EUROPEAN
COMMISSION

Brussels, 16.1.2018
SWD(2018) 16 final

**COMMISSION STAFF WORKING DOCUMENT**
***Accompanying the document***

**Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions**

**A European Strategy for Plastics in a Circular Economy**

{COM(2018) 28 final}

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# 1 Introduction

Back in 2013, the European Commission launched a broad reflexion[1] of possible responses to the public policy challenges posed by plastic waste considering that they were not at that time specifically addressed in EU waste legislation. Already, in this Green Paper it was stressed that there were challenges, but also opportunities arising from better management of plastic waste. The reflexion has evolved putting plastics in the Circular Economy context.

The transition to a more circular economy, where the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste minimised, is an essential contribution to the EU's efforts to develop a sustainable, low carbon, resource efficient and competitive economy. Plastics is one of the five priority areas addressed in the "EU action plan for the Circular Economy"[2].

In this EU action plan the European Commission set out a commitment to develop a Plastics Strategy. The Plastics Strategy is part of a broader agenda aiming at the modernisation of our economy, with long-term societal objectives in mind: a competitive, low-carbon, circular, sustainable economy that creates jobs and growth, and increases the quality of life of our citizens.

The EU Action Plan for a Circular Economy also stressed the importance of strategic approach on the interface between chemicals, products and waste legislation, relevant to plastic waste streams and recycled plastics[3].

The recently published EU Industrial Policy Strategy[4] stresses the need to strengthen the European industry's ability to continuously adapt and innovate by facilitating investment in new technologies and embracing changes brought on by the transition to a low-carbon and more circular economy. It announces that the Commission will put forward a new series of actions, including a strategy to move towards a circular plastics economy in Europe. In its 2017 letter of intent[5], the Commission has also announced that such strategy "will work towards all plastic packaging being recyclable by 2030".

This new initiative on plastics[6] aims to address three interrelated issues:

1. High dependence on virgin fossil feedstock,
2. Low rate of recycling and reuse of plastics, and
3. Significant leakage of plastics into the environment.

Higher plastic waste recycling rates, increased volumes and improved quality of recyclates will boost the demand for secondary raw materials. The additional effort to diversify the feedstock will lead to more independence for the EU in terms of energy and resources and will contribute

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1 Green Paper On a European Strategy on Plastic Waste in the Environment COM/2013/0123 final

2 COM/2015/0614 final

3 Roadmap "Analysis of the interface between chemicals, products and waste legislation"; 27 January 2017

4 Investing in a smart, innovative and sustainable Industry A renewed EU Industrial Policy Strategy COM/2017/0479 final

5 State of the Union 2017 Letter of intent to President Antonio Tajani and to Prime Minister Jüri Ratas; Strasbourg, 13 September 2017

6 Roadmap "Strategy on Plastics in a Circular Economy"; 26 January 2017

to the climate and energy goals and the jobs and growth agenda. In addition, more circular plastics economy will significantly reduce the negative environmental externalities by limiting the plastic leakage phenomenon.

This staff working document accompanying the Communication "A European Strategy for Plastics in a Circular Economy", reports on the analysis performed by the Commission regarding the three issues mentioned above, largely supported by evidence, data and information collected during the Fitness Check of five waste stream Directives and taken on board in the Commission December 2015 legislative proposals on the waste targets review. Three additional studies[7] were launched and contributed to gathering the knowledge gaps. Targeted stakeholder consultations, workshops and a major stakeholders' conference[8] were organised by the Commission covering the main aspects of the whole lifecycle and value chain of plastics. It also contributes to the EU initiatives combatting marine litter and its international commitments[9].

The policy options have emerged from this continuous flow of exchanges but they do not indicate a final position of the Commission and are only listed to enable an informed debate. Future discussions with the European Parliament, the Council and interested parties will enable choosing options and defining specific actions at a general or sectorial level for the transition to a more circular plastics economy.

This document first outlines the opportunities and challenges of plastics, before going into the envisaged measures to tackle the environmental leakage and the economics of recycling, and finishes with the international dimension.

[7] "Intentionally added micro-plastics in products"; "Micro-plastics generated from but not intentionally added in products"; "Plastics: reuse, recycling and marine litter" (Draft final report available, the study carried out by Eunomia will be published in 2018)

[8] "Re-inventing Plastics Closing the circle" of 26 September 2017

[9] JOIN(2016) 49 final: International ocean governance: an agenda for the future of our oceans

# 2 Taking the opportunity: re-inventing plastics

## 2.1 Importance of plastics and the plastics industry

### 2.1.1 Current uses of plastics

A plastic material is an organic solid, essentially a polymer, i.e. chain of several thousand of repeating molecular units of monomers, or combination of polymers. The monomers of plastic are either natural or synthetic organic compounds. The term resin is sometimes used as synonym of a commercial polymer[10].

Plastics can be classified by chemical structure: the acrylics, polyesters, polyolefins, silicones, polyurethanes, and halogenated plastics. Plastics can also be classified by the chemical process used in their synthesis, such as condensation, and cross-linking. Other classifications are based on properties that are relevant for manufacturing or product design, e.g. thermoplasticity, biodegradability, electrical conductivity, density, or resistance to various chemical products[11].

Plastic is an important component of our economic activity and daily lives. It has an outstanding number of functionalities such as lightness, robustness, malleability and durability. These characteristics as well as relatively low cost, have led to make plastic a privileged resource and material and also giving a contribution to solve many societal challenges from energy savings to innovation in healthcare and medical devices. Services that plastics can deliver to the society are increasing constantly and is a key enabling materials for many manufacturing industries which explain its ubiquitous presence in many products and applications.

Currently a large variety of polymers is available. As shows the data from Plastics Europe[12], different types of polymers respond to different type of needs.

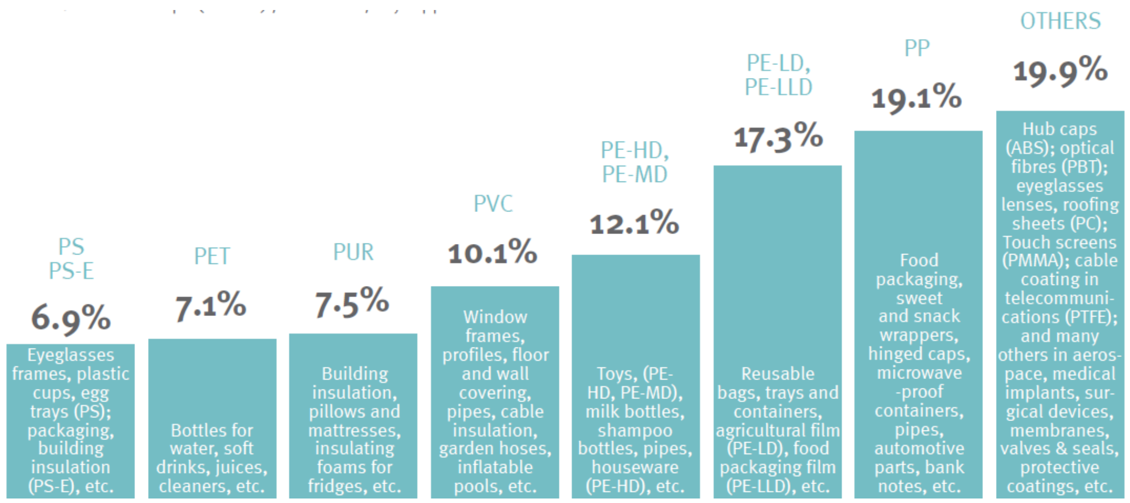


**Figure 1. Plastic materials main fields of application.**

*Source: Plastics Europe (2016). Plastics - the Facts 2016*

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[10] Source: Plastics Europe

[11] http://www.sciencedirect.com/science/article/pii/S0306374714701125

[12] http://www.plasticseurope.org/documents/document/20161014113313-plastics_the_facts_2016_final_version.pdf

Although in some cases plastics are in competition with other traditional materials, e.g. wood, stone, metals, paper, glass, or ceramics, polymers can also be used to create so-called composite materials to obtain different and additional functionalities.

Within Europe, plastics are primarily used in packaging (40%), while the building sector is the second user (20%). Automotive, electrical & electronic and agriculture are the three other sectors with significant plastic use, as explained in the following figure.[13]

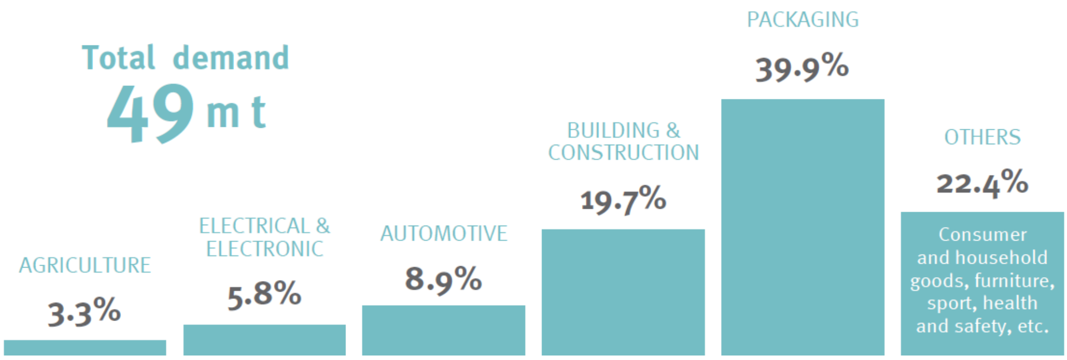


**Figure 2. Distribution of European (EU-28+NO/CH) plastics demand by segment in 2015**

*Source: Plastics Europe (2016). Plastics - the Facts 2016*

### 2.1.2 Feedstock for plastics

As for many other materials, the functionality of the wide array of plastics variants depends on the properties and functionalities of the polymers present in the plastic, largely independent from their origin, primary produced or from recycling.

Plastics are traditionally derived from fossil sources, mainly oil and gas. Plastics can also be made of alternative feedstock such as renewable resources currently mainly derived from different types of agriculture (biomass), organic waste and residues, gaseous effluents (e.g. $CO_2$). And finally, plastics can also be made from secondary materials obtained through the chemical or mechanical recycling of collected plastic waste.

Bio-based products are wholly or partly derived from materials of biological origin, excluding materials embedded in geological formations and/or fossilised. In industrial processes, enzymes are used in the production of chemical building blocks, detergents, pulp and paper, textiles, etc. By using fermentation and bio-catalysis instead of traditional chemical synthesis, higher process efficiency can be obtained, resulting in a decrease in energy and water consumption, and a reduction of toxic waste. As they are derived from renewable raw materials such as plants, bio-based products can help reduce $CO_2$and offer other advantages such as lower toxicity or novel product characteristics (e.g. biodegradable plastic materials). Increasing the use of bio-based plastics could provide greenhouse gas savings in the EU in 2020 of 9-27 million tons of $CO_2$[14].

[13] http://www.plasticseurope.org/documents/document/20161014113313-plastics_the_facts_2016_final_version.pdf
[14] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52007SC1730

However, whether bio-based plastics are effectively the more sustainable alternative, not only depends on their origin from renewable materials and their carbon balance, but also on other aspects such as land use, water use, eutrophication and potential toxicity impacts, e.g. due to pesticides. A broad range of environmental aspects needs to be looked at from a life cycle perspective to evaluate in a comprehensive manner if bio-based plastics have a higher or lower environmental impact compared to fossil-based plastics for specific applications.

Bio-based plastics should not be confused with biodegradable plastics, i.e. they are not synonymous. Both materials were developed these past years in response to multiple environmental, societal and economic concerns or emerging political objectives, such as high rates of $CO_2$emissions from fossil based plastic production processes, development of the bio-economy or reduction of the impact of plastic leakage in the environment. Biodegradable plastics are materials that can be bio-transformed and decomposed by microorganisms into water, naturally occurring gases like carbon dioxide ($CO_2$) and methane ($CH_4$) and biomass (e.g. new microbial cellular constituents)[15]. Bio-based plastics have the same properties as conventional plastics but are derived from biomass[16]. The property of biodegradation does not depend on the resource basis of a material (fossil based or biomass). This biodegradability feature is directly linked to the chemical structure of the polymer and additives included. Biodegradable plastics can be fossil based (e.g. PBAT, PBS, or PCL) or bio-based (e.g. PHA or PLA), and the same is true for non-biodegradable plastics (e.g. PE, PP, PET or PS are fossil-based, while bio-PET or bio-PE are bio-based). In other words, even if they can, not all bio-based plastics have these biodegradable properties[17].

Additionally to these two sources of feedstock, recently, several companies[18] have made a statement that in future other alternative feedstocks will be used for plastic polymer production such as gaseous effluents (e.g. $CO_2$). For the time being, more research and innovation is needed to scale up production processes and make this type of feedstock economically viable.

Even more important for the purposes of attaining the circular economy goals, plastics can also be made from secondary materials obtained through the chemical or mechanical recycling of collected plastic waste. Mechanical recycling refers to operations that aim to recover plastics waste via mechanical processes such as grinding, washing, separating, drying, re-granulating and compounding[19]. Chemical recycling also known as feedstock recycling, allows to chemically degrading the collected plastics waste into monomers, additives or other basic chemicals and separating the "building blocks" into reusable chemicals for the producers of chemicals and plastics. This technology, currently under development is of a particular interest when it comes to contaminated and mixed plastic waste.

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[15] European Centre for Ecotoxicology and toxicology of chemicals, Technical report 123, Definitions according to OECD

[16] as defined in European Standard EN 16575

[17] Biodegradable plastics can be fossil based (e.g. PBAT, PBS, or PCL) or bio-based (e.g. PHA or PLA), and the same is true for non-biodegradable plastics (e.g. PE, PP, PET or PS are fossil-based, while bio-PET or bio-PE are bio-based).

