ARTICLE 6.4 MECHANISM

A6.4-MEP008-A07

Draft Methodological tool

Determination of the mass flow of a greenhouse gas in a gaseous stream

Version 01.0

United Nations
Framework Convention on
Climate Change

COVER NOTE

1. Procedural background

1. The Supervisory Body of the Article 6.4 mechanism, at its fifteenth meeting, approved its workplan for 2025 for the Methodological Expert Panel (MEP) and requested the MEP to initiate work on the revision of CDM methodologies / methodological tools / Standard / Guidelines, including the Tool: Determination of the mass flow of a greenhouse gas in a gaseous stream (hereinafter referred to as the approved CDM Tool).

2. Purpose

2. The purpose of this tool is to provide procedures to determine mass flow of a greenhouse gas in a gaseous stream.

3. Key issues and proposed solutions

3. The methodological tool is developed based on the existing CDM Tool[1] to fit the new Article 6.4 standards.

4. The methodological tool may be used to measure the mass flow of a greenhouse gases in gaseous streams under the Article 6.4 baseline or activity scenarios.

4. Impacts

5. The approval of this draft methodological tool will allow new Article 6.4 activities to determine mass flow of a greenhouse gas in gaseous streams.

5. Subsequent work and timelines

6. The MEP agreed to seek public inputs from stakeholders on this draft version of the proposed new Article 6.4 Tool. The MEP will incorporate the stakeholders' inputs received and recommend a revised draft proposed new Article 6.4 Tool for approval by the Supervisory Body.

6. Recommendations to the Supervisory Body

7. Not applicable (Document is published for a call for public inputs.)

[1] See https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-08-v3.0.pdf/history_view

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1. Introduction

1.1. Scope

1. This methodological tool provides procedures to determine the following parameter:

Table 1. Parameters determined

Parameter	SI Unit	Description
$F_{i,t}$	kg/h	Mass flow of greenhouse gas *i* (CO_2, CH_4, NF_3, N_2O, SF_6 or a PFC) in the gaseous stream in time interval *t*

2. The mass flow of a particular greenhouse gas is calculated based on measurements of: (a) the total volume flow or mass flow of the gas stream, (b) the volumetric fraction of the gas in the gas stream and (c) the gas composition and water content. The flow and volumetric fraction may be measured on a dry basis or wet basis. The tool covers the possible measurement combinations, providing six different calculation options to determine the mass flow of a particular greenhouse gas and the uncertainty associated with the measurement (Options A to F shown in Table 2).

3. Additional guidance for determining the mass flow of methane in biogas is provided in the Appendix to this tool.

1.2. Entry into force and validity

4. This document enters into force on DD/MM/YYYY and is valid for five years, until DD//MM/YYYY, unless an earlier date applies if the methodological tool is revised or withdrawn in accordance with the procedure “Development, revision and clarification of methodologies and methodological tools” (A6.4-PROC-METH-001).

2. Definitions

5. The following definitions shall apply:

(a) **Absolute humidity:** The ratio between the mass of H_2O (vapor phase) in the gas and the mass of the dry gas;

(b) **Dry basis:** A parameter that does not account for the H_2O present in the gas;

(c) **Gaseous stream:** A mixture of gaseous components which may contain different fractions of N_2, CO_2, O_2, CO, H_2, CH_4, N_2O, NO, NO_2, SO_2, SF_6, PFCs and H_2O in the vapor phase and its absolute pressure must be below 10 atm or 1.013 MPa.[1] Other gases may be present (e.g. hydrocarbons) provided their total concentration represents less than 1% (v/v) of the total.[2] A dry gas or dry gaseous stream

[1] This condition is required because it is assumed in the calculations that the gas stream behaves as an ideal binary mixture of water vapor and an ideal gas. If the gaseous stream contains larger fractions of other gases, such as hydrocarbons other than methane or HFCs, the gas cannot be considered an ideal gas mixture. Moderate pressures will assure that gases behave as ideal gases.

[2] For the cases of landfill gas and exhaust gases from thermal oxidation using natural gas, it will be assumed that the total concentration of other gases represents less than 1% (v/v).

excludes the H_2O fraction and a wet gas or wet gaseous stream includes the H_2O fraction;

(d) **Moisture content:** The H_2O concentration in mass of H_2O (vapor phase) per volume of dry gas at normal conditions, also referred to as NPT conditions, expressed in mg H_2O/m^3 dry gas;

(e) **Reference conditions:** Conditions are defined as 0ºC (273.15 K, 32ºF) and 1 atm (101.325 kN/m^2, 101.325 kPa, 14.69 psia, 29.92 in Hg, 760 torr);

(f) **Relative humidity:** The ratio between the partial pressure of H_2O in the gas and the saturation pressure at a given temperature;

(g) **Saturation (absolute) humidity:** The maximum amount of H_2O (vapor phase) that the gas can contain at a given temperature and pressure, expressed as mass of H_2O per mass of the dry gas;

(h) **Wet basis:** A parameter that accounts for the H_2O present in the gas.

3. Applicability

6. This methodological tool is used to measure the mass flow of greenhouse gases in gaseous streams under the Article 6.4 baseline or activity scenarios.

7. This methodological tool applies to ideal gases only and will be updated in the future to incorporate CO_2 under non-ideal gases condition (e.g. for geological storage).

8. Mechanism methodologies intending to use this methodological tool shall include a reference to it and shall specify:

(a) The gaseous streams the tool should be applied to;

(b) For which greenhouse gas the mass flow should be determined;

(c) In which time intervals the flow of the gaseous stream should be measured; and

(d) Situations where the simplification offered for calculating the molecular mass of the gaseous stream (equations (3) or (17)) is not valid (such as the gaseous stream is predominantly composed of a gas other than N_2).

9. The provisions in paragraph 8 above shall be demonstrated in the Project Design Document (PDD) and in each monitoring report and be assessed at the initial validation and at each verification.

4. Normative references

10. The methodological tool was prepared based on the following references:

(a) G. J. Van Wylen, R. E. Sonntag, and C. Borgnakke, *Fundamentals of Classical Thermodynamics*, 4th ed. New York: John Wiley & Sons, 1994;

(b) C. Strumillo and T. Kudra, *Drying: Principles, Applications and Design*. Montreux, Switzerland: Gordon & Breach Science Publishers, 1986;

(c) *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 1: General guidance and reporting.* Chapter 3: Uncertainties.

