ANNEX 2

WORKSHEETS

Contents

Sector	**Waste**		
Category	**Domestic Wastewater Treatment and Discharge**		
Category Code	**4D1**		
Sheet	**1 of 8 Estimation of Total Organically Degradable Material in Domestic Wastewater (Updated)**		
STEP 1			
Region or City	A	B	C
	Population (P) cap	Degradable organic component (BOD) (kg BOD/cap/yr) [1]	Organically degradable material in wastewater (TOW) (kg BOD/yr)
			C = A x B
		Total	

[1] g BOD/cap/day x 0.001 x 365 = kg BOD/cap/yr

Sector		**Waste**				
Category		**Domestic Wastewater Treatment and Discharge**				
Category Code		**4D1**				
Sheet		**2 of 8 Estimation of Total Organics in Domestic Wastewater by Treatment Discharge Pathway or System (New)**				
STEP 1						
Type of treatment or discharge pathway	**Income group**	A Organically degradable material in wastewater (TOW) (kg BOD/yr)	B Fraction of population income group *i* in inventory year (U_i) (fraction)	C Degree of utilization of treatment/ discharge pathway or system, *j*, for each income group *i* (T_{ij}) (fraction)	D Correction factor for industrial BOD discharged in sewers (I_j)[1]	E Total organics in wastewater by income group and pathway (TOW_{ij}) (kg BOD/yr)
		Sheet 1 of 8				E = A x B x C x D
	Rural					
	Urban high income					
	Urban low income					
	Rural					
	Urban high income					
	Urban low income					
	Rural					
	Urban high income					
	Urban low income					
Add as needed						
					Total	

[1] 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 6.22 of the *2019 Refinement*).

Sector	**Waste**			
Category	**Domestic Wastewater Treatment and Discharge**			
Category Code	**4D1**			
Sheet	**3 of 8 Estimation of Organic Component Removed as Sludge from Aerobic Treatment Plants (New)**			
STEP 1A				
Type of treatment or discharge	A	B	C	D
	Amount of sludge removed from wastewater treatment (S_{mass}) (tonnes sludge/yr)	Sludge factor[1] (K_{rem}) (kg BOD/kg sludge)	Conversion factor of tonnes into kg 1000	Organic component removed as sludge ($S_{aerobic}$) (kg BOD/yr)
				D = A x B x C
Add as needed				
			Total	

[1] See Table 6.6a for default values.

Sector	**Waste**			
Category	**Domestic Wastewater Treatment and Discharge**			
Category Code	**4D1**			
Sheet	**4 of 8 Estimation of Organic Component Removed as Sludge from Septic Systems (New)**			
STEP 1A				
	A	B	C	D
Type of treatment or discharge	Total organics in septic systems (TOW_{septic}) (kg BOD/yr)	Fraction of population managing their septic tank in compliance[1] (F) (fraction)	Faction of organics removed in sludge[2] (0.5) (fraction)	Organic component removed as sludge (S_{septic}) (kg BOD/yr)
	Sheet 2 of 8			D = A x B x C
Add as needed				
			Total	

[1] Default value is 0.5.

[2] Default value is 0.5.

Sector	**Waste**
Category	**Domestic Wastewater Treatment and Discharge**
Category Code	**4D1**
Sheet	**5 of 8 Estimation of Total Organics in Treated Domestic Wastewater Effluent (New)**

STEP 1B				
	A	B	C	D
Type of treatment or discharge	Organically degradable material in wastewater (TOW) (kg BOD/yr)	Fraction of wastewater treated exclusively by each wastewater treatment type *j*[1] (T_j) (fraction)	Faction of organics removed in sludge[2] ($TOW_{REM,j}$) (fraction)	Total organics in treated domestic wastewater effluent ($TOW_{EFFtreat}$) (kg BOD/yr)
	Sheet 1 of 8			D = A x B x (1 – C)
Add as needed				
			Total	

[1] See Table 6.5.

[2] See Table 6.6b.

