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Assessing Waste Potential and Greenhouse Gas Emissions from Existing Waste Management Systems: A Case Study of Palembang City South Sumatera of Indonesia

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Abstract:
Background, Palembang City South Sumatera of Indonesia faces serious waste challenges, generating about 983-1,200 tons daily, 35% plastic and under 10% recycled. Improper disposal drives methane emissions and climate impacts. This study explores low-cost waste-to-energy (WtE) strategies to cut emissions, support a circular economy, and empower communities through sustainable, participatory waste management.
Aim, This study analyzes Palembang's waste generation and GHG emissions to support sustainable and efficient waste management strategies.
Methods, This study used mixed methods to assess Palembang's waste management and emissions, conducted from July-October 2025, data from key stakeholders were analyzed using IPCC Tier 1 Guidelines to compare baseline and intervention scenarios for sustainable community solutions.
Results, The analysis revealed that Palembang City South Sumatera of Indonesia generates approximately 1,000 tons of municipal solid waste per day, with organic waste (56%) and plastic waste (24%) as the dominant fractions. Current waste treatment processes, mainly open dumping and limited composting, result in an estimated carbon emission of 420-460 tons CO_2-eq per day. Scenario modeling indicated that implementing a low-cost waste-to-energy (WtE) system and community-based segregation programs could reduce emissions by up to 55%, while generating additional energy potential of 7-9 MWh per day. These findings demonstrate the significant potential of an integrated waste management approach to simultaneously mitigate greenhouse gas emissions and enhance energy recovery in Palembang.
Conclusions, Palembang generates 983-1,200 tons of waste daily, mostly food (40.8%) and plastic (20.4%), with 60% sent to Sukawinatan and 40% to Kramasan landfills. Management still relies on open dumping, causing methane emissions of 2,352.9 tons (65,888.2 tons CO_2-eq) valued at about IDR 1.97 trillion. These results underscore the need for integrated, sustainable waste-to-energy (WtE) solutions.
Implication, The study guides policymakers in developing low-cost, sustainable waste management through community-based waste-to-energy (WtE) initiatives that reduce emissions and support a circular, resilient city.

Keywords: Carbon emission reduction, community-based management, low-cost technology, waste-to-energy (WtE).

INTRODUCTION

Waste has become one of the most critical environmental issues faced by society today. Each year, the volume of waste continues to increase in line with population growth and rapid urbanization. In Indonesia, improper waste disposal and reliance on final disposal sites (TPA) contribute significantly to greenhouse gas (GHG) emissions, particularly methane. Therefore, effective and sustainable waste management is essential (Citrasari et al., 2025). This study aims to analyze the potential for carbon emission reduction through improved waste management, focusing on affordable waste-to-energy (WtE) technologies and community participation. Palembang City has experienced a significant increase in plastic waste generation. According to the Environmental Agency and the National Waste Management Information System (SIPSN), approximately 20-30% of total waste produced consists of plastic, which is difficult to decompose and often ends up in landfills (Setiawan, Susanto, et al., 2025). This situation calls for innovative and effective solutions for plastic waste management and recycling. Based on the Waste Potential Data of Palembang City, total daily waste generation is around 1,200 tons, with plastic waste accounting for 30-35% (approximately 400 tons per day) and a current recycling rate of less than 10%. The issue of waste has become an increasing global concern, particularly in developing countries. With rapid population growth and urbanization, waste generation continues to rise, creating adverse impacts on the environment. However, behind these challenges lies a great potential to utilize waste as a source of energy and raw materials, which can help reduce GHG emissions and promote sustainability (Islam et al., 2024).

Waste, including organic, inorganic, and hazardous types, can be converted into energy. Organic waste, in particular, can be processed through composting (producing fertilizer), anaerobic digestion (producing biogas), or incineration (generating energy but with emission risks). These methods reduce landfill volume and help lower greenhouse gas emissions. Treating organic waste reduces CO_2 and methane emissions from landfills. Community-level, low-cost energy conversion technologies such as biogas kits, small-scale Waste-to-Energy (WtE) plants, and mobile apps for waste reporting can enhance waste utilization and recycling (Hariyani et al., 2025). Effective waste management is a critical environmental challenge, especially in large cities like Palembang. As the volume of waste continues to increase, GHG emissions from the decomposition process in landfills also rise. The direct impacts on climate change and public health call for innovative solutions that are not only effective but also economically feasible (Setiawan & Rinamurti, 2021). This study aims to analyze the potential of utilizing waste to reduce GHG emissions through low-cost WtE technologies in Palembang City South Sumatera of Indonesia.