5. Methodology procedure

11. The mass flow of a greenhouse gas i in a gaseous stream ($F_{i,t}$) is determined through measurement of the flow and volumetric fraction of the gaseous stream. This tool offers the different options to conduct these measurements and the corresponding calculation option to determine $F_{i,t.}$, as shown in Table 2.

12. Activity participants shall document in the PDD which option is applied. $F_{i,t}$ shall be calculated following the steps/guidance described for each option below.

Table 2. Measurement options

Option	Flow of gaseous stream	Volumetric fraction
A	Volume flow – dry basis	dry or wet basis[3]
B	Volume flow – wet basis	dry basis
C	Volume flow – wet basis	wet basis
D	Mass flow – dry basis	dry or wet basis
E	Mass flow – wet basis	dry basis
F	Mass flow – wet basis	wet basis

13. An excel sheet that can be used to calculate the flow of gaseous stream is provided at the following weblink on the UNFCCC website <https://cdm.unfccc.int/methodologies/PAmethodologies/table_am_tool_08.xls>.

5.1. Determination of the absolute humidity of the gaseous stream

14. The absolute humidity is a parameter required for Options B and E. It can be determined from measurement of the moisture content (Option *1*), or by assuming that the gaseous stream is dry or saturated, as a simplified conservative approach (Option *2*). Activity participants shall document in the PDD which option they apply.

5.1.1. Option 1: Calculation using measurement of the moisture content

15. This option provides a procedure to determine the absolute humidity of the gaseous stream ($m_{H2O,t,db}$) from measurements of the moisture content of the gas, according to equation (1).

$$m_{H2O,t,db} = \frac{C_{H2O,t,db,n}}{10^6 \times \rho_{t,db,n}}$$ Equation (1)

Where:

$m_{H2O,t,db}$	=	Absolute humidity of the gaseous stream in time interval *t* on a dry basis (kg H_2O/kg dry gas)
$C_{H2O,t,db,n}$	=	Moisture content of the gaseous stream in time interval *t* on a dry basis at normal conditions (mg H_2O/m3 dry gas)
$\rho_{t,db,n}$	=	Density of the gaseous stream in time interval *t* on a dry basis at normal conditions (kg dry gas/m^3 dry gas)

[3] Flow measurement on a dry basis is not feasible at reasonable costs for a wet gaseous stream, so there will be no difference in the readings for volumetric fraction in wet basis analyzers and dry basis analyzers and both types can be used indistinctly for calculation Options A and D.

16. The density of the gaseous stream on a dry basis at normal conditions ($\rho_{t,db,n}$) is determined as follows:

$$\rho_{t,db.n} = \frac{P_n \times MM_{t,db}}{R_u \times T_n}$$ Equation (2)

Where:

$\rho_{t,db.n}$	=	Density of the gaseous stream in time interval *t* on a dry basis at normal conditions (kg dry gas/m³ dry gas)
P_n	=	Absolute pressure at normal conditions (Pa)
T_n	=	Temperature at normal conditions (K)
$MM_{t,db}$	=	Molecular mass of the gaseous stream in a time interval *t* on a dry basis (kg dry gas/kmol dry gas)
R_u	=	Universal ideal gases constant (Pa.m³/kmol.K)

17. The molecular mass of the gaseous stream ($MM_{t,db}$) is estimated as follows:

$$MM_{t,db} = \sum_k (v_{k,t,db} \times MM_K)$$ Equation (3)

Where:

$MM_{t,db}$	=	Molecular mass of the gaseous stream in time interval *t* on a dry basis (kg dry gas/kmol dry gas)
$v_{k,t,db}$	=	Volumetric fraction of gas *k* in the gaseous stream in time interval *t* on a dry basis (m³ gas k/m³ dry gas)
MM_K	=	Molecular mass of gas *k* (kg/kmol)
k	=	All gases, except H_2O, contained in the gaseous stream (e.g. N_2, CO_2, O_2, CO, H_2, CH_4, N_2O, NO, NO_2, SO_2, SF_6 and PFCs). See available simplification below

18. The determination of the molecular mass of the gaseous stream ($MM_{t,db}$) requires measuring the volumetric fraction of all gases (*k*) in the gaseous stream. However, as a simplification, the volumetric fraction of only the gases k that are greenhouse gases and are considered in the emission reduction calculation in the underlying methodology must be monitored and the difference to 100% may be considered as pure nitrogen. The simplification is not acceptable if it is differently specified in the underlying methodology.

5.1.2. Option 2: Simplified calculation without measurement of the moisture content

19. This option provides a simple and conservative approach to determine the absolute humidity by assuming the gaseous stream is dry or saturated depending on which is the conservative situation.[4]

[4] An assumption that the gaseous stream is saturated is conservative for the situation that the mass flow of greenhouse gas *i* is underestimated (applicable for calculating baseline emissions). Conversely, an assumption that the gas stream is dry is conservative for the situation that the greenhouse gas *i* is overestimated (applicable for calculating activity emissions).

20. If it is conservative to assume that the gaseous stream is dry, then $m_{H2O,t,db}$ is assumed to equal 0. If it is conservative to assume that the gaseous stream is saturated, then $m_{H2O,t,db}$ is assumed to equal the saturation absolute humidity ($m_{H2O,t,db,sat}$) and calculated using equation (4).

$$m_{H2O,t,db,Sat} = \frac{p_{H20,t,Sat} \times MM_{H2O}}{(P_t - p_{H20,t,Sat}) \times MM_{t,db}}$$ Equation (4)

Where:

$m_{H2O,t,db,Sat}$	=	Saturation absolute humidity in time interval *t* on a dry basis (kg H_2O/kg dry gas
$p_{H20,t,Sat}$	=	Saturation pressure of H_2O at temperature T_t in time interval *t* (Pa)
T_t	=	Temperature of the gaseous stream in time interval *t* (K)
P_t	=	Absolute pressure of the gaseous stream in time interval *t* (Pa)
MM_{H2O}	=	Molecular mass of H_2O (kg H_2O/kmol H_2O)
$MM_{t,db}$	=	Molecular mass of the gaseous stream in a time interval *t* on a dry basis (kg dry gas/kmol dry gas)

21. Parameter $MM_{t,db}$ is estimated using equation (3).

5.1.2.1. Option A

22. Flow measurement on a dry basis is not doable for a wet gaseous stream. Therefore, it is necessary to demonstrate that the gaseous stream is dry to use this option. There are two ways to do this:

(a) Measure the moisture content of the gaseous stream ($C_{H2O,t,db,n}$) and demonstrate that this is less or equal to 0.05 kg H_2O/m^3 dry gas; or

(b) Demonstrate that the temperature of the gaseous stream (T_t) is less than 60°C (333.15 K) at the flow measurement point.

