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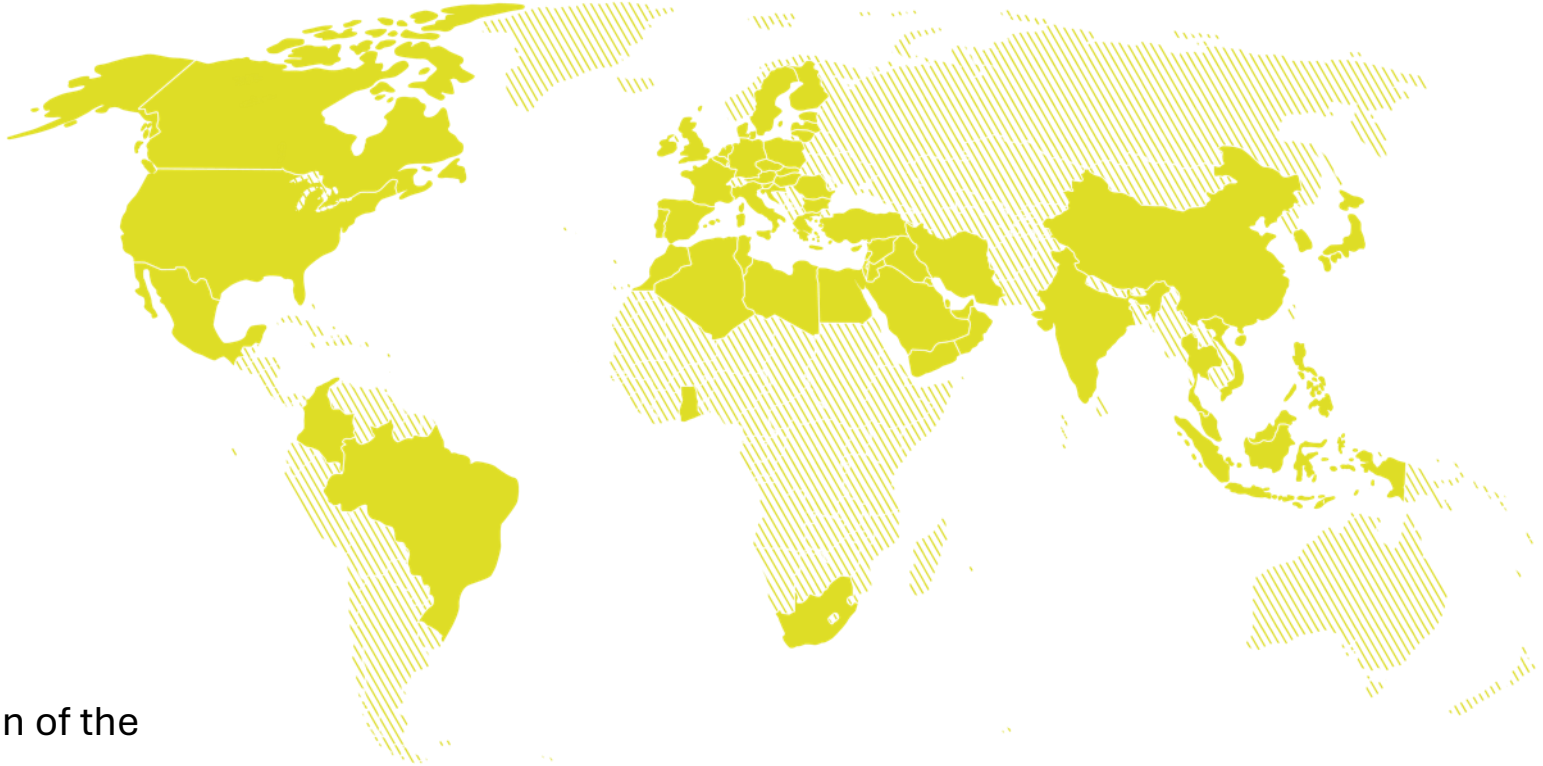


Short version of the

Global Plastics Flow Study 2023

Elaborated for

BKV PLASTICS CONCEPTS RECOVERY

Messe Düsseldorf

WE ARE PLASTICS

GKV German Association of Plastics Converters

VDMA Plastics and Rubber Machinery

October 2025

Study Background

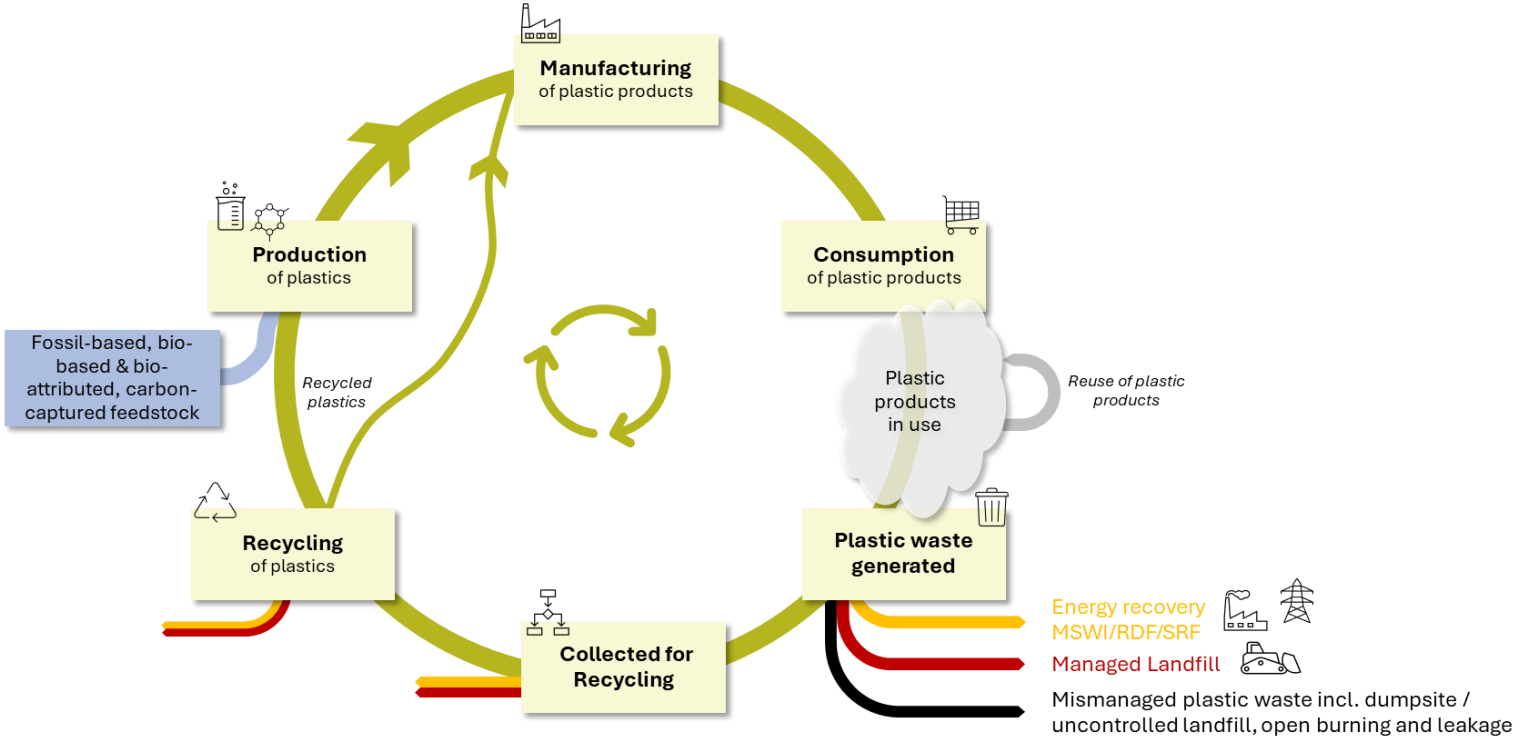
The global plastics industry is challenged to further develop and improve the circular economy for plastics and to contribute to establishing global waste management and recycling solutions. These efforts are also essential for reducing marine litter.