This research focuses on developing local regulations and community-based strategies for sustainable waste management that support the circular economy. It highlights the global adoption of the Zero Waste concept and the potential of waste-to-energy technologies to reduce landfill pressure and generate energy. The study examines low-cost, community-driven approaches to lower GHG emissions and improve waste management in Palembang, addressing infrastructure and participation challenges while promoting economic and environmental benefits. Based on the background described above, the main research questions addressed in this study what is the potential for carbon emission reduction through waste management?. The objectives of this research is to identify and analyze the potential for carbon emission reduction from waste management practices. The expected benefits of this study include providing a scientific contribution to the field of waste management and climate change mitigation.

LITERATURE REVIEW

Waste has become a global challenge requiring sustainable solutions. According to the *World Bank* (2018), the world generates approximately 2.01 billion tons of waste annually, and this figure is projected to increase by 70% to 3.40 billion tons by 2050. Improper waste management contributes to environmental pollution, climate change, and public health risks. Therefore, the concept of sustainable waste management has emerged as a critical approach to minimize the negative impacts of waste. The main objectives of sustainable waste management are to: (1) Reduce waste generation (waste reduction); (2) Increase recycling and reuse practices; (3) Minimize landfill disposal (landfill diversion); and (4) Optimize waste-to-energy (WtE) conversion.

This concept follows the Waste Management Hierarchy, prevention, reuse, recycle, recovery, disposal, implemented through the 5R + WtE approach: (1) Reduce, minimize waste at the source via Zero Waste Lifestyles and Extended Producer Responsibility (EPR); (2) Reuse, promote community reuse through Waste Banks, second-hand use, and upcycling;

(3) Recycle, segregate waste, compost organic materials, recycle plastics and paper, and apply advanced technologies like pyrolysis and bioplastics; (4) Waste-to-Energy (WtE), convert waste into renewable energy; (5) Education and Policy, raise awareness and enforce regulations to support sustainable waste management.

This integrated approach aims to transform waste from an environmental burden into a valuable resource, supporting a circular economy and low-carbon development. WtE Practices and the Role of Education and Policy Waste-to-energy (WtE) practices are implemented through several key approaches. First, Environmentally Friendly Incinerators, which burn waste using advanced technology to generate electricity, for example, Sweden, which even imports waste from other countries to convert it into energy. Second, Biogas Production from Organic Waste, as demonstrated at the Bantargebang Integrated Waste Treatment Facility (TPST) in Jakarta, where organic waste is processed into biogas for renewable energy generation. Beyond waste-to-energy practices, other critical aspects include Public Education and Government Policies. Educational initiatives, such as the Waste Awareness Campaigns, aim to instill public consciousness to reduce waste generation, similar to Japan's "Mottainai" movement, which promotes anti-waste behavior. On the policy side, governments have introduced strict regulations on single-use plastics, such as Bali Provincial Regulation No. 97/2018, which bans disposable plastic bags, straws, and styrofoam.

Several countries have excelled in waste management: Sweden sends only 1% of its waste to landfills, Japan enforces sorting into 10 categories, and Germany's "Green Dot System" holds producers responsible for packaging. Waste significantly impacts climate change through rising global temperatures, extreme weather events, and ecosystem damage, such as plastics disrupting CO_2 absorption by phytoplankton. Key strategies to reduce GHG emissions from waste include: (1) Waste Prevention and Reduction, adopting a zero-waste lifestyle and Extended Producer Responsibility (EPR); (2) Segregation and Recycling, converting organic waste into compost or biogas, recycling inorganic materials, and using technologies like pyrolysis; (3) Organic Waste-to-Energy Conversion, community biogas and compost programs; (4) Environmentally Friendly Incineration. high-tech waste-to-energy incinerators reducing emissions by up to 90%; (5) Policies and Public Education-regulatory measures (e.g., Bali's single-use plastic ban) and ongoing community campaigns like 3R (Reduce, Reuse, Recycle).