23. If it cannot be demonstrated that the gaseous stream is dry, then the flow measurement shall be assumed to be on a wet basis and the corresponding option from Table 2 shall be applied instead.

24. The mass flow of greenhouse gas *i* ($F_{i,t}$) is determined as follows:

$$F_{i,t} = V_{t,db} \times v_{i,t,db} \times \rho_{i,t}$$ Equation (5)

With:

$$\rho_{i,t} = \frac{P_t \times MM_i}{R_u \times T_t}$$ Equation (6)

Where:

$F_{i,t}$	=	Mass flow of greenhouse gas *i* in the gaseous stream in time interval *t* (kg gas/h)

$V_{t,db}$	=	Volumetric flow of the gaseous stream in time interval *t* on a dry basis (m³ dry gas/h)
$v_{i,t,db}$	=	Volumetric fraction of greenhouse gas *i* in the gaseous stream in a time interval *t* on a dry basis (m³ gas i/m³ dry gas)
$\rho_{i,t}$	=	Density of greenhouse gas *i* in the gaseous stream in time interval *t* (kg gas *i*/m³ gas *i*)
P_t	=	Absolute pressure of the gaseous stream in time interval *t* (Pa)
MM_i	=	Molecular mass of greenhouse gas *i* (kg/kmol)
R_u	=	Universal ideal gases constant (Pa.m³/kmol.K)
T_t	=	Temperature of the gaseous stream in time interval *t* (K)

5.1.2.2. Option B

25. The mass flow of greenhouse gas *i* ($F_{i,t}$) is determined using equations (5) and (6). The volumetric flow of the gaseous stream in time interval *t* on a dry basis ($V_{t,db}$) is determined by converting the measured volumetric flow from wet basis to dry basis as follows:

$$V_{t,db} = {}^{V_{t,wb}}\Big/_{\left(1 + v_{H2O,t,db}\right)}$$ Equation (7)

Where:

$V_{t,db}$	=	Volumetric flow of the gaseous stream in time interval *t* on a dry basis (m³ dry gas/h)
$V_{t,wb}$	=	Volumetric flow of the gaseous stream in time interval *t* on a wet basis (m³ wet gas/h)
$v_{H2O,t,db}$	=	Volumetric fraction of H_2O in the gaseous stream in time interval *t* on a dry basis (m³ H2O/m³ dry gas)

26. The volumetric fraction of H_2O in time interval *t* on a dry basis ($v_{H2O,t,db}$) is estimated according to equation (8).

$$v_{H20,t,db} = \frac{m_{H2O,t,db} \times MM_{t,db}}{MM_{H2O}}$$ Equation (8)

Where:

$v_{H20,t,db}$	=	Volumetric fraction of H_2O in the gaseous stream in time interval *t* on a dry basis (m³ H_2O/m³ dry gas)
$m_{H2O,t,db}$	=	Absolute humidity in the gaseous stream in time interval *t* on a dry basis (kg H_2O/kg dry gas)
$MM_{t,db}$	=	Molecular mass of the gaseous stream in time interval *t* on a dry basis (kg dry gas/kmol dry gas)
MM_{H2O}	=	Molecular mass of H_2O (kg H_2O/kmol H_2O)

27. The absolute humidity of the gaseous stream ($m_{H2O,t,db}$) is determined using either Option 1 or 2 specified in the Determination of the absolute humidity of the gaseous stream section of the tool and the molecular mass of the gaseous stream ($MM_{t,db}$) is determined using equation (3).

5.1.2.3. Option C

28. The mass flow of greenhouse gas *i* ($F_{i,t}$) is determined as follows:

$$F_{i,t} = V_{t,wb,n} \times v_{i,t,wb} \times \rho_{i,n}$$ Equation (9)

With

$$\rho_{i,n} = \frac{P_n \times MM_i}{R_u \times T_n}$$ Equation (10)

Where:

$F_{i,t}$	=	Mass flow of greenhouse gas *i* in the gaseous stream in time interval *t* (kg gas/h)
$V_{t,wb,n}$	=	Volumetric flow of the gaseous stream in time interval *t* on a wet basis at normal conditions ($m^3_{wet\ gas}$/h)
$v_{i,t,wb}$	=	Volumetric fraction of greenhouse gas *i* in the gaseous stream in time interval *t* on a wet basis ($m^3_{gas\ i}$ / $m^3_{wet\ gas\ i}$)
$\rho_{i,n}$	=	Density of greenhouse gas *i* in the gaseous stream at normal conditions ($kg_{gas\ i}$ / $m^3_{wet\ gas\ i}$)
P_n	=	Absolute pressure at normal conditions (Pa)
T_n	=	Temperature at normal conditions (K)
MM_i	=	Molecular mass of greenhouse gas *i* (kg/kmol)
R_u	=	Universal ideal gases constant (Pa.m^3/kmol.K)

29. The following equation shall be used to convert the volumetric flow of the gaseous stream from actual conditions to normal conditions of temperature and pressure:

$$V_{t,wb,n} = V_{t,wb} \times \left(\frac{T_n}{T_t}\right) \times \left(\frac{P_t}{P_n}\right)$$ Equation (11)

Where:

$V_{t,wb,n}$	=	Volumetric flow of the gaseous stream in a time interval *t* on a wet basis at normal conditions (m^3 wet gas/h)
$V_{t,wb}$	=	Volumetric flow of the gaseous stream in time interval *t* on a wet basis ($m^3_{wet\ gas}$/h)
P_t	=	Pressure of the gaseous stream in time interval *t* (Pa)
T_t	=	Temperature of the gaseous stream in time interval *t* (K)
P_n	=	Absolute pressure at normal conditions (Pa)
T_n	=	Temperature at normal conditions (K)

5.1.2.4. Option D

30. Flow measurement on a dry basis is not doable for a wet gaseous stream. Therefore, it is necessary to demonstrate that the gaseous stream is dry to use this option. There are two ways to do this:

(a) Measure the moisture content of the gaseous stream ($C_{H2O,t,db,n}$) and demonstrate that this is less or equal to 0.05 kg H_2O/m^3 dry gas; or

(b) Demonstrate that the temperature of the gaseous stream (T_t) is less than 60°C (333.15 K) at the flow measurement point.