[18] See for example the German based company Covestro https://www.co2-dreams.covestro.com/

[19] http://www.plasticsrecyclers.eu/mechanical-recycling

### 2.1.3 The European plastics industry

***International dimension***

As a leading exporter and importer of goods and services, the EU is deeply embedded in global value chains. The EU's share of global goods exports is above 15%[20]. The EU accounted for a 21.8% share of the world's GDP in 2016 (GDP per capita in the EU's 28 Member States is €29,000)[21]. This places Europe among the five top performing global economies. The EU is also at the forefront of efforts to support environmentally sound waste management through the promotion of a more circular economy.

Per capita plastic consumption has reached 100 kg in Western Europe and North America; Asia currently uses just 20 kg per person, but this figure is expected to grow rapidly[22]. Plastics production in Asia in 2013 accounted for 45.6 % of global plastics, while China alone produced nearly a quarter of world's plastic. Increasing trends of plastics production have also been seen in India, mainly driven by population growth and the expansion of the manufacturing sector The Middle East, Africa and Central and South America account for the smallest global shares of product[23] (see Figure 3).

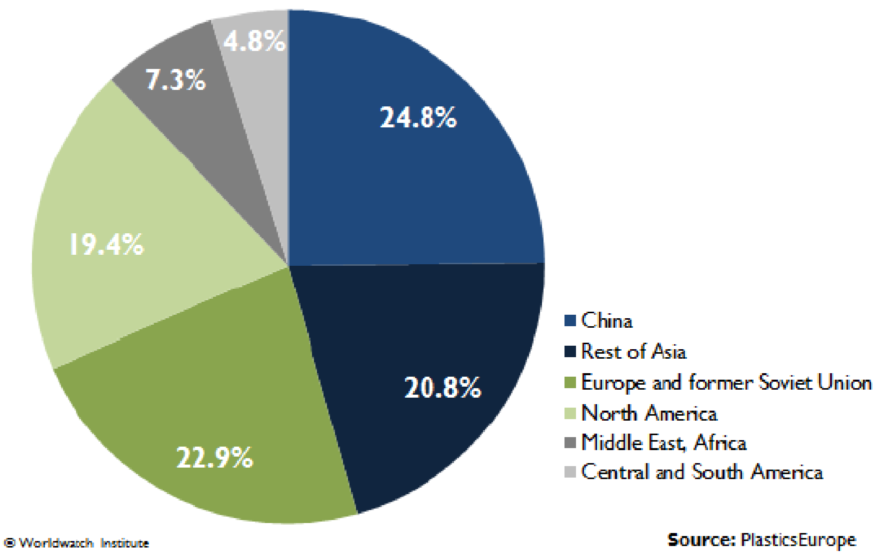


**Figure 3. World production of plastic materials by region (2013)**

International trade in waste plastics is increasing. With global production of plastics skyrocketing and a continuing shift of production from the West to Asia (more than 40% by

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[20] Reflection paper on harnessing globalisation, COM(2017) 240.

[21] Facts and figures about the EU and the G20, 7-8 July 2017, DG Communication – Spokesperson's Service, European Commission.

[22] Vital Signs (2015), Global Plastic Production Rises, Recycling Lags http://vitalsigns.worldwatch.org/sites/default/files/vital_signs_trend_plastic_full_pdf.pdf

[23] Plastics Europe, Plastics – the Facts 2015 – An Analysis of European plastics production, demand and waste data, note 65.

weight of world production in 2013), the annual volume of transnationally traded waste plastics is 15 million tonnes[24].

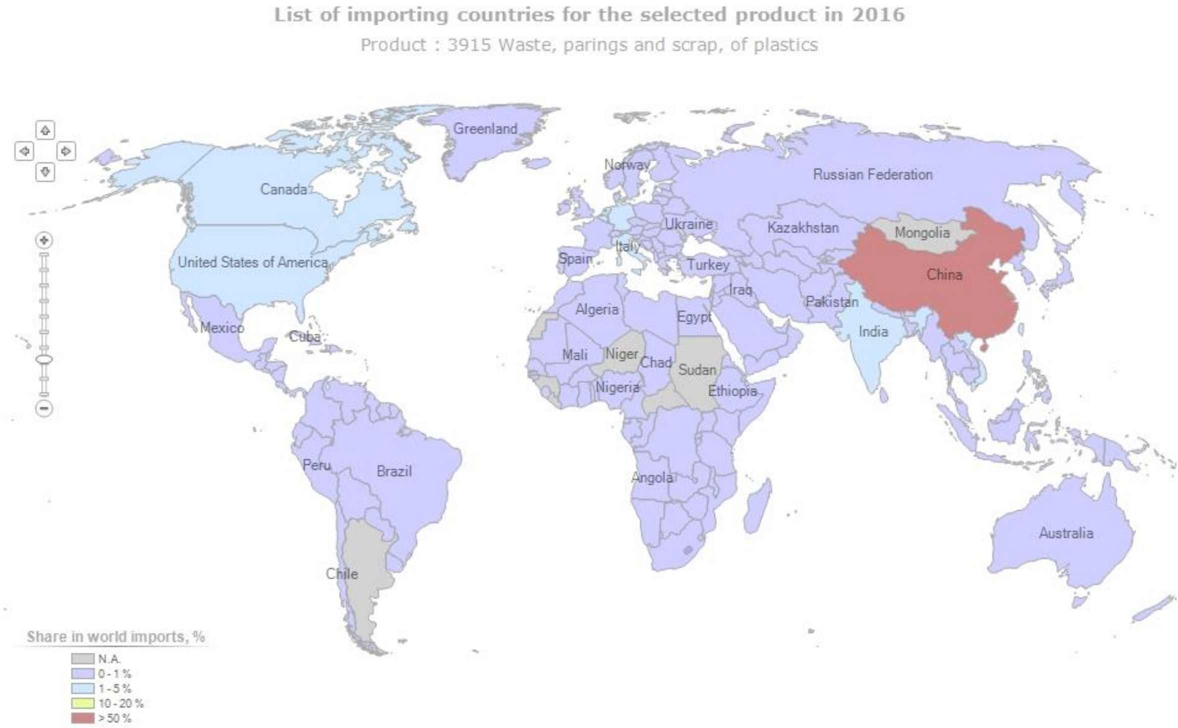


**Figure 4. Share in world imports of waste (parings and scrap) of plastic[25]**

According to EU estimates, about half of the plastics waste collected in the EU for recycling is exported to third countries, where more labour-intensive, low-tech processes remain widespread. Europe's insufficient domestic recycling capacity, higher cost of recycling and the insufficient quality of the sorted materials are key drivers for such high export levels. China hosts the world’s largest recycling industry, importing over 50% of the global trade for end-of-life plastic and 85% of the EU's plastic waste exports. This is a situation that is expected to change following China's decision to ban the import of certain types of wastes, including plastic waste[26].

### *Plastics production in Europe*

If plastics are produced worldwide, mainly in China, Asia, North America, they are also produced here in Europe. The global production represents approximately 322 million tons of fossil based plastics (approximately 4% is used annually as raw material for production of plastics).

In Europe 57 million tonnes of primary plastics were produced in 2016, the share of bio-based plastics being 0.5 and 1% of EU annual plastic consumption. The European plastics industry is a big part of the chemicals industry and plays a vital role in the EU economy. It employs about 1.45 million people and has a turnover of 350 billion (including plastic converters and technology providers). In 2013, the bioplastics industry accounted for around 23,000 jobs in

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[24] UNEP-ISWA Global Waste Management Outlook 2015, p.84.
[25] ITC calculations based on UN COMTRADE and ITC statistics.
[26] WTO Notification G/TBT/N/CHN/1211 of 18 July 2017, https://www.wto.org/english/news_e/news17_e/impl_03oct17_e.htm

Europe. Plastics recyclers account for a 30 000 jobs linked to the plastics industry. This general information can be details as follows.

- In 2014, in the EU 28, the manufacturing of plastic in primary forms (NACE C2016) employed more than 135 thousand persons in 2,600 firms. In terms of value added (at factor costs), the sector generated 15 billion EUR, i.e. the 0.9% of total EU manufacturing.[27] SMEs account for roughly 25% of value added.
- The manufacturing of plastic products (NACE C222) employed some extra 1,300,000 persons, distributed over 55 thousand firms, of which only 753 were not SMEs. About 20% of persons are employed in the manufacturing of plastic packaging goods. In terms of value added, the sector generated 64 billion EUR, accounting for 3.7% of total EU manufacturing. [28]
- In 2014, about 17,700 firms with 164 thousand employees were active in the recovery of sorted materials (NACE E3832). This category does not only refer to the recovery of plastic, but also of other materials such as paper and metal. Recovery of sorted materials generated nearly 10 billion EUR in value added. SMEs can be estimated to contribute with 17,200 firms, accounting for 8.5 billion EUR value added[29]. Information on the specific share of plastic however is not available.

## 2.2 Environmental impacts

### 2.2.1 Causes, pathways and figures

While the importance of plastics for our economies and society cannot be underestimated, there are also important health and environmental externalities. The Green Paper on plastics waste already pointed out the gravity of these impacts.[30]

According to the Eurobarometer survey on citizens perception of plastics almost three in four (74%) agree that they are worried about the impact on their health of everyday products made of plastic, while an even greater proportion (87%) agree that they are worried about the impact of plastic products on the environment[31].

Marine litter is therefore one of the most important emerging global environmental issues.

#### From mismanaged waste to marine litter

Major land based sources of plastic marine litter appear to be: storm water discharges, sewer overflows, tourism-related litter, wastes released from dumpsites near the coast or river banks, illegal dumping, industrial activities, improper transport, consumer cosmetic products, synthetic sandblasting media or polyester and acrylic fibers from washing clothes. Plastic pellets can be found in most of the world’s oceans, even in non-industrialized areas such as the Southwest Pacific. Sea-based sources such as shipping, fishing, aquaculture and offshore also contributes to marine pollution.

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27 Eurostat, Structural Business Statistics

28 Eurostat, Structural Business Statistics

29 Assuming the share of SMEs in chapter E383 is also valid for subchapter E3832.

30 COM(2013) 123, GREEN PAPER on a European Strategy on Plastic Waste in the Environment

31 European Commission (2017) Special Eurobarometer 468 Report Attitudes of European citizens towards the environment

A frequently quoted study[32] estimated to 4.8 to 12.7 million tonnes the quantities of plastic waste enter our oceans per year (see **Error! Reference source not found.**). For the EU the estimated quantities are approximately 0.15 to 0.5 million tonnes.

While these amounts are not measured but calculated on the base of models and they do not take into account transboundary shipments of plastic waste, they do give us an idea of the high order of magnitude of the problem

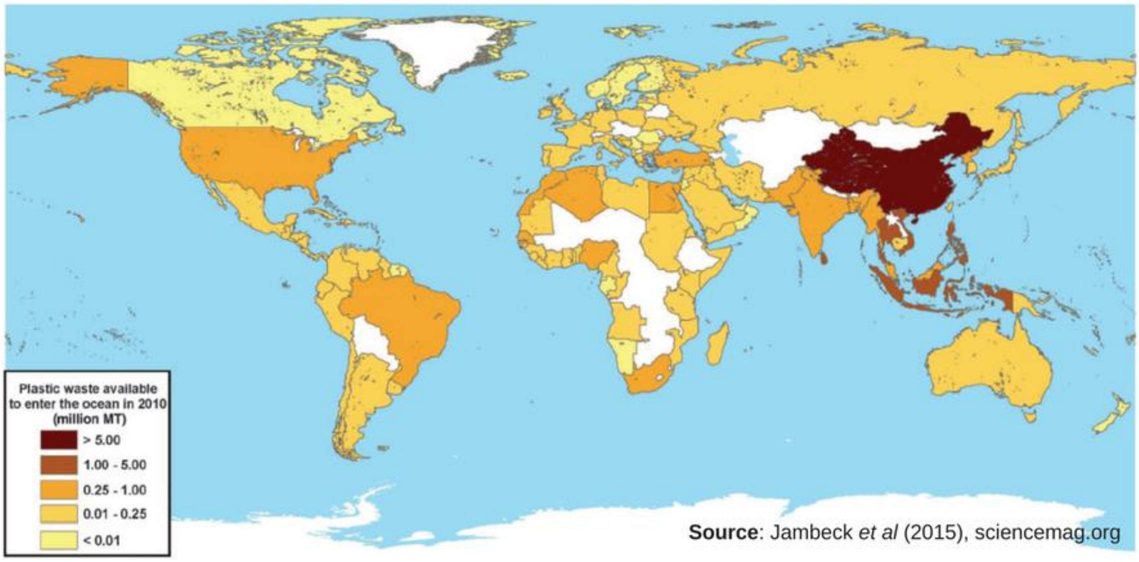


**Figure 5. Plastic waste available to enter the oceans (million tonnes) (2010)[33]**

A recent assessment concludes that 79% of the plastic waste generated since the beginning of plastic production has accumulated in landfills or the natural environment[34], with uncontrolled disposal still being a major problem, predominantly in developing countries[35]. According to Jambek *et al.* (2015)[36], over 50% of the global leakage into the marine environment currently comes from five emerging markets in Asia (see **Error! Reference source not found.**).

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[32] Jenna R. Jambeck et al. (2015), *Plastic waste inputs from land into the ocean*, Science, 347 (6223), 768-771 (DOI: 10.1126/science.1260352), http://science.sciencemag.org/content/347/6223/768

[33] Global map with each country shaded according to the estimated mass of mismanaged waste (million tonnes) generated in 2010. Countries not included in the study are shaded in white (Jambeck et al., 2015, p. 769).

[34] Geyer et al. (2017), Production, use, and fate of all plastics ever made, Science Advances, 3 (7), e1700782 (DOI: 10.1126/sciadv.1700782).

[35] According to Global Waste Management Outlook (2015), 2 billion people are still without access to solid waste collection, and 3 billion people lack access to controlled waste disposal facilities.

