_{PL,y}$ = Emissions due to physical leakage of biogas in year *y* (t CO_2e)

$PE_{flare,y}$ = Emissions from flaring or combustion of the biogas stream in the year *y* (t CO_2e)

$PE_{power,y}$ = Emissions from the use of fossil fuel or electricity for the operation of the installed facilities in the year *y* (t CO_2e)

$PE_{transp,y}$ = Emissions from incremental transportation in the year *y* (t CO_2e), as per relevant paragraph in AMS-III.F

$PE_{storage,y}$ = Emissions from the storage of manure (t CO_2e)

19. Project emissions due to physical leakage of biogas from the animal manure management systems used to produce, collect and transport the biogas to the point of flaring or gainful use is estimated as:

(a) 10% of the maximum methane producing potential of the manure fed into the management systems implemented by the project activity:[2]

(i) If option in paragraph 14(a) is chosen, it is determined as:

$$PE_{PL,y} = 0.10 \times GWP_{CH4} \times D_{CH4} \times \sum_{i,LT} B_{0,LT} \times N_{LT,y} \times VS_{LT,y} \times MS\%_{i,y} \quad \text{Equation (6)}$$

[2] 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Chapter 10 guidelines specify a default value of 10% of the maximum methane producing potential (Bo) for the physical leakages from anaerobic digesters.

Where:

$MS\%_{i,y}$ = Fraction of manure handled in system *i* in year *y*

If the project activity involves sequential manure management systems, the procedure specified in paragraph 15(e) shall be used to estimate the project emissions due to physical leakage of biogas in each stage.

(ii) If the option in paragraph 14(b) is chosen, it is determined as:

$$PE_{PL,y} = 0.10 \times GWP_{CH4} \times D_{CH4} \times \sum_{i,LT} B_{O,LT} \times Q_{manure,LT,y} \times SVS_{LT,y} \times MS\%_{i,y}$$ Equation (7)

(b) Optionally, ~~a default value of 0.05 m³ biogas leaked/m³ biogas produced may be used for both options in paragraph 9(a) and (b) as an alternative to calculations per equation (6) and equation (7).~~ the relevant procedure in the methodological tool *"Project and leakage emissions from anaerobic digesters"* may be followed. In such a case, $PE_{PL,y}$ is equivalent to $PE_{CH4,y}$ in the tool.

20. In the case of flaring~~/combustion~~ of the recovered biogas, project emissions are estimated using the procedures described in the methodological tool "~~Tool to determine project emissions from flaring gases containing methane~~ "*Project emissions from flaring*". If the recovered biogas is combusted for electrical/thermal energy production or for other gainful use, the methane destruction efficiency can be considered as 100%. However, this use of the recovered biogas shall be included in the project boundary and its output shall be monitored in order to ensure that the recovered biogas is actually destroyed, even if the emission reductions from this component are not claimed.

21. Project emissions from electricity and fossil fuel consumption are determined by following the methodological tool "*Project and leakage emissions from anaerobic digesters*", where $PE_{power,y}$ is the sum of $PE_{EC,y}$ and $PE_{FC,y}$ in the tool. ~~as per the procedures described in AMS-I.D "Grid connected renewable electricity generation". For project emissions from fossil fuel consumption the emission factor for the fossil fuel shall be used (tCO_2/tonne). Local values are to be used, if local values are difficult to obtain, IPCC default values may be used. If recovered methane is used to power auxiliary equipment of the project it should be taken into account accordingly, using zero as its emission factor.~~

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

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

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

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

$$PE_{storagey} = GWP_{CH_4} \times D_{CH_4} \times \sum_{LT,l}\left[\frac{365}{AI_l}\sum_{d=1}^{AI}(N_{LT,y} \times VS_{LT,d} \times MS\%_l \times (1-e^{-k\ (AI_l-d)}) \times MCF_l \times B_{0_{LT}})\right] \quad \text{Equation (8)}$$

Where:

$PE_{storage,y}$	=	Project emissions on account of manure storage in year *y* (t CO_2e)
AI_l	=	Annual average interval between manure collection and delivery for treatment at a given storage device *l* (days)
$VS_{LT,d}$	=	Amount of volatile solid production by type of animal *LT* in a day (kg VS/head/d)
$MS\%_l$	=	Fraction of volatile solids (%) handled by storage device *l*
k	=	Degradation rate constant (0.069)
d	=	Days for which cumulative methane emissions are calculated; d can vary from 1 to 45 and to be run from 1 up to AI_l
MCF_l	=	Annual methane conversion factor for the project manure storage device l from Table 10.17, Chapter 10, Volume 4

4.5. Leakage

24. It is determined by following the relevant procedure in the methodological tool *"Project and leakage emissions from anaerobic digesters"*. ~~No leakage calculation is required~~.

4.6. Emission reductions

25. The emission reductions achieved by the project activity will be determined ex post through direct measurement of the amount of methane fuelled, flared or gainfully used. It is likely that the project activity involves manure treatment steps with higher methane conversion factors (*MCF*) than the *MCF* for the manure treatment systems used in the baseline situation, therefore the emission reductions achieved by the project activity are limited to the *ex post* calculated baseline emissions minus the project emissions using the actual monitored data for the project activity (i.e. $N_{LT,y}$, $MS\%_{i,y}$, $MS\%_l$, AI_l, as well as $VS_{LT,y}$ in cases where ~~nd in case~~ adjusted values for animal weight are used~~) as defined in paragraph 10 (c): $VS_{LT,y}$).~~ The emission reductions achieved in any year are the lowest value of the following:

$$ER_{y,ex\ post} = \min[(BE_{y,ex\ post} - PE_{y,ex\ post}),(MD_y - PE_{power,y,ex\ post})] \quad \text{Equation (9)}$$

Where:

$ER_{y,ex\ post}$	=	Emission reductions achieved by the project activity based on monitored values for year *y* (t CO_2e)

$BE_{y,ex\ post}$ = Baseline emissions calculated using equation 1 (for projects using option in paragraph 14(a)) using ex post monitored values of $N_{LT,y}$ and if applicable $VS_{LT,y}$. For projects using option in paragraph 14(b), the ex post monitored values for $Q_{manure,j,LT,y}$ and $SVS_{j,LT,y}$ are used

$PE_{y,ex\ post}$ = Project emissions calculated using equation 5 using ex post monitored values of $N_{LT,y}$, $MS\%_{i,y}$, $MS\%_{l}$, AI_l, $Q_{res\ waste,y}$ and if applicable $VS_{LT,y}$

MD_y = Methane captured and destroyed or used gainfully by the project activity in year *y* (t CO_2e)

$PE_{power,y,ex\ post}$ = Emissions from the use of fossil fuel or electricity for the operation of the installed facilities based on monitored values in the year *y* (t CO_2e)

26. Biogas flared or combusted, (MD_y) shall be determined using the flare efficiency and methane content of biogas~~, conditions of the flaring process~~:

$$MD_y = BG_{burnt,y} \times w_{CH4,y} \times D_{CH4} \times FE \times GWP_{CH4} \quad \text{Equation (10)}$$

Where:

$BG_{burnt,y}$ = Biogas flared or combusted in year *y* (m^3)

$w_{CH4,y}$ = Methane content in biogas in the year *y* (volume fraction)

FE = Flare efficiency in the year *y* (fraction)

27. The method for integration of the terms in equation above to obtain the results for one year of measurements within the confidence level, as well as the methods and instruments used for metering, recording and processing the data obtained, shall be described in the project design document and monitored during the crediting period.

