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Plastic Pollution



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Plastic Pollution

Mounds of plastics at the Thilafushi waste dumping site. Thilafushi is an artificial island created as a municipal landfill situated to the west of Malé, and is located between Kaafu Atoll's Giraavaru and Gulhifalhu of the Maldives.



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SINGLE-USE PLASTICS

A Roadmap
for Sustainability



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Executive summary

The benefits of plastic are undeniable. The material is cheap, lightweight and easy to make. These qualities have led to a boom in the production of plastic over the past century. This trend will continue as global plastic production skyrockets over the next 10 to 15 years. We are already unable to cope with the amount of plastic waste we generate, unless we rethink the way we manufacture, use and manage plastics. Ultimately, tackling one of the biggest environmental scourges of our time will require governments to regulate, businesses to innovate and individuals to act.

This paper sets out the latest thinking on how we can achieve this. It looks at what governments, businesses and individuals have achieved at national and sub-national levels to curb the consumption of single-use plastics. It offers lessons that may be useful for policymakers who are considering regulating the production and use of single-use plastics.

The Age of Plastic – why we need to change

Since the 1950s, the production of plastic has outpaced that of almost every other material. Much of the plastic we produce is designed to be thrown away after being used only once. As a result, plastic packaging accounts for about half of the plastic waste in the world. Most of this waste is generated in Asia, while America, Japan and the European Union are the world's largest producers of plastic packaging waste per capita.

Our ability to cope with plastic waste is already overwhelmed. Only nine per cent of the nine billion tonnes of plastic the world has ever produced has been recycled. Most ends up in landfills, dumps or in the environment. If current consumption patterns and waste management practices continue, then by 2050 there will be around 12 billion tonnes of plastic litter in landfills and the environment. By this time, if the growth in plastic production continues at its current rate, then the plastics industry may account for 20 per cent of the world's total oil consumption.

Most plastics do not biodegrade. Instead, they slowly break down into smaller fragments known as microplastics. Studies suggest that plastic bags and containers made of expanded polystyrene foam (commonly referred to as "Styrofoam") can take up to thousands of years to decompose, contaminating soil and water.

The most common single-use plastics found in the environment are, in order of magnitude, cigarette butts, plastic drinking bottles,

plastic bottle caps, food wrappers, plastic grocery bags, plastic lids, straws and stirrers, other types of plastic bags, and foam take-away containers. These are the waste products of a throwaway culture that treats plastic as a disposable material rather than a valuable resource to be harnessed.

Plastic waste causes a plethora of problems when it leaks into the environment. Plastic bags can block waterways and exacerbate natural disasters. By clogging sewers and providing breeding grounds for mosquitoes and pests, plastic bags can increase the transmission of vector-borne diseases like malaria. High concentrations of plastic materials, particularly plastic bags, have been found blocking the airways and stomachs of hundreds of species. Plastic bags are often ingested by turtles and dolphins who mistake them for food. There is evidence that the toxic chemicals added during the manufacture of plastic transfer to animal tissue, eventually entering the human food chain. Styrofoam products, which contain carcinogenic chemicals like styrene and benzene, are highly toxic if ingested, damaging the nervous systems, lungs and reproductive organs. The toxins in Styrofoam containers can leach into food and drinks. In poor countries, plastic waste is often burned for heat or cooking, exposing people to toxic emissions. Disposing of plastic waste by burning it in open-air pits releases harmful gases like furan and dioxin.

The economic damage caused by plastic waste is vast. Plastic litter in the Asia-Pacific region alone costs its tourism, fishing and shipping industries \$1.3 billion per year. In Europe, cleaning plastic waste from coasts and beaches costs about €630 million per year. Studies suggest that the total economic damage to the world's marine ecosystem caused by plastic amounts to at least \$13 billion every year. The economic, health and environmental reasons to act are clear.

Key findings and recommendations

Plastic bag bans, if properly planned and enforced, can effectively counter one of the causes of plastic overuse. Nevertheless, to tackle the roots of the problem, governments need to **improve waste management practices** and introduce **financial incentives** to change the habits of consumers, retailers and manufacturers, enacting strong policies that push for a more **circular model** of design and production of plastics. They must finance more research and development of **alternative materials**, raise **awareness** among consumers, fund innovation, ensure plastic products are properly labelled and carefully weigh possible solutions to the current crisis. Governments must engage a broad range of stakeholders in the decision-making process as they seek to tackle the crisis. To meet

the rising tide of plastics, we urgently need strong government leadership and intervention.

