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TRADE POLICIES TO PROMOTE THE CIRCULAR ECONOMY

A CASE STUDY OF THE PLASTICS VALUE CHAIN

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Trade Policies to Promote the Circular Economy: A Case Study of the Plastics Value Chain

Evdokia Moïsé and Enxhi Tresa

Plastic products present several environmental, health, social and economic challenges that span from the extraction of raw materials to primary and final plastics production, to their distribution and use, and to the collection and sorting of plastic waste. International trade, which has facilitated the development of plastics supply chains, also comes with a range of challenges, such as a surge in demand for plastics — notably in packaging — difficulties to monitor plastics embedded in other products, and an increased risk of plastic waste leaking in countries that have less rigorous environmental regulations. Yet trade can also serve as a vehicle to access foreign pollution control technologies or to foster economies of scale for circular economy practices. Indeed, the implementation of circular economy solutions through trade policies is crucial in addressing plastic pollution. Such policies could include reduced tariffs on environmentally-friendly alternatives to plastic products; trade facilitation measures for reverse supply chains; or technical regulations, standards, labelling schemes, and conformity assessment procedures that promote product designs which will minimise pollution throughout the entire plastic lifecycle.

Key words: Value chains, trade policies, green transition

JEL codes: F18, F53, F64, K32, O34, Q38, Q53, Q56

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Executive Summary

Plastics is an important sector that was in 2018 estimated to be at over USD 1 trillion globally across its entire lifecycle. Most plastics are sourced from fossil fuels and OECD projections show that emissions from the plastics industry will account for 4.5% of total emissions by 2060. The increasing production and use of plastics, together with insufficient waste management and leakage prevention measures, have had detrimental effects on the environment at every production stage: from the carbon footprint of their production, the chemical pollution associated with their manufacture, to end-of-life leakage into the environment. Transitioning to circular value chains for plastics is vital to achieve environmental sustainability goals, and yet as the OECD reported in 2019 only 8% of plastics use was circular.

Implementing circular economy solutions across the entire plastics value chain — upstream (discovery and extraction of raw materials, production of primary plastics), midstream (production of intermediate and final plastics, use of final plastic products), and downstream (collection and sorting, waste management) — can significantly contribute to mitigating plastic pollution.

At present, international trade facilitates the movement of plastics across borders to meet the demand from various sectors and countries, with overall annual global use of plastics more than tripling from 1991 to 2021, reaching 460 million tonnes (Mt) in 2019 (OECD, 2022[1]). This steep increase in plastics use poses several challenges, including the difficulty to track plastics embedded in other products, increased demand for plastics especially in packaging, as well as a higher risk of plastic waste leakage in countries with less stringent environmental regulations or that lack recycling facilities. It is notable that recycled plastics production accounted for only 6% of total plastics production in 2019 (OECD, 2022[2]).

While trade can make the lack of adequate environmental policies more apparent when it contributes to an increase in polluting activities, it can also play an important role in mitigating pollution by providing access to foreign pollution control technologies, by fostering economies of scale for circular economy practices, and by importing goods produced with cleaner technologies. In identifying and classifying these flows through the harmonized system (HS), trade statistics can contribute to the development of effective policies that address plastics leakage and pollution. However, environmentally-related plastics patents data shows that innovation in circular economy solutions for plastics is very concentrated. The diffusion of technology through trade is thus a necessary channel to encourage the widespread adoption of innovative solutions at all stages of the plastics life cycle in countries where such technologies are lacking.

Trade policies can have a significant impact on the economic sustainability of recycling markets, including the distribution of goods, services, and technologies related to the collection, waste management, recycling, and environmental clean-up of plastics, as well as to the feasibility of repair and remanufacturing operations for products that incorporate plastics. They can also impact the viability of markets for environmentally-friendly and efficient alternatives to plastics. Measures taken at the border and beyond that could positively affect the circular economy of plastics include the following.

- Reducing tariffs on plastic substitutes is important for the economic viability of alternatives to environmentally harmful plastic products, in particular single-use plastics. Tariff reductions may complement measures such as bans or other restrictions on plastic products and waste, including restrictions on unnecessary packaging, which aim to minimise plastic waste generation upstream.
- Trade facilitation measures can accelerate the transit of equipment used to sort and recycle plastic waste, non-plastic alternatives, or plastic waste and scrap destined for certified environmentally-responsible waste management facilities. Internationally recognised environmental labels, or the adoption of innovative identification technologies, can assist customs authorities to recognise products crafted from recycled or recyclable plastics.
- Regulatory measures — including technical regulations, standards, labelling schemes, and conformity assessment procedures — can have a substantial impact in promoting product designs that reduce pollution throughout the plastic lifecycle.
- Government incentives, such as financial support towards primary and intermediate plastic production, can discourage the adoption of more sustainable product designs and new business models that use less plastic. Incentives could be directed to stimulate innovation, trade, and the transfer of technology in alternative materials to plastic, recycled plastics, and recyclable plastics. Finally, taxes on landfill and incineration, as well as charges and fees imposed on single-use plastics or virgin plastic materials, can serve as catalysts for the transition to more efficient waste management systems and technologies.

1. Introduction

The growing production and use of plastics, combined with inadequate waste management and leakage prevention, generate a range of environmental, social, public health, and economic challenges.

Plastics is an important sector, estimated in 2018 to be worth more than USD 1 trillion globally across its entire life cycle. Of this, around USD 200 billion is related to plastic in textiles and USD 50 billion to packaging. Plastics value chains employ millions of people and have been for many developing countries a way to diversify their economies and increase value-added. Most plastics are derived from fossil fuels,[1] and the annual global production of primary fossil fuel-based plastics has surged over the past 30 years, from less than 2 Mt in 1950 to over 450 Mt in 2019 (Geyer, 2020[3]).

Given the carbon intensity of the plastics production process and projected growth, recent estimates using the OECD ENV-Linkages model show that, absent further policy measures, emissions from plastics will represent 4.5% of emissions by 2060 (OECD, 2022[1]).

The transition to circular value chains for plastics is critical to achieve environmental sustainability objectives…

Plastics can harm the environment in various ways throughout their lifecycle, from the carbon footprint of their production, the chemical pollution associated with their manufacture, to leakage into the environment at their end-of-life. In particular, single-use plastic products, which have limited value after use, are a major reason for widespread plastic pollution.[2] Furthermore, plastic pollution can be costly in itself due to possible damage to the tourism, fishing and shipping industries (Patrício Silva et al., 2021[4]).

To reduce plastic pollution, governments are increasingly considering circular economy policies and measures, yet the OECD estimates that only 8% of current plastics use was circular in 2019 (OECD, 2022[2]).[3]

…and trade has an important role to play in this transition

While domestic policies to promote sustainable production and use of plastics attract increasing attention, given that plastics pollution has a global dimension (i.e. plastics production and recycling/end-of-life management occur in different places) trade needs to be part of the picture. Trade policies may significantly affect the economic viability of recycling markets, including in relation to the diffusion of goods, services and technologies for the collection, waste management, recycling and reuse of plastics; the viability of repair and remanufacturing operations for products that contain plastics; and the growth of markets for environmentally sound and effective substitutes to plastics. Trade is also a central factor behind "hidden" flows of plastics, which consist of plastics used in pre-packaged products and embedded in consumer and household goods that are traded internationally and difficult to track through data.

This paper explores how trade and trade policy can promote or hinder the transition to a sustainable circular plastics economy with a view to reducing the harmful effects of plastics on the environment. In particular, the analysis focuses on trade policies (as opposed to domestic environmental policies), at the upstream (production of primary plastics, and manufacture of intermediate plastics and final plastic products), midstream (retail and use), and downstream (end-of-life, or post-consumer) parts of the plastics value chain (including plastics embedded in or associated with traded products) and how they may affect the pursuit of circular economy objectives. This paper also explores the complementarity between trade and

[1] Estimates from the *Global Plastic Outlook* find that bio-based plastics (e.g. converting the sugar present in plants into plastics) represented 0.6% of total plastics in 2019.

[2] The increase in single use plastics during the COVID-19 pandemic is an illustration of this. The urgent demand for single use plastic personal protective equipment — such as masks, gloves and face shields — resulted in the temporary suspension of several bans on single-use plastic, although reusable shopping bags were banned and, in some places, traditionally recyclable plastic food containers were considered hazardous owing to potential pathogenic contamination (Patrício Silva et al., 2021[4]).

[3] Circularity is calculated as the ratio between secondary plastics and plastic waste, which was 8% in 2019.

domestic policies that could improve the circular economy, including policies that liberalise trade in plastic substitutes.

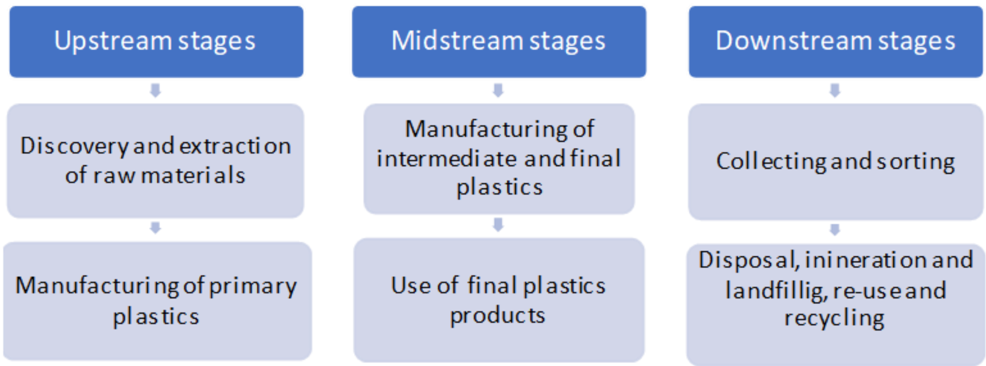
Section 2 provides an overview of the actors and materials involved in the plastics production chain, the different categories of plastics and their application, and reviews the key environmental challenges that arise across the life cycle of plastics – from extraction and production to the use and disposal of plastics – as well as the environmental relevance and implications of recycled plastics. Section 3 discusses the role of trade in tackling plastics pollution and of several trade trends for various products along plastics supply chains. Section 4 reviews existing trade policies that affect trade in plastics and their potential implications, both in terms of facilitating or hindering a transition to a circular economy. Section 5 concludes.

2. Understanding the plastics value chain and the associated environmental challenges

2.1. Composition and circularity of the plastics value chain from a lifecycle perspective

According to the Basel Convention's draft update of the technical guidelines for the identification and environmentally sound management (ESM) of plastic wastes and their disposal (Basel Convention Secretariat, 2022[5]), "plastic is usually a synthetic material, either a polymer or combination of polymers of high molecular mass modified or compounded with additives such as fillers, plasticizers, stabilisers, lubricants, pigments."[4] There are several stages involved in the production of plastics; these include the supply of raw materials, the manufacturing stages of primary and final plastics, and the last stage consisting of plastic waste management and treatment (Figure 1).

Figure 1. Plastics supply chain stages



Source: Authors' compilation.

2.1.1. The upstream stages: Discovery and extraction of raw materials, and the production of primary plastics

For most plastics, the first stage of the life cycle is the discovery and extraction of raw materials. Generally, polymers are produced from fossil fuel-derived materials (fossil fuel based). Petrochemical feedstock accounts for 12% of global oil demand (IEA, 2018[6]) and around 70% of oil feedstock is used to produce plastics, the demand for which has grown rapidly in recent years (IEA, 2022[7]).

The term bio-based plastics refers to plastics that are fully or partially derived from biomass and/or can decompose in some receiving environments at the end of their life cycle (i.e. biodegradable plastics). In

[4] A polymer is defined as "a chain of several thousand repeating molecular units or several different types of monomers which are either natural or synthetic organic compounds" (Villanueva and Eder, 2014[68]). Natural polymers occur in nature and can be extracted. They are often water-based. Examples of naturally occurring polymers are DNA, cellulose and proteins, including silk and wool. Natural rubber, silk and other proteins, cellulose (found in wood and cotton), and starch are a few other examples of the most useful natural sources of plastics.

particular, bio-based plastics are manufactured using fully or partially biomass as feedstock (rather than oil or scrap). Although these plastics represent only a small proportion of plastics production (Figure 2), they could under certain circumstances contribute to a more sustainable and circular plastics economy. Although plastics produced from biomass, in particular if those that can biodegrade in specific conditions, present several advantages, increasing scientific evidence shows they also present sustainability challenges and trade-offs. Even when the production of bio-based plastics generates fewer greenhouse gas emissions than fossil-based plastics, it is important to assess their impact compared to fossil-based plastics from a full life-cycle perspective. For instance, the negative effects from indirect land use change need to be considered (OECD, 2022[2]).

To produce fossil-fuel based plastics, fossil fuels undergo *a cracking process* to deliver hydrocarbon monomers such as ethylene and propylene. These monomers are then transformed (usually through polymerisation) into different forms of *virgin* plastic polymers that usually come in the form of resin pellets or fibres.

Global plastics use has quadrupled in the last 30 years, mainly driven by emerging economies (OECD, 2022[2]). More than half of all plastics have been produced since 2004 (Mafuta et al., 2021[8]). While historically, global plastics production was dominated by Europe and North America,[5] in the last decade Asia has emerged as a significant producer, with the People's Republic of China (hereafter "China") accounting for 28% of total plastic resin production and 64% of synthetic fibre production in 2016 (Ryberg, Laurent and Hauschild, 2018[9]) (Geyer, 2020[10])).

2.1.2. The midstream stages: Production of intermediate and final plastics, use of final plastic products

The intermediate stage of plastics production involves the production of outputs such as plastic sheets, rods, tubes, film, pipes, fittings and valves and synthetic yarns, threads, strings and fabrics. The final production stage involves the production of a multitude of final plastic applications or products that contain plastics, ranging from "*plastic packaging, household and consumer goods, industrial goods and car parts to adhesives, foams, paints, coatings and sealants, as well as a variety of synthetic fibres and rubber tires*" (Barrowclough and Deere Birkbeck, 2022[11]).

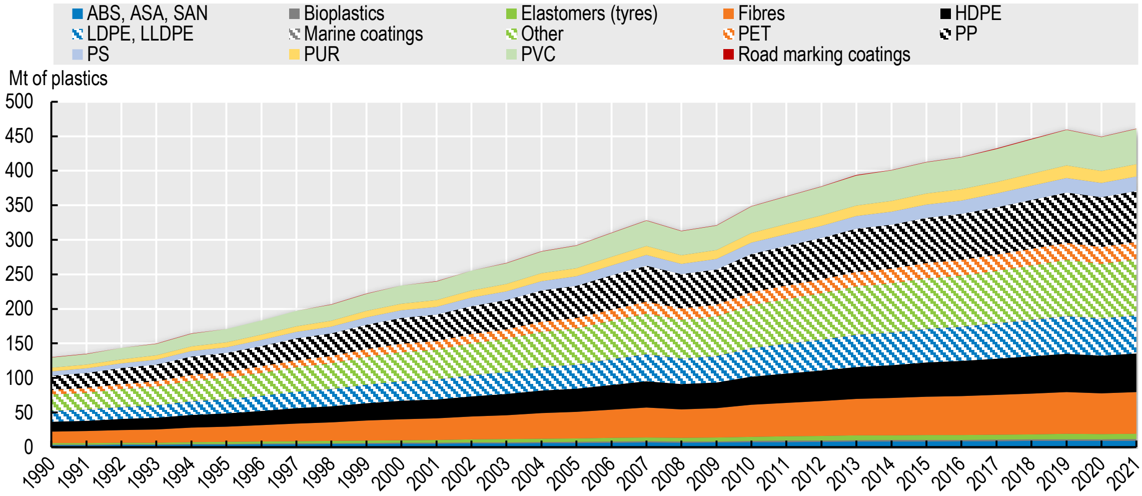
The next step of the plastics life cycle involves the sale and use of plastics in the form of plastic products, including plastic packaging, products containing embedded plastics, and products packaged in plastic by final individual consumers, brands, institutions, retailers and distributors.

