

Improving Markets for Recycled Plastics

Trends, Prospects and
Policy Responses

POLICY HIGHLIGHTS



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Trends, Prospects and Policy Responses



“We need to support the design, development and delivery of policies to make our use of plastics more sustainable, enabling our societies and economies to reap the benefits of plastics, while avoiding associated impacts to the environment, health and to the economy.”

Angel Gurría, OECD Secretary-General



Key Messages

- **Plastics are widely used materials that deliver a range of important benefits to society. Their global production and use are expected to increase fourfold to 2050.**
- **Plastics production, use and disposal are also responsible for significant greenhouse gas emissions and when poorly managed lead to pollution in the natural environment, particularly in drinking water and the oceans. The ecosystem damages and risks to human health resulting from marine litter are only beginning to emerge, but are of considerable concern given the longevity of plastics.**
- **Transitioning to a more circular economy – one characterised by longer lived plastics products with less toxic content and higher plastics collection and recycling rates – could reduce the diffusion of plastics pollution in the environment. One of the obstacles to this transition is poorly functioning markets for recycled plastics: market volumes and liquidity are limited, and prices are highly volatile. Global plastics recycling rates are estimated to be less than 20% (with significant variation across countries), and the market share of recycled plastics is currently less than 10%.**
- **Potential suppliers of recycled plastics do not invest sufficiently in sorting and recycling capacity because the profitability of these operations is limited. Potential buyers (i.e. manufacturing firms) have limited incentives to use recycled plastics as inputs because of uncertainty about their availability and quality. Market outcomes could improve significantly if these issues were addressed.**
- **Policy interventions need to address bottlenecks on the demand and supply side of recycled plastics markets. On the demand side, measures should focus on helping establish a separate demand for recycled plastics and levelling the playing field between virgin and recycled plastics. On the supply side, measures are needed to help increase the supply of recovered plastics and the quality of the resulting feedstock. This should include efforts to improve the sustainability of plastic materials and products at the design stage.**

1

Plastics: production, uses and benefits to society

Plastics have gathered much attention recently due to their ubiquity in the global economy, the low material recovery rates that they currently achieve, and the environmental impacts associated with current disposal methods.

Since 1950, the use of plastics has grown rapidly. Today, plastics have become one of the most commonplace materials on the planet.

The production and use of plastics is expected to continue to increase in the coming decades:

- Annual plastics production grew at a rate of 5% per annum between 2000 and 2015; more than half of the plastics ever produced were made during this period.
- If production continues to grow at current rates, annual plastics production will reach 1 600 million tonnes in 2050 (EMF, 2017).

407

MILLION TONNES

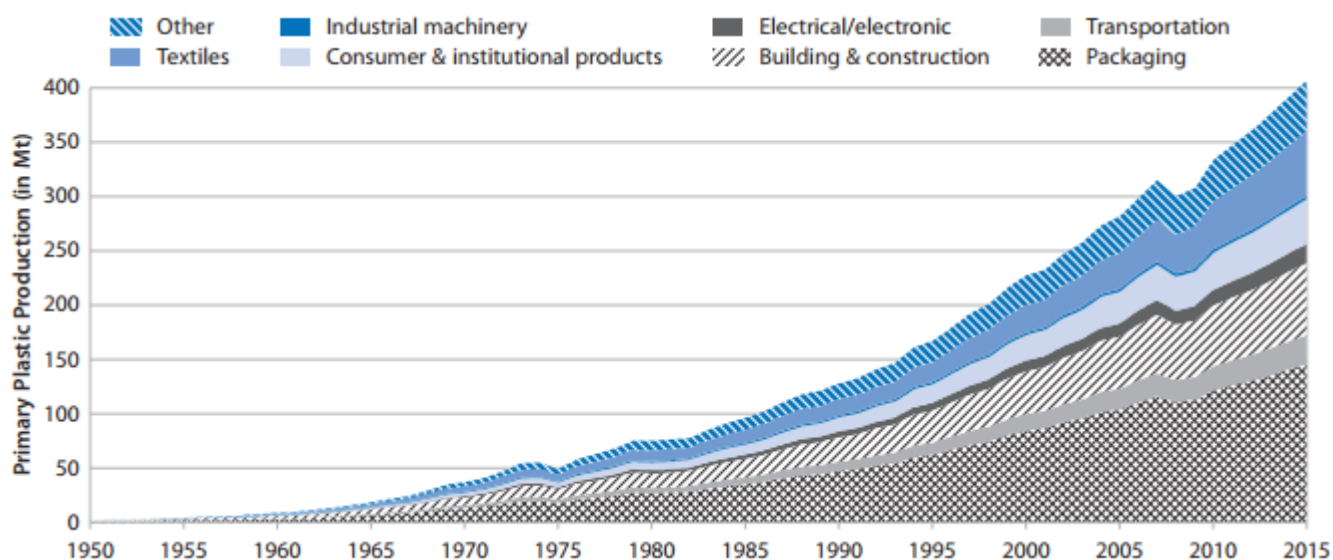
407 million tonnes of plastic was produced in 2015: triple the amount produced in 1990 (Geyer et al., 2017).