31. If it cannot be demonstrated that the gaseous stream is dry, then the flow measurement shall be assumed to be on a wet basis and the corresponding option from Table 2 shall be applied instead.

32. The mass flow of greenhouse gas *i* ($F_{i,t}$) is determined using equations (5) and (6). The volumetric flow of the gaseous stream in time interval *t* on a dry basis ($V_{t,db}$) is determined by converting the mass flow of the gaseous stream to a volumetric flow as follows:

$$V_{t,db} = \frac{M_{t,db}}{\rho_{t,db}}$$ Equation (12)

Where:

$V_{t,db}$	=	Volumetric flow of the gaseous stream in time interval *t* on a dry basis (m^3 dry gas/h)
$M_{t,db}$	=	Mass flow of the gaseous stream in time interval *t* on a dry basis (kg/h)
$\rho_{t,db}$	=	Density of the gaseous stream in time interval *t* on a dry basis (kg dry gas/m^3 dry gas)

33. The density of the gaseous stream ($\rho_{t,db}$) shall be determined as follows:

$$\rho_{t,db} = \frac{P_t \times MM_{t,db}}{R_u \times T_t}$$ Equation (13)

Where:

$\rho_{t,db}$	=	Density of the gaseous stream in a time interval *t* on a dry basis (kg dry gas/m^3 dry gas)
$MM_{t,db}$	=	Molecular mass of the gaseous stream in a time interval *t* on a dry basis (kg dry gas/kmol dry gas)
P_t	=	Pressure of the gaseous stream in time interval *t* (Pa)
T_t	=	Temperature of the gaseous stream in time interval *t* (K)

34. The molecular mass of the gaseous stream ($MM_{t,db}$) is estimated using equation (3).

5.1.2.5. Option E

35. The mass flow of greenhouse gas *i* ($F_{i,t}$) is determined using equations (5) and (6). The volumetric flow of the gaseous stream in time interval *t* on a dry basis ($V_{t,db}$) is determined

in two steps. First the mass flow of the gaseous stream in time interval *t* on a wet basis ($M_{t,wb}$) is converted from wet basis to dry basis as follows:

$$M_{t,db} = \frac{M_{t,wb}}{\left(1 + m_{H2O,t,db}\right)}$$ Equation (14)

Where:

$M_{t,db}$	=	Mass flow of the gaseous stream in time interval *t* on a dry basis (kg/h)
$M_{t,wb}$	=	Mass flow of the gaseous stream in time interval *t* on a wet basis (kg/h)
$m_{H2O,t,db}$	=	Absolute humidity of H_2O in the gaseous stream in a time interval *t* on a dry basis (kg H_2O/kg dry gas)

36. Then, the mass flow of the gaseous stream in time interval *t* on a dry basis ($M_{t,db}$) is converted to the volumetric flow of the gaseous stream in time interval *t* on a dry basis ($V_{t,db}$) using equation (12).

37. The absolute humidity of the gaseous stream ($m_{H2O,t,db}$) is determined using either Option 1 or 2 specified in the "Determination of the absolute humidity of the gaseous stream" section of the tool.

5.1.2.6. Option F

38. The mass flow of greenhouse gas *i* ($F_{i,t}$) is determined using equations (9), (10), and the following equations:

$$V_{t,wb,n} = \frac{M_{t,wb}}{\rho_{t,wb,n}}$$ Equation (15)

And

$$\rho_{t,wb,n} = \frac{P_n \times MM_{t,wb}}{R_u \times T_n}$$ Equation (16)

Where:

$V_{t,wb,n}$	=	Volumetric flow of the gaseous stream in time interval *t* at normal conditions on a wet basis (m^3 wet gas/h)
$V_{i,t,wb}$	=	Volumetric fraction of greenhouse gas *i* in the gaseous stream in time interval *t* on a wet basis (m^3 gas *i*/m^3 wet gas)
$M_{t,wb}$	=	Mass flow of the gaseous stream in time interval *t* on a wet basis (kg/h)
$\rho_{t,wb,n}$	=	Density of the gaseous stream in time interval *t* on a wet basis at normal conditions (kg wet gas/m_3 wet gas)
P_n	=	Absolute pressure at normal conditions (Pa)
T_n	=	Temperature at normal conditions (K)
$MM_{t,wb}$	=	Molecular mass of the gaseous stream in time interval *t* on a wet basis (kg wet gas/kmol wet gas)
R_u	=	Universal ideal gases constant (Pa.m^3/kmol.K)

39. The molecular mass of the gaseous stream ($MM_{t,wb}$) is determined as follows:

$$MM_{t,wb} = \sum_{k} \left(v_{k,t,wb} \times MM_k \right)$$ Equation (17)

Where:

$MM_{t,wb}$	=	Molecular mass of the gaseous stream in time interval *t* on a wet basis (kg wet gas/kmol wet gas)
$v_{k,t,wb}$	=	Volumetric fraction of gas *k* in the gaseous stream in time interval *t* on a wet basis (m^3 gas k/m^3 wet gas)
MM_k	=	Molecular mass of gas k (kg/kmol)
k	=	All gases contained in the gaseous stream (e.g. N_2, CO_2, O_2, CO, H_2, CH_4, N_2O, NO, NO_2, SO_2, SF_6 and PFCs and H_2O in vapor phase). See available simplification below

40. The determination of the molecular mass of the gaseous stream ($MM_{t,wb}$) requires measuring the volumetric fraction of all gases (k) in the gaseous stream. However, as a simplification, the volumetric fraction of only the gases *k* that are greenhouse gases and are considered in the emission reduction calculation in the underlying methodology must be monitored and the difference to 100% may be considered as pure nitrogen. The simplification is not acceptable if it is differently specified in the underlying methodology.

5.2. Uncertainty determination

41. The uncertainty shall be determined considering the uncertainty in data and measurements of all parameters required following the guidance from Volume 1, Chapter 3 of the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. The uncertainty shall be expressed as the standard error of the mean and shall be incorporated in the uncertainty calculations in the methodology.

5.3. Data and parameters not monitored

Data / Parameter table 1.

