CRIC Training on Integrated Waste Management (IWM)

Module 1
Overview of solid waste management

CLIMATE RESILIENT AND INCLUSIVE CITIES

Main learning objectives of this module

understand the basics of solid waste management, with a focus on Municipal solid waste in the Indonesian context

understand the importance of proper solid waste management (SWM) for human health, economic development and environmental protection

understand how SWM influences global climate

understand the main circular economy concepts and their application to waste management, and why we require a shift to circular economy

Overview of waste generation and management in Indonesia

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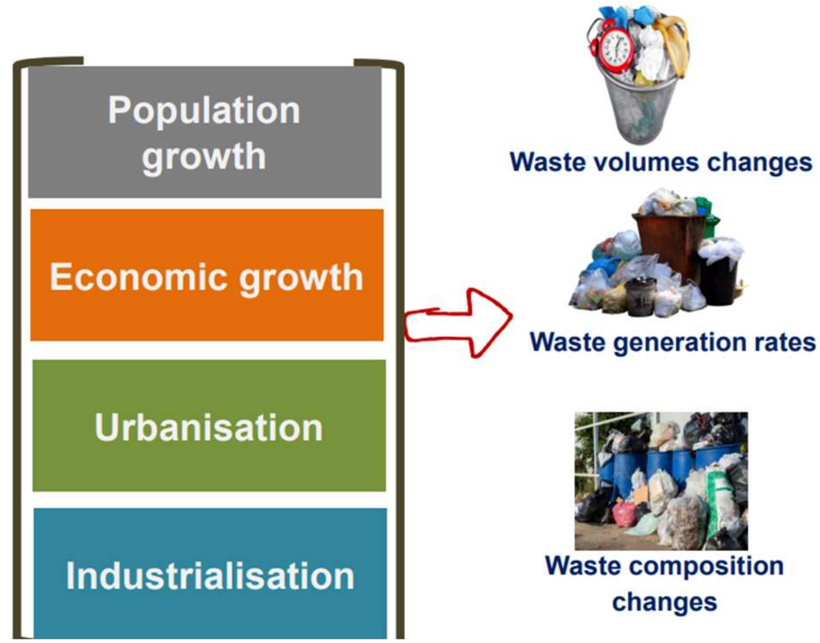
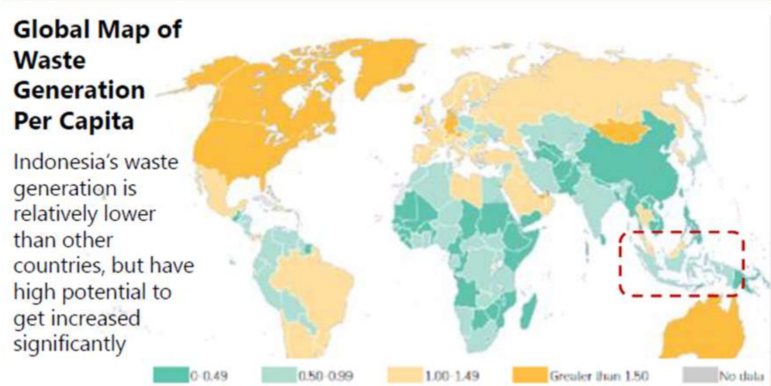
General waste trends

Waste volumes to increase in time following increase of population and urbanisation

§From 2000 to 2010, Indonesia's urban population increased by about 3% annually. By 2016, the urban population reached 142 million, representing more than half of the total population (World Bank, 2019).

§Development gaps between the fast-growing urban population and the provision of basic services and infrastructure, with inadequate solid waste management





Source: Danish Embassy, 2024

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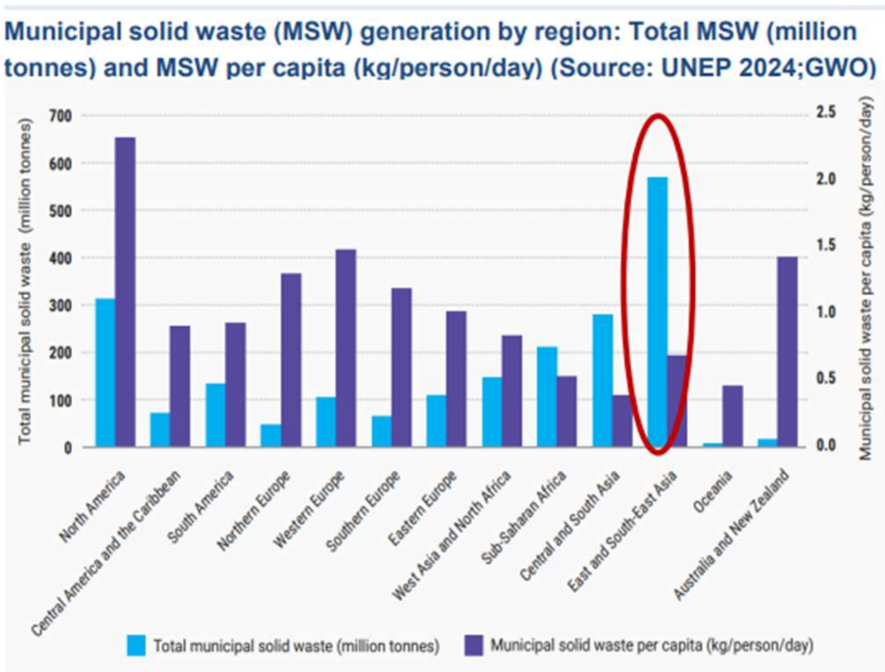
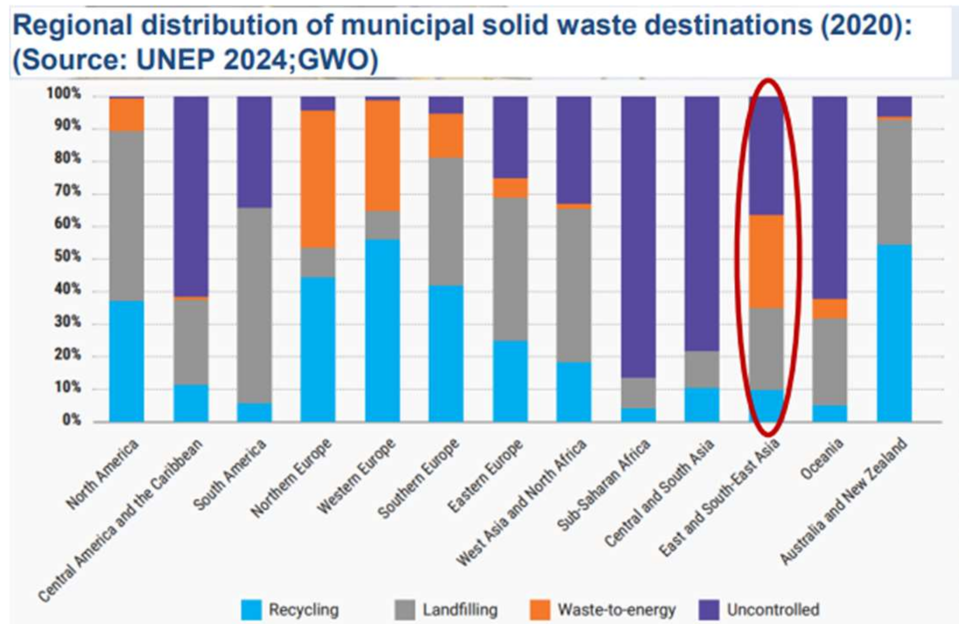
Waste management status in ASEAN