1 600

MILLION TONNES

If current trends continue, 1 600 million tonnes of plastics will be produced annually in 2050. This represents a fourfold increase from present levels (EMF, 2017).

Figure 1. **Global primary plastics production has grown rapidly, and is projected to continue increasing to 1 600 million tonnes in 2050**



Source: Geyer et al. (2017).

Explaining the rapid growth in plastics

The rapid growth of plastics production and use is largely due to the unique properties of the material. Plastics have a high strength-to-weight ratio, can be easily shaped into a wide variety of forms, are impermeable to liquids, and are highly resistant to physical and chemical degradation. Plastics can also be produced at relatively low cost. It is these properties that have led to the substitution of traditional materials (e.g., concrete, glass, metals, wood, and paper) by plastics in many applications.

The widespread use of plastics has generated a number of benefits for society and for the environment.

- Plastics are often used to protect or preserve foodstuffs and, in doing so, help to reduce food waste.
- Plastics are also an important input in vehicles, where their relatively light weight results in lower fuel use and greenhouse gas emissions.
- Plastics are widely used in infrastructure applications, where their impermeability and durability can lead to water, material and energy savings in urban areas.
- Finally, the use of plastics, rather than materials derived from biomass (e.g., wood and paper), in a range of applications can slow land-cover change and biodiversity loss.



2

The environmental impacts of plastics production and use



The increasing pervasiveness of plastics has not been without drawbacks. The production, use and disposal of plastics is responsible for significant greenhouse gas emissions and generates plastics pollution in the natural environment when poorly managed.

Greenhouse gas emissions

Traditional plastics production involves the transformation of petroleum or natural gas into their constituent monomers. This process is highly energy-intensive, and was estimated to account for 400 million tonnes of greenhouse gas emissions (around 1% of the global total) in 2012 (EC, 2017).

The fossil fuel feedstock used in plastics production also accounts for 4% to 8% of global oil and gas production and this share could increase further in the future (Hopewell et al., 2009; WEF, 2016). The hydrocarbon molecules that are bound into the structure of plastics are initially inert, but release carbon dioxide as well as other air emissions when incinerated.

Plastics pollution

The proliferation of plastics use, in combination with poor end-of-life waste management, has resulted in widespread, persistent plastics pollution.

Around 6 300 million tonnes of plastics waste are thought to have been generated between 1950 and 2015, of which only 9% had been recycled, and 12% incinerated, leaving nearly 80% to accumulate in landfills or the natural environment (Geyer et al., 2017).

Plastic pollution is present in all the world's major ocean basins, including remote islands, the poles and the deep seas, and an additional 5 to 13 million tonnes are introduced every year (Jambeck et al., 2015).



Implications of plastics pollution for marine ecosystems and environmental quality

The proliferation of marine plastics, in the form of micro- or macro-plastics, has impacts on the quality of marine and coastal environments. Marine wildlife is harmed through ingestion of macro-plastics or entanglement, with negative implications for ecosystem health and the overall sustainability of fisheries. Ingestion of plastics, or entanglement in them, has been documented in around 500 species of marine mammals, fish and seabirds, with clear negative consequences for marine ecosystems and the fishing industry (UNEP, 2016). Coastal tourism is also affected as tourists seek to avoid beaches known to have high concentrations of plastics litter. Taken together, the economic cost of these impacts has been estimated at USD 13 billion per year (UNEP, 2014).