Data/parameter	$\boldsymbol{R_u}$
Description	Universal ideal gases constant
Data unit	Pa.m^3/kmol.K
Equations referred	(2), (6), (10), (13), (16)
Purpose of data	☒ Baseline emissions ☒ Activity emissions ☐ Leakage emissions
Value(s) applied	8,314
Source of data	☐ Measured ☒ Other sources
Choice of data or measurement methods and procedures	Universal constant
Treatment of uncertainties	N/A
Additional comments	-

Data / Parameter table 2.

<table>
<tr><th>Data/parameter</th><th>MM_i</th></tr>
<tr><td>Description</td><td>Molecular mass of greenhouse gas i</td></tr>
<tr><td>Data unit</td><td>kg/kmol</td></tr>
<tr><td>Equations referred</td><td>(6), (10)</td></tr>
<tr><td>Purpose of data</td><td>☒ Baseline emissions ☒ Activity emissions ☐ Leakage emissions</td></tr>
<tr><td>Value(s) applied</td><td>
<table>
<tr><th>Compound</th><th>Structure</th><th>Molecular mass (kg / kmol)</th><th>Uncertainty (%)</th></tr>
<tr><td>Carbon dioxide</td><td>CO2</td><td>44.009</td><td>± 0.0064</td></tr>
<tr><td>Methane</td><td>CH4</td><td>16.043</td><td>± 0.013</td></tr>
<tr><td>Nitrogen trifluoride</td><td>NF3</td><td>71.001</td><td>± 0.0045</td></tr>
<tr><td>Nitrous oxide</td><td>N2O</td><td>440.13</td><td>± 0.0051</td></tr>
<tr><td>Perfluoromethane</td><td>CF4</td><td>88.003</td><td>± 0.0051</td></tr>
<tr><td>Perfluoroethane</td><td>C2F6</td><td>138.01</td><td>± 0.0052</td></tr>
<tr><td>Perfluoropropane</td><td>C3F8</td><td>188.017</td><td>± 0.0053</td></tr>
<tr><td>Perfluorobutane</td><td>C4F10</td><td>238.024</td><td>± 0.0054</td></tr>
<tr><td>Perfluorocyclobutane</td><td>c-C4F8</td><td>200.028</td><td>± 0.0057</td></tr>
<tr><td>Perfluoropentane</td><td>C5F12</td><td>288.031</td><td>± 0.0054</td></tr>
<tr><td>Perfluorohexane</td><td>C6F14</td><td>338.038</td><td>± 0.0055</td></tr>
<tr><td>Sulfur hexafluoride</td><td>SF6</td><td>146.048</td><td>± 0.014</td></tr>
</table>
</td></tr>
<tr><td>Source of data</td><td>☐ Measured ☒ Other sources</td></tr>
<tr><td>Choice of data or measurement methods and procedures</td><td>The molecular mass and the uncertainty of the elements C, H, O, N, F and S were sourced from the periodic table of elements published by the International Union of Pure and Applied Chemistry (IUPAC).[5]
The molar mass of the substances were determined by multiplying the molecular mass of each atom by the number of atoms in each substance, and the uncertainty was calculated based on the uncertainty of the molecular mass of each substance by applying the error propagation method</td></tr>
<tr><td>Treatment of uncertainties</td><td>Refer to the table above in row “Values applied” above</td></tr>
<tr><td>Additional comments</td><td>-</td></tr>
</table>

Data / Parameter table 3.

Data/parameter	MM_k
Description	Molecular mass of gas *k*
Data unit	kg/kmol
Equations referred	(3), (17)

[5] Available at https://iupac.org/what-we-do/periodic-table-of-elements/, accessed on 22 August 2025

<table>
<tr><td>Purpose of data</td><td>☒ Baseline emissions ☒ Activity emissions ☐ Leakage emissions</td></tr>
<tr><td>Value(s) applied</td><td>
<table>
<tr><th>Compound</th><th>Structure</th><th>Molare mass (kg/kmol)</th><th>Uncertainty (%)</th></tr>
<tr><td>Nitrogen</td><td>N_2</td><td>28.014</td><td>0.0071</td></tr>
<tr><td>Oxygen</td><td>O_2</td><td>31.99</td><td>0.0063</td></tr>
<tr><td>Carbon monoxide</td><td>CO</td><td>28.01</td><td>0.0079</td></tr>
<tr><td>Hydrogen</td><td>H_2</td><td>2.016</td><td>0.021</td></tr>
<tr><td>Nitric oxide</td><td>NO</td><td>30.01</td><td>0.0047</td></tr>
<tr><td>Nitrogen dioxide</td><td>NO_2</td><td>46.01</td><td>0.0049</td></tr>
<tr><td>Sulfur dioxide</td><td>SO_2</td><td>64.06</td><td>0.034</td></tr>
</table>
</td></tr>
<tr><td>Source of data</td><td>☐ Measured ☒ Other sources</td></tr>
<tr><td>Choice of data or measurement methods and procedures</td><td>The molecular mass and the uncertainty of the elements C, H, O, N and S were sourced from the periodic table of elements published by the International Union of Pure and Applied Chemistry (IUPAC).
The molecular mass of the substances were determined by multiplying the molecular mass of each atom by the number of atoms in each substance, and the uncertainty was calculated based on the uncertainty of the molecular mass of each substance by applying the error propagation method</td></tr>
<tr><td>Treatment of uncertainties</td><td>Refer to the table above in row “Values applied” above</td></tr>
<tr><td>Additional comments</td><td>-</td></tr>
</table>

Data / Parameter table 4.

Data/parameter	MM_{H_2O}
Description	Molecular mass of the water
Data unit	kg/kmol
Equations referred	(4), (8)
Purpose of data	☒ Baseline emissions ☒ Activity emissions ☐ Leakage emissions
Value(s) applied	18.015
Source of data	☐ Measured ☒ Other sources
Choice of data or measurement methods and procedures	The molecular mass of the elements H and O were sourced from the periodic table of elements published by the International Union of Pure and Applied Chemistry (IUPAC) and the molar mass of H_2O was determined by multiplying the molecular mass of H and O by 2 and 1, respectively
Treatment of uncertainties	Apply an uncertainty of 0.0060%, calculated based on the error propagation method applied to the uncertainty of the molecular mass of H and O sourced from the periodic table of elements published by the International Union of Pure and Applied Chemistry (IUPAC)
Additional comments	-

Data / Parameter table 5.