The bulk of plastic products for final consumption, according to the type of polymer contained in plastic products, include LDPE-based packaging (e.g. bags, containers, food packaging film), HDPE containers (e.g. milk bottles, shampoo bottles, ice cream tubs), and PET containers (e.g. bottles for water and other drinks).[6] Most of these are used only for a short period (e.g. disposable cups, plates, cutlery, takeaway containers, carrier bags), with many being used for less than a day (Resource Futures, 2018[12]). Figure 2 provides a breakdown of plastics use by type of polymer. As mentioned above, bio-based plastics represent a very small part of total plastic use; despite having tripled in the last 30 years, it accounts for less than 1% of total plastic use.

[5] The headquarters of the biggest 20 producers of these primary plastics are in Europe (including Germany, the Netherlands, France and Belgium), followed by the United States, China, Saudi Arabia, United Kingdom, Chinese Taipei, Japan, Korea, India, Brazil, and Thailand. This does not necessarily mean, however, that all of their production takes place in those countries. Braskem, a top thermoplastic resins producer based in Brazil, has over 35 industrial plants in several countries, including Brazil, the United States, Mexico and Germany (Barrowclough and Deere Birkbeck, 2022[11]).

[6] See Table A.1 for a full decomposition of types of polymers used in plastics production and their corresponding end-use examples.

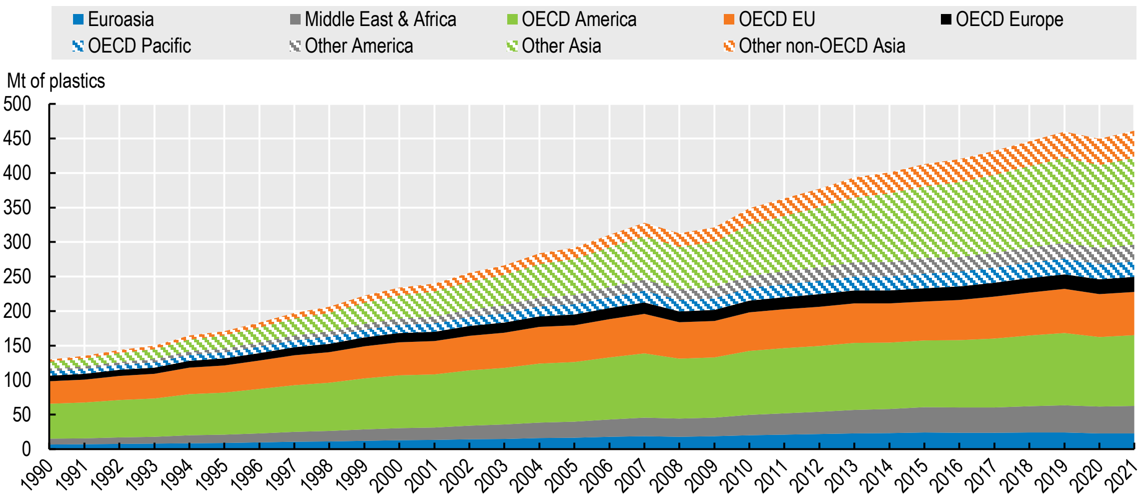
Figure 2. Plastics use by type of polymer



Source: OECD (2022[1]). Global Plastics Outlook database. Table A.1 provides a more detailed explanation about the types of polymers.

The production of intermediate plastics and final plastic products is more geographically dispersed than it is for primary plastics and involves many more countries. Global plastics use is mainly driven by Other Asia (27%) where most plastics use occurs in China, OECD America (approximately 22%), and OECD EU and non-EU (about 18%), with the rest of OECD countries representing around 5% of global plastics use (Figure 3). Overall, annual global use of plastics more than tripled from 1991 to 2021, reaching 460 Mt in 2019 (OECD, 2022[1]). Such an increase explains the urgent need to tackle plastics pollution and to provide circular economy solutions.

Figure 3. Plastics use by region



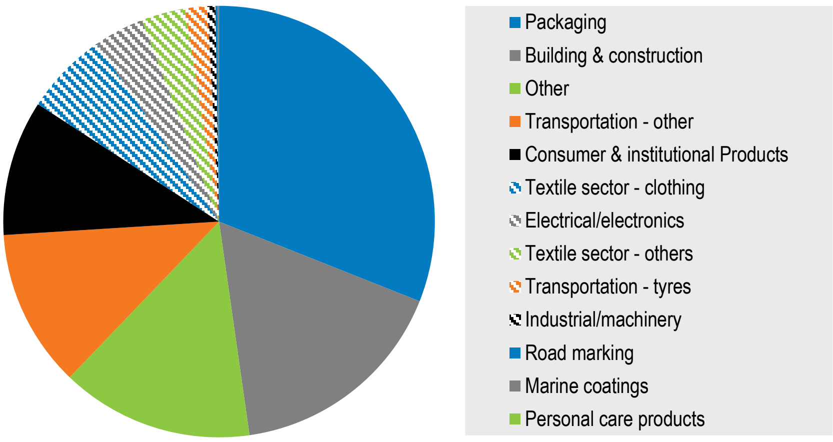
Source: Authors' compilation based on Plastics Outlook database, OECD (2022[1]). OECD America includes the United States, Canada and other OECD America. OECD Europe includes OECD EU and OECD non-EU. OECD Pacific includes OECD Asia and OECD Oceania, Other America includes Latin America, Middle east & Africa includes Middle East and North Africa, Other Africa. Other Asia includes other non-OECD Asia, China and India. Eurasia country group includes other EU and other Eurasia.

Plastics can be used for non-packaging and packaging purposes. Most environmental concerns have historically focussed on packaging plastics, such as single-use disposable water bottles, and shipping supplies. However, plastics are widely present in non-packaging applications such as in building materials, furniture, and consumer electronics. For instance, the majority of plastic consumption in Europe comes from non-packaging applications, such as construction, furniture, and consumer electronics. Recent assessments by the European Environmental Agency (EEA) indicate that non-packaging uses are as much as 74% of overall consumption.[7]

Together, packaging, construction, and transportation account for more than 60%, by weight, of plastics use (OECD, 2022[1]). Other significant uses include textiles and electrical equipment (Figure 4). The most common use of plastics (by volume) relates to plastics packaging and varies by sector. For instance, packaging for the food and beverage sector is responsible for the greatest volume of packaging plastic use and is expected increase substantially due to the growing demand for packaged foods and beverages, particularly liquor and energy drinks (Grand View Research, 2020[13]). The top users of plastics packaging in the food and beverage sector include some of the largest global brands, e.g. Coca-Cola, PepsiCo, Nestlé, Danone, and Unilever (Heinrich Böll Stiftung and Break Free from Plastic, 2019[14]) (Ellen MacArthur Foundation, 2019[15])). Other major users of plastic packaging are personal care product brands such as Johnson & Johnson, and Procter & Gamble. In addition, major supermarkets, retail chains, and online retailers use plastic packaging to facilitate the conservation, distribution, and sale of products.

Building and construction, textiles, transportation and electrical equipment also account for a substantial share of the plastics market. Plastic items used for such purposes generally have longer life spans than do, for example, plastic packaging and enter the waste stream only after a longer timeframe (e.g. five years for textiles and electrical equipment, to more than 20 years for construction materials and industrial machinery) (Resource Futures, 2018[12]).

Figure 4. Share of total plastics use by sector, 2019



Source: OECD (2022[1]). Global Plastics Outlook database.

2.1.3. Downstream stages: Collection and sorting, waste management

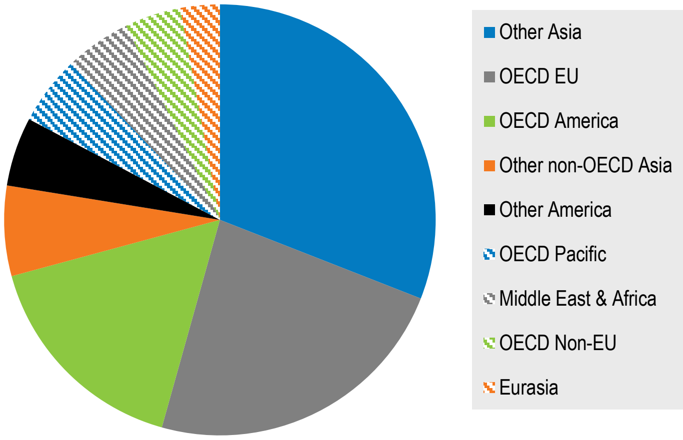
The downstream stages of the plastic life cycle can have several steps, including recycling, re-use or reprocessing of plastic waste, as well as landfilling, open burning, and incineration, with or without energy recovery, and can contribute to leakage into the environment. One of the first steps in the downstream stages consists of the collection and sorting of plastic waste. The organisation of such activities differs structurally between countries. For instance, in most high-income countries, governments organise a formal system of separate collection, and the sorting of collected material is frequently carried out using capital-intensive processing.[8] In contrast, in low-income countries separate collection and sorting of high value recyclables, such as PET, are often performed by low-skilled workers or by an informal recycling sector (i.e. waste pickers) (OECD, 2022[1]).

[7] For more details, see https://www.eea.europa.eu/en/topics/in-depth/plastics.

[8] For instance, some OECD countries apply Extended Producer Responsibility (EPR) schemes for plastic packaging (OECD, 2016[71]).

The next step in the downstream stages relates to either the re-use or reprocessing of plastic waste or of its disposal — including through landfills, open burning, incineration, or recycling — and dumping of waste. Plastic waste collected for recycling differs significantly by region. It is very high in the *Other Asia* region (around 30%), with China and India the two most important economies; it is also high in OECD EU (23%) and OECD America (17%).While the production of recycled or secondary plastics more than quadrupled in weight over the last twenty years, in 2019 recycled plastics production accounted for only 6% of total plastics production (OECD, 2022[2]). It is important to note that the value of recycled plastics depends on the level of purity that can be attained after recycling, which in turn depends on the original plastics waste stream.

Figure 5. Plastics waste collected for recycling by region, 2019



Source: Authors' compilation based on Plastics Outlook database, OECD (2022[1]). OECD America includes the United States, Canada and other OECD countries in North or South America. OECD Europe includes OECD EU and OECD non-EU. OECD Pacific includes OECD Asia and OECD Oceania, Other America includes Latin America not in the OECD, Middle east & Africa includes Middle East and North Africa, Other Africa. Other Asia includes other non-OECD Asia, China and India. Eurasia country group includes other EU and other Eurasia.

2.2. Environmental and health impacts along the plastics value chain

Plastics have a significant carbon footprint, estimated at 3.4% of global emissions in 2019, with 90% of that footprint stemming from the use of fossil fuels (OECD, 2022[2]). A key environmental impact of plastics arises from the production of plastics from fossil fuels, which generates greenhouse gas emissions that contribute to climate change. GHG emissions from the production and conversion of polymers vary depending on the polymer considered (with a range from 2.7 to 6.3 tCO2eq. per tonne of plastics) (OECD, 2022[1]). The OECD ENV-Linkages model estimates that in 2019, total GHG emissions related to fossil-based plastics were 1.8 gigatonnes of carbon dioxide equivalent (Gt CO2e). As plastics use and waste increase, these emissions are projected to more than double by 2060, reaching 4.5% of global GHG emissions in 2060 (OECD, 2022[2]).

The manufacturing phase of plastics is also associated with chemical pollution. Environmental scientists have highlighted the health impacts associated with pollution during the production phase, including chemical emissions from production facilities and contamination of local soils and water sources (Centre for International Environmental Law (CIEL), 2019[16]).

With respect to the downstream stage of the plastics lifecycle, the OECD *Global Plastics Outlook* observes that "there are serious concerns about relatively inefficient and environmentally harmful recycling processes that often fail to prevent emissions of hazardous substances and result in health and environmental risks" (OECD, 2022[2]). Mechanical recycling is considered to be a less polluting and first best option for recycling, notwithstanding its limits in terms of the waste that can be recycled. A recent study on the environmental impact of plastic waste recycling found that chemical recycling is preferable to incineration (even with energy recovery) with respect to its impact on climate change across all investigated input waste streams (Garcia-Gutierrez et al., 2023[17]). While there is growing interest in the potential of chemical recycling, capacity is far below the scale needed to tackle the growing volume of plastic waste, and there are numerous concerns about the environmental and health risks associated with chemical recycling.

The growing production and use of plastics, combined with inadequate waste management and leakage prevention, and with the *longevity* of plastic waste present in the environment result in significant health and environmental hazards. Macroplastic pieces left in the environment are a significant source of microplastics. Reducing their presence in the environment would be an effective way of tackling their degradation into microplastics. Microplastics, toxic chemicals, and additives present in plastic particles pollute marine and terrestrial environments, the air, and can eventually make their way into the food chain. For example, plastics in the ocean can take from decades to hundreds of years to break down depending on their type and on external environmental conditions (Whiting, 2018[18]).

In particular, extensive dispersion of synthetic microfiber particles in the environment has harmful ecological impacts. Primary sources of these tiny particles are clothing detergents, household sludge, throwing unused garments into the rivers and oceans, cosmetics, and cleaning agents. Most of the microfibers found in the ocean are released from textile industries, with other key sources including indoor and outdoor laundering, domestic drainages, and direct dumping of waste garments in waterways (Carney Almroth et al., 2018[19]). Such pollution could be avoided by intervening at different stages of the production chain, for instance via more environmentally based product design (Mishra and Das, 2019[20]), efficient recycling methods, as well as via policy tools discussed in Section 4.

According to findings from the *Global Plastics Outlook*, the amount of mismanaged waste is increasing, driven by growth in waste – nearly doubling from 79 Mt in 2019 to 153 Mt in 2060. The largest source (82%) of plastic leakage (i.e. plastics that enter terrestrial and aquatic environments) is mismanaged plastic waste (e.g. waste that is not captured by any state-of-the-art waste collection or treatment facilities[9]). Other sources of leakage relate to loss of microplastics (12%), littering (5%), and the loss of fishing gear and related equipment from marine activities (1%) (OECD, 2022[2]).

While leakage of plastics occurs in all regions, there are significant geographical differences in leakage drivers. Of the leakage indicators presented above, the share of OECD countries is 11% for global leakage from mismanaged waste, 35% from microplastics losses, 32% from littered waste, and 19% from marine activities. Non-OECD countries account for 86% of overall plastic leakage, largely due to the volume of mismanaged waste ending up in the environment (OECD, 2022[2]).

3. International trade and plastics pollution

3.1. The role of international trade in tackling plastic pollution

International trade through global value chains has been an important factor in the development and growth of the plastics sector in many countries. Indeed, the plastics industry illustrates the dynamics within global value chains. Similar to other industries that involve labour-intensive final assembly stages (e.g. textiles, garments, toys, basic consumer goods, and consumer electronics), the production process of plastics is characterised by extensive fragmentation and the presence of numerous dominant companies that do not have their own manufacturing facilities (Murphree and Anderson, 2018[21]). Typically, these industries rely on a vast pool of contract manufacturers, often situated in cost-effective production hubs.

