Chapter 2

Problematic single-use plastics

Most common single-use items found on beaches

According to a recent report,[23] the most common finds during international coastal cleanups are, in order of magnitude, cigarette butts, plastic beverage bottles, plastic bottle caps, food wrappers, plastic grocery bags, plastic lids, straws and stirrers, glass beverage bottles, other kinds of plastic bags, and foam take-away containers. Single-use plastics took most of the spots in this Top Ten and it is not hard to imagine the rankings for waste found inland would be similar.

In addition to people's negligence, the large presence of single-use plastics in the environment is symptomatic of poor or failing waste management systems.

> Single-use plastics end up littering the environment in part because of irresponsible individual behavior. But poor waste management systems also play an enormous role.

To reduce plastic pollution, action should be taken in line with the waste management hierarchy (Figure 1.7) and the circular economy approach (Figure 3.2), to minimize plastic waste generation first of all, improve the state of solid waste collection services, strengthen the recycling industry and ensure safe disposal of waste to controlled landfills.

Although there are some successful initiatives that aim to tackle other types of single-use plastics (such as plastic bottles, with an example given in Box 2), the recent drive for action by governments largely focuses on plastic bags and, to a certain extent, foamed plastic items. **Plastic bags and foamed plastic products seem to be perceived by governments as the most problematic single-use plastics, given their easily observable**

23 International Costal Cleanup Report 2017: Ocean Conservancy. https://oceanconservancy.org/wp-content/uploads/2017/06/International-Coastal-Cleanup_2017-Report.pdf

Box 2. Reducing PET bottle litter

In several developed and developing countries, the introduction of **Extended Producer Responsibility (EPR)** and **deposit-return schemes**[1] have proven effective in reducing littering from PET bottles while boosting the recycling sector.

Germany, Japan and South Africa are among many successful examples where the responsibility for recycling used PET bottles is embraced by manufacturers (either voluntarily or by act of law).

The initiative introduced by the **PET Recycling Company** (PETCO[2]) in South Africa, for instance, shows how the introduction of EPR (even when voluntary) can help develop local end-use markets for recycling and build the country's resilience to global shocks in the recycling market. In South Africa EPR has created jobs and business opportunities, while addressing one kind of problematic single-use plastics. While some other African countries are now starting to consider banning PET bottles, the South African example shows what can be achieved if due consideration is given to the socio-economic context and the most appropriate policy instrument (not necessarily banning) is selected.

1 https://www.unenvironment.org/fr/node/19362
2 http://petco.co.za/

presence (as an eyesore) in the environment, such as windblown bags clinging onto fences or trees or floating in rivers.

In the next sections the focus will be mainly on plastic bags and foamed plastic containers, noting that lessons that are drawn for these items could be applicable to the broader category of single-use plastics.

2.1 Plastic bags and foamed plastic products

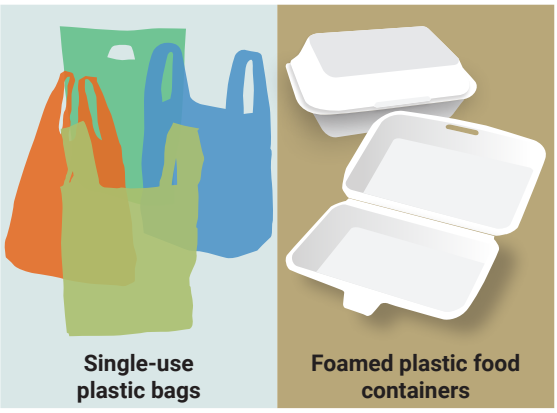
Single-use plastic bags are used to carry goods and usually provided to customers at the point of sale. The most common shopping bags are made of a type of plastic called polyethylene – or polythene – a tough, light, flexible, synthetic resin obtained by polymerizing ethylene.[24]

Foamed plastics, commonly but often erroneously referred to by the brand name "Styrofoam",[25] is the material most widely used to produce food containers as it is rigid, lightweight, and has good insulation properties. There are two main types of foamed plastics: foamed polystyrenes and foamed polyurethanes. Foamed polystyrenes can be further categorized – based on the production method – into expanded polystyrenes (EPS) and extruded polystyrenes (XPS). To make the contents of this assessment more easily understandable to non-specialists, this paper will generally not distinguish between the different types of foamed plastics, and instead refer to all types of single-use polystyrene foam

