CLEAN DEVELOPMENT MECHANISM

CDM-MP98-A01

Draft Large-scale Consolidated Methodology

ACM0010: GHG emission reductions from manure management systems

DRAFT

Version 09.0

Sectoral scope(s): 13 and 15

United Nations
Framework Convention on
Climate Change

COVER NOTE

1. Procedural background

1. The proposed new methodology “NM0386: GHG emission reductions through comprehensive animal manure management systems” (hereinafter referred as NM0386) was received on 17 March 2024 and considered complete. At MP94, noting the similarity of NM0386 with the approved methodology “AM0073: GHG emission reductions through multi-site manure collection and treatment in a central plant” (hereinafter referred as AM0073) and the approved consolidated methodology ACM0010, the Meth Panel (MP) agreed to consolidate NM386 and AM0073 with “ACM0010: GHG emission reductions from manure management systems” (hereinafter referred as ACM0010).

2. At EB116, the Board requested the MP to analyze and consider possible revision of ACM0010, addressing fugitive methane emissions from biogas digesters and use of updated Intergovernmental Panel on Climate Change (IPCC) methods.

3. At MP95, MP96 and MP97 the MP considered the revised draft and agreed to continue working at its next meeting.

2. Purpose

4. The purpose of the revision is to consolidate NM0386 and AM0073 with ACM0010, and to address the mandate provided by the Board at EB116.

3. Key issues and proposed solutions

5. The following key issues are identified in the methodology:

(a) Reference to 2019 IPCC Refinement for VS_{LT}: in the 2019 Refinement there was a change on how parameter VS_{LT} (annual volatile solid excretions for livestock LT) is reflected. In the 2006 Guidelines the value was provided per head of animal, while in 2019 Refinement it is provided per 1000kg of animal;

(b) Allowing the calculation of BE based on the amount of manure treated: the current versions of ACM0010 and AM0073 require the monitoring of the number of animals to be used as a cap for emission reductions. Allowing the use of the amount of manure treated, as proposed in NM0386, instead of the monitored number of animals would open potential issues, as it cannot be assured that the amount of waste measured only involves animal manure from farms including in the project boundary (it could include manure from other sources or other agricultural waste);

(c) Emissions from storage of manure: the methodology is only applicable if the storage time of the manure after removal from the animal barns, including transportation, does not exceed 45 days before being fed into the anaerobic digester. Including the calculation of emissions from storage is not straightforward and is beyond the scope of the mandate for this revision.

4. Impacts

6. The revised methodology will consolidate the methodological provisions for large scale project activities involving manure treatment and address the mandate provided by the Board at EB116.

5. Subsequent work and timelines

7. The MP agreed to launch a call for public input following the “Procedure: Development, revision and clarification of baseline and monitoring methodologies and methodological tools”.

6. Recommendations to the Board

8. If there are no substantial inputs received during the call, the MP recommends the Board approve the methodology, as contained in annex 1 to this report.

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1. Introduction

Table 1. Methodology key elements

Typical project(s)	Manure management on livestock farms (cattle, buffalo, swine, sheep, goats, and/or poultry) where the existing anaerobic manure treatment system is replaced by, or a new system is constructed as, one or a combination of more than one animal waste management systems that result in less GHG emissions
Type of GHG emissions mitigation action	(a) GHG destruction Destruction of methane emissions and displacement of a more-GHG-intensive service

2. Scope, applicability, and entry into force

2.1. Scope

1. This methodology applies to project activities that ~~include destruction of methane emissions and displacement of a more GHG-intensive service in manure management of livestock farms by introducing a new animal waste management system or a combination of animal waste management systems that result in less GHG emissions.~~ implement animal waste management system(s) in a livestock farm or in a centralized treatment plant, that result in lower GHG emissions compared to the baseline system(s).

2.2. Applicability

2. This methodology is applicable to manure management [measures] ~~on~~ in livestock farms where the existing anaerobic manure treatment system~~, within the project boundary,~~ is replaced by ~~one or a combination of more than one~~ [new] animal waste management systems (AWMSs) that result in less GHG emissions ~~compared to the existing system~~. The methodology is also applicable to Greenfield manure treatment facilities.

3. This methodology is applicable ~~to manure management projects~~ under the following conditions:

(a) Farms where livestock populations~~, comprising of~~ (cattle, buffalo, swine, sheep, goats, and/or poultry)~~, is~~ are managed under confined conditions;

(b) Farms where manure is not discharged into natural water resources (e.g. rivers or estuaries);

(c) In case of anaerobic lagoons treatments systems, the depth of the lagoons used for manure management under the baseline scenario should be at least 1 m;

(d) The annual average ambient temperature at the site where the anaerobic manure treatment facility in the baseline existed is higher than 5°C;

(e) ~~In the baseline case, the minimum retention time of manure waste in the anaerobic treatment system is greater than one month~~ In case the baseline treatment system is an uncovered anaerobic lagoon, the retention time of the manure in the system should be at least 12 months, in accordance specifications in the “2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 10, table 10.17, footnote 7;

(f) The AWMS(s) ~~in the project case~~ implemented by the project activity results in no leakage of manure waste into ground water, for example the covered lagoon should have a non-permeable layer at the lagoon bottom;

(g) The AWMS(s) implemented by the project activity does not involve co-digestion of manure with other organic wastes;

(h) The storage time of the manure after removal from the animal barns, including transportation, does not exceed 45 days before being fed into the anaerobic project treatment system;

(i) Technical measures shall be implemented to ensure that all biogas produced by the project treatment system is used or flared;

(j) In order to avoid double counting of emission reductions, CERs can only be claimed by the managing entity of the AWMS. This shall be ensured through a contractual agreement with the owner of the farms or other relevant stakeholder.

4. In addition, the applicability conditions included in the tools referred to above apply.

2.3. Entry into force

5. The date of entry into force of the revision is the date of the publication of the EB 126 meeting report on 7 November 2025.

3. Normative references

6. This consolidated baseline methodology is based on elements from the following methodologies:

(a) “AM0006: GHG emission reductions from manure management systems”;

(b) “AM0016: Greenhouse gas mitigation from improved Animal Waste Management Systems in confined animal feeding operations”

(c) “AM0073: GHG emission reductions through multi-site manure collection and treatment in a central plant;

(d) “NM0386: GHG emission reductions through comprehensive animal manure management systems” by CS Climate Solutions Danışmanlık Anonim Şirketi”.

7. This methodology also refers to the latest approved versions of the following tools:

(a) “TOOL02: Combined tool to identify the baseline scenario and demonstrate additionality”;

(b) “TOOL03: Tool to calculate project or leakage CO2 emissions from fossil fuel combustion”;

(c) “TOOL05: ~~“Tool to calculate baseline, project and/or leakage emissions from electricity consumption”;~~ Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”;

(d) ~~"Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion";~~

(e) "TOOL08: Tool to determine the mass flow of a greenhouse gas in a gaseous stream";

(f) "TOOL09: Determining the baseline efficiency of thermal or electric energy generation systems";

(g) "TOOL11: Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period";

(h) ~~"Combined tool to identify the baseline scenario and demonstrate additionality";~~

(i) "TOOL12: Project and leakage emissions from transportation of freight";

(j) "TOOL14: Project and leakage emissions from anaerobic digesters".

(k) ~~"Tool to determine the baseline efficiency of thermal or electric energy generation systems";~~

(l) ~~"Tool to determine the mass flow of a greenhouse gas in a gaseous stream".~~

8. For more information regarding the proposed new methodologies and the tools as well as their consideration by the Executive Board (hereinafter referred to as the Board) of the clean development mechanism (CDM) please refer to http://cdm.unfccc.int/goto/MPappmeth.

3.1. Selected approach from paragraph 48 of the CDM modalities and procedures

9. "Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment".

4. Definitions

10. The definitions contained in the Glossary of CDM terms shall apply.

5. Baseline methodology

5.1. Project boundary

11. The spatial extent of the project boundary encompasses the livestock farms, the site of the AWMS(s), including the flare or energy and/or heat generation equipment and the power/heat source(s).

Figure 1. The project boundary

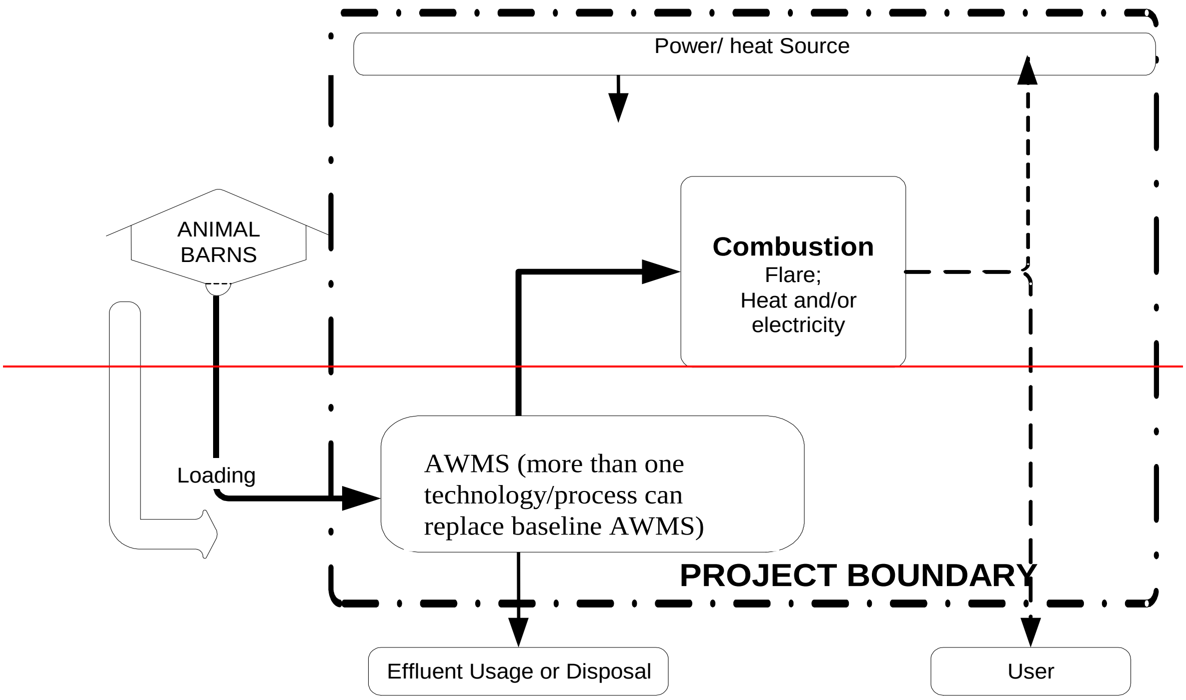


Table 2. Emissions sources included in or excluded from the project boundary

Source		Gas	Included	Justification/Explanation
Baseline	Emissions from the waste treatment processes	CO_2	No	CO_2 emissions from the decomposition of organic waste are not accounted
		CH_4	Yes	The major source of emissions in the baseline
		N_2O	Yes	Direct and indirect N_2O emissions are accounted
	Emissions from electricity consumption/ generation	CO_2	Yes	Electricity may be consumed from the grid or generated onsite in the baseline scenario
		CH_4	No	Excluded for simplification. This is conservative
		N_2O	No	Excluded for simplification. This is conservative
	Emissions from thermal energy generation	CO_2	Yes	If thermal energy generation is included in the project activity
		CH_4	No	Excluded for simplification. This is conservative
		N_2O	No	Excluded for simplification. This is conservative

Source		**Gas**	**Included**	**Justification/Explanation**
Project activity	Emissions from thermal energy use	CO_2	Yes	May be an important emission source
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small
	Emissions from on-site electricity use	CO_2	Yes	May be an important emission source. If electricity is generated from collected biogas, these emissions are not accounted for
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small
	Emissions from the waste treatment processes	CO_2	No	CO_2 emissions from the decomposition of organic waste are not accounted
		CH_4	Yes	The emission from anaerobic digesters and aerobic treatment
		N_2O	Yes	Direct and indirect N_2O emissions are accounted
	Emissions from road transportation of manure and processed materials	CO_2	Yes	Direct source of emissions
		CH_4	No	Excluded for simplification
		N_2O	No	Excluded for simplification.

12. The project ~~proponents~~ participants shall provide a clear diagrammatic representation in the CDM-PDD of the project scenario showing all the manure waste treatment~~s~~ steps as well as its final disposal. This shall include the final use of methane, if any is captured, and also the auxiliary energy used to run project treatments steps. The diagrammatic representation shall also indicate the fraction of volatile solids degraded within the project boundary in the pre-project situation before disposal.

13. The precise location of the farm(s) where the project activity takes place shall be identified in the CDM-PDD (e.g. co-ordinates of farm(s) using global positioning system).

5.2. Identification of the baseline scenario and demonstration of additionality

14. ~~Identify the baseline scenario and demonstrate additionality using the “Combined tool to identify the baseline scenario and demonstrate additionality”, following the requirements below.~~ The identification of the baseline scenario shall be conducted in accordance with “TOOL02: Combined tool to identify the baseline scenario and demonstrate additionality”, following the requirements below.

