CLEAN DEVELOPMENT MECHANISM

CDM-MP78-A04

Draft Large-scale Consolidated Methodology

ACM0001: Flaring or use of landfill gas

Version 19.0

Sectoral scope(s): 01 and 13

United Nations
Framework Convention on
Climate Change

COVER NOTE

1. Procedural background

1. The Executive Board of the clean development mechanism (CDM) (hereinafter referred to as the Board), at its 101st meeting approved the new methodological tool "Positive lists of technologies" that contain list of technologies and associated conditions that confer automatic additionality to CDM project activities and Programme of Activities (PoAs).

2. The current version of "TOOL32: Positive lists of technologies" contains lists of technologies and associated conditions for (a) Landfill gas recovery and its gainful use; and (b) Methane recovery in wastewater treatment, from following methodologies;

   (a) ACM0001: Flaring or use of landfill gas (ACM0001);

   (b) ACM0014: Treatment of wastewater (ACM0014);

   (c) AMS-III.G: Landfill methane recovery (AMS-III.G) and

   (d) AMS-III.H: Methane recovery in wastewater treatment (AMS-III.H).

2. Purpose

3. The purpose of the draft revision is to:

   (a) Avoid duplication of requirements for simplified additionality demonstration procedures already included in TOOL32;

   (b) Harmonize simplified procedures for additionality demonstration.

3. Key issues and proposed solutions

4. The proposed revision to ACM0001 will simplify the process for updating positive lists within the methodology.

4. Impacts

5. The revision of the methodology will avoid duplication of requirements for simplified additionality demonstration procedures included in TOOL32.

5. Subsequent work and timelines

6. The MP, at its 78th meeting, agreed to seek public inputs on the draft methodology. If inputs are received, the inputs will be taken into account when preparing the recommendation to the Board. If no inputs are received, the draft methodology is recommended by the MP for consideration by the Board at a future meeting. No further work is envisaged.

6. Recommendations to the Board

7. If no inputs are received during the call for public input, the MP recommends that the Board adopt this draft methodology, to be made effective at the time of the Board's approval. If inputs are received, this section is not applicable.

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1. Introduction

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

Table 1. Methodology key elements

Typical projects	Capture of landfill gas (LFG) and its flaring and/or use to produce energy and/or use to supply consumers
Type of GHG emissions mitigation action	GHG destruction: Destruction of methane emissions and displacement of a more-GHG-intensive service

2. Scope, applicability, and entry into force

2.1. Scope

2. This methodology applies to project activities that include the destruction of methane emissions and displacement of a more-GHG-intensive service by capturing landfill gas from the landfill site and/or flaring and/or using to produce energy (i.e. electricity, thermal energy); and/or using to supply consumers through natural gas distribution network**,** dedicated pipeline or trucks.

2.2. Applicability

3. The methodology is applicable under the following conditions:

(a) Install a new LFG capture system in an existing or new (Greenfield) SWDS where no LFG capture system was or would have been installed prior to the implementation of the project activity; or

(b) Make an investment into an existing LFG capture system to increase the recovery rate or change the use of the captured LFG, provided that:

(i) The captured LFG was vented or flared and not used prior to the implementation of the project activity; and

(ii) In the case of an existing active LFG capture system for which the amount of LFG cannot be collected separately from the project system after the implementation of the project activity and its efficiency is not impacted on by the project system: historical data on the amount of LFG capture and flared is available;

(c) Flare the LFG and/or use the captured LFG in any (combination) of the following ways:

(i) Generating electricity;

(ii) Generating heat in a boiler, air heater or kiln (brick firing only) or glass melting furnace;[1] and/or

[1] For claiming emission reductions for other heat generation equipment (including other products in kilns), project participants may submit a revision to this methodology.

(iii) Supplying the LFG to consumers through a natural gas distribution network;

(iv) Supplying compressed/liquefied LFG to consumers using trucks;[2]

(v) Supplying the LFG to consumers through a dedicated pipeline;

(d) Do not reduce the amount of organic waste that would be recycled in the absence of the project activity.

Box 1. Non-binding best practice example 1: demonstration of the applicability condition 3(d)

1. When demonstrating compliance with requirement (d) above, the PP may:
   (a) Describe the prevailing waste management practices pertinent to organic waste recycling in the area that is served by the landfill. The area served by the landfill should be clearly identified in the PDD, with supporting evidence (e.g. by providing contracts or licenses);
   (b) Identify any facility(ies) that recycle the organic fraction of the waste in the area identified in (a) above.; and
   (c) If there are facilities identified in (b) above, explain whether the project activity will impact the amount of organic waste which is recycled in the absence of the project.
   (d) If the facility(ies) identified in (c) above is(are) not operating at its maximum capacity, explain, with supporting evidence (e.g. by providing a balance of processed waste or receipts for transported waste), why the organic fraction of the solid waste would not have been treated in this(ese) facility(ies).
2. In doing so, the PPs may conduct interviews with authorities, refer to national/local statistics or studies related to MSW management in the area, and obtain opinion from relevant local experts.

4. The methodology is only applicable if the application of the procedure to identify the baseline scenario confirms that the most plausible baseline scenario is:

(a) Atmospheric release of the LFG or capture of LFG and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons; and

(b) In the case that the LFG is used in the project activity for generating electricity and/or generating heat in a boiler, air heater, glass melting furnace or kiln:

(i) For electricity generation: that electricity would be generated in the grid or in captive fossil fuel fired power plants; and/or

(ii) For heat generation: that heat would be generated using fossil fuels in equipment located within the project boundary;

(c) In the case of LFG supplied to the end-user(s) through natural gas distribution network, trucks or the dedicated pipeline, the baseline scenario is assumed to be displacement of natural gas.

(d) In the case of LFG from a Greenfield SWDS, the identified baseline scenario is atmospheric release of the LFG or capture of LFG in a managed SWDS and

[2] In case other means of transportation are used a revision to this methodology may be requested.

destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons.

5. This methodology is not applicable:

   (a) In combination with other approved methodologies. For instance, ACM0001 cannot be used to claim emission reductions for the displacement of fossil fuels in a kiln or glass melting furnace, where the purpose of the CDM project activity is to implement energy efficiency measures at a kiln or glass melting furnace;

   (b) If the management of the SWDS in the project activity is deliberately changed during the crediting in order to increase methane generation compared to the situation prior to the implementation of the project activity.

6. The applicability conditions included in the tools referred to below also apply.

2.3. Entry into force

7. The date of entry into force is the date of the publication of the EB XX meeting report on the DD Month YYYY.

2.4. Applicability of sectoral scopes

8. For validation and verification of CDM projects and programme of activities by a designated operation entity (DOE) using this methodology:

   (a) If the recovered Land fill gas (LFG) is only flared and not used for any other purposes the application of sectoral scope 13 is mandatory;

   (b) If the recovered LFG is used for any other purposes than flaring, then application of sectoral scopes 13 and sectoral scope 01 is mandatory.

3. Normative references

9. The consolidated baseline and monitoring methodology is based on the following proposed new methodologies:

   (a) “AM0002: Greenhouse Gas Emission Reductions through Landfill Gas Capture and Flaring” where the baseline is established by a Public Concession Contract (approved based on proposal “NM0004 rev: Salvador da Bahia LFG project”, whose project design document and baseline study, monitoring and verification plans were developed by ICF Consulting (version 03, June 2003);

   (b) “AM0003: Simplified financial analysis for LFG capture projects” (approved based on proposal “NM0005: Nova Gerar LFG to energy project”, whose project design document and baseline study, monitoring and verification plans were developed by EcoSecurities Ltd. (version 14, July 2003) for the Carbon Finance Unit of the World Bank);

   (c) “AM0010: Landfill gas capture and electricity generation projects” where LFG capture is not mandated by law (approved based on proposal “NM0010-rev: Durban-landfill-gas-to-electricity project”, whose project design document and baseline study, monitoring and verification plans were developed by Prototype Carbon Fund of the World Bank (April 2003);

(d) "AM0011: Landfill gas recovery with electricity generation and no capture or destruction of methane in the baseline scenario" (approved based on proposal "NM0021: Cerupt methodology for LFG recovery", whose project design document and baseline study, monitoring and verification plans were developed by Onyx (July 2003).

10. The methodology also refers to the latest approved version of the following methodological tools:

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

(b) "Emissions from solid waste disposal sites";

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

(d) "Project emissions from flaring";

(e) "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation";

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

(g) "Tool to determine the remaining lifetime of equipment";

(h) "Determining the baseline efficiency of thermal or electric energy generation systems";

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

(j) "Project and leakage emissions from transportation of freight";

(k) "Positive lists of technologies".

