

ANNEX 1

WORKSHEETS

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Note: For 4A Category Solid Waste Disposal, see spreadsheet IPCC Waste Model.

Sector		Waste				
Category		Biological Treatment of Solid Waste				
Category Code		4B				
Sheet		1 of 1 Estimation of CH ₄ emissions from Biological Treatment of Solid Waste				
		STEP 1		STEP 2	STEP 3	
Biological Treatment System	Waste Category/ Types of Waste ¹	A	B	C	D	E
		Total Annual amount treated by biological treatment facilities ³	Emission Factor	Gross Annual Methane Generation	Recovered/flared Methane per Year	Net Annual Methane Emissions
		(Gg)	(g CH ₄ /kg waste treated)	(Gg CH ₄)	(Gg CH ₄)	(Gg CH ₄)
				$C = (A \times B) \times 10^{-3}$		$E = (C - D)$
Composting						
Anaerobic digestion at biogas facilities²						
Total						
<p>1 Information on the waste category should include information of the origin of the waste (MSW, Industrial, Sludge or Other) and type of waste (Food waste or Garden and Park Waste).</p> <p>2 If anaerobic digestion involves recovery and energy use of the gas, the emissions should be reported in the Energy Sector.</p> <p>3 Information on whether the amount treated is given as wet or dry weight should be given.</p>						

Sector		Waste		
Category		Biological Treatment of Solid Waste		
Category Code		4B		
Sheet		1 of 1 Estimation of N₂O emissions from Biological Treatment of Solid Waste		
		STEP 1	STEP 2	
Biological Treatment System	Waste Category /Types of Waste¹	A	B	C
		Total Annual amount treated by biological treatment facilities ³ (Gg)	Emission Factor (g N ₂ O/kg waste treated)	Net Annual Nitrous Oxide Emissions (Gg N ₂ O)
				$C = (A \times B) \times 10^{-3}$
Composting				
Anaerobic digestion at biogas facilities²				
Total				
<p>1 Information on the waste category should include information of the origin of the waste (MSW, Industrial, Sludge or Other) and type of waste (Food waste or Garden and Park Waste).</p> <p>2 If anaerobic digestion involves recovery and energy use of the gas, the emissions should be reported in the Energy Sector.</p> <p>3 Information on whether the amount treated is given as wet or dry weight should be given.</p>				

Sector		Waste					
Category		Waste Incineration					
Category Code		4C1					
Sheet		I of I Estimation of CO ₂ emissions from Incineration of Waste					
Type of Waste	A	B	C	D	E	F	G
	Total Amount of Waste Incinerated (Wet Weight) (Gg Waste)	Dry Matter Content ¹ dm (fraction)	Fraction of Carbon in Dry Matter ² CF (fraction)	Fraction of Fossil Carbon in Total Carbon ³ FCF (fraction)	Oxidation Factor OF (fraction)	Conversion Factor 44/12	Fossil CO ₂ Emissions (Gg CO ₂) G = A x B x C x D x E x F
Municipal Solid Waste (MSW) ^{4, 5}							
Composition ^{4,5}	Plastics						
	Textiles						
	Rubber						
	Nappies						
Industrial solid waste							
Hazardous waste							
Clinical waste							
Sewage sludge							
Other (specify)							
Total							
<p>1 For default data and relevant equations on the dry matter content in MSW and other types of waste, see Section 5.3.3 in Chapter 5.</p> <p>2 For default data and relevant equations on the fraction of carbon, see Section 5.4.1.1 in Chapter 5.</p> <p>3 For default data and relevant equations on the fraction of fossil carbon, see Section 5.4.1.2 in Chapter 5.</p> <p>4 Users may either enter all MSW incinerated in the MSW row or the amount of waste by composition by adding the appropriate rows.</p> <p>5 All relevant fractions of fossil C should be included. For consistency with the CH₄ and N₂O sheets, the total amount incinerated should be reported here. However the fossil CO₂ emissions from MSW should be reported either for total MSW or its components.</p>							