Data/parameter	P_n
Description	Total pressure at normal conditions

Data unit	Pa
Equations referred	(2), (10), (11), (16)
Purpose of data	☒ Baseline emissions ☒ Activity emissions ☐ Leakage emissions
Value(s) applied	101,325
Source of data	☐ Measured ☒ Other sources
Choice of data or measurement methods and procedures	-
Treatment of uncertainties	N/A
Additional comments	-

Data / Parameter table 6.

Data/parameter	T_n
Description	Temperature at normal conditions
Data unit	K
Equations referred	(2), (10), (11), (16)
Purpose of data	☒ Baseline emissions ☒ Activity emissions ☐ Leakage emissions
Value(s) applied	273.15
Source of data	☐ Measured ☒ Other sources
Choice of data or measurement methods and procedures	-
Treatment of uncertainties	N/A
Additional comments	-

6. Monitoring methodology

6.1. Data and parameters to be monitored

42. All monitored data must be linked in time, i.e. calculations shall be performed considering only a set of data acquired in the same time interval. As noted above, activity participants may use an hour or a smaller discrete time interval. Furthermore, additional guidance is provided in the Appendix for the purpose of monitoring mass flow of methane in the biogas.

Data / Parameter table 7.

Data/parameter	$V_{t,wb}$
Description	Volumetric flow of the gaseous stream in time interval *t* on a wet basis
Data unit	$m^3_{wet\ gas}$/h
Equations referred	(7), (11)

Purpose of data	☒ Baseline emissions ☒ Activity emissions ☐ Leakage emissions	
Measurement and updating frequency	Continuous if not specified in the underlying methodology	
Measurement methods and procedures	Volumetric flow measurement shall always refer to the actual pressure and temperature. Instruments with recordable electronic signal (analogical or digital) are required	
Entity/person responsible for the measurement	Activity participants	
Measuring instrument(s)	*Type of instrument*	N/A
	Accuracy class	N/A
	Calibration requirements	Periodic calibration against a primary device provided by an independent accredited laboratory. Calibration and frequency of calibration is according to manufacturer's specifications
	Location	N/A
QA/QC procedures	As per the calibration requirements	
Treatment of uncertainties	Uncertainties are determined based on the measuring instruments	
Additional comment	This parameter will be monitored in Options B and C	

Data / Parameter table 8.

Data/parameter	$\boldsymbol{V_{t,db}}$	
Description	Volumetric flow of the gaseous stream in time interval *t* on a dry basis	
Data unit	$m^3_{dry\ gas}/h$	
Equations referred	(5), (7), (12)	
Purpose of data	☒ Baseline emissions ☒ Activity emissions ☐ Leakage emissions	
Measurement and updating frequency	Continuous if not specified in the underlying methodology	
Measurement methods and procedures	Volumetric flow measurement shall always refer to the actual pressure and temperature. Calculated based on the wet basis flow measurement plus water concentration measurement	
Entity/person responsible for the measurement	Activity participants	
Measuring instrument(s)	*Type of instrument*	N/A
	Accuracy class	N/A
	Calibration requirements	Periodic calibration against a primary device provided by an independent accredited laboratory.

		Calibration and frequency of calibration is according to manufacturer's specifications
	Location	N/A
QA/QC procedures	As per the calibration requirements	
Treatment of uncertainties	Uncertainties are determined based on the measuring instruments	
Additional comment	This parameter will be monitored in Options A	

Data / Parameter table 9.

Data/parameter	$v_{i,t,db}$	
Description	Volumetric fraction of greenhouse gas *i* in a time interval *t* on a dry basis	
Data unit	$m^3_{gas\ i}$ /$m^3_{dry\ gas}$	
Equations referred	(5)	
Purpose of data	☒ Baseline emissions ☒ Activity emissions ☐ Leakage emissions	
Measurement and updating frequency	Continuous if not specified in the underlying methodology	
Measurement methods and procedures	Continuous gas analyser operating in dry-basis	
Entity/person responsible for the measurement	Activity participants	
Measuring instrument(s)	*Type of instrument*	Continuous gas analyser operating in dry-basis
	Accuracy class	N/A
	Calibration requirements	Calibration shall include zero verification with an inert gas (e.g. N_2) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases must have a certificate provided by the manufacturer and must be under their validity period
	Location	N/A
QA/QC procedures	As per the calibration requirements	
Treatment of uncertainties	Uncertainties are determined based on the measuring instruments	
Additional comment	This parameter will be monitored in Options B and E and may be monitored in Options A and D	

Data / Parameter table 10.

Data/parameter	$v_{i,t,wb}$
Description	Volumetric fraction of greenhouse gas *i* in a time interval *t* on a wet basis
Data unit	$m^3_{gas\ i}$ /$m^3_{wet\ gas}$

Equations referred	(9)	
Purpose of data	☒ Baseline emissions ☒ Activity emissions ☐ Leakage emissions	
Measurement and updating frequency	Continuous if not specified in the underlying methodology	
Measurement methods and procedures	Calculated based on the dry basis analysis plus water concentration measurement or continuous in-situ analyzers if not specified in the underlying methodology	
Entity/person responsible for the measurement	Activity participants	
Measuring instrument(s)	*Type of instrument*	Continuous gas analyser operating in dry-basis
	Accuracy class	N/A
	Calibration requirements	Calibration shall include zero verification with an inert gas (e.g. N_2) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases must have a certificate provided by the manufacturer and must be under their validity period
	Location	N/A
QA/QC procedures	As per the calibration requirements	
Treatment of uncertainties	Uncertainties are determined based on the measuring instruments	
Additional comment	This parameter will be monitored in Options C and F and may be monitored in Options A and D	

Data / Parameter table 11.

Data/parameter	$M_{t,wb}$	
Description	Mass flow of the gaseous stream in time interval *t* on a wet basis	
Data unit	kg/h	
Equations referred	(14), (15), (16), (17)	
Purpose of data	☒ Baseline emissions ☒ Activity emissions ☐ Leakage emissions	
Measurement and updating frequency	Continuous if not specified in the underlying methodology	
Measurement methods and procedures	Instruments with recordable electronic signal (analogical or digital) are required	
Entity/person responsible for the measurement	Activity participants	
Measuring instrument(s)	*Type of instrument*	N/A
	Accuracy class	N/A

	Calibration requirements	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. Calibration and frequency of calibration is according to manufacturer's specifications
	Location	N/A
QA/QC procedures	As per the calibration requirements	
Treatment of uncertainties	Uncertainties are determined based on the measuring instruments	
Additional comment	This parameter will be monitored in Options E and F	

Data / Parameter table 12.