11. For more information regarding the approved 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

12. "Existing actual or historical emissions, as applicable";

or

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

4. Definitions

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

15. For the purpose of this methodology the following definitions apply:

(a) **Biogas processing facility** - the facility which processes, upgrades and compresses/liquefies the biogas collected from a Solid Waste Disposal Site (SWDS) with the purpose of supplying it to end-users;

(b) **Continuous brick kiln** - a brick kiln where bricks are loaded continuously into the kiln, rather than in batches. Continuous brick kilns are distinguished as moving ware kilns and moving fire annular kilns. Moving ware kilns include tunnel and vertical shaft kilns. Moving fire annular kilns use Hoffmann, Bull's trench and Zig-zag technologies;

(c) **Existing LFG capture system** - a system that has been in operation in the last calendar year prior to the start of the operation of the project activity;

(d) **LFG capture system** - a system to capture LFG. The system may be passive, active or a combination of both active and passive components. Passive systems capture LFG by means of natural pressure, concentration, and density gradients. Active systems use mechanical equipment to capture LFG by providing pressure gradients. Captured LFG can be vented, flared or used;

(e) **Intermittent brick kiln** - bricks are loaded into the kiln and fired in batches. Types include Clamp, Scotch and Scove technologies;

(f) **Landfill gas (LFG)** - the gas generated by decomposition of waste in a SWDS. LFG is mainly composed of methane, carbon dioxide and small fractions of ammonia and hydrogen sulphide;

(g) **Reference conditions** - reference conditions are defined as 0 ^{o}C (273.15 K, 32 ^{o}F) and 1 atm (101.325 kN/m2, 101.325 kPa, 14.69 psia, 29.92 in Hg, 760 torr);

(h) **Solid waste** - material that is unwanted and insoluble (including gases or liquids in cans or containers). Hazardous waste is not included in the definition of solid waste;

(i) **Solid waste disposal site (SWDS)** - designated areas intended as the final storage place for solid waste.

5. Baseline methodology

5.1. Project boundary

16. The project boundary of the project activity shall include the site where the LFG is captured and, as applicable:

(a) Sites where the LFG is flared or used (e.g. flare, power plant, boiler, air heater, glass melting furnace, kiln, natural gas distribution network, dedicated pipeline or biogas processing facility);

(b) Captive power plant(s) (including emergency diesel generators) or power generation sources connected to the grid, which are supplying electricity to the project activity;

(c) Captive power plant(s) (including emergency diesel generators) or power generation sources connected to the grid, which are supplying electricity in the baseline that is displaced by electricity generated by captured LFG in the project activity;

(d) Heat generation equipment or sources which are supplying heat in the baseline that is displaced by heat generated by captured LFG in the project activity; and

(e) The transportation of the compressed/liquefied LFG from the biogas processing facility to consumers.

Table 2. Summary of greenhouse gases and sources included in and excluded from the project boundary

Source		Gas	Included	Justification/Explanation
Baseline	Emissions from decomposition of waste at the SWDS site	CH_4	Yes	The major source of emissions in the baseline
		N_2O	No	N_2O emissions are small compared to CH_4 emissions from SWDS. This is conservative
		CO_2	No	CO_2 emissions from decomposition of organic waste are not accounted since the CO_2 is also released under the project activity
	Emissions from electricity generation	CO_2	Yes	Major emission source if power 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
	Emissions from heat generation	CO_2	Yes	Major emission source if heat 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
	Emissions from the use of natural gas	CO_2	No	Excluded for simplification. This is conservative
		CH_4	Yes	Major emission source if supply of LFG through a natural gas distribution network, dedicated pipeline or using trucks is included in the project activity
		N_2O	No	Excluded for simplification. This is conservative
Project activity	Emissions from fossil fuel consumption for purposes other than electricity generation or transportation due to the project activity	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 electricity consumption	CO_2	Yes	May be an important emission source

Source		Gas	Included	Justification/Explanation
	due to the project activity	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 flaring	CO_2	No	Emissions are considered negligible
		CH_4	Yes	May be an important emission source
		N_2O	No	Emissions are considered negligible
	Emissions from distribution of LFG using trucks and dedicated pipelines	CO_2	Yes	May be an important emission source
		CH_4	Yes	May be an important emission source
		N_2O	No	Emissions are considered negligible

5.2. Procedure for estimating the end of the remaining lifetime of existing equipment

17. This procedure applies if LFG is used in equipment that was in operation prior to the implementation of the project activity.

18. For each item of equipment which was in operation prior to the implementation of the project activity and in which the captured LFG is used after the implementation of the project activity,[3] project participants shall estimate its remaining lifetime by applying the "Tool to determine the remaining lifetime of equipment". These items of equipment and their remaining lifetime shall be recorded in the CDM-PDD.

19. At the end of the remaining lifetime of each item of equipment, the procedure for the selection of the most plausible baseline scenario related to electricity and/or heat generation shall be updated in order to determine the most plausible baseline fuel that would be used after installation of the new equipment in the absence of the CDM project activity. At the same time, the parameters related to this item of equipment shall also be re-estimated according to the procedures in this methodology used to make the original estimation (for example the baseline fuel may change, and this then has impacts on the emission factor for this baseline fuel).

5.3. Procedure for the selection of the most plausible baseline scenario and demonstrate additionality

20. Project participants may either apply the simplified procedures in section 5.3.1 below or the procedures in section 5.3.2 to select the most plausible baseline scenario and demonstrate additionality. ~~The procedures in section 5.3.1 are only applicable to the project types specified in paragraph 22 below.~~

[3] Depending on the project activity, relevant items of equipment may include power plants, boilers, air heaters, glass melting furnace, or kilns.

5.3.1. Simplified procedures to identify the baseline scenario and demonstrate additionality

21. For simplified procedure to demonstrate additionality the project proponent shall refer to methodological tool "Positive lists of technologies" ~~The simplified procedures are valid for three years from the date of entry into force of Version 18 of ACM0001 on 4 May 2017;[4] before the end of this period, the CDM Executive Board will reassess the validity of these simplified procedures and extend or update them if needed. Any update of the simplified procedures does not affect the projects that request registration as a CDM project activity or a programme of activities by 4 May 2020 and apply the simplified procedures contained in Version 18.0 of ACM0001~~.

~~22. The following types of project activities at new or existing landfills (greenfield or brownfield) are deemed automatically additional, if prior to the implementation of the project activity the LFG was or would have been only vented and/or flared but not utilized for energy generation:~~

~~(a) The LFG is used to generate electricity in one or several power plants with a total nameplate capacity that equals or is below 10 MW;~~

~~(b) The LFG is used to generate heat for internal or external consumption;~~

~~(c) The LFG is flared.~~

23. The baseline scenario for LFG is assumed to be the atmospheric release of the LFG or capture of LFG and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons.

24. If all or part of the electricity generated by the project activity is exported to the grid, the baseline scenario for all or the part of the electricity exported to the grid is assumed to be electricity generation in existing and/or new grid-connected power plants. If all or part of the electricity is supplied to off-grid application, the baseline electricity generation equipment is assumed to correspond to the default emission factor from Option B2 of the "Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation".

25. The baseline scenario for heat is assumed to be a new natural-gas-fired heat generation equipment with a default baseline efficiency of 100 per cent or with a default baseline efficiency as provided in Option F of the "Tool to determine the baseline efficiency of thermal or electric energy generation systems".

5.3.2. Procedures according to the "Combined tool to identify the baseline scenario and demonstrate additionality"

26. Identify the baseline scenario and demonstrate additionality using the "Combined tool to identify the baseline scenario and demonstrate additionality" and following the requirements below.

~~[4] To collect the information required for the update of this provision, the project activities that are registered using these simplified procedures are required to report cost and revenue information at the first issuance request after each phase of the project is fully implemented, taking into account confidentiality provisions as per paragraph 6 of the CDM Modalities & Procedures. Further guidance is provided in section 6.1 below.~~

27. In applying Step 1 of the tool, baseline alternatives for the destruction of LFG, shall take into consideration, inter alia, the following alternatives:

    (a) LFG1: The project activity implemented without being registered as a CDM project activity (i.e. capture and flaring or use of LFG);

    (b) LFG2: Atmospheric release of the LFG or capture of LFG in a managed SWDS and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons;

    (c) LFG3: Atmospheric release of the LFG or capture of LFG in an unmanaged SWDS and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons;

    (d) LFG4: LFG generation is partially avoided because part of the organic fraction of the solid waste is recycled and not disposed in the SWDS;

    (e) LFG5: LFG generation is partially avoided because part of the organic fraction of the solid waste is treated aerobically and not disposed in the SWDS;

    (f) LFG6: LFG generation is partially avoided because part of the organic fraction of the solid waste is incinerated and not disposed in the SWDS.