It is therefore crucial to understand the global situation and the level of development of the plastics circular economy—particularly the actual quantities of plastics waste in relation to littering, collection, recycling, recovery, and disposal—both in a global context and in selected countries.

In 2019, a worldwide study on the status of the Global Plastics Flow was conducted for the reference year 2018.

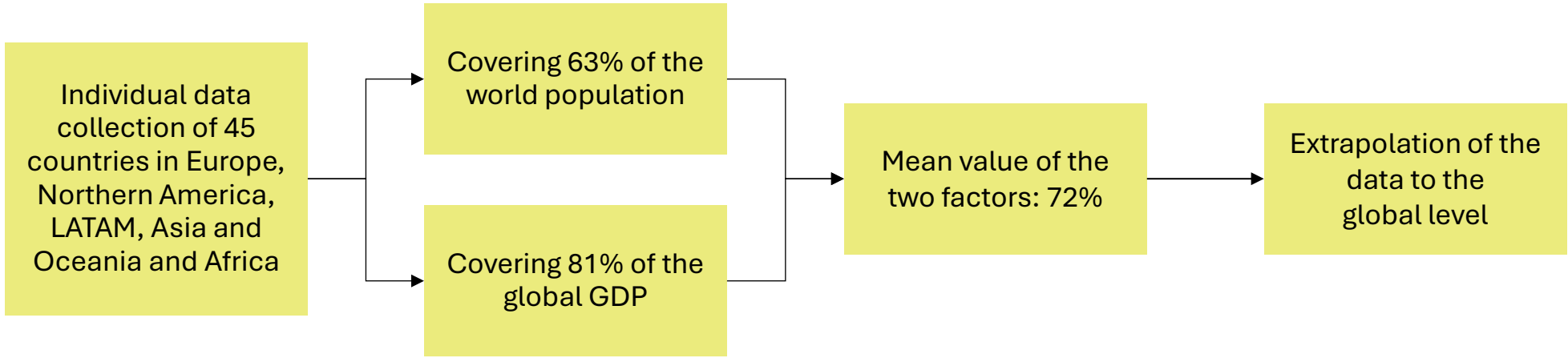
The new edition for the reference year 2023 will now assess the progress of the global plastics circular economy, with a particular focus on waste management and the prevention of mismanagement and littering.

This report incorporates retrospective harmonization of earlier analyses and data for the reference year 2018 to ensure consistency with the updated scope for the reference year 2023, incl. alignment of definitions, methodologies, learnings, and data continuity.



Data model extrapolation

The global plastics flow study includes data and information along the plastics value chain from production to waste management, incl. recycling and mismanaged plastics waste, from 45 in-depth analyses, which cover ~63% of the world population and ~81% of the global GDP.



- Data extrapolations were realized on a regional and global basis. Extrapolations were calculated using a correlation factor based on differences in population and GDP to obtain baseline figures for countries within regions that were not subject to in-depth analyses.
  Different extrapolation approaches were used and reviewed.
- The final data was used to refine extrapolated figures by incorporating additional researched regional and non-target country secondary data, along with existing information from our previous studies on other countries.
- Overall data extrapolation accuracy reached over 99% for plastic waste generation, 96% for formal and informal plastics waste collection for environmentally sound waste treatment, 95% for leakage and 92% for plastic recycling compared to the modified data set used.

Results at a glance – 1

About the study – Edition 2023

- The Global Plastics Flow 2023 study builds on the first edition (2019, reference year 2018) and analyzes plastics flows in 45 countries, covering 63% of the world's population and 81% of global GDP.
- Insights were extrapolated globally based on the insights gathered in individual countries and at the application level with input from national industry representatives.
- The study provides a comprehensive overview of post-consumer plastics, focusing on waste generation, collection, treatment, and leakage due to mismanagement.
- Compared with 2019, the 2023 edition deepens the analysis of non-packaging plastics (construction, automotive, electronics, and other durable products) to track progress in the global circular economy and highlight developments in waste management and litter prevention.

Countries & regions included

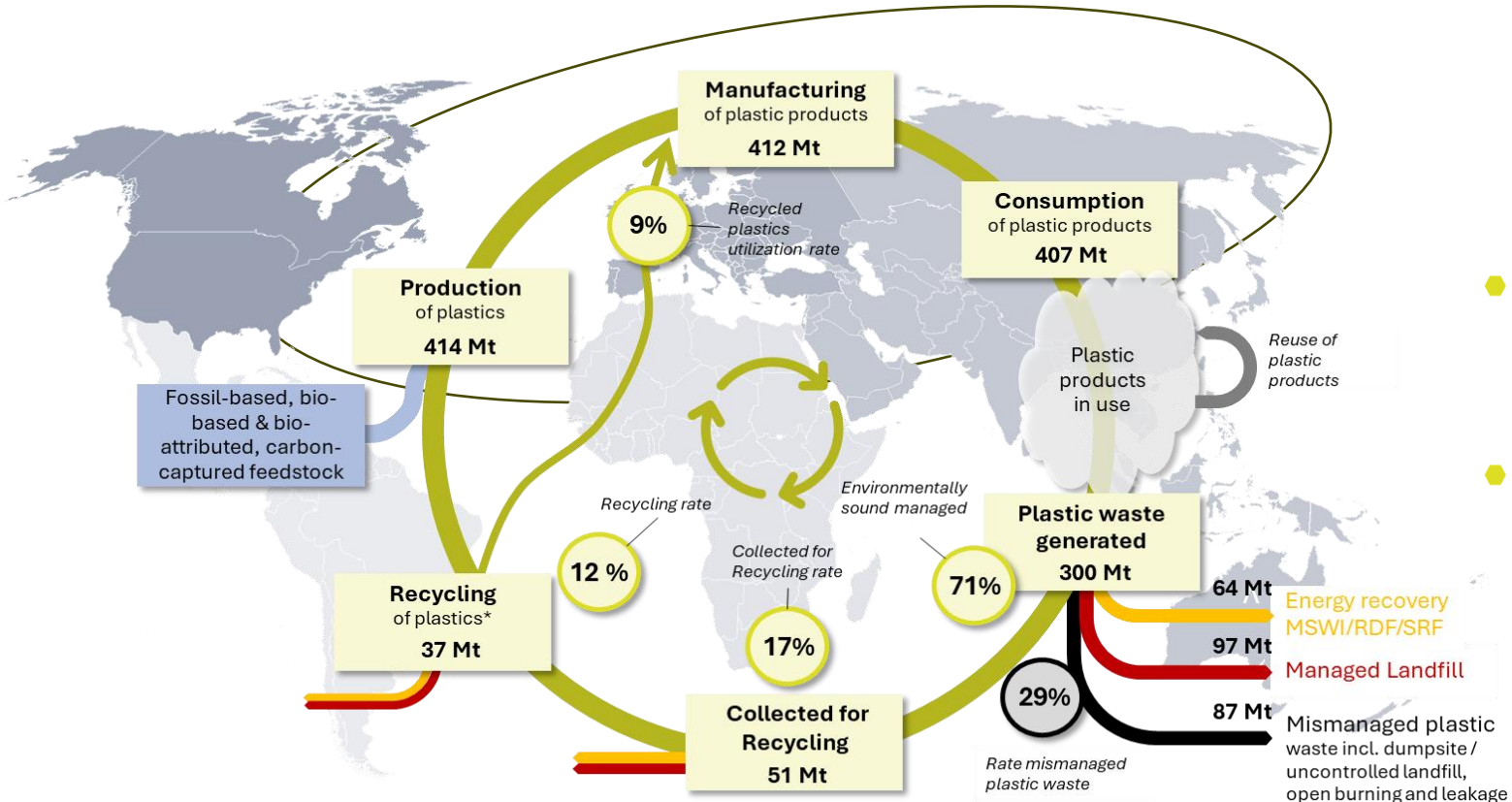
Plastics applications included

- Packaging
- Building & Construction
- Electronics
- Automotive
- Others

Results at a glance – 2

The Global Plastics Flow 2023 – **Production, manufacturing and consumption**

The figures in this study refer exclusively to waste from post-consumers



*Recycling of plastics at measuring point / "before the extruder"

