विद्युत मंत्रालय
MINISTRY OF
POWER

METHODOLOGICAL TOOL

BM-T-011

Emissions from solid waste disposal sites

INDIAN
Carbon
MARKET

Publication Date: 27 March 2025

Version 1.0

Table of Contents

1. Introduction

1. This tool provides procedures to calculate baseline, project or leakage emissions of methane from solid waste disposed or prevented from disposal at a solid waste disposal site (SWDS).

2. Definitions

2. The definitions contained in the Detailed Procedure of Offset Mechanism under CCTS

3. For the purpose of this tool, the following definitions apply:

(a) **Managed SWDS** - a SWDS that has controlled placement of waste (i.e. waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires) and will include at least one of the following: (i) cover material; (ii) mechanical compacting; or (iii) levelling of the waste. In this tool, a SWDS that does not meet this definition is considered an unmanaged SWDS;

(b) **Municipal solid waste (MSW)** - a heterogeneous mix of different solid waste types, usually collected by municipalities or other local authorities. MSW includes household waste, garden/park waste and commercial/institutional waste;

(c) **Residual waste** - a solid waste type with largely homogenous properties. This includes, inter alia, material that remains after the waste is treated, e.g. anaerobic digestate and compost, and biomass residues (by-product, residue or waste stream from agriculture, forestry and related industries);

(d) **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. Solid waste may include residual wastes;

(e) **Solid waste disposal site (SWDS)** - designated areas intended as the final storage place for solid waste. Stockpiles are considered a SWDS if: (a) their volume to surface area ratio is 1.5 or larger; and if (b) a visual inspection by the DOE confirms that the material is exposed to anaerobic conditions (i.e. it has a low porosity and is moist);

(f) **Stockpile** - a pile of solid waste (not buried below ground). Anaerobic conditions are not assured in a stockpile with low volume to surface area ratios (less than 1.5) because the waste may be exposed to higher aeration.

3. Scope & Applicability

3.1. Scope

4. This tool provides procedures to calculate baseline, project or leakage emissions of methane from solid waste disposed or prevented from disposal at a SWDS.

3.2. Applicability

5. The tool can be used to determine emissions for the following types of applications::

(a) Application A: The ICM project activity mitigates methane emissions from a specific existing SWDS. Methane emissions are mitigated by capturing and flaring or combusting the methane (e.g. "BM-WA03.002: Flaring or use of landfill gas"). The methane is generated from waste disposed in the past, including prior to the start of the ICM project activity. In these cases, the tool is only applied for an ex-ante estimation of emissions in the project design document (ICM-PDD). The emissions will then be monitored during the crediting period using the applicable approaches in the relevant methodologies (e.g. measuring the amount of methane captured from the SWDS);

(b) Application B: The ICM project activity avoids or involves the disposal of waste at a SWDS. An example of this application of the tool is a situation where municipal solid waste (MSW) is treated with an alternative option, such as composting or anaerobic digestion, and is then prevented from being disposed of in a SWDS. The methane is generated from waste disposed or avoided from disposal during the crediting period. In these cases, the tool can be applied for both ex ante and ex post estimation of emissions. These project activities may apply the simplified approach detailed in 0 when calculating baseline emissions.

6. These two types of applications are referred to in the tool for determining parameters.

7. In the case that: (a) different types of residual waste are disposed or prevented from disposal; or that (b) both MSW and residual waste(s) are prevented from disposal, then the tool should be applied separately to each residual waste and to the MSW.

4. Parameters

This tool provides procedures to determine the following parameters:

Table 1. Parameters

Parameter	SI Unit	Description
$BE_{CH4,SWDS,y}$ $PE_{CH4,SWDS,y}$ $LE_{CH4,SWDS,y}$	t CO_{2e}/yr	Baseline, project or leakage methane missions occurring in year y generated from waste disposal at a SWDS during a time period ending in year y (where *y* is a period of 12 consecutive months)
$BE_{CH4,SWDS,m}$ $PE_{CH4,SWDS,m}$ $LE_{CH4,SWDS,m}$	t CO_{2e}/m	Baseline, project or leakage methane emissions occurring in month m generated from waste disposal at a SWDS during a time period ending in month *m*

5. Procedure

5.1. Simplified procedure to determine methane emissions from the SWDS

8. Simplified approaches to the FOD model and their respective simplified calculations are detailed in the appendix. Project activities and component project activities implementing

a simplified approach do not need to apply the procedure detailed in section 5.2 and would require to determine only the relevant parameters from section 5.3.