Sector	**Waste**		
Category	**Domestic Wastewater Treatment and Discharge**		
Category Code	**4D1**		
Sheet	**6 of 8 Estimation of CH_4 Emission Factor for Domestic Wastewater**		
STEP 2			
Type of treatment or discharge	A	B	C
	Maximum methane producing capacity (B_o) (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		**7 of 8 Estimation of CH_4 Emissions from Domestic Wastewater for Each Income Group and Treatment Discharge Pathway (Updated)**				
STEP 3						
		A	B	C	D	E
Type of treatment or discharge pathway	**Income group**	Total organics in wastewater by income group and pathway (TOW_j) (kg BOD/yr)	Sludge removed (S_j)[1] (kg BOD/yr)	Emission Factor (EF_j) (kg CH_4/kg BOD)	Methane recovered and flared (R_j) (kg CH_4/yr)	Net methane emissions (CH_4) (kg CH_4/yr)
		Sheet 2 of 8	Sheet 3 and 4 of 8	Sheet 6 of 8		E = [(A - B) x C - D]
	Rural					
	Urban high income					
	Urban low income					
	Rural					
	Urban high income					
	Urban low income					
	Rural					
	Urban high income					
	Urban low income					
Add as needed						
					Total	

[1] Default value is zero for systems other than centralized aerobic treatment systems or septic systems.

Sector	**Waste**
Category	**Domestic Wastewater Treatment and Discharge**
Category Code	**4D1**
Sheet	**8 of 8 Estimation of Total CH_4 Emissions from Domestic Wastewater Treatment and Discharge (New)**

STEP 3		
A	B	C
Total methane emissions (CH_4) (kg CH_4/yr)	Conversion factor of kg into Gg 10^{-6}	Total methane emissions (CH_4) (Gg CH_4/yr)
Sheet 7 of 8		C = A x B

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				
	A	B	C	D
Industry Sectors	Total industry product (P_i) ($t_{product}$/yr)	Wastewater generated (W_i) ($m^3/t_{product}$)	Chemical Oxygen Demand (COD_i) (kg COD/m^3)	Total organic degradable material in wastewater for each industry sector (TOW_i) (kg COD/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 CH_4 Emission Factor for Industrial Wastewater**		
STEP 2			
	A	B	C
Type of treatment or discharge	Maximum Methane Producing Capacity (B_0) (kg CH_4/kg COD)	Methane Correction Factor for the Treatment System (MCF_j)	Emission Factor (EF_j) (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							
		A	B	C	D	E	F
Industrial sector	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)	Conversion factor of kg into Gg 10^{-6}	Net methane emissions (CH_4) (kg CH_4/yr)
		Sheet 1 of 3		Sheet 2 of 3			F = [[(A – B) x C] – D] x E
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 5 Estimation of Nitrogen in Domestic Wastewater (New)**

STEP 1

Type of treatment or discharge pathway	A Population served by the treatment pathway, *j* ($P_{treatment}$) (people/year)	B Per capita protein consumption (Protein) (kg/person/ year)	C Fraction of nitrogen in protein (F_{NPR}) (kg N/kg protein)	D Additional nitrogen from household products[1] N_{HH} (fraction)	E Fraction of non-consumed protein and additional nitrogen from household products ($F_{NON-CON}$) (-)	F Fraction of industrial and commercial co-discharged protein ($F_{IND-COM}$) (-)	G Total nitrogen in domestic wastewater (treated) by treatment pathway (TN_{DOM_j}) (kg N/year)
							G = (A x B x C x D x E x F)
Add as needed							
						Total	

[1] Default value is 1.1.

Sector	Waste	
Category	**Domestic Wastewater Treatment and Discharge**	
Category Code	**4D1**	
Sheet	**2 of 5 Estimation of Protein Consumed (New)**	
STEP 1		
A	B	C
Annual per capita protein supply ($Protein_{SUPPLY}$) (kg protein/person/year)	Fraction of protein consumed (FPC) (fraction)	Protein consumed (Protein) (kg protein/person/year)
		C = (A x B)
Total		

Sector	**Waste**			
Category	**Domestic Wastewater Treatment and Discharge**			
Category Code	**4D1**			
Sheet	**3 of 5 Estimation of Nitrogen in Effluent from Domestic Wastewater (New)**			
STEP 1				
	A	B	C	D
Type of treatment or discharge pathway	Total nitrogen in domestic wastewater (TN_{DOM}) (kg N/year)	Fraction of wastewater treated exclusively by each wastewater treatment type *j* (T_j) (fraction)	Fraction of total wastewater nitrogen removed during wastewater treatment per treatment type j ($N_{REM,j}$) (-)	Total nitrogen in effluent ($N_{EFFLUENT,DOM}$) (kg N/year)
	Sheet 1 of 4			D = [A x (B x (1 - C))]
Add as needed				
			Total	

