WASTE SECTOR

30th April 2024

Presenter: Sabino Del Vento

(supported by U.S. EPA)

30th April – Agenda

Time	Activity	Presenters
Session 1 09.00-10.15	IPCC Inventory Software – Waste (data entry and CRTs)	Sandro Federici, IPCC team with support from EPA team (Mausami Desai)
10:15 - 10:30	Tea/Coffee Break	
10:30 - 11:30	General discussion and cross cutting issues: Energy, IPPU and Waste	All Resource Persons
11:30 - 12:30	Lunch Break	
Session 2 12.30-14.30	Waste Sector Overview Emissions reported in TCN, GHGI Completeness, Cross linkage within and with other sector, Double counting, Data collection\gaps, Higher tier level methodology, Mandatory Requirements and Flexibility Provisions Solid Waste Disposal: • Key methodological approaches in the IPCC 2006 GL • Recalculations • Moving from Tier 1 to Tier 2 • Emission estimates using the IPCC Waste Model	*Virtual Session* Sabino Del Vento Serena Churchill
14.30-14.45	Tea / Coffee Break	
Session 3 14.45-16.45	Waste Sector: Wastewater Treatment and Discharge: • Key methodological approaches in the IPCC 2006 GL • Moving from Tier 1 to Tier 2 • Emission estimates using the All Worksheets in Vol.5	*Virtual Session* Sabino Del Vento Serena Churchill

INDIA'S TOTAL NATIONAL GHG EMISSIONS

- Waste sector is often considered to be less significant compared to Energy and AFOLU
- In 2019 its contribution was ~2%
- CH_4 emissions from waste is usually significant (2nd source after CH_4 from agriculture)
- Waste generation and management are major challenges for countries with expanding economies and industries
- Managing waste emissions is crucial when considering options for mitigating GHG emissions

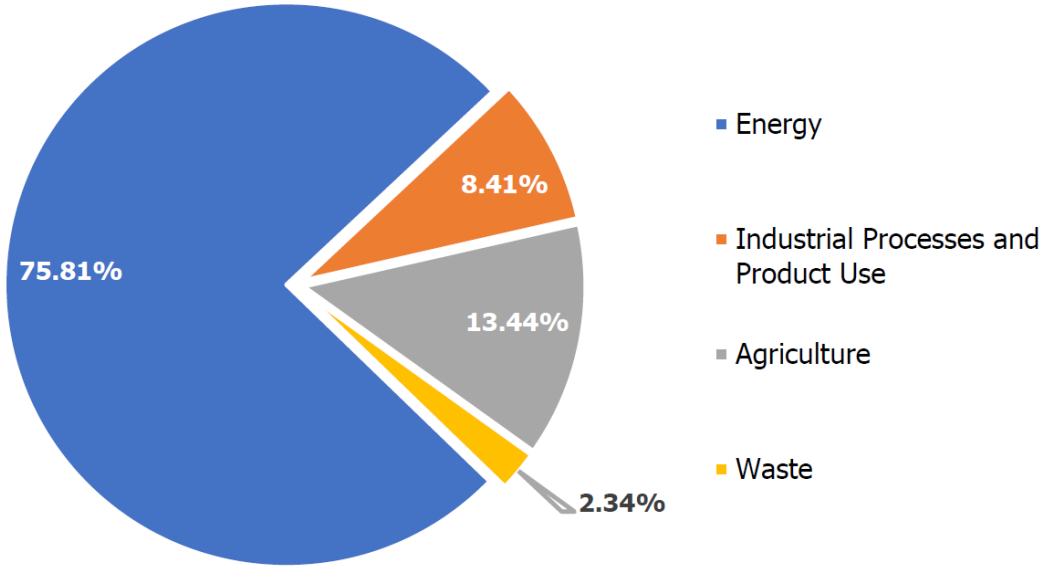
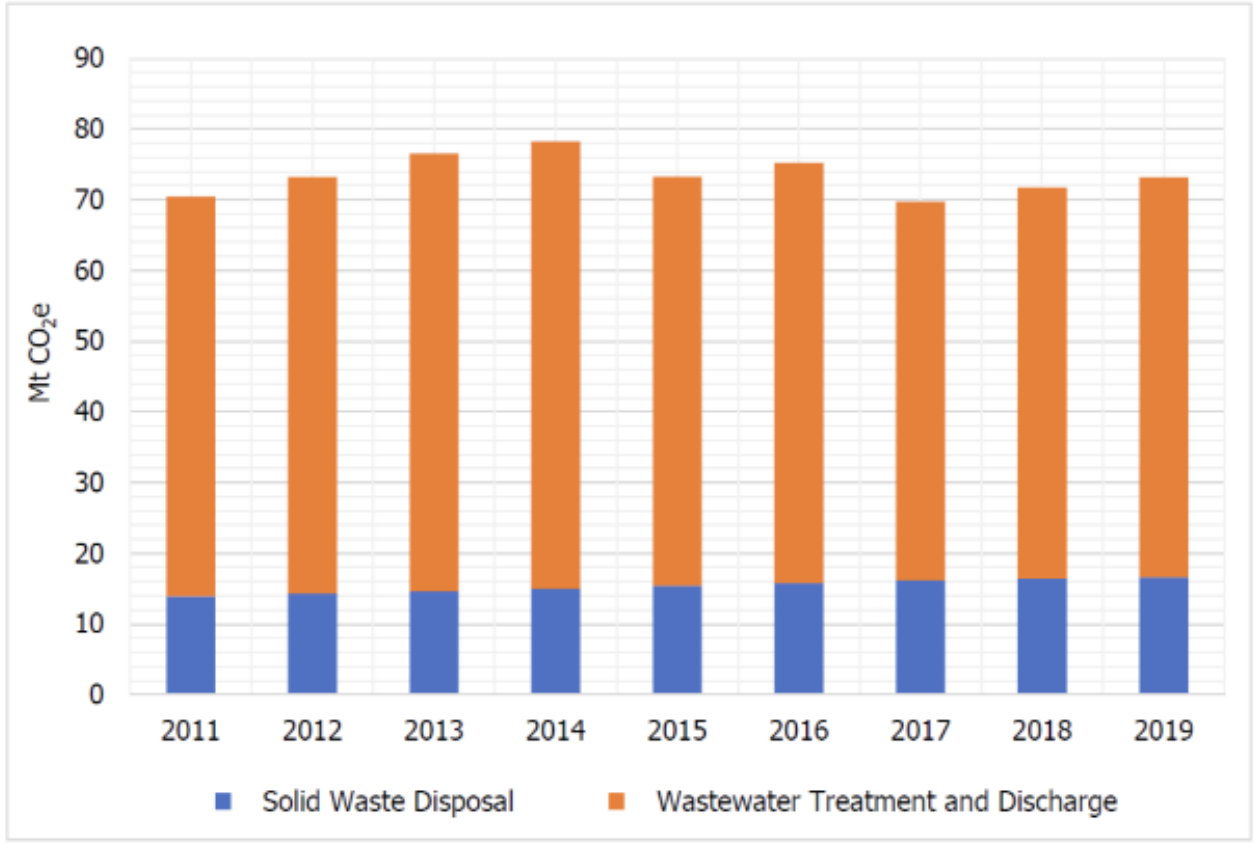


Table 2.3: Sector-wise National GHG emission in $MtCO_2e$ for 1994-2019

GHG Sources and Removals	1994	2000	2007	2010	2014	2016	2017	2018	2019
	Mt CO_2e								
Source	INC	SNC	SNC	BUR1	BUR2	BUR3	TNC	TNC	TNC
Energy	744	1027	1374	1510	1910	2129	2204	2344	2374
Industrial Processes and Product Use (IPPU)	103	89	142	172	202	226	244	263	264
Agriculture	344	356	373	390	417	408	411	417	421
Land Use, Land Use Change and Forests	14	-223	-177	-253	-301	-308	-312	-437	-485
Waste	23	53	58	65	78	75	70	72	73
Total (without LULUCF)	1214	1524	1947	2137	2607	2839	2929	3096	3132
Total (with LULUCF)	1229	1301	1772	1884	2306	2531	2617	2659	2647

WASTE OVERVIEW

Waste GHG emissions (Mt CO_2e)



WASTE OVERVIEW

Type of emission factor and level of methodological tier employed for GHG estimation						
Gas	CO_2		CH_4		N_2O	
Sector/ Category	Method used	Emission Factor	Method used	Emission Factor	Method used	Emission Factor
5. Waste						
A. Solid waste disposal on land	NO		T2	D, CS	NO	
B. Waste-water handling	NO		T1, T2	D, CS	T1, T2	D, CS
T1- Tier 1; T2- Tier 2; T3- Tier 3; CS- Country Specific; D- IPCC Default, NO-Not Occurring, NA-Not Applicable, NE-Not Estimated						

Are methods and EFs accurate?