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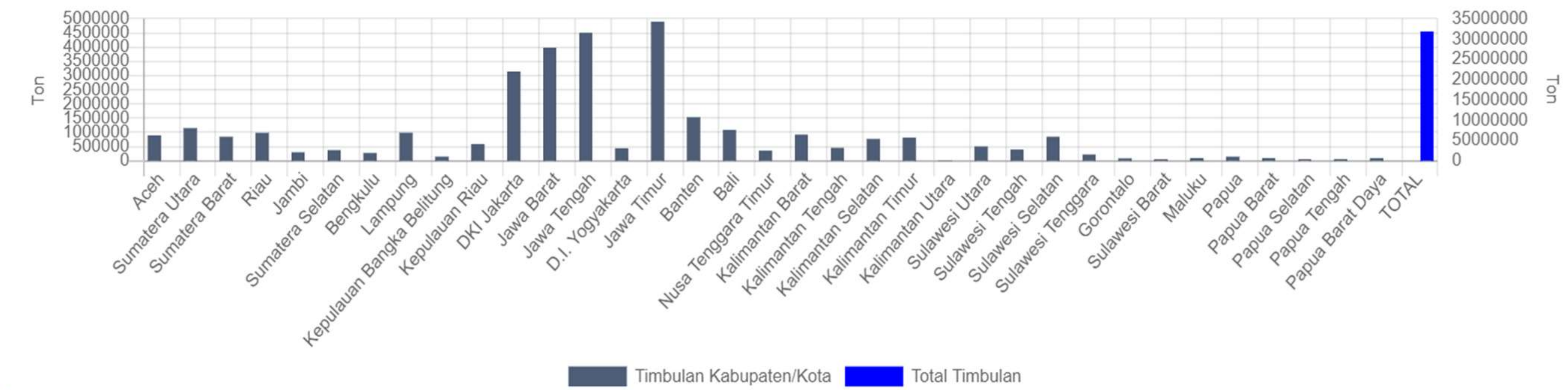
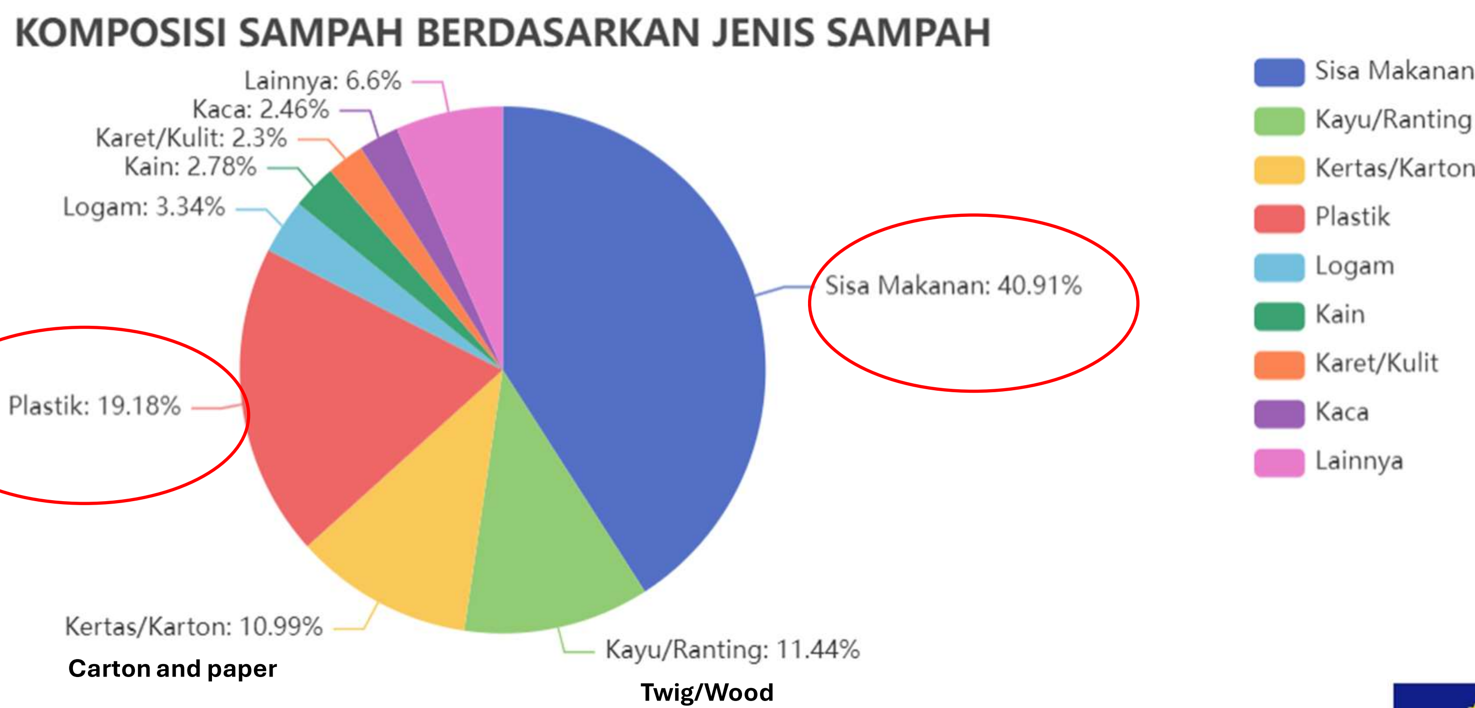
Waste generation in Indonesia

- In 2023, Indonesia generated almost **32 million tonnes of waste**
- By 2045, could reach 150/200 million tonnes/year