Implications of plastics pollution for human health

Plastics pollution also poses risks for human health. The presence of plastic in seafood, including fish and shellfish, and their subsequent consumption by the public has led to concerns about chemical bio-accumulation in the food chain, even if empirical evidence for this is currently limited (Thompson, 2015; GESAMP, 2015; Koelmans et al., 2017).

Plastics pollution warrants considerable attention for two additional reasons:

1. Plastics that accumulate in the natural environment will only decompose over hundreds, or even thousands of years, during which time they fragment into smaller microplastics and nanoplastics.
2. There remains uncertainty about the magnitude of the damages. Significant quantities of plastic have only been introduced into the natural environment relatively recently and the full impact on marine and terrestrial ecosystems will only emerge in the longer term.



3

Higher plastics recycling rates could improve environmental outcomes

The environmental impacts of plastics can be reduced in a number of ways, including through better collection and treatment of waste plastics, the promotion of waste prevention strategies such as the introduction of reusable plastic products, through the substitution of alternative, less environmentally harmful materials, through the development of bio-based or bio-degradable plastics, or through the design of more easily recyclable plastics and effectively recovering them at end-of-life.

Better functioning markets for recycled plastics can contribute to higher plastics collection and recycling rates. This would help to reduce the diffusion of plastics pollution in the environment while continuing to allow the beneficial aspects of plastics use to be realised. The diversion of waste plastics towards recycling facilities, and the resulting production of recycled plastics, would also reduce demand for incineration of waste plastics and of virgin plastics production (due to substitution), both of which are highly carbon-intensive activities.

A large number of life-cycle assessments (LCAs) have been carried out on the relative environmental impacts of various options for end-of-life plastics management. Several recent meta-analyses of this body of work unambiguously conclude that plastics recycling has a significantly smaller greenhouse gas footprint than plastics incineration or landfilling (WRAP, 2010; HPRC, 2015; Bernardo et al., 2016). Around three quarters of the individual LCA studies assessed in WRAP (2010) found that the global warming potential associated with plastics recycling was, at a minimum, half of that associated with incineration or landfilling.



The displacement of virgin plastics by their recycled equivalents is one important reason for the relative desirability of plastics recycling. Figure 2 shows the energy intensity of virgin and recycled plastics production.

The LCA literature for plastics focuses mostly on environmental indicators such as global warming potential, energy use, and water use. Less attention has been directed towards other environmental impact categories such as those associated with marine plastic pollution. Despite the lack of empirical evidence, recycling is likely to be just as effective as alternative waste treatment options – landfilling or incineration – in reducing the flow of plastics waste into the environment: in each case, initial waste collection is a prerequisite for further treatment.