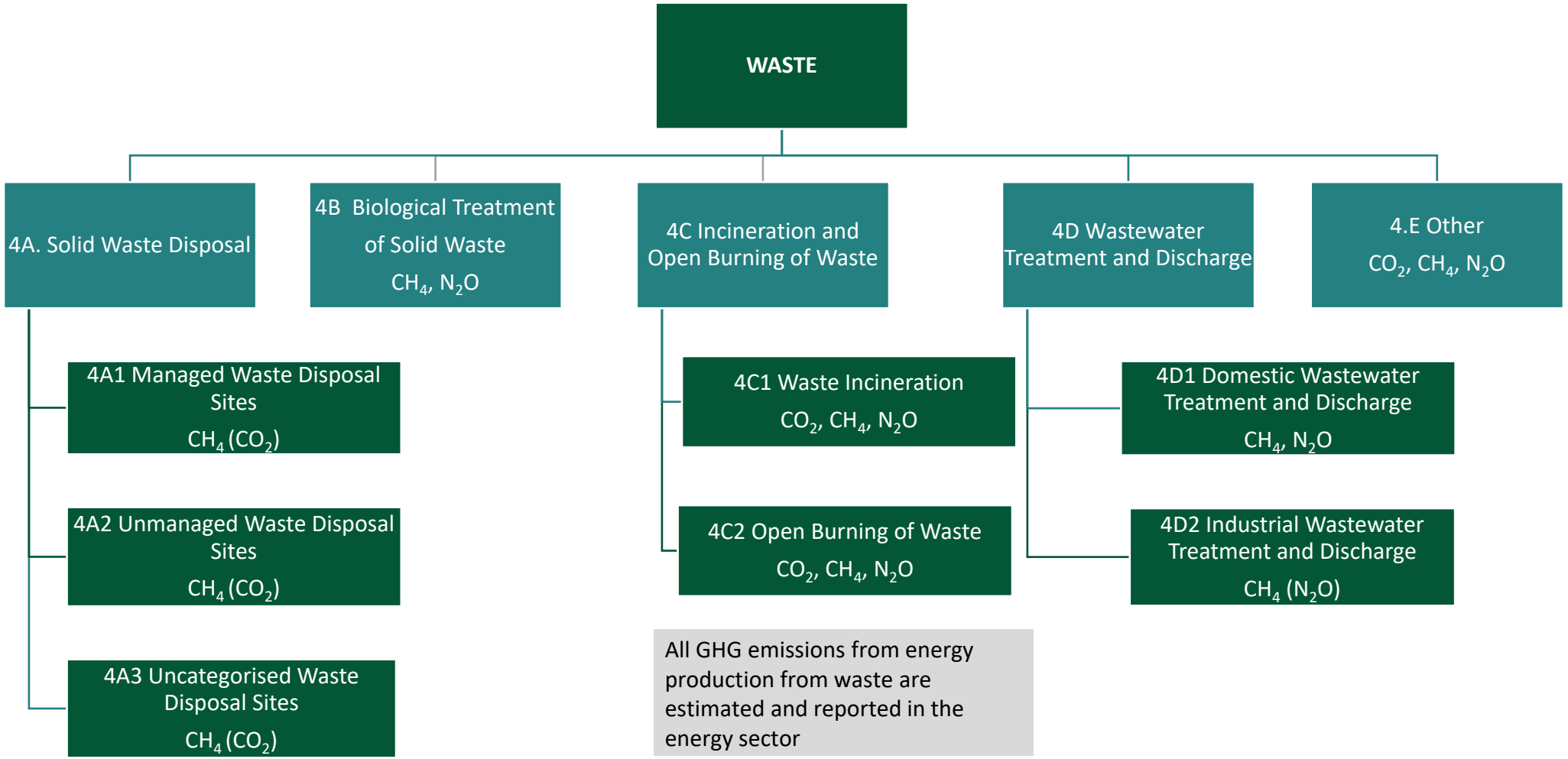
	2019 Without LULUCF		
Sr. No.	IPCC Code, Category, Gas	Gg CO_2e	Level %
17	4D1 Domestic and Commercial Wastewater, CH_4	21785	0.70%
18	1A3a Civil Aviation, CO_2	19440	0.62%
19	4D2 Industrial Wastewater, CH_4	17981	0.57%
20	4D1 Domestic and Commercial Wastewater, N_2O	16815	0.54%
21	4A Managed Waste Disposal on Land, CH_4	16608	0.53%

	2011-2019 without LULUCF		
Sr. No.	IPCC Code, Category, Gas	Trend Assessment (Txt)	% Contribution to Trend
14	4D2 Industrial Wastewater, CH_4	0.0029760	0.98%
19	4D1 Domestic and Commercial Wastewater, CH_4	0.0018677	0.62%
24	4D1 Domestic and Commercial Wastewater, N_2O	0.0011628	0.38%

GWP

- Second IPCC Assessment Report (AR2)
- Fifth IPCC Assessment Report (AR5)

CATEGORIES OF GHG EMISSIONS IN THE WASTE SECTOR



All GHG emissions from energy production from waste are estimated and reported in the energy sector

WASTE SECTOR CATEGORIES

	Category	GHG	2006 IPCC Guidelines reference	Common reporting table
5.A	Solid waste disposal	CH_4	Vol. 5, chaps. 2 and 3	CRT 5.A
5.B	Biological treatment of solid waste	CH_4 , N_2O	Vol. 5, chaps. 2 and 3	CRT 5.B
5.C	Incineration and open burning of waste	CO_2 , CH_4 , N_2O	Vol. 5, chaps. 2 and 3	CRT 5.C
5.D	Wastewater treatment and discharge	CH_4 , N_2O	Vol. 5, chaps. 2 and 3	CRT 5.D

COMPLETENESS

Estimation of emissions from all sources with a method in the IPCC guidelines:

- 5B – Biological treatment of solid waste
- 5C – Incineration and open burning of waste

Correct use of notation keys to indicate why emissions are not reported

TABLE 8.1
NOTATION KEYS

Notation Key	Definition	Explanation
NE	Not estimated	Emissions and/or removals occur but have not been estimated or reported.
IE	Included elsewhere	Emissions and/or removals for this activity or category are estimated and included in the inventory but not presented separately for this category. The category where these emissions and removals are included should be indicated (for example in the documentation box in the correspondent table).
C	Confidential information	Emissions and/or removals are aggregated and included elsewhere in the inventory because reporting at a disaggregated level could lead to the disclosure of confidential information.
NA	Not applicable	The activity or category exists but relevant emissions and removals are considered never to occur. Such cells are normally shaded in the reporting tables.
NO	Not occurring	An activity or process does not exist within a country.

5B – BIOLOGICAL TREATMENT OF SOLID WASTE

Categories		Gas emitted
5.B.1 - Composting	Subcategories: 5.B.1.a – MSW 5.B.1.b – Other	CH_4, N_2O
5.B.2 – Anaerobic digestion at biogas facilities	Subcategories: 5.B.2.a – MSW 5.B.2.b – Other	CH_4, N_2O*
Reported in CRT	CRT 5.B	

* N2O emissions from anaerobic digestion are assumed to be negligible.

Tier 1: Calculation of emissions using equations 4.1 (for CH_4) and 4.2 (for N_2O) based on default EFs.
Tier 2: Calculation of emissions using equations 4.1 (CH_4) and 4.2 (N_2O) and use of country-specific EFs based on representative measurements to cover relevant biological treatment options applied in the country.
Tier 3: Calculation of emissions using equations 4.1 (CH_4) and 4.2 (N_2O) and use of country-specific EFs based on facility-/site-specific measurements.

5C – INCINERATION AND OPEN BURNING OF WASTE

Table 5.1 – Incineration and open burning of waste and gas emitted.