Governments around the world are increasingly awake to the scale of plastic pollution. More than 60 countries have introduced **bans** and **levies** to curb single-use plastic waste. Plastic bags and, to a certain extent, foamed plastic products like Styrofoam have been the main focus of government action so far. This is understandable. These plastic products are often the most visible forms of plastic pollution. It is estimated that one¹ to 5 trillion² plastic bags are consumed worldwide each year. Five trillion is almost 10 million plastic bags per minute. If tied together, all these plastic bags could be wrapped around the world seven times every hour.

It is too early to draw robust conclusions on the **environmental impact** that **bans and levies** have had. In 50 per cent of cases, information about their impact is lacking, partly because some countries have adopted them only recently and partly because monitoring is inadequate. In countries that do have data, about 30 per cent have registered drastic drops in the consumption of plastic bags within the first year. The remaining 20 per cent of countries have reported little to no change.

Of the countries that have reported little to no impact, the main problems appear to be (i) a lack of enforcement and (ii) a lack of affordable alternatives. The latter has led to cases of smuggling and the rise of black markets for plastic bags or to the use of thicker plastic bags that are not covered by the bans. This has increased environmental problems in some cases.

Public-private partnerships and **voluntary agreements** can be good alternatives to bans. Voluntary reduction strategies allow citizens time to change their consumption patterns and provide an opportunity for affordable and eco-friendly alternatives to hit the market. The promotion and adoption of reusable bags is an example of a reduction strategy where the choice lies with the consumer. This strategy has changed consumer behaviour and reduced the use of conventional plastic bags in many regions.

Given the broad range of possible actions to curb single-use plastics and their mixed impact, UN Environment has drawn up a **10-step roadmap for governments** that are looking to adopt similar measures or improve on current ones. The steps are based on the experiences of 60 countries around the globe:

¹ Earth Policy Institute (2014). http://www.earth-policy.org/press_room/C68/plastic_bags_fact_sheet

² The Worldwatch Institute estimates that 4-5 trillion plastic bags were produced in 2002, ranging from large trash bags to thick shopping totes to flimsy grocery sacks. Assuming that the number has remained stable since then, the value used is the upper estimate of 5 trillion. http://www.theworldcounts.com/counters/waste_pollution_facts/plastic_bags_used_per_year

1. **Target the most problematic single-use plastics** by conducting a baseline assessment to identify the most problematic single-use plastics, as well as the current causes, extent and impacts of their mismanagement.
2. **Consider the best actions to tackle the problem** (e.g. through regulatory, economic, awareness, voluntary actions), given the country's socio-economic standing and considering their appropriateness in addressing the specific problems identified.
3. **Assess the** potential social, economic and environmental **impacts** (positive and negative) of the preferred short-listed instruments/actions. How will the poor be affected? What impact will the preferred course of action have on different sectors and industries?
4. **Identify and engage** key **stakeholder groups** – retailers, consumers, industry representatives, local government, manufacturers, civil society, environmental groups, tourism associations – to ensure broad buy-in. Evidence-based studies are also necessary to defeat opposition from the plastics industry.
5. **Raise public awareness** about the harm caused by single-used plastics. Clearly explain the decision and any punitive measures that will follow.
6. **Promote alternatives.** Before the ban or levy comes into force, assess the availability of alternatives. Ensure that the pre-conditions for their uptake in the market are in place. Provide economic incentives to encourage the uptake of eco-friendly and fit-for-purpose alternatives that do not cause more harm. Support can include tax rebates, research and development funds, technology incubation, public-private partnerships, and support to projects that recycle single-use items and turn waste into a resource that can be used again. Reduce or abolish taxes on the import of materials used to make alternatives.
7. **Provide incentives to industry** by introducing tax rebates or other conditions to support its transition. Governments will face resistance from the plastics industry, including importers and distributors of plastic packaging. Give them time to adapt.
8. **Use revenues** collected from taxes or levies on single-use plastics **to maximize the public good.** Support environmental projects or boost local recycling with the funds. Create jobs in the plastic recycling sector with seed funding.

9. **Enforce** the measure chosen effectively, by making sure that there is clear allocation of roles and responsibilities.
10. **Monitor** and **adjust** the chosen measure if necessary and update the public on progress.

Target audience

Drawing from the experience of over 60 countries, this report is designed for policymakers considering the introduction of measures to curb consumption and improve management of single-use plastics.

Structure

The assessment starts with an overview of the global and regional trends of plastic production, consumption and end-of-life management. The assessment continues by examining the environmental, social and economic impacts of mismanaged and problematic single-use³ plastics, in particular bags and foamed plastic products.