Decomposing waste in landfills produces methane, a potent greenhouse gas with much higher global warming potential than CO_2. In Indonesia, solid waste contributes approximately 30% of total GHG emissions. Efficient waste management is therefore essential. Key emission reduction strategies include: Composting, separating organic waste for composting reduces landfill volume and methane emissions. Recycling, recycling non-organic waste lowers demand for new raw materials and saves production energy. Energy conversion**,** converting waste to energy via gasification or pyrolysis generates usable energy, optimizes resource use, and reduces fossil fuel dependence.

This study is grounded in the understanding that poor waste management significantly contributes to greenhouse gas (GHG) emissions, particularly methane (CH_4) and carbon dioxide (CO_2) generated from the degradation of organic waste in landfills (Delgado et al., 2023). On the other hand, energy conversion technologies such as biogas systems, pyrolysis, small-scale incineration, and refuse-derived fuel (RDF) based on appropriate technology (AT), ave the potential to transform waste into usable energy (Setiawan et al., 2024). This not only reduces the total volume of waste but also significantly decreases carbon emissions. Building on this issue, the research is designed to address main objective: identification and Analysis of Carbon Emission Reduction Potential The first step in this study involves identifying the types and quantities of dominant waste (e.g., organic, plastic, paper) in the study area and assessing the current waste management practices. The analysis compares two scenarios: Business as Usual (BAU): Waste is disposed of in landfills without proper treatment. Intervention Scenario: Waste is managed using energy conversion technologies. The potential CO_2-equivalent emission reductions from both scenarios are then calculated and compared using a life cycle assessment (LCA) approach or a similar analytical method. Research Hypotheses the implementation of proper waste management significantly reduces carbon emissions.

Baseline Emission Calculation. The next step involves calculating the potential emissions from current waste management practices in Palembang City. The calculation process adopts the Intergovernmental Panel on Climate Change (IPCC) methodology. Specifically, the First Order Decay (FOD) Tier 1 approach is used to estimate methane (CH_4) emissions generated from waste. This method assumes that methane generation is highest in the first year after waste disposal and gradually decreases over time (IPCC, 2006), due to the declining carbon content in decomposing waste (Permatasari et al., 2025). The FOD Tier 1 equation is expressed as follows:

$$[\text{CH4 Emission} = [\text{sum x CH4 generated}\{x,T\} - RT](1 - OXT)] \quad \text{(Equation 1)}$$

Where:

(CH4 Emission) = Methane emissions generated in year T
(x) = Waste type x
(RT) = Methane recovered in year T
(OXT) = Oxidation factor in year T

From Equation (1), (CH4 generated{x,T}) represents methane generated in year T for a specific waste type (x), which can be calculated as follows:

$$[\text{CH4 generated} = \text{DDOCm}\{\text{decompT}\} \times F \times \frac{16}{12}] \quad \text{(Equation 2)}$$

Where:

(CH4 generated) = Methane generated from decomposition in year T
(DDOCm{decompT}) = Decomposed degradable organic carbon in year T
(F) = Fraction of methane in landfill gas
(16/12) = Molecular weight ratio of CH_4 to C

The value of (DDOCm) refers to the total biodegradable organic material that can potentially produce methane, and is determined using the following equation (Murti et al., 2022; Intergovernmental Panel on Climate Change, 2019):

$$[\text{DDOCm} = W \times DOC \times DOC\ f \times MCF] \quad \text{(Equation 3)}$$

Where:

(DDOCm) = Mass of degradable organic material
(W) = Mass of waste disposed
(DOC) = Fraction of degradable organic carbon (C/waste ratio)
(DOC f) = Fraction of DOC that actually decomposes
(MCF) = Methane correction factor

Equations (1) to (3) are used to calculate the methane emissions produced by landfill waste. Before performing these calculations, it is essential to determine the waste composition characteristics in Palembang City South Sumatera of Indonesia.

METHOD

This study employs a *mixed-methods* approach, combining quantitative and qualitative methods to achieve a comprehensive understanding of waste management and its emission impacts. a) The quantitative approach is used to measure potential carbon emission reductions through waste management and energy conversion technologies, as well as to analyze survey data. b) The qualitative approach explores community perceptions, waste management practices, and develops community-based implementation strategies through interviews and field observations. Research location and duration. The study focuses on areas with high waste generation and potential for energy conversion technology development (e.g., urban districts or villages with active waste banks). The research is conducted over three months, from July to October 2025. respondent criteria: community members involved in formal or informal waste management, waste bank managers or community-based organizations (CBOs), Village or sub-district environmental officers, Practitioners of appropriate technology (AT). Purposive sampling for qualitative respondents (in-depth interviews) and stratified random sampling for quantitative surveys to represent diverse community groups (by area, age, or waste management role).