Categories		Gas emitted
5.C.1 – Waste incineration	Subcategories: 5.C.1.a – Biogenic 5.C.1.b – Non biogenic	CO_2,CH_4, N_2O
5.C.2 – Open burning of waste	Subcategories: 5.C.2.a – Biogenic 5.C.2.b – Non biogenic	CO_2, CH_4, N_2O
Reported in CRT	CRT 5.C	

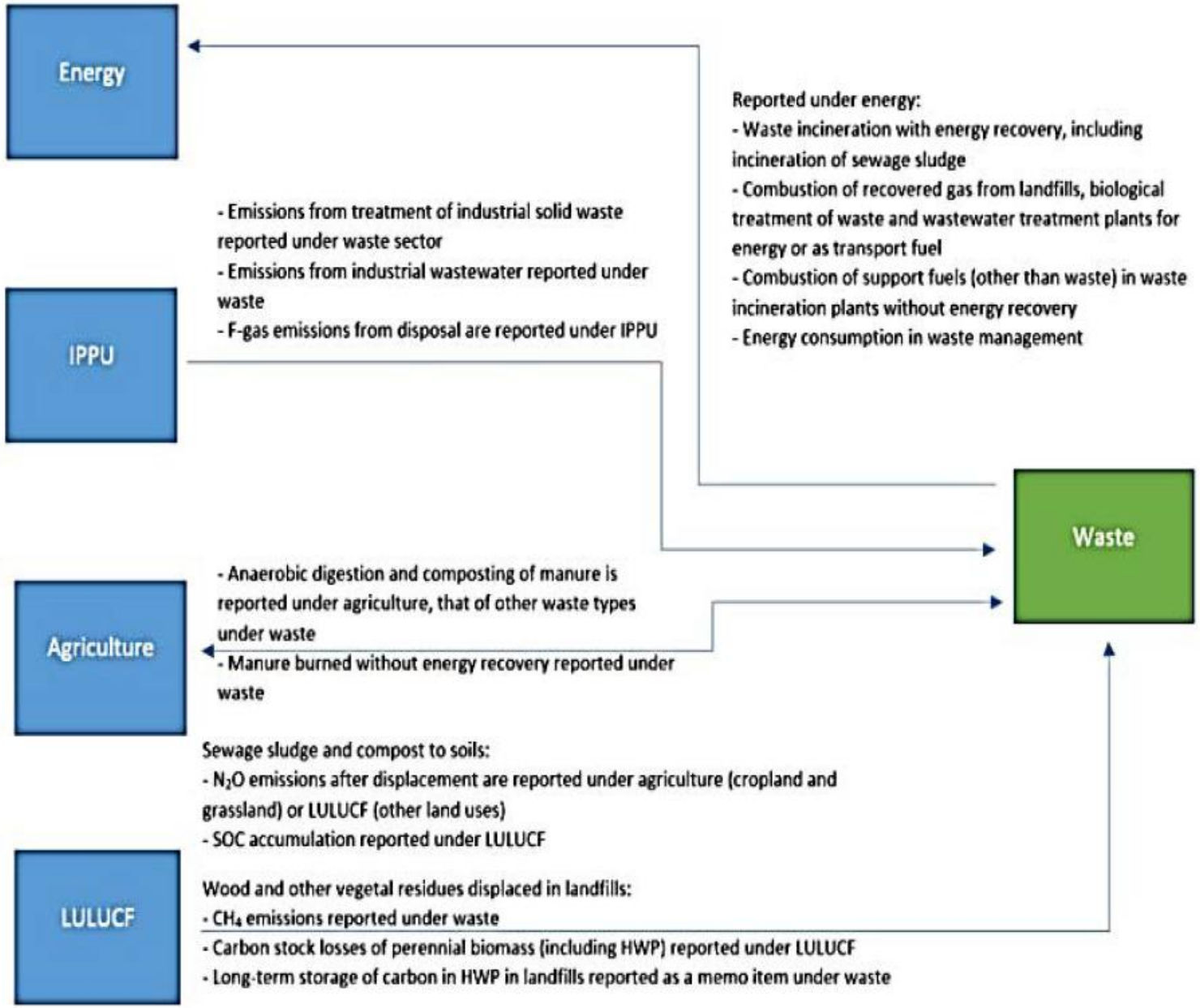
Tier 1 Calculation of emissions using data on the amount of waste incinerated or open burned with default data for parameters related to EFs (see table 5.2 of the 2006 IPCC Guidelines (vol. 5, chap. 5)). AD can be the total amount of waste combusted (as equation 5.1) or the MSW composition (as equation 5.2). AD can be default or country specific (see table 5.1).

Tier 2a Calculation of emissions using country specific AD for MSW based on the waste composition (percentages of paper, wood, plastics, etc. in waste) as in equation 5.2, with default data for parameters related to EFs (see tables 5.1 and 5.2). For other types of waste (e.g industrial waste, sludge, clinical, etc) country specific AD on the amount is required (equation 5.1).

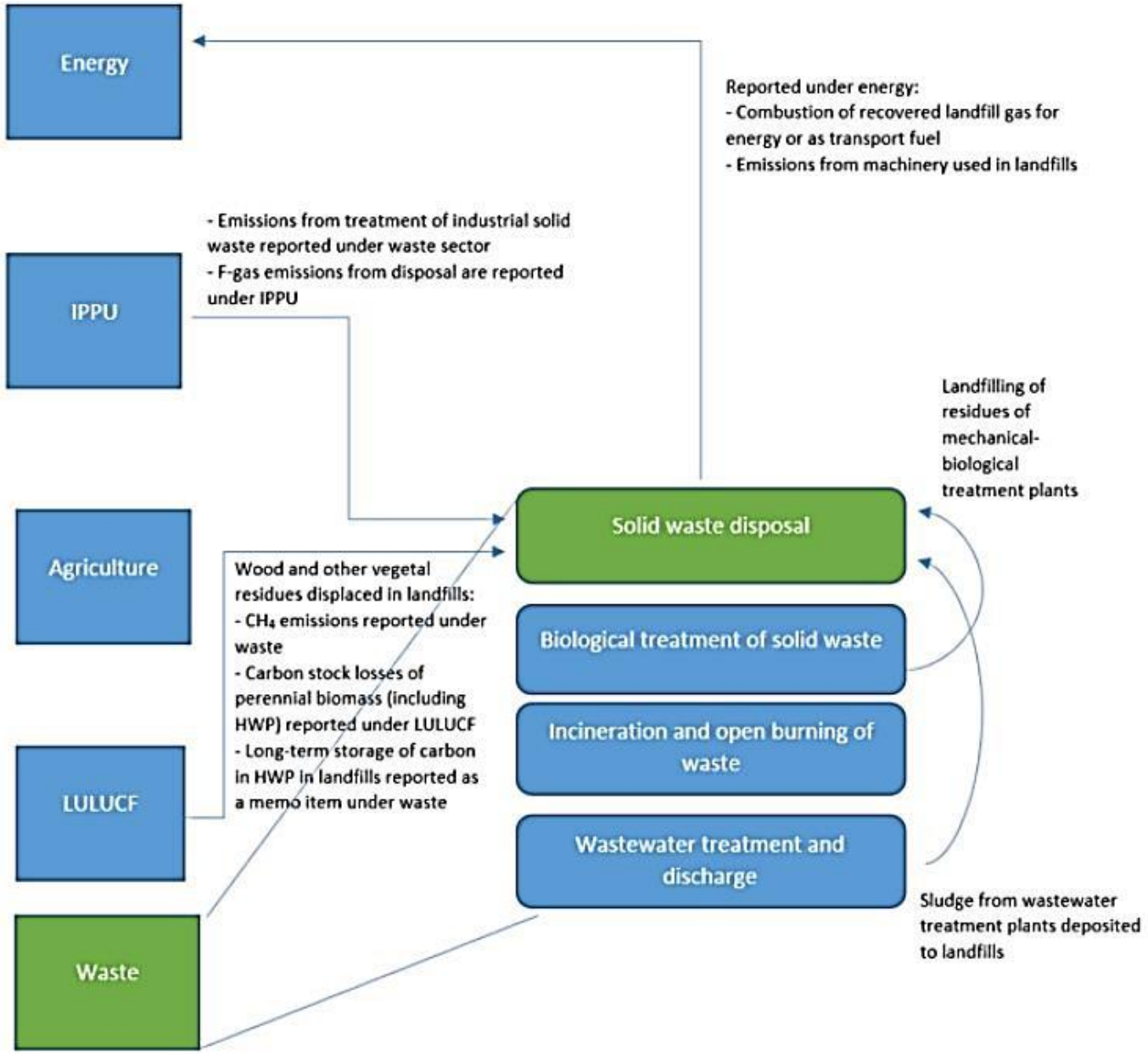
Tier 2b As tier 2a but with country specific parameters for dry matter content and carbon content. For fossil carbon fraction and oxidation factor if can be used default or country specific data.

Tier 3 Use of plant-specific data. The total fossil CO_2 emissions from waste incineration are calculated as the sum of all plant-specific fossil CO_2 emissions. It is good practice at this tier level to consider parameters affecting both the fossil carbon content and the oxidation factor.