Sector	**Waste**
Category	**Domestic Wastewater Treatment and Discharge**
Category Code	**4D1**
Sheet	**4 of 5 Estimation of N_2O Emissions from Domestic Wastewater Treatment Plants for each Income Group and Treatment Discharge Pathway or System (New)**

STEP 3

Income group	**Type of treatment or discharge pathway**	A Fraction of population in income group *i* in inventory year (U_i) (fraction)	B Degree of utilisation of treatment/ discharge pathway or system, *j*, for each income group, *i* (T_{ij}) (fraction)	C Emission factor for treatment/discharge pathway or system, *j* (EF_j) (kg N_2O-N/kg N)	D Total nitrogen in domestic wastewater (treated) (TN_{DOM}) (kg N/year)	E Conversion factor of kg N_2O-N into kg N_2O 44/28	F N_2O emissions from domestic wastewater treatment plants in inventory year (N_2O $Plants_{DOM}$) (kg N_2O/yr)
					Sheet 1 of 4		F = A x B x C x D x E
Rural							
Urban high income							
Urban low income							
						Total	

Sector	**Waste**			
Category	**Domestic Wastewater Treatment and Discharge**			
Category Code	**4D1**			
Sheet	**5 of 5 Estimation of N2O Emissions from Domestic Wastewater Effluent (New)**			
STEP 4				
Type of treatment or discharge pathway	A	B	C	D
	Nitrogen in effluent ($N_{EFFLUENT,DOM}$) (kg N/year)	Emission factor ($EF_{EFFLUENT}$) (kg N_2O-N/kg N)	Conversion factor of kg N_2O-N into kg N_2O 44/28	Total N_2O emissions (kg N_2O/year)
	Sheet 3 of 5	See Table 6.8a (New)		D = A x B x C
			Total	

Sector	**Waste**			
Category	**Industrial Wastewater Treatment and Discharge**			
Category Code	**4D2**			
Sheet	**1 of 4 Estimation of Nitrogen in Industrial Wastewater (New)**			
STEP 1				
	A	B	C	D
Industry Sectors	Total industry product (P_i) ($t_{product}$/yr)	Wastewater generated (W_i) ($m^3/t_{product}$)	Total nitrogen (TN_i) (kg N/m^3)	Total nitrogen in industrial wastewater (treated) (TN_{INDi}) (kg N/year)
				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 4 Estimation of Nitrogen in Effluent from Industrial Wastewater (New)**			
STEP 1				
	A	B	C	D
Type of treatment or discharge pathway	Total nitrogen in industrial wastewater (TN_{INDi}) (kg N/year)	Fraction of wastewater treated exclusively by each wastewater treatment type *j* (T_j) (fraction)	Fraction of total wastewater nitrogen removed during wastewater treatment per treatment type *j* ($N_{REM,j}$) (-)	Total nitrogen in effluent ($N_{EFFLUENT,IND}$) (kg N/year)
	Sheet 1 of 4			D = [A x (B x (1 - C))]
Add as needed				
			Total	

Sector	**Waste**
Category	**Industrial Wastewater Treatment and Discharge**
Category Code	**4D2**
Sheet	**3 of 4 Estimation of N_2O Emissions from Industrial Wastewater Treatment Plants (New)**

STEP 3					
Type of treatment	A	B	C	D	E
	Degree of utilisation of treatment/discharge pathway or system, *j*, for each industry, *i*	Emission factor for treatment/discharge pathway or system, *j*	Nitrogen in wastewater from industry, *i* (treated)	Conversion factor of kg N_2O-N into kg N_2O	N_2O emissions from industrial wastewater treatment plants in inventory year
	($T_{i,j}$) (fraction)	(EF_j) (kg N_2O-N/kg N)	(TN_{INDi}) (kg N/year)	44/28	(N_2O $Plants_{IND}$) (kg N_2O/year)
			Sheet 1 of 4		E = (A x B x C x D)
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	**4 of 4 Estimation of N_2O Emissions from Industrial Wastewater Effluent (New)**			
STEP 4				
Type of treatment or discharge pathway	A	B	C	D
	Nitrogen in effluent ($N_{EFFLUENT,IND}$) (kg N/year)	Emission factor ($EF_{EFFLUENT}$) (kg N_2O-N/kg N)	Conversion factor of kg N_2O-N into kg N_2O 44/28	Total N_2O emissions from industrial wastewater effluent ($N_2OEffluent_{IND}$) (kg N_2O/year)
	Sheet 2 of 4	See Table 6.8a		D = A x B x C
Add as needed				
			Total	