28. Alternatively, if project activities utilize the recovered methane for power generation, MD_y may be calculated as follows, based on the amount of monitored electricity generation, without monitoring methane flow and concentration.

$$MD_y = \frac{EG_y \times 3600}{NCV_{CH4} \times EE_y} \times D_{CH4} \times GWP_{CH4} \quad \text{Equation (11)}$$

Where:

EG_y = Total electricity generated from the recovered biogas in year *y* (MWh)

3600 = Conversion factor (1 MWh = 3600 MJ)

NCV_{CH4} = NCV of methane (MJ/Nm^3) use default value: 35.9 MJ/Nm^3)

EE_y = Energy conversion efficiency of the project equipment, which is determined by adopting one of the following criteria:

- Specification provided by the equipment manufacture. The equipment shall be designed to utilize biogas as fuel, and efficiency specification is for this fuel. If the specification provides a range of efficiency values, the highest value of the range shall be used for the calculation;
- Default efficiency of 40 %

29. Project proponents shall provide evidence to a validating DOE that only the biogas recovered through the project manure management system is used for power generation; no other gas or fuels except a start-up fuel[3] are used.

30. In case of project activities covered under paragraph 6, the relevant procedure in AMS-III.H shall be followed.

31. Project activities where a portion of the biogas is destroyed through flaring and the other portion is used for energy may consider applying the flare efficiency to the portion of the biogas used for energy, if separate measurements of the respective flows are not performed. When the amount of methane that is combusted for energy and that is flared is separately monitored, or when only the biogas flow to the flare is monitored and the biogas used for energy is calculated based on electricity generation, a destruction efficiency of 100% can be used for the amount that is combusted for energy.

32. Where applicable, the proper soil application (not resulting in methane emissions) of the residual waste shall be monitored.

33. The monitoring plan should include on-site inspections for each individual farm included in the project boundary where the project activity is implemented for each verification period.

34. If the option in paragraph 14(a) is chosen for baseline emission determination,

    (a) The PDD shall describe the system used for monitoring the fraction of the manure handled in the animal manure management system ($MS\%_{,i,y}$), the average weight of the livestock (W_{site}) and the livestock population ($N_{LT,y}$) taking into account the average number of days the animals are alive in the farm in a specific year. The consistency between these values and indirect information (records of sales, records of food purchases) shall be assessed. Significant changes in livestock population and average weight shall be explained;

    (b) If developed country *VS* values are being used the following shall be monitored:

        (i) Genetic source of the production operations livestock originate from an Annex I Party;

[3] If a fuel is defined as a start-up fuel, it should not represent more than 1% of the total fuel utilized in the process, on energy basis.

(ii) The formulated feed rations (*FFR*). If equation 2 is used to estimate the value $VS_{default}$ (kg-dm/animal/day), the default average animal weight of a defined population (kg) shall be recorded and archived.

5. Monitoring methodology

35. Relevant parameters shall be monitored as indicated in section 5.1 below. The applicable requirements specified in the *"General Guidelines for SSC CDM methodologies"* (e.g. calibration requirements, sampling requirements) are also an integral part of the monitoring guidelines specified below and therefore shall be referred by the project participants.

5.1. Data and parameters monitored

Data / Parameter table 1.

Data / Parameter:	$VS_{LT,y}$
Data unit:	kg dry matter/animal/year
Description:	Volatile solids for livestock *LT* entering the animal manure management system in year *y*
Source of data:	-
Measurement procedures (if any):	Only required when data from national published source are not available or IPCC default value from 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 10 table 10 A-4 to 10 A-9 are not used. When country-specific excretion rates is to be estimated from feed intake levels as indicated in the para 16(b), via the enhanced characterisation method (Tier 2) described in section 10.2 in 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 10, parameters of GE_{LT}, DE_{LT}, *UE, ASH* and ED_{LT} shall be monitored as detailed below to derive this value. When developed country values are to be used in the project, relevant parameters specified in the paragraph 15(d) and 33(b) shall be monitored/documented. If IPCC default values are to be adjusted for a site-specific average animal weight as specified in paragraph 15(c), the average animal weight of a defined livestock population at the project site (W_{site}) shall be monitored as detailed below
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 2.

Data / Parameter:	$N_{da,y}$
Data unit:	Number
Description:	Number of days animal is alive in the farm in the year *y*

Source of data:	-
Measurement procedures (if any):	The PDD should describe the system for monitoring the number of livestock population. The consistency between the value and indirect information (records of sales, records of food purchases) should be assessed sales, records of food purchases) should be assessed
Monitoring frequency:	Annually, based on monthly records
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 3.

