Technical Appendix - Indonesia:

Methods for estimating community-scale sectoral data from national and regional statistics for the purpose greenhouse gas accounting and climate action planning

Varsha Suresh, Kevin Kurkul, Eko Supriyanto, Retno Wihanesta, and Rebecca Davis – World Resources Institute

Buildings and Stationary Energy Sector

This document details the calculation approaches and data sources for producing community-level activity data and emission factors for the buildings and stationary energy sector. This sector contains the following subsectors:

Building and Stationary Energy Sector	
Residential	Estimated
Commercial	Estimated
Municipal	Not Currently Estimated
Industry	Not Currently Estimated
Agriculture, forestry and fisheries	Not Currently Estimated
Fugitive emissions	Not Currently Estimated

Residential Buildings

Subsector Summary

The residential buildings subsector encompasses all GHG emitting activities from energy use in households[1] including heating, cooking, and lighting. The two primary categories of GHG emitting activities within the subsector are: scope 1) emissions from fuel combustion associated with residential buildings within the community boundary and scope 2) emissions from consumption of grid-supplied electricity (which may be generated outside the community boundary).

Inclusions:

For Indonesia, based on data availability and country-specific relevance, estimates for the following activity data points are produced:

- **Liquid Petroleum Gas** used by households, based on annual fuel consumption by residential customers at national level.
- **Kerosene** used by households, based on annual fuel consumption by residential customers at province level.
- **Grid- supplied Electricity** used by households, based on annual electricity consumed by residential customers at the province level.

Exclusions:

Due to lack of data availability and country-specific relevance, estimates for the following activity data points are not produced:

- **Off-highway motor gasoline** consumption, e.g. for use in lawn and gardening equipment
- **District heating, cooling,** or other non-electricity grid-supplied energy

Activity Data Coverage

The specific data points and energy sources covered by the methodology are outlined in the table below.

Fuels/Energy Source	GHGDP Definition	Units	Scope
Liquid Petroleum Gas (LPG)	All LPG consumption within community boundary for a single year for all households.	MJ	Scope 1
Kerosene	All Kerosene consumption within community boundary for a single year for all households.	MJ	Scope 1
Grid-supplied Electricity	All Electricity consumption within community boundary for a single year for all households.	MJ	Scope 2

Calculations Methodologies:

Scope 1: Liquid Petroleum Gas (LPG)

Methodology Notes

Residential building LPG consumption is calculated from Indonesia's National Energy Balance data for the year 2017 from the **Handbook of Energy & Economic Statistics Indonesia published by Ministry of Energy & Mineral Resources**. The initial input data is allocated to communities based on the number of households in the municipality using LPG relative to the national household total using LPG.

Total national count of households and total households by municipality using LPG are sourced from the Census data by Badan Pusat Statistik (BPS) Indonesia for the year 2010.

The following equation is utilized to estimate household kerosene consumption.

Equation 1: Household LPG Consumption

$$\begin{aligned} &Community\ scale\ Household\ Consumption \\ &= Aggregate\ Fuel\ Sales\ _{National} \\ &\times \left(\frac{No.of\ Households\ using\ LPG_{Community}}{No.of\ Households\ using\ LPG\ _{National}}\right) \end{aligned}$$

Equation Data Elements

Data element	Description	Source	Units
$Community\ scale\ Household\ Consumption$	All LPG consumption within community boundary for a single year for all households.	Equation 1	MJ
$Aggregate\ Fuel\ Sales\ _{National}$	Amount of fuel distributed to residential customers within entire country	Indonesia Energy Balance 2017	MJ
$\left(\frac{No.of\ Households\ using\ LPG_{Community}}{No.of\ Households\ using\ LPG_{National}}\right)$	Ratio representing the number of households within community using LPG over the number of households in the country using LPG	BPS 2010	households

Methodology Assumptions

General assumptions and limitations

- All households that use LPG within a community use the same quantity of LPG
- LPG consumption within the residential sector is mainly for cooking purposes
- For the purpose of this methodology, we only accessed community-specific household data from the 2010 census. Improvements to this method can be made when a more recent census is released.
- National Energy Balance totals are assumed to encompass all LPG national residential consumption

Scope 1: Kerosene

Methodology Notes

Residential building Kerosene consumption is taken from Indonesia's Oil and Gas Regulatory data for Fuel sales by sector by province for the year 2017. The initial input data is allocated to communities based on the number of households in the municipality relative to the state totals.