Data/parameter	$M_{t,db}$	
Description	Mass flow of the gaseous stream in time interval *t* on a dry basis	
Data unit	kg/h	
Equations referred	(12), (13), (14)	
Purpose of data	☒ Baseline emissions ☒ Activity emissions ☐ Leakage emissions	
Measurement and updating frequency	Continuous if not specified in the underlying methodology	
Measurement methods and procedures	Calculated based on the wet basis flow measurement plus water concentration measurement	
Entity/person responsible for the measurement	Activity participants	
Measuring instrument(s)	*Type of instrument*	N/A
	Accuracy class	N/A
	Calibration requirements	Calibration and frequency of calibration is according to manufacturer's specifications
	Location	N/A
QA/QC procedures	As per the calibration requirements	
Treatment of uncertainties	Uncertainties are determined based on the measuring instruments	
Additional comment	This parameter will be monitored in Option D	

Data / Parameter table 13.

Data/parameter	$C_{H_2O,t,db,n}$
Description	Moisture content of the gaseous stream at normal conditions, in time interval *t*
Data unit	$mg_{H2O}/m^3_{dry\ gas}$
Equations referred	(1)

Purpose of data	☒ Baseline emissions ☒ Activity emissions ☐ Leakage emissions	
Measurement and updating frequency	The mean value among three consecutive measurements performed in the same day (at least 2 hours each) shall be considered. Measurements shall coincide with the Annual Surveillance Test (associated with requirements of the EN 14181 standard) or the calibration of the flow meter for the gaseous stream	
Measurement methods and procedures	According to the USEPA CF42 method 4 – Gravimetric determination of water content	
Entity/person responsible for the measurement	Activity participants	
Measuring instrument(s)	*Type of instrument*	According to the USEPA CF42 method 4
	Accuracy class	According to the USEPA CF42 method 4
	Calibration requirements	According to the USEPA CF42 method 4
	Location	According to the USEPA CF42 method 4
QA/QC procedures	According to the USEPA CF42 method 4	
Treatment of uncertainties	Uncertainties are determined based on the measuring instruments	
Additional comment	Monitoring is required if Option 1 described in the “Determination of the absolute humidity of the gaseous stream” section of the tool is applied, or as one of the ways of proving that the gaseous stream is dry (necessary for Options A or D)	

Data / Parameter table 14.

Data/parameter	T_t	
Description	Temperature of the gaseous stream in time interval *t*	
Data unit	K	
Equations referred	(6), (11), (13)	
Purpose of data	☒ Baseline emissions ☒ Activity emissions ☐ Leakage emissions	
Measurement and updating frequency	Continuous unless differently specified in the underlying methodology	
Measurement methods and procedures	Instruments with recordable electronic signal (analogical or digital) are required.	
Entity/person responsible for the measurement	Activity participants	
Measuring instrument(s)	*Type of instrument*	Thermocouples, thermo resistance, etc
	Accuracy class	N/A

	Calibration requirements	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. Calibration and frequency of calibration is according to manufacturer's specifications
	Location	N/A
QA/QC procedures	As per the calibration requirements	
Treatment of uncertainties	Uncertainties are determined based on the measuring instruments	
Additional comment	Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture content determination and therefore it should be metered only when performing such measurements (with same frequency). However, if the applicability condition related to the gaseous stream flow temperature being below 60ºC is adopted, this parameter must be monitored continuously to assure the applicability condition is met	

Data / Parameter table 15.

Data/parameter	P_t	
Description	Pressure of the gaseous stream in time interval *t*	
Data unit	Pa	
Equations referred	(4), (6), (11), (13)	
Purpose of data	☒ Baseline emissions ☒ Activity emissions ☐ Leakage emissions	
Measurement and updating frequency	Continuous unless differently specified in the underlying methodology	
Measurement methods and procedures	Instruments with recordable electronic signal (analogical or digital) are required	
Entity/person responsible for the measurement	Activity participants	
Measuring instrument(s)	*Type of instrument*	Pressure transducers, etc
	Accuracy class	N/A
	Calibration requirements	Periodic calibration against a primary device must be performed periodically and records of calibration procedures must be kept available as well as the primary device and its calibration certificate. Pressure transducers (either capacitive or resistive) must be calibrated monthly
	Location	N/A
QA/QC procedures	As per the calibration requirements	
Treatment of uncertainties	Uncertainties are determined based on the measuring instruments	
Additional comment	Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture	

	content determination and therefore it should be metered only when performing such measurements (with same frequency)

Data / Parameter table 16.

Data/parameter	$p_{H_2O,t,sat}$	
Description	Saturation pressure of H_2O at temperature T_t in time interval *t*	
Data unit	Pa	
Equations referred	(4)	
Purpose of data	☒ Baseline emissions ☒ Activity emissions ☐ Leakage emissions	
Measurement and updating frequency		
Measurement methods and procedures	This parameter is solely a function of the gaseous stream temperature Tt and can be found at reference [1] for a total pressure equal to 101,325 Pa	
Entity/person responsible for the measurement		
Measuring instrument(s)	*Type of instrument*	N/A
	Accuracy class	N/A
	Calibration requirements	N/A
	Location	N/A
QA/QC procedures	N/A	
Treatment of uncertainties	Uncertainties are determined based on the measuring instruments	
Additional comment	[1] Fundamentals of Classical Thermodynamics; Gordon J. Van Wylen, Richard E. Sonntag and Borgnakke; 4º Edition 1994, John Wiley & Sons, Inc.	

Data / Parameter table 17.

Data/parameter	$v_{k,t,db}$
Description	Volumetric fraction of gas *k* in the gaseous stream in time interval *t* on a dry basis
Data unit	$m^3_{gas\ k}$ / $m^3_{dry\ gas}$
Equations referred	(3)
Purpose of data	☒ Baseline emissions ☒ Activity emissions ☐ Leakage emissions
Measurement and updating frequency	Continuous if not specified in the underlying methodology/tool
Measurement methods and procedures	Continuous gas analyser operating in dry-basis

Entity/person responsible for the measurement	Activity participants	
Measuring instrument(s)	*Type of instrument*	Continuous gas analyser
	Accuracy class	N/A
	Calibration requirements	Calibration should include zero verification with an inert gas (e.g. N_2) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases must have a certificate provided by the manufacturer and must be under their validity period
	Location	N/A
QA/QC procedures	As per the calibration requirements	
Treatment of uncertainties	Uncertainties are determined based on the measuring instruments	
Additional comment	-	

Data / Parameter table 18.