[36] Jenna R. Jambeck *et al.* (2015), *Plastic waste inputs from land into the ocean*, Science, 347 (6223), 768-771 (DOI: 10.1126/science.1260352)

**Table 1. Waste estimates for 2010 for the top 20 countries ranked by mass of mismanaged plastic waste (in units of millions of metric tons per year)**[37]

| Rank | Country | Econ. classif. | Coastal pop. [millions] | Waste gen. rate [kg/ppd] | % plastic waste | % mismanaged waste | Mismanaged plastic waste [MMT/year] | % of total mismanaged plastic waste | Plastic marine debris [MMT/year] |
|---|---|---|---|---|---|---|---|---|---|
| 1 | China | UMI | 262.9 | 1.10 | 11 | 76 | 8.82 | 27.7 | 1.32–3.53 |
| 2 | Indonesia | LMI | 187.2 | 0.52 | 11 | 83 | 3.22 | 10.1 | 0.48–1.29 |
| 3 | Philippines | LMI | 83.4 | 0.5 | 15 | 83 | 1.88 | 5.9 | 0.28–0.75 |
| 4 | Vietnam | LMI | 55.9 | 0.79 | 13 | 88 | 1.83 | 5.8 | 0.28–0.73 |
| 5 | Sri Lanka | LMI | 14.6 | 5.1 | 7 | 84 | 1.59 | 5.0 | 0.24–0.64 |
| 6 | Thailand | UMI | 26.0 | 1.2 | 12 | 75 | 1.03 | 3.2 | 0.15–0.41 |
| 7 | Egypt | LMI | 21.8 | 1.37 | 13 | 69 | 0.97 | 3.0 | 0.15–0.39 |
| 8 | Malaysia | UMI | 22.9 | 1.52 | 13 | 57 | 0.94 | 2.9 | 0.14–0.37 |
| 9 | Nigeria | LMI | 27.5 | 0.79 | 13 | 83 | 0.85 | 2.7 | 0.13–0.34 |
| 10 | Bangladesh | LI | 70.9 | 0.43 | 8 | 89 | 0.79 | 2.5 | 0.12–0.31 |
| 11 | South Africa | UMI | 12.9 | 2.0 | 12 | 56 | 0.63 | 2.0 | 0.09–0.25 |
| 12 | India | LMI | 187.5 | 0.34 | 3 | 87 | 0.60 | 1.9 | 0.09–0.24 |
| 13 | Algeria | UMI | 16.6 | 1.2 | 12 | 60 | 0.52 | 1.6 | 0.08–0.21 |
| 14 | Turkey | UMI | 34.0 | 1.77 | 12 | 18 | 0.49 | 1.5 | 0.07–0.19 |
| 15 | Pakistan | LMI | 14.6 | 0.79 | 13 | 88 | 0.48 | 1.5 | 0.07–0.19 |
| 16 | Brazil | UMI | 74.7 | 1.03 | 16 | 11 | 0.47 | 1.5 | 0.07–0.19 |
| 17 | Burma | LI | 19.0 | 0.44 | 17 | 89 | 0.46 | 1.4 | 0.07–0.18 |
| 18* | Morocco | LMI | 17.3 | 1.46 | 5 | 68 | 0.31 | 1.0 | 0.05–0.12 |
| 19 | North Korea | LI | 17.3 | 0.6 | 9 | 90 | 0.30 | 1.0 | 0.05–0.12 |
| 20 | United States | HIC | 112.9 | 2.58 | 13 | 2 | 0.28 | 0.9 | 0.04–0.11 |

*If considered collectively, coastal European Union countries (23 total) would rank eighteenth on the list

Research shows that river networks can facilitate the transport of plastics thus connecting most of the global land surface to the ocean[38]. According to Schmidt *et al.* (2017), rivers from the 10 top-ranked catchments alone (see Figure 6. The top-10 rivers for land-based contribution to marine litter) contribute between 88% and 94% of the total plastic debris and reducing plastic loads by 50% in the 10 top-ranked rivers would reduce the total river-based load to the sea by 45%.

Poor waste management on land, in particular marginal plastic waste collection and recovery rates, aggravate the problem of plastic marine pollution.

While the EU is relatively well equipped for the land-based sources in terms of legislation (mainly through waste management and waste water treatment legislation), this is less the case for sea-based sources such as shipping, fishing, aquaculture and offshore (e.g. oil and gas) activities, where the only legal instruments at our disposal are the Port Reception Facilities Directive and certain provisions of the Common Fisheries Policy and especially the Control Regulation[39].

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[37] Jambek et al. (2015), op. cit.

[38] Christian Schmidt, Tobias Krauth, Stephan Wagner. Export of Plastic Debris by Rivers into the Sea. Environmental Science & Technology, 2017; DOI: 10.1021/acs.est.7b02368.

[39] Council Regulation (EC) No 1224/2009 of 20 November 2009 establishing a Community control system for ensuring compliance with the rules of the common fisheries policy


**Figure 6. The top-10 rivers for land-based contribution to marine litter[40]**

## Accumulation of plastics in the environment

Since 1980, over 150 million tonnes of plastic marine litter are estimated to have accumulated, out of which between 1.4 and 3.7 million tonnes in the EU.

Deep-sea sediments were demonstrated to accumulate micro-plastics and retention of macro and micro-plastics in particular sea-bed locations is increased by topographic features. Micro-plastics, i.e. plastic particles (so called micro-plastics particles), are generally defined as synthetic water insoluble plastic polymers of 5mm or less in any dimension, result both from the intentional use of such particles in products as well as from decades of photo degradation and mechanical abrasion of macro plastics that have leaked into the environment.

Recent research conducted by the University of Ghent[41] suggests that Europeans currently consume up to 11,000 pieces of plastic in their food each year as a result of consumption of seafood. The impact on human health of this exposure still needs to be further assessed.

Micro-plastics intentionally added in products such as cosmetics and detergents or generated during use of products such as tyres and textiles or along the plastics production and supply chain i.e. plastic pellets, were calculated in the order of 200 thousand tonnes in the EU[42].

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[40] Source of the data: Christian Schmidt, Tobias Krauth, Stephan Wagner. Export of Plastic Debris by Rivers into the Sea. Environmental Science & Technology, 2017; DOI: 10.1021/acs.est.7b02368. Source of the map: European Commission.

[41] Unpublished study cited in http://news.sky.com/story/micro-plastics-in-seafood-could-be-a-health-risk-experts-fear-10739835

[42] http://ec.europa.eu/environment/marine/good-environmental-status/descriptor-10/pdf/MSFD%20Measures%20to%20Combat%20Marine%20Litter.pdf

Updated calculations[43] are under preparation for all major sources of all types of micro-plastics. It should be noted that data about the use of microbeads in products is scarce. All plastic waste entering the sea, if not removed, fragments in smaller pieces and becomes ultimately, because of weathering and fragmentation, micro-plastics.

Waste patches in the Atlantic and the Pacific oceans are estimated to be in the order of 100 Mt, about 80% of which is plastic. Plastic is accumulating in the Mediterranean Sea at a similar scale to that in oceanic gyres (the rotating ocean currents in the Indian Ocean, North Atlantic, North Pacific, South Atlantic and South Pacific)[44]. Plastic debris found in the Mediterranean surface waters are composed by millimetre-sized fragments, together with a proportion of large plastic objects, larger than the one present in oceanic gyres (see Figure 7).

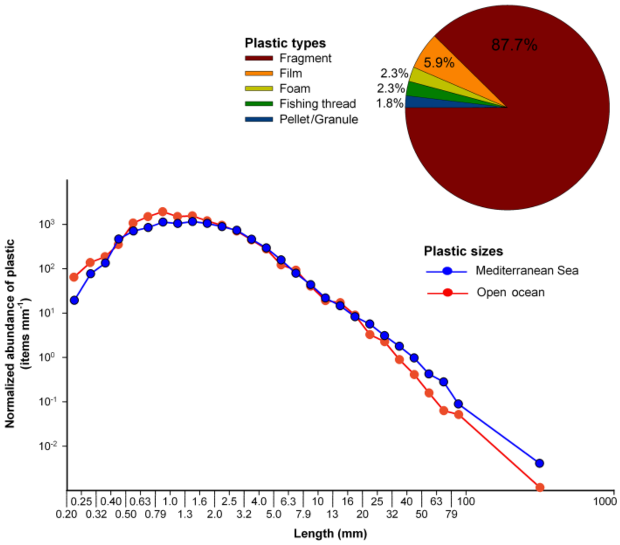


**Figure 7. Size distribution and aspect of the floating plastic debris collected in the Mediterranean Sea[45]**

The accumulation of plastic in the Mediterranean Sea is likely to be the result of a significant plastic input combined with a limited export to the Atlantic Ocean. In addition to this, the Mediterranean Sea acts as a convective basin, absorbing also the floating plastic originating from the Atlantic and many other terrestrial and maritime sources (e.g. the inputs from the Nile River). The special distribution of plastics concentrations in the Mediterranean is often irregular due to the variability of the Mediterranean Sea circulation patterns that prevent the formation of fixed plastic retention areas. Moreover, the multiple sources of plastic leakage and pollution in the Mediterranean could significantly impact plastic concentration in the short term[46]. See Figure 8 concentrations of plastic debris in surface waters of the Mediterranean Sea compared to the plastic concentrations reported for the global ocean[47].

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43 EU microplastics. Ongoing study for the Commission : http://www.eumicroplastics.com/eumpwp/wp-content/uploads/investigating-options-eunomia-draft-report-v4-main-report-public.pdf

44 PLOS, A Cozar, Plastic Accumulation in the Mediterranean Sea, 2015.

45 Ibidem

46 Ibidem

47 Ibidem

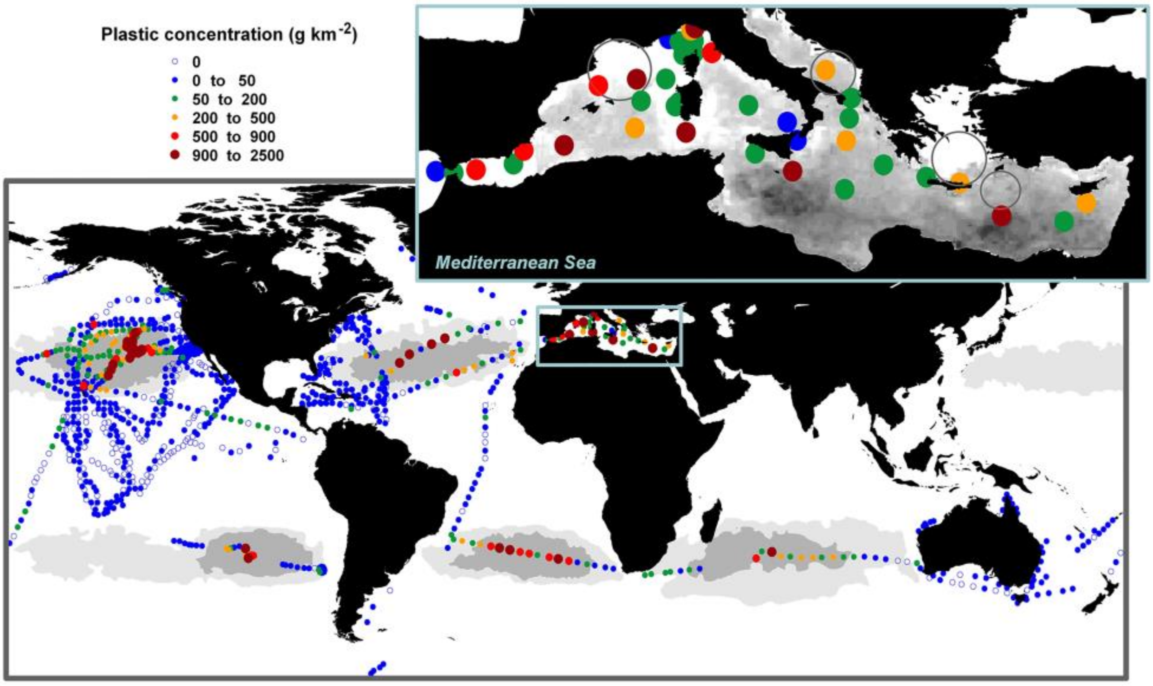


**Figure 8. Concentrations of plastic debris in surface waters of the Mediterranean Sea compared to the plastic concentrations reported for the global ocean[48]**

### 2.2.2 Impacts on the environment, health and economy

Once in the environment - particularly in the marine environment - plastic waste can persist for hundreds of years. The 10 million tonnes of litter, mostly plastic, which ends up in the world's oceans and seas annually, turning them into the world's biggest plastic dump[49], harm the coastal and marine environment as well as aquatic life.

Marine litter causes enormous harm to ecosystems : impacts include mortality or sub-lethal effects on plants and animals through entanglement[50] (e.g. from ghost nets[51]) physical damage, smothering, ingestion of plastic by animals such as turtles or birds, including micro-plastics; these micro-plastics have the potential to accelerate accumulation of chemicals throughout the food chain, with potential negative impacts on human health. Furthermore, marine litter facilitates the invasion of alien species, altering benthic community structure[52]. Most plastic debris eventually comes to rest on the seabed[53].

Species known to be affected by the marine litter are now almost 800, the proportion of cetacean and seabird species has risen to 40% and 44% respectively, while some surveys show

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48 Ibidem

49 Wurpel G.,Van den Akker J.,Pors J., Ten Wolde, Plastics do not belong in the ocean. Towards a roadmap for a clean North Sea. IMSA Amsterdam (2011), p. 13.

50 UNEP, 2009, Marine Litter: A global challenge, http://www.unep.org/pdf/unep_marine_litter-a_global_challenge.pdf.

51 A phenomenon by which large lumps of derelict fishing nets float in water, unintentionally catching large amounts of fish.

52 Deudero S., Alomar C. (2015) "Mediterranean marine biodiversity under threat: Reviewing influence of marine litter on species" in Marine Pollution Bulletin, Volume 98, Issues 1-2: 58-68

53 Near large cities and offshore canyons, the density could extend to 100,000 pieces per square kilometre. See further: Wurpel, G. loc.cit., p. 32, 35.

that 100% of turtles are affected by ingestion of litter. A recent technical report from JRC provides insight about the major negative impacts from marine litter by describing the mechanisms of harm[54].

Micro-plastics are ubiquitous and reach even the most remote areas[55] with a concentration in water sometimes higher than that of plankton. These micro plastics, and the chemical additives they contain, if ingested in large quantities by marine fauna may have a high potential for contaminating the food chain through predator-prey interaction.