Box 2. Non-binding best practice example 2: elimination of alternative LFG scenarios 26(c), (d) and (e)

1. When considering any of the alternatives above, the PP may:
   - (a) Describe the prevailing waste management practices pertinent to organic waste in the area that is served by the landfill. The area served by the landfill should be clearly identified in the PDD, with supporting evidence (e.g. by providing contracts);
   - (b) Provide information on the existence of any facility(ies) that:
     - (i) recycle the organic fraction of the waste (regarding alternative “LFG3”) in the area identified in (a) above;
     - (ii) aerobically treat the organic fraction of the waste, such as composting plants (regarding alternative “LFG4”), in the area identified in (a) above;
     - (iii) incinerate the organic fraction of the waste (regarding alternative “LFG5”), in the area identified in (a) above;
   - (c) If there is(are) facility(ies) identified, indicate which is the processing capacity of each facility (tonnes/day, tonnes/month, tonnes/year). If the facility(ies) is(are) operating at its maximum capacity, then the alternative scenario can be excluded. The rationale is that in the absence of the project, the organic fraction of the waste would not be recycled or aerobically treated or incinerated, for example, because the recycling or aerobic treatment or incineration plant(s) located in the region that is served by the landfill would not be able to receive more waste.
   - (d) If the facility(ies) identified in (c) above is(are) not operating at its maximum capacity, explain, with supporting evidence (e.g. by providing a balance of processed waste or receipts for transported waste), why the organic fraction of the solid waste would not have been treated in this(ese) facility(ies)
2. In doing so, the PPs may conduct interviews with authorities, refer to national/local statistics or studies related to MSW management in the area, and obtain opinion from relevant local experts.

28. In addition to the alternative baseline scenarios identified for the destruction of LFG, alternative scenarios for the use of LFG shall also be identified (if this is an aspect of the project activity):

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

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

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

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

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

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

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

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

        (iv) H4: Heat generation in existing or new fossil fuel-based boiler(s), air heater(s), glass melting furnace(s) or kiln(s);

        (v) H5: Heat generation in existing or new renewable energy-based boiler(s), air heater(s), glass melting furnace(s) or kiln(s);

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

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

    (c) For the supply of LFG to a natural gas distribution network and/or dedicated pipeline and/or distribution of compressed/liquefied using trucks, the baseline is assumed to be the supply with natural gas.

29. To identify the baseline fuel for electricity generation by captive fossil fuel fired power plants and/or heat generation:

    (a) Project participants shall demonstrate that the identified baseline fuel used for generation of electricity and/or heat is available in the host country and there is no supply constraint. In case of partial supply constraints (seasonal supply), the project participants shall consider the period of partial supply among potential alternative fuel(s) the one that results in the lowest baseline emissions;

    (b) Detailed justifications shall be provided and documented in the CDM-PDD for the selected baseline fuel. As a conservative approach, the lowest carbon intensive fuel, such as natural gas, may be used throughout all period of the year.

5.4. Baseline emissions

30. Baseline emissions are determined according to equation (1) and comprise the following sources:

(a) Methane emissions from the SWDS in the absence of the project activity;

(b) Electricity generation using fossil fuels or supplied by the grid in the absence of the project activity;

(c) Heat generation using fossil fuels in the absence of the project activity; and

(d) Natural gas used from the natural gas network in the absence of the project activity.

$$BE_y = BE_{CH4,y} + BE_{EC,y} + BE_{HG,y} + BE_{NG,y}$$ Equation (1)

Where:

BE_y	=	Baseline emissions in year *y* (t CO_2e/yr)
$BE_{CH4,y}$	=	Baseline emissions of methane from the SWDS in year *y* (t CO_2e/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)
$BE_{NG,y}$	=	Baseline emissions associated with natural gas use in year *y* (t CO_2/yr)

5.4.1. Baseline emissions of methane from the SWDS ($BE_{CH4,y}$)

31. Baseline emissions of methane from the SWDS are determined as follows, based on the amount of methane that is captured under the project activity and the amount that would be captured and destroyed in the baseline (such as due to regulations). In addition, the effect of methane oxidation that is present in the baseline and absent in the project is taken into account:

$$BE_{CH4} = \left(\left(1 - OX_{top\_layer}\right) \times F_{CH4,PJ,y} - F_{CH,BL,y}\right) \times GWP_{CH4}$$ Equation (2)

Where:

$BE_{CH4,y}$	=	Baseline emissions of methane from the SWDS in year *y* (t CO_2e/yr)
OX_{top_layer}	=	Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline (dimensionless)
$F_{CH4,PJ,y}$	=	Amount of methane in the LFG which is flared and/or used in the project activity in year *y* (t CH_4/yr)
$F_{CH4,BL,y}$	=	Amount of methane in the LFG that would be flared in the baseline in year *y* (t CH_4/yr)
GWP_{CH4}	=	Global warming potential of CH_4 (t CO_2e/t CH_4)

5.4.1.1. Ex post determination of $F_{CH4,PJ,y}$

32. During the crediting period, $F_{CH4,PJ,y}$ is determined as the sum of the quantities of methane flared and used in power plant(s), boiler(s), air heater(s), glass melting furnace(s), kiln(s) and natural gas distribution, as follows:

$$F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y} + F_{CH4,HG,y} + F_{CH4,NG,y} \quad \text{Equation (3)}$$

Where:

$F_{CH4,PJ,y}$	=	Amount of methane in the LFG which is flared and/or used in the project activity in year *y* (t CH_4/yr)
$F_{CH4,flared,y}$	=	Amount of methane in the LFG which is destroyed by flaring in year *y* (t CH_4/yr)
$F_{CH4,EL,y}$	=	Amount of methane in the LFG which is used for electricity generation in year *y* (t CH_4/yr)
$F_{CH4,HG,y}$	=	Amount of methane in the LFG which is used for heat generation in year *y* (t CH_4/yr)
$F_{CH4,NG,y}$	=	Amount of methane in the LFG which is sent to the natural gas distribution network and/or dedicated pipeline and/or to the trucks in year *y* (t CH_4/yr)

33. $F_{CH4,EL,y}$, $F_{CH4,HG,y}$ and $F_{CH4,NG,y}$ are determined using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" and monitoring the working hours of the power plant(s), boiler(s), air heater(s), glass melting furnace(s) and kiln(s), so that no emission reduction are claimed for methane destruction during non-working hours. This is taken into account by monitoring the hours that the equipment utilizing the LFG is operating in year *y* ($Op_{j,h,y}$).

34. The following requirements apply:

(a) As per the gaseous stream tool, if the LFG is used for multiple purposes (e.g. flaring or energy generation), and all methane destruction devices are verified to be operational (e.g. by means of flame detectors records, energy generated), a single flow meter may be used to record the flow into multiple destruction devices. The destruction efficiency of the least efficient among the destruction devices shall be used as the destruction efficiency for all destruction devices monitored by this flow meter. If there are any periods for which one or more destruction devices are not operational, paragraph 5 (a) and (b) of the Appendix of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" tool shall be followed;

(b) CH_4 is the greenhouse gas for which the mass flow should be determined;

(c) The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations (3) or (17) in the tool);

(d) The mass flow should be calculated on an hourly basis for each hour *h* in year *y*;

(e) The mass flow calculated for hour *h* is 0 if the equipment is not working in hour *h* ($Op_{j,h}$=not working), the hourly values are then summed to a yearly unit basis.

35. $F_{CH4,flared,y}$ is determined as the difference between the amount of methane supplied to the flare(s) and any methane emissions from the flare(s), as follows:

$$F_{CH4,flared,y} = F_{CH4,sent\_flare,y} - \frac{PE_{flare,y}}{GWP_{CH4}} \quad \text{Equation (4)}$$

Where:

$F_{CH4,flared,y}$	=	Amount of methane in the LFG which is destroyed by flaring in year *y* (t CH_4/yr)
$F_{CH4,sent\_flare,y}$	=	Amount of methane in the LFG which is sent to the flare in year *y* (t CH_4/yr)
$PE_{flare,y}$	=	Project emissions from flaring of the residual gas stream in year *y* (t CO_2e/yr)
GWP_{CH4}	=	Global warming potential of CH_4 (t CO_2e/t CH_4)

36. $F_{CH4,sent\_flare,y}$ is determined directly using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", applying the requirements described above where the gaseous stream the tool shall be applied to is the LFG delivery pipeline to the flare(s).

37. $PE_{flare,y}$ shall be determined using the methodological tool "Project emissions from flaring". If LFG is flared through more than one flare, then $PE_{flare,y}$ is the sum of the emissions for each flare determined separately.