5.2.1. Baseline scenario ~~for managing the manure~~

5.2.1.1. For existing facilities

15. In applying Step 1 of the tool, baseline alternatives for managing the manure, shall take into consideration, inter alia, the complete set of existing/possible manure management systems listed in the *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4, Chapter 10, Table 10.17*). In drawing up a list of possible scenarios, possible combinations of AWMS shall be taken into account.

5.2.1.2. For Greenfield facilities

16. For Greenfield facilities, the methodology only applies where the baseline scenario selected from the complete set of the list of the *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4, Chapter 10, Table 10.17)*, is an uncovered anaerobic lagoon.

17. The following two steps will define the baseline uncovered anaerobic lagoon:

    (a) Define several anaerobic lagoon design options for the particular manure stream that meet the relevant regulations and take into consideration local conditions (e.g. environmental legislation, ground water table, land requirement, temperature). Design specifications shall include average depth and surface area of the anaerobic lagoon, residence time of the organic matter, as well as any other key parameters. Document the different design options in a transparent manner and provide transparent and documented evidence of key assumptions and data used, and offer conservative interpretations of this evidence;

    (b) Carry out an economic assessment of the identified lagoon design option, as per Step 3 (investment analysis) of the latest approved version of ~~the~~ "TOOL02: Combined tool to identify the baseline scenario and demonstrate additionality" and additional guidance given below. Choose the least cost anaerobic lagoon design option from the options identified through Step (a) above. If several options with comparably low cost exist, choose the one with the lowest lagoon depth as the baseline lagoon design.

18. In applying Step 3 of the tool, baseline alternatives for managing the manure shall take into consideration the following additional guidance to compare the economic or financial attractiveness for Step (b) above.

19. To compare the economic attractiveness without revenues from CERs for all possible anaerobic lagoon design options that are identified, and in applying the investment analysis the IRR shall be used as an indicator. The following parameters inter alia should be explicitly documented:

    (a) Land cost;

    (b) Engineering, procurement and construction cost;

    (c) Labour cost;

    (d) Operation and maintenance cost;

    (e) Administration cost;

(f) Fuel cost;

(g) Capital cost and interest;

(h) Revenue from electricity sales;

(i) All other costs of implementing the technology of each lagoon design option;

(j) All revenues generated by the implementation of the proposed technology (including energy savings due to captive use of biogas as fuel for either electricity or heat generation at the project site, revenue on account of avoided water consumption, fossil fuel replacement, sale of concentrated solids as fertilizers, subsidies/fiscal incentives etc.).

5.2.2. Baseline scenario for electricity and heat generation

20. In addition to the alternative baseline scenarios identified for managing the manure, alternative scenarios for the use of gas generated from an anaerobic digester (biogas) shall also be identified if this is an aspect of the project activity:

21. For electricity generation, alternative(s) shall include, inter alia:

(a) E1: Electricity generation from biogas, undertaken without being registered as CDM project activity;

(b) E2: Electricity generation in existing or new renewable based captive power plant(s);

(c) E3: Electricity generation in existing and/or new grid-connected power plant;

(d) E4: Electricity generation in an off-grid fossil fuel fired captive power plant;

(e) E5: Electricity generation in existing and/or new grid-connected power plant and fossil fuel fired captive power plant(s).

22. Baseline emissions due to electricity generation can be accounted for **only** if the baseline scenario is E3, E4 and E5.

23. For heat generation, alternative(s) shall include, inter alia:

(a) H1: Heat generation from biogas undertaken without being registered as CDM project activity;

(b) H2: Heat generation in existing or new fossil fuel fired cogeneration plant(s);

(c) H3: Heat generation in existing or new renewable based cogeneration plant(s);

(d) H4: Heat generation in existing or new on-site or off-site fossil fuel based boiler(s) or air heater(s);

(e) H5: Heat generation in existing or new on-site or off-site renewable energy based boiler(s) or air heater(s);

(f) H6: Any other source, such as district heat; and

(g) H7: Other heat generation technologies (e.g. heat pumps or solar energy).

24. Baseline emissions due to heat generation can be accounted for **only** if the baseline scenario is H4.

5.2.3. Additionality

25. The demonstration of additionality of the project activity shall be conducted following the latest version of “TOOL02: Combined tool to identify baseline scenario and demonstrate additionality”.

5.3. Baseline emissions

~~26. The baseline is the AWMSs identified through the baseline selection procedure, as well as, when relevant, the baseline for the use of gas generated from the anaerobic digester.~~

27. Baseline emissions are calculated as follows:

$$BE_y = BE_{CH4,y} + BE_{N20,y} + BE_{elec/heat,y} \quad \text{Equation (1)}$$

Where:

BE_y	=	Baseline emissions in year *y* (t CO_2/yr)
$BE_{CH4,y}$	=	Baseline CH_4 emissions in year *y* (t CO_2/yr)
$BE_{N20,y}$	=	Baseline N_2O emissions in year *y* (t CO_2/yr)
$BE_{elec/heat,y}$	=	Baseline CO_2 emissions from electricity and/or heat used in the baseline (t CO_2/yr)

5.3.1. Baseline CH_4 emissions ($BE_{CH4,y}$)

28. ~~The manure management system in the baseline could be based on different livestock, treatment systems and on one or more stages. Therefore~~ Baseline CH_4 emissions are calculated as follows:

$$BE_{CH4,y} = GWP_{CH4} \times D_{CH4} \times \sum_{f}\sum_{j}\sum_{LT}\left(MCF_j \times B_{0,LT} \times N_{LT} \times VS_{LT,y} \times MS\%_{BL,y}\right) \quad \text{Equation (2)}$$

Where:

$BE_{CH4,y}$	=	Baseline CH_4 emissions (t CO_2/yr)
GWP_{CH4}	=	Global Warming Potential (GWP) of CH_4 (t CO_2e/t CH_4)
D_{CH4}	=	Density of CH_4 at reference conditions (t/m^3)
MCF_j	=	Annual methane conversion factor (MCF) for the baseline *AWMSj*
$B_{0,LT}$	=	Maximum methane producing ~~potential~~ capacity of the volatile solid generated by animal type *LT* (m^3CH_4/kg -dm)
N_{LT}	=	Annual average number of animals of type *LT* ~~for the~~ in year *y* (number)
$VS_{LT,y}$	=	Annual volatile solid excretions for livestock LT entering all AWMS on a dry matter weight basis (kg -dm/animal/yr)

$MS\%_{Bl,j}$	=	Fraction of manure handled in system *j* in the baseline
LT	=	Type of livestock
j	=	Type of treatment system
f	=	Farm included in the project activity

5.3.1.1. ~~Estimation of various variables and parameters used in the above equation~~ Annual volatile solid excretions for livestock LT (VS_{LT})

29. The annual volatile solid excretions for livestock LT ($VS_{LT,y}$) shall be determined in one of the following ways, presented in the order of preference:

5.3.1.2. ~~Option 1~~

30. Option 1: Using published country specific data. If the data is expressed in kilogram volatile solid excretion per day on a dry-matter basis (kg -dm per day), multiply the value with nd_y (number of days treatment plant was operational in year *y*).

5.3.1.3. ~~Option 2~~

31. Option 2: ~~Estimation of $VS_{LT,y}$~~ Calculation based on dietary intake of livestock as follows:

$$VS_{LT,y} = \left[GE_{LT} \times \left(1 - \frac{DE_{LT}}{100}\right) + (UE \times GE_{LT})\right] \times \left[\left(\frac{1 - ASH}{ED_{LT}}\right)\right] \times nd_y \qquad \text{Equation (3)}$$

Where:

$VS_{LT,y}$	=	Annual volatile solid excretions for livestock *LT* entering all AWMS on a dry matter weight basis (kg -dm/animal/yr)
GE_{LT}	=	Daily average gross energy intake (MJ/animal/day)
DE_{LT}	=	Digestible energy of the feed (per cent)
UE	=	Urinary energy (fraction of GE_{LT})
ASH	=	Ash content of manure (fraction of the dry matter feed intake)
ED_{LT}	=	Energy density of the feed fed to livestock type *LT* (MJ/kg -dm)
nd_y	=	Number of days treatment plant was operational in year *y*

5.3.1.4. ~~Option 3~~

32. Option 3: Scaling default 2019 IPCC values $VS_{default}$ to adjust for a site-specific average animal weight as shown in equation below[1]:

$$VS_{LT,y} = \left(\frac{W_{site,LT}}{W_{default,LT}}\right) \times \cancel{VS_{default}} VS_{rate,LT,y}/1000 \times nd_y \qquad \text{Equation (4)}$$

[1] Option 3 can only be used if the average animal weight is monitored.

Where:

$VS_{LT,y}$	=	Annual volatile solid excretions for livestock *LT* entering all AWMS on a dry matter weight basis (kg -dm/animal/yr)
$W_{site,LT}$	=	Average animal weight of a defined livestock population at the project site (kg)
$W_{default,LT}$	=	Default average animal weight of a defined population (kg)
~~$VS_{default}$~~	~~=~~	~~Default value for the volatile solid excretion per day on a dry-matter basis for a defined livestock population (kg-dm/animal/day)~~
$VS_{rate,LT,y}$	=	Daily volatile solid excretion rate per 1,000 kg animal mass for livestock type LT in year y (kg VS per 1,000 kg animal mass per day, dry basis)
nd_y	=	Number of days treatment plant was operational in year *y*

5.3.1.5. ~~Option 4~~

33. Option 4: Utilizing published 2019 IPCC defaults values for $VS_{LT,y}$ (*IPCC 2006 guidelines, volume 4, chapter 10, Table 10.13A*), multiplyied the value by nd_y (number of days in year *y* nd_y). as follows:

$$VS_{LT,y} = VS_{rate,LT,y}/1000 \times W_{LT,y} \times nd_y \quad \text{Equation (5)}$$

Where:

$VS_{LT,y}$	=	Annual volatile solid excretions for livestock *LT* entering all AWMS on a dry matter weight basis (kg -dm/animal/yr)
$VS_{rate,LT,y}$	=	Daily volatile solid excretion rate per 1,000 kg animal mass for livestock type LT in year y (kg VS per 1,000 kg animal mass per day, dry basis)
$W_{LT,y}$	=	Average animal weight of a defined livestock population in year y (kg)
nd_y	=	Number of days treatment plant was operational in year *y*

34. Developed countries ~~$VS_{LT,y}$~~ values for $VS_{LT,y}$ may be used provided the following conditions are satisfied:

(a) The genetic source of the production operations livestock originate from an Annex I Party;

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

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

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

35. For subsequent 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 - R_{VS}), where R_{VS} is the relative reduction of volatile solids from the

previous stage. The relative reduction (R_{VS}) of volatile solids depends on the treatment technology and should be estimated in a **conservative manner**. Default values for different treatment technologies can be found in appendix 1 (values for *VS*).

5.3.1.6. Annual average number of animals of type *LT* (N_{LT}) ~~shall be determined in one of the following ways, presented in order of preference~~:

36. The annual average number of animals of type LT (N_{LT}) shall be determined in one of the following ways, presented in order of preference:

(a) Option 1: If the project developer can monitor in a reliable and traceable way the daily stock of animals in the farm, discounting dead animals and animals discarded from the productive process from the daily stock, then the annual average number of animals (N_{LT}) ~~may~~shall be calculated as follows:

$$N_{LT} = \frac{\sum_{1}^{365} N_{AA,LT}}{365}$$ Equation (6)

Where:

N_{LT}	=	Annual average number of animals of type *LT* ~~for the~~ in year *y* (number)
$N_{AA,LT}$	=	Daily stock of animals of type *LT* in the farm, discounting dead and discarded animals (number)

(b) Option 2: Alternatively, N_{LT} may be calculated as follows:

$$N_{LT} = \cancel{N_{da,LT}} N_{p,LT} \times \left(\frac{\cancel{N_{p,LT}} N_{da,LT}}{365}\right)$$ Equation (7)

Where:

N_{LT}	=	Annual average number of animals of type *LT* ~~for the~~ in year *y* (number)
$\cancel{N_{da,LT}} N_{p,LT}$	=	~~Number of days animal of type *LT* is alive in the farm in the year *y* (number)~~ Number of animals of type *LT* present in year *y* (number)
$\cancel{N_{p,LT}} N_{da,LT}$	=	~~Number of animals of type *LT* produced annually for the in year *y* (number)~~ Number of days animal of type *LT* is alive in the farm in year *y* (number)

5.3.2. Baseline N_2O emissions ($BE_{N2O,y}$)

$$BE_{N20,y} = GWP_{N20} \times CF_{N20-N,N} \times \frac{1}{1000} \times \left(E_{N20,D,y} + E_{N20,ID,y}\right)$$ Equation (8)

Where:

$BE_{N20,y}$	=	Annual baseline N_2O emissions in (t CO_2e/yr)
GWP_{N20}	=	Global Warming Potential (GWP) for N_2O (t CO_2e/tN_2O)
$CF_{N20-N,N}$	=	Conversion factor N_2O-N to N_2O (44/28)
$E_{N20,D,y}$	=	Direct N_2O emission in year *y* (kg N_2O-N/year)

$E_{N20,ID,y}$ = Indirect N_2O emission in year *y* (kg N_2O-N/year)

$$E_{N20,D,y} = \sum_{j,LT} EF_{N20,D,j} \times NEX_{LT,y} \times N_{LT} \times MS\%_{Bl,j} \quad \text{Equation (9)}$$

Where:

$E_{N20,D,y}$	=	Direct N_2O emission in year *y* (kg N_2O-N/yr)
$EF_{N20,D,j}$	=	Direct N_2O emission factor for the treatment system *j* of the manure management system (kg N_2O-N/kg N)
$NEX_{LT,y}$	=	Annual average nitrogen excretion per head of a defined livestock population (kg N/animal/yr) estimated as described in appendix 2
$MS\%_{Bl,j}$	=	Fraction of manure handled in system *j* (fraction)
N_{LT}	=	Annual Average number of animals of type LT ~~for the~~ in year *y* estimated as per equation (5(a)) or (5(b)) (number)

$$E_{N20,ID,y} = \sum_{j,LT} EF_{N20,ID} \times F_{gasMS,j,LT} \times NEX_{LT,y} \times N_{LT} \times MS\%_{Bl,j} \quad \text{Equation (10)}$$

Where:

$E_{N20,ID,y}$	=	Indirect N_2O emission in year *y* (kg N_2O-N/year)
$EF_{N20,ID}$	=	Indirect N_2O emission factor for N_2O emissions from atmospheric deposition of nitrogen on soils and water surfaces (kgN_2O-N/kg NH3-N and NO_X-N)
$NEX_{LT,y}$	=	Annual average nitrogen excretion per head of a defined livestock population (kg N/animal/year) estimated as described in appendix 2
$MS\%_{Bl,j}$	=	Fraction of manure handled in system *j* (fraction)
$F_{gasMS,j,LT}$	=	Default values for nitrogen loss due to volatilisation of NH_3 and NO_X from manure management (fraction)
N_{LT}	=	Annual average number of animals of type *LT* f~~ for the~~ in year *y* estimated as per equation (5(a)) or (5(b)) (number)

37. For subsequent treatment stages, the reduction of the nitrogen 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 nitrogen adjusted for the reduction from the previous treatment stages by multiplying by (1 - R_N), where R_N is the relative reduction of nitrogen from the previous stage. The relative reduction (R_N) of nitrogen depends on the treatment technology and should be estimated in a **conservative manner**. Default values for different treatment technologies can be found in appendix 1 (values for TN).

5.3.3. Baseline CO_2 emission from electricity and/or heat used in the baseline

$$BE_{elec/heat,y} = BE_{EC,y} + BE_{HG,y} \quad \text{Equation (11)}$$

Where:

$BE_{elec/heat,y}$	=	Baseline CO_2 emissions from electricity and/or heat used in the baseline (t CO_2/yr)
$BE_{EC,y}$	=	Baseline emissions associated with electricity generation in year *y* (t CO_2/yr)
$BE_{HG,y}$	=	Baseline emissions associated with heat generation in year *y* (t CO_2/yr)

5.3.4. Baseline emissions associated with electricity generation (***$BE_{EC,y}$***)

38. The baseline emissions associated with electricity generation in year *y* ($BE_{EC,y}$) shall be calculated using the “Tool to calculate baseline, project *and*/or leakage emissions from electricity consumption”. When applying the tool:

(a) The electricity sources *k* in the tool correspond to *t*he sources of electricity identified in the selection of the most plausible baseline scenario;

(b) $EC_{BL,k,y}$ in the tool is equivalent to the net amount of electricity generated using biogas in year *y* ($EG_{d,y}$).

5.3.5. Baseline emissions associated with heat generation (***$BE_{HG,y}$***)

39. The baseline emissions associated with heat generation in year *y* ($BE_{HG,y}$) are determined based on the amount of biogas which is sent to the heat generation equipment in the project activity (boiler or air heater), as follows:

$$BE_{HG,y} = \eta \sum_{k=1}^{n} \frac{HG_{PJ,k,y} \times EF_{co2,BL,HG,k}}{\eta\,\eta_{HG,BL,k}} \quad \text{Equation (12)}$$

Where:

$BE_{HG,y}$	=	Baseline emissions associated with heat generation in year *y* (t CO_2/yr)
$HG_{PJ,k,y}$	=	Net quantity of heat generated with biogas by equipment type *k* in the project in year *y* (TJ/yr)
$EF_{co2,BL,HG,k}$	=	CO_2 emission factor of the fossil fuel type used for heat generation by equipment type *k* in the baseline (t CO_2/TJ)
$\eta\,\eta\,\eta$	=	Efficiency of the heat generation equipment type *k* used in the baseline
k	=	Heat generation equipment (boiler or air heater or kiln)

5.3.5.1. Determination of $EF_{CO2,BL,HG,k}$

40. For existing facilities:

    (a) Project participants shall choose the fossil fuel with the lowest emission factor among all the fuel options that were being used in the existing facility for heating purposes in the heat generation equipment.

41. For Greenfield facilities:

    (a) Project participants shall identify what is the most common fuel used in the identified baseline scenario and use it as the baseline fuel. Detailed justifications shall be provided and documented in the CDM-PDD for the selected baseline fuel.

42. To estimate the baseline energy efficiency of an air heater or boiler ($\eta_{HG,BL,k}$) project participants shall apply the “Tool to determine the baseline efficiency of thermal or electric energy generation systems”.

5.4. Project emissions

43. The project activity might include one or more AWMS to treat the manure. For example, the manure might be first treated in an anaerobic digester and then treated waste might be further processed using an aerobic pond. Each AWMS is referred to as a treatment stage.

44. Project emissions are estimated as follows:

$$PE_y = PE_{AD,y} + PE_{Aer,y} + PE_{N20,y} + PE_{EC/FC,y} + PE_{flare,y} + PE_{TR,y} \qquad \text{Equation (13)}$$

Where:

PE_y	=	Project emissions in year *y*
$PE_{AD,y}$	=	Project emissions associated with the anaerobic ~~digester~~ AWMS treatment system in year *y* (t CO_2e~~/yr~~)
$PE_{Aer,y}$	=	Project CH_4 emissions from aerobic AWMS treatment system (t CO_2e~~/yr~~)
$PE_{N20,y}$	=	Project N_2O emissions in year *y* (t CO_2~~/yr~~)
$PE_{EC/FC,y}$	=	Project emissions from electricity consumption and fossil fuel combustion (t CO_2e~~/yr~~)
$PE_{flare,y}$	=	Project emissions from flaring or combustion of biogas in year *y* (t CO_2e)
$PE_{TR,y}$	=	Project emissions from road transportation of manure and processed materials to the centralized plant (t CO_2e)

5.4.1. Project emissions associated with the anaerobic ~~digester~~ AWMS treatment system in year y ($PE_{AD,y}$)

45. $PE_{AD,y}$ is determined using the methodological tool “Project and leakage emissions from anaerobic digesters”.

5.4.2. Project CH4 emissions from aerobic AWMS treatment system ($PE_{Aer,y}$)

46. The IPCC guidelines specify emissions from aerobic lagoons as 0.1 per cent of total methane generating potential of the waste *processed*, which can be used as a default for all types of aerobic AWMS treatment systems.

$$PE_{Aer,y} = GWP_{CH4} \times D_{CH4} \times 0.001 \times F_{Aer} \times \left[\prod_{n=1}^{N}(1 - R_{VS,n})\right] \times \sum_{j,LT}(B_{0,LT} \times N_{LT} \times VS_{LT,y} \times MS\%_j) + PE_{SL,y}$$

Equation (14)

Where:

GWP_{CH4}	=	Global Warming Potential (GWP) of CH_4 (t CO_2e/tCH_4)
$R_{VS,n}$	=	Fraction of volatile solid degraded in AWMS treatment method *n* of the *N* treatment steps prior to waste being treated (fraction)
D_{CH4}	=	Density of CH_4 (t/m^3)
F_{Aer}	=	Fraction of volatile solid directed to aerobic system (fraction)
LT	=	Type of livestock
$B_{0,LT}$	=	Maximum methane producing potential of the volatile solid generated by animal type *LT* (m^3CH_4/kg dm)
$VS_{LT,y}$	=	Annual volatile solid excretion livestock type LT entering all AWMS on a dry matter weight basis in (kg -dm/animal/yr)
N_{LT}	=	Annual average number of animals of type *LT* ~~for the~~ in year *y* (number) as estimated in equation (5(a)) or (5(b))
$PE_{Sl,y}$	=	Project CH_4 emissions from sludge disposed of in storage pit prior to disposal during the year *y* (t CO_2e/yr)
$MS\%_j$	=	Fraction of manure handled in system *j* in the project activity (fraction)

47. Aerobic treatment results in large accumulations of sludge. Sludge requires removal and has large VS values. It is important to identify the following management process for the sludge and estimate the emissions from that management process. If the sludge ponds are not within the project boundary, the emissions should be included as leakage. The emissions from sludge ponds shall be estimated as follows:

$$PE_{Sl,y} = GWP_{CH4} \times D_{CH4} \times MCF_{sl} \times F_{Aer} \times \left[\prod_{n=1}^{N}(1 - R_{VS,n})\right] \times \sum_{j,LT}(B_{0,LT} \times N_{LT} \times VS_{LT,y} \times MS\%_j)$$

Equation (15)

Where:

GWP_{CH4}	=	Global Warming Potential (GWP) of CH_4 (t CO_2e/t CH_4)

$R_{VS,n}$	=	Fraction of volatile solid degraded in AWMS treatment method *n* of the *N* treatment steps prior to waste (sludge) being treated. (fraction)
D_{CH4}	=	Density of CH_4 (t/m^3)
F_{Aer}	=	Fraction of volatile solid directed to aerobic system (fraction)
LT	=	Type of livestock
$B_{0,LT}$	=	Maximum methane producing potential of the volatile solid generated by animal type *LT* (m^3CH_4/kg dm)
$VS_{LT,y}$	=	Annual volatile solid excretion livestock type *LT* entering all AWMS on a dry matter weight basis in (kg -dm/animal/yr)
N_{LT}	=	Annual average number of animals of type *LT* ~~for the~~ in year *y* (number) as estimated as per equation (5(a)) or (5(b))
$MS\%_j$	=	Fraction of manure handled in system *j* in the project activity (fraction)
MCF_{sl}	=	Methane conversion factor (*MCF*) for the sludge stored in sludge pits (fraction)

5.4.3. Project N_2O emissions in year *y* (*$PE_{N2O,y}$*)

$$PE_{N2O,y} = GWP_{N2O} \times CF_{N2O-N,N} \times \frac{1}{1000} \times \left(E_{N2O,D,y} + E_{N2O,ID,y}\right) \quad \text{Equation (16)}$$

Where:

$PE_{N2O,y}$	=	Project N_2O emissions in year *y* (t CO_2/yr)
GWP_{N2O}	=	Global Warming Potential (GWP) for N_2O (t CO_2e/tN_2O)
$CF_{N2O-N,N}$	=	Conversion factor N_2O-N to N_2O (44/28)
$E_{N2O,D,y}$	=	Direct N_2O emission in year *y* (kg N_2O-N/year)
$E_{N2O,ID,y}$	=	Indirect N_2O emission in year *y* (kg N_2O-N/year)

5.4.3.1. Option 1

$$E_{N2O,D,y} = \sum_{j,LT} EF_{N2O,D,J} \times NEX_{LT,y} \times N_{LT} \times MS\%_j \quad \text{Equation (17)}$$

Where:

$E_{N2O,D,y}$	=	Direct N_2O emission in year *y* (kg N_2O-N/yr)
$EF_{N2O,D,j}$	=	Direct N_2O emission factor for the treatment system *j* of the manure management system (kg N_2O-N/kg N)
$NEX_{LT,y}$	=	Annual average nitrogen excretion per head of a defined livestock population (kg N/animal/yr) estimated as described in appendix 2
$MS\%_j$	=	Fraction of manure handled in system *j* in the project activity (fraction)
N_{LT}	=	Annual average number of animals of type *LT* ~~for the~~ in year *y* estimated as per equation (5(a)) or (5(b)) (number)

$$E_{N20,ID,y} = \sum_{j,LT} EF_{N2O,ID} \times F_{gasMS,j,LT} \times NEX_{LT,y} \times N_{LT} \times MS\%_j$$ Equation (18)

Where:

$E_{N20,ID,y}$	=	Indirect N_2O emission in year *y* (kg N_2O-N/year)
$EF_{N20,ID}$	=	Indirect N_2O emission factor for N_2O emissions from atmospheric deposition of nitrogen on soils and water surfaces(kg N_2O-N/kg NH_3-N and NO_X-N)
$NEX_{LT,y}$	=	Annual average nitrogen excretion per head of a defined livestock population (kg N/animal/yr) estimated as described in appendix 2
$MS\%_j$	=	Fraction of manure handled in system *j* in the project activity (fraction)
$F_{gasMS,j,LT}$	=	Default values for nitrogen loss due to volatilisation of NH_3 and NO_X from manure management (fraction)
N_{LT}	=	Annual average number of animals of type *LT* ~~for the~~ in year *y* estimated as per equation (5(a)) or (5(b)) (number)

5.4.3.2. Option 2

$$E_{N20,D,y} = \sum_{j} EF_{N20,D,j} \times \sum_{m=1}^{12} (Q_{EM,m} \times [N]_{EM,m})$$ Equation (19)

$$E_{N20,ID,y} = EF_{N20,ID} \times \sum_{j,LT} F_{gasMS,j,LT} \times \sum_{m=1}^{12} (Q_{EM,m} \times [N]_{EM,m})$$ Equation (20)

Where:

$E_{N20,D,y}$	=	Direct N_2O emission in year *y* (kg N_2O-N/year)
$E_{N20,ID,y}$	=	Indirect N_2O emission in year *y* (kg N_2O-N/year)
$EF_{N20,D,j}$	=	Direct N_2O emission factor for the treatment system *j* of the manure management system (kg N_2O-N/kg N)
$Q_{EM,m}$	=	Monthly volume of the effluent mix entering the manure management system (m^3/month)
$[N]_{EM,m}$	=	Monthly total nitrogen concentration in the effluent mix entering the manure management system (kg N/m^3)
$EF_{N20,ID}$	=	Indirect N_2O emission factor for N_2O emissions from atmospheric deposition of nitrogen on soils and water surfaces (kg N_2O-N/kg NH_3-N and NO_X-N)
$F_{gasMS,j,LT}$	=	Default values for nitrogen loss due to volatilisation of NH_3 and NO_X from manure management (fraction)

48. Option 2 is the preferred option for estimating N_2O emissions since it is based on actual measurements. Project proponents should indicate in the PDD which option will be used and should continue with the selected option throughout the crediting period.

49. For subsequent treatment stages, the reduction of the nitrogen 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 nitrogen adjusted for the reduction from the previous treatment stages by multiplying by (1-R_N), where R_N is the relative reduction of nitrogen from the previous stage. The relative reduction (R_N) of nitrogen depends on the treatment technology and should be estimated in a conservative manner. Default values for different treatment technologies can be found in appendix 1 (values for TN).

5.4.4. Project emissions from use of heat and/or electricity ($PE_{elec/heat,y}$)

50. These emissions should only be considered for consumption of electricity or heat that is not related to the anaerobic digester, as those emissions will be considered while estimating $PE_{AD,y}$.

$$PE_{EC/FC,y} = PE_{EC,y} + \sum_j PE_{FC,j,y} \quad \text{Equation (21)}$$

Where:

$PE_{EC,y}$	=	Project emissions from electricity consumption in year *y*. The project emissions from electricity consumption will be calculated following the latest version of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption". In case, the electricity consumption is not measured then the electricity consumption shall be estimated as follows $EC_{PJ,y} = \sum_i CP_{i,y} \, x \, 8760$, where $CP_{i,y}$ is the rated capacity (in MW) of electrical equipment *i* used for the project activity
$PE_{FC,j,y}$	=	Project emissions from fossil fuel combustion in process *j* during the year *y*. The project emissions from fossil fuel combustion will be calculated following the latest version of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion". For this purpose, the processes *j* in the tool corresponds to all fossil fuel combustion in the AWMS (not including fossil fuels consumed for transportation of feed material and sludge or any other on-site transportation)

5.4.5. Project emissions from flaring or combustion of biogas in year *y* (t CO_2e) ($PE_{flare,y}$)

51. Project emissions from flaring are calculated following "TOOL06: Project emissions from flaring".

52. If the recovered biogas is flared or combusted for energy use (heat or electricity) within the project boundary, the methane destruction efficiency can be considered as 100%.

5.4.6. Project emissions from road transportation of manure and processed materials to the centralized plant *($PE_{TR,y}$)*

53. For cases involving a centralized treatment plant, project emissions from road transportation of manure and processed materials shall be calculated in accordance with methodological “TOOL12: Project and leakage emissions from transportation of freight.”

5.5. Leakage

54. Leakage covers the emissions from land application of treated manure as well as the emissions related to anaerobic digestion in a digester, occurring outside the project boundary. These emissions are estimated as net of those released under project activity and those released in the baseline scenario. Net leakage are only considered if they are positive.

$$LE_y = \left(LE_{PJ,N20,y} - LE_{BL,N20,y}\right) + \left(LE_{PJ,CH4,y} - LE_{BL,CH4,y}\right) + LE_{AD,y} \quad \text{Equation (22)}$$

Where:

$LE_{PJ,N20,y}$	=	Leakage N_2O emissions released during project activity from land application of the treated manure in year *y* (t CO_2e/yr)
$LE_{BL,N20,y}$	=	Leakage N_2O emissions released during baseline scenario from land application of the treated manure in year *y* (t CO_2e/yr)
$LE_{PJ,CH4,y}$	=	Leakage CH_4 emissions released during project activity from land application of the treated manure in year *y* (t CO_2e/yr)
$LE_{BL,CH4,y}$	=	Leakage CH_4 emissions released during baseline scenario from land application of the treated manure in year *y* (t CO_2e/yr)
$LE_{AD,y}$	=	Leakage emissions associated with the anaerobic digester in year *y* (t CO_2e)

5.5.1. Estimation of leakage N_2O emissions released during baseline scenario from land application of the treated manure in year *y*

$$LE_{BL,N20,y} = GWP_{N20} \times CF_{N20-N,N} \times \frac{1}{1000} \times \left(LE_{N20,land,y} + LE_{N20,runoff,y} + LE_{N20,vol,y}\right) \quad \text{Equation (23)}$$

$$LE_{N20,land,y} = EF_1 \times \prod_{n=1}^{N}\left(1 - R_{N,n}\right) \times \sum_{LT} NEX_{LT,y} \times N_{LT} \quad \text{Equation (24)}$$

$$LE_{N20,runoff,y} = EF_5 \times F_{leach} \times \prod_{n=1}^{N}\left(1 - R_{N,n}\right) \times \sum_{LT} NEX_{LT,y} \times N_{LT} \quad \text{Equation (25)}$$

$$LE_{N20,vol,y} = EF_4 \times \prod_{n=1}^{N} \left(1 - R_{N,n}\right) \times F_{gasm} \times \sum_{LT} NEX_{LT,y} \times N_{LT}$$ Equation (26)

Where:

GWP_{N20}	=	Global Warming Potential (GWP) for N_2O (t CO_2e/tN_2O)
$CF_{N20-N,N}$	=	Conversion factor N_2O-N to N_2O (44/28)
$LE_{N20,land,y}$	=	Leakage N_2O emissions from application of manure waste in year *y* (kg N_2O-N/year)
$LE_{N20,runoff,y}$	=	Leakage N_2O emissions due to leaching and run-off in year *y* (kg N_2O-N/year)
$LE_{N20,vol,y}$	=	Leakage N_2O emissions due to volatilisation in year *y* (kg N_2O-N/year)
F_{gasm}	=	Fraction of *N* lost due to volatilization (fraction)
N_{LT}	=	Annual average number of animals of type *LT* estimated as per equation (5(a)) or (5(b)) (number)
$NEX_{LT,y}$	=	Annual average nitrogen excretion per head of a defined livestock population (kg N/animal/year) estimated as described in appendix 2
EF_1	=	Emission factor for N_2O emissions from N inputs (kg N_2O-N/kg N input)
EF_5	=	Emission factor for N_2O emissions from N leaching and runoff in (kg N_2O-N/kg N leached and runoff)
EF_4	=	Emission factor for N_2O emissions from atmospheric deposition of N on soils and water surfaces, [kg N- N_2O/(kg NH_3-N + NO_X-N volatilized)]
F_{leach}	=	Fraction of all N added to/mineralised in managed soils in regions where leaching/runoff occurs that is lost through leaching and runoff (fraction)
$R_{N,n}$	=	Nitrogen reduction factor (fraction)

5.5.2. Estimation of leakage N_2O emissions released during project activity from land application of the treated manure in year *y*

$$LE_{PJ,N20} = GWP_{N20} \times CF_{N20-N,N} \times \frac{1}{1000} \times \left(LE_{N20,land,y} + LE_{N20,runoff,y} + LE_{N20,vol,y}\right)$$ Equation (27)

$$LE_{N20,land,y} = EF_1 \times \prod_{n=1}^{N} \left(1 - R_{N,n}\right) \times \sum_{LT} NEX_{LT,y} \times N_{LT}$$ Equation (28)

$$LE_{N20,runoff,y} = EF_5 \times F_{leach} \times \prod_{n=1}^{N} \left(1 - R_{N,n}\right) \times \sum_{LT} NEX_{LT,y} \times N_{LT}$$ Equation (29)

$$LE_{N20,vol} = EF_4 \times \prod_{n=1}^{N}\left(1 - R_{N,n}\right) \times F_{gasm} \times \sum_{LT} NEX_{LT,y} \times N_{LT}$$ Equation (30)

Where:

GWP_{N20}	=	Global Warming Potential (GWP) for N_2O (t CO_2e/tN_2O)
$CF_{N20-N,N}$	=	Conversion factor N_2O-N to N_2O (44/28)
$LE_{N20,land,y}$	=	Leakage N_2O emissions from application of manure waste in year *y* (kg N_2O-N/year)
$LE_{N20,runoff,y}$	=	Leakage N_2O emissions due to leaching and run-off in year *y* (kg N_2O-N/year)
$LE_{N20,vol}$	=	Leakage N_2O emissions due to volatilisation in year *y* (kg N_2O-N/year)
F_{gasm}	=	Fraction of *N* lost due to volatilization (fraction)
N_{LT}	=	Annual average number of animals of type *LT* estimated as per equation (5(a)) or (5(b)) (number)
$NEX_{LT,y}$	=	Annual average nitrogen excretion per head of a defined livestock population in year *y* (kg N/animal/year) estimated as described in appendix 2
EF_1	=	Emission factor for N_2O emissions from *N* inputs (kg N_2O-N/kg N input)
EF_5	=	Emission factor for N_2O emissions from *N* leaching and runoff in (kg N_2O-N/kg N leached and runoff)
EF_4	=	Emission factor for N_2O emissions from atmospheric deposition of *N* on soils and water surfaces, [kg N-N_2O/(kg NH_3-N + NO_X-N volatilized)]
F_{leach}	=	Fraction of all *N* added to/mineralised in managed soils in regions where leaching/runoff occurs that is lost through leaching and runoff (fraction)
$R_{N,n}$	=	Nitrogen reduction factor (fraction)

55. It is possible to measure the quantity of manure applied to land in kg manure/yr (Q_{DM}) and the nitrogen concentration in kg N/kg manure (N_{DM}) in the manure to estimate the total quantity of nitrogen applied to land. In this case, $\prod_{n=1}^{N}\left(1 - R_{N,n}\right) \times \sum_{LT} NEX_{LT,y} \times N_{LT}$ in equations (26), (27) and (28) above should be substituted by $Q_{DM} \times N_{DM}$.

5.5.3. Estimation of leakage CH_4 emissions from land application of the treated manure

56. The calculation of methane emissions from land application of manure in the baseline and project cases are estimated from equations (29) and (30) below:

$$LE_{BL,CH4,y} = GWP_{CH4} \times D_{CH4} \times MCF_d \times \left[\prod_{n=1}^{N}(1 - R_{VS,n})\right] \times \sum_{j,LT}\left(B_{0,LT} \times N_{LT} \times VS_{LT,y} \times MS\%_j\right)$$ Equation (31)

$$LE_{PJ,CH4,y} = GWP_{CH4} \times D_{CH4} \times MCF_d \times \left[\prod_{n=1}^{N}(1 - R_{VS,n})\right] \times \sum_{j,LT}\left(B_{0,LT} \times N_{LT} \times VS_{LT,y} \times MS\%_j\right)$$ Equation (32)

Where:

$LE_{BL,CH4,y}$	=	Leakage CH_4 emissions released during baseline scenario from land application of the treated manure in year *y* (t CO_2e/yr)
$LE_{PJ,CH4,y}$	=	Leakage CH_4 emissions released during project activity from land application of the treated manure in year *y* (t CO_2e/yr)
$R_{VS,n}$	=	Fraction of volatile solid degraded in AWMS treatment method *n* of the *N* treatment steps prior to sludge being treated
GWP_{CH4}	=	Global Warming Potential (GWP) of CH_4 (t CO_2e/tCH_4)
D_{CH4}	=	Density of CH_4 (t/m^3)
$B_{0,LT}$	=	Maximum methane producing potential of the volatile solid generated by animal type LT (m^3CH_4/kg dm)
N_{LT}	=	Annual average number of animals of type *LT* estimated as per equation (5(a)) or (5(b)), expressed (number)
$VS_{LT,y}$	=	Annual volatile solid excretions for livestock *LT* entering all AWMS on a dry matter weight basis (kg -dm/animal/yr)
$MS\%_j$	=	Fraction of manure handled in system *j* in the project activity (fraction)
MCF_d	=	Methane conversion factor (MCF) assumed to be equal to 1

5.5.4. Estimation of leakage emissions associated with the anaerobic digester

57. $LE_{AD,y}$ is determined using the methodological tool “Project and leakage emissions from anaerobic digesters”.