24 Oxford Dictionaries, accessed on 21 August 2017.

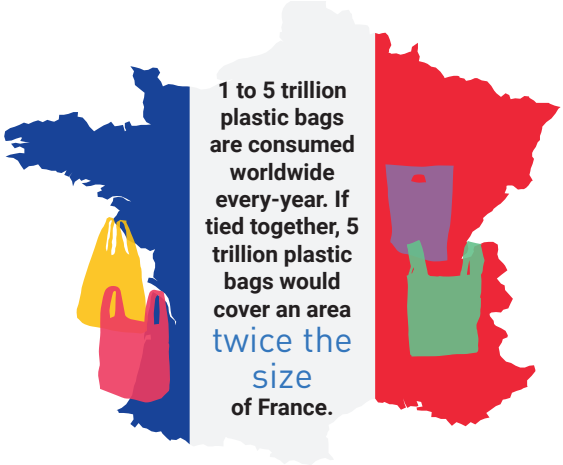
25 "Styrofoam" is a Dow Chemical Company trademarked name for closed-cell extruded (not expanded) polystyrene foam used primarily in construction as insulation and water barrier for roofs, walls, and foundations. In contrast, coffee cups, food trays, box packaging, and other daily life items commonly referred to as "Styrofoam" are actually expanded polystyrene (EPS) foam, which has been moulded into blocks from expanded resin. This means that none of these daily life products are in fact made from "Styrofoam." Despite the inaccuracy of using "Styrofoam" to refer to foamed single-use products, this paper makes use of the term to refer to such daily-life items because of the high degree of penetration of this colloquial expression among the general public, while more accurate terms such as "EPS foam products" or "single-use polystyrene foam products" are often unrecognizable to non-specialists.

and other foamed plastic products by the colloquially accepted (but in fact inaccurate) term "Styrofoam."



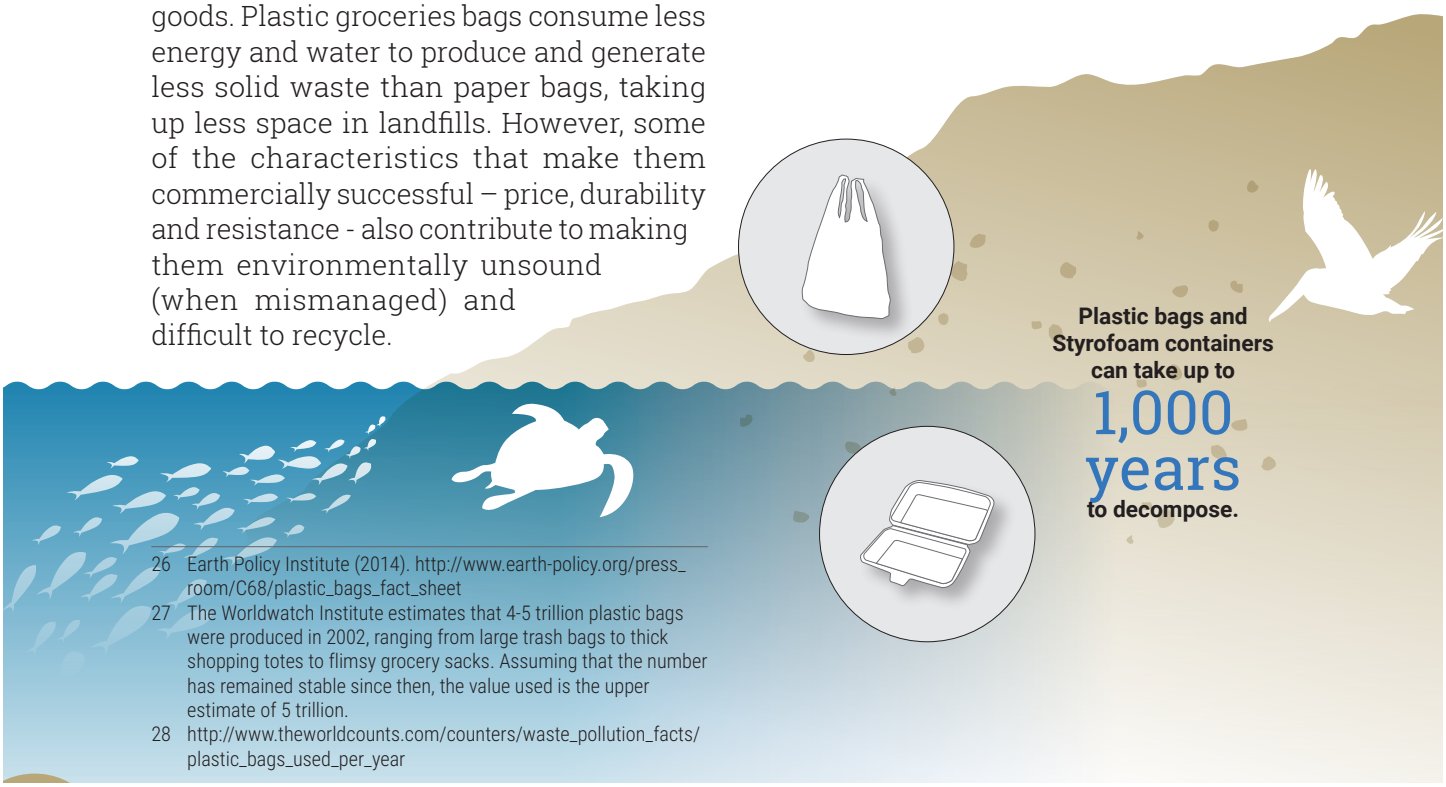
It is estimated that between one[26] to five[27] trillion plastic bags are consumed worldwide each year. Five trillion is almost 10 million plastic bags a minute. If tied together, they would go around the world seven times every hour and cover an area twice the size of France.[28]