Total count of households by province and total households by municipality are sourced from the Census data by Badan Pusat Statistik (BPS) Indonesia for the year 2010.

The following equation is utilized to estimate household kerosene consumption.

Equation 2: Community Kerosene Consumption

$$Community\ scale\ Household\ \ Consumption = Aggregate\ Fuel\ Sales_{Province} \times \left(\frac{No.\ of\ Households_{Community}}{No.\ of\ Households_{Province}}\right)$$

Equation Data Elements

Data element	Description	Source	Unit
$Community\ scale\ Household\ Consumption$	All Kerosene consumption within community boundary for a single year for all households.	Equation 2	MJ
$Aggregate\ Fuel\ Sales_{Province}$	Amount of fuel distributed to residential customers within entire state	Province Fuel Sales 2017	MJ
$\left(\frac{No.\ of\ Households_{Community}}{No.\ of\ Households_{Province}}\right)$	Ratio representing the households within community over the number of households in the	BPS 2010	households

Methodology Assumptions

General assumptions and limitations

- All households within a community use the same quantity of kerosene
- For the purpose of this methodology, we only accessed community-specific household data from the 2010 census. Improvements to this method can be made when a more recent census is released.
- Oil and Gas Regulatory totals are assumed to encompass all kerosene national residential consumption.

Scope 2: Electricity

Methodology Notes

Residential building electricity consumption is taken from Indonesia's Electricity Statistics Handbook by province for the year 2017. The initial input data is allocated to communities based on the number of households in the municipality relative to the state totals.

Total count of households by province and total households by municipality are sourced from the Census data by Badan Pusat Statistik (BPS) Indonesia for the year 2010.

The following equation is utilized to estimate household electricity consumption

Equation 3: Community Electricity Consumption

$$Community\ scale\ Household\ Consumption = Aggregate\ Electricity\ Consumption_{Province} \times \left(\frac{No.of\ Households_{Community}}{No.of\ Households_{Province}}\right)$$

Equation Data Elements

Data element	Description	Source	Units
$Community\ scale\ Household\ Consumption$	All electricity consumption within community boundary for a single year for all households.	Equation 3	MJ

$Aggregate\ Electricity\ Consumption_{Province}$	Amount of electricity consumed by residential customers within entire province	BPS 2017	MJ
$\left(\frac{No.of\ Households_{Community}}{No.of\ Households_{Province}}\right)$	Ratio representing the households within community over the number of households in the province	BPS 2010	households

Methodology Assumptions

- All households use the same quantity of electricity within a community
- For the purpose of this methodology, we only accessed community-specific household data from the 2010 census. Improvements to this method can be made when a more recent census is released
- Electricity Statistics totals are assumed to encompass all electricity residential consumption in the country.

Emission Factors

The following table provides IPCC 2006 emission factor values for the list of fuels used in the buildings and stationary sector methodology for Indonesia.

Emission Factor Data Elements

Fuel type	Carbon Dioxide (CO2) kg/GJ	Methane (CH4) kg/GJ	Nitrous Oxide (N2O) kg/GJ	Heating Value Mass GJ/ton	Heating Value Liquid Volume GJ/liter	Heating Value Gaseous Volume GJ/m3
Fossil						
Natural Gas	56.1	0.005	0.0001			0.0336
Kerosene	71.9	0.01	0.0006		0.035	
Liquified Petroleum Gas (LPG)	63.1	0.005	0.0001	47.3	0.0255	0.0336

References

Badan Pusat Statistik (BPS), Statistics Indonesia. Population by Region, Types of Enumeration Documents Used, and Gender.

https://sp2010.bps.go.id/index.php/site/index

Population census by region & municipality for the year 2010

Badan Pusat Statistik (BPS), Statistics Indonesia. Electricity Statistics, 2012 -2017

https://www.bps.go.id/publication/2018/12/25/2c2849012b157560865d5442/statistik-listrik-2012-2017.html