Box 1. ADDITIONAL APPROACHES TO ADDRESSING THE ENVIRONMENTAL IMPACTS OF PLASTICS – AND THEIR ASSOCIATED RISKS

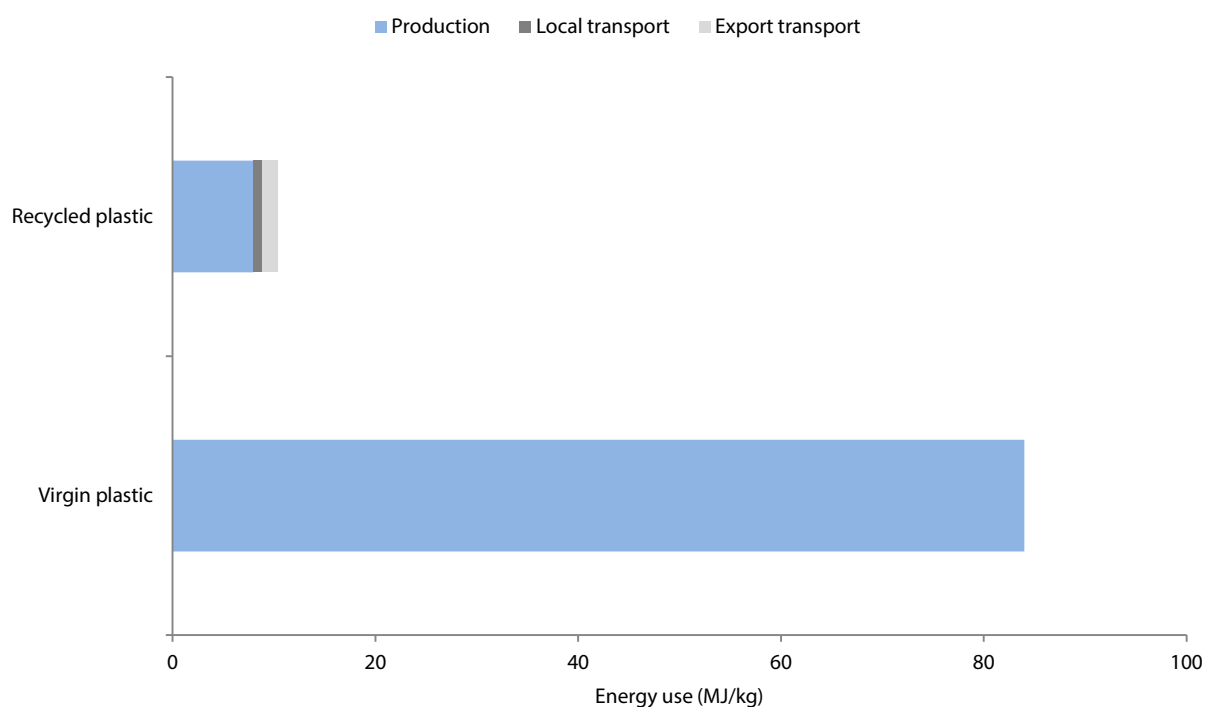
In addition to higher plastic waste collection and recycling rates, there are at least three other pathways through which the environmental side effects of plastics production and use could be addressed. Each of these approaches has considerable potential, but also raises a set of associated risks.

Waste prevention (through “light weighting”, product re-use, or the reduced use of unnecessary plastic packaging or products more generally) is a widely accepted means of reducing plastics pollution. However, depending on the approach taken, prevention may also create new risks. One example relates to the emergence of “dematerialised” or low-density plastics. There is anecdotal evidence to suggest that the low market value of these plastics serves to hinder informal collection in low-income countries.

The use of alternative materials in the place of plastics can reduce the environmental damages associated with plastics, but may also negate the use-phase energy savings that they bring in the first instance. Switching to alternative materials can also magnify environmental burdens elsewhere. For instance, cotton tote shopping bags, while helping to reduce the diffusion of plastics in the environment, also have a relatively large greenhouse footprint. Recent research indicates that a cotton shopping bag would need to be re-used around 150 times before attaining the lifecycle greenhouse gas footprint of a single-use plastic bag (UK EA, 2011; Denmark EPA, 2018).

Shifting to bio-based or biodegradable plastics may also have unintended consequences. Increased demand for biomass feedstock can amplify land-cover change and biodiversity loss. Enhanced biodegradability can increase the dispersion of microplastic fragments in the environment (when degradation is incomplete) and reduce the quality of the waste plastics required for recycled plastics production.

Figure 2. **Producing plastic from fossil fuels is significantly more energy intensive than doing so from plastics scrap**



Note: Data are for plastic resins only.

Source: Wong (2009).

4

Markets for recycled plastics are not functioning well



The dysfunctional character of markets for recycled plastics manifests itself in several ways. Market volumes and liquidity are limited, trade flows are small as a proportion of total plastics waste generation, and market prices are highly volatile. Global plastics recycling rates are low and the market share of recycled plastics is less than 10%.

Recycling rates

Despite recent efforts, plastic recycling continues to be an economically marginal activity. Current recycling rates are thought to be 14–18% at the global level. The remainder of plastic waste is either incinerated (24%), or disposed of in landfill or the natural environment (58–62%) (Geyer et al., 2017). Plastics recycling rates are substantially lower than those for other widely used materials. Recycling rates for major industrial metals – steel, aluminium, copper, etc. – and paper are thought to exceed 50% (UNEP, 2013; van Ewijk, 2017).

Plastic recycling rates vary significantly across different waste streams and polymer types. Recycling of post-industrial plastics is well-established and has been relatively stable over recent decades. In contrast, recycling of post-consumer plastics is less common, but has increased steadily since the 1980s as municipal recycling schemes have developed in high income countries. Certain polymers are more widely recycled than others. Recycling rates for polyethylene terephthalate (PET) and high-density polyethylene (HDPE) commonly exceed 10%, while those for polystyrene (PS) and polypropylene (PP) are closer to zero (see Table 1).