Single-use plastic bags and Styrofoam products are widely used because they are strong, cheap and hygienic ways to transport goods. Plastic groceries bags consume less energy and water to produce and generate less solid waste than paper bags, taking up less space in landfills. However, some of the characteristics that make them commercially successful – price, durability and resistance - also contribute to making them environmentally unsound (when mismanaged) and difficult to recycle.



2.1.1 Environmental impacts

While it is still unclear, some studies suggest that plastic bags and Styrofoam containers can take up to thousands of years to decompose, contaminating soil and water, and posing significant ingestion, choking and entanglement hazards to **wildlife** on land and in the ocean (Box 3). Due to their light weight and balloon-shaped design, plastic bags are easily blown in the air, eventually ending up on land and in the ocean.



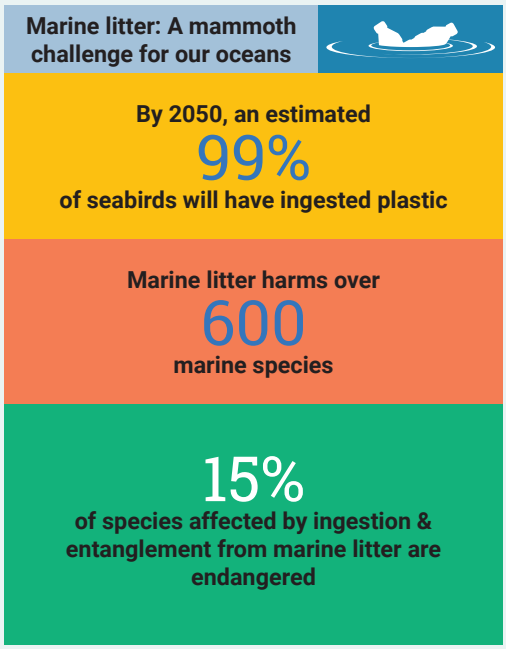
26 Earth Policy Institute (2014). http://www.earth-policy.org/press_room/C68/plastic_bags_fact_sheet

27 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.

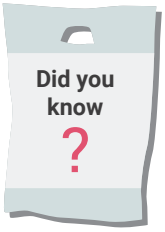
28 http://www.theworldcounts.com/counters/waste_pollution_facts/plastic_bags_used_per_year

Box 3. Biodiversity loss and food chain contamination

Plastics in the environment pose significant hazards to wildlife both on land and in the ocean. High concentrations of plastic materials, particularly plastic bags, have been found blocking the breathing passages and stomachs of hundreds of different species. Plastic bags in the ocean resemble jellyfish and are often ingested by turtles and dolphins who mistake them for food. There is emerging evidence that the toxic chemicals added during the manufacturing process transfer from the ingested plastic into the animals' tissues, eventually entering the food chain for humans as well. When plastic breaks down into microplastic particles, it becomes even more difficult to detect and remove from the open oceans. Therefore, **the most effective mitigation strategy is to reduce their input**.