Sector	Waste					
Category	Open Burning of Waste					
Category Code	4C2					
Sheet	1 of 1 Estimation of total amount of waste open-burned					
STEP 1						
Region, city, etc.	A	B	C	D	E	F
	Population	Fraction of Population Burning Waste	Per Capita Waste Generation	Fraction of the waste amount burned relative to the total amount of waste treated	Number of days by year 365	Total Amount of MSW Open-burned
	P (Capita)	P _{frac} (fraction)	MSW _P (kg waste/capita/day)	B _{frac} ¹ (fraction)	(day)	MSW _B (Gg/yr)
						$F = A \times B \times C \times D \times E \times 10^{-6}$
Sum of regions, cities, etc. (Total amount of MSW open-burned in the country)						
Total						
<p>1 When all the amount of waste is burned B_{frac} could be considered equal 1. When a substantial quantity of waste in open dumps is burned, a relatively large part of waste is left unburned. In this situation, B_{frac} should be estimated using survey or research data available or expert judgement.</p>						

Sector		Waste					
Category		Open Burning of Waste					
Category Code		4C2					
Sheet		1 of 1 Estimation of CO ₂ emissions from Open Burning of Waste					
STEP 1			STEP 2				
Type of Waste	F	G	H	I	J	K	L
	Total Amount of Waste open-burned (Wet Weight) (Gg Waste)	Dry Matter Content ¹ dm (fraction)	Fraction of Carbon in Dry Matter ² CF (fraction)	Fraction of Fossil Carbon in Total Carbon ³ FCF (fraction)	Oxidation Factor OF (fraction)	Conversion Factor 44/12	Fossil CO ₂ Emissions (Gg CO ₂)
	$F = A \times B \times C \times D \times E \times 10^{-6,4}$						$L = F \times G \times H \times I \times J \times K$
Municipal Solid Waste (MSW) ^{5,6}	This comes from previous table						
Composition ^{5,6}	Plastics						
	Textiles						
	Rubber						
	Nappies						
	etc						
	add as needed						
Other (specify)							
Total							
<p>1 For default data and relevant equations on the dry matter content in MSW and other types of waste, see Section 5.3.3 in Chapter 5.</p> <p>2 For default data and relevant equations on the fraction of carbon, see Section 5.4.1.1 in Chapter 5.</p> <p>3 For default data and relevant equations on the fraction of fossil carbon, see Section 5.4.1.2 in Chapter 5.</p> <p>4 The amount MSW can be calculated in the previous sheet "Estimation of Total Amount of Waste Open-burned". See also Equation 5.7.</p> <p>5 Users may either enter all MSW incinerated in the MSW row or the amount of waste by composition by adding the appropriate rows.</p> <p>6 All relevant fractions of fossil C should be included. For consistency with the CH₄ and N₂O sheets, the total amount open-burned should be reported here. However, the fossil CO₂ emissions from MSW should be reported either for total MSW or its components.</p>							

Sector	Waste				
Category	Waste Incineration				
Category Code	4C1				
Sheet	I of I Estimation of CO₂ emissions from incineration of fossil liquid waste				
Type of Waste	A	B	C	D	E
	Total Amount of Fossil Liquid Waste Incinerated (Weight)	Fossil Carbon Content of Fossil Liquid Waste	Oxidation Factor for Fossil Liquid Waste of type i	Conversion Factor	Fossil CO ₂ Emissions
	Gg Waste	CL (fraction)	OF (fraction)	44/12	(Gg CO ₂)
					E= A x B x C x D
Lubricants					
Solvents					
Waste oil					
Other (specify)					
Total					

Sector	Waste		
Category	Waste Incineration		
Category Code	4C1		
Sheet	I of I Estimation of CH ₄ emissions from Incineration of Waste		
Type of Waste	A	B	C
	Amount of Waste Incinerated (Wet Weight) ¹ (Gg Waste)	Methane Emission Factor (kg CH ₄ /Gg Wet Waste) ¹	Methane Emissions (Gg CH ₄)
			$C = A \times B \times 10^{-6}$ ²
Municipal Solid Waste			
Industrial solid waste			
Hazardous waste			
Clinical waste			
Sewage sludge			
Other (specify)			
Total			
<p>1 If the total amount of waste is expressed in terms of dry waste, the CH₄ emission factor needs to refer to dry waste instead.</p> <p>2 10⁻⁶ converts result into Gg.</p>			