Electricity consumption by sector for Indonesia for the year 2017

Volume of Fuel Sales per Type per Sector 2017. Oil & Gas Regulatory
https://onewri.sharepoint.com/:f:/s/GHGDP/EnfDJIrik_1Fs2skv3AyXuABL-1kSJbC3H9zf9Z3l3RHSw?e=YBxFJU

Household consumption of Kerosene by province for the year 2017

Indonesia Energy Balance 2017, Handbook of Energy & Economic Statistics Indonesia. Ministry of Energy & Mineral Resources

https://www.esdm.go.id/assets/media/content/content-handbook-of-energy-and-economic-statistics-of-indonesia-2018-final-edition.pdf

National LPG consumption by sector for Indonesia for the year 2017

https://sp2010.bps.go.id/index.php/site/tabel?tid=302&wid=0

Household consumption of LPG for cooking by municipality for the year 2010

Commercial Buildings

Subsector Summary

The commercial buildings subsector encompasses all GHG emitting activities from energy use in commercial buildings, including heating, cooling, and lighting. The two primary categories of GHG emitting activities within the subsector are: scope 1 emissions from fuel combustion associated with commercial buildings within the community boundary and scope 2 emissions from consumption of grid-supplied electricity.

Inclusions:

For Indonesia, based on data availability and occurrence in-country, estimates for the following activity data points are produced:

- **Grid-supplied electricity** used by commercial businesses, based on annual electricity consumed by commercial customers at the national level.

Exclusions:

Due to lack of data availability or occurrence in-country, estimates for the following activity data points are not produced:

- **Off-highway motor gasoline** consumption, e.g. for use in landscaping equipment
- **District heating, cooling,** or other non-electricity grid-supplied energy
- **Natural gas**, **liquefied petroleum gas**, and **diesel oil** used by commercial buildings, based on annual fuel consumption by customers at national level.

Activity Data Coverage

The specific data points and energy sources covered by the methodology are outlined in the table below.

Fuels/Energy Source	**GHGDP Definition**	**Corresponding contextual Data**
Grid-Electricity	Electricity consumption within community boundary for a single year for all commercial buildings	No. of workers in commercial sector

Calculation Methodologies

Scope 2: Electricity

Methodology Notes

Commercial building electricity consumption is taken from Indonesia's Electricity Statistics Handbook for the year 2017. This initial input data is allocated to communities based on the **proportion of employees** in the community relative to the province totals.

Total count of employees by province and total employees by municipality for the commercial sector is sourced from the Census data by Badan Pusat Statistik (BPS) Indonesia for the year 2010.

The following equation is utilized to estimate commercial electricity consumption.

Equation 4: Community Electricity Consumption

$$Community\ scale\ Commercial\ \ Consumption = Aggregate\ Electricity\ Consumption_{Province} \times \left(\frac{Sector\ Employees_{Community}}{Sector\ Employees_{Province}}\right)$$

Equation Data Elements

Data element	Description	Source	Units
$Community\ scale\ Commercial\ Consumption$	Electricity consumption within community boundary for a single year for all commercial buildings	Equation 4	MJ
$Aggregate\ Electricity\ Consumption_{Province}$	Amount of fuel distributed to commercial customers within entire province	BPS 2017	MJ
$\left(\frac{Sector\ Employees_{Community}}{Sector\ Employees_{Province}}\right)$	Calculated ratio representing the estimated number of commercial sector employees within the community over the estimated state province	BPS 2010	employees

Methodology Assumptions

- Number of commercial sector employees is proportionally related to the size of a commercial facility which is in turn proportional to the amount of electricity consumed.
- Electricity Statistics numbers are assumed to encompass all electricity national commercial consumption.
- All electricity sold to commercial customers is consumed within the year it is delivered

Emission Factors

The following table provides IPCC 2006 emission factor values for the list of fuels used in the buildings and stationary sector methodology for Indonesia.