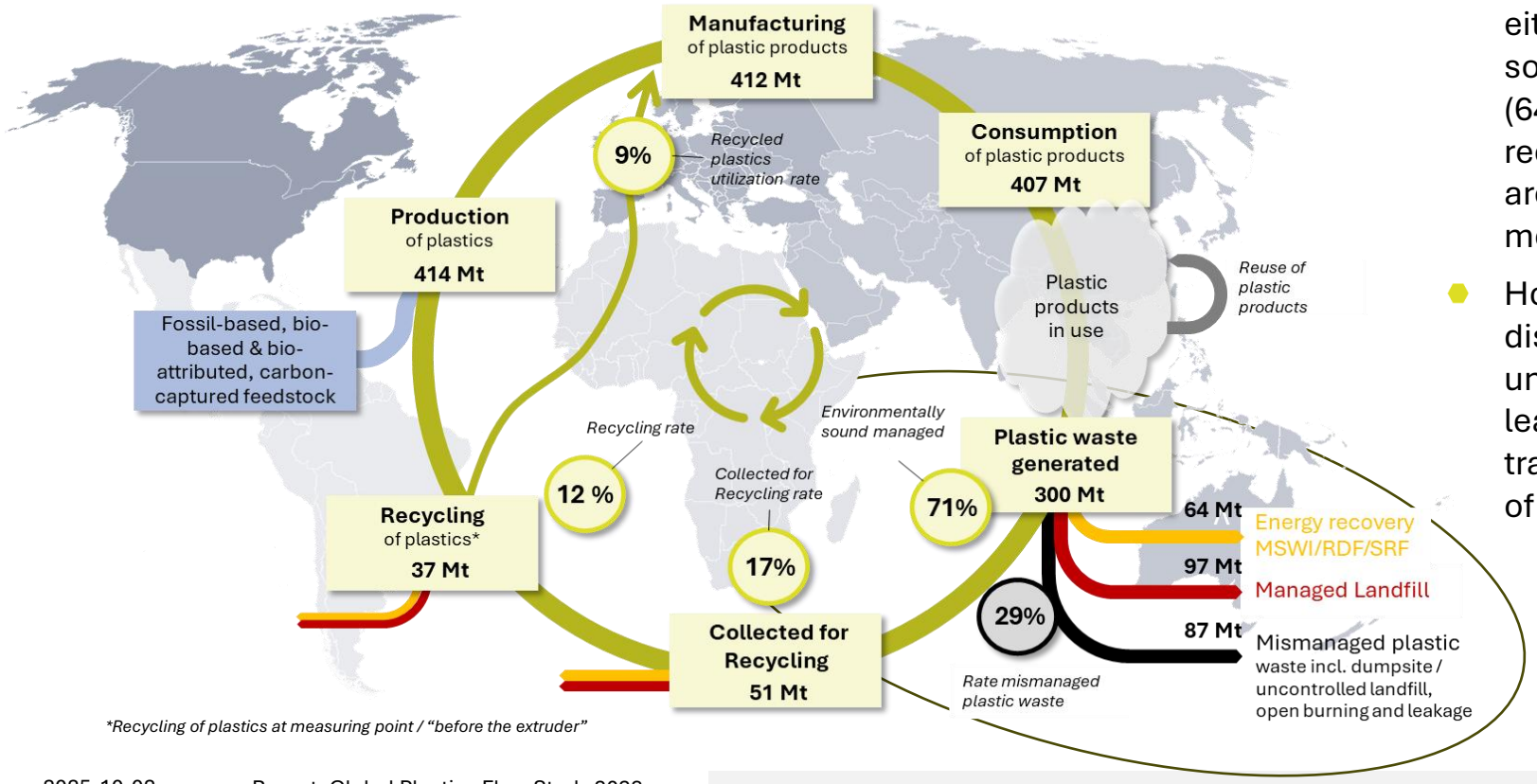
- Around 414 Mt plastics were produced in 2023, thereof 374 Mt of fossil-based plastics.
  412 Mt plastics (including 37 Mt post-consumer resins and 3 Mt bio-based plastics) were converted into plastics products and ~407 Mt plastic products were consumed or put on the market.
- The lifecycle of plastics products varies, resulting in a disparity in the number of plastics consumed and the amount of plastics waste. Not all plastics produced become waste in the same year.
- In 2023, ~300 Mt of post-consumer plastics waste were generated globally after consumption, while roughly 107 Mt of plastic products are in stock or in use and will reach the end of their service life at some point in the future.

Due to rounding, some totals may not match the sum of the individual figures

Results at a glance – 3

The Global Plastics Flow 2023 – **Plastics waste generated and environmentally sound managed vs. mismanaged waste**

The figures in this study refer exclusively to waste from post-consumers.



*Recycling of plastics at measuring point / "before the extruder"

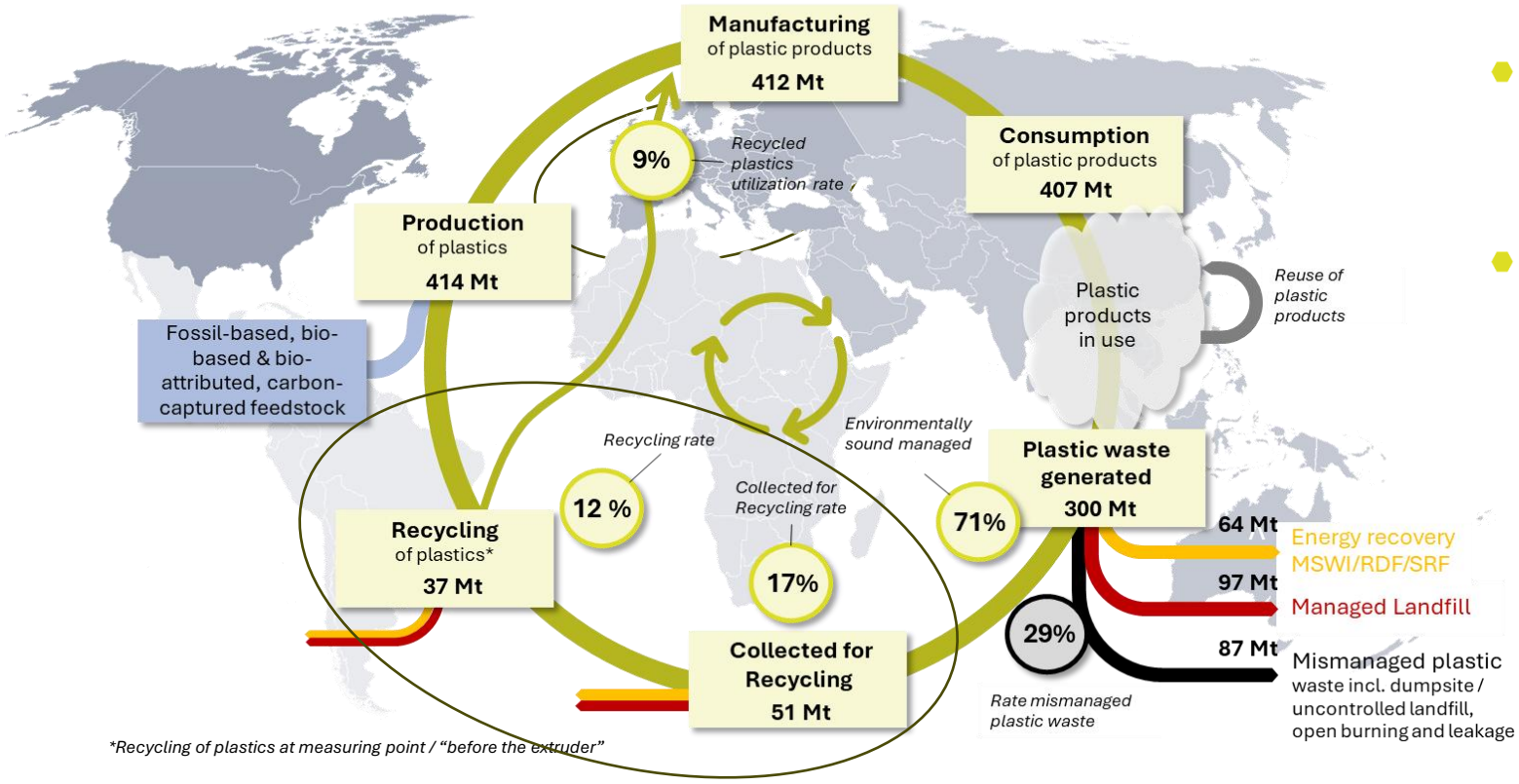
- 300 Mt of plastics waste generated globally correspond to plastics waste per capita of ~37 kg.
- Most of the plastics waste 71% (212 Mt) is managed in an environmentally sound manner in either managed landfills (97 Mt) or in municipal solid waste incineration plants and cement kilns (64 Mt) (i.e., for heat utilization and energy recovery) or is collected for recycling (51 Mt) and around 37 Mt of plastics prepared for recycling at measuring point after post-sorting.
- However, still 87 Mt of plastics waste were disposed of under improper conditions (i.e., unmanaged landfills, open burning, littering or leakage into aquatic and terrestrial environment) translating into a mismanaged plastics waste rate of 29%.