The study then presents a global mapping of actions introduced by both public and private sector actors to reduce the production and consumption of plastic bags and foamed plastic products, followed by selected case studies from each region of the world. A roadmap for policymakers looking to reduce single-use plastic pollution is found in the concluding chapter.

³ The terms “single-use plastics” and “disposable plastics” are used interchangeably in this paper.

Chapter

1

The plastic context

1.1 Definitions

Plastic is a lightweight, hygienic and resistant material which can be moulded in a variety of ways and utilized in a wide range of applications. Figure 1.1 presents an illustrated overview of the two main categories of plastics.

Unlike metals, plastics do not rust or corrode. Most plastics do not biodegrade, but instead photodegrade, meaning that they slowly⁴ break down into small fragments known as **microplastics**.⁵ The fragmentation of large plastic items into microplastics is common on land such as beaches because of high UV irradiation and abrasion by waves, while the degradation process is much slower in the ocean due to cooler temperatures and reduced UV exposure.⁶ The assertions made in this document refer mostly to fossil-derived plastics and not to plastics of biogenic origins, although reference to the latter group is made in section 2.1.1.

Single-use plastics, often also referred to as disposable plastics, are commonly used for plastic packaging⁷ and include items intended to be used only once before they are thrown away or recycled. These include, among other items, grocery bags, food packaging, bottles, straws, containers, cups and cutlery. Figure 1.1 introduces the main polymers used to manufacture single-use plastic items and indicates their most common applications.

1.2 Production

Since the 1950s, growth in the production of plastic has largely outpaced that of any other material,⁸ with a global shift from the production of durable plastics to single-use plastics (including packaging), as shown in Figure 1.2. The production of plastic is largely reliant on fossil hydrocarbons, which are non-renewable resources.⁹ If the growth in plastic production continues at the current rate, by 2050 the plastic industry may account for 20% of the world's total oil consumption.¹⁰

More than one-fourth of the resins globally used in the production of single-use plastics¹¹ are manufactured in Northeast Asia (China, Hong Kong, Japan, Republic of Korea and Taiwan). This is followed by North America, the Middle East and Europe (Figure 1.3).

1.3 Consumption

Global consumption of plastic can be estimated by observing the amount of plastic waste produced (Figure 1.4). Plastic packaging is mostly single-use, especially in business-to-consumer applications, and a majority of it is discarded the same year it is produced.

⁸ Geyer, Jambeck, and Law, 2017.

⁹ Ibid.

¹⁰ World Economic Forum, 2016.

¹¹ LDPE, HDPE, PS and EPS

⁴ Clapp and Swanston, 2009

⁵ **Primary microplastics** are those originally produced at the micro-size level for applications such as cosmetics or industrial scrubbers; **secondary microplastics** are fragments at the micro-size level that have resulted from the breakdown of larger plastic products. Source: GESAMP, 2015b.

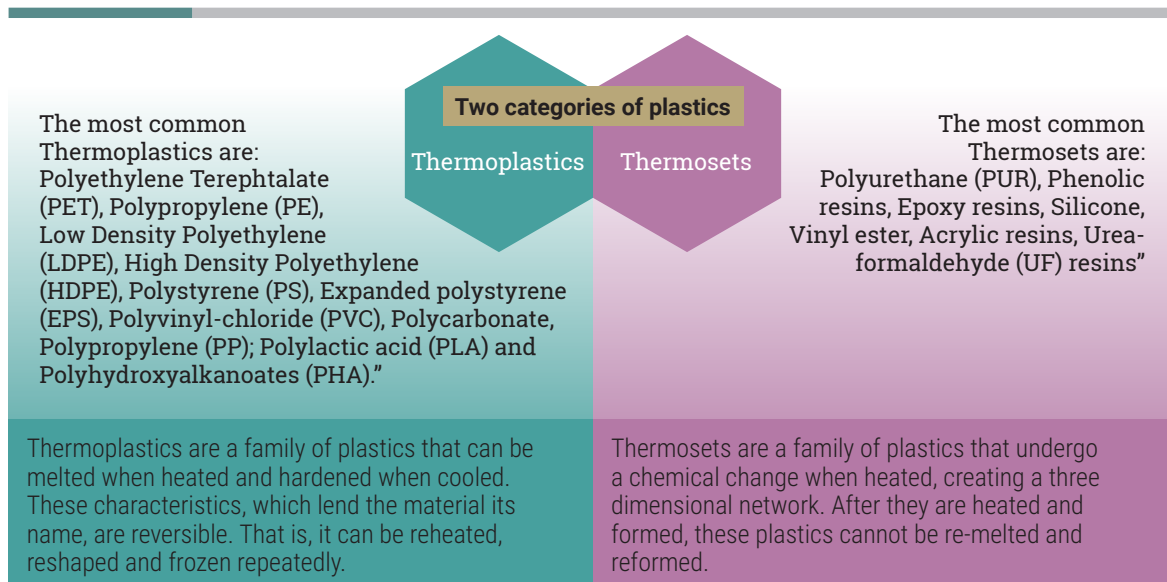
⁶ GESAMP, 2015a.