5.4.1.2. Ex ante estimation of $F_{CH4,PJ,y}$

38. An ex ante estimate of $F_{CH4,PJ,y}$ is required to estimate baseline emission of methane from the SWDS (according to equation (2)) in order to estimate the emission reductions of the proposed project activity in the CDM-PDD. It is determined as follows:

$$F_{CH4,PJ,y} = \eta_{PJ} \times BE_{CH4,SWDS,y} / GWP_{CH4} \quad \text{Equation (5)}$$

Where:

$F_{CH4,PJ,y}$	=	Amount of methane in the LFG which is flared and/or used in the project activity in year *y* (t CH_4/yr)
$BE_{CH4,SWDS,y}$	=	Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* (t CO_2e/yr)
η_{PJ}	=	Efficiency of the LFG capture system that will be installed in the project activity
GWP_{CH4}	=	Global warming potential of CH_4 (t CO_2e/t CH_4)

39. $BE_{CH4,SWDS,y}$ is determined using the methodological tool "Emissions from solid waste disposal sites". The following guidance should be taken into account when applying the tool:

(a) f_y in the tool shall be assigned a value of 0 because the amount of LFG that would have been captured and destroyed is already accounted for in equation (2) of this methodology;

(b) In the tool, *x* begins with the year that the SWDS started receiving wastes (e.g. the first year of SWDS operation); and

(c) Sampling to determine the fractions of different waste types is not necessary because the waste composition can be obtained from previous studies.

5.4.1.3. Determination of $F_{CH4,BL,y}$

40. This section provides a procedure to determine the amount of methane that would have been captured and destroyed (by flaring) in the baseline due to regulatory or contractual requirements, to address safety and odour concerns, or for other reasons (collectively referred to as requirement in this section). The four cases in Table 3 are distinguished. The appropriate case should be identified, and the corresponding instructions followed.

Table 3. Cases for determining methane captured and destroyed in the baseline

Situation at the start of the project activity	Requirement to destroy methane	Existing LFG capture and destruction system
Case 1	No	No
Case 2	Yes	No
Case 3	No	Yes
Case 4	Yes	Yes

5.4.1.3.1. Case 1: No requirement to destroy methane exists and no existing LFG capture system

41. In this situation:

$$F_{CH4,BL,y} = 0 \quad \text{Equation (6)}$$

5.4.1.3.2. Case 2: Requirement to destroy methane exists and no existing LFG capture system

42. In this situation:

$$F_{CH4,BL,y} = F_{CH4,BL,R,y} \quad \text{Equation (7)}$$

43. $F_{CH4,BL,R,y}$ should be determined based on the information contained in the requirement to destroy methane, as follows:

(a) If the requirement specifies the amount of methane that must be flared then that amount is $F_{CH4,BL,R,y}$;

(b) If the requirement specifies a percentage of the captured LFG that is required to be flared, the amount shall be calculated as follows:

$$F_{CH4,BL,R,y} = \rho_{reg,y} \times F_{CH4,PJ,capt,y}$$ Equation (8)

Where:

$F_{CH4,BL,R,y}$	=	Amount of methane in the LFG which is flared in the baseline due to a requirement in year *y* (t CH_4/yr)
$\rho_{reg,y}$	=	Fraction of LFG that is required to be flared due to a requirement in year *y*
$F_{CH4,PJ,capt,y}$	=	Amount of methane in the LFG which is captured in the project activity in year *y* (t CH_4/yr)

44. Project participants may choose to calculate $F_{CH4,PJ,capt,y}$ by either of the two options:

(a) **Option 1:** Calculate using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", applying the following requirements:

(i) The gaseous stream tool shall be applied to the LFG pipeline immediately downstream of the LFG capture system and before any split in the gaseous flow to different uses or flares;

(ii) CH_4 is the greenhouse gases for which the mass flow should be determined;

(iii) The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations (3) or (17) in the tool); and

(iv) The mass flow should be calculated on an hourly basis for each hour *h* in year *y*.

(b) **Option 2:** Calculate as the sum of the amount of methane that is sent to the flare, electricity generating or heat generating equipment in year *y* as measured in section 5.4.1.1, however, not taking into account the working hours of the equipment;

(i) If the requirement does not specify the amount or percentage of LFG that should be destroyed but requires the installation of a capture system, without requiring the captured LFG to be flared then:

$$F_{CH4,BL,R,y} = 0$$ Equation (9)

(ii) If the requirement does not specify any amount or percentage of LFG that should be destroyed, but requires the installation of a system to capture and flare the LFG, then a typical destruction rate of 20 per cent is assumed:[5]

[5] This default value of 20 per cent is based on assuming a situation in which: the efficiency of the LFG capture system in the project is 50 per cent; the efficiency of the LFG capture system in the baseline is 20 per cent; and, the amount captured in the baseline is flared using an open flare with a destruction efficiency of 50 per cent (consistent with the default value provided in the tool "Project emissions from flaring"). Project participants may propose and justify an alternative default value as a request for revision to this methodology.

$$F_{CH4,BL,R,y} = 0.2 \times F_{CH4,PJ,capt,y}$$ Equation (10)

5.4.1.3.3. Case 3: No requirement to destroy methane exists and a LFG capture system exists

45. In this situation:

$$F_{CH4,BL,y} = F_{CH4,BL,sys,y}$$ Equation (11)

46. If the amount of methane captured with the existing system can be monitored separately from the amount captured under the project, and the efficiency of the existing system is not impacted on by the project system during the crediting period(s), then $F_{CH4,BL,sys,y}$ is determined as follows:

$$F_{CH4,BL,sys,y} = F_{CH4,sent\_flare,y}$$ Equation (12)

Where:

$F_{CH4,BL,sys,y}$	=	Amount of methane in the LFG that would be flared in the baseline in year *y* for the case of an existing LFG capture system (t CH_4/yr)
$F_{CH4,sent\_flare,y}$	=	Amount of methane in the LFG which is sent to the flare in year *y* (t CH_4/yr)

47. $F_{CH4,sent\_flare,y}$ is determined using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" and applying the requirements described in section 5.4.1.1, where the gaseous stream the tool shall be applied to is the pipeline collecting LFG from the existing LFG capture system.

48. If there is no monitored data available, but there is historic data on the amount of methane that was captured in the year prior to the implementation of the project activity, then in this situation:

$$F_{CH4,BL,sys,y} = F_{CH4,hist,y}$$ Equation (13)

49. In determining $F_{CH4,hist,y}$ it is assumed that the fraction of LFG that was recovered in the year prior to the implementation of the project activity will be the same fraction recovered under the project activity:

$$F_{CH4,hist,y} = \frac{F_{CH4,BL,x-1}}{F_{CH4,x-1}} \times F_{CH4,PJ,y}$$ Equation (14)

Where:

$F_{CH4,hist,y}$	=	Historical amount of methane in the LFG which is captured and destroyed (t CH_4/yr)
$F_{CH4,BL,x-1}$	=	Historical amount of methane in the LFG which is captured and destroyed in the year prior to the implementation of the project activity (t CH_4/yr)

$F_{CH4,x-1}$ = Amount of methane in the LFG generated in the SWDS in the year prior to the implementation of the project activity (t CH_4/yr)

$F_{CH4,PJ,y}$ = Amount of methane in the LFG which is captured in the project activity in year *y* (t CH_4/yr)

50. $F_{CH4,x-1}$ shall be estimated using the methodological tool "Emissions from solid waste disposal sites". The guidance and requirements described in section 5.4.1.2 for applying the tool shall be followed. The year *y* in the tool is equivalent to the year prior to the implementation of the project activity.

51. If there is no monitored or historic data on the amount of methane that was captured in the year prior to the implementation of the project situation, then:

$$F_{CH4,BL,sys,y} = 0.2 \times F_{CH4,PJ,y} \quad \text{Equation (15)}$$

52. The 20 per cent default factor is consistent with the default factor given in equation (10).

5.4.1.3.4. Case 4: Requirement to destroy methane exists and LFG capture system exists

53. $F_{CH4,BL,y}$ shall be determined based on information in contract of regulation requirements and data related to the existing LFG capture system, as follows:

$$F_{CH4,BL,y} = max\{F_{CH4,BL,R,y}; F_{CH4,BL,sys,y}\} \quad \text{Equation (16)}$$

Where:

$F_{CH4,BL,R,y}$ = Amount of methane in the LFG which is flared in the baseline due to a requirement in year *y* (t CH_4/yr)

$F_{CH4,BL,sys,y}$ = Amount of methane in the LFG that would be flared in the baseline in year *y* for the case of an existing LFG capture system (t CH_4/yr)

54. $F_{CH4,BL,R,y}$ and $F_{CH4,BL.sys,y}$ shall be determined according to the respective procedures for Case 2 and Case 3 above.