Due to rounding, some totals may not match the sum of the individual figures

Results at a glance – 4

The Global Plastics Flow 2023 – **Recycling of plastics waste**

The figures in this study refer exclusively to waste from post-consumers.

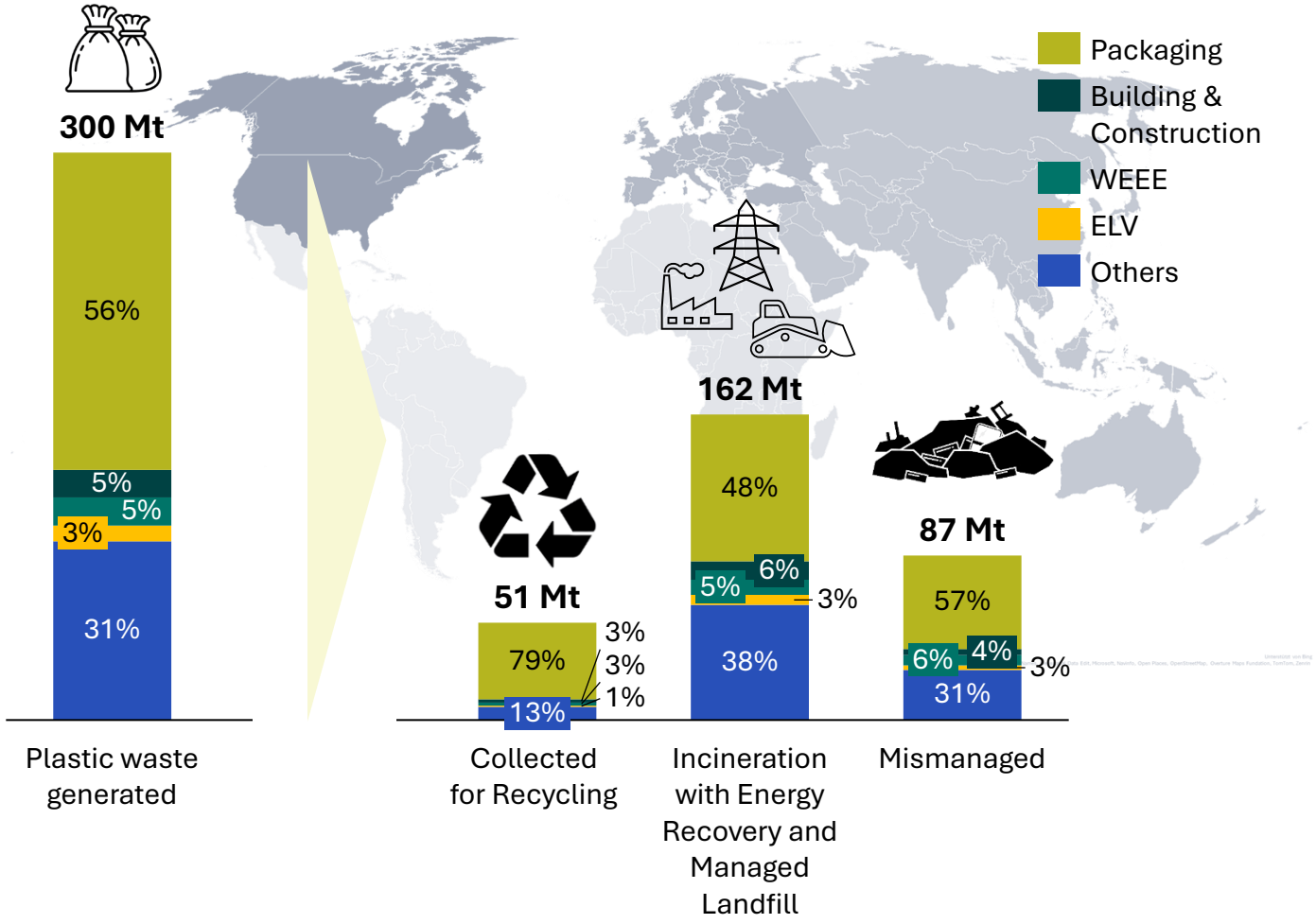


- While formal and informal waste collection and management ensure that 71% of the global plastics waste are environmentally sound managed, only 17% (~51 Mt) are collected for recycling processes.
- Due to further sorting and process losses, the resulting plastics recycling quantity accounted for 37 Mt, which translated into an average recycling rate worldwide of 12% in 2023.
- Utilized for the manufacturing in plastics products, this share accounted for ~9% based on the total quantity of 412 Mt of plastics products manufactured.