5.2. Procedure to determine methane emissions from the SWDS

9. The amount of methane generated from disposal of waste at the SWDS is calculated based on a first order decay (FOD) model. The model differentiates between the different types of waste j with respective constant decay rates (k_j) and fractions of degradable organic carbon (DOC_j).

10. The model calculates the methane generation occurring in year y (a period of 12 consecutive months) or month m based on the waste streams of waste types j ($W_{j,x}$ or $W_{j,i}$) disposed in the SWDS over a specified time period (years or months).

11. In cases where at the SWDS methane is captured (e.g. due to safety regulations) and flared, combusted or used in another manner that prevents emissions of methane to the atmosphere, the emissions are adjusted for the fraction of methane captured (f_y).

12. The amount of methane generated from disposal of waste at the SWDS is calculated for year y ($BE_{CH4,SWDS,y}$ or $PE_{CH4,SWDS,y}$ or $LE_{CH4,SWDS,y}$) using equation (1) or for month m ($BE_{CH4,SWDS,m}$ or $PE_{CH4,SWDS,m}$ or $LE_{CH4,SWDS,m}$) using equation (2). Either of these two approaches may be used to calculate the amount of methane from disposal of waste at the SWDS.. All data used to apply the equations should be documented transparently in ICM-PDD or the monitoring reports.

13. The ICM-PDD should also clearly specify the time period (the consecutive years x or months i) in which waste disposal is considered in the calculation. For application A, this time period may begin before the start of the project activity and typically starts when the SWDS starts receiving waste.

14. The emissions are calculated as follows:

$$\left.\begin{array}{l} BE_{CH4,SWDS,y} \\ PE_{CH4,SWDS,y} \\ LE_{CH4,SWDS,y} \end{array}\right\} = \varphi_y \times (1 - f_y) \times GWP_{CH4} \times (1 - OX) \times \frac{16}{12} \times F \times DOC_{f,y} \times MCF_y \times \sum_{x=1}^{y} \sum_{j} \left(W_{j,x} \times DOC_j \times e^{-k_j \times (y-x)} \times (1 - e^{-k_j}) \right)$$

Equation (1)

$$\left.\begin{array}{l} BE_{CH4,SWDS,m} \\ PE_{CH4,SWDS,m} \\ LE_{CH4,SWDS,m} \end{array}\right\} = \varphi_y \times (1 - f_y) \times GWP_{CH4} \times (1 - OX) \times \frac{16}{12} \times F \times DOC_{f,m} \times MCF_y \times \sum_{i=1}^{m} \sum_{j} \left(W_{j,i} \times DOC_j \times e^{\frac{-k_j}{12}(m-i)} \times \left(1 - e^{\frac{-k_j}{12}}\right) \right)$$

Equation (2)

Where, for the yearly model:

$BE_{CH4,SWDS,y}$ $PE_{CH4,SWDS,y}$ $LE_{CH4,SWDS,y}$	= Baseline, project or leakage methane emissions occurring in year *y* generated from waste disposal at a SWDS during a time period ending in year *y* (t CO_{2e}/yr)
x	= Years in the time period in which waste is disposed at the SWDS, extending from the first year in the time period (*x* = 1) to year *y* (*x* = *y)*
y	= Year of the crediting period for which methane emissions are calculated (*y* is a consecutive period of 12 months)
$DOC_{f,y}$	= Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for year *y* (weight fraction)
$W_{j,x}$	= Amount of solid waste type *j* disposed or prevented from disposal in the SWDS in the year *x* (t)

Where, for the monthly model:

$BE_{CH4,SWDS,m}$ $PE_{CH4,SWDS,m}$ $LE_{CH4,SWDS,m}$	= Baseline, project or leakage methane emissions occurring in month *m* generated from waste disposal at a SWDS during a time period ending in month *m* (t CO2e/m)
m	= Month of the crediting period for which methane emissions are calculated
i	= Months in the time period in which waste is disposed at the SWDS, extending from the first month in the time period (*i* = 1) to month *m* (*i* = m)
$DOC_{f,m}$	= Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for month *m* (weight fraction)
$W_{j,i}$	= Amount of organic waste type *j* disposed/prevented from disposal in the SWDS in the month *i* (t)

Where, for both the yearly and monthly model:

φ_y	= Model correction factor to account for model uncertainties for year *y*
f_y	= Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in year *y*
GWP_{CH4}	= Global Warming Potential of methane

OX = Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)

F = Fraction of methane in the SWDS gas (volume fraction)

MCF_y = Methane correction factor for year y

DOC_j = Fraction of degradable organic carbon in the waste type *j* (weight fraction)

k = Decay rate for the waste type *j* (1 / yr)

j = Type of residual waste or types of waste in the MSW

5.2.1. Determining the parameters required to apply the FOD model

15. Table 2 summarizes how the parameters required in this tool can be determined. This includes the use of default values, one-time measurements or monitoring throughout the crediting period. The selection of the option that can be used depends on whether the tool is used for application A or B.