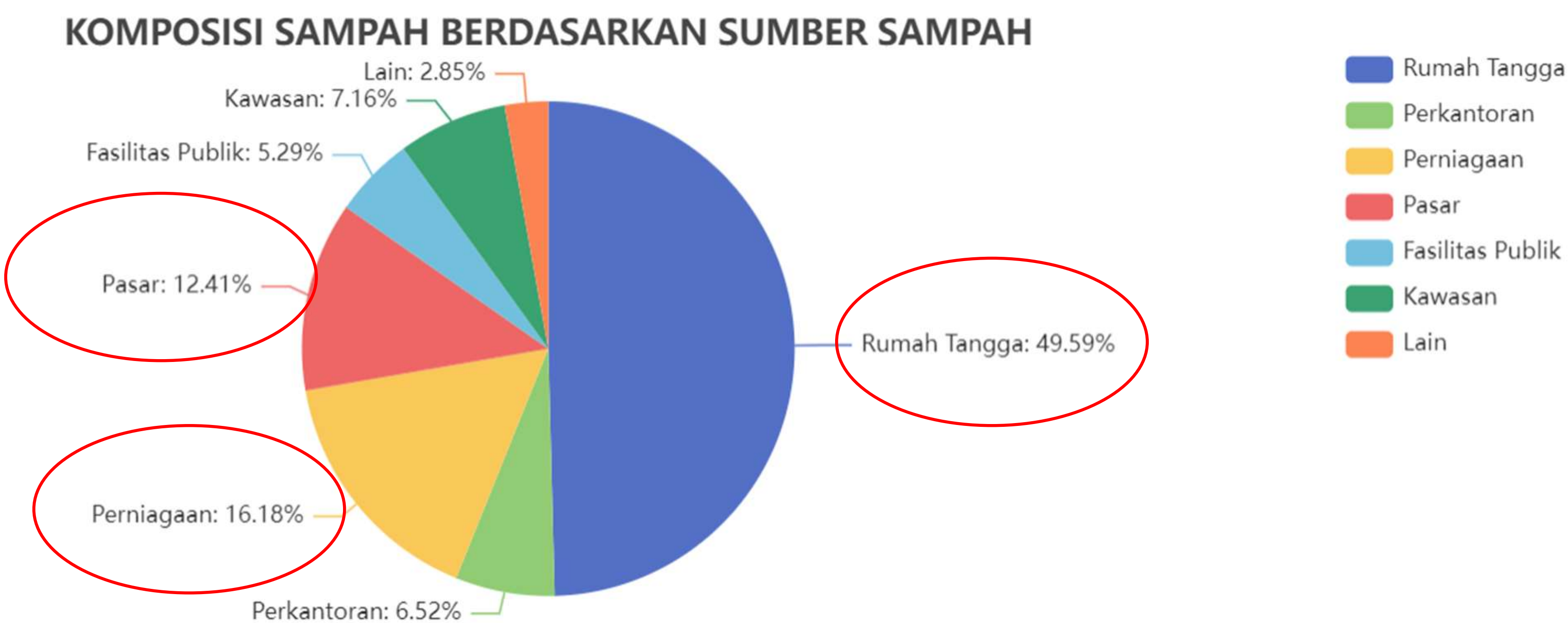


Source: SIPSN, 2023

Waste composition in Indonesia (2023, SIPSN)



Waste source (2023, SIPSN)



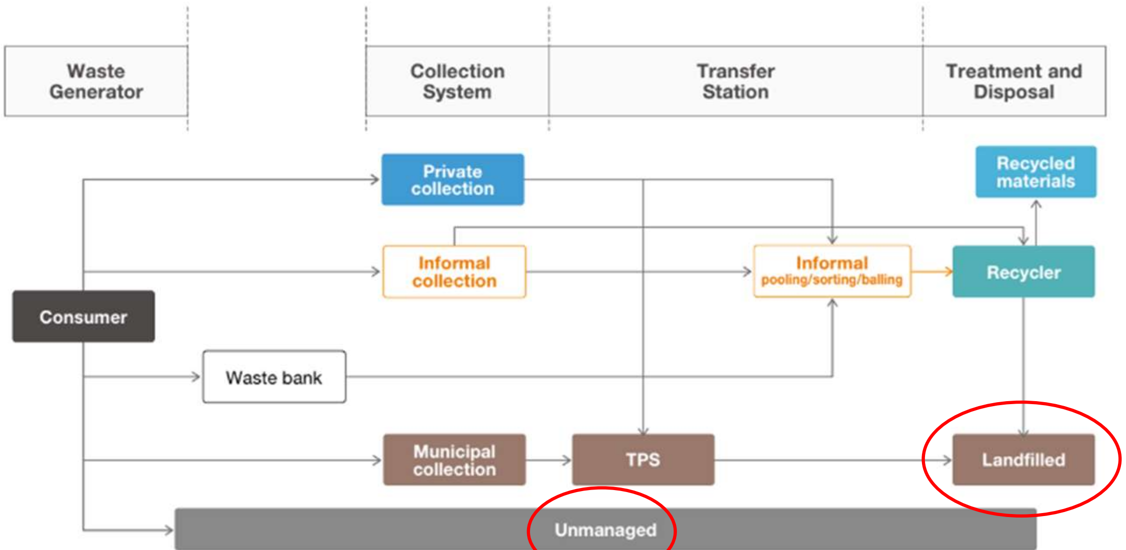
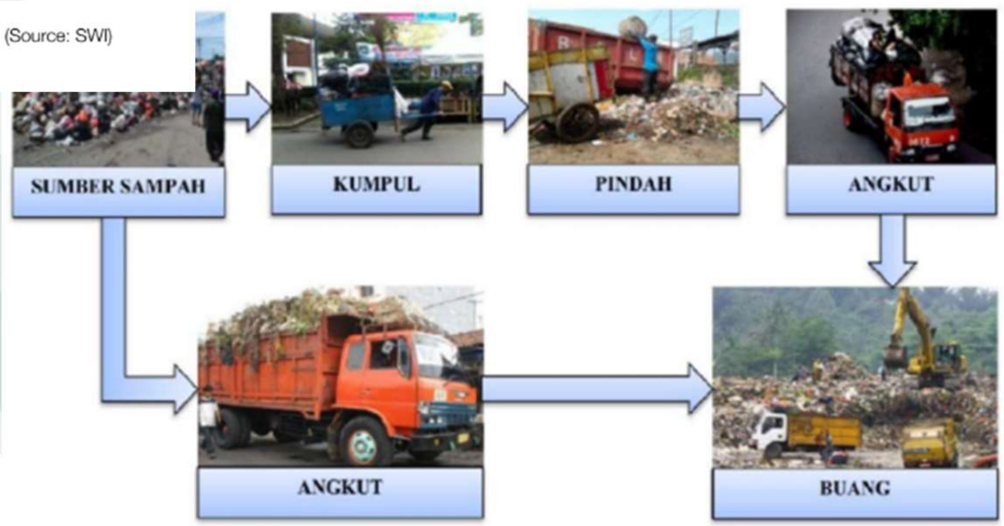


Fig. 5 Municipal solid waste management flow in Indonesia

(Source: SWI)