Data / Parameter:	$N_{p,y}$
Data unit:	Number
Description:	Number of animals produced annually of type LT for the year *y*
Source of data:	-
Measurement procedures (if any):	The PDD should describe the system on monitoring the number of livestock population. The consistency between the value and indirect information (records of sales, records of food purchases) should be assessed
Monitoring frequency:	Annually, based on monthly records
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 4.

Data / Parameter:	W_{site}
Data unit:	kg
Description:	Average animal weight of a defined livestock population at the project site
Source of data:	-
Measurement procedures (if any):	When IPCC values of VS are adjusted for site specific animal weight as per para 16(c) and equation 2 sampling procedures can be used to estimate this variable as per the *"Standard for sampling and surveys for CDM project activities and Programmes of Activities"* ~~General guidelines for sampling and surveys for SSC project activities~~
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 5.

Data / Parameter:	$BG_{burnt,y}$
Data unit:	m^3
Description:	Biogas volume in year *y*
Source of data:	-
Measurement procedures (if any):	The amount of biogas recovered and fuelled, flared or used gainfully shall be monitored ex post, using flow meters. If the biogas flared and fuelled (or utilized) is continuously monitored separately, the two fractions can be added to determine the biogas recovered. In that case, recovered biogas need not be monitored separately. The system should be built and operated to ensure that there is no air ingress into the biogas pipeline. The methane content measurement shall be carried out close to a location in the system where a biogas flow measurement takes place, and on the same basis (wet or dry)
Monitoring frequency:	Annually, based on continuous flow measurement with accumulated volume recording (e.g. hourly/daily accumulated reading)
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 6.

Data / Parameter:	$w_{CH4,y}$
Data unit:	%
Description:	Methane content in biogas in the year *y*
Source of data:	-
Measurement procedures (if any):	The fraction of methane in the biogas should be measured with a continuous analyser (values are recorded with the same frequency as the flow) or, with periodical measurements at a 90/10 confidence/precision level by following the "*Standard for sampling and surveys for CDM project activities and Programme of Activities*" ~~General guidelines for sampling and surveys for SSC project activities~~, or, alternatively a default value of 60% methane content can be used. Option chosen should be clearly specified in the PDD. It shall be measured using equipment that can directly measure methane content in the biogas - the estimation of methane content of biogas based on measurement of other constituents of biogas such as CO_2 is not permitted. The methane content measurement shall be carried out close to a location in the system where a biogas flow measurement takes place, and on the same basis (wet or dry)
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 7.

Data / Parameter:	*T*
Data unit:	°C
Description:	Temperature of the biogas at the flow measurement site
Source of data:	-
Measurement procedures (if any):	As per the relevant procedure in AMS-III.H
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 8.

Data / Parameter:	***P***
Data unit:	Pa
Description:	Pressure of the biogas at the flow measurement site
Source of data:	-
Measurement procedures (if any):	As per the relevant procedure in AMS-III.H
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 9.

Data / Parameter:	**%**
Data unit:	FE
Description:	The flare efficiency
Source of data:	-
Measurement procedures (if any):	As per the "~~Tool to determine project emissions from flaring gases containing methane~~Project emissions from flaring". Regular maintenance shall be carried out to ensure optimal operation of flares
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 10.

Data / Parameter:	$Q_{manure,j,LT,y}$
Data unit:	Tonnes DM/year

Description:	Quantity of manure treated from livestock type *LT* at animal manure management system *j*
Source of data:	-
Measurement procedures (if any):	As the case in paragraph 15(b), manure weight shall be directly measured or alternatively manure volume can be measured together with the density determined from representative sample (90/10 precision). The quantity of animal manure from different farms and different animal types shall be recorded separately for crosscheck. Recording of the baseline animal manure management system where the animal manure would have been treated anaerobically is also required
Monitoring frequency:	Annually, based on daily measurement and monthly aggregation
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 11.