Table 2. Overview of the option to determine parameters

Parameter	Application A	Application B
φ_y	Project or leakage emissions: default values Baseline emissions: default values or project specific value estimated yearly	
OX	Default value	
F	Default value	
$DOC_{f,y}$ or $DOC_{f,m}$	Default value	In the case of MSW: default value or estimated once In the case of residual waste: estimated once
MCF_y	Default values (based on SWDS type)	Monitored for SWDS with a water table above the bottom of the SWDS Default values (based on SWDS type) for SWDS without a water table above the bottom of the SWDS
k_j	Default values (based on waste type)	
$W_{j,x}$ or $W_{j,i}$	Estimated once	Calculated based on monitored data
DOC_j	Default values (based on waste type)	Default values or waste specific value estimated once
f_y	Estimated once	Monitored

5.2.1.1. Determining the model correction factor (φy)

16. The model correction factor (φ_y) depends on the uncertainty of the parameters used in the FOD model. If project or leakage emissions are being calculated, then $\varphi_y = \varphi_{default} = 1$. If baseline emissions are being calculated, then non-obligated entities may choose between the following two options to calculate φ_y.

5.2.1.1.1. Option 1: Use a default value

17. Use a default value: $\varphi_y = \varphi_{default}$. Default values for different applications and climatic conditions are provided in the section "Data and parameters not monitored" below.

5.2.1.1.2. Option 2: Determine φ_y based on specific situation of the project activity

18. Undertake an uncertainty analysis for the specific situation of the proposed project activity. The overall uncertainty of the determination of methane generation in year y (v_y) is calculated as follows:

$$Vy=\sqrt{a2+b2+c2+d2+e2+g2} \qquad \text{Equation (3)}$$

19. The factors a, b, c, d, e and g quantify the effect of the uncertainty of different parameters (listed in the second column of Table 3), used in the FOD model, on the overall uncertainty of the methane generation in year y. Non-obligated entities shall select for each factor a value within the range provided in Table 3,2 following the instructions in the table, and justify their selection.

Table 3. Instructions for the selection of values for the factors a, b, c, d, e and g

Factor	Parameter	Lower value	Higher value	Instructions for selecting the factor
a	*W*	2%	10%	Use the lower value if solid waste is weighed using accurate weighbridges. Use the higher value if the amount of waste is estimated, such as from the depth and surface area of an existing SWDS
b	DOC_j	5%	10%	Use the lower value if the DOC*j* is measured. Use the higher value if default values are used
c	DOC_f	5%	15%	Use the lower value if more than 50 per cent of the waste is rapidly degradable organic material or if the SWDS is located in a tropical

Factor	Parameter	Lower value	Higher value	Instructions for selecting the factor
				climate. Otherwise use the higher value
d	*F*	0%	5%	Use the lower value if more than 50 per cent of the waste is rapidly degradable organic material
e	MCF_y	0%	50%	Use the lower value for managed SWDS. For unmanaged SWDS, use the higher value or determine the factor as 2/d, where d is the depth of the SWDS (in meters)
g	$e{-}kj{\times}(y{-}x){\times}(1{-}e{-}kj)$	5%	20%	The uncertainty values provided express the uncertainty for the exponential term as a whole. Use the lower uncertainty value in the following cases: (i) Application B: if residual waste is disposed at the SWDS and if the value of *k* is larger than 0.2 y^{-1}); and (ii) Application A: if the SWDS compartments where the project is implemented were closed less than three years ago. In all other cases, use the higher value

φ_y is then calculated as follows:

$$\varphi_y=1(1+V_y) \qquad \text{Equation (4)}$$

20. For the case that the monthly FOD model is being used (equation (2)), then φ_y refers to the year y to which the month m belongs.