5.6. Emission reduction

58. The *ex ante* emission reductions ~~ER_y by the project activity during a given year *y* is the difference between the baseline emissions (BE_y) and the sum of project emissions (PE_y) and leakage,~~ are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y$$ Equation (33)

59. Since the project activity involves manure treatment systems with higher methane conversion factors (*MCF*) than those corresponding to the manure treatment systems used in the baseline situation, the *ex post* emission reductions are calculated as follows:

$$ER_{y,ex\,post} = min\left[\left(BE_{CH4,ex\,post} - PE_{y,ex\,post}\right), \left(MD_y - PE_y - LE_y\right)\right]$$ Equation (34)

Where:

$ER_{y,ex\ post}$	=	Ex post emission reductions in year *y* (t CO_2e)
$BE_{CH4y,ex\ post}$	=	Ex post baseline methane emissions (t CO_2e)
$PE_{y,ex\ post}$	=	Ex post project emissions (t CO_2e)
MD_y	=	Methane captured and destroyed by the project activity in year *y* (t CO_2e)

60. The amount of methane captured and destroyed *(MD_y)* shall be determined as follows:

$$MD_y = BG_{burnt,y} \times w_{CH4,y} \times D_{CH4} \times GWP_{CH4}$$ Equation (35)

Where:

$BG_{burnt,y}$	=	Volume of biogas flared or combusted at reference condition in year *y* (m^3)
$w_{CH4,y}$	=	Volume fraction of methane in biogas in year *y* (fraction)

5.7. Changes required for methodology implementation in 2nd and 3rd crediting periods

61. At the start of the second and third crediting period for a project activity, the continued validity of the baseline scenario shall be assessed by applying the latest version of the tool “Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period”.

5.8. Project activity under a programme of activities

62. In addition to the requirements set out in the latest approved version of the “Standard for demonstration of additionality, development of eligibility criteria and application of multiple methodologies for programme of activities”, the following shall be applied for the use of this methodology in a project activity under a programme of activities (PoAs).

63. The PoA may consist of one or several types of CPAs. CPAs are regarded to be of the same type if they are similar with regard to the demonstration of additionality, emission reduction calculations and monitoring. The coordination/managing Entity (CME) shall describe in the CDM-PoA-DD for each type of CPAs separately:

(a) Eligibility criteria for CPA inclusion used for each type of CPAs:

   (i) In case of different setups of animal waste management systems in one CPA, the eligibility criteria shall be defined for each setup of animal waste management system separately;

   (ii) Emission reduction calculations for each type of CPAs;

   (iii) Monitoring provisions for each type of CPAs.

64. The CME shall describe transparently and justify in the CDM-PoA-DD which CPAs are regarded to be of the same type. CPAs are *not* regarded to be of the same type if one of the following conditions is different:

    (a) The baseline scenario with regard to any of the following aspects:

        (i) The manure management system used in the baseline;

        (ii) The alternative scenarios for the use of gas generated from an anaerobic digester (biogas);

    (b) The project activity with regard to the animal waste management systems used and the use of the gas generated from an anaerobic digester (biogas): flaring, electricity generation or heat generation;

    (c) The legal and regulatory framework;

    (d) Type of animal manure.

65. For example, one type of CPAs may be characterized by the following combinations. The baseline scenario is the use of an uncovered anaerobic lagoon for manure treatment. Under the project activity, an anaerobic digester is used. The biogas from the digester is used to produce heat.

66. When defining eligibility criteria for CPA inclusion for a distinct type of CPAs, the CME shall consider relevant technical and economic parameters, such as:

    (a) Ranges of design specifications of baseline and project manure management systems (e.g. a range of average depths and surface areas of lagoons, electricity consumption, residence time of the organic matter and effluent adjustment factor);

    (b) Local conditions (temperature);

    (c) Ranges of capacity of biogas production;

    (d) Ranges of costs (capital investment in Greenfield manure management system, operating and maintenance costs, etc.);

    (e) Ranges of revenues (income from electricity or heat production, subsidies/fiscal incentives, ODA).

67. When Option (ii) in the latest approved version of the “Standard for demonstration of additionality, development of eligibility criteria and application of multiple methodologies for programmes of activities” is applied, that is related to defining technical and economic criteria as ranges of values for each input parameter required for the inclusion of the CPA in the PoA-DD, the eligibility criteria related to the costs and revenues parameters shall be updated every two years in order to correctly reflect the technical and market circumstances of a CPA implementation.

5.9. Data and parameters not monitored

68. All data collected as part of not monitored parameters or monitoring should be archived electronically and be kept at least for two years after the end of the last crediting period.

Data / Parameter table 1.

Data / Parameter:	$R_{VS,n}$
Data unit:	Fraction
Description:	Fraction of volatile solid degraded in AWMS treatment method *n* of the *N* treatment steps prior to waste being treated
Source of data:	Refer to appendix 1 (values for VS)
Measurement procedures (if any):	-
Any comment:	The **most conservative** value for the given technology must be used

Data / Parameter table 2.

Data / Parameter:	$EF_{N2O,\ D,j}$
Data unit:	kg N_2O-N/kg N
Description:	Direct N_2O emission factor for the treatment system *j* of the manure management system
Source of data:	Estimated with site-specific, regional or national data if such data is available, otherwise use default EF_3 from table 10.21, chapter 10, volume 4, in the 2019 Refinement to the IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Measurement procedures (if any):	-
Any comment:	-

Data / Parameter table 3.

Data / Parameter:	$EF_{N2O,ID}$
Data unit:	kg N_2O-N/kg NH3-N and NO_X-N
Description:	Indirect N_2O emission factor for N_2O emissions from atmospheric deposition of nitrogen on soils and water surfaces
Source of data:	Estimated with site-specific, regional or national data if such data is available. Otherwise, default values for EF_4 from table 11.3, chapter 11, volume 4 of the 2019 Refinement to the IPCC 2006 Guidelines for National Greenhouse Gas Inventories can be used
Measurement procedures (if any):	-
Any comment:	-

Data / Parameter table 4.

Data / Parameter:	$F_{gasMS,j,LT}$
Data unit:	Fraction
Description:	Default values for nitrogen loss due to volatilisation of NH_3 and NO_X from manure management
Source of data:	2019 Refinement to the IPCC 2006 Guidelines. Volume 4, Chapter 10 - Table 10.22

Measurement procedures (if any):	-
Any comment:	-

Data / Parameter table 5.

Data / Parameter:	$\mathbf{F_{gasm}}$
Data unit:	Fraction
Description:	Fraction of N lost due to volatilization
Source of data:	Estimated with site-specific, regional or national data if such data is available. Otherwise, default values from table 11.3, chapter 11, volume 4 of the 2019 Refinement to the IPCC 2006 guidelines can be used
Measurement procedures (if any):	-
Any comment:	-

Data / Parameter table 6.

Data / Parameter:	$\mathbf{EF_1}$, $\mathbf{EF_4}$, $\mathbf{EF_5}$
Data unit:	kg N_2O-N/kg N for EF_1, EF_5 and [kg N_2O-N/(kg NH_3-N and NO_X-N) for EF_4
Description:	Emission factor for N_2O emissions from *N* inputs; from *N* leaching and runoff; from atmospheric deposition of *N* on soils and water surfaces
Source of data:	Estimated with site-specific, regional or national data if such data is available
Measurement procedures (if any):	-
Any comment:	2019 Refinement to the IPCC 2006 Guidelines default values may be used, if country specific or region specific data are not available. EF_1 from table 11.1, chapter 11, volume 4. EF_4 and EF_5 from table 11.3, chapter 11, volume 4

Data / Parameter table 7.

Data / Parameter:	$\mathbf{F_{leach}}$
Data unit:	Fraction
Description:	Fraction of all N added to/mineralised in managed soils in regions where leaching/runoff occurs that is lost through leaching and runoff
Source of data:	Estimated with site-specific, regional or national data if such data is available. Otherwise, default values from table 11.3, chapter 11, volume 4 of the 2019 Refinement to the IPCC 2006 guidelines can be used
Measurement procedures (if any):	-
Any comment:	-

Data / Parameter table 8.

Data / Parameter:	**$MS\%_{Bl,j}$**
Data unit:	Fraction
Description:	Fraction of manure handled in system *j* in the baseline
Source of data:	Project proponents
Measurement procedures (if any):	-
Any comment:	-

Data / Parameter table 9.

Data / Parameter:	**GWP_{CH4}**
Data unit:	t CO_2e/t CH_4
Description:	Global warming potential of CH_4
Source of data:	IPCC
Measurement procedures (if any):	~~21 for the first commitment period~~ Default value of 25 from IPCC Fourth Assessment Report (AR4). Shall be updated according to any future COP/MOP decisions
Any comment:	-

Data / Parameter table 10.

Data / Parameter:	**GWP_{N2O}**
Data unit:	t CO_2e/tN_2O
Description:	Global warming potential for N_2O
Source of data:	IPCC
Measurement procedures (if any):	~~310 for the first commitment period~~ Default value of 298 from IPCC Fourth Assessment Report (AR4). Shall be updated according to any future COP/MOP decisions
Any comment:	-

Data / Parameter table 11.

Data / Parameter:	**D_{CH4}**
Data unit:	t/m^3
Description:	Density of CH_4
Source of data:	Technical literature
Measurement procedures (if any):	-
Any comment:	0.00067 t/m^3 at room temperature 20^{o}C and 1 atm pressure

Data / Parameter table 12.

Data / Parameter:	**MCF_d**
Data unit:	-

Description:	Methane conversion factor for leakage calculation assumed to be equal 1
Source of data:	-
Measurement procedures (if any):	-
Any comment:	-

Data / Parameter table 13.

Data / Parameter:	**MCF_j**
Data unit:	-
Description:	Methane conversion factor for the baseline AWMS$_j$
Source of data:	2019 Refinement to the IPCC 2006 table 10.17, chapter 10, volume 4 ~~(see appendix 3)~~
Measurement procedures (if any):	-
Any comment:	(a) MCF values depend on the annual average temperature where the anaerobic manure treatment facility in the baseline existed. For average annual temperatures below 10 ºC and above 5 ºC, a linear interpolation should be used to estimate the MCF value at the specific temperature assuming an MCF value of 0 at an annual average of 5 ºC. Future revisions to the IPCC Guidelines for National Greenhouse Gas Inventories should be taken into account; (b) A conservativeness factor should be applied by multiplying MCF values (estimated as per above bullet) with a value of 0.94, to account for the 20 per cent uncertainty in the MCF values as reported by IPCC ~~2006~~

Data / Parameter table 14.

Data / Parameter:	**$W_{default,LT}$**
Data unit:	Kg
Description:	Default average animal weight of a defined population
Source of data:	2019 Refinement to the IPCC 2006 ~~or US-EPA, whichever is lower~~ (Table 10A.5)
Measurement procedures (if any):	-
Any comment:	-

Data / Parameter table 15.

Data / Parameter:	**~~$VS_{default}$~~ $VS_{rate,LT,y}$**
Data unit:	~~kg -dm/animal/day~~ kg VS per 1,000 kg animal mass per day
Description:	~~Default value for the volatile solid excretion per day on a dry-matter basis for a defined livestock population~~ Daily volatile solid excretion rate per 1,000 kg animal mass for livestock type LT in year y

Source of data:	IPCC 2019 Refinement to the 2006 guidelines ~~or US-EPA, whichever is lower~~ (Table 10.13a)
Measurement procedures (if any):	-
Any comment:	-

Data / Parameter table 16.

Data / Parameter:	$N_{retention,LT,y}$
Data unit:	kg N retained/animal/yr
Description:	Portion of that *N* intake that is retained in the animal
Source of data:	~~Default values are reported in Table 10.20 in~~ 2019 Refinement to the IPCC 2006 guidelines, volume 4, chapter 10 (Table 10.20a)
Measurement procedures (if any):	-
Any comment:	This parameter is used to estimate $NEX_{LT,y}$ in appendix 2

Data / Parameter table 17.

Data / Parameter:	$NEX_{IPCCdefault}$
Data unit:	kg N/animal/year
Description:	Default value for the nitrogen excretion per head of a defined livestock population
Source of data:	IPCC 2019 Refinement to the 2006 guidelines ~~or US-EPA~~ (Table 10.19)
Measurement procedures (if any):	-
Any comment:	This parameter is used to estimate $NEX_{LT,y}$ in appendix 2

Data / Parameter table 18.