Field observation: to assess existing waste management conditions, infrastructure, and AT potential. Conducted with community leaders, waste bank managers, and policymakers to obtain qualitative insights. Measures public knowledge, attitudes, and practices regarding waste management and energy utilization. Collects secondary data such as municipal waste reports, environmental agency records, and emission profiles. Quantitative surveys among community respondents. Developed for semi-structured interviews with key informants. Carbon emission estimation tools based on IPCC Guidelines (Tier 1 Method) and emission calculators using waste volume and composition data. The analytical framework integrates waste management, energy conversion, and carbon emission reduction. a) statistical analysis: survey data are analyzed using descriptive and inferential statistics (e.g., correlation or regression tests). b) comparative analysis: compares business as usual and technology intervention scenarios in terms of carbon emissions and social impacts. c). carbon emission calculation: estimates CO_2-equivalent emissions based on waste volume, composition, and applied technology following IPCC or national standards (SNI).

DISCUSSION

Identification of waste potential and emission measurement. Calculation of Palembang City’s Waste Potential The research location is Palembang City, and therefore, data collection on waste potential was carried out within this area. The process was based on official data obtained from the management authorities of the city’s final disposal sites (TPA). Palembang City operates two main landfills, Sukawinatan TPA and Kramasan TPA. The research team conducted field visits to both landfill management offices to obtain verified data on the total waste transported and disposed of daily. The data are considered valid since every waste load entering the landfill is weighed and recorded systematically. The figure below presents documentation of the data collection process for waste potential in Palembang City South Sumatera of Indonesia.

Figure 1. Documentation of the Visit to the Landfill Sites in Palembang City

In general, Palembang City South Sumetara of Indonesia, Indonesia generates approximately 983.866 tons of waste per day. This figure represents the average amount of waste transported to the city's two landfill sites (TPAs), Sukawinatan and Kramasan. Sukawinatan Landfill receives about 60% of the total transported waste, while Kramasan Landfill handles the remaining 40%. The following table presents the waste transport data to the TPAs in Palembang City, Indonesia for the year 2025. However, it is important to note that these figures represent only the waste that reaches the TPAs, not the total waste generated by residents. Several estimates indicate that the actual waste generation potential in Palembang may reach up to 1,200 tons per day.

Table 1. Waste Transport Data to TPAs in Palembang City, Indonesia (2025)

No	Month	Total Weight per Month (Kg)	Average Weight per Day (Kg)
1	January	30,481,243	983,266
2	February	27,289,322	974,619
3	March	30,586,460	986,660
4	April	29,441,250	981,375
5	May	30,515,160	984,360
6	June	29,695,800	989,860
7	July	30,594,520	986,920
Average		**29,943,394**	**998,113**

(Source: UPTD TPA Palembang City, Indonesia)