5.2.1.2. Determining the amounts of waste types *j* disposed in the SWDS ($W_{j,x}$ or $W_{j,i}$)

21. Where different waste types j are disposed or prevented from disposal in the SWDS (for example, in the case of MSW), it is necessary to determine the amount of different waste types *($W_{j,x}$ or $Wj_{,i}$).* In the case that only one type of waste is disposed (for example, in the

case of a residual waste), then $W_{j,x} = W_x$ and $W_{j,i} = W_i$ and the following procedures do not need to be applied (e.g. waste sampling is not required).

5.2.1.2.1. Application A

22. Calculate $W_{j,x}$ or $W_{j,i}$ based on information from the SWDS owner and administration and from interviews with senior employees. The total amount of waste can be calculated from the SWDS surface area and average depth, assuming a specific weight of 1-1.2 t per cubic meter. If the SWDS has distinct compartments and if the amount of waste per compartment and the exploitation period of a compartment is known, then the amounts of waste for a specific series of years can be obtained. Further historic information on amounts, composition and origin of the waste might be found in SWDS administration documents (e.g. contracts with clients and invoices to clients) or obtained from old business plans or business evaluations.

5.2.1.2.2. Application B

23. Determine the amount of different waste types through sampling and calculate the mean from the samples either using equation (5) to determine the value of $W_{j,x}$ for the yearly model or using equation (6) to determine the value of $W_{j,i}$ for the monthly model, as follows:

$$W_{j,x}=W_x\times p_{j,x} \quad \text{Equation (5)}$$

Where:

$W_{j,x}$	= Amount of solid waste type j disposed or prevented from disposal in the SWDS in the year *x* (t)
W_x	= Total amount of solid waste disposed or prevented from disposal in the SWDS in year *x* (t)
$p_{j,x}$	= Average fraction of the waste type *j* in the waste in year *x* (weight fraction)
j	= Types of solid waste
x	= Years in the time period for which waste is disposed at the SWDS, extending from the first year in the time period (*x* = 1) to year *y* (*x* = y)

$$W_{j,i}=W_i\times p_{j,i} \quad \text{Equation (6)}$$

Where:

$W_{j,i}$	= Amount of solid waste type j disposed or prevented from disposal in the SWDS in the month *i* (t)
W_i	= Total amount of solid waste disposed or prevented from disposal in the SWDS in month *i* (t)
$p_{j,i}$	= Average fraction of the waste type *j* in the waste in month *i* (weight fraction)
j	= Types of solid waste
x	= Months in the time period in which waste is disposed at the SWDS, extending from the first month in the time period (*i* = 1) to month m (*i* = m)

24. The fraction of the waste type *j* in the waste for the year *x* or month *i* are calculated according to equations (7) and (8), as follows:

$$p_{j,x} = \frac{\sum_{n=1}^{Z_x} p_{n,j,x}}{Z_x} \qquad \text{Equation (7)}$$

Where:

$p_{j,x}$	= Average fraction of the waste type *j* in the waste in year *x* (weight fraction)
$p_{n,j,x}$	= Fraction of the waste type *j* in the sample *n* collected during the year *x* (weight fraction)
Z_x	= Number of samples collected during the year *x*
n	= Samples collected in year *x*
j	= Types of solid waste
x	= Years in the time period for which waste is disposed at the SWDS, extending from the first year in the time period (*x* = 1) to year *y* (*x* = y)

$$p_{j,i} = \frac{\sum_{n=1}^{3} p_{n,j,i}}{3}$$ Equation (8)

Where:

$p_{j,i}$ = Average fraction of the waste type *j* in the waste in month *i* (weight fraction)

$p_{n,j,i}$ = Fraction of the waste type *j* in the sample *n* collected during or recent to month *i* (weight fraction)

n = The three most recent samples collected during or previous to month *i*

j = Types of solid waste

i = Months in the time period in which waste is disposed at the SWDS, extending from the first month in the time period (*i* = 1) to month *m* (*i* = m)

5.3. Determining the fraction of DOC that decomposes in the SWDS ($DOC_{f,y}$)

5.3.1. Application A

25. $DOC_{f,y}$ is given as a default value ($DOC_{f,y} = DOC_{f,default}$) provided in the section "Data and parameters not monitored" below.