The journey of waste



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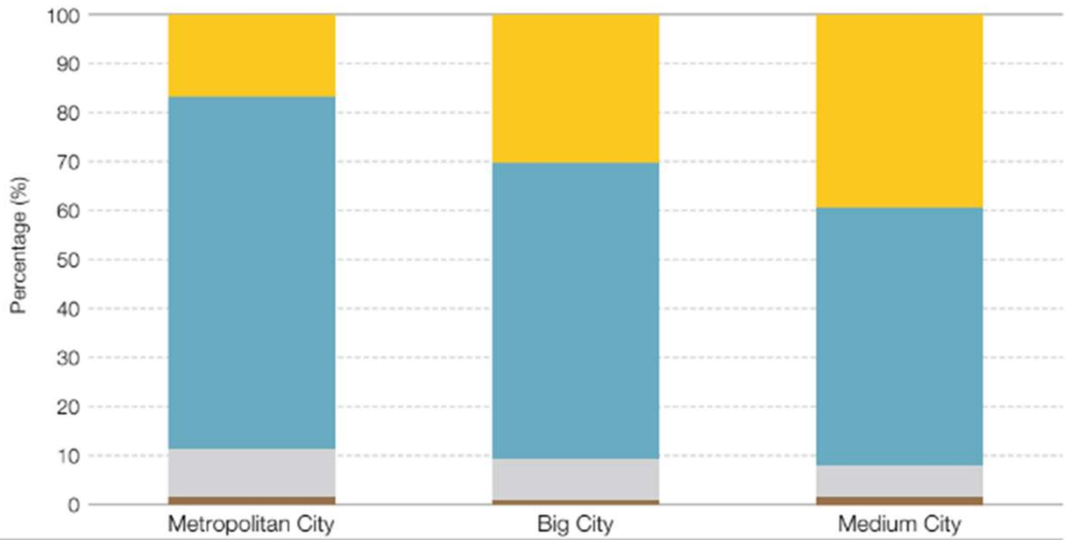
SWM performance in Indonesia



	Metropolitan City	Big City	Medium City
Loss Rate (%)	17.00	30.00	39.00
Disposal Rate (%)	71.84	60.43	52.68
Treatment Rate (%)	9.96	8.46	6.56
Reduction at Source Rate (%)	1.39	0.83	1.51

Fig. 6 SWM Performance in Indonesia

Note)
- Not all cities (total >400 cities in Indonesia) join ADIPURA
- Small cities (population <250k) has even lower collection rate than medium cities
- Comparison data from BPS (National Statistic Bureau), 2014
- National level of those indicators are; Loss Rate (34.5%), Disposal Rate (56.8%), Treatment Rate (7.38%), and Reduction Source Rate (1.37%) respectively.

(Source: SWI analysis based on ADIPURA Data of 104 cities and World Bank, 2016)

Improved access of municipal waste services in peri-urban, rural areas, and small islands with medium and small cities is crucial for reducing waste leakage into the environment.

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The fate of waste

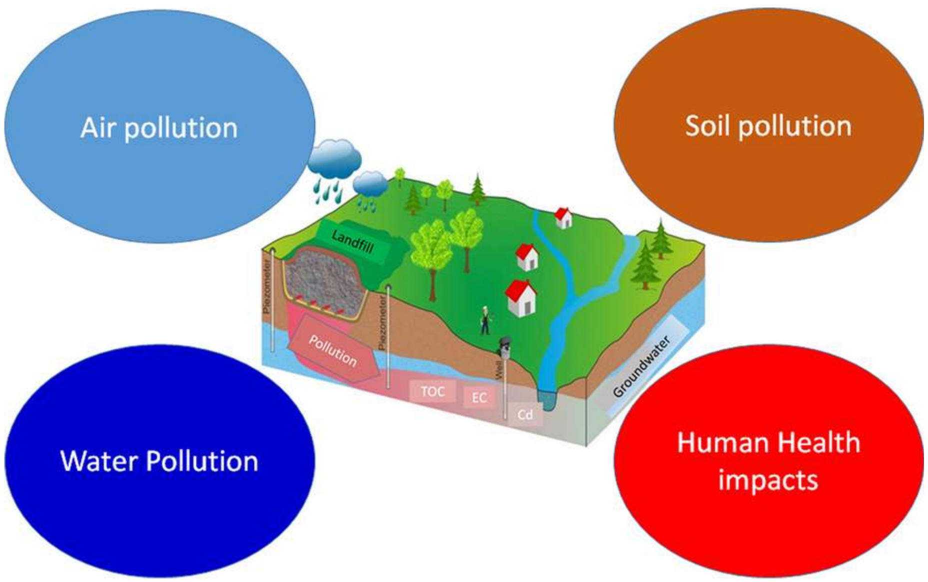
Of the 6.8 million tons of total plastic waste generated in 2017, 10% was recycled in about 1,300 "recycling centers" in Indonesia

Where do the remaining waste go?

- Retained at disposal site
- Openly burnt
- Retained on land and drains
- River and marine pollution

Source: https://urban-links.org/wp-content/uploads/USAID_CCBO_CaseStudy_Integrated-SWM-Plans_r5_508.pdf

Environmental and health impacts of waste landfilling and openburning



- Respiratory issues and higher chances of developing cancer from landfills and open burning
- Groundwater contamination due to the harmful by-products released during the degradation process of waste.
- Pests and diseases from uncollected waste

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Source:https://link.springer.com/article/10.1007/s11356-022-21578-z

Why waste management is so important for islands?

- **Damage to island marine“natural capital”** (seafood quality and availability, aesthetics) jeopardises the well-being, economic prosperity and sustainability of island communities.
- Islands face common challenges due to their **isolated geographical situation and the seasonality of tourism industry**

-limited financial resources to invest in infrastructure

-tourism induces rise in waste generation and changes in its composition

-not enough mass to develop cost-efficient and efficient waste management services and facilities

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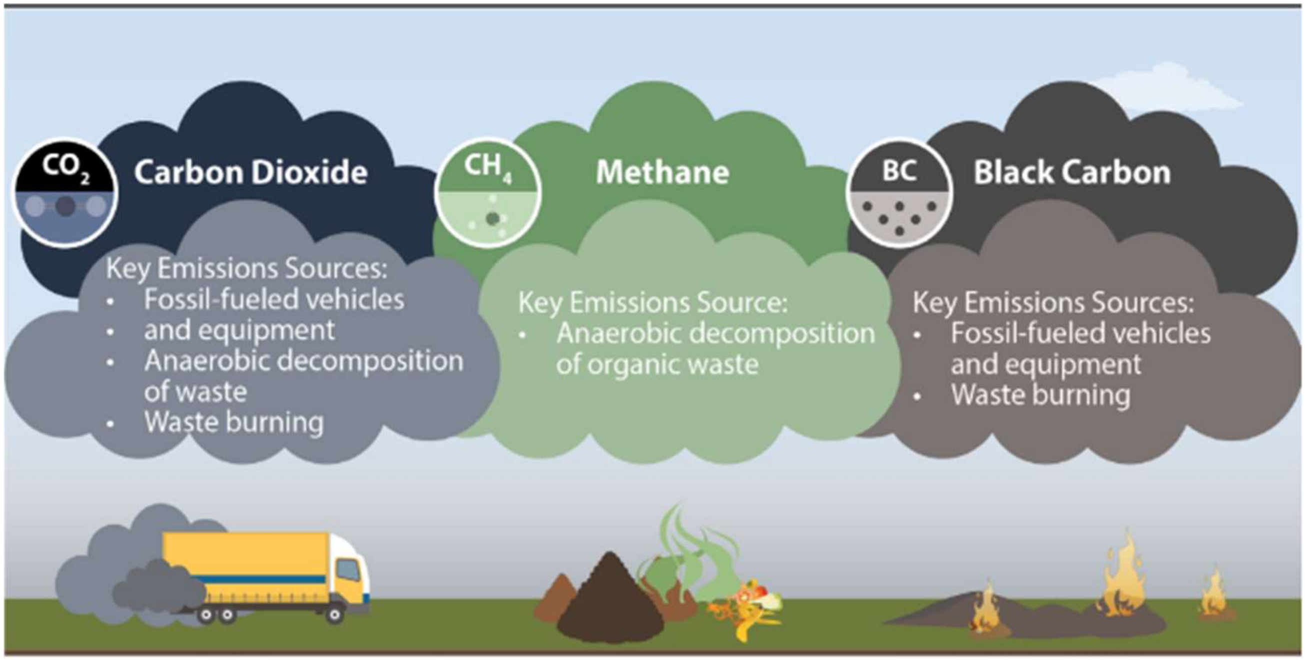
The contribution of waste sector to climate change