Table 1. Plastic recycling rates vary significantly across polymer types

Polymer	USA*	Japan***
PET	19.1%	85%
HDPE	10.5%	16%****
LDPE	5.8%	
PS	1.3%	21%
PP	0.8%	15%
EPS	No data	No data
PVC	0.0%	24%

Note: *2014, **2016, ***2015, ****Combined data for HDPE and LDPE.

Source: OECD questionnaire responses.

14-18%

Between 14% and 18% of plastics at the global level are recycled. (Geyer et al., 2017).

Recycled plastics market share

Production statistics for recycled plastics are largely unknown. However, a recent study showed that approximately 46 million tonnes of recycled plastics resins are produced per year (Geyer et al. 2017). This represents 12% of total global plastic resin production, but this is likely to be an upper estimate.

Trade flows

The volume of plastics waste trade is small relative to total plastics waste generation. Of the 300 million tonnes of plastics waste generated in 2015 (Geyer et al., 2017), only around 13 million tonnes (or 4%) was exported outside the country of origin (UN COMTRADE, 2018). Imports of these materials are concentrated in a small number of countries. For example, China accounted for around 8 million tonnes (or 60%) of plastics waste imports in 2016 (UN COMTRADE, 2018).

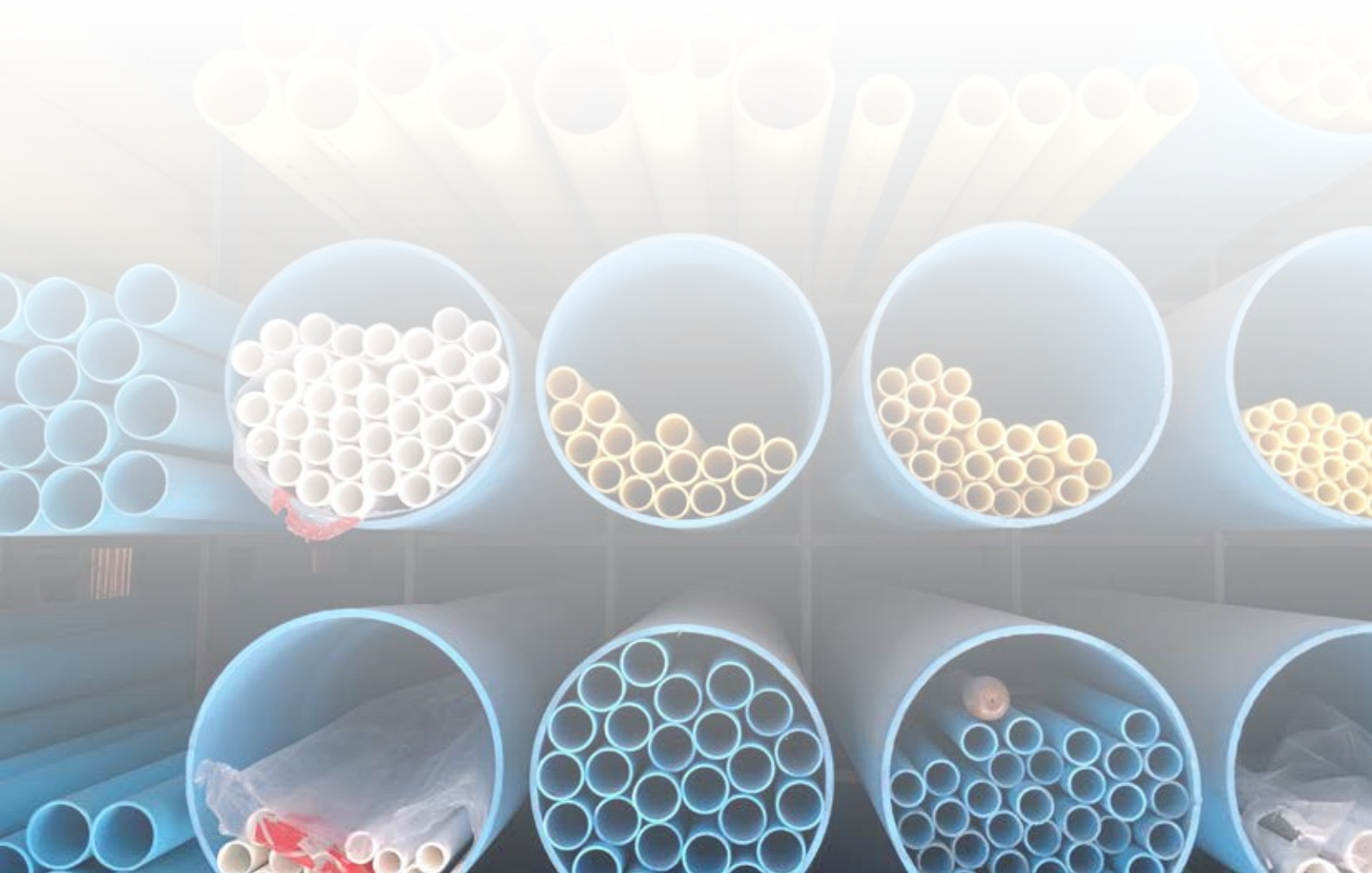
The concentration of demand in a small number of countries renders the markets for recycled plastics vulnerable to demand shocks. For example, the implementation of restrictions on the import of certain types of waste plastic by China in 2017 has created significant market disruption. Reduced access to the Chinese market for waste plastics has led to growing waste stockpiles in many countries. There are also concerns that the diversion of these materials to countries with relatively weak treatment and environmental standards could create new health and environmental impacts.