5.3.2. Application B

26. *In* the case that the tool is applied to MSW, then non-obligated entities may choose to either apply a default value *($DOC_{f,y} = DOC_{f,default}$)* or to determine $DOC_{f,y}$ *or* $DOC_{f,m}$ based on measurements of the biochemical methane potential of the MSW *(BMP_{MSW}),* as follows:

$$DOC_{f,y} = 0.7 * \frac{12}{16} * \frac{BMP_{MSW}}{F * \sum_j (p_{j,y} * DOC_j)}$$ Equation (9)

and

$$DOC_{f,m} = 0.7 * \frac{12}{16} * \frac{BMP_{MSW}}{F * \sum_j (p_{j,m} * DOC_j)}$$ Equation (10)

Where

$DOC_{f,y}$	=	Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for year *y* (weight fraction)
$DOC_{f,m}$	=	Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for month *m* (weight fraction)
BMP_{MSW}	=	Biochemical methane potential for the MSW disposed or prevented from disposal (t CH_4/t waste)
F	=	Fraction of methane in the SWDS gas (volume fraction)
DOC_j	=	Fraction of degradable organic carbon in the waste type *j* (weight fraction)
p_j, y	=	Average fraction of the waste type *j* in the waste in year *y* (weight fraction)
pj, m	=	Average fraction of the waste type *j* in the waste in month *m* (weight fraction)
j	=	Types of solid waste in the MSW
y	=	Year of the crediting period for which methane emissions are calculated (*y* is a consecutive period of 12 months)
m	=	Month of the crediting period for which methane emissions are calculated

27. *In* the case that the tool is applied to a residual waste, then non-obligated entities shall determine $DOC_{f,y}$ or $DOC_{f,m}$ based on measurements of the biochemical methane potential of the residual waste type *j* (BMP_j), as follows:

$$DOC_{f,y} = DOC_{f,m} = 0.7 * \frac{12}{16} * \frac{BMP_j}{F * DOC_j} \quad \text{Equation (11)}$$

Where:

$DOC_{f,y}$	=	Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for year *y* (weight fraction)
$DOC_{f,m}$	=	Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for month *m* (weight fraction)
BMP_j	=	Biochemical methane potential for the residual waste type *j* disposed or prevented from disposal (t CH_4/t waste)
F	=	Fraction of methane in the SWDS gas (volume fraction)
DOC_j	=	Fraction of degradable organic carbon in the waste type *j* (weight fraction)

j	=	Residual waste type applied to the tool
y	=	Year of the crediting period for which methane emissions are calculated (y is a consecutive period of 12 months)
m	=	Month of the crediting period for which methane emissions are calculated

5.4. Procedure to determine the methane correction factor (MCF_y)

5.4.1. Application A

28. *The* MCF should be selected as a default value ($MCF_y = MCF_{default}$) provided in the section "Data and parameters not monitored" below.

5.4.2. Application B

29. In case of a water table above the bottom of the SWDS (for example, due to using waste to fill inland water bodies, such as ponds, rivers or wetlands), the MCF should be determined as follows:

$$\boldsymbol{MCF_y = Max(\left(1 - {}^{2}/_{d_y}\right), \frac{h_{w,y}}{d_y})} \quad \text{Equation (12)}$$

Where

M_{CFy}	= Methane correction factor for year y
$h_{w,y}$	= Height of water table measured from the base of the SWDS (m)
d_y	= Depth of SWDS (m)

30. In other situations, the MCF should be selected as a default value ($MCF_y = MCF_{default}$).

5.4. Data and parameters not monitored

Data / Parameter table 1.

Data / Parameter:	$\boldsymbol{\varphi_{default}}$
Data unit:	-
Description:	Default value for the model correction factor to account for model uncertainties
Source of data:	-
Value to be applied:	For project or leakage emissions: $\varphi_{default}$ = 1. For baseline emissions: refer to the table below to identify the appropriate factor based on the application of the tool (A or B) and the climate where the SWDS is located. **Default values for the model correction factor** <table><tr><td></td><td></td><td>**Humid/Wet Condition**</td><td>**Dry Condition**</td><td></td></tr></table>

	Application A	0.75	0.75
	Application B	0.85	0.80
Monitoring frequency:	-		
QA/QC procedures:	-		
Any comment:	The table above is applicable to Option 1 in the procedure "Determining the model correction factor (φy)"		

Data / Parameter table 2.

Data / Parameter:	**OX**
Data unit:	-
Description:	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data:	Based on an extensive review of published literature on this subject, including the IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value to be applied:	0.1
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	When methane passes through the top-layer, part of it is oxidized by methanotrophic bacteria to produce CO_2. The oxidation factor represents the proportion of methane that is oxidized to CO_2 This should be distinguished from the methane correction factor (MCF) which is to account for the situation that ambient air might intrude into the SWDS and prevent methane from being formed in the upper layer of SWDS

Data / Parameter table 3.