Jambeck et al., 2015



The **Irish** have coined the term **"witch's knickers"** to refer to windblown plastic bags caught in trees?

...that in **South Africa**, there are so many plastic bags littering the environment that many joke that plastic bags are **"the new national flower"**.[29]

Plastic bags can choke waterways and exacerbate natural disasters. In 1988, poor drainage resulting from plastic bag litter clogging drains contributed to devastating **floods** in Bangladesh, causing several deaths as two-thirds of the country was submerged[30] (see case study 4.3.2).

Styrofoam products, due to their low density and light weight - like plastic bags - can be blown away by the wind. They can float in water and break down into smaller pieces that are highly toxic if ingested.

According to 2015 estimates, 16 of the top 20 countries contributing to marine plastic litter are **middle-income countries**, whose economic growth is outpacing waste management infrastructure development.[31]

29 Ritch, Brennan, and MacLeod, 2009.
30 Ibid.
31 Jambeck et al., 2015.

Box 4. Biodegradable plastic: The unintended consequences

In an effort to reduce plastic pollution, many governments have outlawed conventional plastic bags, allowing only the use and production of "biodegradable" bags.[32] Nonetheless, to limit leakage and damage to the environment, the presence of sound waste management systems are as relevant for the so-called bio-degradable options as for fossil fuel-based plastics. Often "biodegradable" plastic items (including single-use plastic bags and containers) break down completely only if exposed to prolonged high temperatures above 50°C (122°F). Such conditions are met in incineration plants, but very rarely in the environment. Therefore, even **bioplastics** derived from renewable sources (such as corn starch, cassava roots, or sugarcane[33]) or from bacterial fermentation of sugar or lipids (PHA[34]) **do not automatically degrade in the environment** and especially not in the ocean.[35]

2.1.2 Health and Social impacts

Styrofoam items contain **toxic chemicals** such as styrene and benzene. Both are considered carcinogenic and can lead to additional health complications, including adverse effects on the nervous, respiratory and reproductive systems, and possibly on the kidneys and liver.[36] Several studies have shown that the toxins in Styrofoam containers can transfer to food and drinks, and this risk seems to be accentuated when people reheat the food while still in the container.[37] In low-income regions, domestic waste - including plastics - is often burnt for heating and/or cooking purposes, exposing largely women and children to prolonged **toxic emissions**. Illegal disposal practices of plastics often take the form of open burning, accentuating the release of toxic gases that include furans and dioxins.