Data / Parameter:	$SVS_{j,LT,y}$
Data unit:	tonnes VS/tonnes DM
Description:	Specific volatile solids content of animal manure from livestock type *LT* and animal manure management system *j* in year *y*
Source of data:	-
Measurement procedures (if any):	If animal manure is treated in a centralized plant, as the case in paragraph 14(b), testing shall be performed according to the guideline in annex 2 of AM0073. It can be on sample basis by following the "Standard for sampling and surveys for CDM project activities and programme of activities "~~General guidelines for sampling and surveys for SSC project activities~~, with a maximum margin of error of 10% at a 90% confidence level
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 12.

Data / Parameter:	**-**
Data unit:	-
Description:	Parameters related to project emissions from incremental transportation distances in year *y*
Source of data:	-
Measurement procedures (if any):	Used to calculate $PE_{transp,y}$. As per the relevant procedure in AMS-III.AO

Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 13.

Data / Parameter:	**-**
Data unit:	-
Description:	Parameters related to project emissions from flaring of the residual gas stream in year *y*
Source of data:	-
Measurement procedures (if any):	Used to calculate $PE_{flare,y}$. As per the *"~~Tool to determine project emissions from flaring gases containing methane~~Project emissions from flaring"*
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 14.

Data / Parameter:	**-**
Data unit:	-
Description:	Parameters related to emissions from electricity and/or fuel consumption in year *y*
Source of data:	-
Measurement procedures (if any):	Used to calculate $PE_{power,y}$. As per the procedure in the *"Tool to calculate baseline, project and/or leakage emissions from electricity consumption"* and/or *"Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"*. Alternatively it shall be assumed that all relevant electrical equipment operate at full rated capacity, plus 10% to account for distribution losses, for 8760 hours per annum
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 15.

Data / Parameter:	$MS\%_{i,y}$
Data unit:	%
Description:	Fraction of manure handled in system i in project activity in year *y*
Source of data:	-

Measurement procedures (if any):	If animal manure is treated in different treatment systems manure weight delivered to each system shall be directly measured or alternatively manure volume can be measured together with the density determined from representative sample (90/10 precision). The quantity of animal manure from different farms and different animal types shall be recorded separately for cross-check. Recording of the baseline animal manure management system where the animal manure would have been treated anaerobically is also required
Monitoring frequency:	Annually, based on daily measurement and monthly aggregation
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 16.

Data / Parameter:	AI_l
Data unit:	Days
Description:	Annual average interval between manure collection and delivery for treatment at a given storage device *l*
Source of data:	-
Measurement procedures (if any):	It is to be used to calculate possible project emissions due the storage of animal manure, as per paragraph 22
Monitoring frequency:	Annually, based on monthly records
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 17.

Data / Parameter:	nd_y
Data unit:	Days
Description:	Number of days that the animal manure management system was operational
Source of data:	-
Measurement procedures (if any):	If any farm has no operations on a given day it needs to be documented (e.g. logbook) and taken into account for the calculation of $BE_{ex\ post}$
Monitoring frequency:	Annually, based on daily records and monthly aggregation
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 18.

Data / Parameter:	$MS\%_l$
Data unit:	%
Description:	Fraction of volatile solids handled by storage device *l*
Source of data:	-
Measurement procedures (if any):	It is to be used to calculate possible project emissions due the storage of animal manure, as per paragraph 23
Monitoring frequency:	Monthly
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 19.

Data / Parameter:	$B_{0,LT}$
Data unit:	m^3 CH_4/kg dm
Description:	Maximum methane producing potential of the volatile solid generated for animal type *LT*
Source of data:	-
Measurement procedures (if any):	Only when developed country values are to be used in the project, in such a case relevant parameters specified in the paragraph 15(d) shall be monitored/documented
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 20.

Data / Parameter:	GE_{LT}
Data unit:	MJ/day
Description:	Daily average gross energy intake in MJ/day
Source of data:	-
Measurement procedures (if any):	Only when country-specific excretion rates are to be estimated from feed intake levels as indicated in the para 10(b), via the enhanced characterisation method (Tier 2) described in section 10.2 in 2006 *IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 10*
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 21.