⁷ Ten Brink, 2016.

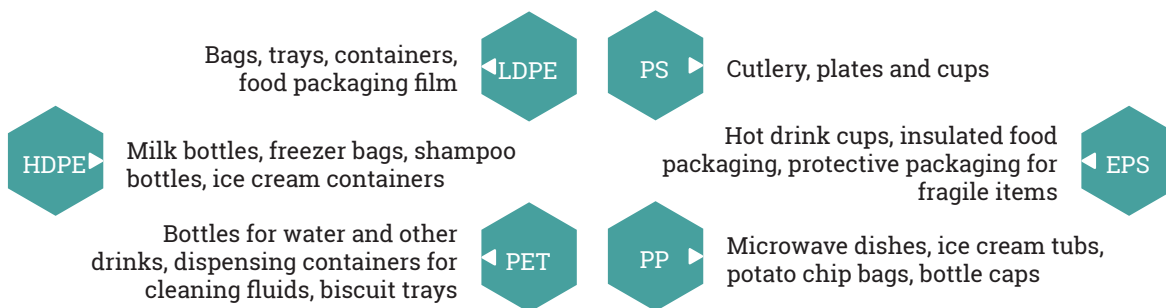


Nearly 50% of the plastic waste generated globally in 2015 was plastic packaging.

Figure 1.1. The two main categories of plastics and their single-use applications