24%

Approximately 24% of plastics at the global level are incinerated. (Geyer et al., 2017).

58-62%

Between 58% and 62% of plastics at the global level are disposed of in landfill or in the natural environment. (Geyer et al., 2017).



5

The rationale for policy action

There is a co-ordination failure at the heart of poorly functioning markets for recycled plastics. Potential suppliers of recycled plastics do not invest sufficiently in sorting and recycling capacity because the profitability of these operations is limited. Potential buyers (i.e. manufacturing firms) have limited incentives to use recycled plastics as inputs because of uncertainty about their availability and quality. Market outcomes could improve significantly if these issues were addressed.

Suppliers and buyers of recycled plastics would both benefit from larger and more liquid markets for recycled plastics, but neither party has strong incentives to act alone. In turn, improved market outcomes could, to some extent, become self-fulfilling as scale efficiencies are captured and a more widespread consumer acceptance develops.

These factors provide a clear rationale for policy intervention, as well as potential insights into how to do it effectively. In particular, policies are likely to be more effective if they jointly address the challenges – market failures, policy misalignments, and status quo biases – on both the supply and demand sides of recycled plastics markets. Put differently, an effective policy framework would address challenges across the entire plastics life cycle, from plastics and product design through to end-of-life management and recycled plastic production.



6

The demand for recyclable plastics: Key challenges and policy responses

Barrier #1: There is no differentiated demand for recycled plastics.

Manufacturers of recycled plastics operate in the same market as traditional (virgin) plastics producers and are price takers in that market.

At present, recycled plastic production is for the most part not economically competitive at current prices. This is partly a consequence of the cost structure of recycled production, but also reflects virgin plastics prices that are highly volatile and perhaps too low to reflect all external costs. Un-addressed market failures and existing policy misalignments (e.g., government support for hydrocarbon inputs to plastics production) both contribute to the low prices for virgin plastics.

Policy interventions to address these challenges could aim to level the playing field between virgin and recycled plastics or support the market for recycled plastics. They include:

- Taxes on the use of virgin plastics or differentiated value added taxes for recycled plastics or plastic products;
- Reform of support for fossil fuel production and consumption;
- Introduction of recycled content standards, targeted public procurement requirements, or recycled content labelling;
- Creation of consumer education and awareness campaigns (concerning the environmental benefits of recycled plastics) in order to stimulate demand for products containing recycled plastics.





Barrier #2: There is uncertainty about the availability and quality of recycled plastics.

Manufacturing firms have incentives to use recycled plastics in their production processes. Doing so can create reputational benefits, and may also allow a small price premium to be charged if the final product can be marketed as “green”. That said, many manufacturers continue to rely solely on virgin plastic inputs, both because of their lower cost, but also due to inertia and uncertainty about the properties of recycled plastics.