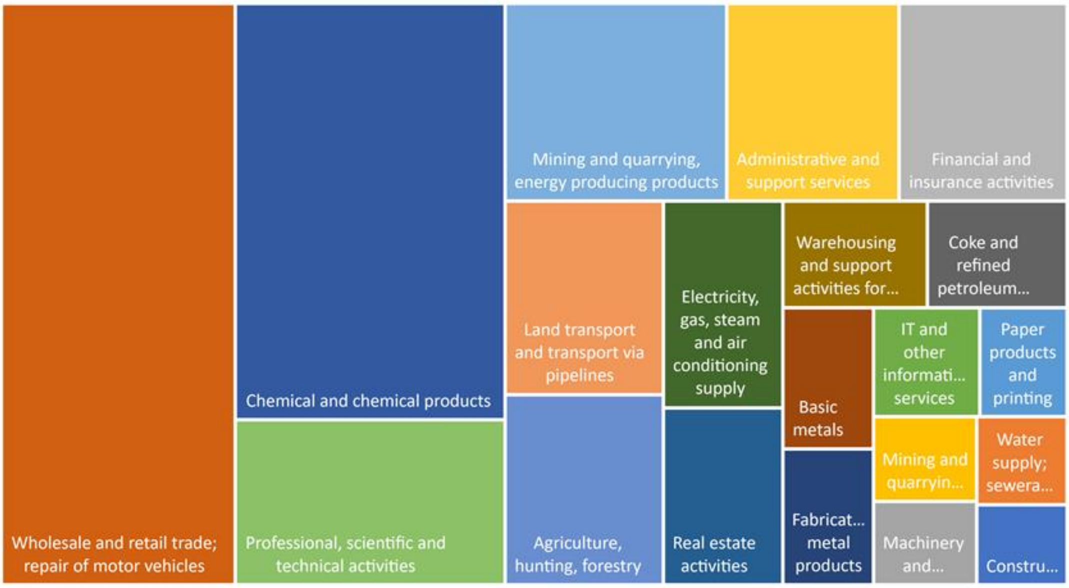
As noted in Section 2, the plastics value chain involves several steps and is spread across many countries, often with plastics value added (VA) embedded in other products. The trade in value added database (TiVA) allows tracking value that originates in a sector-country and is being used in another sector-country, by capturing the origin of VA that is embedded in goods and crosses more than one border.[10] The plastics sector in TiVA is included under *Plastics and Rubber*, so the level of aggregation does not allow to track

[9] This includes waste burned in open pits, dumped into seas or open waters, or disposed of in unsanitary landfills and dumpsites.

[10] TiVA contains information on 45 sectors, 65 countries, and an aggregation for the Rest of the World. The sectoral coverage of TiVA can be found in Annex Table A.2.

the exact amount of value added for plastics alone. It is important to note that the environmental profile of plastics and rubber separately could be different. However, an analysis of this aggregated sector provides insights about the main origin and destination of value that serves and is sold by the plastics sector, and which represents an important share of the *Plastics and Rubber* sector. Findings from input-output analysis using the TiVA database show that by tracking value added origin among all countries (i.e. VA imported directly or embedded in imported products), on average 40% of the value added used to produce output from the *Plastics and Rubber* sector in a country is foreign.[11] Many sectors contribute to the final output production in *Plastics and Rubber* sector (apart from the sector itself which represents the biggest chunk) (Figure 6), including wholesale and retail trade, the repair of motor vehicles, chemical and chemical products, and the mining and quarrying of energy-producing products.

Figure 6. Sourcing industries of plastics and rubber in TiVA, 2018



Source: Authors' computation using TiVA database. This chart shows only the top sourcing industries of plastics and rubber. It does not include sourcing from the sector itself (i.e. plastics and rubber) which represents the biggest share.

International trade has allowed plastics to travel across borders and to be used in many sectors and countries. TiVA value added analysis is used shows there are many sectors that use plastics, directly imported or embedded in other goods (Figure 7). The main sectors that use value added listed under *Plastics and Rubber* in TiVA (other than the sector itself) are construction, motor vehicles, trailers and semi-trailers, food products, beverages and tobacco, wholesale and retail trade, and the repair of motor vehicles. In particular, the use of plastics in the construction sector has increased significantly due to the population growth and increasing urbanisation. Interestingly, demand by the construction sector for plastics is expected to increase because of the resources that green building construction uses to minimise environmental pollution (Grand View Research, 2017$_{[22]}$).[12]

[11] Although the level of aggregation in TiVA does not allow for a granular tracking of plastics value chains, as plastics represent a big share in the plastics and rubber sector of TiVA, these results nevertheless provide insights on sectors that contribute the most to plastics production.

[12] Plastics such as PET, low-density polyethylene (LDPE), polyvinyl chloride (PVC), polypropylene (PP), high-density polyethylene (HDPE), and polystyrene (PS) are recyclable, durable, and exhibit high strength, which are likely to increase their use in the construction of green buildings.

Figure 7. User industries of plastics and rubber in TiVA, 2018

Source: Authors' computation using TiVA database. This chart shows only the top buying industries of plastics and rubber. It does not include selling to the sector itself (i.e. plastics and rubber) which represents the biggest share.

International trade has also increased the circulation of waste between countries. While this has facilitated recycling in some instances, it has allowed to export of waste to countries that have a lower capacity to treat contaminated and hazardous waste. This has led to the improper management of waste. Findings and projections from the *Global Plastics Outlook* show that plastic waste is projected to almost triple in the coming decades, from 353 Mt in 2019 to 1 014 Mt in 2060 (OECD, 2022[2]). Increased plastics trade could lead to a higher risk of increased plastic leakage into the environment if it ends up in countries with limited waste management capabilities. Import restrictions to tackle this issue have been imposed. For instance, China was long an important importer of plastics waste until its Operation National Sword (ONS) policy took effect on 1 January 2018, significantly restricting foreign waste and scrap imports. Many developing countries have also started introducing restrictions or bans on plastic waste imports, driven by environmental concerns. Growing awareness of the external effects of trade in plastic waste led to the 2021 amendment to the Basel Convention that subjected a much larger share of plastic waste to Prior Informed Consent (PIC) procedures (Section 4.1.3).

A key challenge in tracing plastics along value chains to address leakage and pollution issues is the lack of granularity to define the components that are part of the plastics life cycle, mainly due to "hidden" or "semi-hidden" flows associated with product packaging or plastic embedded in products. While *non-hidden trade flows* relate to materials and products that can be easily identified and tracked under the corresponding plastics chapter (i.e. chapter 39) of the World Custom Organization's Harmonized Commodity Description, identifying and tracking *semi-hidden* or *hidden* flows of plastics trade is less straightforward (Deere Birkbeck and Sugathan, 2022[23]). *Semi-hidden trade flows* are defined as products that are entirely or largely plastics for which trade classifications exist (e.g. synthetic rubber and synthetic textiles), but which are not separately categorised under HS Chapter 39 on plastics.[13] Finally, *hidden trade flows* include plastic packaging associated with products (pre-packaged food and beverages), as well as packaging used in the distribution and transportation of products (including business to business). These flows also include plastics embedded in millions of products traded internationally, such as cars, electronic appliances, and construction materials.

While trade volumes for such "hidden plastics" are significant, neither official trade statistics nor the Harmonized System (HS) classifications that underpin them enable the volume or value of the 'plastic

[13] In 2019, 'non-hidden' plastic flows reached an estimated volume of 268 MT million. Semi-hidden plastic trade flows were estimated to have reached 81 MT million in 2019 (Barrowclough and Finkill, 2021[52]).

component' of these trade flows to be easily identified or traced, in particular due to the diversity of plastics materials and final products that are traded internationally.[14] According to research supported by the Geneva Graduate Institute,[15] key sectors containing "hidden plastic" (either in the form of packaging or embedded plastic in final manufactured products) are electrical and electronics, processed food, and agriculture and textiles (Deere Birkbeck and Sugathan, 2022[23]). Preliminary studies suggest that hidden flows accounted for an additional 70 MT million in plastic trade flows in 2018 (Boucher, Paruta and Deere Birkbeck, 2021[24])[16] and that hidden flows of plastic packaging exceeded trade flows in 'empty' plastic packaging captured by official international classifications (Deere Birkbeck and Sugathan, 2022[23]).

The only official trade statistics available for trade in plastic with several distinct HS subheadings at the 6-digit level relate to trade in plastic packaging. However, the subheading does not offer the possibility to differentiate between *new* virgin plastic packaging and recycled or reused packaging. Statistics derived from the Harmonized System (HS) also do not include "hidden" trade flows of plastic packaging directly wrapped around products (pre-packaged goods) or packaging used to protect goods in transportation; the HS Code only provides specific codes for a subset of plastic packaging that crosses international borders, namely various kinds of "empty" plastic packaging.[17]

Nor do HS classifications of plastic waste provide information on chemical substances of high environmental and health concern that are present in plastics traded internationally — such as persistent organic pollutants (POP) and other additives identified as toxic by national, regional, or international health and environmental regulatory agencies — nor do they mirror the different categories used in the new Basel Convention plastic waste amendments (e.g. hazardous, contaminated, mixed, or residual material). This further complicates the monitoring of trade flows across the life cycle of plastics (Vaca Eyzaguirre and Deere Birkbeck, 2022[25]). However, correctly identifying and classifying the flows through the HS would allow trade statistics to contribute to the development of effective policies that address plastics leakage and pollution. A more accurate estimate of plastics trade flows and their corresponding inputs would require efforts by governments to update the HS classification of a range of plastics and plastic products, as well as additives, or to identify, develop and apply technological solutions to tracking flows of certain plastic materials and products.

Notwithstanding its contribution to the increased use of plastics, international trade can be part of the solution to plastic pollution. While trade can make countries' lack of adequate environmental policies more apparent and pressing, whenever it supports the growth of polluting activities and the relocation of pollution, it can also help to abate pollution via access to foreign pollution control technologies, the creation of economies of scale for the circular economy, or to access imports that would be more damaging to the environment if produced domestically.

[14] For instance, the HS does not differentiate between different types of plastic polymers, including different types of conventional plastic polymers, or on the feedstocks used for different polymers and in different products (e.g. bio-based, recyclates, and virgin fossil fuels), nor does it capture much of the internationally traded plastic embedded in goods (e.g. cars, household and consumer goods).

[15] To estimate the volume of the 'hidden' plastics trade, the research relied on estimates of the share of plastic in the material composition of products by sector, which were then applied to trade flows by sector.

[16] This study also estimated flows of hidden plastics between regions, revealing that 'hidden' trade flows in plastics accounted for 22% of Africa's plastic imports in 2018.

[17] Note that some packaging may be traded twice – once as 'empty' packaging and later as packaging used in boxes to protect goods in transport.

International trade enables economic efficiencies through the movement of plastic waste and scrap to countries with a comparative advantage in recycling, allows for access to best practices recycling facilities, and provides incentives to innovate. For instance, Asian markets, specifically China and India, have been producing secondary materials at a lower cost due to their well-established recycling infrastructure and lower labour costs, making these countries prime destinations for exports of plastic waste and scrap (Locock et al., 2017[26]). In this context, trade allows for economies of scale, which can strengthen secondary markets and help bridge the gap between primary and secondary plastics production. However, it is important to note that mismanagement of such flows can also lead to leakage, which in the case of China motivated the ONS policy (see above).

Innovation is another important pillar that can facilitate circularity of plastics, as it may prevent leakage of plastics in the environment as well as reduce other environmental impacts of plastics, such as the greenhouse gas emissions related to plastics production. Evidence shows that environmentally relevant patented plastics innovation increased by a factor of four globally between 1990 and 2017 (Dussaux and Agrawala, 2022[27]). Furthermore, innovation has a central role to play in the new circular business models that are oriented to finding substitutes for non-essential uses of plastics.

The diffusion of technology through trade is a necessary channel for the spread of innovation in different phases of the plastics life cycle in countries where such technologies are lacking. Patent data help keep track of the latest innovations in the plastics sector. Figure 8 shows the share of environmentally relevant patents in technologies related to plastics filed as IP5 families[18] based on the applicant's residence. As IP5 patent families are filed in at least two offices worldwide (i.e. the country of residence and one of the 5 IP offices), this count reflects both the intent to innovate in the plastics sector relative to other sectors and to diffuse related technology.[19] Figure 8 shows the countries with the highest share of environmentally-related patents in plastics as a share of total IP5 patent families filed. Environmentally-related patents in plastics have been traced based on the Cooperative Patent Classification (CPC) codes, as well as a keyword search through the corresponding abstracts of each CPC as explained in Annex B. However, the data may still overestimate environmentally-related patents in plastics as some may include patents that are not exclusively environmentally related or that may bring environmental benefits without explicitly containing any label or keyword related to the environment. It is important to note that the share could appear small for countries that are innovating more in sectors other than plastics, although in absolute terms they also innovate significantly on plastics (Figure 9).

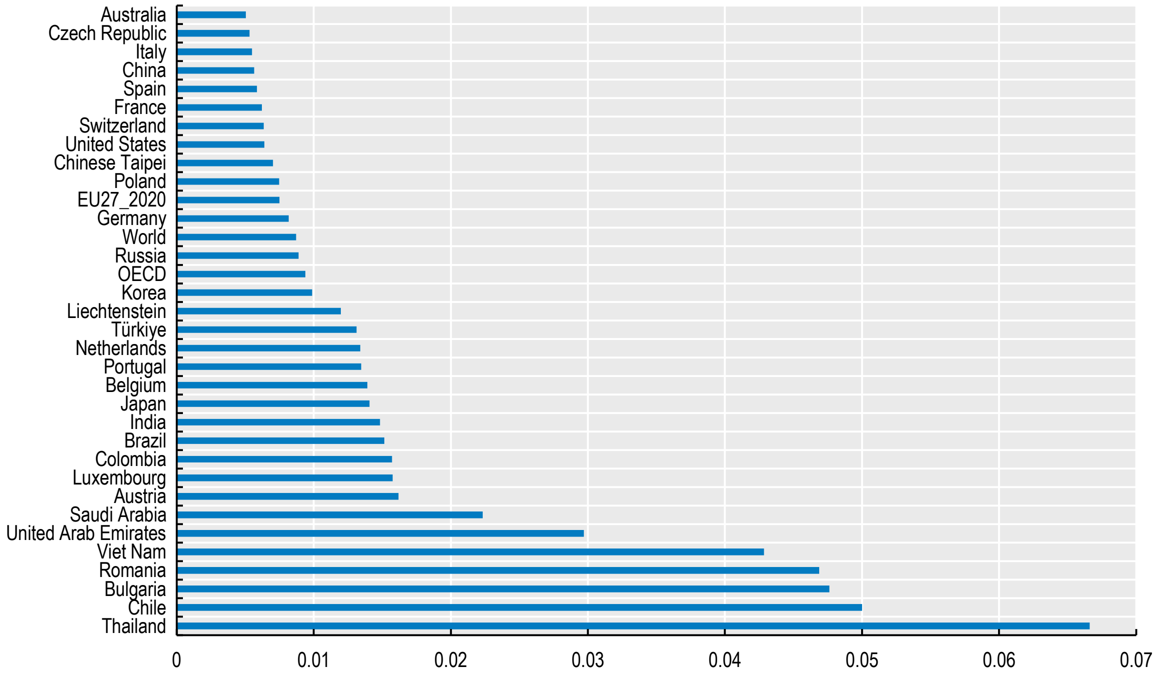
Regarding the total number of patents in plastics filed per country of residence, Japan, the United States, Korea, China, and Germany are among the countries having the highest number of environmentally-related patents in plastics (Figure 9).[20]

[18] IP5 is the name given to a forum of the five largest intellectual property offices in the world that was set up to improve the efficiency of the examination process for patents worldwide. IP5 offices are the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the National Intellectual Property Administration of the People's Republic of China (CNIPA) and the United States Patent and Trademark Office (USPTO). The IP5 offices together handle about 80% of the world's patent applications, and 95% of all work carried out under the Patent Cooperation Treaty (PCT). IP5 patent families are patents filed in at least two offices worldwide, including one of the IP5.