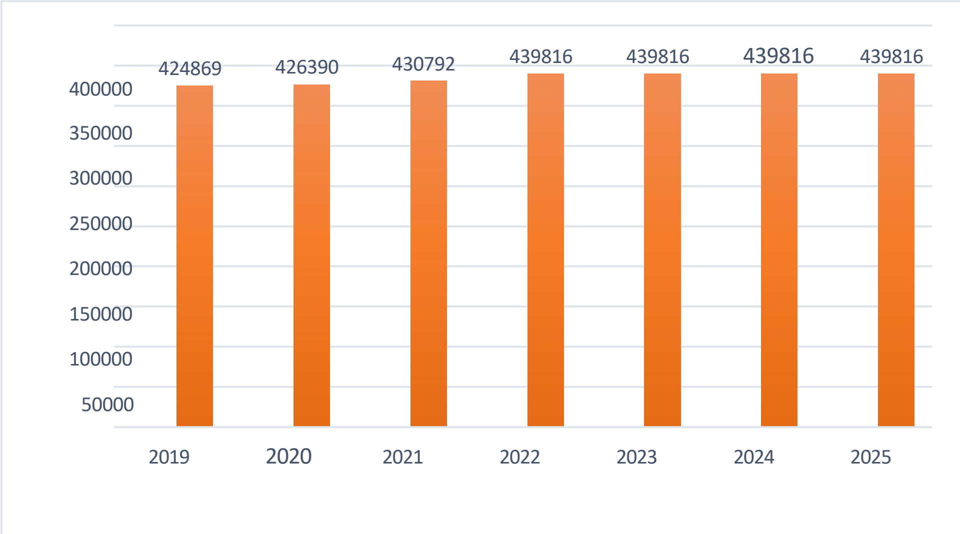

Figure 2 Waste Generation Data in Palembang City, Indonesia (Source: SIPSN)

The waste management system at Palembang City's landfill sites, both Kramasan and Sukawinatan TPAs, still operates using an open dumping system. Currently, waste management activities are limited to leachate treatment through retention ponds. Previously, methane gas extraction had been implemented to generate electricity; however, this initiative was discontinued after a short period (Setiawan, Budiyanto, et al., 2025). At present, the primary process involves waste piling covered with layers of soil.

Methane Gas Emission Calculation

The methane emissions were calculated using the First Order Decay (FOD) Tier 1 method from the IPCC. Based on the waste composition data shown in Figure 2, the waste types with significant potential to generate methane are food waste, wood or branches, and paper/cardboard. Therefore, this study calculates emissions only from these three waste categories (Romianingsih, 2023).

Table 2. Methane Gas Generated from Food Waste Yearly Methane Emission Calculation from Waste Transported to Palembang Landfill

Year	Total Waste Transported to Palembang Landfill (Ton)	MCF	Decomposable DOC (DDOCm) Deposited (Ton)	DDOCm Not Reacted, Deposition Year (Ton)	DDOCm Decomposed, Deposition Year (Ton)	DDOCm Accumulated in SWDS End of Year (Ton)	DDOCm Decomposed (Ton)	CH_4 Generated (Ton)
2019	204,361.99	0.40	6,130.86	5,017.43	1,113.43	5,017.43	1,113.43	556.71
2020	205,093.59	0.40	6,152.81	5,035.39	1,117.41	9,205.40	1,964.84	982.42
2021	207,210.95	0.40	6,216.33	5,087.38	1,128.95	12,738.03	2,683.70	1,341.85
2022	211,551.50	0.40	6,346.54	5,193.95	1,152.60	15,780.58	3,304.00	1,652.00
2023	211,551.50	0.40	6,346.54	5,193.95	1,152.60	18,309.25	3,817.87	1,908.94
2024	211,551.50	0.40	6,346.54	5,193.95	1,152.60	20,410.85	4,244.95	2,122.48
2025	211,551.50	0.40	6,346.54	5,193.95	1,152.60	22,157.49	4,599.90	2,299.95

Formulas Used:
D = W × DOC × DOCf × MCF → Decomposable DOC (DDOCm)
B = D × exp2 → DDOCm decomposed
C = D × (1 − exp2) → DDOCm not reacted
H = B + (H last year × exp1) → Accumulated DDOCm in SWDS
E = C + H last year × (1 − exp1) → Decomposed DDOCm
Q = E × 16/12 × F → Methane (CH_4) generated
Units: Ton for waste and emissions, fraction for MCF.

The Table 2. above shows the calculation of methane emissions generated from food waste. To calculate methane emissions using the FOD Tier 1 approach, several parameters need to be determined. One key parameter is DOC (Degradable Organic Carbon), which is assigned based on the type of waste. According to IPCC data, food waste can use a DOC value of 0.15. Additionally, the DOC fraction must be specified, which can follow the IPCC recommendation of 0.5. The Table 3. below presents the parameter values required for calculating methane generation from food waste.

Table 3. Parameters for Calculating Methane Generation from Food Waste

No	Parameters		Value
1	*DOC*	DOC	0,15
2	*DOCf*	DOCf	0,500
3	*Methane generation rate constant*	k	0,185
4	*Half-life time ($t_{1/2}$, years):*	h = ln(2)/k	3,7
5	*exp1*	exp(-k)	0,83
6	*Process start in deposition year. Month M*	M	0,00
7	*Total MSW/year (Ton)*		424869,00
8	*Fraction Food Waste*		0,408
9	*exp2*	exp(-k*((13- M)/12))	0,82
10	*Fraction to CH4*	F	0,500

According to SIPSN data, food waste in Palembang accounts for approximately 40.8%. Therefore, the parameter Fraction Food Waste is set at 0.408. For the fraction of degradable organic carbon that generates methane (Fraction to CH4), the value is 0.5 for all waste types. The Table 4. below presents the calculation results for methane emissions from wood/branch waste.