Emission Factor Data Elements

Fuel type	Carbon Dioxide (CO2) kg/GJ	Methane (CH4) kg/GJ	Nitrous Oxide (N2O) kg/GJ	Heating Value Mass GJ/ton	Heating Value Liquid Volume GJ/liter	Heating Value Gaseous Volume GJ/m3
Fossil						
Natural Gas	56.1	0.005	0.0001			0.0336
Distillate Fuel Oil	74.1	0.01	0.0006		0.0361	
Liquified Petroleum Gas (LPG)	63.1	0.005	0.0001	47.3	0.0255	0.0336

References:

Badan Pusat Statistik (BPS), Statistics Indonesia. Population by Region, Types of Enumeration Documents Used, and Gender.

https://sp2010.bps.go.id/index.php/site/index

Population census by region & municipality for the year 2010

Badan Pusat Statistik (BPS), Statistics Indonesia. Electricity Statistics, 2012 -2017

https://www.bps.go.id/publication/2018/12/25/2c2849012b157560865d5442/statistik-listrik-2012-2017.html

Electricity consumption by sector for Indonesia for the year 2017

Transportation and Mobile Energy Sector

This document details the calculation approaches and data sources for producing community-level activity data and emission factors for the transportation and mobile energy sector. This sector contains the following subsectors:

Transportation and Mobile Energy Sector	
On-road	Estimated
Rail	Not Estimated
Waterborne navigation	Not Estimated
Aviation	Not Estimated
Off-road	Not Estimated

On-Road

Subsector Summary

GHG emissions within the On-Road subsector result from the consumption of fuel for on-road vehicles such as passenger cars, light trucks, motorcycles, mopeds, buses, heavy trucks, and combination trucks within a community boundary. The GHG emitting activity we focus on in this subsector is fuel consumption (scope 1) from fuels such as gasoline and diesel.

Inclusions

For Indonesia, based on available data and method, activity data produced includes:

- **Gasoline** and **diesel fuel** sales for passenger cars, trucks, motorcycles, and buses

Exclusions

Due to lack of data, this methodology does not include:

- **Fuel consumption disaggregated by fleet type** from all on-road vehicles.
- **The vehicle kilometers traveled by** all on-road vehicles.

Activity Data Coverage

Table 1 includes the emissions sources covered by this methodology.

Table 1 – Allocated activity data, units, and emission sources

Emissions Source	Definition	Units	Scope
Gasoline	The amount of gasoline consumed for a single year by all vehicles in a community boundary	Liters	Scope 1
Diesel	The amount of diesel consumed for a single year by all vehicles in a community boundary	Liters	Scope 1

Allocation Methodology

Fuel Consumption

The input data from the Oil and Gas Regulatory provides province values for gasoline and diesel sales by all on-road vehicles. This dataset therefore required additional disaggregation to be completed using the total number of vehicle registrations by municipality in our methodology.

In Indonesia, there are several gasoline types namely RON 88, RON 90, RON 92, RON 95, RON 98. All these gasoline types were summed together and represented as total province gasoline value. Solar CN 51 and Solar CN 53 are types of diesel which are summed and broadly represented under total province diesel value. These are then disaggregated by vehicle type for each community.

Equation 1 includes the approach used to estimate gasoline and diesel sales for vehicle types.

Equation 1: Community fuel sales

$$\text{Community fuel sales}_{vehicle\ type} = \text{Province fuel sales}_{\ vehicle\ type} \times \frac{\text{Municipality vehicle registrations}_{vehicle\ type}}{\text{Province vehicle registrations}_{vehicle\ type}}$$

Table 2 – Data sources to estimate gasoline consumption

Data element	Definition	Units	Source
Community fuel sales	Gasoline or diesel sales within the community boundary, by vehicle type (passenger car, trucks, bus, or motorcycle)	Liters	Equation 1
Province fuel sales	Gasoline or diesel sales within the province boundary, by vehicle type (passenger car, trucks, bus, or motorcycle)	Liters	Oil and Gas Regulatory 2017
Municipality Vehicle registrations	Municipal-level motor vehicle registration numbers by vehicle type in a single year	Vehicles	BPS, Province Regional Police (2014 – 2017)
Province Vehicle registrations	Province motor vehicle registration numbers by vehicle type in a single year	Vehicles	BPS, Province Regional Police (2014 – 2017)

Methodological and Data Assumptions & Limitations

This methodology assumes that:

- Gasoline and diesel are the only fuels used by vehicles.
- All motorcycles use gasoline, passenger cars use either gasoline (80%) or diesel (20%), all buses and trucks use diesel. It is assumed that 80% of registered passenger cars use gasoline, and that 20% use diesel (Clean Air Asia, 2018)
- Without average fuel consumption by vehicle type, it is assumed that the disaggregation is proportional to the number of vehicles in each vehicle type.