Main polymers used in the production of single-use plastics



Plastics replacing the traditionally used materials









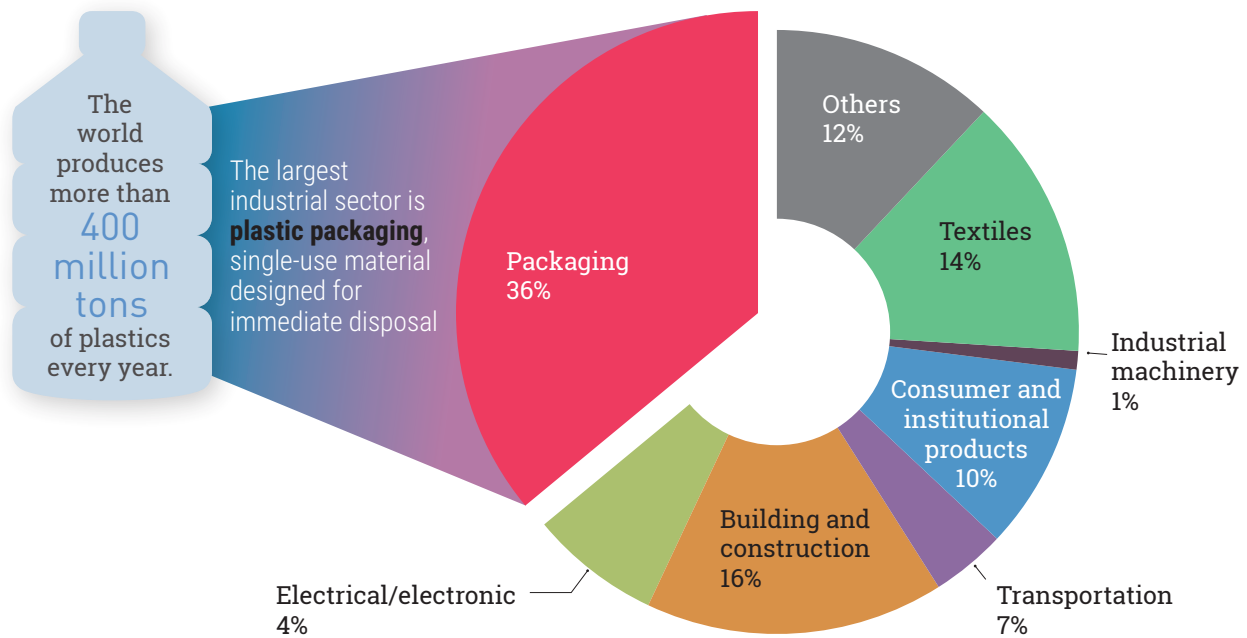
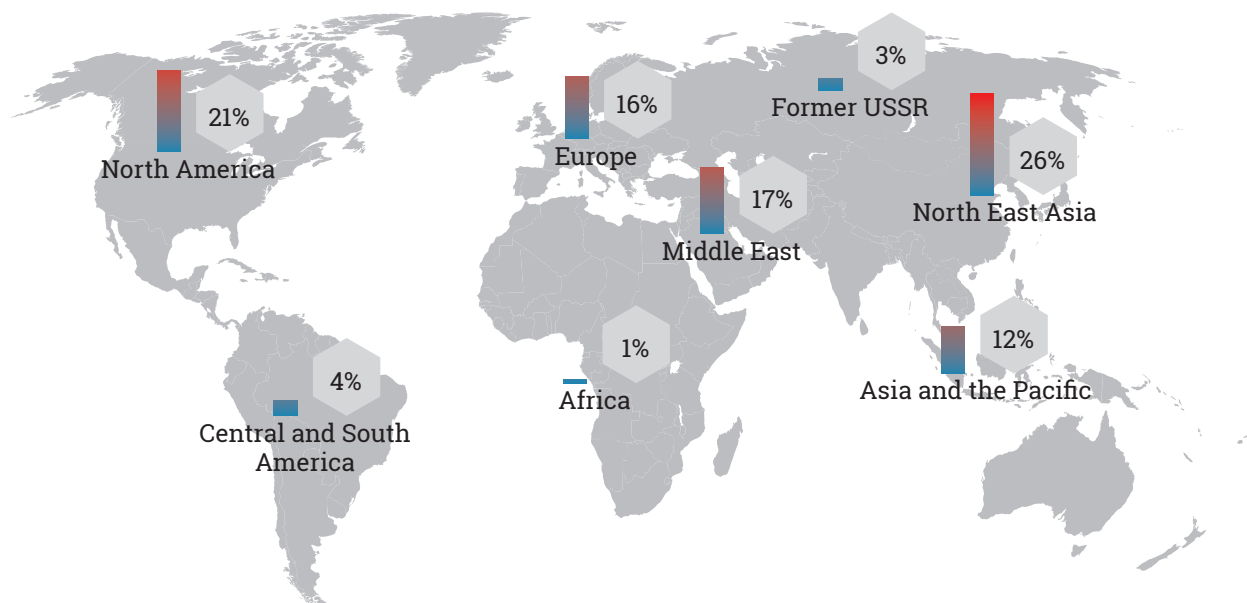
Product	Previous typical packaging material	Current typical packaging material
Milk, edible oil	▶ Glass, metal 	▶ 3 or 5 layer film pouches 
Toiletries (soap/shampoos)	▶ Paper, glass 	▶ Plastic pouches or films 
Cement, fertiliser	▶ Jute 	▶ PP/HDPE woven sack 
Toothpaste	▶ Metal 	▶ Plastic lamitube 

Figure 1.2. Global plastic production by industrial sector, 2015



Source: Adapted from Geyer, Jambeck, and Law, 2017

Figure 1.3. Distribution of single-use plastic¹² production by region (2014)



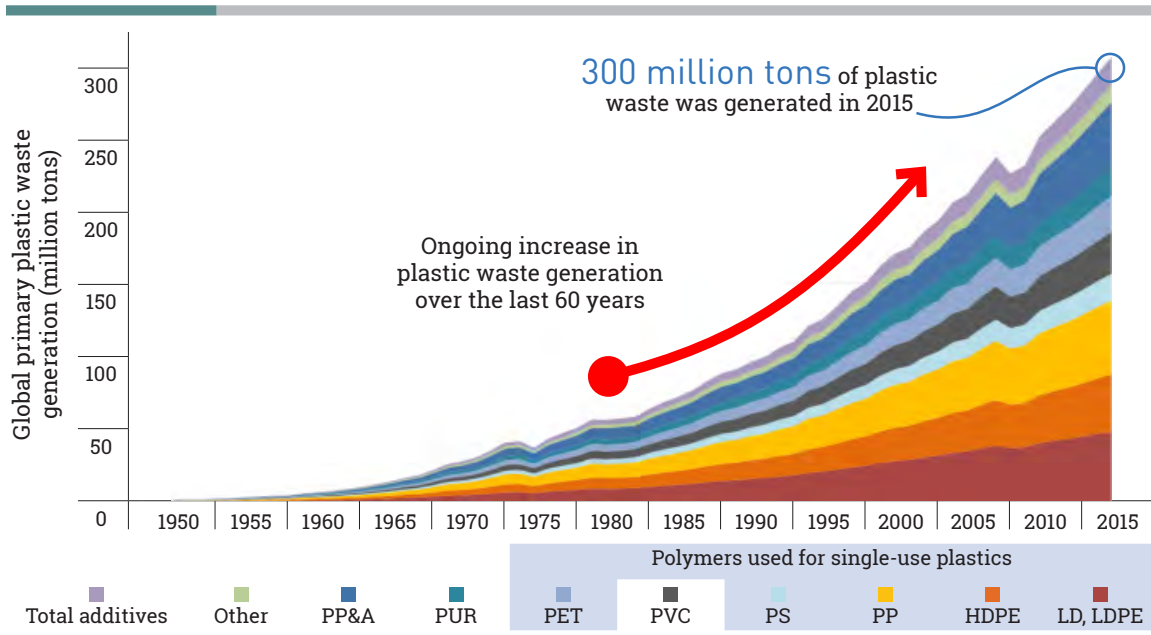
Source: Adapted from ICIS Supply and demand database (2014)