Data / Parameter:	$EF_{CO2,BL,HG,k}$
Data unit:	t CO_2/TJ
Description:	CO_2 emission factor of the fossil fuel type used for heat generation by equipment type *k* in the absence of the project activity
Source of data:	Actual measured or local data is to be used. If local data is not available, regional data should be used and, in its absence, IPCC default values can be used from the ~~latest version of~~2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Measurement procedures (if any):	-
Any comment:	If the measurement results differ significantly from previous measurements or other relevant data sources, conduct additional measurements. Double-checked against IPCC defaults (for consistency) if data is local or regional

Data / Parameter table 19.

Data / Parameter:	**$R_{N,n}$**
Data unit:	Fraction
Description:	Nitrogen reduction factor
Source of data:	Refer to appendix 1
Measurement procedures (if any):	-
Any comment:	Estimated from the table provided in appendix 1 (value for TN). The most conservative value for the given technology must be used

6. Monitoring methodology

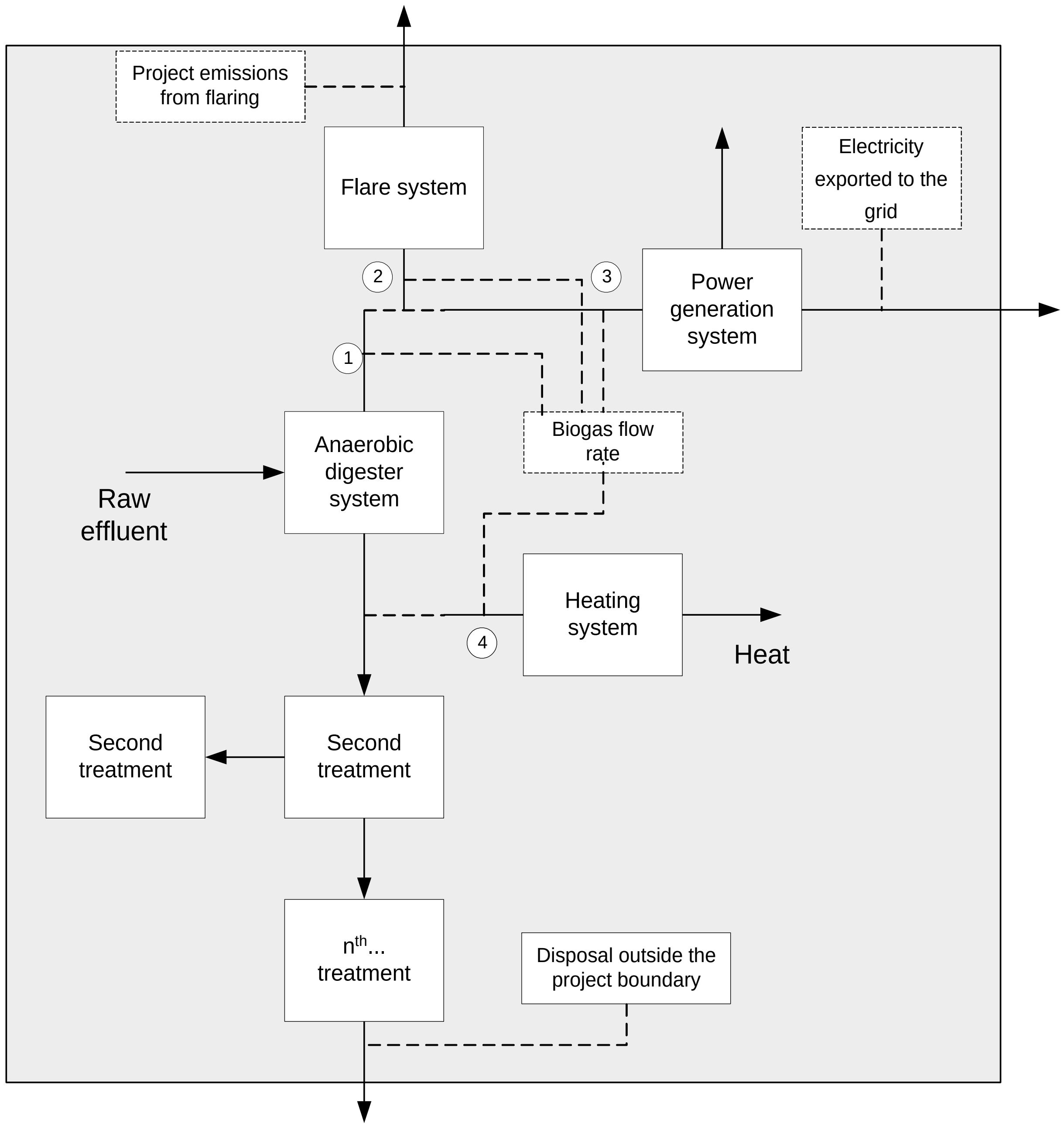
6.1. Monitoring procedures

69. In this methodology, monitoring comprises several activities.

70. 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.

71. Diagrammatic representation of animal waste management system existing on the project site prior to project implementation should be presented (an example is shown in Figure 2).

Figure 2. Flow diagram and biogas flow measurement points of project activity



6.2. Data and parameters monitored

Data / Parameter table 20.

Data / Parameter:	**MCF_{sl}**
Data unit:	Fraction
Description:	Methane conversion factor (MCF) for the sludge stored in sludge pits
Source of data:	2019 Refinement to the IPCC 2006 table 10.17, chapter 10, volume 4 (see appendix 3)
Measurement procedures (if any):	-
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	(a) For average annual temperatures below 10 °C and above 5 °C, a linear interpolation should be used to estimate the MCF value at the specific temperature assuming an MCF value of 0 at an annual average of 5 °C. Future revisions to the IPCC Guidelines for National Greenhouse Gas Inventories should be taken into account; (b) A conservativeness factor should be applied by multiplying MCF values (estimated as per above bullet) with a value of 0.94, to account for the 20 per cent uncertainty in the MCF values as reported by IPCC ~~2006~~

Data / Parameter table 21.

Data / Parameter:	**$B_{0,LT}$**
Data unit:	m^3CH_4/kg dm
Description:	Maximum methane producing potential of the volatile solid generated by animal type *LT*
Source of data:	This value varies by species and diet. ~~Where~~ IPCC default values ~~are~~ may be used from table 10.16a in,~~ they should be taken from tables 10A-4 through 10A-9 (~~IPCC 2019 Refinement to 2006 Guidelines for National Greenhouse Gas Inventories volume 4, chapter 10) specific to the ~~country~~region where the project is implemented. Developed countries $B_{0,LT}$ values can be used provided the following conditions are satisfied: (a) The genetic source of the production operations livestock originate from an Annex I Party; (b) The farm use formulated feed ratios (FFR) which are optimized for the various animal(s), stage of growth, category, weight gain/productivity and/or genetics; (c) The use of FFR can be validated (through on-farm record keeping, feed supplier, etc.); (d) The project specific animal weights are more similar to developed country IPCC default values. Directly measure $B_{0,LT}$ as per: (a) ISO 11734:1995; (b) ASTM E2170-01 (2008);and (c) ASTM D 5210-92

Measurement procedures (if any):	-
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	The value is taken from published sources. The parameter value should be updated on latest available public data source

Data / Parameter table 22.

Data / Parameter:	**Type**
Data unit:	-
Description:	Type of barn and AWMS
Source of data:	Project proponents
Measurement procedures (if any):	-
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	Barn and AWMS layout and configuration

Data / Parameter table 23.

Data / Parameter:	**CP**
Data unit:	%
Description:	Crude protein per cent
Source of data:	Project proponents
Measurement procedures (if any):	-
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	This parameter is used to estimate $NEX_{LT,y}$ in appendix 2

~~**Data / Parameter table 24.**~~

~~**Data / Parameter:**~~	~~**GE**~~
~~Data unit:~~	~~MJ/animal/day~~
~~Description:~~	~~Gross energy intake of the animal~~
~~Source of data:~~	~~Project proponents. Gross energy intake of the animal, in enteric model, based on digestible energy, milk production, pregnancy, current weight, mature weight, rate of weight gain, and IPCC constants~~
~~Measurement procedures (if any):~~	~~-~~
~~Monitoring frequency:~~	~~Annually~~
~~QA/QC procedures:~~	~~-~~
~~Any comment:~~	~~This parameter is used to estimate $NEX_{LT,y}$ in appendix 2~~

Data / Parameter table 25.

Data / Parameter:	**T**
Data unit:	^{o}C
Description:	Annual average ambient temperature at project site
Source of data:	Project proponents
Measurement procedures (if any):	-
Monitoring frequency:	Monthly
QA/QC procedures:	-
Any comment:	Used to select the annual MCF from IPCC ~~2006 guidelines~~

Data / Parameter table 26.

Data / Parameter:	**$EG_{d,y}$**
Data unit:	MWh
Description:	Electricity generated using biogas in year *y*
Source of data:	Project proponents
Measurement procedures (if any):	Archive electronically during project plus five years
Monitoring frequency:	Annual
QA/QC procedures:	Electricity meters will undergo maintenance/calibration subject to appropriate industry standards. The accuracy of the meter readings will be verified by receipts issued by the purchasing power company. Uncertainty of the meters to be obtained from the manufacturers. This uncertainty to be included in a conservative manner while calculating CERs and procedure for doing so should be described in the CDM-PDD
Any comment:	-

Data / Parameter table 27.

Data / Parameter:	**N_{da},LT**
Data unit:	Number
Description:	Number of days animal of type LT is alive in the farm in the year *y*
Source of data:	Project proponents
Measurement procedures (if any):	-
Monitoring frequency:	Monthly
QA/QC procedures:	-
Any comment:	The PDD should describe the system on monitoring the number of days the animal is alive in the farm. The consistency between the value and indirect information (records of sales, records of food purchases) should be assessed. This parameter is used in option 1 to calculate N_{LT}

Data / Parameter table 28.

Data / Parameter:	**$N_{p,LT}$**
Data unit:	Number
Description:	Number of animals of type *LT* present ~~annually for the~~ in year *y*
Source of data:	Project proponents
Measurement procedures (if any):	-
Monitoring frequency:	Monthly
QA/QC procedures:	-
Any comment:	The PDD ~~should~~shall describe the monitoring system ~~on monitoring~~for the number of heads of livestock ~~produced~~. The consistency between the value and indirect information (records of sales, records of food purchases) should be assessed. This parameter is used in Option 1 to calculate N_{LT}

Data / Parameter table 29.

Data / Parameter:	**$W_{site,LT}$**
Data unit:	kg
Description:	Average animal weight of a defined livestock population at the project site
Source of data:	Project proponents
Measurement procedures (if any):	-
Monitoring frequency:	Monthly
QA/QC procedures:	-
Any comment:	This parameter is used in equation 4 for estimating $VS_{LT,y}$ using option 3, and in equation 2 (appendix 2) for estimating $NEX_{LT,y}$ when using IPCC ~~2006~~ default values. Sampling procedures can be used ~~to estimate this variable~~, taking into account the following guidance: (a) To ensure representativeness, each defined livestock population should be classified into a minimum of three age categories; (b) For each defined livestock population, a minimum of one monthly sample per age category should be taken; (c) When estimating baseline emissions and emissions released during baseline scenario from land application of the treated manure in the leakage section, the lower bound of the 95% confidence interval obtained from the sampling measurements should be used; (d) When estimating project emissions and emissions released during project activity from land application of the treated manure in the leakage section, the upper bound of the 95% confidence interval obtained from the sampling measurements should be used. The PDD should describe the system of random sampling taking into account stratification of each livestock population into a minimum of three weight categories as described above

Data / Parameter table 30.

Data / Parameter:	**F_{Aer}**
Data unit:	Fraction
Description:	Fraction of volatile solids directed to aerobic treatment
Source of data:	-
Measurement procedures (if any):	-
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 31.

Data / Parameter:	**V_f**
Data unit:	m^3
Description:	Biogas flow
Source of data:	Project proponents
Measurement procedures (if any):	-
Monitoring frequency:	Continuously by flow meter and reported cumulatively on weekly basis
QA/QC procedures:	Flow meters will undergo maintenance/calibration subject to appropriate industry standards. The frequency of calibration and control procedures would be different for each application. This maintenance/calibration practice should be clearly stated in the CDM-PDD
Any comment:	The biogas flow will be measured at four points, as shown in the figure. But if the project participants can demonstrate that leakage in distribution pipeline is zero, it need be measured at any three points. The biogas flow to electricity or heat equipment in a moment can be considered destroyed, by monitoring that the equipment was working at this time

Data / Parameter table 32.

Data / Parameter:	**N_{DM}**
Data unit:	kg N/KG effluent
Description:	N concentration in disposed manure
Source of data:	Project proponents
Measurement procedures (if any):	-
Monitoring frequency:	Every batch disposed
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 33.

Data / Parameter:	**Q_{DM}**
Data unit:	kg
Description:	Mass of manure disposed outside project boundary
Source of data:	Project proponents
Measurement procedures (if any):	-
Monitoring frequency:	Every batch disposed
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 34.