Source: Solid Waste Management and Climate Change, EPA,2023

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Waste sector is the highest methane emitter in Indonesia

National GHG Inventory

Indonesia 3rd Biennial Update Report, 2021

CH4 Emission

2000: 12,38% (128.702 ton CO2-eq)
2019: 10,04% (185.191 ton CO2-eq)

Highest CH4 emitter

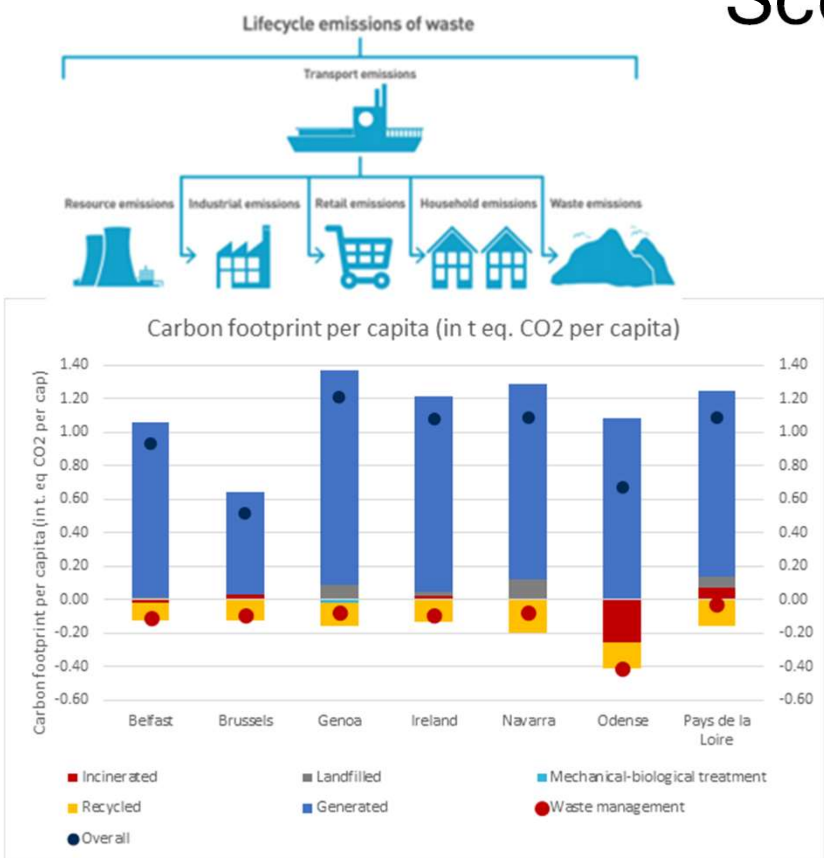
Waste Sector (2019: 113.702 ton CO_2e)

No	Sectors	Year	CO_2	CH_4	N_2O	CF_4	C_2F_6	CO	NOx	NMVOC	SOx	Total 3 Gases
1	Energy	2000	284,503	29,728	3,378			NE	NE	NE	NE	317,609
		2019	615,262	16,464	4,726			NE	NE	NE	NE	636,453
2	IPPU	2000	42,401	98	149	250	22	NO	NO	NO	NO	42,648
		2019	57,252	91	784	46	0	NO	NO	NO	NO	58,128
3	Agriculture	2000	4,710	39,940	39,888			2,737	74	NE	NE	84,537
		2019	7,343	46,407	51,552			2,436	66	NE	NE	105,301
4	FOLU	2000	529,815	1,505	1,040			NE	NE	NE	NE	532,360
		2019	910,280	8,527	6,045			NE	NE	NE	NE	924,853
5	Waste	2000	2,216	57,431	2,544			NE	NE	NE	NE	62,191
		2019	3,026	113,702	3,606			NE	NE	NE	NE	120,333
Total (CO_2-eq)		2000	863,645	128,702	46,998	250	22	2,724	70	0	0	1,039,345
		2019	1,593,163	185,191	66,713	46	0	1,500	41	0	0	1,845,067
Percentage (%)		2000	83.10	12.38	4.52	-	-	-	-	-	-	100.00
		2019	86.35	10.04	3.62	-	-	-	-	-	-	100.00

NE = Not Estimated; NO = Not Occurring

Source: *https://unece.org/sites/default/files/2024-04/4-RATN~1.PDF*

Carbon footprint of waste: the CMI/SWEFT from Scotland



- **The SWEFT tool** assesses the impact of waste management, including the impact "**embodied**" in the waste, linked with the e**xtraction of resources and production processes of products** becoming waste
- **Embodied carbon impacts** of waste material are the **highest contributor** to the net carbon impacts of waste
- **Recycling has a positive, yet limited impact** compared to the embodied emissions
- This is why **waste prevention, in accordance with the waste hierarchy, always offers the greatest carbon savings**

Source: Zero Waste Scotland & ACR+

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Other carbon tools

- **SWEET tool**: Quantify emissions from waste sector

The opportunity of circular economy

Circular economy

A circular economy aims to generate economic growth by maintaining the value of products, materials, and resources in the economy as long as possible, thereby minimising the social and environmental damage caused by a linear economic approach. **It is not just a better form of waste management with more recycling.** A circular economy embraces a broad set of interventions across all economic sectors, and activities focused on the 5Rs: Reduce, Reuse, Recycle, Refurbish, and Renew

REDUCE	▪ Remove waste in production and supply chain (e.g., 3D printing) ▪ Virtualise products and services (e.g., electronic books) ▪ Reduce energy usage (e.g., improving energy efficiency) ▪ Redesign products to require less resource inputs (e.g., high strength steel in construction)
REUSE	▪ Share assets (e.g., cars, rooms, appliances) ▪ Use of secondhand products ▪ Improve asset utility by offering products as a service
RECYCLE	▪ Recycle materials ▪ Anaerobic digestion and extracting biochemicals from organic waste
REFURBISH	▪ Remanufacture products or components ▪ Prolong life through maintenance of products
RENEW	▪ Prioritise renewable energy and materials (e.g., substituting plastic packaging with paper based packaging)