¹² The graph reflects data on the production of virgin and recycled LDPE, HDPE, PS and EPS. PET and PP are excluded from the analysis due to lack of region-specific data.

In 2015, plastic packaging waste accounted for **47%** of the **plastic waste**¹³ generated globally, with half of that appearing to come from Asia. While **China** remains the largest worldwide generator of plastic packaging

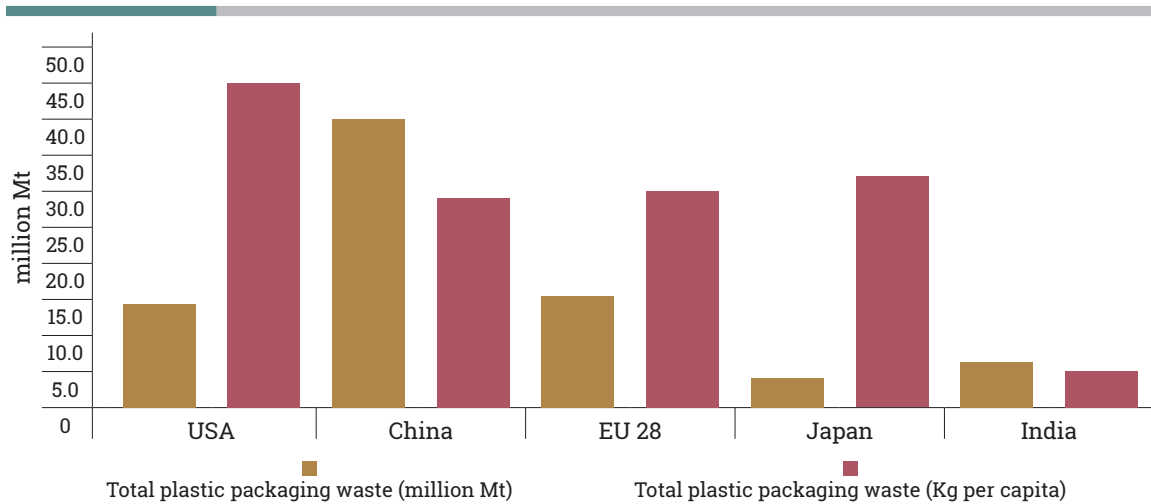
waste,^{14, 15} the **USA** is the largest generator of plastic packaging waste on a per-capita basis, followed by **Japan** and the **EU** (Figure 1.5).

Figure 1.4. Global primary plastics waste generation, 1950 - 2015¹⁶



Source: Adapted from Geyer, Jambeck, and Law, 2017

Figure 1.5. Plastic packaging waste generation, 2014 (million Mt)¹⁷



Source: Adapted from Geyer, Jambeck, and Law, 2017

14 China, Ministry of Commerce, 2017.

15 Due to a lack of robust data, it is difficult to determine the exact amount of plastic packaging waste generated in China.