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

55. The baseline emissions associated with electricity generation in year *y* ($BE_{EC,y}$) shall be calculated using the "Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation". When applying the tool:

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

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

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

56. The baseline emissions associated with heat generation in year *y* ($BE_{HG,y}$) are determined based on the amount of methane in the LFG which is sent to the heat generation

equipment in the project activity (boiler, air heater, glass melting furnace(s) and/or kiln), as follows:

$$BE_{HG,y} = NCV_{CH4} \times \sum_{j=1}^{n} \left(R_{efficiency,j,y} \times F_{CH4,HG,dest,j,y} \times EF_{CO2,BL,HG,j} \right)$$ Equation (17)

Where:

$BE_{HG,y}$	=	Baseline emissions associated with heat generation in year *y* (t CO_2/yr)
NCV_{CH4}	=	Net calorific value of methane at reference conditions (TJ/t CH_4)
$R_{efficiency,j,y}$	=	Ratio of the project and baseline efficiency of heat equipment type *j* in year *y*
$F_{CH4,HG,dest,j,y}$	=	Amount of methane in the LFG which is destroyed for heat generation by equipment type *j* in year *y* (t CH_4/yr)
$EF_{CO2,BL,HG,j}$	=	CO_2 emission factor of the fossil fuel type used for heat generation by equipment type *j* in the baseline (t CO_2/TJ)
j	=	Heat generation equipment (boiler, air heater, glass melting furnace(s) or kiln)
N	=	Number of different heat generation equipment used in the project activity

5.4.3.1. Determination of $R_{efficiency,j,y}$

57. The ratio of the project and baseline efficiency of an air heater, boiler, glass melting furnace or kiln is determined as follows:

$$R_{efficiency,j,y} = min\left\{1; \frac{\eta_{HG,PJ,j,y}}{\eta_{HG,BL,j}}\right\}$$ Equation (18)

Where:

$R_{efficiency,j,y}$	=	Ratio of the project and baseline efficiency of equipment type *j* in year *y*
$\eta_{HG,BL,j}$	=	Efficiency of the heat generation equipment type *j* used in the baseline
$\eta_{HG,PJ,j,y}$	=	Efficiency of the heat generation equipment type *j* used in the project activity in year *y*
j	=	Heat generation equipment type (boiler, air heater, glass melting furnace(s) or kiln)

58. To estimate the baseline energy efficiency of an air heater, boiler, glass melting furnace(s) or kiln ($\eta_{HG,BL,j}$) project participants shall apply the "Tool to determine the baseline efficiency of thermal or electric energy generation systems".

5.4.3.2. Determination of $F_{CH4,HG,dest,j,y}$

59. The amount of methane that is destroyed in the LFG that is sent to heat generation equipment *j* is determined with equation (19) if *j* is a boiler or air heater, or glass melting

furnace, or with equation (20) if *j* is a brick kiln. For the particular case of intermittent brick kilns, project participants may choose to apply either equation (19) or (20).

$$F_{CH4,HG,dest,j,y} = fd_{CH4,HG,j,default} \times F_{CH4,HG,j,y} \quad \text{Equation (19)}$$

Where:

$F_{CH4,HG,dest,j,y}$	=	Amount of methane in the LFG which is destroyed for heat generation by equipment type *j* in year *y* (t CH_4/yr)
$fd_{CH4,HG,j,default}$	=	Default value for the fraction of methane destroyed when used for heat generation equipment type *j*
$F_{CH4,HG,j,y}$	=	Amount of methane in the LFG which is used for heat generation equipment type *j* in year *y* (t CH_4/yr)

60. $F_{CH4,HG,j,y}$ is determined according to section 5.4.1.1, where *j* is each item of heat generation equipment.

$$F_{CH4,HG,dest,j,y} = \sum_{h=1}^{8,760} \left(fd_{CH4,kiln,h} \times F_{CH4,HG,kiln,h} \right) \quad \text{Equation (20)}$$

61. With: $fd_{CH4,kiln,h}$ = 1 if $Q_{O2,kiln,h}$ > 0, and otherwise $fd_{CH4,kiln,h}$ = 0.

Where:

$F_{CH4,HG,dest,j,y}$	=	Amount of methane in the LFG which is destroyed for heat generation by brick kiln in year *y* (t CH_4/yr)
$fd_{CH4,kiln,h}$	=	Fraction of methane destroyed when used for heat generation in a brick kiln in hour *h*
$F_{CH4,HG,kiln,h}$	=	Amount of methane in the LFG which is used for heat generation by brick kiln in hour *h* (t CH_4/hr)
$Q_{O2,kiln,h}$	=	Average volumetric fraction of oxygen in the exhaust gas flow of the kiln in hour *h* (volume of O_2/volume of the gas stream)
H	=	Hours in year *y*

62. $F_{CH4,HG,kiln,h}$ is determined using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", following the requirements given in section 5.4.1.1 for *j* = kiln, except that the mass flow should be summed to an hourly (not yearly) unit basis (t CH_4/hr).

5.4.4. Baseline emissions associated with natural gas use ($BE_{NG,y}$)

63. $BE_{NG,y}$ is estimated as follows:

$$BE_{NG,y} = 0.0504 \times F_{CH4,NG,y} \times EF_{CO2,NG,y} \quad \text{Equation (21)}$$

Where:

$BE_{NG,y}$	=	Baseline emissions associated with natural gas use in year *y* (t CO_2e/yr)
$EF_{CO2,NG,y}$	=	Average CO_2 emission factor of natural gas in the natural gas network or dedicated pipeline or in the trucks in year *y* (t CO2e/TJ)
$F_{CH4,NG,y}$	=	Amount of methane in the LFG which is sent to the natural gas distribution network or dedicated pipeline or to the trucks in year *y* (t CH_4/yr)

64. $EF_{CO2,NG,y}$ is determined using the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion".

5.5. Project emissions

65. Project emissions are calculated as follows:

$$PE_y = PE_{EC,y} + PE_{FC,y} + PE_{DT,y} + PE_{SP,y} \quad \text{Equation (22)}$$

Where:

PE_y	=	Project emissions in year *y* (t CO_2/yr)
$PE_{EC,y}$	=	Emissions from consumption of electricity due to the project activity in year *y* (t CO_2/yr)
$PE_{FC,y}$	=	Emissions from consumption of fossil fuels due to the project activity, for purpose other than electricity generation, in year *y* (t CO_2/yr)
$PE_{DT,y}$	=	Emissions from the distribution of compressed/liquefied LFG using trucks, in year *y* (t CO_2/yr)
$PE_{SP,y}$	=	Emissions from the supply of LFG to consumers through a dedicated pipeline, in year *y* (t CO_2/yr)

66. The project emissions from consumption of electricity by the project activity ($PE_{EC,y}$) shall be calculated using the "Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation". When applying the tool:

    (a) $EC_{PJ,k,y}$ in the tool is equivalent to the amount of electricity consumed by the project activity in year *y* ($EC_{PJ,y}$); and

    (b) If in the baseline a proportion of LFG is destroyed ($F_{CH4,BL,y}$>0), then the electricity consumption in the tool ($EC_{PJ,j,y}$) should refer to the net quantity of electricity consumption (i.e. the increase due to the project activity). The determination of the amount of electricity consumed in the baseline shall be transparently documented in the CDM-PDD.

67. The project emissions from fossil fuel combustion for purposes other than electricity generation ($PE_{FC,y}$) shall be calculated using the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion". When applying the tool:

    (a) Processes *j* in the tool correspond to the sources of fossil fuel consumption due to the project activity other than for electricity generation or and any on-site transportation by trucks or cars;

(b) If in the baseline a proportion of LFG is captured and flared ($F_{CH4,BL,y}$> 0), then the fossil fuels consumption used in calculation ($FC_{i,j,y}$) should refer to the net of that consumed in the baseline. The determination of the amount of fossil fuels consumed in the baseline shall be transparently documented in the CDM-PDD.

68. The project emissions from the distribution of compressed/liquefied LFG using trucks ($PE_{DT,y}$) is determined by the sum of emissions arising from the transportation of LFG using trucks and possible leaks during the transportation, as follows:

$$PE_{DT,y} = PE_{TR,y} + PE_{leaks,y} \quad \text{Equation (23)}$$

Where:

$PE_{DT,y}$	=	Project emissions from the distribution of compressed/liquefied LFG using trucks, in year *y* (t CO_2/yr)
$PE_{TR,y}$	=	Emissions from the transportation of compressed/liquefied LFG using trucks, in year *y* (t CO_2/yr)
$PE_{leaks,y}$	=	Emissions from CH_4 leaks during the transportation of compressed/liquefied LFG, in year *y* (t CO_2/yr)

69. The project emissions from the transportation of compressed/liquefied LFG using trucks ($PE_{TR,y}$) shall be accounted using the methodological tool "Project and leakage emissions from transportation of freight". When applying the tool the following must be considered:

(a) Transportation activity *f* in the tool corresponds to the distribution of compressing/liquefied LFG from the biogas processing plant to consumer(s) through using trucks;

(b) The freight transported is the compressed/liquefied LFG.