Data / Parameter:	**$MS\%_j$**
Data unit:	Fraction
Description:	Fraction of manure handled in system *j* in the project activity
Source of data:	Project proponents
Measurement procedures (if any):	-
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 35.

Data / Parameter:	**$NEX_{LT,y}$**
Data unit:	kg N/animal/year
Description:	Annual average nitrogen excretion per head of a defined livestock population estimated as described in appendix 2
Source of data:	Refer to appendix 2
Measurement procedures (if any):	-
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	When using equation 2 in appendix 2, please refer to above guidance for estimating $W_{site,LT}$

Data / Parameter table 36.

Data / Parameter:	**GE_{LT}**
Data unit:	MJ/animal/day
Description:	Daily average gross energy intake
Source of data:	Monitored by ~~P~~project proponents
Measurement procedures (if any):	-

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

Data / Parameter table 37.

Data / Parameter:	**DE_{LT}**
Data unit:	%
Description:	Digestible energy of the feed in per cent
Source of data:	2019 Refinement to IPCC 2006, table 10.2 (higher bound values shall be used)
Measurement procedures (if any):	-
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	~~IPCC 2006:~~ Typically 45-55 per cent for low quality forages

Data / Parameter table 38.

Data / Parameter:	**UE**
Data unit:	Fraction of GE_{LT}
Description:	Urinary energy
Source of data:	Typically $0.04GE_{LT}$ 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
Measurement procedures (if any):	-
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 39.

Data / Parameter:	**ASH**
Data unit:	Fraction of the dry matter feed intake
Description:	Ash content of the manure
Source of data:	Use country-specific values where available
Measurement procedures (if any):	-
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-

~~**Data / Parameter table 40.**~~

~~**Data / Parameter:**~~	~~ED_{LT}~~
~~Data unit:~~	~~MJ/kg~~
~~Description:~~	~~Energy density of the feed fed to livestock type *LT*~~
~~Source of data:~~	~~Measured in laboratory based on local or international standards or IPCC default (18.45MJ/kg -dm)~~
~~Measurement procedures (if any):~~	~~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:~~	~~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~~

Data / Parameter table 41.

Data / Parameter:	$N_{AA,LT}$
Data unit:	-
Description:	Daily stock of animals in the farm, discounting dead and discarded animals
Source of data:	Daily counting of alive animals in the farm, discounting dead animals and animals discarded from the productive process from the daily stock
Measurement procedures (if any):	-
Monitoring frequency:	Daily
QA/QC procedures:	-
Any comment:	The PDD should describe the system for monitoring stock of animals

Data / Parameter table 42.

Data / Parameter:	$W_{LT,y}$
Data unit:	kg
Description:	Average animal weight of a defined livestock population in year y
Source of data:	Monitored in each farm included in the project activity. Alternatively, default values from 2019 Refinement to 2006 IPCC guidelines (table 10A.5) may be used
Measurement procedures (if any):	Sampling procedures can be used, taking into account the following guidance: a) To ensure representativeness, each defined livestock population should be classified into a minimum of three age categories; b) For each defined livestock population, a minimum of one monthly sample per age category should be taken; c) When estimating baseline emissions and emissions released during baseline scenario from land application of the treated manure in the leakage section, the lower bound

	of the 95% confidence interval obtained from the sampling measurements should be used; d) When estimating project emissions and emissions released during project activity from land application of the treated manure in the leakage section, the upper bound of the 95% confidence interval obtained from the sampling measurements should be used
Monitoring frequency:	
QA/QC procedures:	-
Any comment:	When using IPCC default values, low productivity values shall be applied

Data / Parameter table ~~42.~~ 43.

Data / Parameter:	**nd_y**
Data unit:	Number
Description:	Number of days treatment plant was operational in year *y*
Source of data:	Project proponents
Measurement procedures (if any):	-
Monitoring frequency:	Daily
QA/QC procedures:	-
Any comment:	-

Data / Parameter table ~~43.~~ 44.

Data / Parameter:	**$Q_{EM,m}$**
Data unit:	m^3/month
Description:	Monthly volume of the effluent mix entering the central treatment plant
Source of data:	Project proponents
Measurement procedures (if any):	Using flow meters
Monitoring frequency:	This parameter shall be continuously monitored
QA/QC procedures:	Flow meters will undergo maintenance/calibration subject to appropriate industry standards. This maintenance/calibration practice should be clearly stated in the CDM-PDD
Any comment:	This parameter shall be monitored by continuous flow meters installed after the effluent admittance point or after the equalization tanks (if existent)

Data / Parameter table ~~44.~~ 45.

Data / Parameter:	**$[N]_{EM,m}$**
Data unit:	kg N/m3
Description:	Monthly total nitrogen concentration in the effluent mix entering the central treatment plant
Source of data:	Project proponents

Measurement procedures (if any):	-
Monitoring frequency:	Weekly aggregated for monthly average
QA/QC procedures:	Sample collection procedures shall be performed as described in appendix 5. Total nitrogen determination should be performed according to the guidance provided in appendix 4
Any comment:	The effluent mix shall be collected after the effluent admittance point or after the equalization tanks (if existent)

Data / Parameter table ~~45.~~ 46.

Data / Parameter:	**$HG_{PJ,k,y}$**
Data unit:	TJ/yr
Description:	Net quantity of heat with biogas by equipment type *k* in the project *t* in year *y*
Source of data:	Measured from the heat received by the heated process; else Calculated on the basis of measurement of the volume of biogas captured and used for heat generation by each heat generation equipment type *k* multiplied by the methane content of the gas, net calorific value of methane, and the efficiency of heat generation equipment type *k* during the project (i.e. with biogas)
Measurement procedures (if any):	Amount of methane in the biogas is determined using the “Tool to determine the mass flow of a greenhouse gas in gaseous stream”. For the gaseous stream the tool shall be applied to is the biogas delivery pipeline to each item of heat generation equipment *k*
Monitoring frequency:	Monitored daily
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 47.

Data / Parameter:	**$BG_{burnt,y}$**
Data unit:	m^3
Description:	Biogas volume in year *y* at reference condition
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:	Correct to 0 ºC and 1 atm

Data / Parameter table 48.

Data / Parameter:	**w_{CH4}**
Data unit:	%
Description:	Volume fraction of methane in biogas in 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"
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	In case measured, correct to 0 ºC and 1 atm

Appendix 1. Anaerobic unit process performance

Figure.

Table 8-10. Anaerobic Unit Process Performance

Anaerobic Treatment	HRT	COD	TS	VS	TN	P	K
	days	Percent 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

Source: US-EPA 2001: Development Document for the Proposed Revisions to the National Pollutant Discharge Elimination System Regulation and the Effluent Guidelines for Concentrated Animal Feeding Operations.

Appendix 2. Procedure for estimating $NEX_{LT,y}$

1. Option 1

$$NEX_{LT,y} = N_{intake,LT,y} \times (1 - N_{retention,LT,y}) \times nd_y \qquad \text{Equation (1)}$$

Where:

$N_{intake,LT,y}$	=	Daily *N* intake per animal (kg N/animal/yr)
$N_{retention,LT,y}$	=	Portion of that *N* intake that is retained in the animal (kg N retained/animal/yr)
nd_y	=	Number of days treatment plant was operational in year *y*

$N_{intake,LT,y}$ may be calculated using: $N_{intake,LT,y} = \left(\frac{GE_{LT,y}}{18.45}\right) \times \left(\frac{CP_{LT,y}/100}{6.25}\right)$ Equation (1a)

Where:

$CP_{LT,y}$	=	Crude per cent of protein (per cent)
$GE_{LT,y}$	=	Gross energy intake of the animal (MJ/animal/day^{-})
18.45	=	Conversion factor for dietary GE_{LT} per kg of dry matter (MJ/kg). This value is relatively constant across a wide range of forage and grain-based feeds commonly consumed by livestock
6.25	=	Conversion from kg of dietary protein to kg of dietary *N*, kg feed protein (kg N)$^{-1}$

2. Option 2

1. In the absence of availability of project specific information on protein intake, which should be justified in the CDM-PDD, national or regional data should be used for the nitrogen excretion $NEX_{LT,y}$, if available. In the absence of such data, default values from table 10.19 of the 2019 Refinement to the IPCC 2006 Guidelines, volume 4, chapter 10) may be used and should be corrected for the animal weight at the project site in the following way:

$$NEX_{LT,y} = \frac{W_{site}}{W_{default}} \times NEX_{IPCC\ default} \qquad \text{Equation (2)}$$

Where:

$NEX_{LT,y}$	=	Annual average nitrogen excretion per head of a defined livestock population (kg N/animal/yr)
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 (kg)
$NEX_{IPCC\ default}$	=	Default value for the nitrogen excretion per head of a defined livestock population (kg N/animal/year)

~~Appendix 3. Table 10.17 of IPCC 2006~~

TABLE 10.17
MCF VALUES BY TEMPERATURE FOR MANURE MANAGEMENT SYSTEMS

System[a]		MCFs by Average Annual Temperature (°C)																			Source and Comments
		Cool					Temperate												Warm		
		≤ 10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	≥ 28	
Pasture/Range/Paddock		1.0%					1.5%											2.0%			Judgement of IPCC Expert Group in combination with Hashimoto and Steed (1994).
Daily Spread		0.1%					0.5%											1.0%			Hashimoto and Steed (1993).
Solid Storage		2.0%					4.0%											5.0%			Judgement of IPCC Expert Group in combination with Amon, et. al (2001), which shows emissions of approximately 2% in winter and 4% in summer. Warm climate is based on judgement of IPCC Expert Group and Amon, et. al (1998).
Dry Lot		1.0%					1.5%											2.0%			Judgement of IPCC Expert Group in combination with Hashimoto and Steed (1994).
Liquid/Slurry	With natural crust cover	10%	11%	13%	14%	15%	17%	18%	20%	22%	24%	26%	29%	31%	34%	37%	41%	44%	48%	50%	Judgement of IPCC Expert Group in combination with Mangino et. al (2001) and Sommer (2000). The estimated reduction due to the crust cover (40%) is an annual average value based on a limited data set and can be highly variable dependent on temperature, rainfall, and composition. When slurry tanks are used as fed-batch storage/digesters, MCF should be calculated according to Formula 1.
	Without natural crust cover	17%	19%	20%	22%	25%	27%	29%	32%	35%	39%	42%	46%	50%	55%	60%	65%	71%	78%	80%	Judgement of IPCC Expert Group in combination with Mangino et. al (2001). When slurry tanks are used as fed-batch storage/digesters, MCF should be calculated according to Formula 1.

TABLE 10.17 (CONTINUED)
MCF VALUES BY TEMPERATURE FOR MANURE MANAGEMENT SYSTEMS

System[a]		MCFs by Average Annual Temperature (°C)																			Source and Comments
		Cool					Temperate											Warm			
		≤ 10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	≥ 28	
Uncovered Anaerobic Lagoon		66%	68%	70%	71%	73%	74%	75%	76%	77%	77%	78%	78%	78%	79%	79%	79%	79%	80%	80%	Judgement of IPCC Expert Group in combination with Mangino et. al (2001). Uncovered lagoon MCFs vary based on several factors, including temperature, retention time, and loss of volatile solids from the system (through removal of lagoon effluent and/or solids).
Pit Storage below animal confinements	< 1 month	3%					3%											30%			Judgement of IPCC Expert Group in combination with Moller, et. al (2004) and Zeeman (1994). Note that the ambient temperature, not the stable temperature is to be used for determining the climatic conditions. When pits used as fed-batch storage/digesters, MCF should be calculated according to Formula 1.
	> 1 month	17%	19%	20%	22%	25%	27%	29%	32%	35%	39%	42%	46%	50%	55%	60%	65%	71%	78%	80%	Judgement of IPCC Expert Group in combination with Mangino et. al (2001). Note that the ambient temperature, not the stable temperature is to be used for determining the climatic conditions. When pits used as fed-batch storage/digesters, MCF should be calculated according to Formula 1.

Appendix 4. Determination of total nitrogen in animal waste

1. Definitions

(a) Ammoniacal nitrogen (total ammonia): Both NH_3 and NH_4 nitrogen compounds;

(b) Ammonia nitrogen: A gaseous form of ammoniacal nitrogen;

(c) Ammonium nitrogen: The positively ionized (cation) form of ammoniacal nitrogen;

(d) Total Kjeldahl nitrogen: The sum of organic nitrogen and ammoniacal nitrogen;

(e) Nitrate nitrogen: The negatively ionized (anion) form of nitrogen that is highly mobile;

(f) Total nitrogen: The summation of nitrogen from all the various nitrogen compounds listed above.

2. Principles and guidelines for total nitrogen determination

1. Total Kjeldahl nitrogen (TKN) can be an accurate predictor of total *N* content, because the inorganic *N* content in manure generally is very small when compared to the total *N* content (Paul and Beauchamp, 1993; Eghball, 2000).