Plastic is not inert. Conventional plastic contains chemical additives which can be endocrine disruptors, carcinogenic or provoke other toxic reactions and can, in principle, migrate into the environment, though in small quantities[56] [57]. Persistent organic pollutants (POPs), such as pesticides like DDT and polychlorinated biphenyls (PCBs)[58] since 1970s have been progressively banned but, as they are very persistent in the environment and sometimes still present in some materials or products in use, their presence can still be detected. They can attach themselves from the surrounding water to plastic fragments which can be harmful[59] and enter the food chain via marine fauna which ingest the plastics (Trojan horse effect)[60]. These POPs do not break down naturally very easily but accumulate in body tissue, potentially having carcinogenic, mutagenic and other health effects[61].

Given the high leakage worldwide of plastics in the natural environment with harmful effects for a very long period of time, solutions have been sought to design plastics in a way that they can biodegrade in different environmental compartments. These solutions will only make sense as a complement to a paramount effort to reduce plastic leakages. Complete biodegradation of plastics, a process involving microbial action, occurs when none of the original polymer remains[62]. Most currently available biodegradable plastics generally degrade under specific conditions which may not always be easy to find in the natural environment and can thus still cause harm to ecosystems. Biodegradation in the marine environment is particularly challenging even though recent research projects[63] have shown some progresses made regarding this issue.

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54 https://ec.europa.eu/jrc/en/publication/harm-caused-marine-litter

55 BIOIS,Plastic waste in the Environment, loc.cit, p. 114.

56 Most additives are fillers and reinforcements,, plasticizers, colorants, stabilizers, processing aids, flame retardants, peroxides and antistats, each representing a whole family of chemicals.

57 COM(2013) 123, GREEN PAPER on a European Strategy on Plastic Waste in the Environment

58 Mato Y., Isobe T., Takada H., Kanehiro H., Ohtake C. and Kaminuma T. (2001) "Plastic resin pellets as a transport medium for toxic chemicals in the marine environment" in *Environmental Science and Technology* 35(2): 318-324.

59 Rios, L.M., Moore, C. and P.R. Jones (2007) "Persistent organic pollutants carried by synthetic polymers in the ocean environment" in *Marine* Pollution *Bulletin* 54: 1230-1237.

60 Rios, L.M., Jones, P.R., Moore, C. and U. Narayan (2010) "Quantification of persistent organic pollutants adsorbed on plastic debris from the Northern Pacific Gyres' "Eastern Garbage Patch"", accepted in *Journal of Environment Monitoring*.

61 BIOIS (2010) Plastic waste in the Environment, final report, European Commission, p. 117 http://ec.europa.eu/environment/waste/studies/pdf/plastics.pdf

62 https://wedocs.unep.org/bitstream/handle/20.500.11822/7468/-Biodegradable_Plastics_and_Marine_Litter_Misconceptions,_concerns_and_impacts_on_marine_environments-2015BiodegradablePlasticsAndMarineLitter.pdf.pdf?sequence=3&isAllowed=y

63 Bio-based biodegradable PHA/PHB EU FP7 Open-Bio project - Marine biodegradation work package

**Box 1. Economic impacts from environmental externalities**

| |
|---|
| The economic activities directly affected by marine plastic litter and micro-plastics include shipping, fishing, aquaculture, tourism and recreation. The cost associated could be estimated to be at least $8bn per year (UNEP, 2016). For the EU, costs to the tourism and recreation sector (extrapolated from beach cleaning costs) have been estimated up to 630 million€ per year; costs to the fishing industry up to 57 million€. The "best estimate" within this range is a total of almost 470million€. Economic damage from litter on marine industry users was estimated to be $1.26bn per annum to marine industries in the Asia Pacific region. UN Environment estimates the damage to marine environments globally to be at least $8billion per annum. |

While it is clear that marine litter affects economic activities such as tourism and fisheries and entails substantial cleaning costs, it is also true that fighting against it creates economic opportunities : innovation in product design to avoid plastic litter and micro-plastics, but also investments for marine litter prevention (e.g. in waste and waste water treatment, in port reception facilities or recycling of fishing nets) can create jobs and strengthen technical and scientific skills and industry competitiveness in areas of growing global interest.

## 2.3 Moving towards more circular plastics

### 2.3.1 Linear vs. circular: a new approach for the plastics life-cycle

According to the linear model very frequently applied with this material plastic will then follow a "take-make-consume-dispose" pattern of lifecycle which is not the most resource efficient approach especially if considering the growing demand from a growing world population. It is commonly agreed that this type of model does not correspond to a sustainable growth principles in a sense that it is based on the assumption that resources are abundant, available, easy to source and cheap to dispose of. On the opposite, the circular economy model acknowledges that resources are limited and should be used in an efficient way. Strained natural resources and climate change are becoming an ever more tangible reality. Therefore, a model that is circular has become necessary in order to keep the added value in products for as long as possible and eliminate as much as possible waste generation.

In 2014, the EU generated about 25 million tonnes of post-consumer plastic waste of which only 30 % was recycled. The performance as regards recycling of plastics wastes, although in progress, shows there is ample room for improvement. For example, the current target for recycling of plastic packaging waste is 22.5%. The average recycling rate of plastic packaging waste being 39.8% in 2015[64] clearly demonstrates that this target is obsolete. A more ambitious target is needed to provide incentives for increasing recycling; this is one of the elements of the recently proposed amendment to the Packaging and Packaging Waste Directive (55% of plastic packaging waste to be recycled by 2025).

[64] Source: Eurostat: http://ec.europa.eu/eurostat/statistics-explained/index.php/Packaging_waste_statistics

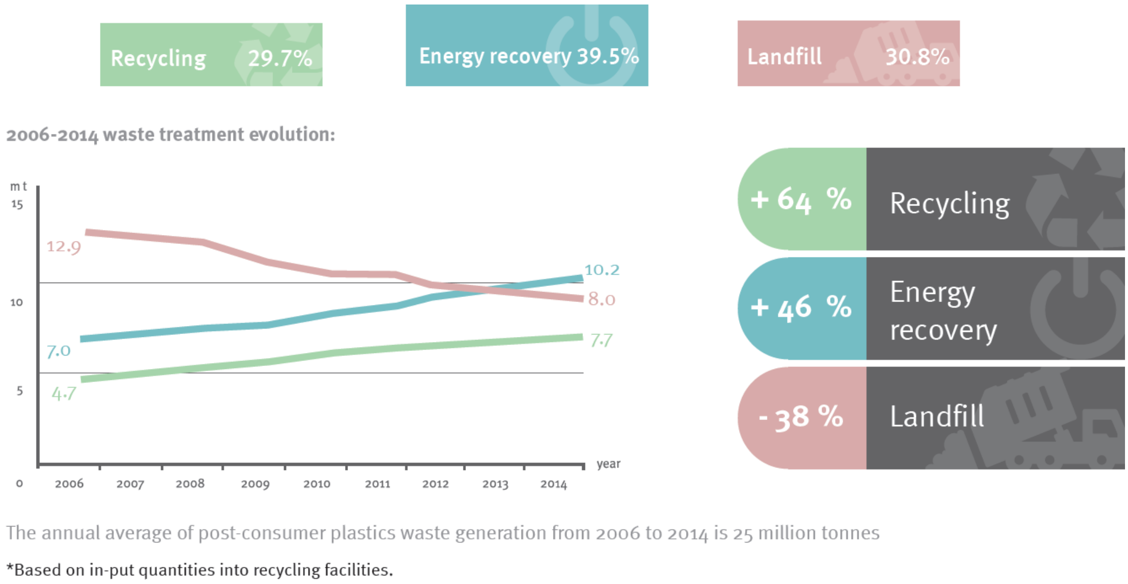


**Figure 9. Waste treatment evolution 2006-2014**

*Source: Plastics Europe (2016). Plastics - the Facts 2016*

Once plastic wastes are considered as a resource to be kept as long as possible in the value chain the lifecycle should be modified accordingly.

### 2.3.2 Plastics produced in a circular value chain

Defining with precision a unique plastic value chain is difficult given the wide number of applications. However, it is legitimate to say that plastics production is just the starting point of a long material/product lifecycle. After being produced (from virgin or secondary raw materials, alternative feedstock or fossil based), plastic goes to plastics converters who manufacture finished plastic products. From converters, plastics in a form of an article or incorporated in articles, go to consumer through a more or less complex purchasing and selling process. Through consumers and the way they manage the end-of-life phase, plastics end up in the hands of waste collecting authorities and recyclers. In a circular model this is not the end of the story because if properly collected, sorted and recycled, plastic waste will serve as a raw material for new purposes.

The recycling of PET bottles shows there is a real business case for a circular approach. This example should be followed by other polymers and applications.

The circular plastics value chain could be presented as in the following figure.

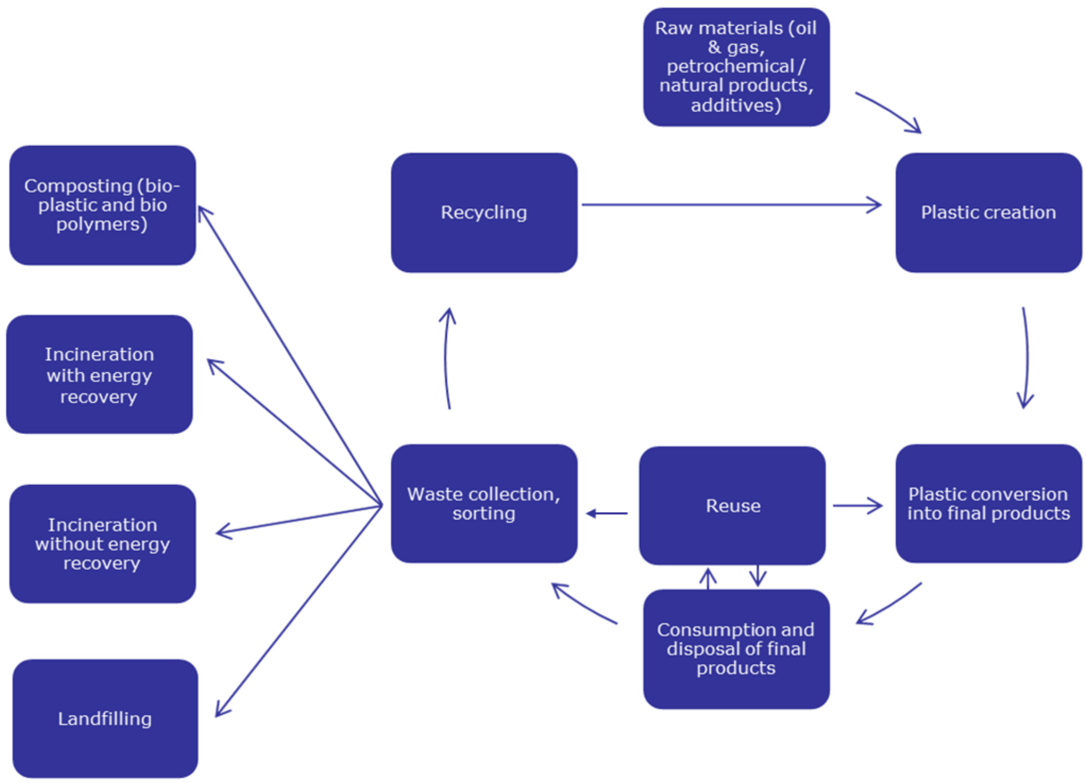


**Figure 10. Circular plastics value chain**

In order to achieve its goals in terms of efficient use of resources, raw materials as well as energy, the plastic sector has managed, in recent years, to produce more plastic with less material input. Additional investment and research are needed to find ways of producing plastic products with less virgin raw materials. The incorporation of secondary raw materials, i.e. recycled plastics, in the products is a way of avoiding the use of virgin raw materials with benefits in terms of energy consumption, imports of fossil fuels, environmental protection and GHG emissions. The use of virgin raw materials for products of a very short lifecycle such as single use items, might be seen as a clear example of inefficient use of resources and contrary to the circular economy principles where the value of products, materials and resources is maintained in the economy for as long as possible and the generation of waste is minimised. Also in line with the waste hierarchy, one should always go for the highest option where it is available, safe for the environment and human health and economically feasible and viable e.g. repair, remanufacturing and reuse over recycling). More durable alternatives are also a way of promoting resource efficiency.

### 2.3.3 Enhanced circularity of plastics improving reuse and recycling rates

Reuse and recycling of end-of-life plastics remains very low, in particular when compared to other materials such as paper, glass or metals.

In 2014, 25.8 million tonnes of post-consumer plastics waste ended up in the official waste streams in the EU, and the greatest proportion is used for food and drink packaging. Only 29.7% of all post-consumer plastic waste was recycled and 39.5% was energetically recovered while 30.8% still went to landfill. No comprehensive data on reuse are available, but experience shows that it is only an option for a limited number of waste streams. These figures show that circularity is still far from being a reality for most plastics.

Packaging is the main application of plastics and also the principal source of plastic waste generated due to the relatively short life of packaging products. In 2014 in the domestic sector alone, 15.2 million tonnes of plastic packaging were generated[65]. It is also the plastic application with the highest recycling rate (39.5% in 2015) as there are in most cases comprehensive collection schemes for that type of waste.

However, this recycling figure is very low compared with other packaging materials. The average packaging recycling rate is currently at 65%: Metals (76%), paper and cardboard (83%), glass packaging (73%) achieved significantly higher recycling rates. One of the reasons for the low recycling rate is the use of different plastic polymers (e.g. PP, PET, PVC, etc.) for different plastic applications. In some cases, a plastic packaging is made from several different polymers, depending on the functions of the packaging. The diversity of polymers, as well as the presence of multi-material and multi-layer packaging, makes recycling more difficult as it requires separation and leads to small quantities of a given polymer type to be managed, which makes logistics difficult and is an obstacle to achieving economies of scale.