Table 4. Parameters for Calculating Methane Generation from Wood/Branch Waste

Years	Total Sampah diangkut ke TPA Palembang	MCF	*Decomposable DOC (DDOCm) deposited*	*DDOCm not reacted. Deposition year*	*DDOCm decomposed. Deposition year*	*DDOCm accumulated in SWDS end of year*	*DDOCm decomposed*	*CH_4 generated*
Formula	W	MCF	D = W * DOC * DOCf * MCF	B = D * exp2	C = D * (1-exp2)	H = B + ($H_{last\ year}$ * exp1)	E = C + $H_{last\ year}$ * (1 - exp1)	Q = E * 16/12 * F
Unit	Ton	fraction	Ton	Ton	Ton	Ton	Ton	Ton
2019	47712,79	0,40	4103,30	3972,09	131,21	3972,09	131,21	65,61
2020	47883,60	0,40	4117,99	3986,31	131,68	7841,00	249,08	124,54
2021	48377,94	0,40	4160,50	4027,46	133,04	11636,72	364,78	182,39
2022	49391,34	0,40	4247,65	4111,83	135,83	15404,63	479,75	239,87
2023	49391,34	0,40	4247,65	4111,83	135,83	19061,18	591,11	295,55
2024	49391,34	0,40	4247,65	4111,83	135,83	22609,66	699,17	349,59
2025	49391,34	0,40	4247,65	4111,83	135,83	26053,27	804,05	402,02

From the Table 4. above, the amount of methane generated from wood/branch waste in 2019 was 65.61 tons, and it continues to increase, reaching an estimated 401.02 tons by 2025. This amount is considerably lower compared to methane emissions from food waste (Suryati et al., 2021). In 2025, food waste is projected to contribute 2,299.95 tons of methane. Compared to the parameters used to calculate methane from food waste, wood/branch waste has some differences, namely the DOC value, methane generation rate constant (k), and Fraction Food Waste, with respective values of 0.34, 0.030, and 0.11.

Table 5. Parameters for Calculating Methane Generation from Paper/Cardboard Waste

Years	Total Sampah diangkut ke TPA Palembang	MCF	*Decomposable DOC (DDOCm) deposited*	*DDOCm not reacted. Deposition year*	*DDOCm decomposed. Deposition year*	*DDOCm accumulated in SWDS end of year*	*DDOCm decomposed*	*CH_4 generated*
Formula	W	MCF	D = W * DOC * DOCf * MCF	B = D * exp2	C = D * (1-exp2)	H = B + ($H_{last\ year}$ * exp1)	E = C + $H_{last\ year}$ * (1 - exp1)	Q = E * 16/12 * F
Unit	Ton	fraction	Ton	Ton	Ton	Ton	Ton	Ton
2019	40617,48	0,40	3493,10	3381,40	111,70	3381,40	111,70	55,85
2020	40762,88	0,40	3505,61	3393,51	112,10	6674,97	212,04	106,02
2021	41183,72	0,40	3541,80	3428,54	113,26	9906,24	310,53	155,27
2022	42046,41	0,40	3615,99	3500,36	115,63	13113,83	408,40	204,20
2023	42046,41	0,40	3615,99	3500,36	115,63	16226,62	503,20	251,60
2024	42046,41	0,40	3615,99	3500,36	115,63	19247,41	595,20	297,60
2025	42046,41	0,40	3615,99	3500,36	115,63	22178,92	684,48	342,24

Table 5. shows the methane gas generated from paper/cardboard waste. Paper and cardboard contribute the least compared to the two previous waste types. By 2025, it is estimated that approximately 342.24 tons of methane will be produced. The figure below presents methane emissions data based on waste type.