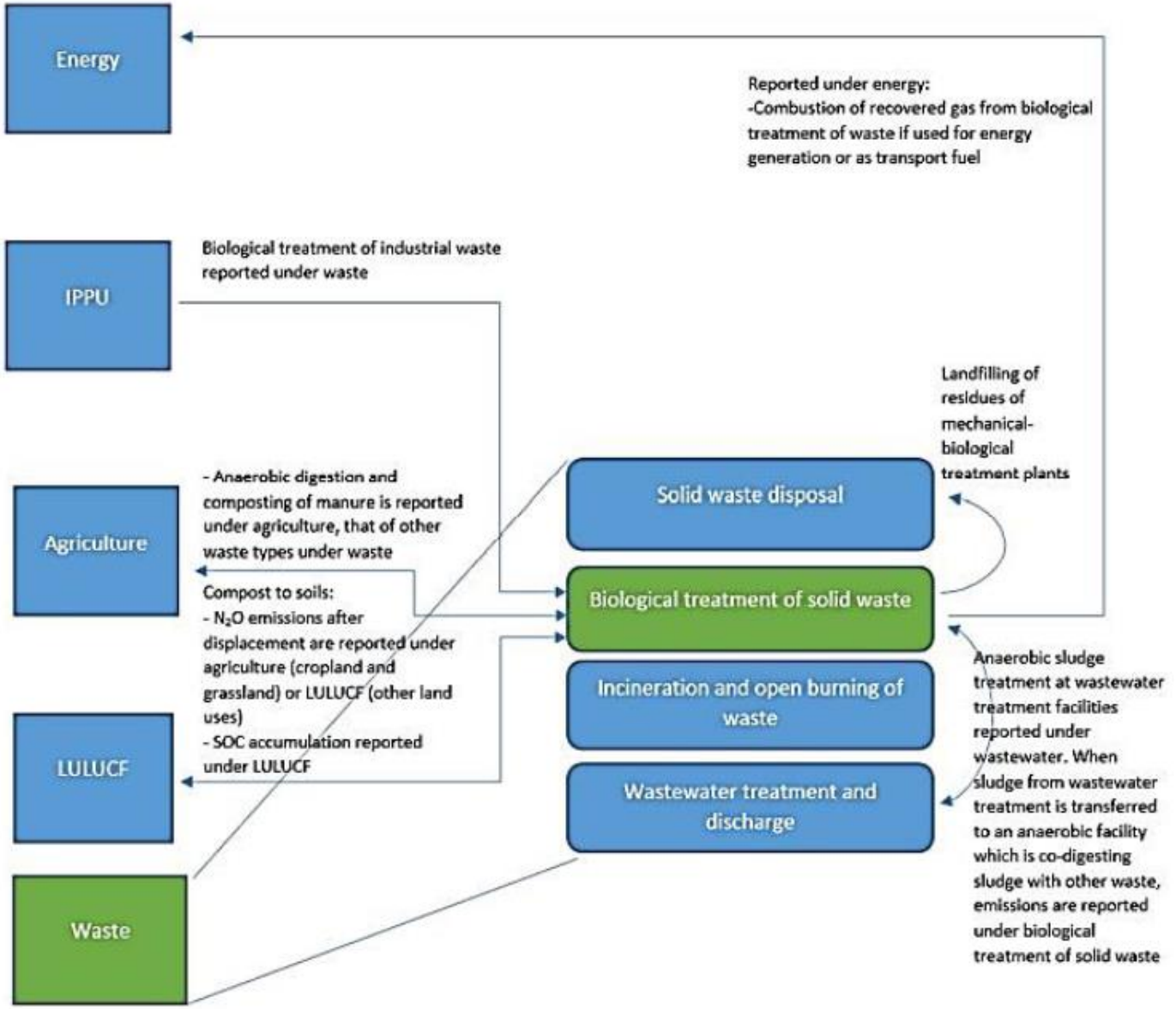
Linkages of the waste sector with other inventory sectors



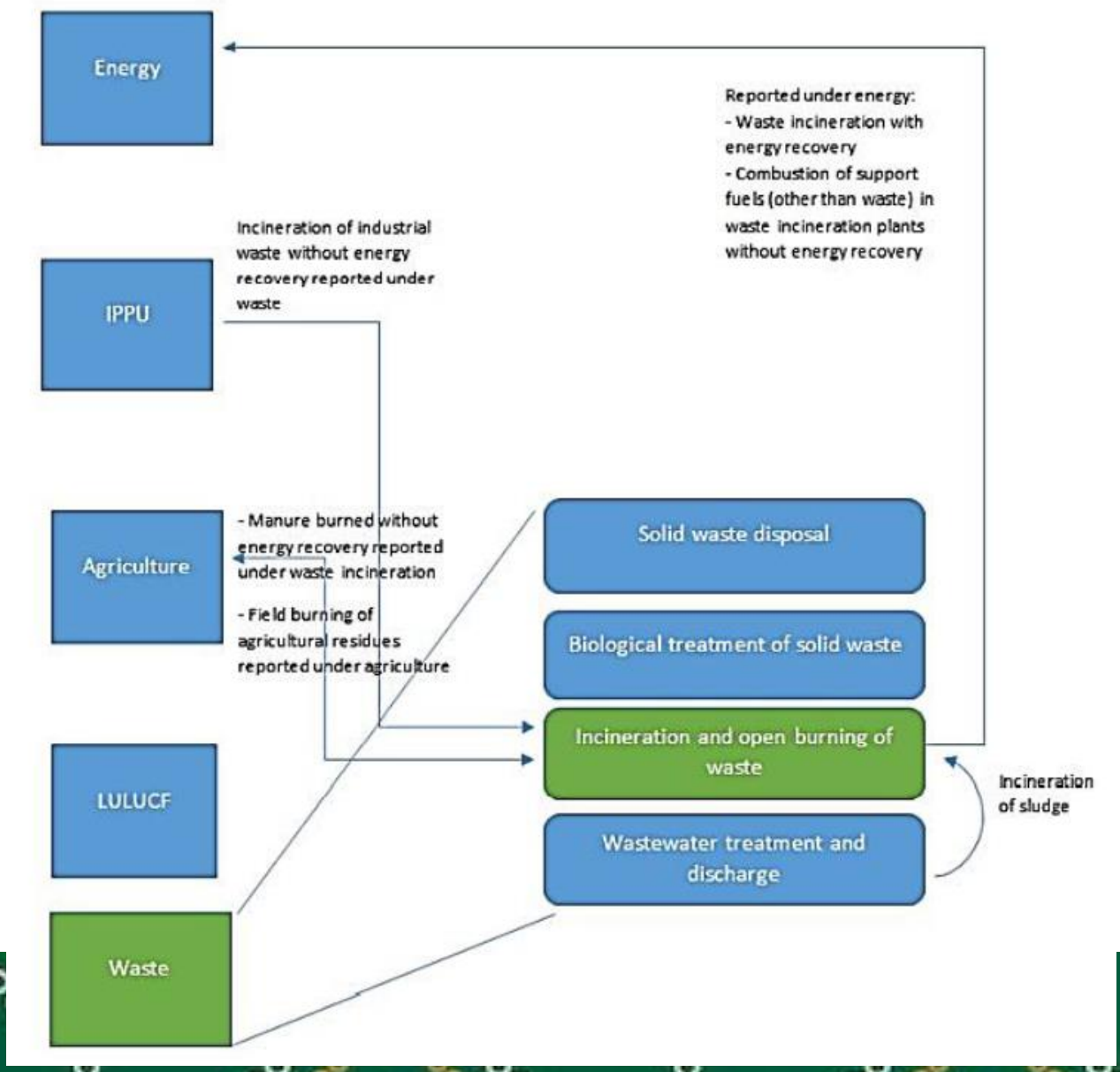
Linkages of the solid waste disposal category with other sectors and categories