70. In addition to project emissions from transportation of freight, methane leak emissions from transport of the compressed/liquefied LFG by trucks shall also be computed as follows:

$$PE_{leaks,y} = GWP_{CH4} \times (F_{CH4,NG\,TR,y} - F_{CH4,NG-cons,y}) \quad \text{Equation (24)}$$

Where:

$PE_{leaks,y}$	=	Emissions from CH_4 leaks during the transportation of compressed/liquefied LFG, in year *y* (t CO_2/yr)
GWP_{CH4}	=	Global Warming Potential of CH_4
$F_{CH4,NG\,TR,y}$	=	Amount of methane in the LFG which is sent to trucks in year *y*
$F_{CH4,NG-cons,y}$	=	Amount of methane in the LFG which is delivered to consumers using trucks in year *y* (t CH_4/yr)

71. The project emissions from the supply of LFG through a dedicated pipeline ($PE_{SP,y}$) shall be determined as follows:

$$PE_{SP,y} = 0.0504 \times DEFT_{SP,y} \times F_{CH4,NG,y} \quad \text{Equation (25)}$$

Where:

$PE_{SP,y}$	=	Project emissions from the supply of LFG to consumers due to physical leakage from the dedicated pipeline, in year *y* (t CO_2/yr)
$DEFT_{SP,y}$	=	Default emission factor for the supply of LFG to consumers due to physical leakage through the dedicated pipeline (tCO_2e/TJ)[6]
$F_{CH4,NG,y}$	=	Amount of methane in the LFG which is sent to the consumer through a dedicated pipeline in year *y* (tCH4/yr)

5.6. Leakage

72. No leakage effects are accounted for under this methodology.

5.7. Emission reductions

73. Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad \text{Equation (26)}$$

Where:

ER_y	=	Emission reductions in year *y* (t CO_2e/yr)
BE_y	=	Baseline emissions in year *y* (t CO_2e/yr)
PE_y	=	Project emissions in year *y* (t CO_2/yr)

74. Project participants should provide an ex ante estimate of emissions reductions in the CDM-PDD. This requires projecting the future GHG emissions of the SWDS for the calculation of baseline emissions.

75. If the energy component is intended to be implemented after the first year of the project activity, then project participants may exclude the energy component from the ex ante estimation of baseline emissions. This avoids overestimating ex ante estimate of emissions if energy generation is not implemented, or a lower capacity is implemented than originally envisaged. This exclusion is not applicable to the determination of the baseline or demonstration of additionality.

5.8. Project activity under a programme of activities

76. 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).

77. 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

[6] This default value (2.2 tCO_2e/TJ) is based on Tool 15 - Upstream leakage emissions associated with fossil fuel use, version 2, Appendix, Table 1, page 19 (Natural gas distribution).

reduction calculations and monitoring. The 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. In case of combinations of the types of use of the captured landfill gas in one CPA, the eligibility criteria shall be defined for each type of use of the LFG separately;

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

(c) Monitoring provisions for each type of CPAs.

78. The CME shall describe transparently and justify in the CDM-PoA-DD which CPAs are regarded to be of the same type. CPAs shall not be 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) Partial release of the LFG from the SWDS;

(ii) Total release of the LFG from the SWDS;

(iii) In case of electricity generation in the project activity:

a. The grid;

b. Captive fossil fuel fired power plants;

(b) In case of heat generation, fossil fuel fired on-site equipment;

(c) The project activity with regard to any of the following aspects of the use of the captured landfill gas:

(i) Flaring;

(ii) Flaring; and

a. Electricity generation;

b. Heat generation;

i. Boiler;

ii. Air heater;

iii. Kiln;

iv. Glass melting furnace;

c. Supplying the LFG to consumers through a natural gas distribution network or dedicated pipeline or using trucks;

(iii) Combinations of types of use of the landfill gas;

(d) The legal and regulatory framework.

79. 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 certain design specifications (ranges of sizes of landfill and amounts of waste disposed);

    (b) Ranges of efficiency of the landfill gas capture system;

    (c) Type of solid waste disposal site:

        (i) New solid waste disposal site;

        (ii) Existing solid waste disposal site;

    (d) Ranges of costs (capital investment, operating and maintenance costs, etc.);

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

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

81. Refer to the latest approved version of the methodological tool "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period".

5.10. Data and parameters not monitored

82. In addition to the parameters listed in the tables below, the provisions on data and parameters not monitored in the tools referred to in this methodology apply.

Data / Parameter table 1.

Data / Parameter:	OX_{top_layer}
Data unit:	Dimensionless
Description:	Fraction of methane that would be oxidized in the top layer of the SWDS in the baseline
Source of data:	Consistent with how oxidation is accounted for in the methodological tool "Emissions from solid waste disposal sites"
Value to be applied:	0.1

Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	Applicable to section 5.4.1 $OX_{top\text{-}layer}$ is the fraction of the methane in the LFG that would oxidize in the top layer of the SWDS in the absence of the project activity. Under the project activity, this effect is reduced as a part of the LFG is captured and does not pass through the top layer of the SWDS. This oxidation effect is also accounted for in the methodological tool "Emissions from solid waste disposal sites". In addition to this effect, the installation of a LFG capture system under the project activity may result in the suction of additional air into the SWDS. In some cases, such as with a high suction pressure, the air may decrease the amount of methane that is generated under the project activity. However, in most circumstances where the LFG is captured and used this effect was very small, as the operators of the SWDS have in most cases an incentive to maintain a high methane concentration in the LFG. For these reasons, the oxidation factor shall be included in the calculation of baseline emissions whereas the effect of oxidation is, as a conservative assumption, neglected under the project activity.

Data / Parameter table 2.

Data / Parameter:	$F_{CH4,BL,x\text{-}1}$
Data unit:	t CH_4/yr
Description:	Historical amount of methane in the LFG which is captured and destroyed in the year prior to the implementation of the project activity
Source of data:	Information recorded by the SWDS operator
Value to be applied:	-
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	Applicable to Case 3 of section 5.4.1.3

Data / Parameter table 3.

Data / Parameter:	GWP_{CH4}
Data unit:	t CO_2e/t CH_4
Description:	Global warming potential of CH_4
Source of data:	IPCC
Value to be applied:	Default value of 25 from IPCC Fourth Assessment Report (AR4). Shall be updated according to any future COP/MOP decisions
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 4.

Data / Parameter:	NCV_{CH4}
Data unit:	TJ/t CH_4
Description:	Net calorific value of methane at reference conditions
Source of data:	Technical literature
Value to be applied:	0.0504
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 5.

Data / Parameter:	$EF_{CO2,BL,HG,j}$
Data unit:	t CO_2/TJ
Description:	CO_2 emission factor of the fossil fuel type used for heat generation by equipment type *j* in the baseline
Source of data:	Table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value to be applied:	The lower limit of the 95 per cent confidence interval of the default values provided in table 1.4 of reference above shall be used
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	Applicable to section 5.4.3

Data / Parameter table 6.

Data / Parameter:	η_{PJ}
Data unit:	Dimensionless
Description:	Efficiency of the LFG capture system that will be installed in the project activity
Source of data:	-
Value to be applied:	Technical specifications of the LFG capture system to be installed (if available) or a default value of 50 per cent
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	Applicable to section 5.4.1.2

Data / Parameter table 7.

Data / Parameter:	$fd_{CH4,HG,j,default}$
Data unit:	-
Description:	Default value for the fraction of methane destroyed when used for heat generation equipment type *j*

<table>
<tr><td>Source of data:</td><td>The values for boilers and air heaters are based on default values provided in the 2006 IPCC Guidelines (Tier 3 approach for Chapter 2: Stationary Combustion of Volume 2: Energy Use).
The value for intermittent brick kilns is based on the assumption that combustion temperatures in the kiln will exceed 600 °C and that the time of exposure is sufficiently long to support 90 per cent combustion</td></tr>
<tr><td>Measurement procedures (if any):</td><td>Select the appropriate factor for the fraction of methane destroyed from the following table:
Table 4. Fraction of CH_4 destroyed by equipment type<table><tr><th>Fraction of CH_4 destroyed</th><th>Equipment type j</th></tr><tr><td>1</td><td>Boilers</td></tr><tr><td>1</td><td>Air heaters</td></tr><tr><td>1</td><td>Glass melting furnaces</td></tr><tr><td>0.9</td><td>Intermittent brick kiln</td></tr></table></td></tr>
<tr><td>Monitoring frequency:</td><td>-</td></tr>
<tr><td>QA/QC procedures:</td><td>-</td></tr>
<tr><td>Any comment:</td><td>Applicable to calculating $F_{CH4,HG,dest,j,y}$ using equation (19) in section 5.4.3.2. For intermittent brick kilns, project participants may choose to instead determine $F_{CH4,HG,dest,j,y}$ using equation (20)</td></tr>
</table>