Due to rounding, some totals may not match the sum of the individual figures

Results at a glance – 5

Plastics applications along the plastics waste value chain in 2023



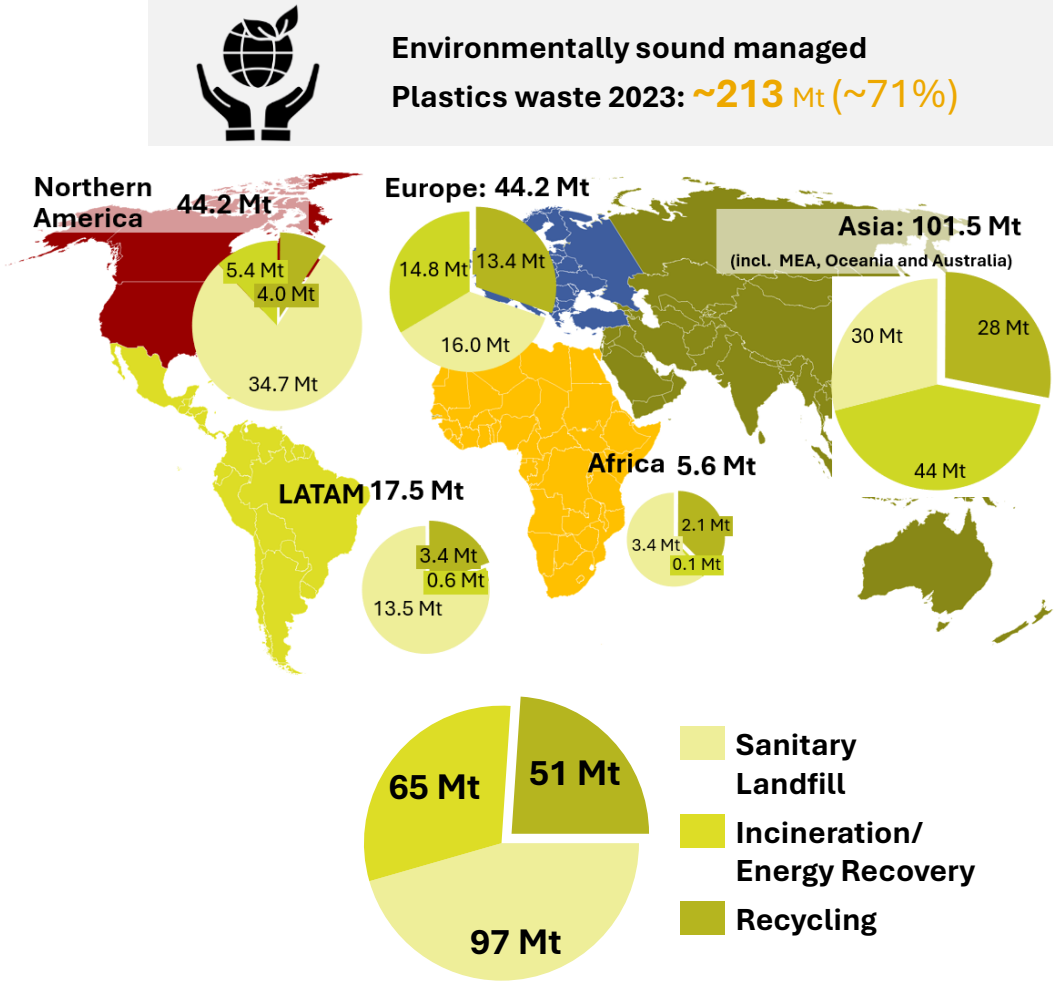
- Most of the plastics waste generated derives from the packaging sector (56% or 168 Mt).
- Plastics packaging waste, composed largely of PET, HDPE, LDPE, and PP, accounts for about 80% of all plastics collected for recycling.
- In total, around 54% (162 Mt) of plastics waste was either incinerated for energy recovery or disposed of in managed landfills. Waste incineration includes municipal waste incineration facilities, dedicated RDF/SRF incineration plants, as well as co-incineration of plastics waste in facilities such as cement kilns.
- Plastics packaging waste accounts for the largest share of mismanaged plastics waste (57%, 49 Mt), mainly due to inadequate waste management infrastructure, such as limited formal collection systems, and the low economic value of plastics waste in many regions.

Due to rounding, some totals may not match the sum of the individual figures

Results at a glance – 6

Environmentally sound managed plastics waste in 2023 by region

- Northern America generates 46.1 Mt of plastics waste, 96% (44.2 Mt) are environmentally sound managed through sanitary landfilling, while recycling plays only a minor role.
- Europe produces of 50.1 Mt plastics waste, 88% (44.2 Mt) of which is environmentally sound managed. The focus is strongly on recycling, supported by advanced systems that promote circular economy practices.
- Asia produces 148.2 Mt of plastics waste. 101.5 Mt (69%) of this amount are handled in environmentally sound manner. The recycling rate is high, and the majority of the world's recycled plastics are produced here.
- LATAM tends to follow similar waste management strategies to North America with high landfill rates and low incineration capacities, but with higher recycling shares.
- Africa has an immature waste management infrastructure as well as underdeveloped systems and technologies.

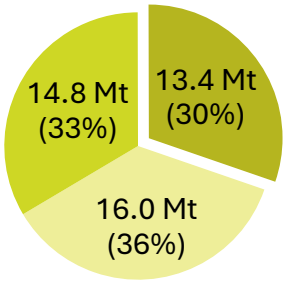


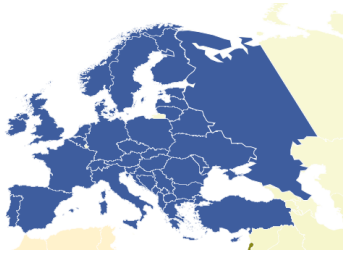
Due to rounding, some totals may not match the sum of the individual figures

Environmentally sound managed plastics waste in Europe in 2023

Environmentally sound managed plastics waste

Europe Total*: 90%



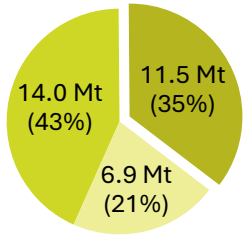


Sanitary Landfill

Incineration/ Energy Recovery

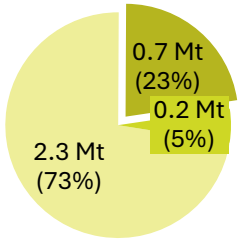
Recycling

*The rate of environmentally sound management of plastic waste is calculated based on the total amount of plastic waste generated within a region.



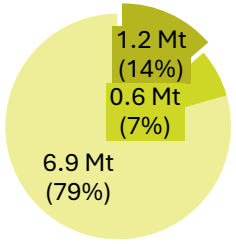
EU 27+3

Total*: 95%



Türkiye

Total*: 67%



Non-EU Eastern European Countries

Total*: 76%

Key insights

- 90% of plastic waste in Europe is managed in an environmentally sound way, with a balanced mix of sanitary landfill, incineration/energy recovery, and recycling.
- However, regional disparities are evident, particularly between EU 27+3 countries and Türkiye and Eastern European countries.
- A key challenge in Türkiye and Eastern European countries is the development of controlled disposal and treatment infrastructure, as 67% and 76% of plastic waste, respectively, is still not managed in an environmentally sound manner.
- EU27+3 countries demonstrate that environmentally sound waste management can be achieved through a multifaceted strategy that incorporates controlled landfill, energy recovery, and recycling.

Results at a glance – 7

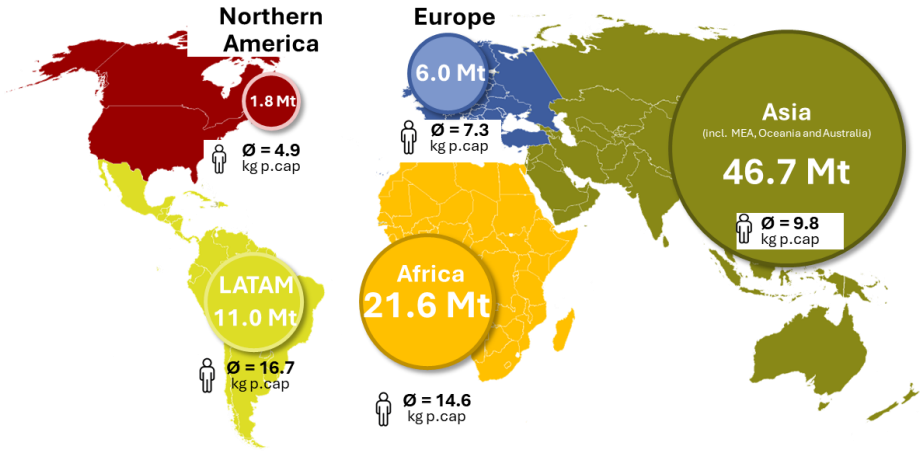
Mismanaged plastics waste by regions in 2023

- Although Asia produces the most mismanaged plastics waste due to its large population size, the per capita mismanagement is lower than in Africa and LATAM.
- In Asia there are significant differences between individual countries. While Japan and China have made great efforts to strengthen their circular economy solutions, and reduce the amount of mismanaged plastics waste, other large countries such as Indonesia or India are still struggling to establish adequate basic waste infrastructure to prevent leakage and improper disposal.
- Africa is responsible for the largest proportion of mismanaged plastics waste per capita due to large absence of sanitary landfills and proper waste collection infrastructure.
- Europe has a considerable amount of mismanaged plastics waste, as it exports waste, electronic devices, and cars to countries with inadequate waste management infrastructure under the guise of recycling.
- The main cause of mismanaged waste in Northern America is the dumping of waste materials into rivers and oceans, as well as the presence of waste littering.