Data / Parameter:	**F**
Data unit:	-
Description:	Fraction of methane in the SWDS gas (volume fraction)
Source of data:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value to be applied:	0.5
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	Upon biodegradation, organic material is converted to a mixture of methane and carbon dioxide

Data / Parameter table 4.

Data / Parameter:	**$DOC_{f,default}$**

Data unit:	Weight fraction
Description:	Default value for the fraction of degradable organic carbon (DOC) in MSW that decomposes in the SWDS
Source of data:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value to be applied:	0.5
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, in the SWDS. This default value can only be used for: (a) Application A; or (b) Application B if the tool is applied to MSW. An alternative to using the default factor is to estimate $DOC_{f,y}$ or $DOC_{f,m}$ using equations (9), (10) and (11) above

Data / Parameter table 5.

Data / Parameter:	$\mathbf{MCF_{default}}$
Data unit:	-
Description:	Methane correction factor
Source of data:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value to be applied:	In case that the SWDS does not have a water table above the bottom of the SWDS and in case of application A, then select the applicable value from the following: (a) 1.0 for **anaerobic managed solid waste disposal sites**. These must have controlled placement of waste (i.e. waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires) and will include at least one of the following: (i) cover material; (ii) mechanical compacting; or (iii) levelling of the waste; (b) 0.5 for **semi-aerobic managed solid waste disposal sites**. These must have controlled placement of waste and will include all of the following structures for introducing air to the waste layers: (i) permeable cover material; (ii) leachate drainage system; (iii) regulating pondage; and (iv) gas ventilation system; (c) 0.8 for **unmanaged solid waste disposal sites – deep.** This comprises all SWDS not meeting the criteria of managed SWDS and which have depths of greater than or equal to 5 meters; (d) 0.4 for **unmanaged-shallow solid waste disposal sites or stockpiles that are considered SWDS.** This comprises all SWDS not meeting the criteria of managed SWDS and which have depths of less than five meters. This includes stockpiles of solid waste that are considered SWDS (according to the definition given for a SWDS)
Monitoring frequency:	-
QA/QC procedures:	-

Any comment:	MCF accounts for the fact that unmanaged SWDS produce less methane from a given amount of waste than managed SWDS, because a larger fraction of waste decomposes aerobically in the top layers of unmanaged SWDS. In case of a water table above the bottom of the SWDS, a larger proportion of the SWDS is anaerobic and MCF shall be estimated according to equation (12)

Data / Parameter table 6.

<table>
<tr><td>Data / Parameter:</td><td>DOC_j</td></tr>
<tr><td>Data unit:</td><td>-</td></tr>
<tr><td>Description:</td><td>Fraction of degradable organic carbon in the waste type j (weight fraction)</td></tr>
<tr><td>Source of data:</td><td>IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4 and 2.5)</td></tr>
<tr><td>Value to be applied:</td><td>For MSW, the following values for the different waste types j should be applied:
Default values for DOC_j
<table>
<tr><th>Waste type j</th><th>DOC_j (% wet waste)</th></tr>
<tr><td>Wood and wood products</td><td>43</td></tr>
<tr><td>Pulp, paper and cardboard (other than sludge)</td><td>40</td></tr>
<tr><td>Food, food waste, beverages and tobacco (other than sludge)</td><td>15</td></tr>
<tr><td>Textiles</td><td>24</td></tr>
<tr><td>Garden, yard and park waste</td><td>20</td></tr>
<tr><td>Glass, plastic, metal, other inert waste</td><td>0</td></tr>
</table>
For the following residual waste types, non-obligated entities may use or derive default values, as follows:
(a) For empty fruit brunches (EFB), as their characteristics are similar to garden waste, the value for garden, yard and park waste in the table above may be used as a default
(b) For industrial sludge, either a value of 9 per cent (% wet sludge) may be used as a default, assuming an organic dry matter content of 35 percent, or alternatively, if the percentage of organic dry matter content is known, then the DOC value may be calculated as follows: DOC_j (% wet sludge) = 9 * (% organic dry matter content/35);
(c) For domestic sludge, either a value of 5 per cent (% wet sludge) may be used as a default, assuming an organic dry matter content of 10 per cent, or alternatively, if the percentage of organic dry matter content is known, then the DOC value may be calculated as follows: DOC_j (% wet sludge) = 5 * (% organic dry matter content/10).
If a waste type is not comparable to MSW and cannot clearly be described as a combination of waste types in the table above or if a default value is not available or if the non-obligated entities wish to measure DOC_j, then non-obligated entities should measure DOC_j in an ignition loss test according to the procedure in EN 15169 or similar national or international standards. This measurement is only required once for each waste type j and the value determined for DOC_j remains valid during the crediting period</td></tr>
</table>

Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	The procedure for the ignition loss test is described in BS EN 15169:2007 Characterization of waste. Determination of loss on ignition in waste, sludge and sediments. The percentages listed in table above are based on wet waste basis which are concentrations in the waste as it is delivered to the SWDS. The IPCC Guidelines also specify DOC values on a dry waste basis, which are the concentrations after complete removal of all moist from the waste, which is not believed practical for this situation

Data / Parameter table 7.

Data / Parameter:	$\mathbf{k_j}$
Data unit:	1/yr
Description:	Decay rate for the waste type *j*
Source of data:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)
Value to be applied:	Apply the following default values for the different waste types *j:* **Default values for the decay rate (k_j)**

		Boreal and Temperate (MAT≤20°C)		**Tropical (MAT>20°C)**	
Waste type *j*		Dry (MAP/PET <1)	Wet (MAP/PET >1)	Dry (MAP< 1000mm)	Wet (MAP > 1000 mm)
Slowly degrading	Pulp, paper, cardboard (other than sludge), textiles	0.04	0.06	0.045	0.07
	Wood, wood products and straw	0.02	0.03	0.025	0.035
Moderately degrading	Other (non-food) organic putrescible garden and park waste	0.05	0.10	0.065	0.17

		Rapidly degrading	Food, food waste, sewage sludge, beverages and tobacco	0.06	0.185	0.085	0.40	
	Note: MAT – mean annual temperature, MAP – Mean annual precipitation, PET – potential evapotranspiration. MAP/PET is the ratio between the mean annual precipitation and the potential evapotranspiration. If a waste type disposed in a SWDS cannot clearly be attributed to one of the waste types in the table above, non-obligated entities should choose, among the waste types that have similar characteristics, the waste type where the values of DOC_j and k_j result in a conservative estimate (lowest emissions), or request a revision of/deviation from this methodology. In the case of EFB, as their characteristics are similar to garden waste, the parameter values correspondent of garden waste shall be used. In case of sludge from pulp and paper industry, a conservative value of 0.03 shall be used for all precipitation and temperature combinations							
Monitoring frequency:	-							
QA/QC procedures:	-							
Any comment:	Document in the ICM-PDD the climatic conditions at the SWDS site (temperature, precipitation and, where applicable, evapotranspiration). Use long-term averages based on statistical data, where available. Provide references							

Data / Parameter table 8.

Data / Parameter:	**BMP_{MSW} and BMP_j**
Data unit:	t CH_4/t waste
Description:	Biochemical methane potential (BMP) of MSW or the residual waste type *j* disposed or prevented from disposal
Source of data:	Samples
Measurement procedures (if any):	Conduct a fermentation test on a sample of the MSW or the residual waste that is at least 500 g in weight. The test should be undertaken according to a national or international standard, which may need to be adapted to conduct the test on a sample that is 500 g or more in weight. The duration of the fermentation test should be until no further methane is generated (indicating the complete conversion of BMP to methane). Take the average of at least three test results
Monitoring frequency:	At least three samples from different batches. Once calculated, the value determined is valid during the crediting period
QA/QC procedures:	According to the standard followed (or adapted) to measure BMP
Any comment:	The BMP is the basis of estimating $DOC_{f,y}$ and $DOC_{f,m}$ which describes the fraction of DOC that degrades under the specific conditions occurring in the SWDS (for example the moisture, temperature and salt content of the SWDS). For MSW, a default value for $DOC_{f,y}$ and $DOC_{f,m}$

	may be used instead of measurement of the BMP

Data / Parameter table 9.

Data / Parameter:	**GWP_{CH4}**
Data unit:	t CO_2e/t CH_4
Description:	Global Warming Potential of methane
Source of data:	IPCC
Value to be applied:	Global warming potential of methane valid for the relevant period.
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-

5.5. Monitoring methodology procedures

5.5.1. Monitoring procedures

Monitoring involves an annual assessment of the conditions at the SWDS where the waste is disposed or prevented from disposal.