Data/parameter	$v_{k,t,wb}$	
Description	Volumetric fraction of gas *k* in the gaseous stream in time interval *t* on a wet basis	
Data unit	$m^3_{gas\ k}$ / $m^3_{wet\ gas}$	
Equations referred	(17)	
Purpose of data	☒ Baseline emissions ☒ Activity emissions ☐ Leakage emissions	
Measurement and updating frequency	Continuous if not specified in the underlying methodology/tool	
Measurement methods and procedures	Calculated based on the dry basis analysis plus water concentration measurement or continuous in-situ analyzers if not specified in the underlying methodology/tool	
Entity/person responsible for the measurement	Activity participants	
Measuring instrument(s)	*Type of instrument*	Continuous gas analyser
	Accuracy class	N/A
	Calibration requirements	Calibration should include zero verification with an inert gas (e.g. N_2) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases must have a certificate provided by the manufacturer and must be under their validity period
	Location	N/A

QA/QC procedures	As per the calibration requirements
Treatment of uncertainties	Uncertainties are determined based on the measuring instruments
Additional comment	-

Data / Parameter table 19.

Data/parameter	**Status of biogas destruction device**	
Description	Operational status of biogas destruction devices	
Data unit	-	
Equations referred		
Purpose of data	☒ Baseline emissions ☒ Activity emissions ☐ Leakage emissions	
Measurement and updating frequency	Continuous if not specified in the underlying methodology/tool	
Measurement methods and procedures	Monitoring and documenting may be undertaken by recording the energy production from methane captured or the operation of the flare by means of a flame detector to demonstrate the actual destruction of methane, unless a different method is specified in the underlying methodology/tool. Emission reductions will not accrue for periods in which the destruction device is not operational	
Entity/person responsible for the measurement	Activity participants	
Measuring instrument(s)	*Type of instrument*	N/A
	Accuracy class	N/A
	Calibration requirements	N/A
	Location	N/A
QA/QC procedures	As per the calibration requirements	
Treatment of uncertainties	Uncertainties are determined based on the measuring instruments	
Additional comment	For Flame detector devices refer to the “Methodological tool Activity emissions from flaring”	

Additional data handling and monitoring guidance for determining the mass flow of methane in biogas

1. This appendix is applicable to the determination of mass flow of methane in biogas from waste treatment and landfill gas.

Data substitution for methane content or biogas flow

2. If missing data are encountered in the course of determining the methane mass flow, it may be substituted with conservative data sets (see below) from specific periods. However, data substitution shall only be applied to either the methane concentration or the biogas volumetric flow readings, but not to both simultaneously. If data is missing for both parameters during a given period of time, no data substitution shall be allowed for that period.

3. Substitution as outlined in Table 1 below may be undertaken only if the following conditions are met:

    (a) For methane concentration, biogas flow rates during the period where data gap occurred (data gap period) shall be consistent with normal operation (i.e. the average flow rates during the gap period shall not deviate from the average flow rates of the period taken for data substitution (data substitution period)[1] by more than +/- 20%); and

    (b) For biogas flow rate, methane concentration during the data gap period shall be consistent with the methane concentration observed during normal operations (i.e. the average methane concentration during the data gap period shall not deviate from the average methane concentration of the data substitution period by more than +/- 20%); and

    (c) Activity participants shall demonstrate that the methane is being destroyed during the period of the data gap. If corroborating parameters fail to demonstrate any of these requirements, no substitution shall be allowed.

Table 1. Data substitution procedure

Duration of Missing Data	Data Substitution procedure
Less than six hours	Use the weighted average of the four hours period immediately before and four hours period immediately after the outage
Six to 24 hours	Use the upper bound or lower bound of 95% confidence interval of the data spanning 24 hours prior to and 24 hours after the outage, whichever results in more conservative estimate of emission reductions

[1] The data substitution period is determined as detailed in data substitution procedure in table 1 below.

Duration of Missing Data	Data Substitution procedure
One to seven days	Use the upper bound or lower bound of 95% confidence interval of the data spanning 72 hours prior to and 72 hours after the outage, whichever results in more conservative estimate of emission reductions
Greater than one week	No data may be substituted

Use of a single flow meter for multi-use of recovered biogas

4. If the recovered biogas (e.g. landfill gas) 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.

5. If there are any periods for which one or more destruction devices are not operational, emission reductions from methane destruction for these periods may be claimed provided that verification confirms the fulfilment of all the following conditions indicated below. In such a case, the destruction efficiency of the least efficient destruction device in operation shall be used as the destruction efficiency for all destruction devices monitored by this single flow meter:

   (a) All destruction devices are either equipped with valves on the input gas line that close automatically (e.g., normally closed valves) if the device becomes non-operational (i.e., requiring no manual intervention), or designed in such a manner that it is physically impossible for the gas to pass through and into the atmosphere while the device remains non-operational; and

   (b) For any period where one or more destruction devices within this arrangement are not operational, it shall be demonstrated that the remaining operational devices have the capacity to destroy the actual gas flow recorded during the period. For devices other than flares, it shall be shown that the output corresponds to the flow of gas (e.g., through mass and/or energy balance).

6. Measurement of methane content shall be conducted immediately downstream of the flow meter, while respecting the installation requirements of the flow meter.

Use of a sampling method for methane content of landfill gas

7. Methane content of landfill gas can be monitored by sampling, provided that the following conditions are met:

   (a) The maximum waste treatment capacity of the landfill is 200 tonnes waste per day; and

   (b) The standard “Sampling and surveys for Article 6.4 activities” (still to be adopted by the SBM) is applied for conducting sampling with a minimum sampling frequency of two samples per week; and

   (c) National or international protocols for measuring methane content of biogas by a semi-continuous analysis shall be followed; otherwise, meter reading can only be collected when the methane content has reached stabilization for at least 3 minutes. Orsat analysis is not eligible; and

(d) The biogas flow rate is monitored continuously. The methane content measured by sampling for a given period can be used directly only if the average flow rate during the following week does not fluctuate by more than +/- 20% as compared to the mean value of the flow rates for the period during which the methane content is measured by sampling. Otherwise, a conservative adjustment shall be applied to the measured methane content, i.e. by applying the observed deviation as a discounting factor.

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Document information

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