[19] The methodology of retrieving environmentally relevant patents for plastics is explained in Annex B.

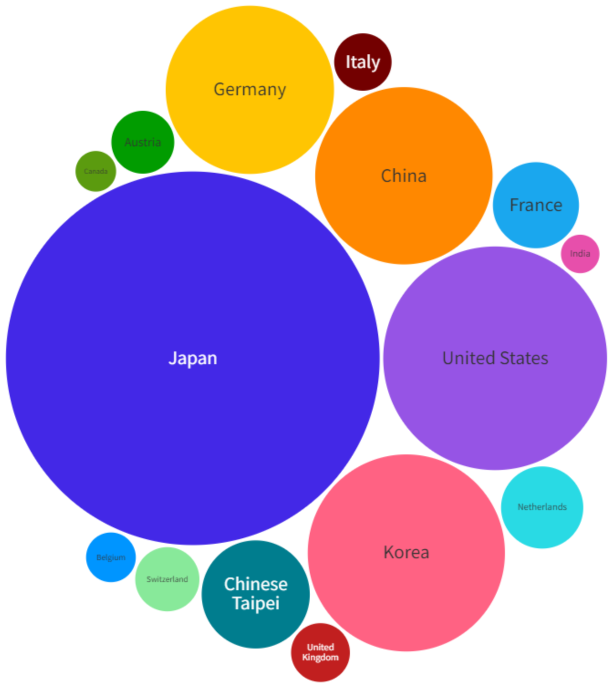
[20] The total number of patents filed per country in 2019, can be found in Table A.3.

Figure 8. Environmentally-related patents in plastics as a share of total IP5 patent families filed, per country, 2019



Note: Countries in the chart are those with a share of environmentally-related patents in plastics with a share different from 0. The country groups EU27, OECD and World serve as a relative measure to position individual countries compared to those groups.
Source: Authors' compilation based on data from OECD, STI Micro-data Lab: Intellectual Property Database, http://oe.cd/ipstats.

Figure 9. Number of environmentally-related patents in plastics filed at IP5 offices, 2019



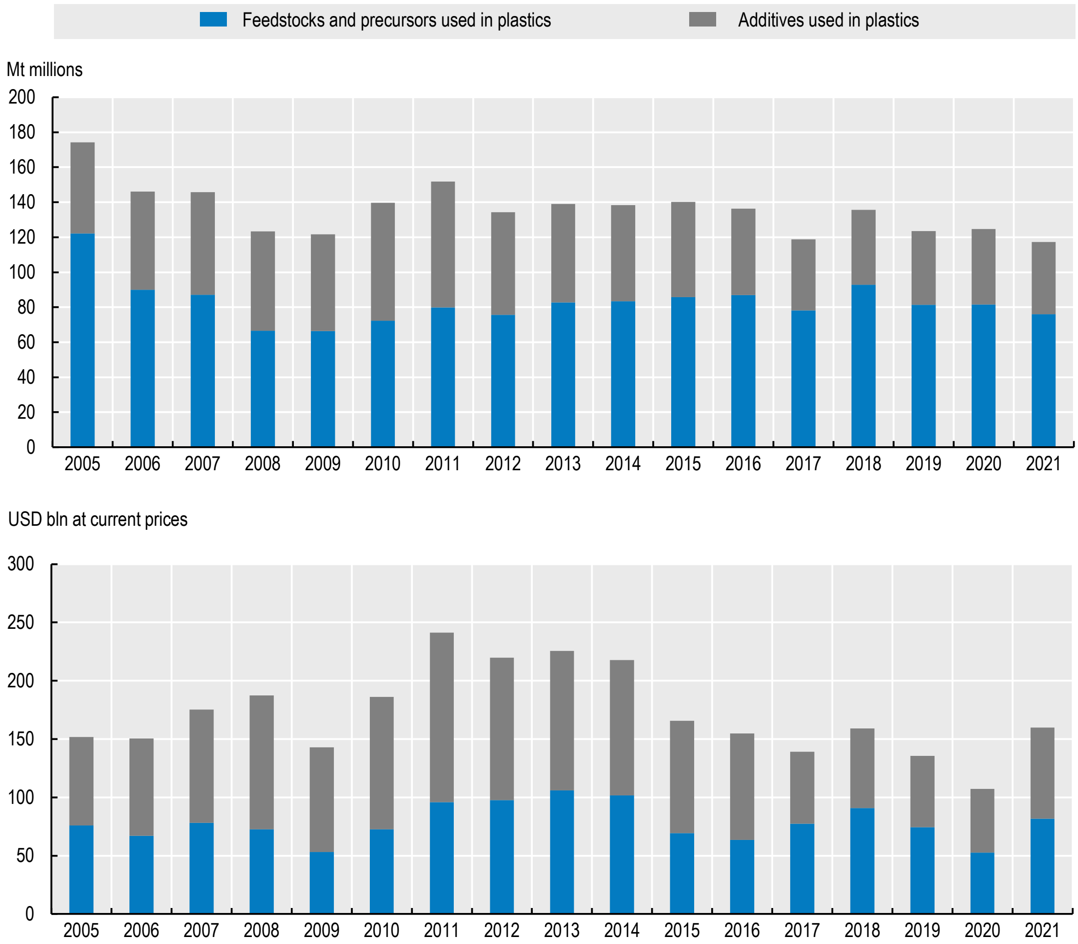
Note: The size of the circles corresponds to the number of patent families filed at one of the IP5 patent offices in 2019.
Source: Authors' compilation based on data from OECD, STI Micro-data Lab: Intellectual Property Database, http://oe.cd/ipstats.

3.2. Trade trends in plastics along the life cycle

Trade trends across the life cycle of plastics can be identified using plastics trade flows that are identifiable through the HS and compiled through official UN Comtrade statistics and CEPII's BACI database, as developed by UNCTAD and the Geneva Graduate Institute.

Materials such as feedstocks, precursors and additives play a crucial role in the production of plastics and are associated with many aspects of plastic pollution. Figure 10 shows the evolution of a range of feedstocks, precursors and chemical additives exports known to be used in plastics, with the caveat that not all of the trade flows captured are destined for plastic production.[21] In 2021, global exports of feedstocks and precursors were around 76 Mt in 2021, with a value of USD 82 billion. Global exports of additives that are relevant to the plastics sector have declined in volume terms over 2005-21 from about 52 Mt in 2005 to just over 42 Mt in 2021. Export values have also shown a decline over the same period from nearly USD 76 billion in 2005 to about USD 54.5 billion in 2020 but increased in 2021 to USD 78 billion.[22]

Figure 10. World exports of products relevant to the life cycle of plastics by volume million (Mt) and value (USD billions)



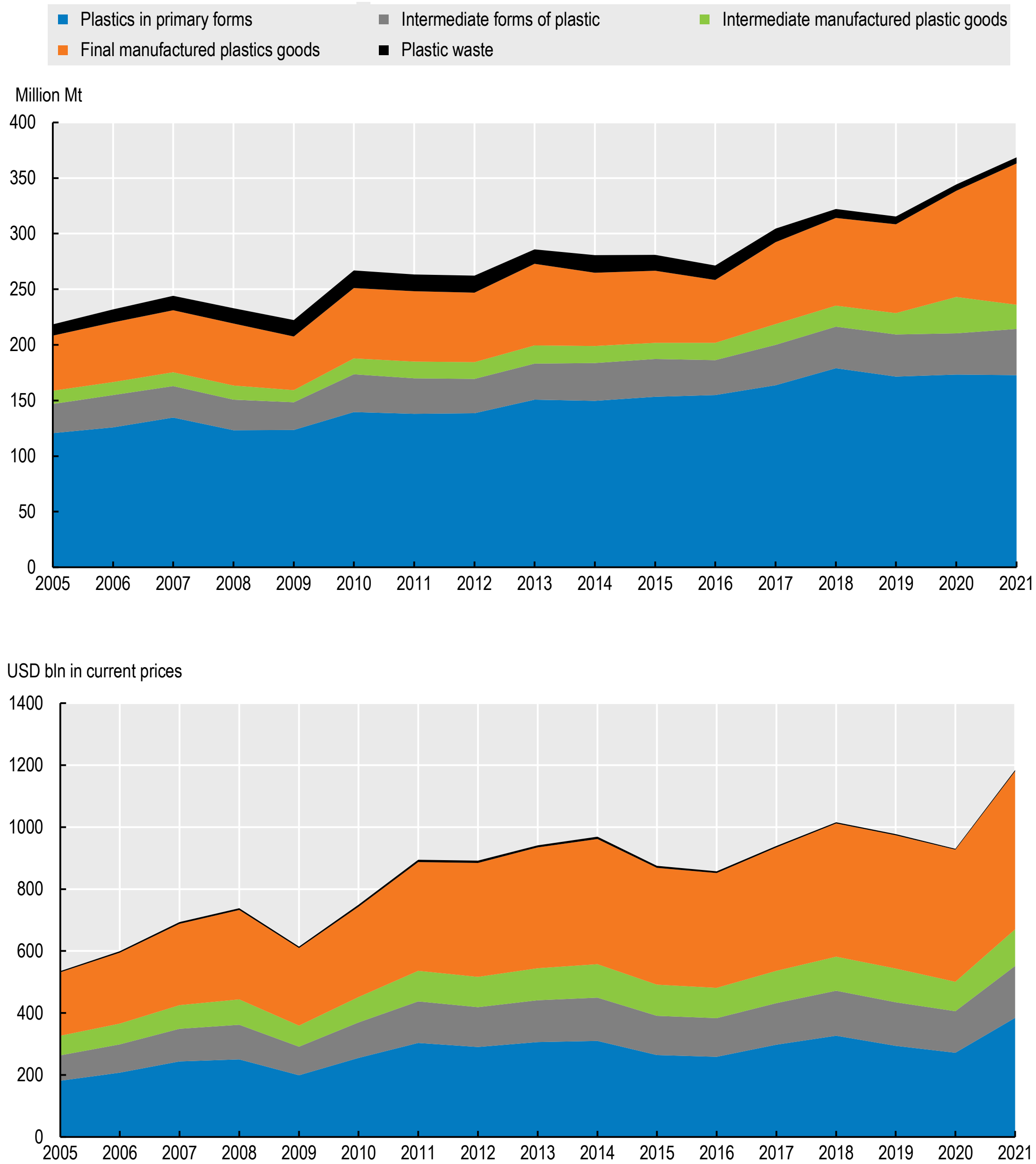
Source: Authors' elaboration based on UNCTAD Plastics Life cycle Trade Database.

[21] Further research is needed to determine the share of specific feedstocks, such as naphtha for instance, that is destined for the plastics sector.

[22] Notably, here again the list of product HS codes used for additives in the Geneva Graduate Institute-UNCTAD database includes additives those that may not be exclusively used for plastics (Barrowclough, Deere Birkbeck and Christen, 2020[69]).

From 2005 to 2021, global exports of plastics rose from around 220 Mt to about 370 MT in volume terms while export value increased from USD 535 bn to USD 930 bn (Figure 11).[23] It is important to note that while primary plastics represent the largest global export category in volume terms, final manufactured plastic goods represent the biggest share of global exports by value.

Figure 11. World exports of plastic by volume million (Mt) and value (USD billions)

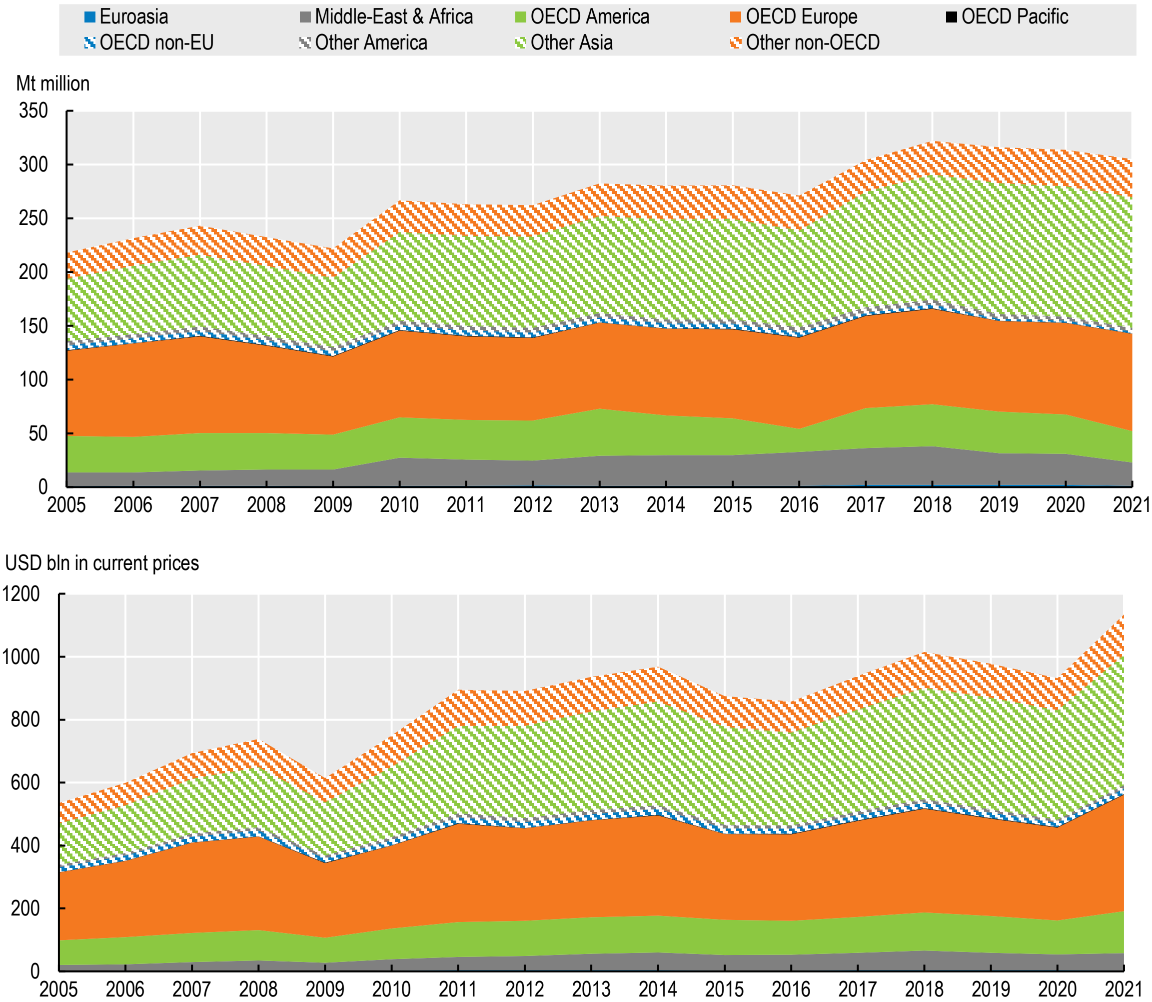


Note: Authors' elaboration based on UNCTAD Plastics Life cycle Trade Database.