- All trucks are categorized as single-unit trucks because no additional information was available about type of truck.
- It is assumed that motorcycles and cars use all the gasoline subtypes (summed to represent total gasoline value) in equal proportions.
- It is assumed that cars, trucks and buses all use the diesel subtypes (summed to represent total diesel value) in equal proportions.

Emission Factors

This methodology uses emission factors from the IPCC *Guidelines for National Greenhouse Gas Inventories Volume 2: Energy* (IPCC, 2006). These are globally recognized default emission factor values. Table 2 includes the fuels used in Indonesia and their corresponding emission factor values.

Table 2 – IPCC Emission Factors for Fuels

Fuel type	Carbon Dioxide (CO2) kg/GJ	Methane (CH4) kg/GJ	Nitrous Oxide (N2O) kg/GJ	Heating Value Mass GJ/ton	Heating Value Liquid Volume GJ/liter	Heating Value Gaseous Volume GJ/m3
Fossil						
Diesel	74.1	0.01	0.0006		0.0361	
Gasoline	69.3	0.01	0.0006		0.0328	

Citations

Eggleston, S., Buendia, L., Miwa, K., Ngara, T., & Tanabe, K. (Eds.). (2006). "2006 IPCC guidelines for national greenhouse gas inventories (Vol. 2): Energy." Hayama, Japan: Institute for Global Environmental Strategies.

Retrieved from https://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html

This webpage provides standard GHG emission factor variables for each fuel type used.

Fuel Sales for Transportation sector, BPH Migas (Oil and Gas Regulatory), 2017

Received upon request, from BPH Migas, Badan Pengatur Hilir Minyak dan Gas Bumi

Includes province wise, fuel wise sales data for the year 2017

Vehicle registrations by regency/municipality, (latest available years) (2014 – 2017)

Available on Badan Pusat Statistik (BPS) Indonesia's province website https://www.bps.go.id/. Received upon request from Province Regional Police when not available online.

Includes vehicle registrations by vehicle type (passenger cars, motorcycles, trucks, buses) by regency/city

Vehicle emission standards for Indonesia, Clean Air Asia (2018)

https://cleanairasia.org/wp-content/uploads/2018/05/Ahmad-Safrudin-Vehicle-Emission-Standard-in-Indonesia.pdf

Includes percentage of vehicles using Diesel and Gasoline in Indonesia

Waste Sector

This document details the calculation approaches and data sources for producing community-level activity data and emission factors for the waste sector. This sector contains the following subsectors:

Waste Sector	
Solid waste	Estimated
Biological waste	Not Currently Estimated
Incinerated and burned waste	Not Currently Estimated
Wastewater	Not Currently Estimated

Solid Waste

Subsector Overview

This section covers the activity data and emission factors needed for communities in Indonesia to estimate emissions from the disposal of municipal solid waste (MSW). While other gases are also emitted through the collecting, sorting, and transporting of solid waste to treatment facilities—namely biogenic carbon dioxide, non-methane volatile organic compounds, and nitrous oxide—this methodology focuses on estimating values related to MSW treated at landfill facilities or open dumps only. If desired, communities may consult international resources such as the IPCC guidelines for national reporting or local guidance documents, if available, to estimate non-methane GHG emissions from solid waste disposal. Hence, emissions under this sub-sector are influenced by the following five factors:

1) The mass of community-generated waste disposed in landfills or open dumps;
2) The methane generation potential
3) The methane correction factors; influenced by waste composition
4) The oxidation factors
5) The amount of methane recovered (for facilities with existing technology to do so).

Methane (CH_4) is the main gas emitted during the MSW treatment processes. The following section discusses methods for estimating the mass of waste, methane correction factor, oxidation factor and methane recovery fraction—where applicable—at a community level. All of these variables impact the final total of methane emissions reported in Indonesia.