SOURCE: Ellen MacArthur Foundation; expert interviews

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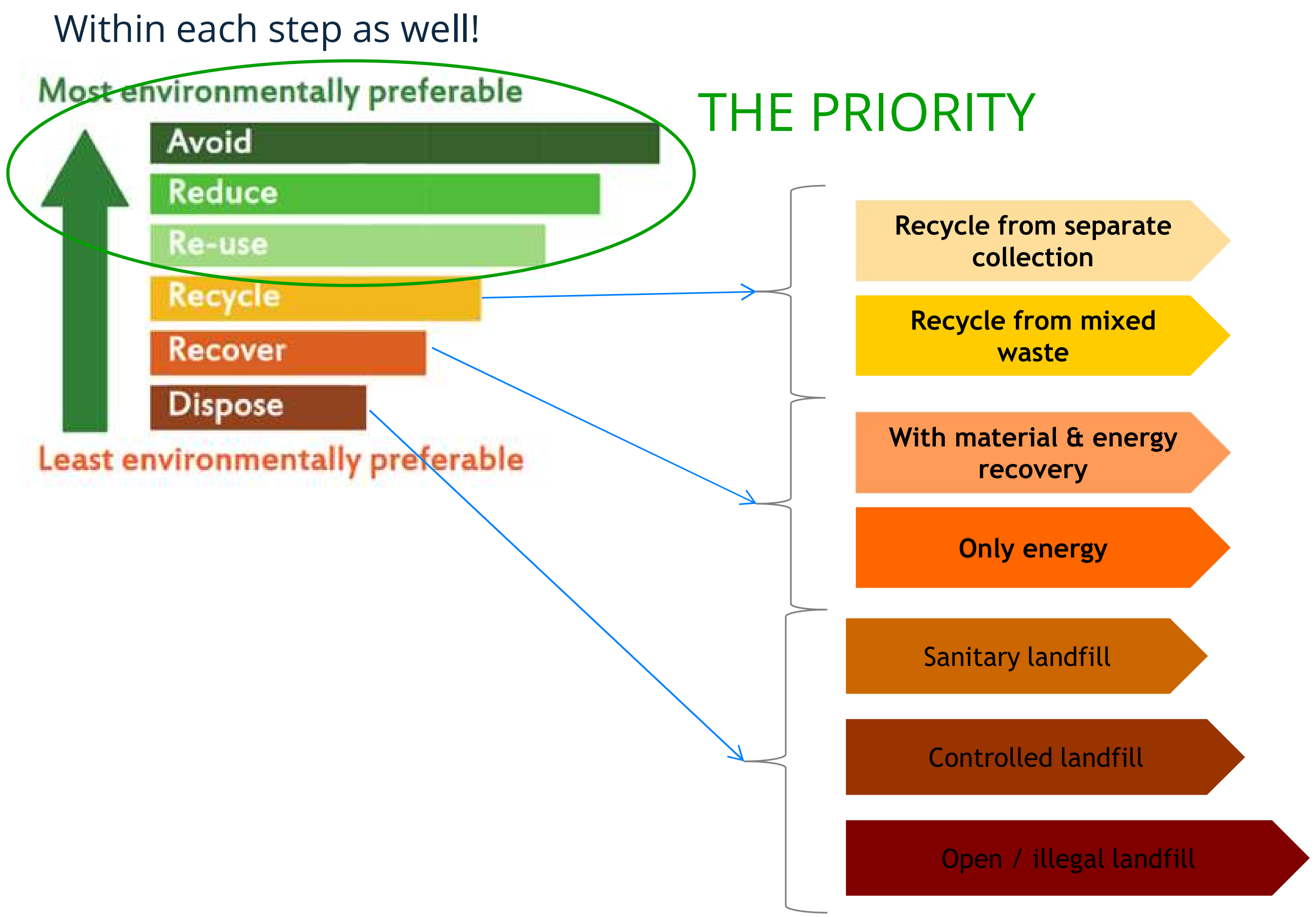
Waste hierarchy



Linear Economy

Chain Economy

Circular Economy

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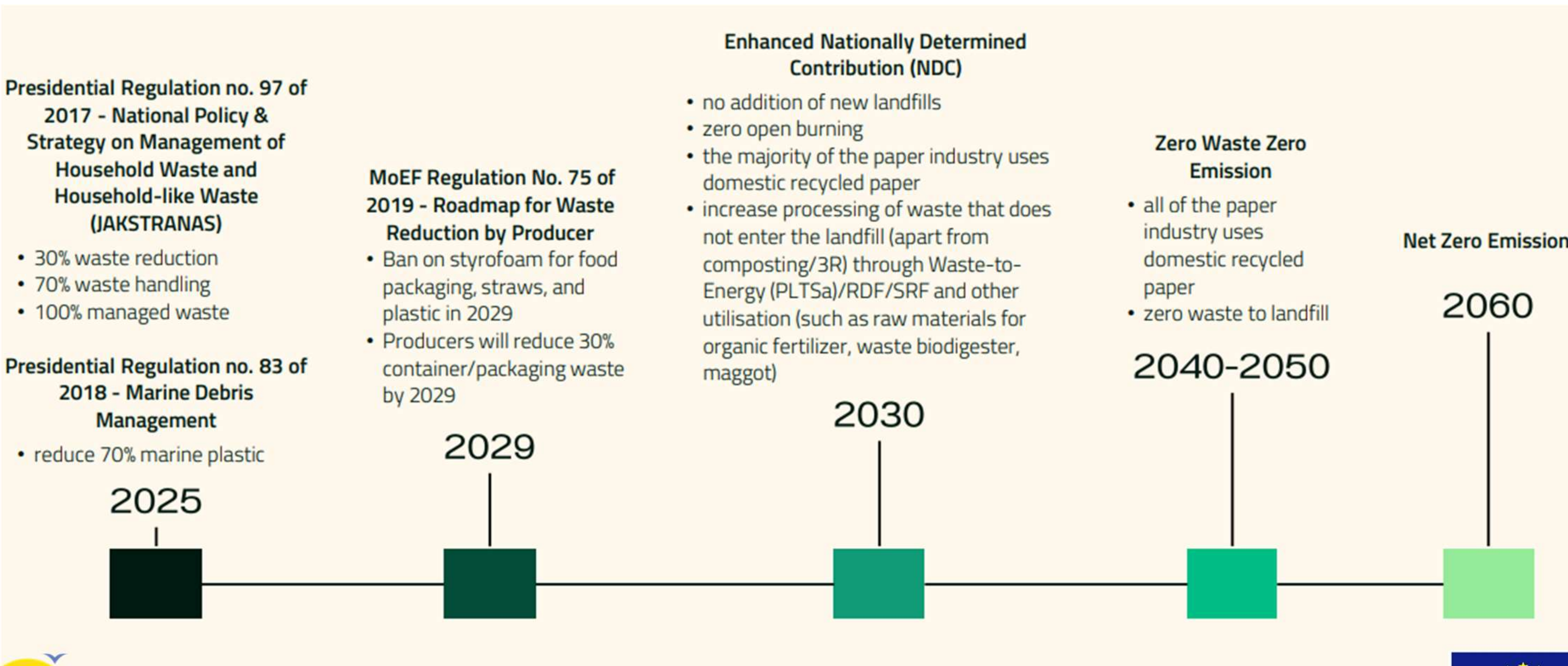
Indonesia’s net zero commitment roadmap