[23] Global exports of plastics include plastics in primary form, intermediate form of plastic, intermediate manufactured plastic good, final manufactured plastic good, plastic waste.

The evolution in terms of the volume of plastics trade has been heterogenous across regions, with a notable increase by *Other Asia*, represented by big economies such as China, India and Indonesia, and the region *Middle East & Africa*. The increase in the volume of plastic exports has slowed down in the *Other Asia* region, starting from 2018, which could be related to restrictions in terms of plastics waste imports. In absolute terms, the regions that export the most in volume terms total plastic products are *OECD Europe* and *Other Asia* followed by *OECD America* and *Other non-OECD*. In terms of value of plastic exports, *OECD Europe*, *OECD America* and *Other Asia* remain as leading export regions. Although the volume of total plastics has increased slowly in recent years, it seems that exports in terms of value have become more expensive, although this could result from the increasing number of border restrictions.

Figure 12. Exports of plastics by volume million (Mt) and value (USD billions), by region

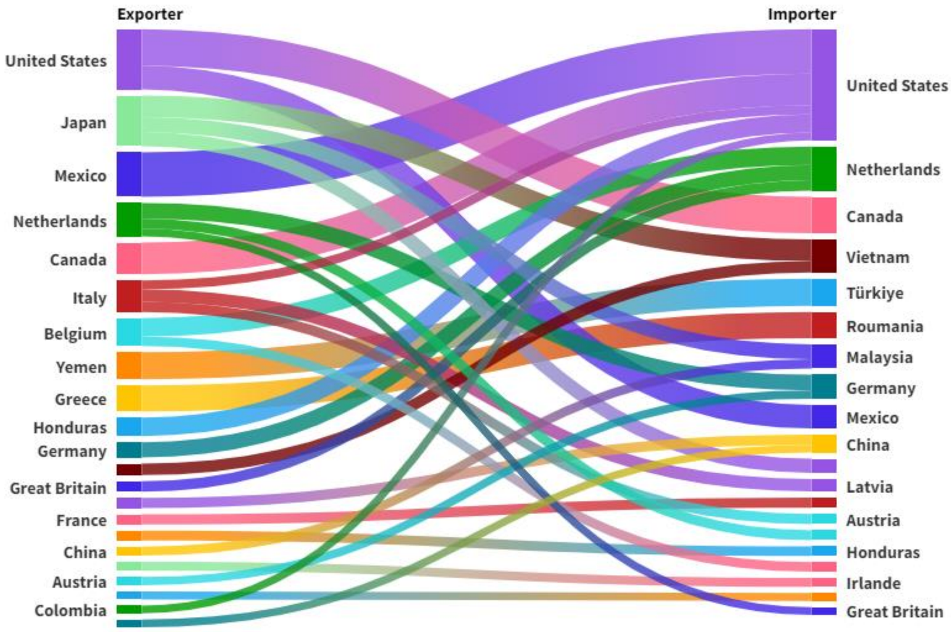


Source: Authors' elaboration based on UNCTAD Plastics Life cycle Trade Database.

Any of the above-mentioned traded plastics can generate plastics waste, which may then leak into the environment. Data from the *Global Plastic Outlook* show that the recycling rate for plastic waste is only 9%. Of the total plastic waste collected for recycling which includes both domestic waste and imported, only 15% is actually recycled, while 40% of this waste is disposed as recycling residues. Additionally, 19% of plastic waste is incinerated, while 50% finds its way into landfills, and 22% of plastic waste escapes proper waste management systems, either ending up in uncontrolled dumpsites, burned in open pits, or entering terrestrial or aquatic environments. This is particularly the case in in less developed countries.

The latest trade data from 2021 show that the main exporters of plastic waste were the United States, Japan, Mexico, Netherlands, and Canada, and that the main importers were the United States, Netherlands, Canada, Viet Nam, and Türkiye (Figure 13). It is important to note that the main importers of plastics waste were not necessarily those that possessed adequate technologies for plastic waste management.

Figure 13. Trade flows in plastics waste, 2021



Source: Authors' elaboration based on UNCTAD Plastics Life cycle Trade Database and BACI database.

Trade data does not provide information on the ultimate destination or process used for the management of the waste in the destination country (i.e. recycle, landfill, or incineration) (Brooks, 2018[28]). As discussed in the previous sub-section, an important volume of plastics is embedded in other products, escaping the general classification of waste in the HS chapters. Karlsson et al. (2023[29]) argue that global plastic trade exceeds previous estimates by over 40%. However, even this figure does not encompass trade in plastics and waste embedded in textiles, rubber, plastic-infused paper bales, and other products. It is likely that the actual quantity of plastics, plastic waste, and hazardous chemicals present in plastics and waste, which are transported globally through trade, is greater.

4. Trade-related policies to promote circularity in plastics value chains

Trade policies may significantly affect the economic viability of recycling markets, including in relation to the diffusion of goods, services and technologies for collection, waste management, recycling, and clean-up of plastics; the viability of repair and remanufacturing operations for products that contain plastics; and that of markets for environmentally sound and effective substitutes to plastics. They can thus significantly contribute to reducing plastic pollution in a co-ordinated manner, complementing domestic measures that target production and consumption. Trade-related policies that promote a circular plastics economy are present at all stages of the life cycle. They can be broadly organised around the nine main objectives (Table 1).

Table 1. Objectives guiding trade-related policies along the plastics supply chains

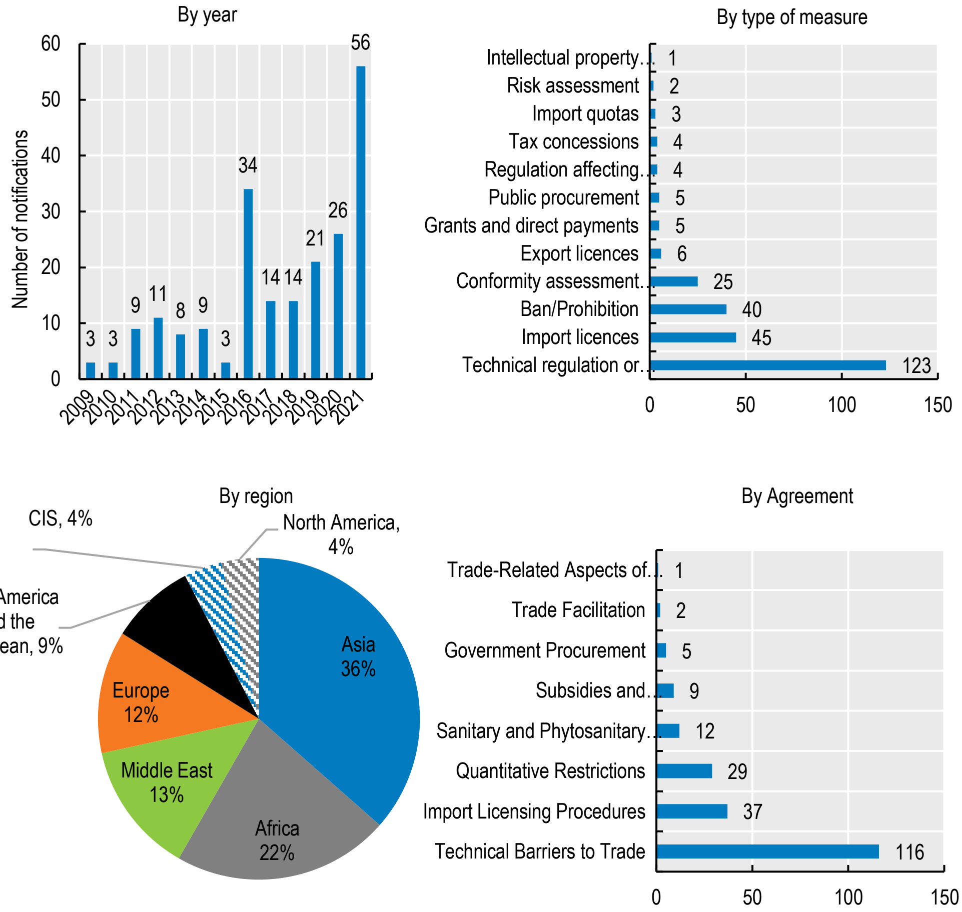
Upstream circular economy policies: reduce production and trade; substitute	1. Reducing growth in virgin plastic production and trade.
	2. Reducing production and trade in toxic or environmentally harmful plastic products.
	3. Replacing plastics with environmentally sound substitutes.
Midstream circular economy policies: re-design, decrease use, reuse	4. Designing products that are less polluting, use less plastic, have an extended product life, are re-usable, use more recycled content or that can be recycled in an environmentally sound manner; disseminate less polluting production technologies.
	5. Reducing unnecessary packaging.
	6. Reusing plastics through multiple use of plastic products, including re-use, refill, repair, and remanufacturing.
Downstream circular economy policies: recycle and dispose	7. Recycling plastics into feedstocks that are environmentally sound and non-toxic.
	8. Disposing plastic waste in ways that prevent leakage to the environment.
	9. Fostering access to technologies, goods and services for environmentally-sound waste management, clean up and recycling.

Note: This captures the direct effects in terms of trade policy, not secondary effects such as incentives to innovate or dissemination of innovation.
Source: Authors' elaboration.

Drawing on the WTO Environmental Database, which compiles information on all notified trade-related environmental measures, between 2009 and 2021 WTO Members notified 211 trade-related environmental policy measures affecting plastics. The number of notifications has fluctuated over the years (reflecting in part the timeline for notifications requested under different WTO agreements), but shows a consistent upward trend in recent years. Overall, 82% of the measures were notified by developing countries, including Least Developed Countries, highlighting the critical importance of this environmental issue for those countries (Figure 14). More than half of the measures have been notified as technical barriers to trade (51.6%), followed by import licensing procedures (21.3%) and quantitative restrictions (11.6%). Most of the measures tend to focus on midstream and downstream segments of the value chain, in particular on waste and scrap management, recycling, packaging, and finished products. While technical barriers to trade represent the category with the most notifications for both developed and developing countries, developed countries have placed more emphasis on government procurement and subsidies, whereas developing countries and LDCs tend to be more concentrated in import licensing and quantitative restrictions, including in the form of bans and prohibitions.

At the upstream end of the plastics chains, relevant trade or trade-related policies include primarily on the one hand border measures such as import and export bans or restrictions, tariff measures and trade facilitation-related measures affecting virgin plastics and plastic materials or non-plastic substitutes. They also include economic incentives, such as government support and tax incentives and disincentives for the production of plastics or non-plastic substitutes (Table 2).

Figure 14. Trends in the number of trade-related plastic measures notified to the WTO (2009-2021)



Source: Authors' compilation based on the WTO Environmental Database available at Homepage | WTO - EDB.

At the midstream stage, relevant trade or trade-related policies include: bans or restrictions and trade facilitation-related measures at the border on the use of plastic packaging in international trade; regulatory measures, such as technical regulations and standards applying to plastic products design, or on the reuse, repair and remanufacturing of plastics; and economic incentives, including government support on reuse and recycling, and requirements for the use of recycled content in government procurement.

At the downstream end of the plastics circular chains, relevant trade or trade-related policies include: border measures, such as import and export bans or restrictions, tariff measures and trade facilitation-related measures affecting plastic waste; regulatory measures, including voluntary or mandatory schemes imposing recycling targets or extended producer responsibility (EPR) schemes; and economic incentives, including government support on R&D for plastic waste management and clean up.

In practice, the distinction between different types of measures is not always straightforward. For example, EPR schemes often involve both an economic incentive and a regulatory dimension through the payment of a fee which can be modulated based on the product's performance. Similarly, technical regulations on plastic products can be equivalent to an import ban. Keeping these caveats in mind, the following section will discuss each of these policies in turn.

Table 2. Overview of trade-related policy options to promote circularity along the plastics life cycle

	Trade-related circular economy measures / Circularity objectives	Import bans & quantitative restrictions	Tariff and non-tariff measures[24]	Export prohibition & restrictions	Trade & investment facilitation	Loans & subsidies	Environmental taxes, fees & charges	Regulations, standards & conformity assessment	Government procurement
Upstream: reduce and substitute	Reduce growth in virgin plastic production and trade	Import bans on virgin plastics	Import tariffs on virgin plastics	-	-	Reduction of subsidies to fossil fuel and plastics	Taxes on carbon, fossil fuels or virgin plastics	-	-
	Reduce production and trade in unnecessary, problematic, toxic or environmentally harmful plastic materials, items, products or wastes	Import bans on unnecessary, problematic, toxic or environmentally harmful plastic materials, items, products or wastes	Import tariffs or licenses on certain plastics products	Export bans on domestically prohibited plastics and plastic wastes	-	-	Environmental fees, taxes & charges on domestic production of plastics	Regulatory requirements & standards to reduce plastics use (such & packaging & single-use plastics), and improve transparency of the material composition of products. Prohibitions on domestic production of plastics known to be especially harmful to the environment	-
	Replacing plastics with environmentally sustainable effective substitutes	-	Reduce tariffs and non-tariff barriers to environmentally sustainable and effective non-plastic substitutes	-	Facilitate foreign investment in domestic production and waste management of environmentally sound non-plastic substitutes	Subsidies, tax breaks, R&D & technology transfer for the production and use of non-plastic substitutes	-	Standards for responsible sourcing and waste management of substitutes, and regulations requiring use of non-plastic substitutes in domestic production	Requirements to use environmentally sound and effective non-plastic substitutes

[24] A number of NTMs in the form of regulations are also itemized separately in this table.

Midstream: Redesign, reduce and reuse	Designing products that are less polluting (e.g. less unnecessary plastics, higher share of recycled content, non-toxic additives) and that can be recycled in an environmentally sound and safe manner	-	-	-	-	Subsidies, tax breaks, R&D for products that are less polluting or that can be recycled in an environmentally sound and safe manner	Eco-modulated EPR fees based on product's design or recyclability	Circular economy regulations, standards and conformity assessment (such as mandatory recycled content), and labelling schemes	Requirements to procure only plastics that a that can be recycled in an environmentally & safe sound manner
	Reusing plastics or multiple use of plastic products, as well as promoting re-use and refill business models that do not use plastics.	-	-	-	Facilitate investment in business models and supply chains that promote re-use and refill business models	Subsidies, tax breaks, R&D, & tech transfer for products that are less polluting or can be recycled in environmentally sound and safe manner	Eco-modulated EPR fees based on product's durability, reparability, re-usability, and recyclability	Regulations, standards and conformity assessments that relate to reusable and repairable products	Requirement not to purchase single-use plastics and to purchase only re-usable products e.g. re-usable cups and plates
	Reducing unnecessary, problematic & harmful plastic packaging	Ban on imports of unnecessary, problematic & harmful plastic packaging.	-	Ban on export of unnecessary, harmful, & problematic plastic packaging	-	-	Environmental taxes or charges on plastic packaging	Plastic packaging requirements & standards for design of packaging for pre-packaged products, and for B2B international distribution	Requirements to purchase only products that eliminate unnecessary, harmful or problematic plastic packaging.