Reuse of consumer plastic packaging is not very common. There is increasingly prevalent and widespread use of plastic packaging in applications where the packaging is intended to be thrown away after one use even though more sustainable alternatives (including other plastics) exist. Use of refillable plastic containers (e.g. some PET bottles, some hygiene and detergent bottle refill) happens only where this is mandated (e.g. in Germany), but has declined to very low levels in general. In some cases, this is due to the business models used to deliver products to consumers: e.g. the use of refillable bottles for detergents and washing up liquids relies on the existence of available refill points that consumers can use, or suitable take-back schemes for refillable containers. In addition, refillable models are rejected by well-known consumer brands which tend to use packaging as one of the principal means to differentiate their products from (cheaper) competitors.

Reuse and recycling of plastic packaging is relatively simple for tertiary and secondary packaging, as it is produced in large quantities and results usually in relatively clean and pure recyclates: much of this packaging is also composed of a single polymer.

Reuse is mostly used in the business-to-business (B2B) sector. Reuse of plastic crates between manufacturers and retailers, for example, is common practice. Even plastic film packaging waste from the industrial and retail sectors can be baled and collected in bulk, thus making recycling economically viable. However there are indications that the share of reused packaging is declining.

Recycling rates for building/construction plastic waste are also remarkably low: In 2014, only 24% of this waste stream was recycled, with 42% sent to energy recovery, and the remaining

[65] Source Eurostat http://ec.europa.eu/eurostat/web/circular-economy/indicators/monitoring-framework

34% sent to landfill[66]. The fact some Member States are recycling more than 40% of this waste stream shows that the recycling potential is not fully exploited.

Direct reuse of construction plastic products at end of first life is considered to be very limited in scale and only in particular niches (such as over- ordered materials), and products (such as PVC windows and doors).

The low recycling rates are due to the fragmentation of the plastics construction product supply chain, which leads to a lack of coordination and consistency between the construction and demolition companies, the material re-processors and manufacturers of plastic products. In addition, the fact that selective demolition and separation at source is not commonly applied in many Member States, and the presence of legacy additives in some plastic products are obstacles to reuse and recycling.

Despite a high recycling rate for end of life vehicles (ELVs), the proportion of plastics from ELVs being recycled is extremely low: only 9%. Closed loop recycling of plastics is generally hindered by the limited effectiveness of collection/pre-sorting activities, the lack of a market for recyclates, and the limited skills and collaboration between value chain partners. The fact that the recycling target laid down in the ELV Directive can be achieved mostly by recycling metals provides little incentives for recycling of plastic parts, which in addition consist of different polymers and may contain hazardous additives, hence requiring more elaborated technology.

Waste electrical and electronic equipment (WEEE) is an important source of waste plastics. In the European Union about 3.5 million tonnes of WEEE are being collected yearly[67], but according to reports the figure of total WEEE generated is much higher with approximately 9.4 million tonnes of WEEE generated each year. Approximately 20% of this waste stream consists of plastics. The estimated quantity of WEEE plastics based on the plastic content per WEEE category is 1.2 million tonnes[68]. The quantity of plastic recyclate from the EU WEEE collected is estimated to be around 0.5 million tonnes.

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[66] Consultic (2014) Post–Consumer Plastic Waste Management in European Countries 2014, Report for PlasticsEurope, 15th October 2015

[67] Eurostat WEEE statistics http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do

[68] Eunomia 2017 and own calculations

# 3 Improving the economics and quality of plastics recycling

Increasing plastic recycling could bring significant environmental and economic benefits. It is becoming increasingly clear that higher level of plastic recycling, comparable to those of other materials, will only be achieved by improving the way plastics and plastics articles are produced and designed and by increasing cooperation across the value-chain. The economics and quality of plastics recycling could be improved through enhanced recyclability of plastics and plastic products, increased and improved separation of plastic waste collection and modernised EU's sorting and recycling infrastructure. By achieving these objectives, the Commission will boost both the supply of and the demand for recycled plastics. In order to achieve these objectives, a supportive and business friendly framework should be established providing economic incentives where justified and supporting research and innovation.

## 3.1 Design for recyclability

It is estimated that over 80% of all product-related environmental impacts are determined during the design phase of a product. Optimised design can lead to more durable, reparable, reusable, dismantable and recyclable plastic products. It can also help to fight planned obsolescence since the plastic components can constitute the weakest link in some products like electronics. However, design for increased circularity is currently facing several obstacles that are linked to the production processes, habits and a lack of dialogue across the value chain and between different actors. The choices made at the product design phase have a direct impact on the recyclability of plastics and the possibility to find their way back in the loop.

### 3.1.1 Issues at stake

Although it is estimated that over 80% of all product-related environmental impacts are determined during the design phase of a product, currently, there is no agreed definition of design for recyclability.

Optimised design can lead to more durable, reparable, reusable, dismantable and recyclable plastic products. It can also help to fight planned obsolescence since the plastic components can constitute the weakest link in some products like electronics. The choices made at the product design phase have a direct impact on the recyclability of plastics and the possibility to find their way back in the loop.

However, design for increased recyclability is currently facing several obstacles that are linked to the production processes, habits and a lack of dialogue across the value chain and between different actors. There may be some plastic items that, taken in isolation, are recyclable but are not suitable for recycling if occurring in low quantities and collected together with other often incompatible plastic materials. Moreover, although recycling is technically possible, it could not be economically viable.

***Use of different types of polymers and additives***

A plastic material is an organic solid, essentially a polymer, i.e. chain of several thousand of repeating molecular units of monomers, or combination of polymers.  The monomers of plastic are either natural or synthetic organic compounds. The term resin is sometimes used as synonym of a commercial polymer[69].

Plastics can be classified by chemical structure: the acrylics, polyesters, polyolefins, silicones, polyurethanes, and halogenated plastics. Plastics can also be classified by the chemical process used in their synthesis, such as condensation, and cross-linking. Other classifications are based on properties that are relevant for manufacturing or product design, e.g. thermoplasticity, biodegradability, electrical conductivity, density, or resistance to various chemical products[70].

Plastics contain a main polymer, and a bespoke load of additives. Whereas these additives render plastics extremely versatile material that can display a number of specific properties (e.g. hardness, softness, UV resistance, flame formation resistance, or behaviour during manufacture), some additives cause some problems during the recycling phase or may be hazardous substances.

**Table 2. List of additives used in plastics**

| Type | Function |
|---|---|
| Anti-Counterfeiting | Manufacturers and brand owners can combat counterfeiting by employing one of several or indeed multilayer anti-counterfeiting technologies. Optical brighteners absorb ultraviolet and violet light then re-emit this energy at a higher wavelength, normally as a blue glow. |
| Antimicrobials/ Biostabilisers | Help prevent deterioration of plastic materials where part of the material might be susceptible to microbiological attack. Such attacks can cause staining, discolouration, odour and loss of aesthetics but more importantly, loss of electrical insulating properties, hygiene and overall loss of mechanical properties in the material. |
| Antioxidants | Help prevent "oxidation", the polymer reacting with oxygen. Oxidation can cause loss of impact strength, elongation, surface cracks and discolouration. Antioxidants help prevent thermal oxidation reactions when plastics are processed at high temperatures and light-assisted oxidation when plastics are exposed to UV light. |
| Antistatic Agents | Help to prevent the build-up of static electric charge. Plastics are generally insulating and so have the capacity to build up static charges on the surface which greatly disturb processing procedures and can be an issue for hygiene and aesthetics. |
| Biodegradable Plasticisers | Used to make plastics softer and more flexible and to enhance the degradability of the product. |
| Blowing Agents | Form gases in the plastic to produce a foam material. The blowing agents form gases by breaking down on heating at a pre-determined temperature and form a foam structure within the plastic's polymer matrix. |
| External Lubricants | To prevent damage to plastics or the mould during processing. Applied to the material or directly to the machine to allow processing without damage. |
| Fillers/ Extenders | Natural substances used to improve strength and lower the cost of the material. Usually mineral-based, fillers/extenders literally increase the overall "bulk" of the plastic. |
| Flame Retardants | To prevent ignition or spread of flame in plastic material. Plastics see substantial use in critical construction, electrical and transport applications which have to meet |

[69] Source: Plastics Europe

[70] http://www.sciencedirect.com/science/article/pii/S0306374714701125

| | |
|---|---|
| | fire safety standards either by mandatory regulations or voluntary standards. Flame retardants are added to plastics to meet these requirements. |
| Fragrances | Fragrances and deodorants for plastics are used in a variety of applications and products for the home. |
| Heat Stabilisers | To prevent decomposition of the polymer during processing. Processing usually results in temperatures well above 180°C, which without the addition of heat stabilisers would result in the plastic material literally falling apart |
| Impact Modifiers | Enables plastic products to absorb shocks and resist impact without cracking. Particularly relevant for polyvinyl chloride (PVC), polystyrene (PS) and polypropylene (PP) materials. |
| Internal Lubricants | Used to improve processability of plastics by increasing the flowability. Internal lubricants improve the melt flow of material by lowering the viscosity and heat dissipation (also see Processing Aids). |
| Light Stabilisers | Used to inhibit the reactions in plastics which cause undesirable chemical degradation from exposure to UV light. |
| Pigments | Tiny particles used to create a particular colour. |
| Plasticisers | Used to make plastics softer and more flexible. |
| Process Aids | Used to improve processability of plastics by increasing the flowability. Internal lubricants improve the melt flow of material by lowering the viscosity and heat dissipation (Also see Internal Lubricants) High-polymeric processing aids also improve flowability of PVC compounds. |
| Reinforcements | Used to reinforce or improve tensile strength, flexural strength and stiffness of the material. Often fibre-based. |

*Source: Eunomia (2017)*

The content of additives in plastics varies widely, ranging from less than 1% in PET bottles to 50-60% in PVC, striking often a balance between technical properties and economics, as some additives are considerably more expensive than the main polymers, while others are inexpensive (inorganic fillers such as limestone or talc).

Worldwide consumption of plastic additives is estimated to have reached 12.6 million tonnes in 2013 and is expected to increase to some 17.1 million tonnes by 2020. The Asia-Pacific region is leading globally both in terms of production and consumption of plastic additives. The demand is expected to increase worldwide[71], led by China and India. The on-going replacement of metals by plastics in many application areas, the increase in environmental awareness and intervention by governments to promote non-toxic plastic additives are among the factors driving growth in the plastic additives market[72].

Plasticizers dominate the market of additives followed by flame retardants. PVC is the polymer consuming most additives, about one-third of the sum of plasticizers and heat stabilizers, and used in the early 2000's ca. 73% of the world production of additives by volume, followed by polyolefins (10%) and styrenics (5%) . About 40% of antioxidants and light stabilizers are used in polypropylene[73].

[71] Worldwide consumption of plastic additives is estimated to have reached 12.6 million tonnes in 2013 and is expected to increase to some 17.1 million tonnes by 2020.

[72] JRC Technical report "End-of-waste criteria for waste plastic for conversion" Technical proposals 2014

[73] http://www.sciencedirect.com/science/article/pii/S0306374712701306

Scientific evidence has shown that some additives that were massively used in the past are substances of very high concern and have been restricted by environment, health and safety legislation worldwide and in particular in Europe. This has led to a phase-out or a reduction in the consumption of some additives (e.g. phthalate-based plasticizers).

Additives generally enhance plastic performance. They are essential to compensate the plastic monomers' incapacity to withstand use conditions without losing their useful properties and enhance their performance. However, they cannot be removed using traditional mechanical recycling methods. Hence, in their use there must be a balance between functionality and other characteristics that those additives may confer to plastics. Indeed, if some of those additives are not removed, they may remain in the recycled plastics and occur as legacy substances in recyclates, hinder their quality and create concerns about their safety in certain cases.

Therefore, the use of additives must be carefully analysed during the design phase to ensure that, where possible, less toxic substitution are made, that they can be either easily removed at the end of life stage or do not compromise further recyclability of those materials.

Even for those products that are suitable for recycling and for which recycling schemes exist in some countries (e.g. PVC windows and doors), there are some issues linked to the presence of legacy additives that were allowed to be used in the past but have been restricted in the meantime as there was evidence of their harmfulness. The presence of these additives may make recycling impossible. Alternatively, recycled content may be limited to small percentages in new products to ensure that the existing thresholds for these additives in new products are not exceeded. A more promising approach consists in dissolving the plastic waste and separating the polymer from the (toxic) additive. A pilot plant[74] is applying this technique to recycle polystyrene waste that is contaminated with the banned flame retardant hexabromocyclododecane (HBCD), obtaining a clean polymer that can be used in the production of new plastics and a contaminated waste stream that has to be treated.

Several substances of concern have been phased out over the last decades. However, their presence can still be traced in some cases.

### *Design choices can negatively affect the value of recyclates*

The EU policies on product design have until now focused more on energy efficiency achieved in the use phase of the product and less on material design and composition for circularity, durability and reparability. However, it appears clearly that a circular plastic economy requires that materials used are recyclable.

Plastics are currently a waste stream with very low recycling figures (30% recycling overall; 40% for plastic packaging) compared to other materials such as paper, metal or glass. Complex designs, either material design, for instance, by combining multiple polymers, additives, etc, or functional design, for instance, by integrating plastic materials in complex structure rendering the dismantling very complicated. These design flaws that result of paying little consideration to end-of-life sorting and recycling aspects is one of the reasons that hampers achieving higher plastic waste recycling rates. These choices have also an impact on the final quality of recyclates.

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74 https://polystyreneloop.org/

Products are very often designed taking into account technical, economic and marketing aspects, involving co-operation among experts in these areas. However, end-of-life aspects are too often not taken into account during the design phase, and related experts not involved. Cooperation between production and recycling companies is also lacking.