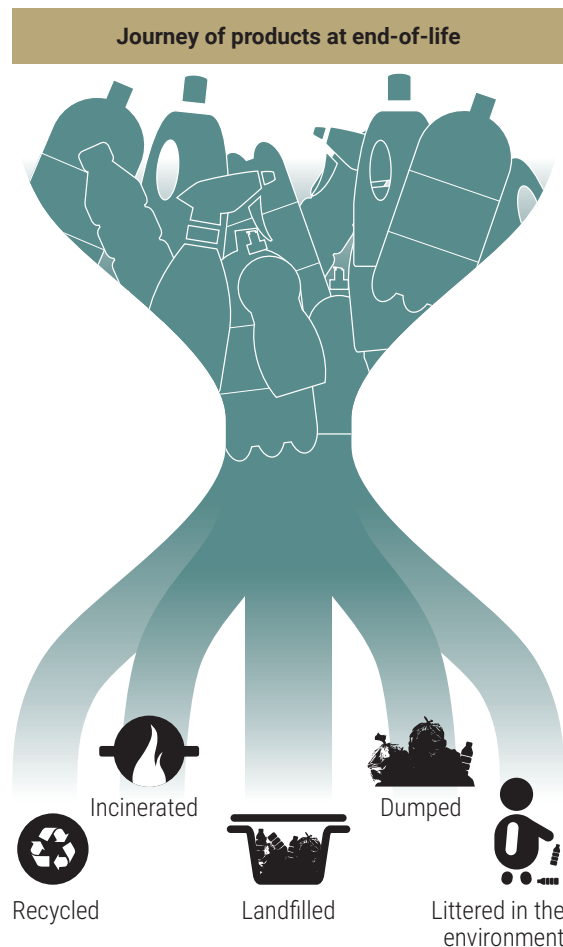
16 "Primary plastics" are plastics produced from virgin materials.

17 The chart is based on an aggregation of datasets. For China, since no reliable data on plastic packaging is available, the overall packaging waste data (including plastic) is used in the graph.

13 Geyer, Jambeck, and Law, 2017.

1.4 End of life

At the end of its lifetime, a product or packaging is recycled, incinerated, landfilled, dumped in uncontrolled sites, or littered in the environment. According to recent estimates,¹⁸ 79% of the plastic waste ever produced now sits in landfills, dumps or in the environment, while about 12% has been incinerated and only 9% has been recycled (Figure 1.6). Although it is not yet possible to show a similar regional breakdown due to a lack of robust data, regional action has been recorded recently. For instance, the European Council, European Parliament and European Commission reached a preliminary political agreement in December 2017 to set a target for packaging recycling at 65% by 2025, to be increased to 70% by 2030, and a specific target for plastic packaging recycling at 50% by 2025, to be increased to 55% by 2030.



¹⁸ Geyer, Jambeck, and Law, 2017.

Figure 1.6 also shows the nations generating the largest amounts of **mismanaged plastic waste**.^{19, 20} If current consumption patterns and waste management practices do not improve, by 2050 there will be **about 12 billion tons of plastic litter** in landfills and the natural environment.²¹

Energy recovery processes are preferable to landfilling or improper forms of disposal (Figure 1.7). However, if the desire to recoup the large investment required to set up energy recovery infrastructures indirectly discourages policies geared at reducing plastic waste generation, this would be problematic. In the waste management hierarchy, prevention of waste should always take first priority.

Box 1. Plastic recycling market: China

Imports into China account for 56% (by weight) of the worldwide imports of waste plastic¹ destined for recycling. In July 2017, the Chinese government announced that the importation of eight types of plastic scraps including PE, PS, PET and PVC will be banned starting from 2018.² Chinese officials reported that the decision was taken to protect the environment and public health, since hazardous waste was found mixed inside the waste imported. While this announcement was initially met with worldwide alarm, it can present an opportunity for countries that have historically counted on China as a plastic waste importer to identify new strategies to deal with plastic waste and strengthen their local recycling industry.

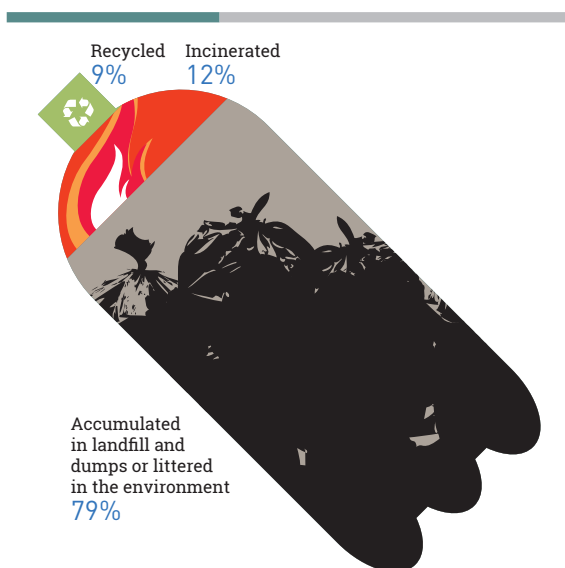
Source: ¹Velis, 2014; ²Toloken. 2017

¹⁹ Mismanaged waste is estimated as the sum of inadequately managed waste plus 2% littering.

²⁰ Jambeck et al. (2015) provides estimates of the 20 largest waste generators for 2010, ranked by mass of mismanaged plastic waste. The paper calculates total mismanaged plastic waste for populations within 50 km of the coast in 192 countries.