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***Source**: https://unece.org/sites/default/files/2024-04/4-RATN~1.PDF*

Indonesia’s enhanced NDC

To reach the mitigation targets, the waste sector shall be of focal concern

Table 1. Projected BAU and emission reduction from each sector category

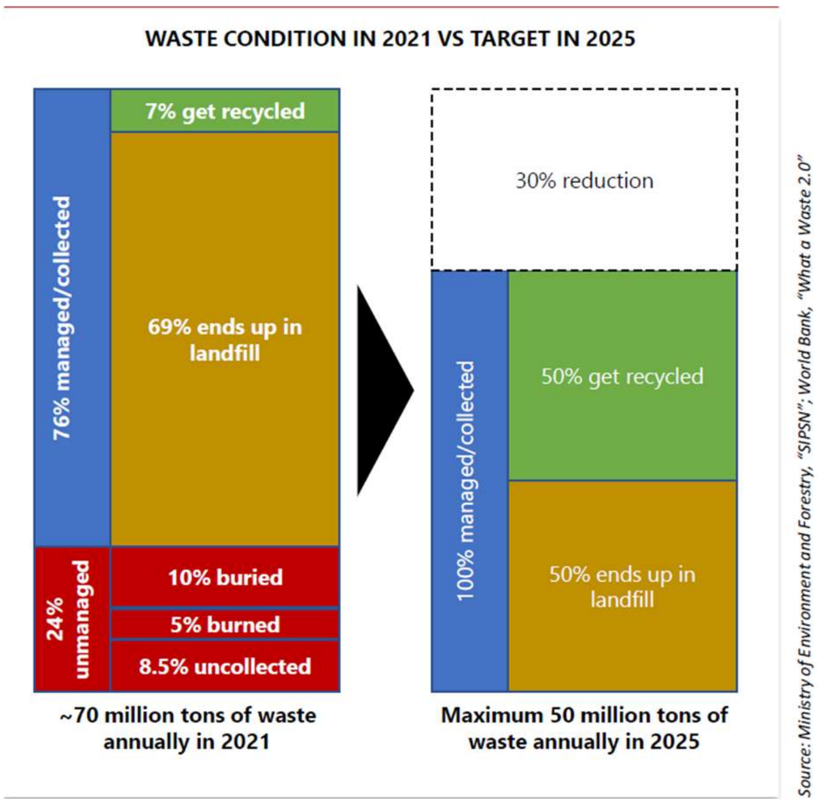
Sector	GHG Emission Level 2010* (MTon CO2-eq)	GHG Emission Level 2030			GHG Emission Reduction				Annual Average Growth BAU (2010-2030)	Average Growth 2000-2012
		MTon CO_2-eq			MTon CO_2-eq		% of Total BaU			
		BaU	CM1	CM2	CM1	CM2	CM1	CM2		
1. Energy*	453.2	1,669	1,311	1,223	358	446	12.5%	15.5%	6.7%	4.50%
2. Waste	88	296	256	253	40	43.5	1.4%	1.5%	6.3%	4.00%
3. IPPU	36	69.6	63	61	7	9	0.2%	0.3%	3.4%	0.10%
4. Agriculture	110.5	119.66	110	108	10	12	0.3%	0.4%	0.4%	1.30%
5. Forestry and Other Land Uses (FOLU)**	647	714	214	-15	500	729	17.4%	25.4%	0.5%	2.70%
TOTAL	**1,334**	**2,869**	**1,953**	**1,632**	**915**	**1,240**	**31.89%**	**43.20%**	**3.9%**	**3.20%**

Notes: **CM1**= Counter Measure 1 (*unconditional mitigation scenario*)
CM2= Counter Measure 2 (*conditional mitigation scenario*)

*) Including fugitive.
**) Including emission from estate and timber plantations.

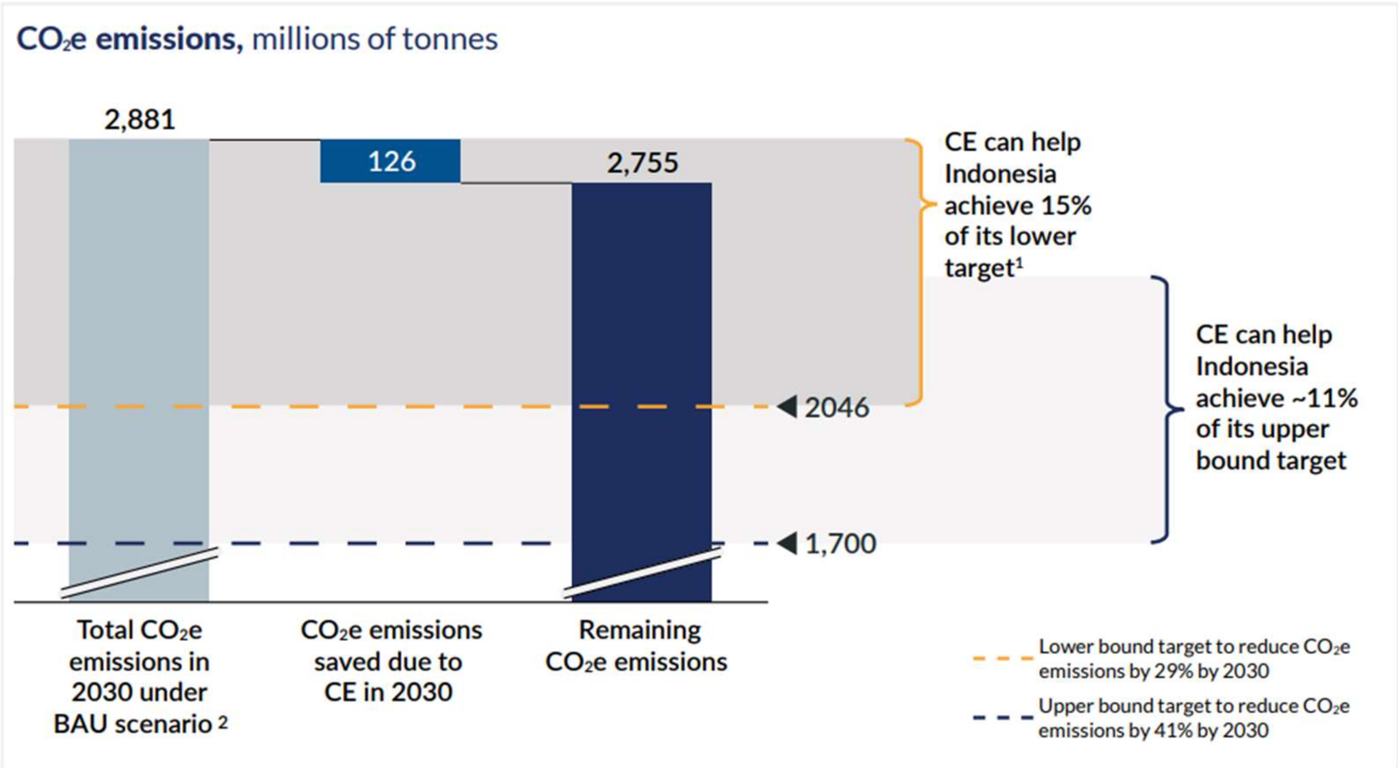
Source: ENHANCED NATIONALLY DETERMINED CONTRIBUTION, REPUBLIC OF INDONESIA, 2023