Sector	Waste		
Category	Open Burning of Waste		
Category Code	4C2		
Sheet	I of I Estimation of CH₄ emissions from Open Burning of Waste		
Type of Waste	F	G	H
	Total Amount of Waste Open-burned (Wet Weight) ^{1,2} (Gg Waste)	Methane Emission Factor (kg CH ₄ /Gg Wet Waste) ²	Methane Emissions (Gg CH ₄)
			$H = F \times G \times 10^{-6}$ ³
Municipal Solid Waste			
Other (specify)			
Total			
<p>1 Total amount of MSW open-burned is obtained by estimates in the Worksheet "Total amount of waste open-burned".</p> <p>2 If the total amount of waste is expressed in term of dry waste, the CH₄ emission factor needs to refer to dry waste instead.</p> <p>3 10⁻⁶ converts result into Gg.</p>			

Sector	Waste		
Category	Waste Incineration		
Category Code	4C1		
Sheet	I of I Estimation of N₂O emissions from Incineration of Waste		
Type of Waste	A	B	C
	Total Amount of Waste Incinerated (Wet Weight ¹) (Gg Waste)	Nitrous Oxide Emission Factor (kg N ₂ O/Gg Wet Waste) ¹	Nitrous Oxide Emissions (Gg N ₂ O)
			$C = A \times B \times 10^{-6}$ ²
Municipal Solid Waste			
Industrial solid waste			
Hazardous waste			
Clinical waste			
Sewage sludge			
Other (specify)			
	Total		
<p>1 If the total amount of waste is expressed in terms of dry waste, the N₂O emission factor needs to refer to dry waste instead.</p> <p>2 10⁻⁶ converts result into Gg.</p>			

Sector	Waste		
Category	Open Burning of Waste		
Category Code	4C2		
Sheet	I of I Estimation of N₂O emissions from Open Burning of Waste		
	F	G	H
Type of Waste	Total Amount of Waste Open-burned (Dry Weight) ¹ (Gg Waste)	Nitrous Oxide Emission Factor (kg N ₂ O/Gg Dry Waste)	Nitrous Oxide Emissions (Gg N ₂ O)
			$H = F \times G \times 10^{-6}$ ²
Municipal Solid Waste			
Other (specify)			
		Total	
<p>1 These data are given by multiplying columns F and G in sheet 1 of 1 "Estimation of CO₂ emissions from Open Burning of Waste" in page A1.7</p> <p>2 10⁻⁶ converts result into Gg</p>			

Sector	Waste			
Category	Domestic Wastewater Treatment and Discharge			
Category Code	4D1			
Sheet	1 of 3 Estimation of Organically Degradable Material in Domestic Wastewater			
STEP 1				
Region or City	A	B	C	D
	Population (P) cap	Degradable organic component (BOD) (kg BOD/cap/yr) ¹	Correction factor for industrial BOD discharged in sewers (I) ²	Organically degradable material in wastewater (TOW) (kg BOD/yr)
				D = A x B x C
			Total	
<p>1 g BOD/cap/day x 0.001 x 365 = kg BOD/cap/yr</p> <p>2 Correction factor for additional industrial BOD discharged into sewers, (for collected the default is 1.25, for uncollected the default is 1.00) (see page 6.14).</p>				

Sector	Waste		
Category	Domestic Wastewater Treatment and Discharge		
Category Code	4D1		
Sheet	2 of 3 Estimation of CH₄ emission factor for Domestic Wastewater		
STEP 2			
Type of treatment or discharge	A	B	C
	Maximum methane producing capacity (B ₀) (kg CH ₄ /kgBOD)	Methane correction factor for each treatment system (MCF _j)	Emission factor (EF _j) (kg CH ₄ /kg BOD) C = A x B
add as needed			