Downstream: recycle and dispose	Recycling plastics into feedstocks or other raw materials that are environmentally sound	-	-.	-	Facilitate functioning of markets for environmentally sound plastics recycling and recycled plastic inputs and products	Subsidies, tax breaks, R&D for recycling and use of recycled content	Landfill or incineration taxes	Voluntary or mandatory schemes imposing recycling targets	-
	Regulating plastic waste in ways that prevent leakage to the environment.	Ban imports of hazardous and contaminated plastics waste, and other wastes that cannot be managed in an environmentally sound manner domestically.	-	Prohibit plastic waste exports to countries with inadequate capacity to manage waste in environmentally sound manner	Facilitate trade in recyclable waste to countries with adequate environmentally - sound capacity for recycling	Subsidies, tax breaks, R&D for waste management and clean up	-	Voluntary or mandatory EPR schemes that make producers/retailers responsible for plastic waste	-
	Access to technologies, goods and services for environmentally-sound recycling, waste management, and clean up.	-	Reduce tariff & non-tariff barriers for goods, technologies and services involved in waste management, recycling & clean up.	-	Facilitate foreign investment in locally-appropriate domestic recycling, waste management & clean up.	Subsidies, tax breaks, R&D, technology transfer enabling IP policies, and capacity building	-	-	-

4.1. Trade and trade-related policies at the border

4.1.1. Import tariffs

Import tariffs can influence how costly it is for plastics to be traded internationally. They could potentially be used to facilitate the shift towards more sustainable trade in plastic and plastic products, provided that such products can be separately identified both in the HS and at the border. Overall, import tariffs on plastics have been decreasing over time and even where applied most-favoured-nation (MFN) tariffs are high, trade may already be duty-free in most if not all plastic categories between a country and its free trade agreement (FTA) partners.[25] This leaves little margin for encouraging more sustainable plastics trade through the lowering of tariffs on sustainable plastic and plastic products.

Conversely, while tariff increases for environmentally harmful plastics could be used by countries that have the scope to raise their applied MFN tariff rates, such increases would contribute little to shifting plastics trade toward greater circularity and sustainability compared to an outright ban. Consumer's limited capacity to appreciate the negative externalities, including health, safety, and environmental impacts of plastic products, means that price-based instruments, such as increased tariffs, are less likely to encourage the uptake of less harmful substitutes.

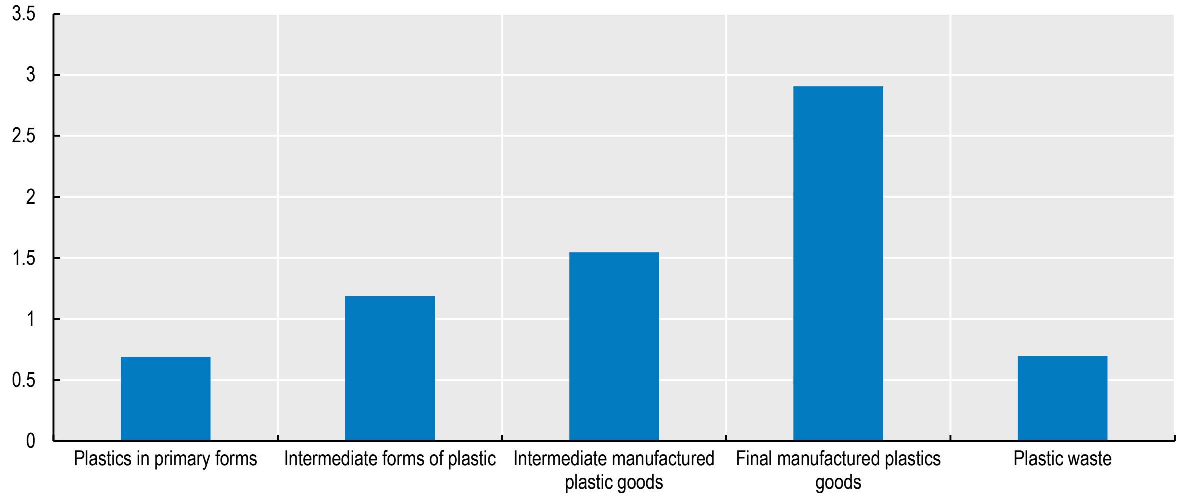
Moreover, the use of tariffs as an effective policy instrument is limited by the constraints of the HS system, which distinguishes goods in terms of their purpose rather than the production components and techniques and their environmental impact or consequences. More specifically, the HS classification does not distinguish between virgin primary plastics and primary plastics based on secondary raw materials or between new and recycled plastic products (e.g. recycled plastic packaging), making it difficult to tailor tariff increases in a way that would promote circularity. Attempts to introduce the concepts of biodegradable or compostable plastic waste in the HS 2022 edition were thwarted by the failure to agree on a definition and universally accepted certification, or to identify practical methods to test such waste at the border (Omi, 2020[30]).

In order to promote the use of tariffs as an effective policy instrument, adjusting the HS system to better reflect environmental considerations is necessary, although the difficulty of physically distinguishing between products according to their environmental impacts during border or other controls could present additional hurdles (under Section 4.1.3). In some countries the cost of collecting tariffs — administrative costs, and direct and indirect costs generated by delays and risks of fraudulent claims (Tarr, 2000[31]) (Mitra, 1992[32]) — may be disproportionally high in relation to the potential environmental benefits from enhanced circularity.

On the other hand, tariffs will affect the economic viability of alternatives to environmentally harmful plastic products, in particular single-use plastics, given that tariffs on plastic substitutes, including reusable non-plastic substitutes, often tend to be higher than those applied to corresponding plastics (UNCTAD, 2023[33]). The jute value chain, for instance, is subject to tariff escalation affecting jute packaging, mostly among developing countries, while intermediate jute products, such as jute yarn, are subject to lower tariffs (UNCTAD, 2021[34]). While some major importers such as Türkiye and China, apply lower average tariffs on jute bags and sacks (3% and 4% respectively, although bound tariffs are rather high at -25% in Türkiye), the average of applied MFN tariffs on jute bags and sacks for Thailand, Viet Nam and the Philippines is 10%, 12% and 15% respectively, while tariffs on jute yarn are only 5%. India and Bangladesh – two big jute producers and processors –apply very high tariffs on all major products along the jute value chain, from raw jute to bags, presumably with the aim of protecting their domestic jute industry (UNCTAD, 2021[34]).

[25] For example, some of the biggest bilateral trade flows in polyethylene packaging take place between Canada and the United States and between Mexico and the United States under the umbrella of the Canada-US-Mexico Agreement (CUSMA). Given their potentially wide coverage of the plastics life cycle, bilateral or regional trade agreements may warrant closer examination as part of future research initiatives (Deere Birkbeck and Sugathan, 2022[23]).

Figure 15. Applied tariffs (average) for different types of plastic products, 2021



Source: Authors' computation using WITS database and the compiled list of plastic products by UNCTAD.

UNCTAD's recent illustrative list of 282 HS codes associated with alternatives or substitutes to plastics confirms that, in most cases, such products have a higher unit price and undergo higher tariffs compared to plastics equivalents (UNCTAD, 2023[33]). Many of those products are concentrated under HS chapters: Wood and articles of wood; Pulp of wood or other; fibrous cellulosic material; Paper and paperboard; Wool, fine or coarse animal hair, yarn and woven fabric; Vegetable textile fibres, paper yarn and woven fabrics of paper yarn; and Aluminium.

In the context of South-South trade in other non-plastic substitutes, for example under the South Asian Free Trade Agreement (SAFTA), referential duty rates for unwrought aluminium alloys are zero while preferential duties for various aluminium articles are higher at 5% with average applied MFN rates much higher at 25% (UNCTAD, 2022[35]). Lowering or even eliminating MFN and preferential import duties for environmentally sound plastic substitutes that are reusable (e.g. jute bags) or recyclable (e.g. aluminium containers) could help promote circularity and environmental sustainability. Concerns about revenue foregone as a result of such tariff reform could be addressed by eliminating single digit "nuisance" tariffs that cost governments more to collect than they generate in revenue.

4.1.2. Import and export bans or restrictions

Several countries seek to cap or phase out the production of specific types of plastic that are considered environmentally harmful, or to outlaw the use of certain chemicals in plastic products or the use of microplastics in certain products. According to OECD (2022[1]), reducing plastic production and consumption represents the best option to minimise plastic waste generation compared to other types of interventions, such as substitution or better waste management, and the most attractive solution from an environmental perspective, including for reducing GHG emissions associated with plastics (see also The Pew Charitable Trusts and SYSTEMIQ (2020[36]).

These policies are often accompanied by trade bans or restrictions. A wide range of countries – including developing countries – have introduced outright bans on the import of certain single-use plastics (alongside bans to their production or use), in particular regarding plastic bags,[26] plastic straws,[27] or single-use plastic

[26] See, for instance, WTO notification G/MA/QR/N/URY/3 from Uruguay or G/MA/QR/N/MUS/5 from Mauritius.

[27] See, for instance, WTO notification G/TBT/N/SYC/4 from Seychelles, or Directive (EU) 2019/904 on the reduction of the impact of certain plastic products on the environment, which also bans other single-use plastics such as cotton bud sticks or plastic plates and cutlery.

packaging.[28] Some countries impose non-automatic licensing requirements to import plastic products or plastic waste into the country.[29] According to UNEP (2020[37]), 127 countries have passed legislation to ban, tax or regulate the use of plastic shopping bags. However, not all of these regulations are fully implemented or enforced (OECD, 2021[38]).

Measures such as import bans or other restrictions on plastic waste and products ranging from plastic fish nets and straws to detergents containing microplastics are imposed with increasing frequency and represent the second most important group of measures notified to the WTO (Figure 14).

To date, however, there has been little systematic analysis on the impact of these restrictions. In terms of bans on plastic waste, there is evidence that import bans have prompted major exporting countries and companies to introduce measures to reduce plastic waste, increase recycling, and promote a more circular plastics economy (Wang et al., 2019[39]). The rise of plastic waste import bans seems to have spurred the diversion of plastic waste to countries without the regulatory framework and capacity to manage such waste in an environmentally sound manner and has exacerbated illegal trade. For instance, when China (which had previously imported up to 70% of the world's plastic waste) imposed an import ban on plastic waste, exports were redirected to countries without adequate domestic waste processing capacity, leading to increased stockpiling, incineration, landfilling, and leakage into the environment (Yamaguchi, 2021[40]).

In parallel to import measures, several countries have announced export restrictions or prohibitions applied to plastic waste and certain single-use plastics destined to developing countries. Australia, for example, bans exports of unrecyclable waste and whole used tires (with the exception of bus, truck, and aviation tires exported to a verified facility for retreading).[30] Since the entry into force of the plastic waste amendments[31] of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel Convention Secretariat, 2019[41]), the European Union and the United Kingdom have been working to implement bans on exports of certain plastic wastes. The European Union, for instance, has banned the export of plastic waste to non-OECD countries, except for clean plastic waste sent for recycling.

Beyond these bans and restrictions principally applying to plastic waste or to single-use plastics, there have been calls to ban or restrict certain types of plastic packaging, starting with packaging that cannot be affordably and safely recycled, or to reduce unnecessary packaging of either final products or in business-to-business (B2B) transactions. This would include targets for reducing the amount of plastic packaging traded internationally in pre-packaged goods, as well as packaging used in transportation and distribution. Such targets would imply finding efficient and cost-effective alternative solutions to ensure the safety and quality protection of packaged goods. This would also require international co-operation.

4.1.3. Administrative procedures at the border

The addition in 2019 of most types of plastic waste to the list of controlled wastes under the Basel Convention resulted in subjecting these to Prior Informed Consent (PIC) procedures under the Convention. A narrow category of plastic waste[32] can be traded freely, provided they are sorted, clean, uncontaminated and effectively designed for recycling. Controlled plastic waste cannot be traded between Parties and non-

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[28] The ban on single-use plastic packaging for the sale of fruits and vegetables introduced by the Article 77 of the French Act nº 2020-105 on the fight against waste and on the circular economy awaits the adoption of the implementing ordinance defining the concerned fruits and vegetables.

[29] See, for instance, WTO notification G/LIC/N/3/IND/20 from India covering the requirement for an import authorisation for plastic waste, or G/LIC/N/2/MAR/3 from Morocco on polyethylene products.

[30] See Australian Government, Department of Agriculture, Water and Environment, *Waste Export Ban*, https://www.environment.gov.au/protection/waste-resource-recovery/waste-export-ban.

[31] Amendments of Annex II (Categories of Wastes Requiring Special Consideration) to include plastic waste, and Annexes VIII (Lists of Wastes Characterised as Hazardous) and IX (Lists of wastes presumed non-hazardous) to clarify the scope of plastic wastes covered (COP-14, 29 April-10 May 2019). The amendments are in effect since January 2021.

[32] Entry B3011, covering plastic waste consisting of one non-halogenated polymer; one cured resin or condensation product; one of certain fluorinated polymers; and certain narrowly defined mixtures.

Parties and fall under the scope of the "Ban Amendment"[33] preventing the movement of hazardous wastes destined for resource recovery, recycling, reclamation, direct re-use or alternative uses,[34] from OECD and EU countries and Liechtenstein to other countries. The OECD Control System for Waste Recovery[35] clarified as of 1 January 2021 that each OECD country retains its right to control non-hazardous plastic waste as identified under Basel Convention provisions in conformity with its domestic legislation and international law.

The prior notification by the exporter, written consent by the transit and importing states and related transboundary movement documents required under the PIC procedure could represent a significant administrative burden, where slow and diverging approval processes are applied in different countries. The important delays in obtaining consent for individual or multiple shipments may create significant disincentives for reuse, recovery or recycling operations across borders. Companies express concerns that the time, effort and legal uncertainties of administrative requirements at the border may outweigh the costs of investing in recycling capacities intended for scale, especially in view of the low prices for virgin plastic (World Economic Forum, 2020[42]). In addition, the identification at the border of various categories of plastic waste based on environmental characteristics or on post-importation uses, such as recycling or disposal, can be particularly challenging in case it relies solely on physical tests.

A number of trade facilitation-related measures could support circular economy goals in the plastics sector. The most important one would be to enhance the efficiency of the PIC process, namely by digitizing related formalities and enhancing coordination and cooperation between Customs and other concerned authorities, including environmental protection agencies (Yamaguchi, 2022[43]). Other measures would include promoting faster and more expedited procedures for the movement of goods relevant to the circular economy, such as equipment for sorting and recycling plastic waste, or non-plastic substitutes. Plastic waste and scrap destined for certified environmentally sound waste management facilities could benefit from an accelerated procedure as foreseen by the OECD Decision on the Control of Transboundary Movements of Wastes Destined for Recovery Operations for shipments to pre-consented recovery facilities. Easy identification by customs authorities of goods made from recycled or recyclable plastics could be enabled by means of internationally agreed environmental labels, or the use of new identification technologies such as digital product footprints and bar code scanners. Similarly, harmonized forms for clusters of goods being imported for circular economy purposes (including final goods and raw materials) could facilitate speedier clearance.

Finally, the WTO Trade Facilitation Agreement also includes provisions on technical assistance and capacity-building for developing and least-developed countries that could be used to support circular economy objectives related to plastic pollution. Some examples include training of customs officials in identifying goods that meet specific environmental requirements or circular economy standards, or scanning equipment to facilitate identification of recyclable products or products that contain harmful additives.[36] Future endeavours could be inspired by projects such as the Asia Pacific Plastic Waste Project (APPWP), aimed at enhancing Customs officers' capacities to deal with illegal plastic waste. The APPWP, led by the WCO and funded by Japan, run between April 2020 and June 2023 and involved Customs Administrations in Cambodia, Indonesia, Lao PDR, Malaysia, the Philippines, Sri Lanka, Thailand and Viet Nam.