Data / Parameter:	DE_{LT}
Data unit:	%
Description:	Digestible energy of the feed in per cent
Source of data:	-
Measurement procedures (if any):	If IPCC Tier 2 is used for VS determination. *IPCC 2006 Table 10.2, Chapter 10, Volume 4*
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 22.

Data / Parameter:	***UE***
Data unit:	Fraction of GE
Description:	Urinary energy expressed as fraction of *GE*
Source of data:	-
Measurement procedures (if any):	If IPCC Tier 2 is used for VS determination. Typically 0.04GE can be considered urinary energy excretion by most ruminants (reduce to 0.02 for ruminants fed with 85% or more grain in the diet or for swine). Use country-specific values where available
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 23.

Data / Parameter:	*ASH*
Data unit:	Fraction of the dry matter feed intake
Description:	Ash content of the manure calculated as a fraction of the dry matter feed intake
Source of data:	-
Measurement procedures (if any):	If IPCC Tier 2 is used for VS determination. Use country-specific values where available
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 24.

Data / Parameter:	ED_{LT}
Data unit:	MJ/kg DM
Description:	Energy density of the feed in MJ/kg fed to livestock type LT
Source of data:	-
Measurement procedures (if any):	If IPCC Tier 2 is used for VS determination. IPCC notes the energy density of feed, ED, is typically 18.45 MJ/kg DM, which is relatively constant across a wide variety of grain-based feeds. The project proponent will record the composition of the feed to enable the DOE to verify the energy density of the feed
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 25.

Data / Parameter:	EG_y
Data unit:	MWh
Description:	Total electricity generated from the recovered biogas in year *y*
Source of data:	-
Measurement procedures (if any):	Only required for project activities that utilize the recovered methane for power generation as per paragraph 27
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 26.

Data / Parameter:	EE_y
Data unit:	%
Description:	Energy Conversion Efficiency of the project equipment
Source of data:	-
Measurement procedures (if any):	As per paragraph 27 Specification provided by the equipment manufacture. The equipment shall be designed to utilize biogas as fuel, and the efficiency specification is for this fuel. If the specification provides a range of efficiency values, the highest value of the range shall be used for the calculation
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-

6. Project activity under a programme of activities

36. The following conditions apply for use of this methodology in a project activity under a programme of activities:

    (a) If 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.

Appendix 1. Anaerobic unit process performance

Table 1. Anaerobic unit process performance

Anaerobic Treatment	HRT	COD	TS	VS	TN	P	K
	days	Per cent Reduction					
Pull plug pits	4-30	—	0-30	0-30	0-20	0-20	0-15
Underfloor pit storage	30-180	—	30-40	20-30	5-20	5-15	5-15
Open top tank	30-180	—	—	—	25-30	10-20	10-20
Open pond	30-180	—	—	—	70-80	50-65	40-50
Heated digester effluent prior to storage	12-20	35-70	25-50	40-70	0	0	0
Covered first cell of two cell lagoon	30-90	70-90	75-95	80-90	25-35	50-80	30-50
One-cell lagoon	>365	70-90	75-95	75-85	60-80	50-70	30-50
Two-cell lagoon	210+	90-95	80-95	90-98	50-80	85-90	30-50
HRT=hydraulic retention time; COD=chemical oxygen demand; TS=total solids; VS=volatile solids; TN=total nitrogen; P=phosphorus; K=potassium; — =data not available.							