2. Total Kjeldahl nitrogen is a wet oxidation procedure used to determine the organic *N* present as NH_3 in soils, plants and organic residues, such as manure. The three main steps of the Kjeldahl method are: (1) digestion, (2) separation of ammonia, and (3) determination of ammonia. In some techniques the separation stage is omitted and the ammonia is determined directly on the digest. Separation of ammonia may be effected by steam distillation, aeration, or diffusion, steam distillation being conventional. With automated procedures this separation step is invariably omitted (Fleck, 1969).

3. The determination of ammonia may be by: (1) simple titration, (2) iodometric methods, (3) coulometric methods or (4) colorimetric methods. Without separation of ammonia from the digest simple titration cannot be utilized (Fleck, 1969).

4. The remaining three techniques can, however, be applied directly to the digest. Iodometric and analogous methods have disadvantages (McKenzie & Wallace, 1954 APUD Fleck, 1969) and are not popular. Coulometric methods are not widely applied. Colorimetry remains as the only well-tried approach for automation (Fleck, 1969).

5. The three popular colorimetric methods of NH_3, determination are: ninhydrin, Nessler, and the phenol-hypochlorite or Berthelot reaction. The ninhydrin method has been successfully applied following sealed-tube digestion (Jacobs, 1965 APUD Fleck, 1969). The Nessler method, although excellent for simple aqueous ammonia solutions, is not advisable when ammonia is to be determined in Kjeldahl digestion mixtures (Fleck & Munro, 1965 APUD Fleck, 1969).

6. The most important aspect of the Kjeldahl method is digestion, which may be carried out in an open tube or in a sealed tube. The critical factors are: (I) temperature,(2)catalyst, (3) time, (4) reflux and (5) decomposition of the ammonia-catalyst complex. The optimum

temperature for sealed-tube digestion is in the region of 450ºC and the main advantage is that no catalyst or other additions are required.

7. The more commonly utilized open-tube digestion requires a temperature close to 400°C for adequate decomposition of nitrogenous compounds to ammonia. The evidence for this is clear (Bradstreet, 1965; Fleck & Munro, 1965 APUD Fleck, 1969), as is the evidence that the only satisfactory means of attaining this temperature is to add the appropriate amounts of K2SO4. When the temperature exceeds 400°C the digest solidifies on cooling (Bradstreet, 1957 APUD Fleck, 1969). This is an important practical point because temperatures in excess of 400ºC lead to loss of nitrogen (as well as loss of acid which leads to the solid cold digest).

8. With regard to the catalyst, mercury is indicated as the only 'safe' catalyst, with which no losses have been reported (Bradstreet, 1965; Fleck & Munro, 1965APUD Fleck, 1969). The disadvantage of mercury is that it forms a mercury-ammonium complex which must be decomposed before determining ammonia. This decomposition may be achieved by using sodium thiosulphate or zinc dust (Fleck, 1969).

9. The use of oxidizing can cause loss of nitrogen (Peters & Van Slyke, 1932). There the use of such agents is not recommended for the purposes of the project activities employing this methodology.

10. For manual determination project proponents shall follow the protocol depicted below (adapted from Mendham et al., 2002):

(a) Homogenize manure sample through intense agitation;

(b) Before sample precipitates pipette a certain volume (*a* mL) which contains approximately 0.04 g of nitrogen (based on previous experience) and transfer it to a long-necked Kjeldahl digestion tube;

(c) Add 0.7 g mercury oxide (II), 15 gof potassium sulfate and 40 mL of concentrated sulfuric acid;

(d) Gently heat the digestion tube, keeping it slightly tilted. Frothing may occur. If needed frothing may be controlled through the use of anti-frothing agents;

(e) Once frothing ceases, boil reagents during two hours;

(f) After cooling add 200 mL of water and 25 mL of sodium thiosulphate solution (0.5 M). Perform this step under agitation;

(g) Add a few glass beads to the mixture;

(h) Carefully introduce in the digestion tube a sodium hydroxide solution (11 M). Before mixing the reagents, connect the digestion tube to a distillation apparatus (see figure below). Keep the outlet of the condenser immersed into a known volume of 0.1 M HCl solution. Be certain that the contents of the digestion tube are well mixed;

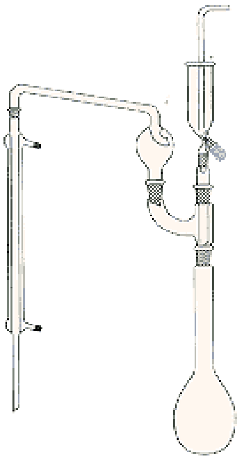
(i) Boil until the 150 mL of the distilled liquid has been collected in the receptor tube;

(j) Add indicator Methyl Red to the receptor tube. Titrate with 0.1 M NaCl (*b* mL). Titrate a blank using the same volume of 0.1 M HCl (*c* mL).

11. With the quantities and concentrations of reagents provided above, the nitrogen concentration in the sample (kg N/m^3) is given as follows:

$$[N] = \frac{(c-b) \times 0.1 \times 14}{a} \times 10^3 \qquad \text{Equation (1)}$$

Figure. Assembly of the Kieldahl apparatus



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Appendix 5. Guidance on sample extraction and statistical procedures

1. For the purposes of the essays described in appendix 2 and 3, project participants shall observe the following guidance on sample extraction procedure:

   (a) For liquid material, samples should be preferably collected using continuous-flow samples at the entrance or exit point of the pertinent treatment stage;

   (b) Samples should be collected in clean wide-mouth glass bottles;

   (c) Samples should be analysed as soon as possible. If samples need to be stored, storage shall be performed at 4ºC;

   (d) It should be checked that the suspended matter does not adhere to the walls, prior to the analysis procedure;

   (e) If results must be expressed in a dry matter basis, dry matter content shall be determined after oven-drying at 103°C for 24 hours or until constant weight is obtained;

   (f) Uncertainty range shall not exceed 20 per cent under a 90 per cent confidence interval, which is calculated as depicted in the formula below:

$$\bar{x} \pm \frac{t \; x \; s}{\sqrt{n}}$$ Equation (1)

Where:

$\bar{x}$	=	Sample average
t	=	*t* student value for *n*– – 1 (v) degrees of freedom (see table on the next page)
s	=	Sample standard deviation
n	=	Number of samples

Table. Values for t-distributions with v degrees of freedom for a range of one-sided confidence intervals

Values for t-distributions with v degrees of freedom for a range of one-sided confidence intervals											
v	**75%**	**80%**	**85%**	**90%**	**95%**	**97.5%**	**99%**	**99.5%**	**99.75%**	**99.9%**	**99.95%**
1	1.000	1.376	1.963	3.078	6.314	12.71	31.82	63.66	127.3	318.3	636.6
2	0.816	1.061	1.386	1.886	2.920	4.303	6.965	9.925	14.09	22.33	31.60
3	0.765	0.978	1.250	1.638	2.353	3.182	4.541	5.841	7.453	10.21	12.92
4	0.741	0.941	1.190	1.533	2.132	2.776	3.747	4.604	5.598	7.173	8.610
5	0.727	0.920	1.156	1.476	2.015	2.571	3.365	4.032	4.773	5.893	6.869
6	0.718	0.906	1.134	1.440	1.943	2.447	3.143	3.707	4.317	5.208	5.959
7	0.711	0.896	1.119	1.415	1.895	2.365	2.998	3.499	4.029	4.785	5.408
8	0.706	0.889	1.108	1.397	1.860	2.306	2.896	3.355	3.833	4.501	5.041
9	0.703	0.883	1.100	1.383	1.833	2.262	2.821	3.250	3.690	4.297	4.781
10	0.700	0.879	1.093	1.372	1.812	2.228	2.764	3.169	3.581	4.144	4.587
11	0.697	0.876	1.088	1.363	1.796	2.201	2.718	3.106	3.497	4.025	4.437
12	0.695	0.873	1.083	1.356	1.782	2.179	2.681	3.055	3.428	3.930	4.318
13	0.694	0.870	1.079	1.350	1.771	2.160	2.650	3.012	3.372	3.852	4.221
14	0.692	0.868	1.076	1.345	1.761	2.145	2.624	2.977	3.326	3.787	4.140
15	0.691	0.866	1.074	1.341	1.753	2.131	2.602	2.947	3.286	3.733	4.073
16	0.690	0.865	1.071	1.337	1.746	2.120	2.583	2.921	3.252	3.686	4.015
17	0.689	0.863	1.069	1.333	1.740	2.110	2.567	2.898	3.222	3.646	3.965
18	0.688	0.862	1.067	1.330	1.734	2.101	2.552	2.878	3.197	3.610	3.922

Values for t-distributions with v degrees of freedom for a range of one-sided confidence intervals											
19	0.688	0.861	1.066	1.328	1.729	2.093	2.539	2.861	3.174	3.579	3.883
20	0.687	0.860	1.064	1.325	1.725	2.086	2.528	2.845	3.153	3.552	3.850
21	0.686	0.859	1.063	1.323	1.721	2.080	2.518	2.831	3.135	3.527	3.819
22	0.686	0.858	1.061	1.321	1.717	2.074	2.508	2.819	3.119	3.505	3.792
23	0.685	0.858	1.060	1.319	1.714	2.069	2.500	2.807	3.104	3.485	3.767
24	0.685	0.857	1.059	1.318	1.711	2.064	2.492	2.797	3.091	3.467	3.745
25	0.684	0.856	1.058	1.316	1.708	2.060	2.485	2.787	3.078	3.450	3.725
26	0.684	0.856	1.058	1.315	1.706	2.056	2.479	2.779	3.067	3.435	3.707
27	0.684	0.855	1.057	1.314	1.703	2.052	2.473	2.771	3.057	3.421	3.690
28	0.683	0.855	1.056	1.313	1.701	2.048	2.467	2.763	3.047	3.408	3.674
29	0.683	0.854	1.055	1.311	1.699	2.045	2.462	2.756	3.038	3.396	3.659
30	0.683	0.854	1.055	1.310	1.697	2.042	2.457	2.750	3.030	3.385	3.646
40	0.681	0.851	1.050	1.303	1.684	2.021	2.423	2.704	2.971	3.307	3.551
50	0.679	0.849	1.047	1.299	1.676	2.009	2.403	2.678	2.937	3.261	3.496
60	0.679	0.848	1.045	1.296	1.671	2.000	2.390	2.660	2.915	3.232	3.460
80	0.678	0.846	1.043	1.292	1.664	1.990	2.374	2.639	2.887	3.195	3.416
100	0.677	0.845	1.042	1.290	1.660	1.984	2.364	2.626	2.871	3.174	3.390
120	0.677	0.845	1.041	1.289	1.658	1.980	2.358	2.617	2.860	3.160	3.373
∞	0.674	0.842	1.036	1.282	1.645	1.960	2.326	2.576	2.807	3.090	3.291

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Document information

Version	*Date*	*Description*
09.0	30 September 2025	MP 98, Annex 1 • A call for input will be issued for this draft document. If no input is received, the draft document will be considered by the Board at EB 126. • Revision to address fugitive methane emissions from biogas digesters and incorporate updated methods by the IPCC.
08.0	4 October 2013	EB 75, Annex 14 The revision: • Removes requirements for specific case CPA-DDs and frequency of updating of eligibility criteria as these requirements are specified in the relevant standards; • Changes the title from “ACM0010: Consolidated baseline methodology for GHG emission reductions from manure management systems” to “ACM0010: GHG emission reductions from manure management systems.
07.0.0	13 September 2012	EB 69, Annex 18 The revision: • Expands the applicability of the methodology to include Greenfield facilities; • Simplifies the procedures to estimate baseline emissions associated with heat generation.
06.0.0	20 July 2012	EB 68, Annex 13 The revision: • Adds a reference to methodological tools; • Improves the clarity of the language and provides an additional option to estimate project N_2O emissions; • Introduces provisions for the use of this methodology in a project activity under a PoA.
05	26 September 2008	EB 42, Annex 8 • Addition of sampling procedures to estimate the animal weight; • Equation 1 in annex 2 was amended to keep unit consistency with equation 1a.
04.1	16 May 2008	EB 39, Paragraph 22 “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” replaces the withdrawn “Tool to calculate project emissions from electricity consumption”.

Version	*Date*	*Description*
04	16 May 2008	EB 39, Annex 5 • Inclusion of new formula to determine the annual average number of animals (N_{LT}); • Reformat of the graphic in the monitoring section showing the points where the gas has to be measured.
03	19 October 2007	EB 35, Annex 9 Incorporation to the methodology of the following tools: • Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion; • Tool to calculate project emissions from electricity consumption. Addition of the formula to determine the annual average number of animals (N_{LT}).
02	15 December 2006	EB 28, Annex 12 • Inclusion of the “Tool to determine project emissions from flaring gases containing methane”; • Replace of emissions Project emissions from flaring of the residual gas stream.
01	29 September 2006	EB 26, Annex 11 Initial adoption.

Decision Class: Regulatory
Document Type: Standard
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