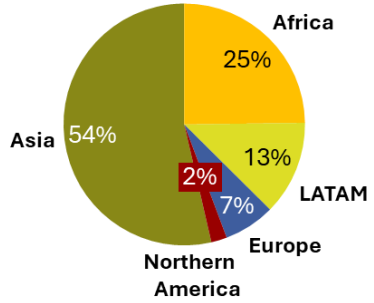
Mismanaged Plastics Waste 2023

~87 Mt (~29%)

~10.8 kg/cap.



Mismanaged Plastic waste split by region



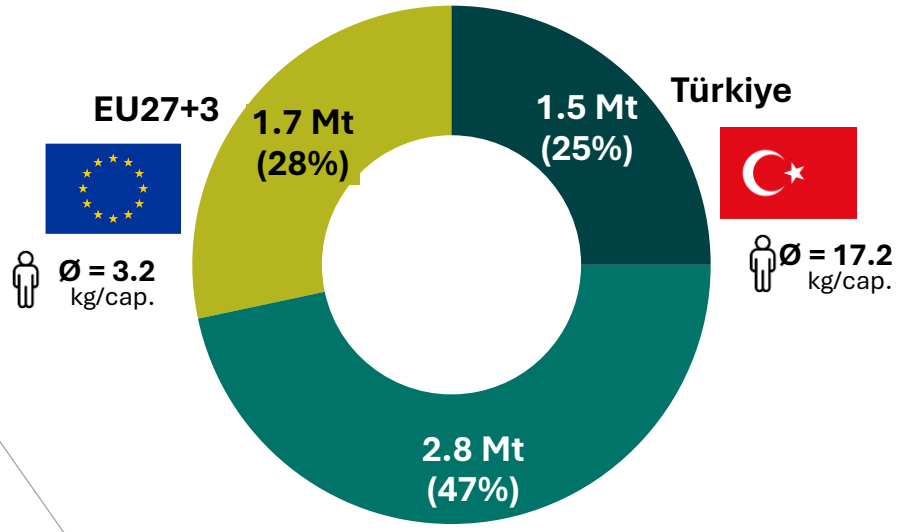
Due to rounding, some totals may not match the sum of the individual figures

Mismanaged plastics waste in Europe in 2023

6.0 Mt

Ø = 7.3 kg/cap.

Mismanaged Plastics Waste Europe

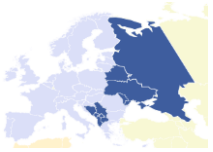


Ø = 3.2 kg/cap.

Ø = 17.2 kg/cap.

Non-EU Eastern European Countries

Ø = 13.8 kg/cap.



Key insights

- Europe generates 6.0 Mt of mismanaged plastic waste annually, averaging 7.3 kg per capita, with major regional differences.
- Türkiye and Eastern European countries are the main contributors, accounting for 25% (1.5 Mt) and 47% (2.8 Mt) of mismanaged waste respectively — both with high per-capita levels (Türkiye: 17.2 kg, Eastern Europe: 13.8 kg).
- EU 27+3 performs significantly better, with only 1.7 Mt (28%) mismanaged and a much lower per-capita level of 3.2 kg, highlighting the effectiveness of their waste management systems.

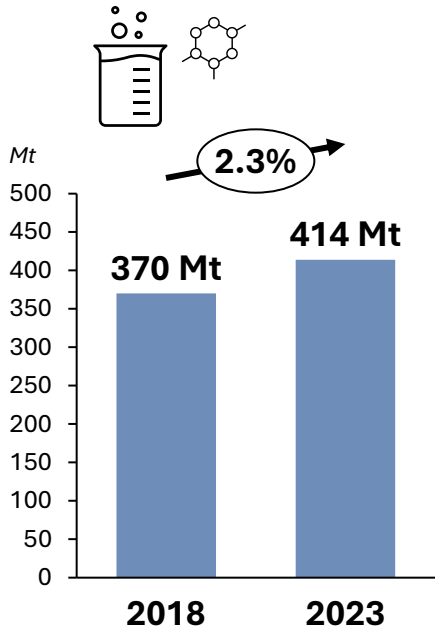
Results at a glance – 8

Growth dynamics in the Global Plastics Flow with CAGR in % and Total in Mt from 2018 to 2023

Population growth

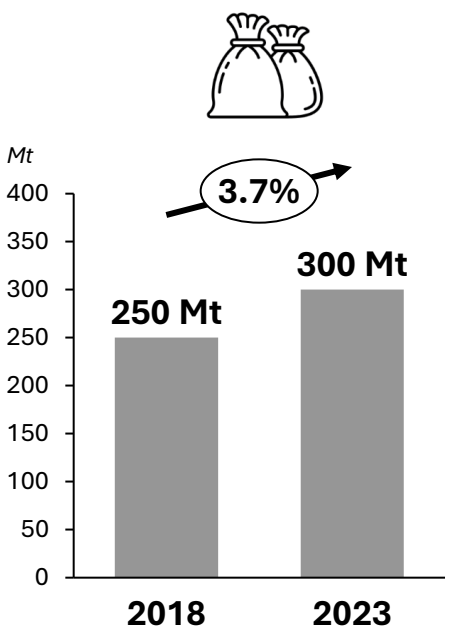
CAGR 2018-2023
+0.9%

Plastics production*

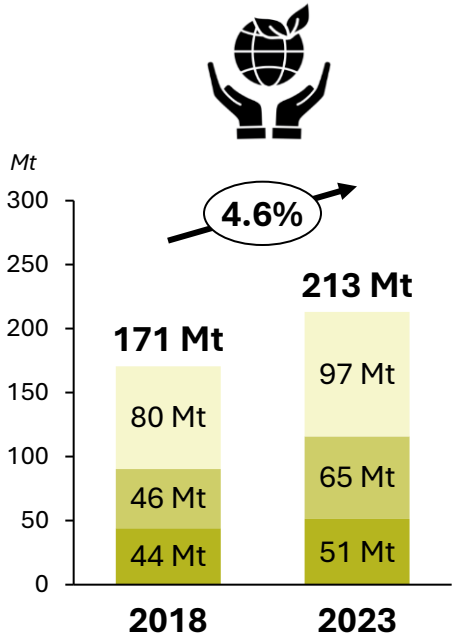


*Including bio-based and post-consumer recycled plastics. Excl. pre-consumer recycled plastics.