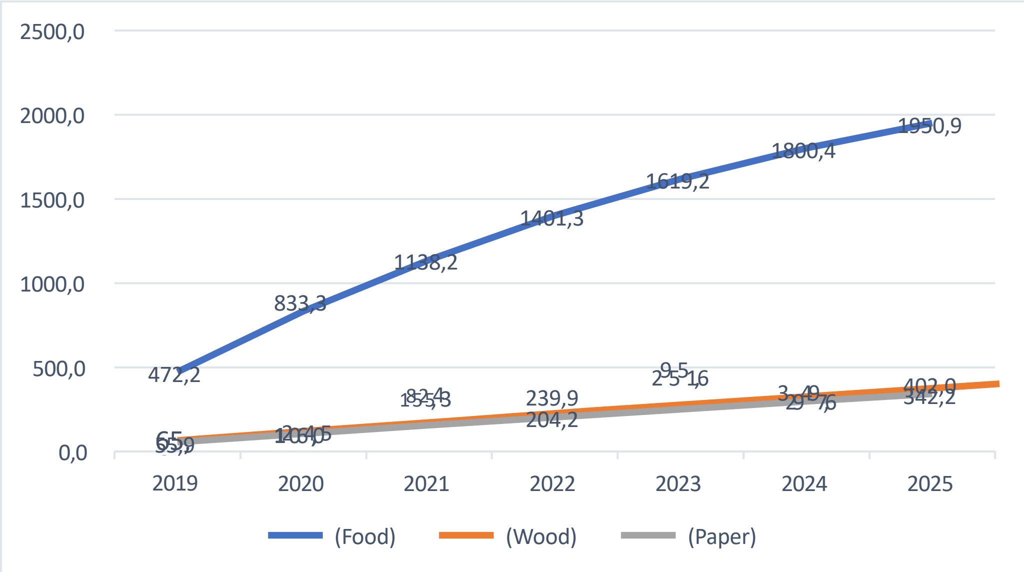

Figure 3. Methane Gas Generated from Three Types of Waste in Palembang City South Sumatera of Indonesia, 2019–2025

In total, Palembang City is projected to generate 2,352.9 tons of methane emissions by 2025 (Fig. 3). The methane emission calculation uses Equation 1. Based on the waste management system in Palembang, no methane recovery activities are currently implemented, either for flaring or electricity generation. Therefore, the methane recovery value is 0 for waste management in Palembang South Sumatera of Indonesia.

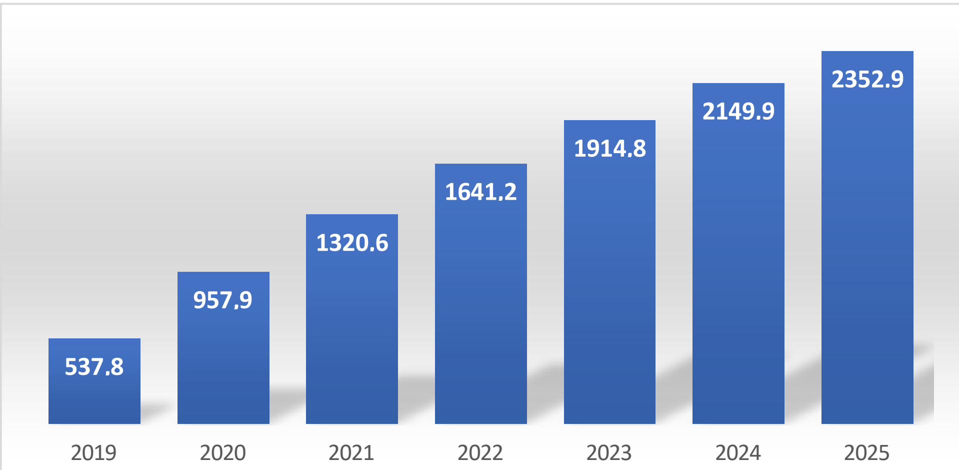

Figure 4. Methane Gas Emissions from Waste in Palembang City, 2019–2025 (Ton)

As previously explained, the emissions shown in Figure 4.5 are contributed by three types of waste: food waste, wood/branches, and paper/cardboard. Other waste types may also have an impact, but they are not included in this study's calculations. In 2025, the total methane emissions generated are projected to reach 2,352.9 tons. This amount is equivalent to 28 times the CO_2-equivalent value, or approximately 65,888.2 tons CO_2-equivalent in 2025. Converted to Carbon Economic Value (NEK), this is estimated at around IDR 1.97 trillion.