**Table 3. Examples of design choices and recyclability in plastics**

| **Examples of a design choice** | **Negative effects on recyclability** |
|---|---|
| Fillers (e.g. chalck, talc powder and marble) | Fillers will increase the density of polymer. This will lead to material losses during the recycling process. |
| Multilayers and combination of non-compatible materials (PE/paper, PE/aluminium etc.) | Plastics combined with different materials are difficult to segregate. If it is first properly sorted by the final user (aka consumer) it will be discarded during the sorting. If it is not taken out of the waste stream in time, if might lead to contamination of the waste stream and of recyclates. |
| Dark pigments | Unpigmented is preferred. Dark recyclates have a lower value. |
| Direct printing on the packaging | Should be avoided because inks will have an impact on the colour of recyclate and will often make it less attractive for future applications or introduce incompatible contaminants. |
| Use of inks | Inks must be chosen that do not bleed colour when agitated in water. Label inks that bleed and can discolour unpigmented HDPE for example regrind in the reclamation process, diminishing or eliminating its value for recycling. |
| Use of additives | Some additives might present a risk for human health if are still present in recycled materials (e.g. flame retardants) in particular if the intended use is sensitive as it is the case for food contact materials. |

There is little incentive to take into account recycling or reuse aspects when designing plastics for applications in automotive, construction and electronics given that the plastic waste fraction is small and there are no EU wide targets for recycling and recovery. Given that the overall recycling and recovery targets can be met without (or with only marginal) recycling of the plastics contained in these products and there are no reuse targets at all, there is little incentive to take into account recycling or reuse aspects when designing plastics for these applications.

### Packaging

Design for recyclability is particular relevant for plastic packaging given that it is the most abundant plastic waste type and its short lifetime. However it is not defined in the Essential Requirements of the Packaging and Packaging Waste Directive (PPWD). It is estimated[75] that around 30%, by weight of the plastics used for packaging needs fundamental redesign and innovation in order to be reused or recycled. Otherwise these materials will end up as litter, will be incinerated or landfilled. It is estimated that improvements in design have the potential of

[75] The Ellen McArthur Foundation, The new Plastic Economy, Catalysing Action, 2017

cutting by half the cost of recycling plastic packaging waste[76]. In addition, there is little or no incentive to sort packaging whose value is low e.g. sachets, or which is a small proportion of what is in the waste stream, unless targets and incentives demand this. The low rates of plastic packaging recycling may also be due to the fact that most sorting systems detecting plastics are using near infra-red technology and sorting will be based primarily on the nature of the polymer that is picked up by the system as the packaging passes the detectors. For each additional stream that is to be sorted, an additional adaptation of the sorting system is required which leads to additional costs and investments. Whether such an investment makes sense will depend on the proportion of the material being targeted in the waste stream, and its value when extracted as a separate material (represented as revenue net of avoided treatment / disposal cost).

Plastic packaging presents often some design flaws that make their reuse or recycling difficult[77]:

- Their design and material may confuse the consumers who do not put the waste in recyclable materials bin (e.g. plastic packaging which resembles paper, multi-material packaging, etc.).
- Plastic components in packaging that are difficult to separate manually from other materials (e.g. plastic labels on glass packaging, plastic handles on cardboard packaging, etc.).
- Coloured plastic materials that are difficult to separate in sorting plants.
- Plastics made of uncommon materials and for which no automatic sorting is foreseen in most of the sorting plants because of their low quantities (PVC, ABS, PU, etc.).
- Compound materials, such as multi-layer materials or multi material materials, are usually difficult to recycle.
- The presence of incompatible materials in the same waste stream (e.g. different types of PET) hampers recycling.
- Thin PET foils and semi-rigid PET foils are difficult to recycle.

### Construction materials

Construction products containing plastic have a long lifetime, usually 25 years or more. For this reasons, in the design phase other factors, such as functionality, durability and energy efficiency, are prioritised over end of life issues. Recycling plastic waste from demolition is hampered by the fact that many plastic construction materials are part of composite structures (e.g. insulation materials), which are difficult to separate.

Material degradation can also pose a problem: some polymers can be affected by exposure to ultraviolet radiation, and products using these materials may degenerate over time. These issues lead to concerns over warranty and liability for construction companies and building owners considering reuse, and so products need to be retested and recertified.

From a market perspective, there are also a number of challenges in terms of the reuse of plastic building components at the end of first life. The performance specification (grade) of reusable products is often unknown: e.g. the insulation or fireproofing properties of insulation

76 BKV: Potenziale zur Steigerung der werkstofflichen Verwertung von Kunststoffverpackungen – recyclinggerechtes Design, Sortiertechnik, 2016 quoted in Recycling Magazin 02/2017

77 BKV: Potenziale zur Steigerung der werkstofflichen Verwertung von Kunststoffverpackungen – recyclinggerechtes Design, Sortiertechnik, 2016 quoted in Recycling Magazin 02/2017

foam may be unclear. This is both in terms of the product specification when manufactured, and any repair, maintenance or modification that may have occurred during its operating life. These challenges are further compounded by a wide range of non-standard size products: while pipes, guttering etc. are often directly reusable, windows and doors are often not standard sizes, or obsolete in terms of meeting construction products regulation (CPR) and building code requirements.

As regards plastic waste from demolition of buildings, one should keep in mind that the massive use of plastic as construction is relatively recent. Therefore, volumes of plastic waste are still low and often of poor quality. During the demolition, plastic waste is often mixed with other waste streams. In consequence, the recycling of plastic waste from demolition is often not economically viable. However, the use of plastic materials in constructions is increasing, which will lead in future to more plastic waste from demolition.

### In automotive sector

In the automotive sector, Directive 2005/64[78] specifies that vehicles may be put on the market only if they are reusable and/or recyclable to a minimum of 85 % by mass and are reusable and/or recoverable to a minimum of 95 % by mass. It can be observed that currently vehicles in general are designed to be more and more resource efficient and durable, their spare parts repairable, reusable and replaceable, tackling safety and weight issues. However when applied specifically to plastic parts in vehicles this design for recycling obligation is not sufficiently taken into account.

The ELV Directive[79] aims, as a first priority, at the prevention of waste from vehicles and, in addition, at the reuse, recycling and other forms of recovery of end-of life vehicles and their components so as to reduce the disposal of waste. Although the ELV Directive requires vehicles to be designed for deconstruction[80], the disassembly or the recycling of car parts can still be improved. Many of the plastic parts in cars are large and easy to remove such as bumpers. Increase in removing these parts might even be achieved without a large increase of costs[81].

The plastic quantity from ELVs available for recycling is significant, yet the recycling process itself is still a challenge. After these big plastic parts are removed or where an easy dismantling process is not possible, ELV processors will opt for shredding the vehicles, instead of manual dismantling, to save costs. Plastic coming from the shredding process is of a much lesser quality and more difficult to recycle.

Design for recyclability of plastic parts in vehicles has also to taken into consideration the use and presence of chemicals as the average lifespan of a car is of 20 years. This might be an issue for cars that were produced in the past and have now come to the end of their life. Cross contamination of plastics by hazardous substances is hence a potential risk and must be limited to maximum following the rules put in place by ELV Directive.

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78 On the type-approval of motor vehicles with regard to their reusability, recyclability and recoverability

79 Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of-life vehicles

80 Complex Waste Plastics Recycling Industry 'Wish List' to promote a rapid transition to a Circular Economy

81 Interview with EuRIC

Closed-loop plastic recycling in automotive sector should be promoted. A further uptake of recycled plastics originating from cars could be envisaged[82]. While doing so, it has to be ensured that legislation on safety of vehicles is fully complied with[83].

#### Electrical and electronic equipment (EEE)

Design for reuse and recycling has not been a priority for the EEE industry. The Eco-design Directive for Energy related Products 2009/125/EC focuses on improving the energy performance of products, but has not introduced any significant impacts on material use (and hence impacted on plastic material resource efficiency considerations). Legislation and regulation aimed at addressing hazardous substances in electrical and electronic equipment has resulted in improvements to product design, with a high proportion of hazardous additives, such as brominated flame retardants (e.g. PBDE and PBB), being phased out from new products on the market and hence, improving recycling opportunity for polymers (and reducing the impact of the thermal treatment of such plastics where this takes place). Reuse of WEEE plastic parts on a large scale is not feasible due to the lack of standardisation in part types, although it would be possible to reuse cases and other plastic parts for repairs. Furthermore, it is claimed that drivers for repair and preparation for reuse (over recycling) are lacking, which result in a lack of demand for low cost spare parts, such as reused plastic casings.

### 3.1.2 Existing EU measures

The European Commission adopted an ambitious Circular Economy Package, which includes revised legislative proposals on waste. The revised legislative proposal on waste sets clear targets for reduction of waste and establishes an ambitious and credible long-term path for waste management and recycling. To ensure effective implementation, the waste reduction targets in the new proposal are accompanied by concrete measures to address obstacles on the ground and the different situations across EU Member States.

Within the Eco-design Working Plan (2016-2019) the Commission remains committed to developing, where appropriate, product requirements under the Ecodesign Directive that take account of circular economy aspects, including recyclability and durability, reparability, upgradeability, design for disassembly, information, and ease of reuse and recycling for Electric and Electronic Equipment (EEE). This includes the development of mandatory product design and marking requirements, with the intention of making it simpler and safer to dismantle, reuse and recycle electronic displays (e.g. computer monitors, televisions and electronic display integrated in other products)[84]. It has also developed criteria to improve recyclability of plastics in its Ecolabel and Green Public Procurement criteria[85.]

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[82] David Schönmayr, Automotive Recycling, Plastics, and Sustainability: The Recycling Renaissance, page 157 (2017)

[83] Interview with European Automobile Manufacturers' Association – ACEA

[84] Assessment of separate collection schemes in the 28 capitals of the EU. Bipro 2015.

[85] For example, marking large plastic parts to facilitate sorting, designing plastic packaging for recyclability, and designing items for easy disassembly such as in furniture and computers

In order to address skills gaps the European Commission has supported, through the Erasmus+ programme, several projects that have developed vocational training content relevant to the circular economy[86].

The development of a new scheme for "Design for Deconstruction", a close collaboration with construction stakeholders and national/regional administrations, will analyse the implications of Design for Deconstruction for the various segments of the construction value chain, i.e. what does it mean in terms of engineering and architecture of buildings, selection of materials and their properties, construction techniques, disassembly of buildings (instead of demolition). This exploratory phase will also address the potential needs regarding the evolution of construction codes and regulations. A second phase is the materialisation of a voluntary framework addressing the principles and rules of design for construction for the various parts of the construction value chain, including the contractual and liability issues.

The Commission Communication "New Skills Agenda for Europe"[87], adopted on 10/6/2016, launched the "Blueprint for Sectoral Cooperation on Skills" to improve skills intelligence and address skills shortages in specific economic sectors. The Blueprint is a new framework for strategic cooperation between key stakeholders (e.g. business, trade unions, research, education and training institutions, public authorities) in a given economic sector. Erasmus+ Sectoral Skills Alliances will be set up at EU level and then rolled out at national or regional level. As of 2017/2018 a second wave of sectors will be eligible for implementing the Blueprint, including green technologies and circular economy including bio-based and secondary recycled products in construction.

### 3.1.3 Actions to be taken

One of the objectives of the Plastics Strategy is to encourage and support product design choices that take into account their entire life cycle and that make them more durable, circular and easily recyclable.

A precise and agreed definition of design for recyclability is needed. It should be established taking into account the context of existing waste streams and treatment plants and aligned, as far as possible, with sorting performance of existing facilities, in particular for plastic packaging.

Alternatively, sorting of plastic waste is to be improved through innovative technologies e.g. scanners for watermarks or tracers/markers of polymers.

As packaging is one of the main applications of plastics, all plastic packaging should be designed recyclable by 2030. To achieve this, the Commission will work on a revision of the essential requirements for placing packaging on the market. To this regard, the concept of design for

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[86] for example Erasmus+ Sector Skills Alliance for the design and testing new management skills for the development of the Waste Electrical and Electronic Equipment Recycling and Re-use System: http://www.ewaster.eu/;
other education & training projects related to the development of the circular economy can be found here: http://ec.europa.eu/programmes/erasmus-plus/projects/#search/keyword=circular%2Beconomy&matchAllCountries=false

[87] COM(2016) 381 final "A New Skills Agenda for Europe – Working together to strengthen human capital, employability and competitiveness"

recyclability should be clarified. Potential instruments include revised product design legislations, in particular revised Essential Requirements for Packaging.

Design for recyclability of plastics should also take a look on removing regulatory barriers if they exist, through more harmonised and efficient EPR schemes, supportive framework for innovation and investments in more circular business models and a better understanding of the needs of actors of the plastics value chain. In this context, the Commission will also look into ways of maximising the impact of new rules on Extended Producers Responsibility (EPR), and support the development of economic incentives to reward the most sustainable design choices. It will also assess the potential for setting a 2030 recycling target for plastic packaging, similar to those put forward in 2015 for other packaging materials.

Any action should be based on a proper lifecycle analysis and taking into account the waste hierarchy (repair, reuse and remanufacturing are to be preferred over recycling, incineration with energy recovery or landfilling as the least preferred option). However, several objectives can be pursued simultaneously.

Research in innovative polymers that can be more durable and suitable for recycling while offering the desired functionality (e.g. protecting the packaged products) could also contribute to an increased recycling (see section on innovation).

A reflexion on additives used in materials is also needed. The objective is to ensure a less toxic material stream and that recycled plastics are compliant with general requirements for products in terms of safety and non-hazardousness. Substitutions of substances of concern should be made, where possible, therefore allowing to limit the risk of presence of legacy substances in recyclates. This is one of the topics to be taken into account in the work on Interface between chemicals, products and waste policy (see section on legacy substances). As part of this work, the Commission is proposing possible ways to make chemicals easier to trace and to tackle the problem of legacy substances in recycled streams.

As more and more plastics are used in construction, design for deconstruction is also important. This should however not specifically relate to plastic but consider all materials that are used. A new scheme for "Design for Deconstruction" will be launched.

In automotive sector, there is a need to improve the design for disassembly and recycling of plastic parts. The overall environmental impact and compliance with other objectives have to be taken into account. A better implementation and/or the revision the ELV directive might be therefore needed.

Greater collaboration is also required throughout the entire value chain. This can be achieved, inter alia, by producing design guidance to ensure recycling is fully taken into account. From a different perspective, actors involved in the design phase may also contribute to creating comprehensive and easily accessible information channels on substances used in materials and articles. The right balance between access to the relevant information and protection of intellectual property and industrial secrets needs to be ensured.