²¹ Geyer, Jambeck, and Law. 2017. As of 2015, the total amount of plastic ever produced amounts to approximately 6,300 million tons.

Figure 1.6. Disposal of all plastic waste ever generated (as of 2015)

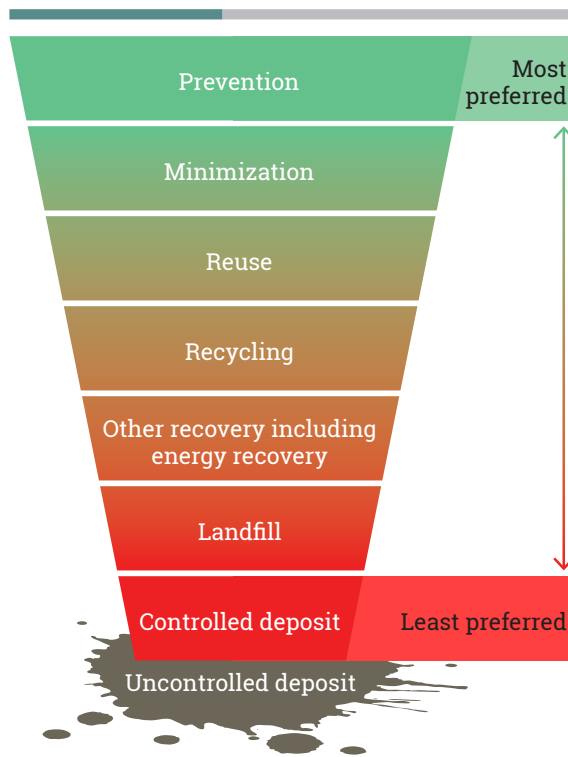


Largest generators of mismanaged plastic waste (2010)

China	8.8 million Mt/year	27% of world total
Indonesia	3.2 million Mt/year	10% of world total

Source: Adapted from Geyer, Jambeck, and Law, 2017; Jambeck et al., 2015

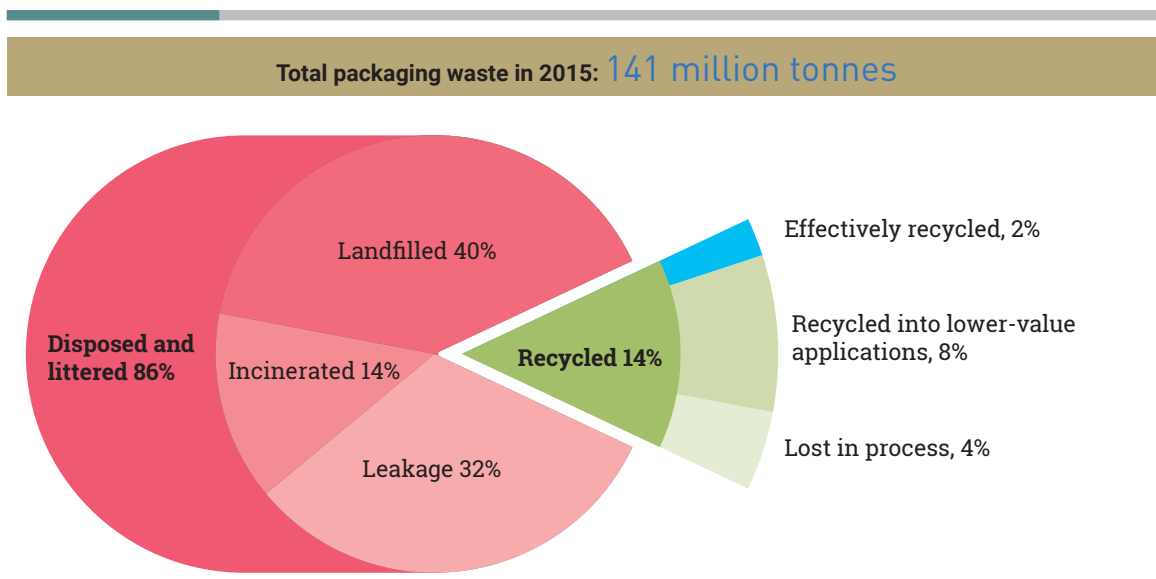
Figure 1.7. Waste management hierarchy



Source: Global Waste Management Outlook, UNEP, 2015.

An overview of the global flow of plastic packaging waste is illustrated in Figure 1.8.²²

Figure 1.8 Global flow of plastic packaging waste, 2015



Source: World Economic Forum, 2016

22 World Economic Forum, 2016.