[33] Decision II/12 of the Conference of Parties to the Basel Convention, adopted in March 1994 (UNEP/CHW.2/30) and entered into force on 5 December 2019.

[34] Unless an Article 11 arrangement is in place. Such an arrangement exists, for instance, between Canada and the United States: Canada-US arrangement on non-hazardous waste and scrap - Canada.ca.

[35] Decision of the Council on the Control of Transboundary Movements of Wastes Destined for Recovery Operations OECD/LEGAL/0266.

[36] Devices based on infrared spectroscopy, such as the one developed by chemical company BASF are gradually finding their way to the market, see "This small device can be a big help in combating plastic waste | Greenbiz".

4.2. Regulatory measures

4.2.1. Technical regulations and standards

Technical regulations, standards, labelling schemes and conformity assessment procedures have implications for plastics circular value chains and for the use of recycled materials. At the midstream level, such regulations and policies can support the design of products that are less polluting at every stage of the plastics life cycle and that can be safely repaired, re-used, remanufactured, and recycled in an environmentally sound manner (eco-design). They can also promote approaches to prevent microplastic loss and reduce unintentional pollution through effective loss prevention standards and certification schemes for the entire supply chain.[37] At the downstream level, standards will target the end-of-life of products (e.g. quality standards for secondary raw materials, recycling requirements).

Examples of mandatory requirements promoting circularity objectives include the 25% recycled content target for polyethylene terephthalate (PET) bottles by 2025 and 30% recycled content target for all beverage bottles by 2030 under the EU Single-Use Plastics Directive.[38] Voluntary schemes promoting circularity involve a wide range of standards and labelling schemes dealing both with organizational and management aspects of the circular economy,[39] as well as product characteristics and their related production or disposal methods (e.g. to limit microplastic leakage from cosmetics, textiles or toys) (Yamaguchi, 2021[40]).

According to The Pew Charitable Trusts and SYSTEMIQ (2020[36]), better design of products and packaging in high-income countries could expand the share of economically recyclable plastic from an around 22% in 2019 to 54% by 2040. Improved design can be incentivized, for example, through standards and regulations and through government procurement specifications (see below).

However, experts caution against assumptions about the environmental sustainability of recycling. For instance, mechanical recycling is currently only possible for a subset of plastics currently on the market; the quality of the recycled material is not necessarily the same over time (i.e. many plastics can only be recycled a certain number of times), and recycling options are limited by the chemical additives used in many plastics, which can concentrate in recycled plastics, making them unsafe or potentially toxic and not available for use in all applications.

From a trade perspective, a critical challenge for companies arises from differences across jurisdictions in the design and implementation of standards, regulations or conformity assessment procedures relevant to plastics and plastic pollution. Differences in regulations applied to the production of plastics, such as on the concentration of regulated substances in plastics feedstock,[40] or on the requirements for preventing contamination of the plastic input in recycling schemes, may affect whether plastic products collected at the downstream stage can be re-used or reprocessed to close material loops. This regulatory heterogeneity can generate additional costs for exporters involved in international supply chains and reduce incentives to adopt and invest in scaling up consistent circular solutions globally. The lack of international alignment on such regulations not only generates compliance costs but also leaves environmental and health risks inadequately addressed at the global level (OECD, 2022[1]). Progress toward greater circularity in the plastics sector and reduction of plastic pollution will require greater international cooperation in the design and implementation of plastics-related standards and regulations, ideally through harmonization or, at minimum, enhanced interoperability of standards. Specific standards

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[37] See for instance the Recommendation of the Convention for the Protection of the Maritime Environment of the North-East Atlantic (OSPAR) 2021/06 on the reduction of plastic pellet loss into the marine environment [Agenda Item 1 (ospar.org)]

[38] See https://ec.europa.eu/environment/topics/plastics/single-use-plastics_en.

[39] In 2019, for example an ISO technical committee on the circular economy (ISO/TC 323) was created to produce a set of internationally agreed principles and terminology on the circular economy and to produce a management system standard.

[40] The OECD (2022[2]) observes, for instance, that a key challenge facing regulatory efforts to detoxify material loops in the plastic industry is the disparity between national policies on concentration of phthalates, extensively regulated among OECD countries but still widely used in consumer applications in most non-OECD countries.

such as European Standard EN 15343 can also encourage proper recycling of plastics by standardising the process for the traceability and assessment of conformity and recycled content of plastics.

Technical regulations can also influence the types of packaging and recycled packaging that can and cannot be used to pack items such as food as well as the subsequent export of such packaging waste for recycling purposes. This is particularly relevant concerning the regulations and standards applying to the packaging of goods traded internationally, which, in seeking to ensure the integrity and safety of the concerned products, may not be coherent with policies to gradually decrease plastic generation and use. Sustainable design requirements to reduce unnecessary packaging or plastics use in products, or that require the use of a specific share of certain types of polymers (such as recycled polymers) could help promote circularity objectives while preserving the safety and quality of traded products.

The divergence in requirements across relevant markets further compounds the barriers to the circularity of plastics value chains. For example, regulations for food packaging in the European Union and the United States require the same level of safety against chemicals migrating into foods, whether for recycled or virgin packaging materials; however, the European Union specifically regulates the use of recycled plastics in food contact materials (FCMs)[41] while US FDA considers recycling processes for plastic food contact articles on a case-by-case basis, inviting plastic recyclers to submit information on their process for evaluation and comment.

In addition, some technical regulations and standards, such as those applying to packaged foods, add more complexity in the recycling process and may act as disincentives for employing recycled materials. This is particularly the case for multi-layered packaging,[42] widely used by the food industry as a means to satisfy food packaging regulations and standards on the protection of the safety, quality, and shelf-life of food products as they are stored and transported, and against contamination or other deteriorations, including on account of the packaging itself, particularly for food-grade packaging made of both primary and recycled materials. These health and safety objectives cannot be overlooked when considering circular economy objectives, thus raising the question of alternative approaches to packaging that would reconcile such conflicting imperatives.

4.2.2. Regulations on services in support of circular solutions

Services trade can play an important role supporting circularity along the plastics value chain, including to promote new circular business models (e.g. those that focus on leasing of products, reuse & refill, and repairability); enhance plastic products' circularity through R&D and eco-design; help close the chain's material loops through collecting, sorting and recycling of waste material; and the remanufacturing or refurbishing of products (Tamminen et al., 2020[44]).

An overview of the role of services to support circular value chains (Tamminen et al., 2020[44]) showed that over half of those services are delivered digitally -– corresponding to Mode 1 of services delivery- and another 45% via foreign subsidiaries – corresponding to Mode 3-, although in theory services in support of the circular economy can be delivered in any of the four GATS Modes. In the case of plastics value chains, this might concern for instance the digital provision of consulting services related to eco-design of plastics or plastics recycling, and the establishment by a foreign company of plastic waste processing operations in the host country. Many of these services, including IT services; professional, technical, and business services; leasing or rental services; R&D services; maintenance, repair, and installation services; sewage and waste collection services; distribution services[43] and professional services related to construction services (see also Bellmann (2021[45])) also have other applications as well and are not limited to circular economic activity. Barriers that affect trade in these services broadly can consequently also affect their deployment for relevant circular economy activity and raise the costs of access to services that can support

[41] Regulation (EU) 2022/1616 of 15 September 2022 on recycled plastic materials and articles intended to come into contact with foods, and repealing Regulation (EC) No 282/2008.

[42] Including different materials such as paperboard, aluminium and plastic (multi-material multilayers) or only plastic multilayers of various polymer types. For many of these types of packaging, there are no recycling processes that would be economically viable or that would guarantee the production of new food-grade packaging free of contamination (Gueke, Groh and Muncke, 2018[62]).

[43] The distribution sector often serves as the main return point for waste for recycling from households.

circularity. Examples include measures such as equity restrictions, joint venture requirements that affect Mode 3 investment, as well as licensing and qualification requirements for Mode 4 access of experts.[44]

In addition, many countries may also have – or wish to introduce – regulations to ensure that waste management services are environmentally sound. Further, for many developing countries, regulations and potential market opening of the services sector will need to be tailored to reflect local priorities in terms of sustaining livelihood opportunities for informal sector workers involved in waste picking, who risk displacement, for instance, by large, mechanized sorting facilities.

4.2.3. Extended Producer Responsibility

Extended Producer Responsibility (EPR) schemes, which extend the producer's responsibility for a product to the post-consumer stage of a product's life cycle may also help promote circularity in plastics value chains. While the most common types of EPR schemes work by imposing recycling targets, some countries also start to use them to incentivize eco-design, such by modulating EPR fees paid by producers based on design criteria, including on the recyclability of the product (Laubinger et al., 2021[46]). Such eco-modulations are in place or envisioned in several countries, including Chile, Estonia, Italy and Portugal (OECD, 2022[2]). In the European Union, the Waste Framework directive requires Member States to introduce modulated EPR fees that take into account, where possible, a product's durability, reparability, re-usability and recyclability, as well as the presence of hazardous substances.[45]

EPR schemes may also help address the loss of plastic pellets in transportation and at production and conversion facilities (which represents 18% of microplastics in oceans). There are proposals, for instance, for supply chain regulatory measures that would make buyers responsible for certifying that the pellet sources for their products are not associated with loss of pellets into the environment.

From a trade perspective, EPR schemes may disadvantage domestic firms by raising their costs vis-a-vis foreign competitors that are not subject to such high standards of responsibility (IEEP, 2019[47]), or conversely, impact foreign companies seeking to export to the regulating country by requiring them to meet domestic standards.

EPR schemes often involve fees (see below). For example, as of May 2021, any company or brand that makes or imports any form of plastic packaging for distribution in South Africa is required to pay a certain EPR fee per ton.[46] A challenge can arise from the lack of harmonisation between EPR fees to be paid, the criteria used and the varying information and reporting requirements under different schemes. Differences across jurisdictions can generate additional costs for producers, which in turn can constrain investment in and scaling up of circular models. This is particularly the case when such schemes are combined with eco-modulations that impose different environmental requirements (Bellmann, 2021[45]).

4.3 The role of government incentives

Government incentives and disincentives affecting the circularity of plastics value chains include subsidies provided to various activities along the value chain, such as for fossil fuel exploration, extraction and refining, or primary, intermediate and final plastics production; financial and other investment incentives for the collection and recycling of plastics (Table 3); landfill and incineration taxes as well as charges and fees on single-use plastics or on virgin plastic materials; and targets and associated incentives for the use of recycled plastic content in public procurement and in private economic activities.

[44] For instance, services trade policies have the potential to support the initial aspect by acknowledging the credentials of architects, engineers, and builders, and by simplifying and digitizing the processes involved in credential recognition.

[45] Directive (EU) 2018/851 of 30 May 2018 amending Directive 2008/98/EC on waste, Article 8a, 4b.

[46] See https://www.packagingworldinsights.com/news/south-africa-implements-mandatory-epr-for-plastics-packaging-from-5-may-2021/.

Table 3.A typology of government support to different stages of the plastics value chain

Plastics life cycle stage	Type of support
Raw material/feedstock providers	Subsidies for fossil fuel exploration, extraction and refining, including tax breaks related to investments by, or the income of, primary producers of crude oil and natural gas; credit-related support; and tax breaks for refineries.
Primary plastic producers	Investment incentives for plants producing plastic resin and fibres.
Plastics converters	Investment incentives for manufacturers converting primary plastics into forms used in final plastic products and products containing plastics.
Final manufacturers of plastics	Government procurement preferences for locally manufactured plastic items and products.
Plastics collectors and recyclers	Investment incentives for recycling plants and subsidies to companies for collecting or recycling plastic. While subsidized collection is commonplace, some countries are moving toward, or have adopted, Extended Producer Responsibility (EPR) systems that require companies to cover the partial or full cost of collection.

Source: Deere Birkbeck and Sugathan (2022[23]).

4.3.1 Government support

The impact of government support on the cost of primary and intermediate production of plastics can be a key driver both of the growth of the plastics sector and of the economic sustainability of circular solutions. Preliminary evidence[47] suggests that such support applies mainly upstream to activities linked to fossil fuel feedstocks, precursors and primary plastics rather than to midstream activities (i.e. production of intermediate and final plastic products) or downstream to waste collection and recycling companies [see also OECD (2023[48])].

Overall government support for fossil fuels in 51 countries worldwide almost doubled from USD 362.4 billion in 2020 to USD 697.2 billion in 2021, as energy prices rose with the rebound of the global economy (IEA, 2023[49]), whereas preliminary findings from IEA, OECD and IMF combined sources, show that for 2021 the total number of fossil fuel subsidies in 2021 for 82 economies reached USD 731.65 billion.

A number of countries are both significant producers of oil or natural gas and of primary plastics, including Brazil, Canada, China, India, Indonesia, Iran, Mexico, the Netherlands, the Russian Federation (hereafter "Russia"), Saudi Arabia, the United Arab Emirates, and the United States (Deere Birkbeck and Sugathan, 2022[23]). Iran and Russia (together with Azerbaijan, Bahrain, Egypt, Kazakhstan, and Kuwait) are among the countries receiving the most subsidies to fossil fuels per unit of GDP. Further, in many countries where governments have a monopoly over natural resources, such as Iran and Saudi Arabia, "dual-pricing" schemes are used as investment incentives, whereby prices are fixed at a lower level for domestic producers, which could have an impact on plastics manufacturers as well (Deere Birkbeck and Sugathan, 2022[23]).

Subsidies affecting the upstream part of the plastics value chain artificially lower the price of virgin plastic feedstocks, encouraging further growth of the sector, discouraging the use of secondary, recycled raw materials by plastics producers, and limiting the space for natural material non-plastic substitutes. For example, a study by the Minderoo Foundation revealed that the 100 largest polymer producers continued to rely almost exclusively on "virgin" (i.e. fossil fuel-based) feedstocks, while production based on recycled polymers accounted for no more than 2% of total output in 2019 (Minderoo Foundation, 2021[50]).

Increasing prices of primary plastics through fossil fuel subsidy reform or increased taxation on virgin plastic polymers could lead to lower demand for virgin plastics, incentivizing greater recycling of plastics, the replacement of certain plastics with substitutes, as well innovative business models based on extending the life and repairability of products or 're-use and refill' of products to reduce the use of plastic packaging. There is growing attention to climate opportunities that can be associated with recycled and secondary

[47] Given the lack of readily available data, considerable research is required to understand the scale, nature and environmental impact of subsidies at different points in the plastics life cycle. A key challenge is discerning the impact of subsidies provided by countries along various segments of the value chain in an industry dominated by large vertically integrated companies that include upstream fossil fuel extraction and supply and downstream plastic production.

plastics as the production process for recycled plastic feedstocks is less carbon intensive than for conventional virgin polymers (OECD, 2022[2]). However, policies that restrain the growth of plastics demand present the most direct way to reduce the overall carbon footprint of plastics production (OECD, 2022[2]).

Subsidies to manufacturers of new plastic products could also disincentivize the shift to more sustainable design of products (such as in regard to repairability) and new business models that use less plastics. Subsidies to plastics manufacturers could, however, potentially be targeted to support the shift to more sustainable product design.