## 3.2 Boosting demand for recycled plastics

### 3.2.1 Issues at stake

***Obstacles hampering the market for recycled plastics***

Recycled plastics today only account for about 4-6% of the EU demand for new plastics materials, representing appr. 3.5 million tonnes / year.

Different reasons may lead businesses to use more recycled plastics. Demand for more sustainable products and circular consumption has also increased over the last years. Recycled plastics can already be used in different types of applications depending on the quality of recyclates which has gradually and constantly increased. However, the uptake of plastic recyclates remains relatively low. A recent survey carried out by the European Plastics Converters Association (EuPC) in cooperation with Polymer Comply Europe (PCE) [88] on the current and future use of recycled plastics materials in the Europe's plastics converting industry found out that only 27% of the European plastics converting companies state that their customers are sufficiently aware of the benefits and needs to use recycled plastic materials. The survey also found out that the quality of recycled plastic materials remains the biggest barrier to stronger use of recyclates as raw materials. Almost 60% of the European plastics converting companies find it hard or very had to get a supply of recycled plastic materials in an acceptable quality.

The EuPC survey shows that "a vast majority of 76% of the respondents currently is using recycled plastic materials, and regarding the future use, 75% of the participants plan to increase their usage of recyclates. Of the companies not currently using recycled plastic materials, 64% plan to do so in the future. The survey concludes by stating that "in the future, this number will further increase to more than 90%". Hence, we can observe both potential and willingness to take up this challenge. Several good examples can be listed:

- In the automotive sector, Renault uses already approximately 42,000 metric tons of recycled plastic per year, and intends to increase this figure to more than 50,000 tons in the coming 3 to 5 years. The Mercedes B Class Electric Drive contains 58 parts (31.9 kg) of recycled and high quality plastics.
- In the area of electronic devices, products benchmarked Sony SORPLAS (Sony Recycled Plastics) are made from up to 99% of recycled plastics. Sony also uses plastic which is a mix of virgin plastics (33%) and recycled content. The Philips PerfectCare Eco Steam Generator and Senseo coffee machine also contain recycled plastics. SEB has also developed a special brand of domestic appliances containing recycled plastics.
- In 2016 Werner & Mertz in collaboration with the bottle manufacturer Alpla-Werke Alwin Lehner GmbH & Co KG and the Green Dot, developed a new type of bottle for cleaning products which is made of 100% recycled plastic obtained from the Yellow Bag. Previously no translucent and white material had ever been produced from recyclable domestic refuse.

[88] https://plastics-converters-europe.prezly.com/eupc-publishes-results-of-its-survey-on-the-use-of-recycled-plastics-materials?asset_type=attachment&asset_id=88881#

- In 2017, P&G in partnership with TerraCycle launched its new detergent bottle made from 100 per cent recycled plastic, including 10 % of plastic waste from the ocean.

However, the whole value chain will need to work hand in hand in order to seize this opportunity. In all cases, specific discussions on design with recycled plastics should take place in order also to clarify, raise awareness amongst industry and end some misgivings regarding the integration of recycled content. A number of specific considerations need to be taken into account.

The fact that China's notified the ban on plastic waste imports in July 2017 will have an impact on the European recycling industry in a sense that there will be more plastic waste to be recycled risking an oversupply of unsorted or poorly sorted plastics waste, which are not., fit for high quality and safe recycling. It is also important to highlight that market prices for recycled plastics in the EU depend on the market prices worldwide. With the Chinese's ban, there is a risk that prices of waste go down hand in hand with quality while quantities available increase. If its quality is poor, plastic waste is more expensive to be recycle. and usually leads to less qualitative recyclates (including safety concerns) that may not find a buyer. In view of this, there is a case for improving the quality of sorting plastics waste in distinct, more homogenous plastic fractions.

### *Lack of quality standards for sorted plastic waste and recycled plastics*

Recycling of plastic waste and the uptake of recyclates remain very low, in particular when compared to other waste streams e.g. paper, glass and cardboard. It is however generally admitted that there is room for improvements when it comes to increase the uptake of recycled plastic. Downcycling, i.e. recycling of waste in cases where the recycled material is of a lower quality and functionality than the original material is also sometimes the preferred option because of some misgivings on the converters' side regarding the quality, safety and fitness-for-purpose of recycled materials, induced by the lack of dialogue across the value chain.

A market for plastic recyclates (from mechanical and chemical recycling) and other secondary raw materials will only develop if such secondary raw materials can fulfil specific quality standards. Recycled plastics shall be demonstrated as safe. Moreover, collection of plastics, which makes up a large part of post-consumer waste, still does not generate sufficiently clean and homogenous streams that could enable recyclers to have the purity and scale that could result in improved material streams. Materials with significant recycling potential, for example clean plastic films are not at all collected in most Member States. If they were, it would contribute to increasing volumes of available plastic waste for recycling and in consequence the use of recyclates.

Beyond the idea to give more certainty to recyclers regarding return on investment, recycling should also be supported by creating legal certainty and a level playing field compared to virgin material production. Indeed, there are indications that uncertainties concerning the legal status and regulatory acceptance of plastic waste stifle investments in plastic recycling, This relates both to the waste management conditions for certain plastic waste which may or may not be considered as hazardous, and to the conditions for recovered plastics to cease to be waste and become a product.

The general end-of-waste criteria, i.e. criteria according to which waste ceases to be waste, and the ways how this can take place, are defined in Article 6 of the Waste Framework Directive (WFD). Such criteria have been set by the Commission for iron, steel and aluminium scrap[89], glass cullet[90] and copper scrap[91]. For plastic waste, the European Commission[92] carried out a review, but end-of waste criteria have not been set because of the complexity and diversity of polymers and variety of potential applications. There would be a merit to provide businesses with harmonised quality standards for recycling practices and for recyclates in order to provide supportive business environment. Moreover, none of the existing standards and technical specifications fits the purpose of end-of-waste criteria and only business to business specifications define in practice the technical characteristics of waste plastics and recyclates.

Hence, to support all actors in their efforts to increase quality and safety in the plastic value and in order to prepare the ground for such a standard, a first mapping exercise was launched by the Commission in the field of sustainable chemicals (plastics included) with the standardisation bodies (CEN, Cenelec and ETSI ) in December 2016. It will last until the end of 2018 when a mandate for standardisation bodies will be defined. For the purpose of this activity the concept of "sustainable chemicals" plastics included shall refer to the full lifecycle of chemicals and assess for each stage how standardisation can contribute to better sustainability.

More recycling of secondary raw materials could be achieved through better waste collection and sorting systems, establishing end of waste criteria for plastic recycling and quality standards for secondary raw materials. Whereas some of these areas are covered by legislation, others are not, which leads to different requirements for standards. This work will recognise the distinction between standardisation documents as a support to markets (voluntary standards) and standardisation documents in support to legislation (harmonised standards). Hence, in areas where legislation is present or under preparation, it will verify whether existing standardisation documents can support legislation (harmonised standards) or whether possible gaps exist and how to close them by also considering pre-and co-normative research.

### *Recycled plastic in food contact materials*

Materials used in food packaging whether they are virgin materials or recycled, have to comply with legal requirements in order to ensure food safety. Beyond the food safety issues, operators may be hesitant to use recycled materials for the packaging because of some material quality concerns e.g. aesthetical aspects, smell, etc..

There might also be concerns about the composition of recycled plastics intended to be used in food packaging as their composition is difficult to control and their origin is sometimes unknown in comparison to virgin raw materials. Recycled plastics may contain incidental contaminants that can originate from multiple sources (e.g. impurities, the use-phase, misuse, degradation, improper separation of materials, legacy substances or cross contamination during waste collection). Such incidental contaminants can affect the quality and safety of recyclates and the trust of operators in fitness for purpose of such materials.

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[89] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32011R0333
[90] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012R1179
[91] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R0715
[92] JRC report on end of waste criteria for plastics

Currently, Food Packaging constitutes approximately 10% of the total plastic market[93].

### *Legacy substances in waste streams and recyclates*

One of the Circular Economy Action Plan's objectives is to address the presence of substances of concern, limit unnecessary burden for recyclers and facilitate the traceability and risk management of chemicals in the recycling process. It also states that "the Commission will therefore develop its analysis and propose options for action to overcome unnecessary barriers while preserving the high level of protection of human health and the environment." This double goal (a boosted market for secondary raw materials and high level of protection of human health and the environment) cannot be achieved without addressing some issues related to how chemicals, products and waste legislation work or do not work together.

It is therefore necessary to clarify how to deal with legacy substances, carefully weighting pros and cons of allowing recycling of certain materials versus elimination of the chemicals of concern these may contain. No such suitable assessment techniques, which take into account all relevant aspects - environmental footprint, risk assessment and socio-economic assessment - to determine the best overall outcome for society, have yet been agreed.

The perception of the different operators on the market on the sourcing of recycled materials containing substances of concern, or eve n of the direct use of materials that have not ceased to be waste in production, varies depending on the materials and the operators and deserves consideration as it may play an important role in determining the viability of different alternative solution to the problem.

There is an important knowledge gap about substances in materials and products and how they circulate from one stage of their life to another, which material or waste streams are concerned and to what extent.  It is of particular importance that the time factor is kept in mind. Time factor should be read as past-present-future but also as lifespan and lifecycle of products, when products were manufactured, when products will become waste.

[93] Non-harmonised food contact materials in the EU: regulatory and market situation; JRC Report; 2016

**Table 4. Origin of some legacy substances**

| Substance | Source of contamination |
|---|---|
| Toxic heavy metals | Cross contamination if not disposed of properly<br>Can occur in recycled materials if not recycled properly (because recycler ignored that those substances are in materials or it is just impossible to take those substances out) |
| Flame retardants | Initially added during manufacturing process<br>Can occur in recycled materials if not recycled properly (because recycler ignored that those substances are in materials or just didn't / could not de-pollute materials)<br>Could also be added after recycling process as such in order to increase resistance to catching fire (but not always needed) |
| Plasticisers | Initially added during manufacturing process (e.g. PVS) and occurs in recycled materials if not recycled properly (because recycler ignored that those substances are in materials or it is just impossible to take those substances out)<br>Could also be added during or after recycling process in order to increase functionality or to improve quality when mixed with virgin raw materials |
| PCBs | Cross contamination if not disposed of properly<br>Can occur in recycled materials if not recycled properly (because recycler ignored that those substances are in materials or it is just impossible to take those substances out) |
| PAH (polycyclic aromatic hydrocarbon) | This group of substances is a natural component of fossil raw materials, specifically coal and petroleum. Refining processes[1] such as coking for coal and cracking for petroleum generate products such as coke, tar, petrols, waxes, or oils. The slags generated in these processes are incinerated or used as a construction material in road building. If PAHs are not removed from slag or from coke oven and refinery products, they will enter the environment due to their persistence. Tar oils and specific oils from petroleum refining can be added as softeners to rubbers and plastics. The largest portion of the PAHs that reach consumers comes from these applications. Can also occur in recycled materials if virgin raw materials (e.g. rubber) are mixed with recycled materials containing PAH |
| Perchlorates | Additives in plastics |

The information flow along the value chain should be ensured. Currently, it is the case to a certain extent and for a certain type of substances, i.e. regulated under CLP and REACH. REACH for example specifies certain obligations for article producers who may be obliged to submit a registration or notify ECHA of the presence of substances of very high concern (SVHCs) in articles or pass information on those SVHCs down the supply chain in accordance with Articles 7 and 33 of REACH.

Dangerous chemical substances have also an impact on the health and safety of workers involved in the recycling operations. The EU legal framework in this field establishes minimum requirements for the protection of workers' health and safety, imposing on the employer several obligations, including the performance of risk assessment and the implementation of protective and preventive measures[94].

However, there are very limited (if any) information channels between producers of materials/products and recyclers. Users of articles, particularly consumers, are the first concerned as they have only limited information about the presence of substances of concern in articles. Waste managers, particularly recyclers, are affected as they will generally have only limited information about the presence of substances of concern in the input waste material they treat (especially in the case of waste originating from articles). Testing all recyclates for all potential contaminants and substances is not feasible and is not economically viable[95] although the Commission may consider monitoring obligations for sensitive applications. From the legal perspective and from the point of view of recyclers, lack of knowledge of the (relevant) composition of the treated waste stream and the potential recycled material may hinder the decision-making process to allow the transition of that recycled material from waste to product status. From the market and business perspective, not knowing if recycled plastics are fit-for-purpose and safe for the intended future use may have a dramatic impact on the reputation and liability of the company.

The mere presence of a substance of concern in an article does not however necessarily equate to the existence of a risk. In that regard the issue of recycling hazardous waste should also be taken into consideration. Waste can be hazardous from the moment it becomes waste. It also seems possible that a waste that did not have hazardous properties acquired them later in its lifetime because of improper management.

The fact that waste is hazardous does not necessarily mean that it cannot be recycled. EU harmonised End of Waste criteria were established for glass cullet, iron, steel and aluminium scrap and copper scrap. In these three cases it is stated that hazardous waste shall not be used as an input except where proof is provided that the specified processes and techniques to remove all hazardous properties have been applied. The output from recycling operation shall be graded according to a customer specification, an industry specification or a standard for direct use in the production of substances or objects.

### *Lack of information flow and cooperation across the value chain*

Improving the circularity of plastics and in particular the uptake of recyclates can also be enhanced through the appropriate information channels (producers of raw materials – converters – retailers - producers of goods – waste stage – recyclers). Enhanced supply chain collaboration, promoted by sectorial platforms and their associations has also a role to play (see the case of VinylPlus as an example).

If it is clearly established that there is a need for information sharing, more reflexion is needed in order to define what kind of information is to be/can be gathered and for which kind of

94 Directive 89/391/EEC on the introduction of measures to encourage improvements in the safety and health of workers at work; Directive 98/24/EC – risks related to chemical agents at work of 7 April 1998 on the protection of the health and safety of workers from the risks related to chemical agents at work; Directive 2004/37/EC on the protection of workers from the risks related to exposure to carcinogens or mutagens at work.