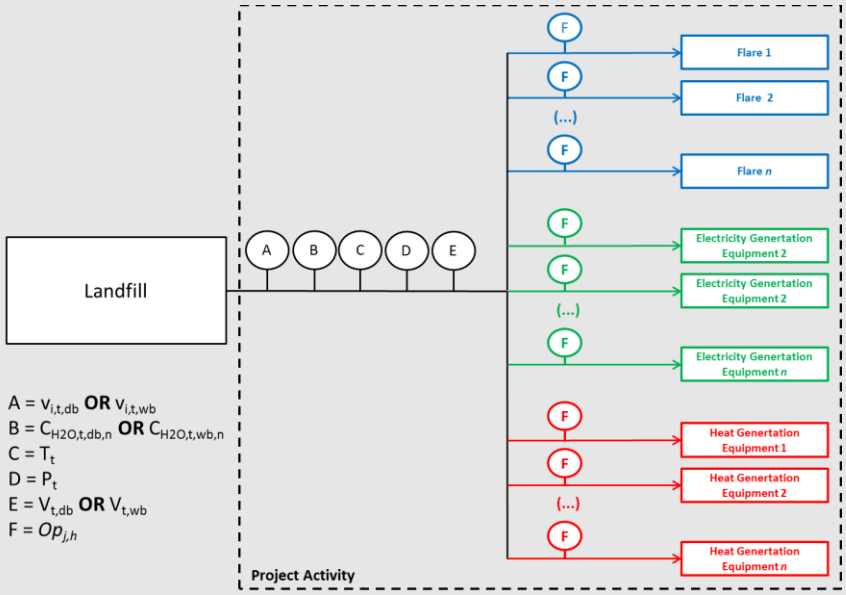
6. Monitoring methodology

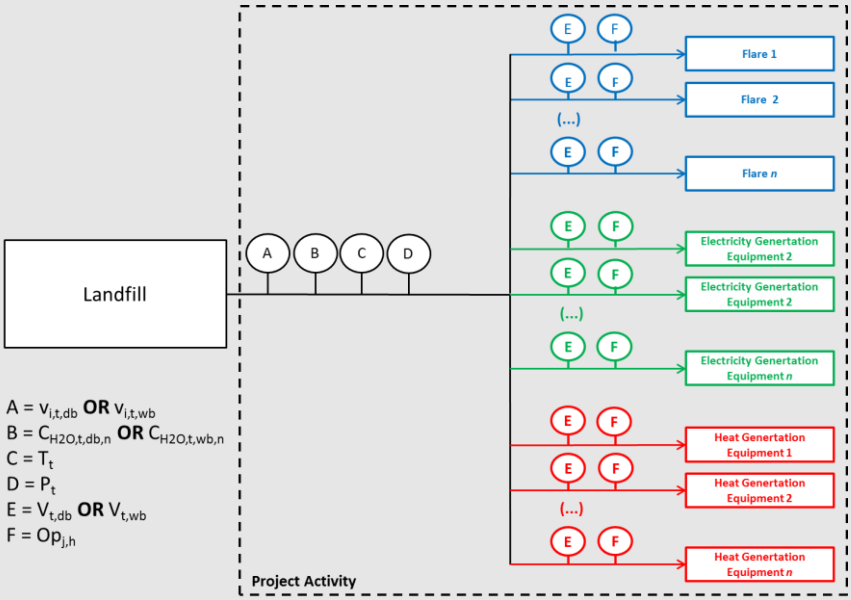
6.1. Data and parameters monitored

83. In addition to the parameters listed in the tables below, the provisions on data and parameters monitored in the tools referred to in this methodology apply.

Box 3. Non-binding best practice example 3: monitoring of the gaseous streams

1. The monitoring of gas flow rate, gas composition, moisture content, temperature, and pressure, following the requirements from paragraphs 34 (a) and 36, may be made at the common header as per the diagram below. However, all methane destruction devices should be verified to be operational (e.g. by means of flame detectors records, energy generated).





Data / Parameter table 8.

Data / Parameter:	**Management of SWDS**
Data unit:	-
Description:	Management of SWDS
Source of data:	Use different sources of data: (a) Original design of the landfill; (b) Technical specifications for the management of the SWDS; (c) Local or national regulations
Measurement procedures (if any):	Project participants should refer to the original design of the landfill to ensure that any practice to increase methane generation have been occurring prior to the implementation of the project activity. Any change in the management of the SWDS after the implementation of the project activity should be justified by referring to technical or regulatory specifications
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 9.

Data / Parameter:	$F_{CH4,BL,R,y}$
Data unit:	t CH_4/yr
Description:	Amount of methane in the LFG which is flared due to a requirement in year *y*
Source of data:	Information of the host country's regulatory requirements relating to LFG, contractual requirements, or requirements to address safety and odour concerns
Measurement procedures (if any):	-
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	Applicable to Case 2 of section 5.4.1.3

Data / Parameter table 10.

Data / Parameter:	$\rho_{reg,y}$
Data unit:	Dimensionless
Description:	Fraction of LFG that is required to be flared due to a requirement in year *y*
Source of data:	Information of the host country's regulatory requirements relating to LFG, contractual requirements, or requirements to address safety and odour concerns
Measurement procedures (if any):	-
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	Applicable to Case 2 of section 5.4.1.3

Data / Parameter table 11.

Data / Parameter:	$\eta_{HG,PJ,j,y}$
Data unit:	Dimensionless
Description:	Efficiency of the heat generation equipment used in the project activity in year *y*
Source of data:	Use one of the following options to determine the efficiency: (a) Measured efficiency during monitoring; (b) Manufacturer's information on the efficiency; or (c) Use a default value of 60 per cent
Measurement procedures (if any):	If measurements are conducted, use recognized standards for the measurement of the heat generator efficiency, such as the "*British Standard Methods for Assessing the thermal performance of boilers for steam, hot water and high temperature heat transfer fluids*" (BS845). Where possible, use preferably the direct method (dividing the net heat generation by the energy content of the fuels fired during a representative time period), as it is better able to reflect average efficiencies during a representative time period compared to the indirect method (determination of fuel supply or heat generation and estimation of the losses). Document measurement procedures and results and manufacturer's information transparently in the CDM-PDD
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	Applicable to section 5.4.3.1

Data / Parameter table 12.

Data / Parameter:	$Op_{j,h}$
Data unit:	-
Description:	Operation of the equipment that consumes the LFG
Source of data:	Project participants
Measurement procedures (if any):	For each equipment unit *j* using *the LFG* monitor that the plant is operating in hour *h* by the monitoring any one or more of the following three parameters: (a) Temperature. Determine the location for temperature measurements and minimum operational temperature based on manufacturer's specifications of the burning equipment. Document and justify the location and minimum threshold in the PDD; (b) Flame. Flame detection system is used to ensure that the equipment is in operation; (c) Products generated. Monitor the generation of steam for the case of boilers and air-heaters and glass for the case of glass melting furnaces. This option is not applicable to brick kilns. $Op_{j,h}$=0 when: (a) One of more temperature measurements are missing or below the minimum threshold in hour *h* (instantaneous measurements are made at least every minute); (b) Flame is not detected continuously in hour *h* (instantaneous measurements are made at least every minute); (c) No products are generated in the hour *h.*

	Otherwise, $Op_{j,h}$=1
Monitoring frequency:	Hourly
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 13.

Data / Parameter:	$EG_{PJ,y}$
Data unit:	MWh
Description:	Amount of electricity generated using LFG by the project activity in year *y*
Source of data:	Electricity meter
Measurement procedures (if any):	Monitor net electricity generation by the project activity using LFG
Monitoring frequency:	Continuous
QA/QC procedures:	Electricity meter will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy. The readings will be double checked by the electricity distribution company
Any comment:	This parameter is required for calculating baseline emissions associated with electricity generation ($BE_{EC,y}$) using the methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"

Data / Parameter table 14.

Data / Parameter:	$EG_{EC,y}$
Data unit:	MWh
Description:	Amount of electricity consumed by the project activity in year *y*
Source of data:	Electricity meter
Measurement procedures (if any):	Sources of consumption shall include, where applicable, electricity consumed for the operation of the LFG capture system, for any processing and upgrading of the LFG, for transportation of the LFG to the flare or other applications (boilers, power generators), for the compression of the LFG into the natural gas network, etc.
Monitoring frequency:	Continuous
QA/QC procedures:	Electricity meter will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy. The readings will be double checked by the electricity distribution company
Any comment:	This parameter is required for calculating project emissions from electricity consumption due to an alternative waste treatment process $t\,PE_{EC,y}$) using the methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"

Data / Parameter table 15.

Data / Parameter:	$F_{CH4,NG\text{-}cons,y}$
Data unit:	t CH_4/yr
Description:	Amount of methane in the LFG which is delivered to consumers using trucks in year *y*
Source of data:	-
Measurement procedures (if any):	Determined using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream"
Monitoring frequency:	Per batch and aggregated annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 16.