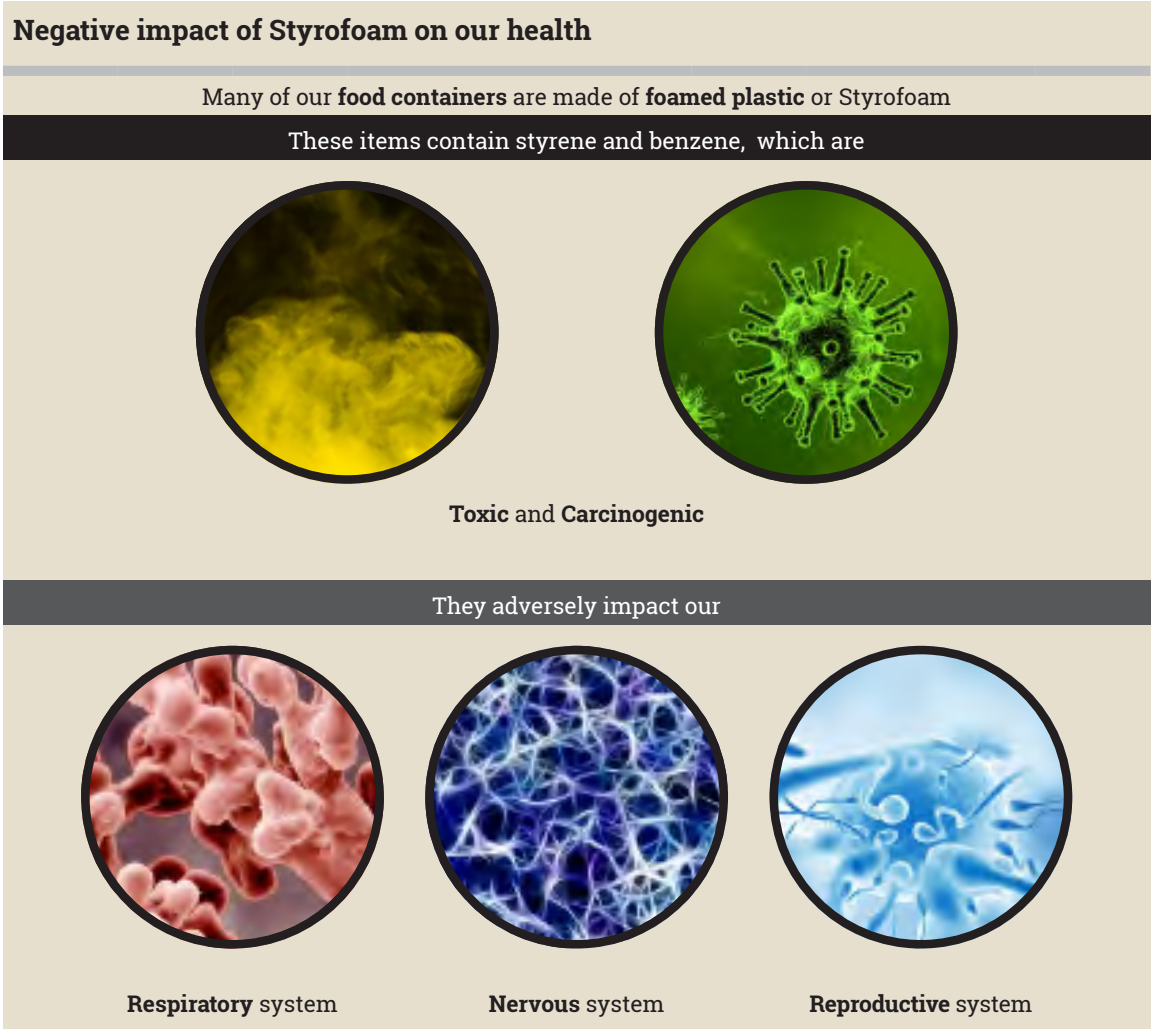
Research has shown that in developed as well as in developing countries, littering of plastic bags and Styrofoam containers can lead to perceived **'welfare losses'** associated for instance to the visual disamenity of a park being contaminated with litter. This increases the indirect social costs of plastic pollution.[38]

In developing countries with inadequate solid waste management regulations, plastic bag litter can aggravate pandemics. By blocking sewage systems and providing breeding grounds for mosquitoes and other pests, plastic bags can raise the risk of transmission of **vector-borne diseases** such as malaria.[39]

As previously mentioned, plastic waste and microplastics, if ingested by fish or other marine life, can enter our **food chain**. Microplastics have already been found in common table salt[40] and in both tap and bottled water.[41] Although in recent years research on the effects of microplastics has

32 Biodegradable plastic materials include thermoplastics such as polylactic acid (PLA) and polyhydroxyalkanoates (PHA).
33 These types of bioplastics are called polylactic acid or PLAs. They are a thermoplastic derived from renewable resources, such as cornstarch (in the United States, Canada and China), cassava roots, chips or starch (mostly in Asia), or sugarcane (in the rest of the world). In 2010, PLA had the second highest consumption volume of any bioplastic in the world. https://www.ceresana.com/en/market-studies/plastics/bioplastics/
34 Polyhydroxyalkanoates or PHAs are thermoplastics produced by numerous microorganisms, including through bacterial fermentation of sugar or lipids. https://www.tandfonline.com/doi/abs/10.1080/15583720903048243
35 UNEP, 2016c.
36 Agency for Toxic Substances and Disease Registry.
37 For instance, a study published in Environmental Health Perspectives conducted by the Tokyo Metropolitan Research Laboratory of Public Health (2001) found that styrene gas from food containers is a cause for the proliferation of human breast tumour cells.