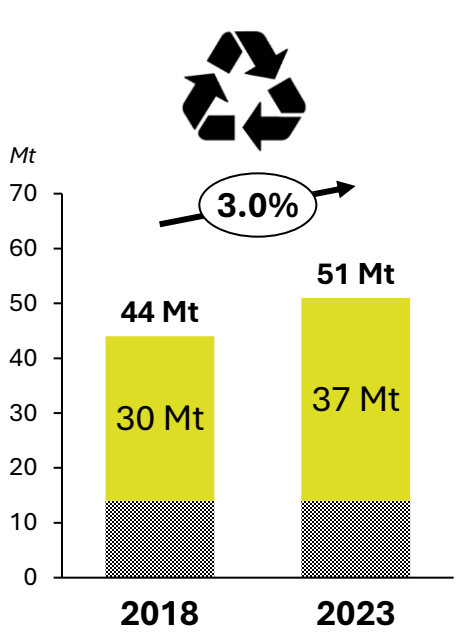
Plastics waste generated



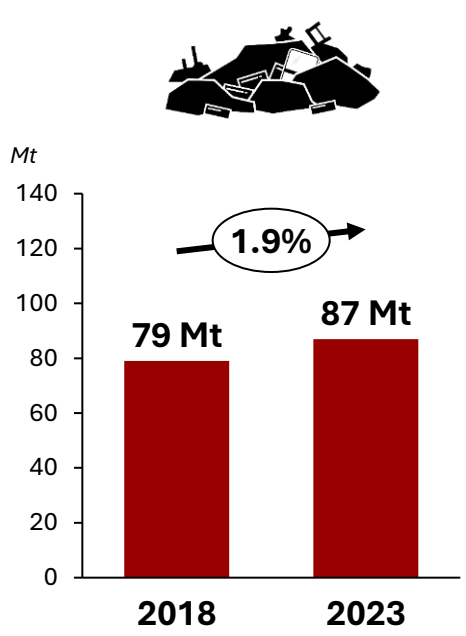
Environmentally managed plastics waste (incl. Recycling)



Plastics waste collected for recycling



Mismanaged plastics waste

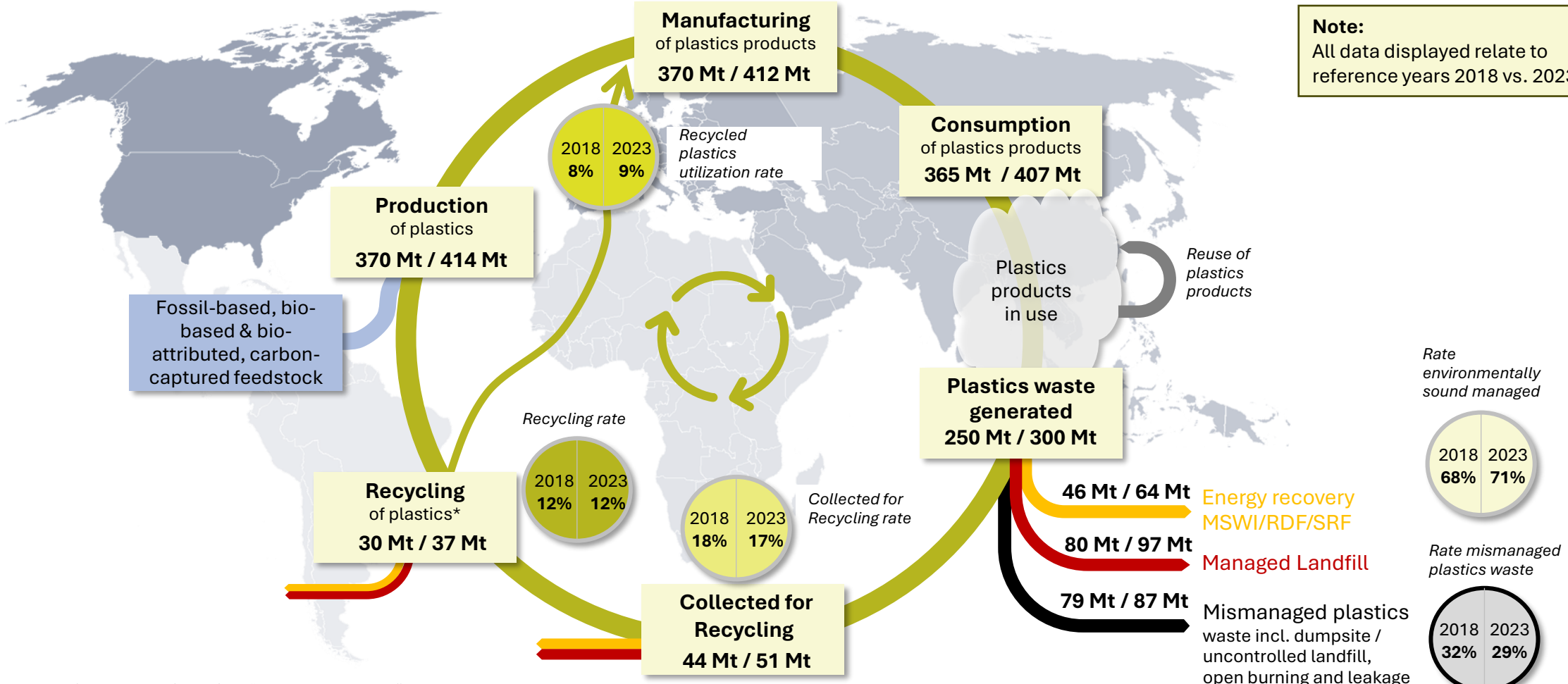


Sanitary Landfill
Incineration / Energy Recovery
Recycling

Recycled plastics
Process losses during sorting and recycling

Due to rounding, some totals may not match the sum of the individual figures

Results at a glance – 9 – Global Plastics Flow 2018 vs. 2023



Note:
All data displayed relate to reference years 2018 vs. 2023

**Recycling of plastics at measuring point / "before the extruder"*

Due to rounding, some totals may not match the sum of the individual figures

Results at a glance – 10

Growth dynamics in the Global Plastics Flow 2018 to 2023

- Since 2018 **plastics production** grew modestly at +2.3% per year to 414 Mt.
- **Plastics waste generation** is increasing at a rate that exceeds the rate of population growth across all regions.
- Plastics waste generation increased from 250 Mt to 300 Mt with CAGR at +3.7%. Population grew only by +0.9% indicating higher plastics waste per capita. Main drivers for this development are higher standards of living and consumption patterns worldwide. The disparity of plastics consumption relative to plastics waste generation indicates that the point of peak plastics turnover has not yet been reached. On the contrary, the volume of plastics waste is expected to continue increasing in the future, underscoring the urgent need to enhance plastics waste management systems and strengthen the circular economy of plastics.
- **Environmentally managed waste** grew most dynamically at +4.6% p.a., showing that waste treatment is catching up and improving.
  Main drivers for this development are increasing capacities for energy recovery in Asia.
- **Plastics waste collected for recycling** rose by +3.0% p.a., signaling steady progress, albeit slower than the overall growth of waste management.
- **Mismanaged plastics waste** increased by +1.9% p.a., still significant in volume, but growing at a slower rate than total waste, indicating gradual improvement. However, due to the significant increase in the amount of plastics waste, the amount of mismanaged plastics waste rose from 79 Mt in 2018 to 87 Mt in 2023.

Results at a glance – 11

Growth dynamics in the Global Plastics Flow 2018 to 2023 – Global assessment, challenges and possible solutions

- **The Global Plastics Flow shows steadily increasing quantities at all steps along the value chain,** including production, converting, plastics waste generation and recycling. For the future, we expect growth rates to be at least similar to those seen in the last survey periods from 2018 to 2023.
- Although the level of circularity has improved slightly, large amounts of mismanaged plastics waste continue to be generated. **Nearly 90 Mt of mismanaged plastics waste** still require substantial improvements and the implementation of effective, nationwide waste management systems.
- The **level of circularity improved** reaching a recycling rate of 12%. (Collected for recycling 17%)
  The share of post-consumer recyclates in the plastics production process reached 9%.
- While in some regions the level of circularity with plastics collected for recycling already exceeded 30% in 2023, the **global recycling rate remains significantly lower with only 12%,** highlighting both the opportunities and the urgent need for substantial further improvements.

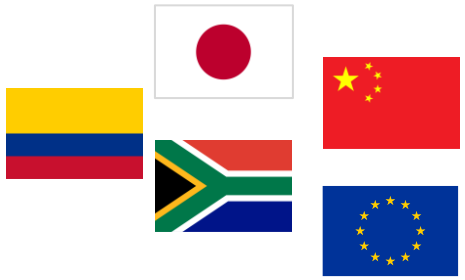
Results at a glance – 12

Growth dynamics in the Global Plastics Flow 2018 to 2023 – Global assessment, challenges and possible solutions

Looking at countries such as South Africa, China, Japan, Colombia, and the EU-27+3* countries, reveal positive developments either in preventing mismanaged plastics waste or in increasing recycling.