Data / Parameter:	$F_{CH4,NG\ TR,y}$
Data unit:	t CH_4/yr
Description:	Amount of methane in the LFG which is sent to trucks in year *y*
Source of data:	-
Measurement procedures (if any):	Determined using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream
Monitoring frequency:	Per batch and aggregated annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 17.

Data / Parameter:	**CAPEX and OPEX**
Data unit:	Currency (USD, EUR, etc.)
Description:	Total investment to implement the project and total cost to operate the project
Source of data:	Engineering, procurement and construction contracts; and maintenance contracts
Measurement procedures (if any):	-
Monitoring frequency:	At the first issuance request after each phase of the project is fully implemented

QA/QC procedures:	Audited by professional, independent financial auditors. The DOE should only verify that the data provided corresponds to the data from independent financial auditors
Any comment:	The information provided for CAPEX shall indicate the investment made: (i) in the collection and flaring system; (ii) in the power plant and connection to the grid (if applicable); and (iii) in the purchase of the new boiler or refurbishment of the existing one and in the steam/hot air pipeline if steam/hot air is exported out of the project boundary (if applicable). The information supplied for OPEX shall indicate the costs for: (i) staff and maintenance involved in the operation of the collection and flaring system; and (ii) staff and maintenance involved in the operation of the collection and power generation system. The monitoring of this parameter is only required for projects applying the simplified procedures to identify the baseline scenario and demonstrate additionality

Data / Parameter table 18.

Data / Parameter:	**Tariff of electricity exported**
Data unit:	Currency (USD, EUR, etc.)
Description:	Tariff of the electricity exported
Source of data:	Power purchase agreement
Measurement procedures (if any):	-
Monitoring frequency:	At the first issuance request after each phase of the project is fully implemented
QA/QC procedures:	Audited by professional, independent financial auditors. The DOE should only verify that the data provided corresponds to the data from independent financial auditors
Any comment:	The monitoring of this parameter is only required for projects applying the simplified procedures to identify the baseline scenario and demonstrate additionality

Data / Parameter table 19.

Data / Parameter:	**Revenues from the sale of heat / Savings based on the heat generated and consumed on-site**
Data unit:	Currency (USD, EUR, etc.)
Description:	(a) Revenues from the heat sold outside of the project boundary; or (b) (ii) Savings based on the heat consumed on-site, which would have been generated outside of the project boundary
Source of data:	(a) Heat supply agreement; (b) Monthly average expenses of heat purchased during the previous year prior to the implementation of the project activity
Measurement procedures (if any):	-
Monitoring frequency:	At the first issuance request after each phase of the project is fully implemented

QA/QC procedures:	Audited by professional, independent financial auditors. The DOE should only verify that the data provided corresponds to the data from independent financial auditors
Any comment:	The monitoring of this parameter is only required for projects applying the simplified procedures to identify the baseline scenario and demonstrate additionality

Data / Parameter table 20.

Data / Parameter:	$F_{CH4,NG,y}$
Data unit:	tCH_4/yr
Description:	Amount of methane in the LFG which is sent to the natural gas distribution network or dedicated pipeline or to the trucks in year *y*
Source of data:	-
Measurement procedures (if any):	Determined using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream"
Monitoring frequency:	Continuous and aggregated annually in case of natural gas distribution network and dedicated pipeline. Pre-batch and aggregated annually in case of trucks
QA/QC procedures:	-
Any comment:	-

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Document Information

Version	*Date*	*Description*
19.0	11 March 2019	MP 78, Annex 4 A call for public input will be issued for this draft document. If no public inputs are received, this draft document will be considered by the Board at a future meeting. Revision to include reference to methodological tool "TOOL32: Positive lists of technologies".
18.1	29 November 2018	EB 101, Annex 12 Minor revision to move text from footnote 5 to Data / Parameter table 1 (parameter: OX_{top_layer}) and to improve the clarity of the text.
18.0	4 May 2017	EB 94, Annex 4 Revision to provide clarity in baseline applicability and the application of simplified additionality provisions.
17.0	13 May 2016	EB 89, Annex 2 Revision to expand the applicability to project supplying LFG through a dedicated pipeline

Version	*Date*	*Description*
16.0	16 October 2015	EB 86, Annex 12 Revision to include non-binding best practice examples.
15.0	8 November 2013	EB 76, Annex 7 Revision to: • Introduce standardized approaches to demonstrate additionality and to identify the baseline for project activities which flare landfill gas, generate heat from landfill gas, or generate electricity with a capacity equal to or below 10MW.
14.0	4 October 2013	EB 75, Annex 12 Revision to: • Improve the consistency in existing regulations related to PoAs; • Broaden the applicability of the methodology to project activities supplying compressed/liquefied LFG to consumers using trucks; and • Correct an error in equation 1.
13.0.0	11 May 2012	EB 67, Annex 12 Revision to: • Broaden the applicability by allowing the use of landfill gas in glass melting furnaces; • Provide more clarity on how to monitor possible changes in the management of the landfill; • Introduce provisions for the use of this methodology in a project activity under a PoA.
12.0.0	25 November 2011	EB 65, Annex 13 Revision to: • Clarify that the methodology is applicable to new and existing SWDS; • Broaden the applicability by allowing the use of landfill gas in brick kilns, by allowing the claim of certified emission reductions associated with fossil fuel displaced by landfill gas fed into a natural gas network and allowing that the use but not the amount of LFG changes between the baseline and project; • Revise the applicability conditions, requiring that: (a) If an existing active landfill gas capture system was in place prior to the implementation of the project activity, then historical or monitored information on the amount of landfill gas captured is required; and (b) The implementation of the project activity does not reduce the amount of organic waste that would be recycled in the absence of the project activity;

Version	*Date*	*Description*
		• Incorporate the effect of methane oxidation in the top layer of the solid waste disposal site in the baseline scenario; • Refer to relevant tools; • Change the title from "Consolidated baseline and monitoring methodology for landfill gas project activities" to "Flaring or use of landfill gas".
11	28 May 2009	EB 47, Annex 6 Revision to: Allow only the option of continuous measurement of methane content of the LFG; Include definition of continuous monitoring system.
10	13 February 2009	EB 45, Annex 9 Revision to: • Include guidance for air heater efficiency; • Include a clarification that emission reductions can be claimed for generation of thermal energy provided that the LFG displaces use of fossil fuel either in a boiler or in an air heater.
09.1	24 October 2008	EB 43, Annex 2 Editorial changes to reflect that the source of data for the "Regulatory requirements relating to LFG" has been changed. Publicly available information should be used instead of contacting the DNA for collecting the information.
09	02 August 2008	EB 41, Annex 4 Following clarifications have been added: • The measurement of both LFG flow and methane fraction in LFG have to be conducted on the same basis (wet or dry); • Inclusion of cases where periodical measurements are allowed and guidance on performing periodical measurements for monitoring the fraction of methane in the LFG; • The title of the "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site" changes to "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site".
08.1	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".
08	30 November 2007	EB 36, Annex 10 Clarify the procedure to calculate the Adjustment Factor, where in the baseline the LFG was captured and destroyed/used; Clarify how to apply the "Tool to determine methane emissions avoided from the dumping waste at a solid waste disposal site" for estimating *ex ante* LFG emissions over the crediting period.

Version	*Date*	*Description*
07	19 October 2007	EB 35, Annex 11 • To include AM0002, AM0003, AM0010, and AM0011; • Reference to the following tools was added: "Tool to calculate project emissions from electricity consumption", "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion", and "Combined tool to identify the baseline scenario and demonstrate additionality".
06	22 June 2007	EB 32, Annex 6 • Include procedures for estimating emissions reductions from use of captured LFG for energy generation; • Expand the applicability to project activities where the captured LFG is used to supply consumers through a natural gas distribution network.
05	15 December 2006	EB 28, Annex 9 Revision to: Replace the procedure for estimating flare efficiency with a reference to the methodological "Tool to determine project emissions from flaring gases containing methane".
04	21 July 2006	EB 25, Annex 6 Revision to: • Allow the use of one measurement point for LFG captured, if the captured LFG is flared only and not used for energy and/or electricity generation; • Provide a default value for methane destruction flare efficiency (50%) should the methane destruction efficiency not be measured.
03	12 May 2006	EB 24, Annex 6 Revision to: • Reflect that separate monitoring of LFG temperature and pressure is not required if the monitoring equipment used automatically adjusts the volume for these two parameters; • Incorporate the procedures of estimating emissions reductions to take into account situations where project activities may not utilize the captured LFG but require use of fossil fuel or purchased electricity in operating the project activity.
02	30 September 2005	EB 21, Annex 9 Guidance on how to estimate the Adjustment Factor (AF) was provided.

Version	*Date*	*Description*
01	03 September 2004	EB 15, Annex 1 Initial adoption.

Decision Class: Regulatory
Document Type: Standard
Business Function: Methodology
Keywords: avoidance of methane emissions, landfill gas