38 Eunomia, 2013. Exploring the direct and indirect costs of litter.
39 Clapp and Swanston, 2009.
40 Yang, Shi, Li, Li, Jabeen, and Kolandhasamy, 2015.
41 Kosuth, Wattenberg, Mason, Tyree, and Morrison, 2017.



been growing, still little is known about the exact impacts on human health.

2.1.3 Economic impacts

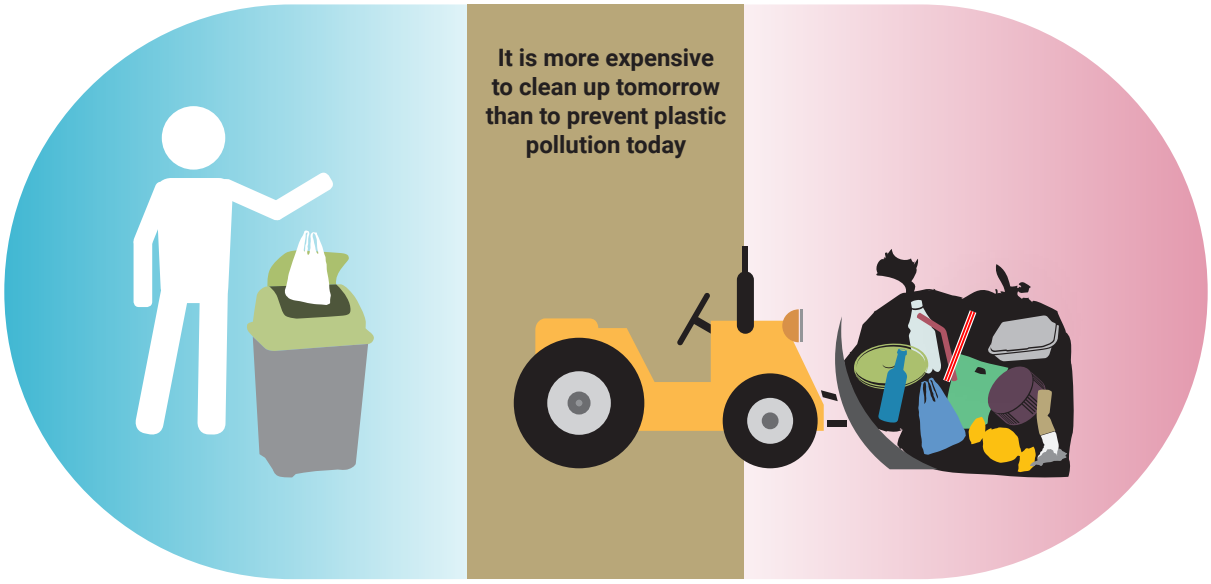
Stranded single-use plastics create visual pollution and are increasingly becoming a priority especially in countries that rely heavily on tourism as a major source of GDP, such as Small Island Developing States. For instance, Asia-Pacific Economic Cooperation (APEC) estimated a $1.3 billion[42] economic impact of marine plastics to the **tourism**, **fishing** and **shipping** industries in that region alone.[43] Styrofoam products present challenging recovery dynamics, making **recycling** – although technically possible – **often financially unviable**.[44] For instance, Styrofoam usually can't be recycled locally but must instead be transported to a centralized plant. In addition, 95% of Styrofoam is air, making it not cost-effective to store or ship for recycling purposes. Because of the porosity of foamed plastic products, cleaning such products, which are often contaminated with food or drinks, is difficult and energy-intensive, further increasing the cost of recycling.

42 In this report, the $ symbol indicates US dollars, the € symbol indicates euros, and the £ symbol indicates British pounds. For other currencies, the ISO currency code is used.

43 APEC, 2009.

44 The Styrofoam products that are recycled are often remanufactured into things like cafeteria trays or packing fillers.

Plastic Mismanagement: the future cost



Finally, the **future costs** of removing all single-use plastics accumulating in the environment is estimated as higher than the costs of preventing littering today. In Europe alone, the estimated costs for cleaning shores and beaches reach €630 million per year,[45] and studies suggest that the annual economic damage plastics impart on the world marine ecosystem is at least $13 billion.[46,47]

45 European Commission, 2015.
46 UNEP, 2014.
47 The overall economic impact of plastic pollution is still unclear and being studied.

UNEP (2018). SINGLE-USE PLASTICS: A Roadmap for Sustainability

The entire report can be found at wedocs.unep.org/handle/20.500.11822/25496.