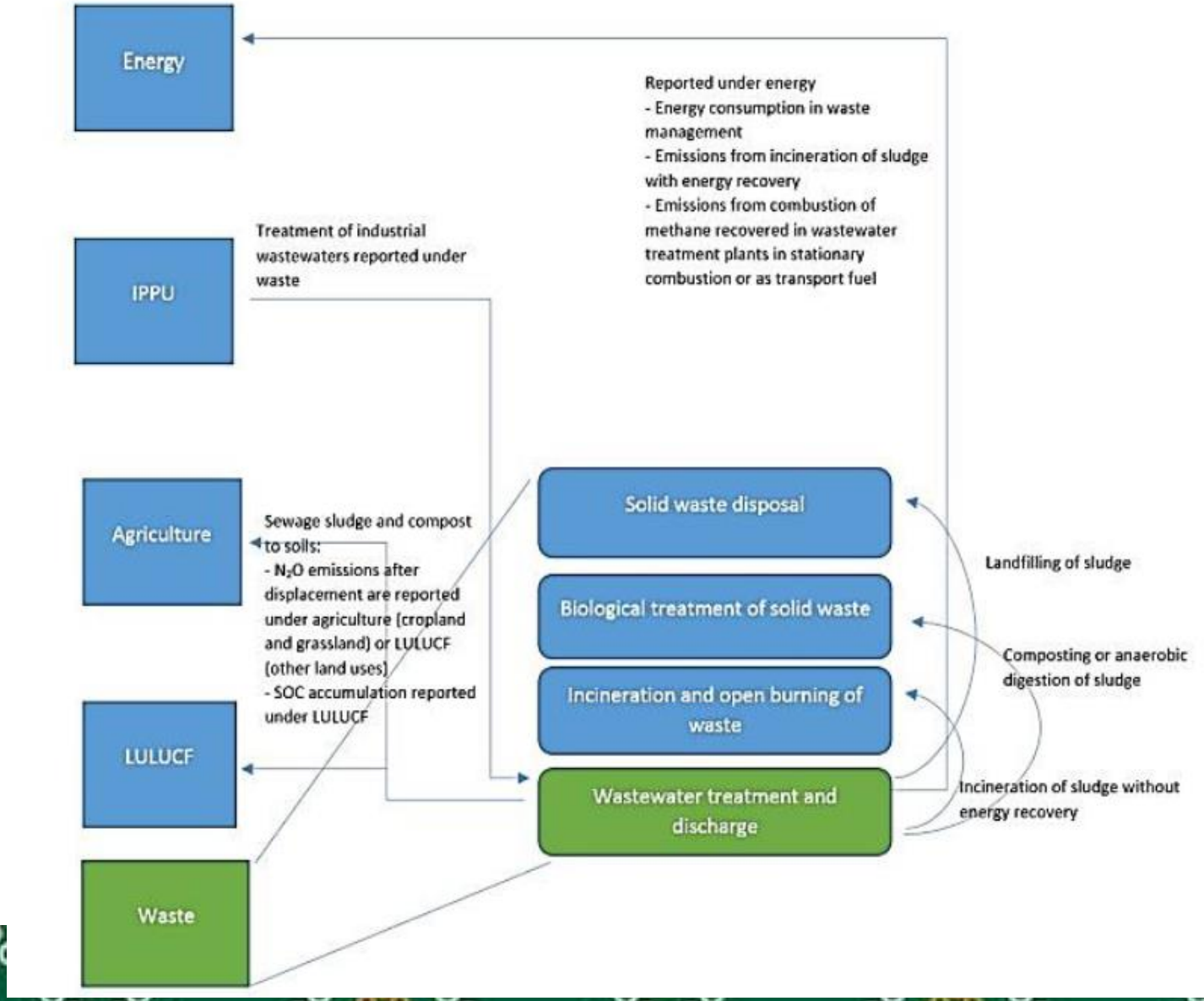
Linkages of the biological treatment of solid waste category with other sectors and categories



Linkages of the incineration category with other sectors and categories



Linkages of the wastewater category with other sectors and categories

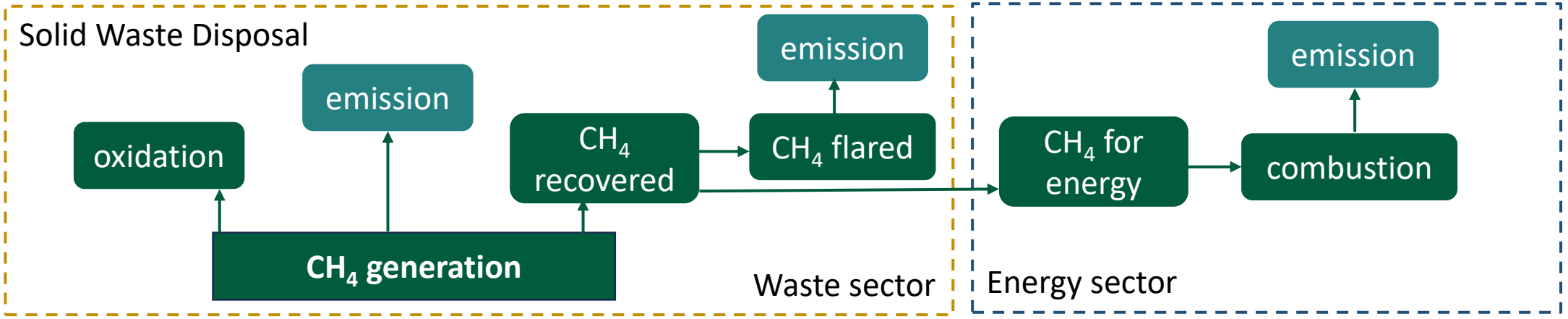


CO_2 from biogenic carbon

- CO_2 emissions resulting from the combustion or biodegradation of biogenic material (e.g. food waste, wood and paper) are not included in national total emissions recovered and flared is reported under the waste sector
- CO_2 emissions due to incineration and open burning of materials containing fossil carbon are included in the national total emissions (category 5.C)
- Materials containing fossil carbon are unlikely to biodegrade in the conditions present in SWDS, installations for biological treatment and in wastewater. As a results, other sectors have negligible CO_2 emissions of a fossil nature and therefore Parties are not required to report these emissions

CH_4 utilization and flaring

- CH_4 recovered and flared is reported under the waste sector
- When CH_4 recovered is used to produce energy (electricity, heat or used as fuel in the transport sector), the emissions should be reported under the energy sector under the related category
- Emissions from flaring are considered insignificant and good practice in the waste sector does not require their estimation



5A Solid Waste Disposal

Table 3.1 – Solid waste disposal categories and gas emitted.

Categories		Gas emitted
5.A.1 - Managed waste disposal sites	Subcategories: 5.A.1.a – anaerobic 5.A.1.b – semi-aerobic 5.A.1.c – active aerobic	CH_4
5.A.2 - Unmanaged waste disposal sites		CH_4
5.A.3 - Uncategorized waste disposal sites		CH_4
Reported in CRT	CRT 5.A	

This is a key category in 2019 for CH_4

Solid waste disposal (5.A)

The category includes CH_4 emissions from the treatment and disposal of municipal, industrial, and other solid wastes at solid waste disposal facilities (SWDS). Solid waste disposal includes managed, unmanaged, and uncategorized waste disposed of in landfills. In 2019, GHG emissions accounted for 16,608 $GgCO_2e$, increasing by 4.90 per cent since 2016, as a result of an increase in population. In 2019, 59,245 Gg of MSW reached landfills in India, resulting in 791 Gg of Methane.

What disposal categories have been considered?

5A Data Requirements

Managed SWDS (5A1)

- Anaerobic managed SWDS that must have controlled placement of waste and one of the following: use of cover material; mechanical compaction; or waste levelling
- Semi-aerobic SWDS that have the specific infrastructure to promote the passive aeration of waste, resulting in partially aerobic conditions. Since semi-aerobic landfills aim at minimizing anaerobic conditions and preventing the generation of CH_4, they do not have CH_4 recovery systems
- Active-aerated SWDS that have the infrastructure for active aeration (forced by a blower) of waste

Unmanaged SWDS (5A2)

- Unmanaged – deep. These are SWDS that do not meet the criteria of managed SWDS and are on average more than 5 m deep. Shallow SWDS with an internal water table at near ground level also fall within this category (ponds, river or wetlands filled with waste)
- Unmanaged – shallow. These are SWDS that do not meet the criteria of managed SWDS and are less than 5 m deep

Uncategorized SWDS (5A3)

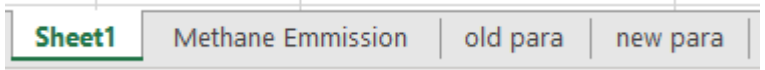
Uncategorized SWDS are used when a country cannot categorize its SWDS in any of the other subcategories

5A Current Method

India is currently using population data with a standard MSW generation per capita value to generate proxy activity data which is used in the IPCC Waste Model workbook