While the quality, performance characteristics, and near-term availability of virgin plastics are largely assured, there may be uncertainty about the same characteristics of recycled plastics. Status quo biases also hinder switching, even in situations where recycled plastics are cost competitive and of comparable quality to their virgin equivalents.

There are also increasing concerns over hazardous or otherwise problematic additives and monomers that are used in the manufacture of some virgin plastics. For manufacturers of recycled plastics, uncertainty about the presence of these additives in plastic waste can hinder recycling altogether (because the resulting output may be of low quality or pose significant health risks in certain food related applications as well as other applications such as toys for children). The lack of transparency regarding hazardous chemicals in plastic waste streams is thus a major barrier to increased plastics recycling.

Policy interventions that could address these challenges include:

- Creation of certification standards for recycled plastics;
- Facilitation of better coordination and communication across the plastics value chain, including through the promotion of chemical information systems;
- Restrictions on the use of hazardous additives in plastics manufacturing.

7

The supply of recycled plastics: Key challenges and policy responses

Barrier #3: The cost of recycled plastics production is relatively high.

The cost structure of recycled plastics production is different from that of virgin production and is, at current oil prices, often higher. There are a number of reasons for this.

Plastics waste generation is geographically dispersed, and aggregating waste materials into economically viable quantities incurs considerable collection and transport costs. In many cases, this waste is co-mingled with food residues, paper and other materials. The separation of the plastics fraction (and the individual polymers of plastic) into clean feedstock for reprocessing can be technically challenging and involves considerable capital or labour costs. In addition, a significant proportion of the plastics in the waste stream are built into more complex end-of-life products that in many cases are difficult and costly to disassemble.

On top of these factors, the alternative waste management options to recycling – landfill or incineration – are relatively cheap in many countries. Gate fees may not necessarily reflect the full social cost of these alternatives.

Policy interventions to address these challenges include:

- Introduction of multiple stream collection systems allowing separated collection of recyclables;
- Creation of incentives for better product and plastics design (e.g. design for reuse and recycling), such as through better designed extended producer responsibility, product stewardship and deposit-refund systems;
- Support for R&D for improved plastics management systems and the sustainable design of plastics (more easily recyclable or more easily biodegradable for example), working in close partnership with industry;
- Introduction of more ambitious recycling rate targets and harmonisation of the methods used to calculate these rates;
- Increased stringency of landfill and incineration fees to better reflect the full social cost of these activities.

Barrier #4: An estimated 2 billion people globally do not have access to even the most basic waste collection services, hence large quantities of waste plastic are not collected.

A lack of effective collection and treatment systems in emerging market economies leads to a significant loss of potentially recyclable material each year. This deprives the recycled plastics industry of scale, and the cost efficiencies that potentially come with it. In addition, the absence of basic collection services and resulting illegal depositing of waste and littering is a key driver of marine plastics pollution.

Several studies estimate that upwards of 70% of the plastics entering the oceans each year originate in less than ten, mostly developing, countries (Jambeck et al., 2015; Schmidt et al., 2017). Similarly, significant amounts of plastic waste, such as from discarded toys, textiles and construction materials, are not captured by formal waste management systems in OECD countries or are diverted to landfills or incinerators, but could be recovered in the future to achieve scale.

Policy interventions that could address these challenges include:

- Use of official development assistance to support the development of effective collection systems and waste-treatment infrastructure, and their operation, and the development of policy frameworks that are conducive to trade and investment in wastecollection and recycling services;
- Setting of recycling targets for plastic waste from additional product groups, possibly implemented through industry-funded product stewardship and extended producer responsibility systems.



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Plastics have become one of the most prolific materials on the planet: in 2015 we produced about 407 million tonnes of plastics globally, up from 2 million tonnes in the 1950s. Yet today only 15% of this plastic waste is collected and recycled into secondary plastics globally each year. This report looks at why this is the case and what we can do about it, as the pervasiveness of plastics is becoming an urgent public health and planetary problem. Not only is the diffusion of waste plastics into the wider environment creating hugely negative impacts, but plastics production emits approximately 400 million tonnes of greenhouse gas (GHG) emissions annually as a result of the energy used in their production, transport, and final waste treatment. Improved plastics collection and recycling represents a promising solution to these concerns.

For further reading see the following publication on which these Policy Highlights are based:

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BETTER POLICIES FOR BETTER LIVES

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