The following approaches and solutions are viable options for further improvement:

- Establishment of a clear and sustainable policy framework and legislation with clear targets supported by governance and administrative measures.
- Declare recycling and circularity as an important strategic goal.
- Establishment of infrastructure tools such as EPR systems and extensive infrastructures for collection and waste treatment
- Conclude a multi stakeholder pact and create transparency.
- Integration or formalization of the informal sector in low salary countries such as Colombia or India.
- Promoting the transmission from mismanaged to managed waste structures, landfills to energy recovery or direct recycling.
- Stimulate the use of recyclates
- Start with “low-hanging fruits” such collecting and recycling of PET bottles.



*European Union plus Switzerland, Norway and UK

Definitions 1/4

Definitions along the plastics value chain from plastics production to plastics waste generated	
Plastics production	Production of plastics raw materials such as moulding compounds (e.g., powder, granulates, basic materials such as PUR raw materials) fabricated by polymerisation. These materials are distributed to plastics product manufacturers, who use them to produce finished goods. Included are the following polymer types: PE-LD, PE-LLD, PE-HD, PP, PVC, PS, EPS, ABS, ASA, SAN, PMMA, PA, PC, PET, PUR, other Thermoplastics and other thermosets for plastics products applications (excluding adhesives, coatings, sealants etc.) Included are the following plastic types: fossil-based, bio-based, bio-attributed, mechanically and chemically recycled and carbon-captured.
Plastics product manufacturing (Conversion)	Plastics product manufacturers or converters utilize plastics raw material (e.g., resins) to produce plastics parts and products for different applications such as packaging, electronics etc.
Plastics consumption	Plastics consumers are either commercial end users or private households. Because of import and export flows of plastic products, consumption levels differ from product manufacturing volumes. In this context, consumption includes both short-life packaging (e.g., single-use packaging materials) and long-life packaging (e.g., pallets, crates, transport boxes) and plastics for other applications such as Building & Construction, Automotive etc. Plastics consumption by country is provided for reference only and has not been further analyzed.
Plastics pre-consumer waste	Pre-consumer plastics waste refers to plastics discarded during manufacturing and converting processes (e.g., faulty parts, sprues, edge sections, leftovers). This does not include materials that are directly reused within the same process, such as regrind, rework or scrap material, or anything that is not defined as waste. This study focuses on plastics pre-consumer waste.
Plastics post-consumer waste	Post-consumer waste is plastics waste generated by households or by commercial, industrial, and institutional users. This definition also includes material returns from the distribution chains or installation leftovers (e.g., cut-offs from insulation materials, flooring, pipes, profiles).

Definitions 2/4

Definitions plastics waste applications	
Packaging	Packaging includes all products, regardless of material, designed to contain, protect, handle, deliver, or present goods, ranging from raw materials to finished products, throughout the supply chain from producer to consumer. It covers sales (primary), grouped (secondary), and transport (tertiary) packaging.
Building & Construction (B&C)	Construction and demolition waste refers to plastics waste generated from building construction, renovation, demolition, and installation activities. It includes materials such as flooring, carpets, roofing, membranes, window profiles, doors, pipes, fittings, cladding, insulation, cables, and other building-related products.
Electronics	Electronic and electrical waste (E-waste) refers to discarded electrical and electronic equipment from households, businesses, and industries. It covers a wide range of products such as large and small appliances, computers and telecommunications equipment, lighting devices, and temperature-control equipment.
Automotive	Automotive plastics waste refers to end-of-life vehicle (ELV) plastics generated during dismantling and shredding processes. It includes all major plastics applications such as interior, exterior, seating, insulation, and under-the-hood components, but excludes waste from routine service or repair workshops.
Others	All other applications of plastics, not explicitly listed above such as agriculture, farming, gardening houseware, leisure, sport, furniture, medical, machinery.

Definitions 3/4

Definitions plastics waste collection and environmentally sound waste treatment	
Formal and informal waste collection for environmentally sound waste treatment	Waste collection refers to the formal and informal gathering of waste (separately collected waste streams as well as mixed waste streams) for a proper and environmentally sound waste management and treatment. It includes organized municipal systems as well as informal collection networks (waste pickers) that contribute to recycling, recovery, and safe disposal worldwide.
Collected for Recycling	Recycling is the recovery of waste materials by reprocessing them into new products, materials, or substances, excluding energy recovery or utilization as fuels. ▪ Mechanical recycling: Recovery of plastics without altering their polymer structure by sorting, cleaning, grinding, and remelting into pellets, flakes, or powders for reuse in manufacturing. ▪ Chemical recycling: Break-down of plastics by altering their chemical structure to create raw materials (e.g., oils, gases, or waxes) for new plastics and products, using methods such as pyrolysis, solvolysis, gasification, or depolymerization. The recycling figures in this report are based on plastics waste collected for recycling. The recycling rates in accordance with EU Directive 2018/852, measured at the recycling input stage after pre-sorting, washing, and post-sorting (“before the extruder”), are provided in the global overview, but not at the regional or country level.
Energy Recovery (incineration)	Energy recovery refers to the incineration of waste to generate electricity and/or heat, or to replace fossil fuels in industrial processes such as cement kilns or pulp mills. This includes direct municipal solid waste incineration as well as the use of fuels derived from waste, such as Refuse Derived Fuel (RDF) and Solid Recovered Fuel (SRF).
Managed Landfill	Waste disposal (landfilling) refers to the final placement of waste onto or into land aboveground or underground, managed either by waste generators themselves (internal sites) or by external facilities. This includes managed landfills, i.e., engineered or controlled disposal sites designed to minimize environmental and health risks by regulating emissions, leachate, and other impacts. It excludes temporary transfer facilities such as those used for preparing waste for onward recovery or treatment and storage intended solely for future processing. UN definitions distinguish types of managed landfills by their control levels. Our data follows each country’s definition of managed landfill.

Definitions 4/4

Definitions mismanaged plastics waste	
Mismanaged	Mismanaged waste refers to waste that is not properly collected, treated, or disposed of in environmentally sound facilities. It encompasses waste that is openly dumped, burned in uncontrolled conditions, or leaked into the natural environment, especially rivers, oceans, and soils, particularly in regions where formal waste management systems are weak or underdeveloped. Notably, exports of plastic waste intended for recycling, but subsequently mismanaged by receiving countries due to poor treatment facilities, also fall under this category.
Open dumpsite / uncontrolled landfill	An open dumpsite or uncontrolled landfill is a disposal area where waste is deposited without protective measures such as liners, leachate collection, or gas control systems. Unlike engineered landfills, these sites leave waste exposed, often mixed with hazardous materials, and prone to uncontrolled fires, vermin, and leaching into soil and water. According to UNEP, open dumping is one of the most widespread and environmentally harmful waste practices, still common in many parts of the world.
Open burning	Open burning is the uncontrolled combustion of waste in open spaces, fields, or dumpsites, without emission controls or energy recovery. It is often practiced to reduce the visible volume of waste but generates significant air pollution, including fine particulate matter, black carbon, dioxins, furans, and heavy metals. This practice is considered one of the largest unaccounted sources of toxic emissions globally, with impacts on both human health and climate change.
Leakage	Leakage describes the unintentional escape of waste into the environment due to inadequate collection, transport, or disposal systems. It includes plastics litter carried into rivers and oceans, as well as dispersed waste in soils and landscapes. Leakage often occurs when formal waste management systems are absent or overwhelmed, making it a driver of marine plastic pollution and biodiversity loss.