Inclusions

For Indonesia, based on available data, this methodology provides estimates on:

- Community-specific **mass of waste landfilled at landfill facilities**
- **Methane Correction Factor** based on historical landfill management characteristics such as managed, unmanaged deep, unmanaged shallow, and uncategorized landfills.
- **Methane Generation Potential (L_0)** based on degradable organic carbon, landfill management type and fraction of methane in landfill gas nationally.
- **Oxidation Factors (OX)** based on waste disposal management practice.

Exclusions

Due to the unavailability of data, the methods exclude:

- Community-specific **mass of industrial, sludge, clinical, and fossil liquid waste.**
- **Landfill methane recovery fraction** at landfill facilities with recovery systems in place.

- The combustion, or flaring, of landfill gas for non-energy purposes[1]
- The combustion of solid waste for non-energy purposes[2]

Activity Data Coverage

Table 1: Activity data, units, and scope covered under solid waste disposal

Activity Data	Definition	Units	Gas Reported	Emissions Scope
Mass of Waste	The mass of waste generated within a community boundary but diverted to an external landfill or open dump for disposal	Tonnes	CH_4	Scope 3

Calculation Methodology

Activity Data – Mass of Waste (Managed Landfills)

Municipal solid waste data at a province level is obtained from the Ministry of Public Works as published in the Information Statistics Book for the year 2017. The community population from the Census data is obtained from Badan Pusat Statistik (BPS) Indonesia. The community-specific mass of waste is calculated as per the following equation.

Equation 1

$$Landfilled\ Waste_{Community} = Landfilled\ Waste_{Province} \times \left(Community\ Population / Province\ Population\right)$$

Data Element	Definition	Units	Data Source

[1] While the flaring of landfill gas is typically reported under the waste sector, to burning of landfill gas for energy purposes is reported under the stationary energy sector

[2] Similar to above, the burning of waste for non-energy purposes falls under the waste sector, whereas any waste burned for energy (e.g. heat or electricity generation) falls under the stationary energy sector

$Landfilled\ Waste_{Community}$	Mass of community - generated organic waste going to landfills	Tonnes	Equation 1
$Landfilled\ Waste_{Province}$	Mass of state - generated organic waste going to landfills	Tonnes	Ministry of Public Works, Indonesia (2017)
$Community\ Population$	Total number of residents living within community boundary	People	Indonesia Census (2010)
$Province\ Population$	Total number of persons living in the state	People	Indonesia Census (2010)

Methane Correction Factor (MCF)

Since CH_4 generation rates are dependent on landfill management practices, this methodology uses the IPCC (2006) default landfill management types to determine an appropriate community-specific methane correction factor. IPCC (2006) assigns a unitless MCF value of 1 for managed landfills and 0.4 for Unmanaged Shallow Landfills. Since there is no information on the type of Landfills in Indonesia a weighted MCF is created by taking the mean of the above factors, yielding an MCF value of 0.7

Methane Generation Potential (L_0)

Methane generation potential (L_0) is itself a combination of several components: The Methane Correction Factor (MCF); Degradable Organic Carbon (DOC), weighted by waste stream type (discussed below); the fraction of waste degraded anaerobically (DOC_f); the fraction of landfill gas that is methane (F); and the methane to carbon ratio. In the absence of facility-specific data, each of these values is derived from IPCC 2006 list of default values. This methodology calculates the methane generation potential of landfilled waste in Indonesia using equation below:

Equation 2

$$L_0 = MCF * DOC * DOC_F * F * {}^{16}/_{12}$$

Table 3: Data elements and sources

Data Element	Definition	Units	Data Source
MCF	Methane Correction Factor (based on management type) – part of the landfilled materials that is left to degrade anaerobically.	Unitless	IPCC (2006)
DOC	Degradable organic carbon – the portion of the waste stream that can decompose under aerobic conditions	Tonnes C/tonne waste	IPCC (2006)
DOC_F	The fraction of DOC ultimately degraded anaerobically	Unitless	IPCC (2006)
F	The fraction of methane in landfill gas	Unitless	IPCC (2006)
$16/12$	Methane to carbon ratio	Unitless	IPCC (2006)

Degradable Organic Carbon (DOC)

Degradable Organic Carbon represents the amount of organic carbon in the waste that can be degraded. The final DOC value is calculated using the fraction of the total mass of the waste and multiplying it with the DOC fractions.