In addition to national government support, international financial institutions (IFIs), including multilateral and regional development banks, as well as export credit agencies, have played an important role in financing petrochemical projects over the past decade, especially in emerging economies (Steenblik, 2021[51]). The presence of a public investment or loan can play a key role in leveraging larger amounts of private finance by decreasing the risk for private investors. As of mid-2021, total state financial flows (comprising financing from governments and government institutions) to the petrochemical sector since 2009 stood at around USD 38 billion globally (Barrowclough and Finkill, 2021[52]).

Subsidies provided by governments to firms involved in waste collection and recycling could support expanding capacity for waste collection, sorting, safe disposal and recycling and avoid negative environmental effects associated with dumping in open landfills or incineration but may also alter conditions of competition for foreign firms if they are solely directed at domestic firms operating in the sector, or distort international recycling markets. Government support for waste management investments has played a key role in OECD countries (OECD, 2019[53]). However, only a few had comprehensive circular economy policies in place at the time of the most recent *OECD Environmental Performance Reviews*, with Japan being one of the leading countries in this direction. The Eco Town Programme in Japan has subsidised private companies to put in place innovative recycling projects for municipal solid waste (MSW) and for key waste streams including organic waste, plastic waste and Waste Electrical and Electronic Equipment (WEEE).

4.2.4. Tax incentives and disincentives

Circular economy policies relevant to reducing plastic pollution also include a range of 'behind the border' policies designed to encourage or discourage certain behaviour, including landfill and incineration taxes as well as charges and fees on single-use plastics or on virgin plastic materials; or positive incentives such as tax rebates to spur innovation, trade and technology transfer in plastic substitutes, recycled, and recyclable plastics, as well as waste management and clean up technologies. Targets for the use of recycled plastic content in various economic activities outside the public sector are usually associated to tax levies for products failing to meet the target, such as, for example, the GBP 200 tax introduced by the UK per ton of plastic packaging with less than 30% recycled content (OECD, 2022[2]).

While such measures do not specifically target trade, they can nonetheless have trade consequences and impact companies involved in international supply chains exporting to the country imposing the levy. Taxes on landfill implemented to foster recycling can also be a driver for trade in waste if companies find it cheaper or more practical to export waste than to pay tax or invest in recycling domestically (Mazzanti and Zoboli, 2013[54]).

Finally, government interventions can encourage the replacement of plastics with environmentally sound substitutes, which preferably are also re-usable and recyclable, such as those derived from jute or natural fibres. Similarly, governments can foster greater use of substitutes such as paper, glass and metal that are often much easier to recycle and can also be re-usable (in the case of glass and metal), although careful assessment of the life cycle environmental impact of such substitutes will also be necessary in order to determine which is, overall, environmentally sound in different settings and whether environmentally sound waste management options are available. Governments can also promote the use of alternative plastics, such as plastics with higher recycled content, although these are not appropriate for all applications. Notably, alternative plastics such as bio-based plastics (e.g. plastics made fully or partially made from biological resources rather than fossil fuel feedstocks) are not necessarily compostable or biodegradable, and their environmental credentials rely on a full life cycle assessment (including changes in land use associated with the production of biological resources). Similarly, while compostable and biodegradable plastics may be a more sustainable alternative to non-biodegradable plastics, there are considerable questions about the environmental credentials and claims associated with these alternative plastics (see in particular the discussion about biodegradability in OECD (2022[2])).

More broadly, government policies to support the development and expansion of delivery and retail models that avoid plastics use, such as through reuse and refill business models, or that promote the extension of product life and multiple use of plastic products by encouraging reuse, refill, repair or remanufacturing complement and reinforce parallel measures to encourage eco-design of products towards higher recyclability. For instance, the French 2020 circular economy Act[48] imposes minimal percentages of packaging refilling or reuse to be gradually implemented by 2027 and foresees the development of bonus/penalty systems to encourage higher recyclability eco-design of products in the market.

4.3.2 Government procurement

Several governments use green public procurement as part of their policy frameworks for reducing plastic pollution and improving circularity. For example, the 2018 European Strategy for Plastics in a Circular Economy[49] highlights the role that public procurement can play in improving recyclability and reducing waste and encourages national and regional authorities to favour reusable and recycled plastics in public procurement. The Strategy endorses the European Union's Ecolabel and Green Public Procurement (GPP) criteria50 to improve the recyclability of plastics (including marking large plastic parts to facilitate sorting; designing plastic packaging for recyclability; and designing items for easy disassembly in furniture and computers). In the context of the French Circular Economy Act – which imposes public procurement targets of between 20% and 100% of reused or recycled products for central government and local authorities- a series of "green clauses" were developed to help procuring entities reach targets for reused and recycled plastic in electronic office equipment.

Australia's 2019 National Waste Policy Action Plan envisages specific procurement targets for the use of recycled material in infrastructure across all government procurement (Australian Government and Australian Local Government Association, 2019[55]). The plan aims to encourage Australian businesses to adopt and publish sustainable procurement policies, including use of recycled content. The Australian government will explore with industry specific opportunities to increase uptake of recycled content in buildings and infrastructure with priority given to plastics, glass and rubber policies, including use of recycled content. Similar objectives are included in Canada's Greening Government Strategy, including through the procurement of sustainable plastics products in the context of the government's actions on plastic waste in federal operations; and in Korea's Green Public Procurement Programs, which identify recycled plastics as a specific product group through the use of Korea's Eco-label Certification System (ECS).[51]

[48] Loi nº 2020-105 relative à la lutte contre le gaspillage et à l'économie circulaire.

[49] COM/2018/028 final EUR-Lex - 52018DC0028 - EN - EUR-Lex (europa.eu).

[50] GPP criteria are voluntary criteria that EU Member procuring authorities can incorporate into a public procurement procedure for goods, services or works in order to reduce the environmental impact of a purchase.

[51] Korea Environmental Policy Bulletin - Eco-label Certification System (ECS) in Korea.pdf (greenpolicyplatform.org).

5. Conclusion

Over the past two decades, the worldwide yearly production of plastic goods has more than doubled, while the global capacity to manage waste has remained inadequate (OECD, 2022[2]). Production is geographically spread out. A wide range of sectors in the economy use plastics, with packaging, construction, and transportation accounting for more than 60% of total use (OECD, 2022[1]). At the end of the plastic chain, 22% of the plastic waste generated escapes proper waste management systems, while only 15% is actually recycled from the total plastic waste collected for recycling. The escalating production and use of plastics, along with insufficient measures to manage waste and prevent leakage, have given rise to a wide array of environmental, social, public health, and economic challenges. Tackling plastic pollution along value chains, from the production of raw materials to consumption and disposal is now pressing.

The lack of adequate waste management capacities in many countries, combined to the difficulty in efficiently reconciling safety and sustainably considerations in recycling, means that plastic pollution cannot be viably dealt with solely through waste management. Whole life-cycle circular solutions, including opting for more environmentally-friendly primary materials in production (e.g. producing bio-based instead of fossil-fuel based plastics), providing substitutes to reduce the use of plastic products, and developing technologies for more effective recycling of plastic waste, would be the way forward.

The economic viability of circular plastic value chains can be greatly influenced by trade policies, including on the diffusion of goods, services and technologies for the collection, waste management, recycling and clean-up of plastics; the viability of repair and remanufacturing operations for products that contain plastics; and that of markets for environmentally sound and effective substitutes to plastics.

Trade-related policies at the border can influence trade costs affecting both plastics and plastic substitutes. In particular, reducing tariffs on plastic substitutes will affect the economic viability of alternatives to environmentally harmful plastic products, in particular single-use plastics. They may constructively complement measures such as bans or other restrictions on plastic products and waste, including restrictions on unnecessary packaging, which aim at minimizing plastic waste generation upstream. An effective implementation of such measures may require adjusting the HS system to better reflect environmental considerations, but would need to ensure that further disaggregation can be efficiently implemented at the border without generating disproportionate hurdles.

While reducing plastic waste generation appears to be the most effective solution from an environmental perspective, there is still a need to improve plastic waste management. Waste import bans may result in diverting waste flows to countries without the regulatory and technical capacity to manage them in an environmentally sound way and appropriately controlled trade of such waste could help direct them where they could be handled more effectively. Trade facilitation measures to expedite the movement of equipment used for sorting and recycling plastic waste, non-plastic alternatives, or plastic waste and scrap intended for certified environmentally sound waste management facilities have the potential to advance circular economy objectives. Internationally agreed environmental labels, or the use of new identification technologies could help customs authorities identify goods made from recycled or recyclable plastics and grant this speedier clearance.

Regulatory measures — such as technical regulations, standards, labelling schemes, and conformity assessment procedures to promote the creation of product designs that minimise pollution at all stages of the plastic life cycle, or establish quality standards and recycling requirements for secondary materials — would play a significant role in shaping the dynamics of plastic circular value chains. In the area of services such regulatory measures can support the emergence of innovative circular business models, such as product leasing, reuse and refill systems, repairability-focused approaches, or enable the trade of remanufacturing and refurbishing services; and promote plastic products' circularity through research and development (R&D) initiatives and eco-design practices. EPR schemes imposing recycling targets, or incentivising eco-design by modulating EPR fees based on a product’s durability, reparability, re-usability and recyclability may also help promote circularity in plastics value chains. Seeking to harmonise these measures could help avoid additional costs for producers resulting from differences across jurisdictions.

Finally, government incentives have in the past been a key driver of the growth of the plastics sector and could, conversely, spur a move towards increased circularity in the plastics value chain. Financial support can disincentivize the shift to more sustainable product design and new business models that use less plastics when it is directed to primary and intermediate production of plastics, or on the contrary stimulate innovation, trade, and the transfer of technology in alternative materials to plastic, recycled plastics, and recyclable plastics. Taxes on landfill and incineration, as well as charges and fees imposed on single-use plastics or virgin plastic materials can also encourage the shift to more efficient waste management systems and technologies.

While it would be important to synchronise domestic regulatory measures and requirements applied at the border, at present, most efforts to tackle plastic pollution are designed domestically in an *ad hoc* and uncoordinated manner with only limited attention to the possible effects on third countries (Jansen, 2012[56]). However, recent initiatives such as UNEP's Intergovernmental Negotiating Committee (INC) work to develop an international legally binding instrument on plastic pollution, including in the marine environment, the High Ambition Coalition to End Plastic Pollution or the WTO Dialogue on Plastic Pollution and Environmentally Sustainable Plastics Trade (DPP) could be game-changing. Enhanced international cooperation to promote trade-related circular economy objectives would reduce the costs of policy heterogeneity, provide incentives for scaling up circular solutions and encourage the adoption of such solutions by a broader set of countries.

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Annex A. Tables and figures

Table A.1. Types of polymers and examples of end-use applications for plastics

Polymer	Abbreviations	End-use examples
Polypropylene	PP	Food packaging, automotive parts
Low-density polyethylene	LDPE	Reusable bags, food packaging film
High-density polyethylene	HDPE	Toys, shampoo bottles, pipes
Polyvinylchloride	PVC	Window frames, floor covering, pipes, cable insulation
Polyethylene terephthalate	PET	Beverage bottles
Polyurethane	PUR	
ABS, elastomers, biobased plastics, PBT, PC, PMMA, PTFE*	Other	Insulation, mattresses
Fibres made of different polymers	Fibres	Tires, packaging, electronics, automotive

Note: *ABS stands for Acrylonitrile butadiene styrene, PBT for Polybutylene terephthalate, PC for Polycarbonates, PMMA for Poly (methyl methacrylate) (also known as plexiglas) and PFTE for Polytetrafluoroethylene.
Source: OECD Plastics Outlook Database (2022).

Table A.2. TiVA sectoral coverage

D01T02	Agriculture, hunting, forestry
D03	Fishing and aquaculture
D05T06	Mining and quarrying, energy producing products
D07T08	Mining and quarrying, non-energy producing products
D09	Mining support service activities
D10T12	Food products, beverages and tobacco
D13T15	Textiles, textile products, leather and footwear
D16	Wood and products of wood and cork
D17T18	Paper products and printing
D19	Coke and refined petroleum products
D20	Chemical and chemical products
D21	Pharmaceuticals, medicinal chemical and botanical products
D22	Rubber and plastics products
D23	Other non-metallic mineral products
D24	Basic metals
D25	Fabricated metal products
D26	Computer, electronic and optical equipment
D27	Electrical equipment
D28	Machinery and equipment, nec
D29	Motor vehicles, trailers and semi-trailers
D30	Other transport equipment
D31T33	Manufacturing nec; repair and installation of machinery and equipment
D35	Electricity, gas, steam and air conditioning supply
D36T39	Water supply; sewerage, waste management and remediation activities
D41T43	Construction
D45T47	Wholesale and retail trade; repair of motor vehicles
D49	Land transport and transport via pipelines
D50	Water transport
D51	Air transport
D52	Warehousing and support activities for transportation
D53	Postal and courier activities
D55T56	Accommodation and food service activities
D58T60	Publishing, audiovisual and broadcasting activities
D61	Telecommunications
D62T63	IT and other information services
D64T66	Financial and insurance activities
D68	Real estate activities
D69T75	Professional, scientific and technical activities
D77T82	Administrative and support services
D84	Public administration and defence; compulsory social security
D85	Education
D86T88	Human health and social work activities
D90T93	Arts, entertainment and recreation
D94T96	Other service activities
D97T98	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use

Table A.3. Number of environmentally-related plastics patents filed at IP5, 2019

Country	Number of filed patents	Country	Number of filed patents
Japan	848	Brazil	4
United States	304	Finland	4
Korea	236	Israel	4
China	191	Luxembourg	4
Germany	172	Russia	3
Chinese Taipei	71	Sweden	3
France	45	Chile	2
Netherlands	41	Liechtenstein	2
Switzerland	25	Poland	2
Austria	24	Portugal	2
United Kingdom	21	Singapore	2
Italy	20	Bulgaria	1
Belgium	15	Romania	1
Canada	10	United Arab Emirates	1
India	9	Czechia	1
Saudi Arabia	5	Hong Kong (China)	1
Spain	5	Denmark	1
Australia	5	Viet Nam	1
Türkiye	5	Colombia	1

Source: Authors' compilation based on data from OECD, STI Micro-data Lab: Intellectual Property Database, http://oe.cd/ipstats.

Annex B. Methodology to collect data on patent filed at IP5 patent families for environmentally-related patents in plastics

The patent data comes from the PATSTAT database provided by STI at the OECD. IP5 patent families cover families of patent applications that have been filed at two different IP offices worldwide, of which at least one of the IP5 offices, namely the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the People's Republic of China National Intellectual Property Administration (CNIPA) and the United States Patent and Trademark Office (USPTO). Patents in technologies related to plastics are identified using a selection of classes of the Cooperative Patent Classification (CPC). The CPC is the result of a partnership between the EPO and the USPTO in their joint effort to develop a common, internationally compatible classification system for technical documents, in particular patent publications, which will be used by both offices in the patent granting process.

The CPC codes includes patent categories that seem most obviously related to the circular economy of plastics such as: Recovery or working-up of waste materials (recovery of plastics; polymerisation processes involving purification or recycling of waste polymers or their depolymerisation products); Recovery of plastics or other constituents of waste material containing plastics; (volume reduction of waste plastics, e.g. by mechanical compacting or melting disposal of solid waste B09B; chemical recovery C08J11/00); Treatment or chemical modification of rubbers; Disposal of solid waste, Plastics recycling; Rubber recycling, etc. To make sure that patents seeming to be related to circular economy of plastics, but necessarily having an environmental purpose a keyword search based on a list of keywords developed by Dussaux and Agrawala (2022[27]) was applied.

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