Indonesia's waste reduction target



***Source**: Embassy of Denmark, 2024*

The circular economy opportunity for Indonesia



Source:*Norwegian Embassy, 2021*

The circular economy opportunity for Indonesia

A CIRCULAR APPROACH COULD GENERATE MEANINGFUL ECONOMIC, ENVIRONMENTAL AND SOCIAL BENEFITS BY 2030 COMPARED TO A "BUSINESS AS USUAL" SCENARIO

- Economic benefits: potential to generate an **additional economy-wide GDP of IDR593 - 638 trillion in 2030**; the direct GDP impact on the 5 sectors could vary from IDR -1,563 trillion to IDR312 trillion based on different scenarios
- Environmental benefits : Reduce waste in each sector by ~18-52% in 2030 **Reduce CO2e emissions by 126 million tonnes and water use by 6.3 billion cubic metres in 2030**
- Social benefits : **Create 4.4 million cumulative jobs by 2030** Create annual household savings of almost 9% of their budgets (IDR4.9 million annually) 1 in 2030

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Circular versus linear

	Linear waste system	**Circular waste systems**
Choice 1: System type	Collection, Transport, Disposal	Door-to-door collection, MRF/TPST, Residual transport, Disposal
Advantage:	• Less expensive • Less complex • Faster	• Builds a circular economy and gives materials a further life • Uses less landfill space • Employs more workers • Nourishes soil
Dis-advantage:	• Requires more land for landfills and higher landfill costs • Loses value of materials	• More expensive, complex and time intensive • Requires household behaviour change to sort waste

Source:*Norwegian Embassy, 2021*

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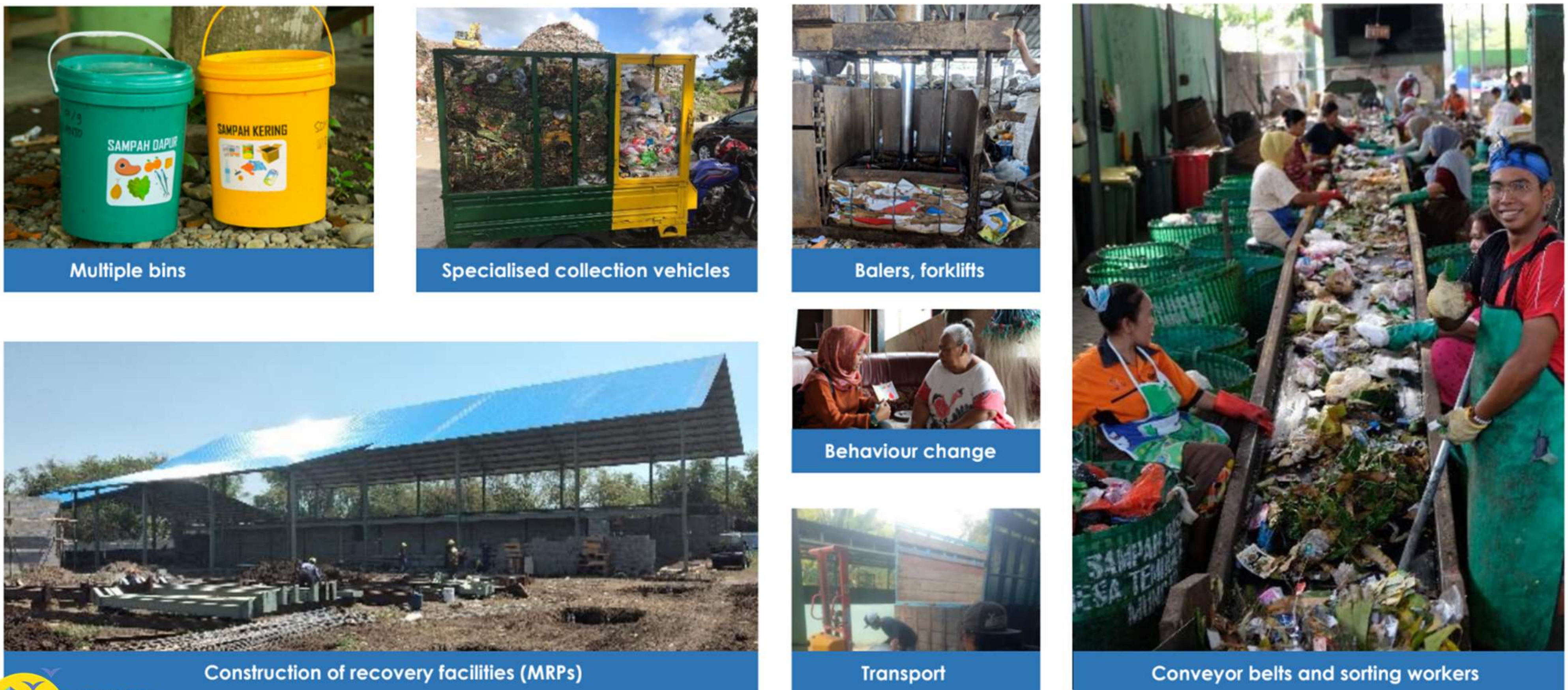
FIGURE 8. CIRCULAR AND LINEAR WASTE SYSTEM CAPEX COMPARISON



Source:_Norwegian Embassy, 2021_

How to implement circular economy in practice?

1. **Separate waste streams at source**
2. **Identifying end-users or recycling routes**
3. **Securing incomes (through EPR, tax on disposal)**
4. **Proper local governance**
5. **Increase commitment of community towards environmental protection and circularity through education and incentives**

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Case study: Tilos, zero waste island

- Tilos is a small island located in the **Region of South Aegean in Greece**. Its population varies from 591 to 780 residents over the year. However, the island welcomes 30,000 to 35,000 visitors in summer, a trend that is on the rise, and over 80 seasonal businesses operate from April to October. Until 2021, the island did not have a separate waste collection system, so the bulk of this ended up in landfill. In just two years, the "**Just Go Zero Tilos**" project transformed Tilos into **the first certified zero waste island in the world.**
- The "Just Go Zero" model relies on **five pillars of actions**:

1. **Educate and raise public awareness regarding environmental protection and circularity**
2. **Separate all waste streams at source**
3. **Collect, manage, and recycle special waste streams**
4. **Prevent and nullify pollution**

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