Equation 3

$$DOC = (0.15 * A) + (0.2 * B) + (0.4 * C) + (0.43 * D) + (0.24 * E) + (0.15 * F)$$

Table 4: Data elements and sources

Metric	Definition
A	Mass of food waste
B	Mass of garden and plant debris
C	Mass of paper
D	Mass of wood
E	Mass of textiles
F	Mass of Industrial waste

Table 5: IPCC Defaults for South East Asia

IPCC Defaults	Food waste	Paper/cardboard	Wood	Textiles	Rubber/leather	Plastic	Metal	Glass	Other
Waste Fractions	43.5	12.9	9.9	2.7	0.9	7.2	3.3	4	16.3
DOC	15	40	43	24	-	-	-	-	-

Emission Factors

Under this method the solid waste disposal emission factor (EF) is a combination of two factors, the methane generation potential (L_0) and the oxidation factor (OX). In the absence of data on facility-specific emission factors, this methodology relies on the default factor for OX derived from IPCC (2006).

Equation 4

$$EF = L_o * (1 - OX)$$

Table 6: Data elements and sources

Data Element	Definition	Units	Data Source
L_O	Methane Generation Potential – the amount of methane generated per tonne of waste	Tonnes CH_4/tonne waste	Equation 2
OX	Oxidation factor (Methane Oxidized in top layer)	Unitless	IPCC (2006)

General Assumptions & Limitations

Mass of Waste

- Mass of waste generated, measured as the amount of waste disposed in landfills in Indonesia is proportionally related to population.
- All waste measured is categorized under scope 3 as we do not have the data to measure scope 1 emissions

Emission Factors

- The IPCC (2006) *IPCC Guidelines for National Greenhouse Gas Inventories. Volume 5: Waste, Chapter 3: Solid Waste Disposal* provides national waste composition estimates for Southeast Asia. In the absence of national or community-specific datasets on industrial, clinical, sludge, and fossil liquid waste this methodology is unable to determine a community-specific DOC estimate for these waste streams.

Methane Correction Factor

- Landfill sites assumed to fall under managed and unmanaged shallow anaerobic IPCC landfill characteristic are assigned an MCF of 1.0 and 0.4. Since there is no information on the type of Landfills in Indonesia a weighted MCF is created by taking the average of the above.

Methane Recovery

- Ministry of Public Works does not provide information for methane recovered therefore methane recovery is not reported.

Citations

IPCC (2006). IPCC Guidelines for National Greenhouse Gas Inventories. Volume 5: Waste, Chapter 3: Solid Waste Disposal, The National Greenhouse Gas Inventories Programme, The Intergovernmental Panel on Climate Change, H.S. Eggleston, L. Buendia, K. Miwa, T. Ngara, and K. Tanabe (eds.). Hayama, Kanagawa, Japan.

http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_3_Ch3_SWDS.pdf

Provides default values for the fraction of degradable organic content present in waste stream.

IPCC (2006). IPCC Guidelines for National Greenhouse Gas Inventories. Volume 5: Waste, Chapter 2: Waste Generation, Composition and Management Data, The National Greenhouse Gas Inventories Programme, The Intergovernmental Panel on Climate Change, Riitta Pipatti (Finland), Chhemendra Sharma (India), Masato Yamada (Japan)

https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_2_Ch2_Waste_Data.pdf

Provides default values for the different waste fractions for South-East Asia

Ministry of Public Works, 2017. Waste Processing Sites by Province.

https://eppid.pu.go.id/assets/common/pdf/info_publik-20180413113551.pdf

Provides landfill capacity and amount of waste landfilled by province for the year 2017

Badan Pusat Statistik (BPS), Indonesia (2010). Population by Region, Types of Enumeration Documents Used, and Gender

https://sp2010.bps.go.id/index.php/site/index

Provides population information at a city/regency level for Indonesia.