Waste Potential and Emissions

Every day, Palembang City generates approximately 1,200 tons of waste, of which only about 998 tons are successfully transported to the landfills (TPA). Palembang has two TPAs: Sukawinatan and Kramasan. Sukawinatan receives about 60% of the waste, while the remaining 40% goes to Kramasan. Both TPAs operate using an open dumping system, supported by facilities such as leachate ponds and coastal wells. Waste management primarily involves covering layers of waste with soil. Sukawinatan landfill previously attempted methane gas extraction for electricity generation, but the system was not successful and is currently inactive.

Waste transportation is carried out using several trucks managed by the UPTD DLHK in each sub-district. Each day, trucks collecting waste from the community are weighed before unloading at designated zones. No waste segregation is conducted at the TPA. Generally, non-hazardous waste (non-B3) is accepted at the landfills; however, occasional hazardous waste (B3), such as household batteries, has been found. Waste volume data between SIPSN and the TPAs show slight differences. Generally, SIPSN data is higher because TPA data only accounts for waste successfully transported to the landfill. In contrast, SIPSN considers total waste generated by the community, including inputs from various sources such as waste banks, 3R stations, and Integrated Waste Treatment Sites (TPST), which may not be recorded at the TPAs (Farahdiba et al., 2023).

In this study, the emission baseline is calculated using the First Order Decay (FOD) Tier 1 method. According to the IPCC 2006 guidelines, the Tier system is based on the quality and source of data for GHG emission calculations. Tier 1 is the most basic level, using default data for emission estimations (Puteri Mahyudin & Herlintama, 2023; Chaerul et al., 2020). However, in this study, waste quantity data is not based on IPCC defaults. Instead, data from SIPSN and comparative data from the TPAs (Sukawinatan and Kramasan) are used. Previous studies comparing Tier 1, 2, and 3 approaches indicate minimal differences in results (Salsabila et al., 2025). Several parameters must be considered in calculating emissions from waste deposits. One key parameter is Degradable Organic Carbon (DOC), derived from IPCC data. For example, for food waste, the DOC value can range from 0.08-0.2, representing the rate at which organic matter decomposes. Lower DOC values indicate faster decomposition. According to Kustiasih et al., 2014, waste such as food scraps, wood, paper, and yard waste generally have low DOC values.

Another important parameter is the methane generation rate constant (k), which represents the rate of methane production from deposited waste. Higher k values indicate faster and higher methane production, which then declines rapidly as the waste decomposes (Araye et al., 2023). The k value is influenced by factors such as moisture content, nutrient availability for decomposer bacteria, pH, and environmental temperature. This study uses IPCC-specified k values: 0.185 for food waste and 0.03 for paper and wood waste. Waste deposition in Palembang is expected to continue, resulting in high and increasing methane emission potential. By 2025, methane emissions are projected to reach 2,352.9 tons. As of 2025, there is no closure plan for Sukawinatan or Kramasan landfills. Therefore, methane emissions are expected to continue rising in 2026.

CONCLUSION

Palembang City produces between 983 and 1,200 tons of waste daily, dominated by food waste (40.8%) and plastic (20.4%). Around 60% of this waste is disposed of at the Sukawinatan landfill and 40% at the Kramasan landfill. Current waste management practices still rely heavily on open dumping with minimal treatment, leading to significant methane emissions estimated at 2,352.9 tons per year, equivalent to 65,888.2 tons of CO_2-equivalent. This emission level represents a substantial environmental and economic loss, with an estimated Carbon Economic Value (CEV) of approximately IDR 1.97 trillion. These findings emphasize the urgent need for an integrated and sustainable waste management strategy in Palembang, combining waste-to-energy (WtE) technologies, recycling, and composting initiatives. A holistic approach involving technological innovation, policy reform, and community participation is essential to reduce emissions, recover energy, and move toward a circular and climate-resilient urban waste management system.

IMPLICATION

This study provides practical guidance for policymakers, local governments, and community organizations to design and implement low-cost, sustainable waste management systems in Palembang. By integrating community-based waste-to-energy (WtE) initiatives, the city can significantly reduce greenhouse gas emissions while generating renewable energy and new sources of local income (Shekari et al., 2025). The findings highlight the importance of inclusive participation, appropriate technology adoption (Setiawan & Rinamurti, 2020), and circular economy principles to build a resilient urban system that aligns environmental goals with social and economic development.

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