Year	Population	Waste Gen Rate	MSW_T	MSW Reaching	DOC	$DDOC_M$	$DDOCm_{at}$	$DDOCm_{decompt}$	CH4 Genereted
		kg/capi/d	Gg	Landfill(80%) (Gg)		Gg	Gg	Gg	Gg
				W		(WXDOCXMCFXDOCF)			$DDOC_m$xFx16/12
							6742.52		
2014	404300000	0.55	81163	56814	0.11	1240.60	6904.31	1078.80	719.20
2015	413400000	0.55	82990	58093	0.11	1268.52	7068.14	1104.69	736.46
2016	422500000	0.55	84817	59372	0.11	1296.44	7233.68	1130.90	753.94
2017	432648000	0.45	71062	56850	0.11	1241.38	7317.67	1157.39	771.59
2018	441726000	0.45	72553	58043	0.11	1267.42	7414.26	1170.83	780.55
2019	450877000	0.45	74057	59245	0.12	1364.77	7592.76	1186.28	790.85
2020	460086000	0.45	75569	60455	0.12	1392.65	7770.56	1214.84	809.89

- **Calculation workbook not complete:** hardcoded values, partial timeseries (2010/2014 – 2020), several versions



- **Population:** use official statistics across the whole Inventory
- **Waste generation rate**: 0.55 kg/p/day - 0.45 kg/p/day (2014 or 2015 onwards)
- **MSW reaching landfill**: 80% - 70%
- **DOC $DDOC_M$ $DDOCm_{at}$ $DDOCm_{decompt}$**
- **Oxidation Factor (OX)**
- **Methane Recovery**

5A Data Requirements

Method	Activity data	Emission factors and Parameters
T1 – FOD or mass balance	a. Population data, MSW data per capita and GDP b. Total bulk waste data disposed of to landfill c. Waste composition	Use default values in the IPCC tool
T2 – FOD	• Detailed waste composition • Gas recovery/ capture • Landfill management	Country specific parameters for some e.g. the degradation parameters

Tier 1: Calculation of emissions using the IPCC FOD method and using mainly default AD and default parameters

Tier 2: Calculation of emissions using the IPCC FOD method and using good-quality country-specific AD on current and historical waste disposal at SWDS

Tier 3: The use of good-quality country-specific AD (see tier 2 above) and the use of the IPCC FOD method with either: (1) nationally developed key parameters or; (2) measurement-derived country-specific parameters. The Parties may also use their own country-specific methods and models if their quality is equal to or higher than that of the IPCC waste model

5A Improvements

For T1	• Include actual data on MSW per capita generated
	• Gather data on total waste disposed of the landfill
	• Gather data on each category of waste disposed of to landfill
For T2	• Gather detailed waste composition
	• Include data on landfill types and any methane capture occurring
	• Develop some country specific factors

5B Biological Treatment of Solid Waste

There are 3 methods of treat waste in the IPCC guidelines:

Composting - an aerobic process and a large fraction of the degradable organic carbon (DOC) in the waste material is converted into carbon dioxide (CO_2). CH_4 is formed in anaerobic sections of the compost, but it is oxidised to a large extent in the aerobic sections of the compost.

Anaerobic digestion - expedites the natural decomposition of organic material without oxygen by maintaining the temperature, moisture content and pH close to their optimum values. Generated CH_4 can be used to produce heat and/or electricity, wherefore reporting of emissions from the process is usually done in the Energy Sector. The CO_2 emissions are of biogenic origin, and should be reported only as an information item in the Energy Sector

Mechanical-biological (MB) treatment - the waste material undergoes a series of mechanical and biological operations that aim to reduce the volume of the waste as well as stabilise it to reduce emissions from final disposal. The operations vary by application. Typically, the mechanical operations separate the waste material into fractions that will undergo further treatment (composting, anaerobic digestion, combustion, recycling). These may include separation, shredding and crushing of the material. The biological operations include composting and anaerobic digestion.

AD and MBT Plants in India

Many small scale domestic biogas installations (mainly using animal dung and kitchen waste water) - https://ashden.org/awards/winners/skg-sangha/

There are large scale plants that process market waste, crop residue and MSW

“Composting is one of the most widely used treatment method in Indian MSW where organic waste fraction is 60–70% ” - https://www.sciencedirect.com/science/article/abs/pii/S0301479719309405

Lots of plans for new AD plant development https://www.bioenergy-news.com/news/igl-plans-19-biogas-plants-in-four-indian-states/

5B Data Requirements

Method	Activity data	Emission factors and Parameters
T1	• Data on the amount of waste treated • Data on amount of waste composted	IPCC default emission factors
T2	• Data on methane recovery from plants • Type of solid waste which is treated biologically	Country-specific emission factors based on representative measurements

T1 – Gather data on total waste sent to AD and MBT facilities and composted

5C Incineration and Open Burning of Waste

Waste Incineration (5C1) - the combustion of solid and liquid waste in controlled incineration facilities. Modern refuse combustors have tall stacks and specially designed combustion chambers, which provide high combustion temperatures, long residence times, and efficient waste agitation while introducing air for more complete combustion. - municipal solid waste (MSW), industrial waste, hazardous waste, clinical waste and sewage sludge

Open burning of waste (5C2) - the combustion of unwanted combustible materials in nature (open-air) or in open dumps, where smoke and other emissions are released directly into the air without passing through a chimney or stack. Open burning can also include incineration devices that do not control the combustion air to maintain an adequate temperature and do not provide sufficient residence time for complete combustion.

Incineration Plants in India

Mumbai Waste management Ltd has 2 incinerators that receive hazardous waste including clinical unclear if it has energy recovery

The Dahej Common Hazardous Waste Incineration Facility - 36,000 t/year capacity

"India's government estimates the country has waste-to-energy capacity potential of as much as 5 gigawatts, almost 30 times more than the nearly 168 megawatts installed today. There are 11 operational plants across the country, and 10 are under construction."

JBM Enviro Sonepat waste-to-energy facility 220,000 t/year MSW capacity with 9MW output

Timarpur-Okhla waste management company 712,000 t/year MSW capacity with 23MW output

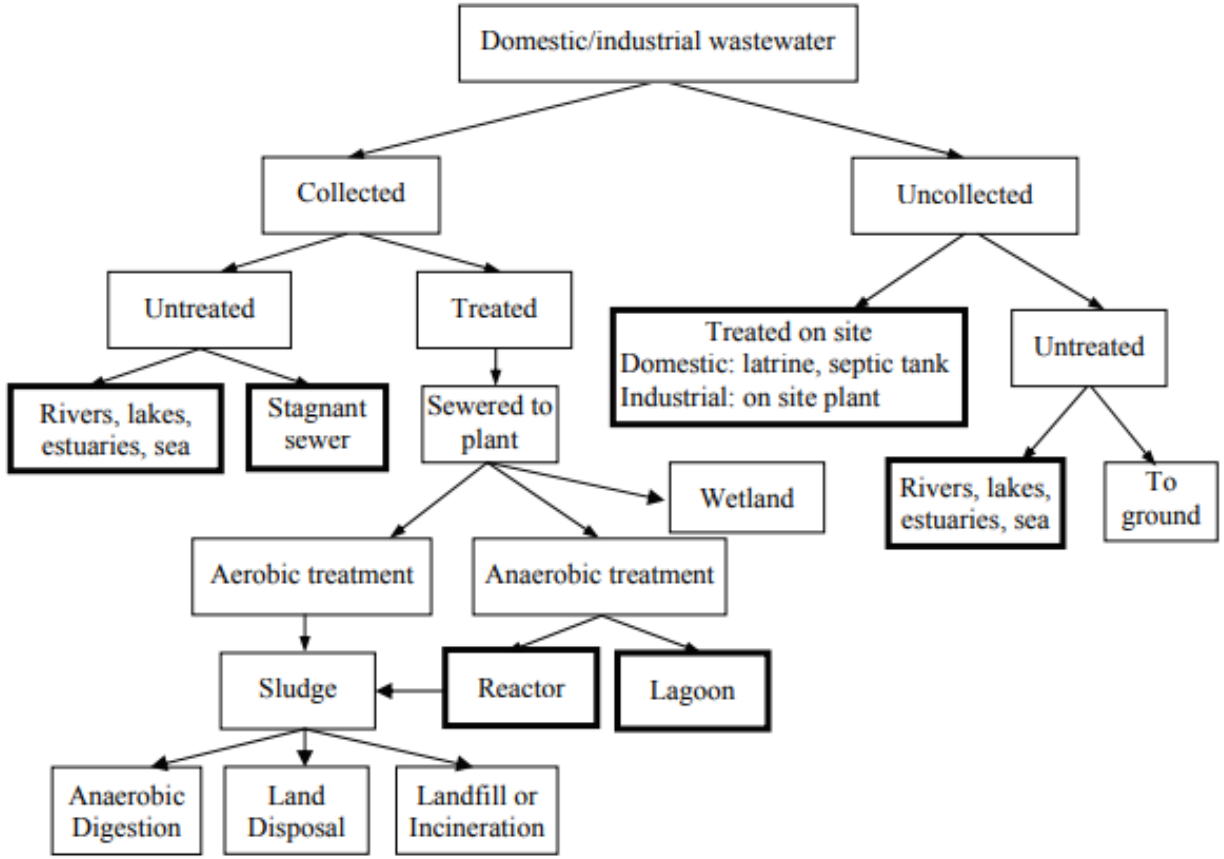
5C Data Requirements

Method	Activity data	Emission factors and Parameters
T1	• Dry matter content of solid waste incinerated • Wet waste incinerated • Fractions of waste burnt (if possible)	• IPCC default emission factors
T2	• Country-specific activity data on the waste composition • Waste incinerated/open-burned by waste type • MSW composition, dry matter content, carbon content, fossil carbon fraction and oxidation factor • Survey data on domestic combustion of waste	• Country-specific emission factors based on representative measurements • Some IPCC default emission factors