Source: Moser and Martin, 1999

Document information*

Version	*Date*	*Description*
19.0	25 October 2012	SSCWG39, Annex 7 To be considered at EB 70. To include simplified requirements for project activities that utilize the recovered methane for power generation; and to include further guidance on additionality demonstration for project applying this methodology.
18	29 September 2011	EB63, Annex 22 To include the monitoring table to clarify the monitoring requirements.
17	26 November 2010	EB58, Annex 20 To cover centralized treatment of animal manure collected from different farms and to include provisions for determining baseline emissions based on the direct measurement of manure quantity and volatile solids.
16.1	01 June 2010	Editorial revision in paragraph 2(c): • To change storage time from 5 days to 45 days.
16	26 March 2010	EB 53, Annex 16 To include additional guidance for long term storage of manure after removal from the animal barns.
15	17 July 2009	EB 48, Annex 18 To provide additional guidance on consideration of the storage time of animal manure taking into account the fact that the manure could be transported from locations other than the location of the anaerobic digester.
14	14 March 2008	EB 38, Annex 11 To: • Clarify the use of the tier 2 approach of 2006 IPCC guidelines for emission reduction calculations for manure management systems; and • Expand the applicability of the methodology to include the possibility of pipeline transport of the recovered and upgraded biogas to the end-users, similar to the revision recommended to AMS-III.H.
13	27 July 2007	EB 33, Annex 32 Revision of the approved small-scale methodology AMS-III.D to allow for its application under a programme of activities (PoA).

* This document, together with the 'General Guidance' and all other approved SSC methodologies, was part of a single document entitled: Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM project activities until version 07.

Version	*Date*	*Description*
12	04 May 2007	EB 31, Annex 22 To clarify that in the monitoring plan on-site inspections are to be conducted for each individual farm and includes additional guidance on how to determine the efficiency of the flaring process in an enclosed flare and in an open flare; To assign scope 15 to this methodology and exclude this methodology from sectoral scopes 10 and 13, and to clarify that that DOE functions (validation, verification etc.) of project activities applying earlier versions can only be performed by DOEs accredited to all of the sectoral scopes to which the earlier versions of these methodologies respectively belong to.
11	23 December 2006	EB 28, Meeting report, Para. 64 To remove the interim applicability condition that is 25 ktCO_2e/y limit from all Type III categories.
10	28 July 2006	EB 25, Annex 25 To expand its applicability to cover project activities that change manure management practices that is from 'lagoon', 'liquid/slurry', 'solid storage' or 'drylot' to 'anaerobic digestion' for the treatment of swine or cattle manure.
9	12 May 2006	EB 24, Meeting report, Para. 64 To introduce the interim applicability condition that is 25kt CO_2e/y limit for all Type III categories.
8	03 March 2006	EB 23, Annex 25 To clarify its applicability and align it with AMS-III.F, AMS-III.G, AMS-III.H and AMS-III.I.

Decision Class: Regulatory
Document Type: Standard
Business Function: Methodology
Keywords: SSC Type III projects, animal manure management systems, biogas recovery and destruction

History of the document: Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM project activities

Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM project activities contained both the General Guidance and Approved Methodologies until version 07. After version 07 the document was divided into separate documents: 'General Guidance' and separate approved small-scale methodologies (AMS).

Version	*Date*	*Description*
07	25 November 2005	EB 22, Para. 59 References to "non-renewable biomass" in Appendix B deleted.
06	20 September 2005	EB 21, Annex 22 Guidance on consideration of non-renewable biomass in Type I methodologies, thermal equivalence of Type II GWhe limits included.
05	25 February 2005	EB 18, Annex 6 Guidance on 'capacity addition' and 'cofiring' in Type I methodologies and monitoring of methane in AMS-III.D included.
04	22 October 2004	EB 16, Annex 2 AMS-II.F was adopted, leakage due to equipment transfer was included in all Type I and Type II methodologies.
03	30 June 2004	EB 14, Annex 2 New methodology AMS-III.E was adopted.
02	28 November 2003	EB 12, Annex 2 Definition of build margin included in AMS-I.D, minor revisions to AMS-I.A, AMS-III.D, AMS-II.E.
01	21 January 2003	EB 7, Annex 6 Initial adoption. The Board at its seventh meeting noted the adoption by the Conference of the Parties (COP), by its decision 21/CP.8, of simplified modalities and procedures for small-scale CDM project activities (SSC M&P).

Decision Class: Regulatory
Document Type: Standard
Business Function: Methodology
Keywords: simplified methodologies, type (iii) projects, animal manure management systems