Sector		Waste						
Category		Domestic Wastewater Treatment and Discharge						
Category Code		4D1						
Sheet		3 of 3 Estimation of CH ₄ emissions from Domestic Wastewater						
STEP 3								
Income group	Type of treatment or discharge pathway	A	B	C	D	E	F	G
		Fraction of population income group (U _i) (fraction)	Degree of utilization (T _{ij}) (fraction)	Emission Factor (EF _j) (kg CH ₄ /kg BOD)	Organically degradable material in wastewater (TOW) (kg BOD/yr)	Sludge removed (S) (kg BOD/yr)	Methane recovered and flared (R) (kg CH ₄ /yr)	Net methane emissions (CH ₄) (kg CH ₄ /yr)
				Sheet 2 of 3	Sheet 1 of 3			$G = [(A \times B \times C) \times (D - E)] - F$
Rural								
Urban high income								
Urban low income								
Total								

Sector	Waste			
Category	Industrial Wastewater Treatment and Discharge			
Category Code	4D2			
Sheet	1 of 3 Total Organic Degradable Material in wastewater for each industry sector			
STEP 1				
Industry Sectors	A	B	C	D
	Total industry product (P _i) (t _{product} /yr)	Wastewater generated (W _i) (m ³ /t _{product})	Chemical Oxygen Demand (COD _i) (kgCOD/m ³)	Total organic degradable material in wastewater for each industry sector (TOW _i) (kgCOD/yr)
				D = A x B x C
Industrial sector 1				
Industrial sector 2				
Industrial sector 3				
add as needed				
Total				

Sector	Waste		
Category	Industrial Wastewater Treatment and Discharge		
Category Code	4D2		
Sheet	2 of 3 Estimation of CH₄ emission factor for Industrial Wastewater		
STEP 2			
Type of treatment or discharge	A	B	C
	Maximum Methane Producing Capacity (B ₀) (kg CH ₄ /kg COD)	Methane Correction Factor for the Treatment System (MCF _i) (-)	Emission Factor (EF _i) (kg CH ₄ /kg COD)
			C = A x B
add as needed			

Sector	Waste					
Category	Industrial Wastewater Treatment and Discharge					
Category Code	4D2					
Sheet	3 of 3 Estimation of CH ₄ emissions from Industrial Wastewater					
STEP 3						
Industrial sector		A	B	C	D	E
	Type of treatment or discharge pathway	Total organic degradable material in wastewater for each industry sector (TOW _i) (kg COD/yr)	Sludge removed in each industry sector (S _i) (kg COD/yr)	Emission factor for each treatment system (EF _i) (kg CH ₄ /kg COD)	Recovered CH ₄ in each industry sector (R _i) (kg CH ₄ /yr)	Net methane emissions (CH ₄) (kg CH ₄ /yr)
Units		Sheet 1 of 3		Sheet 2 of 3		$E = [(A - B) \times C] - D$
Industrial sector 1						
Industrial sector 2						
Industrial sector 3						
add as needed						
Total						

Sector	Waste						
Category	Domestic Wastewater Treatment and Discharge						
Category Code	4D1						
Sheet	1 of 2 Estimation of nitrogen in effluent						
	A	B	C	D	E	F	H
	Population	Per capita protein consumption	Fraction of nitrogen in protein	Fraction of non-consumption protein	Fraction of industrial and commercial co-discharged protein	Nitrogen removed with sludge (default is zero)	Total nitrogen in effluent
	(P)	(Protein)	(F _{NPR})	(F _{NON-CON})	(F _{IND-COM})	(N _{SLUDGE})	(N _{EFFLUENT})
units	(people)	(kg/person/year)	(kg N/kg protein)	(-)	(-)	(kg)	kg N/year
							$H = (A \times B \times C \times D \times E) - F$
						Total	

Sector	Waste				
Category	Domestic Wastewater Treatment and Discharge				
Category Code	4D1				
Sheet	2 of 2 Estimation of emission factor and emissions of indirect N₂O from Wastewater				
	A	B	C	D	E
	Nitrogen in effluent (N _{EFFLUENT}) (kg N/year)	Emission factor (kg N ₂ O-N/kg N)	Conversion factor of kg N ₂ O-N into kg N ₂ O 44/28	Emissions from Wastewater plants (default = zero) (kg N ₂ O/year)	Total N ₂ O emissions (kg N ₂ O/year)
					E= (A x B x C) – D