5.5.2. Data and parameters monitored

Data / Parameter table 10.

Data / Parameter:	**fy**
Data unit:	-
Description:	Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in year *y*
Source of data:	Select the maximum value from the following: (a) contract or regulation requirements specifying the amount of methane that must be destroyed/used (if available) and (b) historic data on the amount captured
Measurement procedures (if any):	-
Monitoring frequency:	For application A: Once for the crediting period ($f_y = f$) For application B: Annually
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 11.

Data / Parameter:	**W_x or W_i**
Data unit:	t
Description:	Total amount of waste disposed in a SWDS in year *x* or month *i*
Source of data:	Measurements by non-obligated entities
Measurement procedures (if any):	Measure on wet basis
Monitoring frequency:	Continuously, aggregated at least annually for year *x* or monthly for month *i*
QA/QC procedures:	-
Any comment:	For application B

Data / Parameter table 12.

Data / Parameter:	**Worg,x**
Data unit:	t
Description:	Total amount of organic waste disposed in a SWDS in year *x*
Source of data:	Measurements by non-obligated entities
Measurement procedures (if any):	Measure on wet basis
Monitoring frequency:	Continuously, aggregated at least annually for year *x*
QA/QC procedures:	-
Any comment:	Applicable when applying simplified approach “Reduced waste composition monitoring” according to the appendix

Data / Parameter table 13.

Data / Parameter:	**$p_{n,j,x}$ or $p_{n,j,i}$**
Data unit:	-
Description:	Weight fraction of the waste type *j* in the sample *n* collected during the year *x* or month *i*
Source of data:	Sample measurements by non-obligated entities
Measurement procedures (if any):	Sample the waste composition, using the waste types *j*, as provided in the table for DOC_j and k_j, and weigh each waste fraction (measure on wet basis)
Monitoring frequency:	Minimum of three samples every three months
QA/QC procedures:	-

Any comment:	This parameter only needs to be monitored for Application B and if the waste includes more than one waste type *j*. Sampling is not required if the waste comprises only one waste type

Data / Parameter table 14

Data / Parameter:	z_x
Data unit:	-
Description:	Number of samples collected during the year *x*
Source of data:	Non-obligated entities
Measurement procedures (if any):	Minimum of three samples every three months
Monitoring frequency:	Continuously, aggregated annually
QA/QC procedures:	The sample size and sampling technique must ensure the sample is representative.
Any comment:	This parameter only needs to be monitored for Application B and if the waste includes more than one waste type *j*

Data / Parameter table 15.

Data / Parameter:	d_y
Data unit:	m
Description:	Depth of the SWDS
Source of data:	Non-obligated entities
Measurement procedures (if any):	-
Monitoring frequency:	Monitoring well that is also used to measure the height of the water table ($h_{w,y}$)
QA/QC procedures:	Monthly, average annual values to be used in the case of application of the yearly model (equation (1))
Any comment:	-
	This parameter needs to be monitored to identify whether the SWDS has a water table above the bottom of the SWDS, such as due to using waste to fill inland water bodies, such as ponds, rivers or wetlands. If the SWDS does have a water table above the bottom of the SWDS, then this parameter is used to determine the MCF

Data / Parameter table 16.

Data / Parameter:	$h_{w,y}$
Data unit:	m
Description:	Height of the water table in the SWDS

Source of data:	Non-obligated entities
Measurement procedures (if any):	Monitoring well
Monitoring frequency:	Monthly, average annual values to be used in the case of application of the yearly model (equation (1))
QA/QC procedures:	-
Any comment:	This parameter needs to be monitored to identify whether the SWDS has a water table above the bottom of the SWDS, such as due to using waste to fill inland water bodies, such as ponds, rivers or wetlands. If the SWDS does have a water table above the bottom of the SWDS, then this parameter is used to determine the MCF

Data / Parameter table 17.

Data / Parameter:	**a, b, c, d, e, g**
Data unit:	%
Description:	Effect of the uncertainty of different parameters
Source of data:	Non-obligated entities
Measurement procedures (if any):	Using the instructions in Table 3 above
Monitoring frequency:	Annually if the conditions described in the “Instructions for selecting the factor” in Table 3 have changed (e.g. a change in how the weight of the waste is measured). Once for the crediting period, if these conditions do not change
QA/QC procedures:	-
Any comment:	Used in Option 2 for determining the model correction factor

Revision/Changes in the Document

Version	*Date*	*Description*
1.0	27 March 2025	Initial Adoption