5D Wastewater Treatment and Discharge

- 5D1 Domestic – is all water originating from domestic and commercial sources together these are referred to as municipal wastewater in the guidance.
- 5D2 Industrial – All wastewater arising from an industrial source

- Wastewater might be directly discharged into a river, lake or sea
- Wastewater might be treated individually at households in latrines or septic tanks or on-site at industries in an industrial wastewater treatment plant (WWTP)
- Wastewater might also be collected and sent to a communal WWTP, with the treated effluent discharged to open waters



(vol. 5, chap. 6 of the 2006 IPCC Guidelines)

5D Data Requirements

Method	Activity data	Emission factors and Parameters
T1	• Fraction of wastewater in each discharge pathway • Population	• Use default values in the IPCC wastewater chapter
T2	• Fraction of wastewater in each discharge pathway • The amount of sludge removed for incineration, landfills, and agricultural land should be taken into consideration.	• Country specific factors (Bo, I, and BOD\COD) • Specific EF for prominent treatment pathways

Tier 1 Use default values for the EF and activity parameters. This method is suitable for countries with limited data. When wastewater treatment and discharge is a key category and the relevant subcategory is significant, a higher-tiered method should be used.

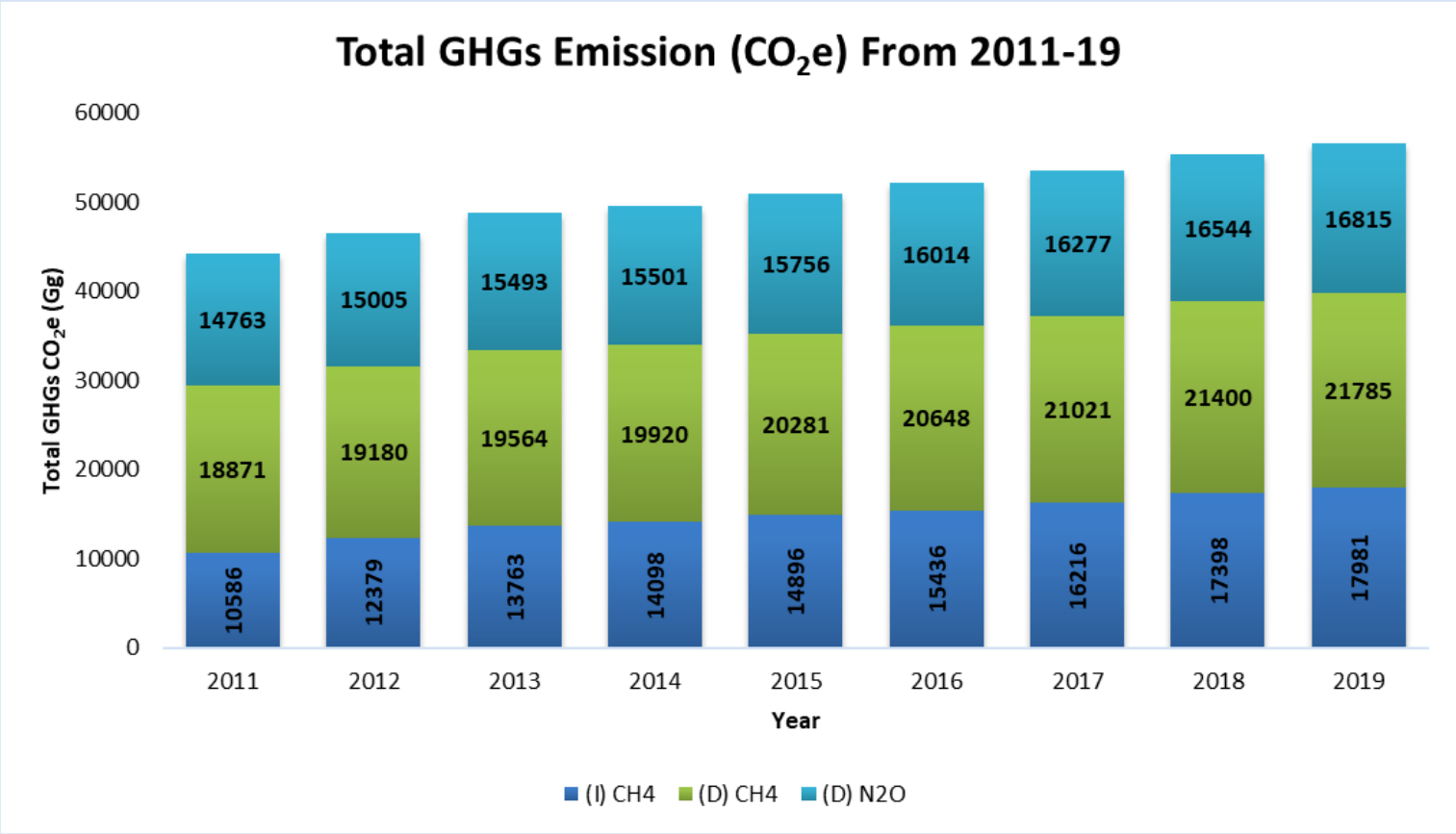
Tier 2 Use the same method as tier 1 but with a country-specific AD and EF. For example, a specific EF for a prominent treatment system based on field measurements could be incorporated under this method. The amount of sludge removed for incineration, landfills and agricultural land should be taken into consideration

Tier 3 Use a country-specific method based on plant-specific data from large wastewater treatment facilities (for a country with good data and advanced methodologies)

5D Current Method

India is currently using a T1 method for calculating wastewater emissions

- Results for 2011 - 2019



5D Current Method

India is currently using a T1 method for calculating wastewater emissions

- Results for 2011 - 2019
- 5D1 – Domestic Wastewater
  - Fractions of wastewater handling (ST, Latrine, Sewer, Other, and None) are provided for each region and split by rural, urban high income, and urban low income
  - Unclear where this data comes from and how it is measured. For some regions, the waste fractions do not sum to 1.
  - BOD used is the maximum default value for India in the guidelines. Bo is the default value and the MCF for ST are default values. It is unclear where the MCF values for latrines, sewers, other and none are derived from
  - Protein Consumption – Food and Agriculture Organization (FAO)
  - Nitrogen in the wastewater effluent ($N_{EFFLUENT}$) and default EF for N2O based on 2006 GLs (Indirect N_2O emissions)
  - Emissions from advanced centralised wastewater treatment plants (Direct N2O emissions) – default EF for N_2O based on 2006 GLs; methodology doesn't seem consistent with 2006 GLs
    - T_{PLANT} = degree of utilization of modern, centralized WWT plants (%) >1 (Unclear source of this data)
    - When a country chooses to include N_2O emissions from plants, the amount of nitrogen associated with these emissions (N_{WWT}) must be back calculated and subtracted from the $N_{EFFLUENT}$. The N_{WWT} can be calculated by multiplying N_2O_{PLANTS} by 28/44, using the molecular weights.

5D Current Method

India is currently using a T1/T2 method for calculating wastewater emissions

- Results for 2011 - 2019
- 5D2 – Industrial Wastewater
  - Production (Tonnes)
  - Wastewater Generation and COD based on 2006 GLs, 'Updated from source' and 'Updated from Primary study'
  - Si = organic component removed as sludge in inventory year, kg COD/yr – 10% for all industrial sectors
  - Ri = amount of CH_4 recovered in inventory year, kg CH_4/yr – 70% for alcohol, dairy products, sugar refining vegetable
  - MCF based on default values from 2006 GLs

TABLE 6.8
DEFAULT MCF VALUES FOR INDUSTRIAL WASTEWATER

Type of treatment and discharge pathway or system	Comments	MCF [1]	Range
Untreated			
Sea, river and lake discharge	Rivers with high organics loadings may turn anaerobic, however this is not considered here.	0.1	0 – 0.2
Treated			
Aerobic treatment plant	Must be well managed. Some CH_4 can be emitted from settling basins and other pockets.	0	0 – 0.1
Aerobic treatment plant	Not well managed. Overloaded	0.3	0.2 – 0.4
Anaerobic digester for sludge	CH_4 recovery not considered here	0.8	0.8 – 1.0
Anaerobic reactor (e.g., UASB, Fixed Film Reactor)	CH_4 recovery not considered here	0.8	0.8 – 1.0
Anaerobic shallow lagoon	Depth less than 2 metres, use expert judgment	0.2	0 – 0.3
Anaerobic deep lagoon	Depth more than 2 metres	0.8	0.8 – 1.0

[1] Based on expert judgment by lead authors of this section

5D Improvements

For T1	Use standard MCF values for all categories Ensure fraction for pathways sum to 1 Develop a timeseries for fractions of discharge pathways utilised
For T2	Find more accurate emissions for large processing facilities Include any methane recovery occurring Develop some country specific factors

WASTE CRT TABLES
TABLE 5 SECTORAL REPORT FOR WASTE

TABLE 5 SECTORAL REPORT FOR WASTE
(Sheet 1 of 1)

Year
Submission
Country

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_X	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste								
5.A. Solid waste disposal								
5.A.1. Managed waste disposal sites								
5.A.2. Unmanaged waste disposal sites								
5.A.3. Uncategorized waste disposal sites								
5.B. Biological treatment of solid waste								
5.B.1. Composting								
5.B.2. Anaerobic digestion at biogas facilities								
5.C. Incineration and open burning of waste								
5.C.1. Waste incineration								
5.C.2. Open burning of waste								
5.D. Wastewater treatment and discharge								
5.D.1. Domestic wastewater								
5.D.2. Industrial wastewater								
5.D.3. Other								
5.E. Other *(please specify)*								
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites								
5.F.2~~1.a~~. Annual change in total long-term C storage								
5.F.3~~1.b~~. Annual change in total long-term C storage in HWP waste [4]								

WASTE CRT TABLES

TABLE 5.A SECTORAL BACKGROUND DATA FOR WASTE

TABLE 5.A SECTORAL BACKGROUND DATA FOR WASTE
Solid waste disposal
(Sheet 1 of 1)

Year
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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA AND OTHER RELATED INFORMATION		IMPLIED EMISSION FACTOR	EMISSIONS	RECOVERY [1]	
	Annual waste at the SWDS	MCF	CH_4 [2]	CH_4	CH_4	
				Emissions [3]	Flaring	Energy recovery [4]
	(kt)		(t/t waste)	(kt)	(kt)	
5.A.1. Managed waste disposal sites						
5.A.1.a. Anaerobic						
Drop down list: [5]						
Less decomposable wastes						
Moderately decomposable wastes						
Highly decomposable waste						
Bulk waste						
5.A.1.b. Semi-aerobic						
Drop down list: [5]						
Less decomposable wastes						
Moderately decomposable wastes						
Highly decomposable waste						
Bulk waste						
5.A.1.c. Active-aeration						
Drop down list: [5]						
Less decomposable wastes						
Moderately decomposable wastes						
Highly decomposable waste						
Bulk waste						
5.A.2. Unmanaged waste disposal sites						
Drop down list: [5]						
Less decomposable wastes						
Moderately decomposable wastes						
Highly decomposable waste						
Bulk waste						
5.A.3. Uncategorized waste disposal sites						
Drop down list: [5]						
Less decomposable wastes						
Moderately decomposable wastes						
Highly decomposable waste						

WASTE CRT TABLES
TABLE 5.B SECTORAL BACKGROUND DATA FOR WASTE

TABLE 5.B SECTORAL BACKGROUND DATA FOR WASTE Year
Biological Treatment of Solid Waste Submission
(Sheet 1 of 1) Country
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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA AND OTHER RELATED INFORMATION	IMPLIED EMISSION FACTOR		EMISSIONS		RECOVERY (1)	
		CH_4 (2)	N_2O	CH_4 (3)	N_2O	CH_4	
	Annual waste amount treated					Amount of CH_4 flared	Amount of CH_4 for energy recovery (4)
	(kt dm)	(g/kg waste)		(kt)			
5.B.1. Composting							
5.B.1.a. Municipal solid waste							
5.B.1.b. Other *(please specify)* (5)							
5.B.2. Anaerobic digestion at biogas facilities (4)							
5.B.2.a. Municipal solid waste							
5.B.2.b. Other *(please specify)* (5)							

WASTE CRT TABLES
TABLE 5.B SECTORAL BACKGROUND DATA FOR WASTE

TABLE 5.B SECTORAL BACKGROUND DATA FOR WASTE Year
Biological Treatment of Solid Waste Submission
(Sheet 1 of 1) Country
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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA AND OTHER RELATED INFORMATION	IMPLIED EMISSION FACTOR		EMISSIONS		RECOVERY (1)	
		CH_4 (2)	N_2O	CH_4 (3)	N_2O	CH_4	
	Annual waste amount treated					Amount of CH_4 flared	Amount of CH_4 for energy recovery (4)
	(kt dm)	(g/kg waste)		(kt)			
5.B.1. Composting							
5.B.1.a. Municipal solid waste							
5.B.1.b. Other *(please specify)* (5)							
5.B.2. Anaerobic digestion at biogas facilities (4)							
5.B.2.a. Municipal solid waste							
5.B.2.b. Other *(please specify)* (5)							

WASTE CRT TABLES

TABLE 5.C SECTORAL BACKGROUND DATA FOR WASTE

TABLE 5.C SECTORAL BACKGROUND DATA FOR WASTE
Incineration and open burning of waste
(Sheet 1 of 1)

Year
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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA Amount of wastes (incinerated/open burned) (kt wet weight)	IMPLIED EMISSION FACTOR (kg/t waste)			EMISSIONS (kt)		
		CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
5.C.1. Waste Incineration							
5.C.1.a. Biogenic [1]							
5.C.1.a.i. Municipal solid waste							
5.C.1.a.ii. Other[2]							
Drop down list							
5.C.1.a.ii.1. Industrial solid wastes							
5.C.1.a.ii.2. Hazardous waste							
5.C.1.a.ii.3. Clinical waste							
5.C.1.a.ii.4. Sewage sludge							
5.C.1.a.ii.5. Other *(please specify)*							
5.C.1.b. Non-biogenic							
5.C.1.b.i. Municipal solid waste							
5.C.1.b.ii. Other[3]							
Drop down list							
5.C.1.b.ii.1. Industrial solid wastes							
5.C.1.b.ii.2. Hazardous waste							
5.C.1.b.ii.3. Clinical waste							
5.C.1.b.ii.4. Sewage sludge							
5.C.1.b.ii.5. Fossil liquid waste [4]							
5.C.1.b.ii.6. Other *(please specify)*							
5.C.2. Open burning of waste							
5.C.2.a. Biogenic [1]							
5.C.2.a.i. Municipal solid waste							
5.C.2.a.ii. Other *(please specify)*							
5.C.2.b. Non-biogenic							
5.C.2.b.i. Municipal solid waste							
5.C.2.b.ii. Other *(please specify)*							

WASTE CRT TABLES
TABLE 5.D SECTORAL BACKGROUND DATA FOR WASTE

TABLE 5.D SECTORAL BACKGROUND DATA FOR WASTE
Wastewater treatment and discharge
(Sheet 1 of 1)

Year
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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA AND RELATED INFORMATION			IMPLIED EMISSION FACTOR		EMISSIONS			RECOVERY [1]	
				CH_4 [3]	N_2O	CH_4 [4]	N_2O		CH_4	
	Total organic product	Sludge removed [2]	N in effluent				Plants	Effluent	Amount of CH_4 flared	Amount of CH_4 for Energy Recovery [5]
	(kt DC [6]/yr)		(kt N/yr)	(kg/kg DC)	kg N_2O-N/kg N	(kt)				
5.D.1. Domestic wastewater										
5.D.2. Industrial wastewater										
5.D.3. Other *(please specify)*										

Additional information

Population (1000s)	
Protein consumption (kg/person/yr)	
Fraction of nitrogen in protein	
$F_{NON-CON}$	
$F_{IND-COM}$	
T_{PLANT}	

Note: Parties are encouraged to supply the