95 Conclusions of a workshop on traceability

products and applications (packaging, construction, EEE, automotive, etc.). Gather too much information might have an adverse effect e.g. recyclers cannot test plastic recyclates for every potentially hazardous substance. Information should be available, up to date and organised in a comprehensive manner, which seems to be challenging for the time being and depends on the willingness to cooperate among relevant actors e.g. problem of information disclosure that varies from one sector to another (EEE,ELV,packaging, construction etc.).

Another question is what are the technics already available or sufficiently advanced that can allow not only access the information gathered e.g. shared plate-forms, digital data basis, but also ensure that its flow is continuously maintained. In other words, how to trace materials and substances and how to ensure that the information follows them wherever they go and is still relevant in future.

In addition, traceability has the potential to :

- increase recycling rates by leading to a better sorting of different types of plastics and polymers;
- improve the quality of the recyclates by a better separation of different types of plastics and polymers and/or allowing to trace substances of concern;
- and, where required, allow product and material identification if traceability is assimilated to a "product passport" mainly for complex products such as electronic devices made from different type of materials.

Traceability of plastics and plastic polymers can be achieved with the help of:

1. markers in plastic polymers and
2. digital watermarks in products.

Both can be combined but they are just one of the measures to be taken and are interlinked with others (innovation, design for recyclability, collection-sorting-recycling)

Every technic available has its purpose and limits. Tracers lead to add chemical substances into polymers. There also might be an issue when plastics are recycled because of the accumulation of previous tracers. The number of tracers that can be used is limited. When plastics are shredded, those pellets might be composed of different polymers and hence have different tracers in them. On the other hand, watermarks are useful only when products are entire (e.g. not shredded) and when materials can be recognised by a scanner and easily sorted in their real conditions.

**Box 2. The case of VinylPlus: long term sustainability framework**[96]

| |
|---|
| VinylPlus is the 10-year Voluntary Commitment to sustainable development by the European PVC industry. The VinylPlus programme was developed through open dialogue with stakeholders, including industry, NGOs, regulators, civil society representatives and PVC users. The regional scope of the programme is the EU-28 plus Norway and Switzerland. Through the VinylPlus initiative, the European PVC industry plans to create a long-term sustainability framework for the entire PVC value chain. It aims to:<br>• recycle 800,000 tonnes of PVC per year by 2020 (570.000 tons achieved in 2016)<br>• promote a sustainable use of additives<br>• improve PVC products sustainability and their contribution to sustainable development<br>• reduce progressively GHG (greenhouse gas) emissions as well as energy and<br>• resource consumption along the entire production chain<br>• move towards a low-carbon circular economy<br>• build sustainability awareness along the value chain and among stakeholders. |

### 3.2.2 Existing EU measures

***Quality standards for sorted plastic waste and recycled plastics***

As a preliminary step in establishing quality standards a mapping exercise regarding sorted plastic waste and recycled plastics is needed, with the objective to have a general and full overview of needs and gaps in this area. The European Commission launched a preliminary study in this regard. It will prepare the ground for the upcoming standard by identifying and prioritising standardisation work. Developing quality standards for recycled plastics will ensure that where recyclates are replacing virgin raw materials, same requirements and technical specifications e.g. safety, fitness-for-purpose are met.

***The Food contact materials (FCMs) legal framework***

The Food contact materials (FCMs) legal framework[97] is very protective of human health. Materials used in contact with food cannot release their constituents to the food in amounts that could adversely affect the health of consumers[98].

Primary plastic materials used in food contact materials are subject to compositional requirements set out in specific legislation[99]. From the legal point of view, there is a distinction between materials made from virgin plastic raw materials and recycled plastic materials[100]. Recycled plastic materials and articles shall only be placed on the market if they contain recycled plastic obtained from an authorised recycling process. The quality of recycled plastic used for food packaging must be characterised and controlled. It must originate from plastic materials and articles that have been manufactured in accordance with Community legislation on plastic food contact materials and articles (general requirements for FCMs). It must originate from a product loop which is in a closed and controlled chain ensuring that only materials and

96 https://vinylplus.eu/
97 https://ec.europa.eu/food/safety/chemical_safety/food_contact_materials/legislation_en
98 See Article 3 of Regulation (EC) No 1935/2004 and https://ec.europa.eu/food/safety/chemical_safety/food_contact_materials/legislation_en
99 http://eur-lex.europa.eu/eli/reg/2011/10/oj
100 http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32008R0282

articles which have been intended for food contact are used and any contamination can be prevented; or it must be demonstrated in a challenge test, or by other appropriate scientific evidence that the process is able to reduce any contamination of the plastic input to a concentration that does not pose a risk to human health. Plus, there must be established conditions of use of the recycled plastic.

Opinion is delivered by EFSA[101] which forms the basis for authorisation at EU level prepared by the Commission and submitted to Comitology procedure. Presently the authorisation decisions are under preparation. Until the Decisions have been adopted, the recyclers may place recycled plastic FCMs on the market subject to national rules. About 140 requests for authorisation for PET under this Regulation are still pending, while having received positive opinions by EFSA.

#### *Enhancing supply chain collaboration*

Dialogues across the value chain need to be stimulated to raise awareness especially amongst plastics converters and brand owners and participate to fully integrating recycling activities into the plastics value chain from a different point of view[102]. The Commission is already working with the stakeholders to improve the flow of information across the value chain in the framework of the Circular Economy Stakeholder Platform, launched in 2017, that promotes the share of information and of good practises between stakeholders. Stakeholders will also have access to studies and reports and policy commitments from other sectors or/and along the value chain. The Platform aims to be a place for dialogue as well, allowing for interactive discussions by topic[103].

#### *Tracking substances of concern*

The role of enhanced supply chain collaboration, promoted by sectorial platforms[104], their associations or existing extended producer responsibility schemes will contribute to this objective. Certain industries have recognised the necessity to track certain substances in their supply chains. A compilation of existing tracking systems has been published (see above).

### 3.2.3 Actions to be taken

#### *Introducing a systemic approach*

By deciding actions to be taken the Commission will follow a systemic approach. Other measures such as developing quality standards, ensuring traceability, improving design for recyclability, enforcing the obligation of separate plastic waste collection and sorting, certification, etc. need to be enhanced in order to strengthen and make the whole plastic value chain more circular.

101 https://ec.europa.eu/food/safety/chemical_safety/food_contact_materials/authorisations_en

102 Vinyl Plus, a program developed by the PVC value chain is an example of such platforms.

103 http://circulareconomy.europa.eu/platform/en

104 Scientific and technical support for collecting information on and reviewing available tools to track hazardous substances in articles with a view to improve the implementation and enforcement of Article 33 of REACH. Published: 11/08/2017. https://publications.europa.eu/en/publication-detail/-/publication/58f951af-809b-11e7-b5c6-01aa75ed71a1/language-en/format-PDF

### *Uptake of recycled plastics*

From a technical perspective, it is possible to include recycled plastics in the production of various applications. In the future, chemical recycling and advanced sorting could open the door for higher use in this market segment.

The Commission will explore, in collaboration with different stakeholders, the potential for increased sector and application specific uptake of recycled plastics. To help tackle these barriers, and before considering regulatory action, the Commission is launching an EU-wide pledging exercise to ensure that by 2025, [X] million tonnes of recycled plastics find their way into new products on the EU market.
Design products to be more fit-for-recycling (see the section on specific design choices and how they can negatively affect the value of recyclates) and design for products with recycled content should be analysed together and lead to a better perception of bottlenecks and how these obstacles could be tackled. The objective is also to ensure that articles made of or containing recycled plastics can be kept in the loop for more than just one circle.

As regards the use of recycled plastics in food-contact applications (e.g. beverage bottles), the current regulatory regime needs to be re-examined to make sure it can deliver high food safety standards, while also providing a clear and reliable framework for investment and innovation in circular economy solutions. Together with EFSA, the Commission will assess options to improve the current system of authorising recycled plastics for food-contact uses.

To further support the integration of recycled plastics in the market, the Commission will also explore more targeted sectoral interventions. For instance, certain applications in the construction and automotive sectors show good potential for uptake of recycled content[105] (e.g. insulation materials or dashboards). In the context of ongoing and upcoming evaluations of EU rules on construction products and on end-of-life vehicles, the Commission will look into specific ways of promoting this. In the context of future work on the Packaging and Packaging Waste Directive, thought will also be given to using economic instruments to reward the use of recycled content in the packaging sector.

### *Setting quality standards for sorted plastic waste and recycled plastics*

The Commission is committed to working with the European Committee for Standardisation and the industry to develop quality standards for sorted plastic waste and recycled plastics.

### *Setting certification schemes of recycling plants*

Setting standards for plastic waste input for recycling and recyclates could be coupled with certification schemes of recycling plants[106]. A certification scheme for plastic recycling plants as an additional benefit to increasing the quality of the supply, will also allow the demonstration that waste exported from Europe to non-OECD countries is treated in an environmentally sound manner.

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[105] Contrary to other applications, such as packaging, aesthetic requirements are less relevant and health and environmental exposure is usually lower. In addition, the European Committee for Standardisation has already developed assessment standards to identify hazardous substances which could be embedded in recycled materials.

[106] https://ec.europa.eu/growth/tools-databases/eip-raw-materials/en/system/files/ged/13%20recycling-treatment-facilities-rpa2012-report_en.pdf

***Links to the Interface between chemicals, waste and product policies***

"Non-toxic" and resource efficient life-cycles need to be put in place as much as technically possible and with as limited a risk as possible. The objective is to ensure that the circularity of today will not have adverse effects on the human health and the environment of tomorrow and, where the presence of substances of concern cannot be eliminated from recycled materials that those substances are able to be better tracked and monitored.

It is necessary to clarify how to deal with legacy substances, carefully weighting pros and cons of allowing recycling of certain materials versus elimination of the chemicals of concern these may contain. No such suitable assessment techniques, which take into account all relevant aspects - environmental footprint, risk assessment and socio-economic assessment - to determine the best overall outcome for society, have yet been agreed.

The first challenge challenge is to track those substances of concern in plastics (input for recycling and recyclates). It could be done through support innovation such as introducing in products or polymers information carriers e.g. tracers, digital watermarks or nano electronics. Technology to be developed depends on the intention and on the information to be collected. However these tracers should not themselves become an issue in terms of chemical load of plastics hampering the recyclability while they are supposed to help smart sorting and efficient recycling.

Hence, Commission’s work on the Interface between chemicals, waste and product policy is set to address these issues and will therefore contribute directly to a greater and safer uptake of recycled plastics. The EU will also finance research and innovation projects on decontamination of plastic waste through Horizon 2020.

***Continuous support efforts towards more circular plastics***

The Commission will accompany business in their efforts towards more circular plastics e.g. by supporting financially innovative project and research. If additional investments in order to adapt the production processes for increased integration of recyclates in final products may be required, it will also offer more opportunities especially for high value applications.

The Commission will continue to support Member States in their efforts to upgrade the existing waste management infrastructure accordingly to the waste hierarchy. Improved dialogue across the value chain and related actions will also help to identify existing barriers e.g. regulatory, economic, behavioural, and technical, to be lifted.

## 3.3 Better and more harmonised separate collection and sorting

### 3.3.1 Issues at stake

Collection and sorting of post-consumer plastic wastes is a complex issue and not always easy to implement. Logistics, infrastructure capacity and waste management practices are diverse across the EU for technical, economic and social reasons,. Setting up well designed, good functioning waste management systems and ensuring the separate collection of plastic and organic waste is a prerequisite for maximising the recovery of resources and preventing their escape to the environment. Upgrading waste management infrastructure (collection, sorting and recycling plants and capacity) will require additional investments also in relevant R&D and technology development.

### *Plastic waste in municipal waste*

Current estimates show that, although approx. 2/3 of all plastic packaging are recyclable, approximately 40% is recycled in practice. Therefore, design for recycling alone cannot be the solution. In addition, improved collection, as well as further improvements in treatment and sorting plants, are needed.

The Waste Framework Directives required Member States to establish separate collection for plastics by 2015. The effects of this provision are still not very visible as many Member States may be late in implementing the obligation and it will appear in statistics with some delay (data are usually published 2 years later).

A study undertaken on behalf of the Commission in 2015[107] shows that plastic was collected within door-to-door systems in 18 countries, of which only four collected plastic as a separate fraction; all others apply co-mingling with one (metal), two or three other fractions. Six Member States collect plastic (five together with metals) via bring-points. Four Member States did not collect plastic separately from residual waste within the main collection system, however this might be possible in civic amenity sites. The study also concludes that collection of plastic as a single fraction within door-to-door collection systems delivers the best outcome – both in terms of quality and quantity of the collected waste. Even if the collection costs are higher, the treatment costs are lower as it results in fewer rejects that must be disposed of and higher revenues from the recyclables.

Systems for separate collection are being increasingly rolled out in the Member States, and there is a trend to move from bring systems to door-to-door systems, which is leading to better collection and recycling results. In addition, a growing number of municipalities are deploying pay-as-you-throw-schemes. This system provides strong incentives for waste prevention and for a correct separation of waste, providing for clean fractions that are easier to recycle. The trend towards separate collection is increasing as the year 2020 approaches and Member States are stepping up efforts to comply with the recycling targets for municipal waste.

### *Plastic waste in the construction sector*

In the construction sector, a distinction has to be made between, on the one hand, construction waste, which consists of clean materials that can be easily sorted and reused or recycled, and demolition waste, on the other hand, which arises during renovation or demolition works.

The quality of the materials depends on the demolition technique applied. Deconstruction is a different process from conventional demolition, requiring different techniques and skills that are not necessarily widespread. It is more time consuming, and requires more detailed assessment of the building and planning before work commences. Deconstruction for reuse and recycling requires larger amounts of storage space to be allocated, since there is often a lag

[107] https://ec.europa.eu/docsroom/documents/24562/attachments/1/translations/

between supply and demand, and related logistics. These requirements then lead to reuse activities being more expensive than demolition.

Where construction and demolition waste is sorted, identifying and sorting plastic polymers is generally not a problem as few different polymers are used for a given application. However, there is an emerging problem as regards identification of plastic waste streams that are contaminated with legacy additives. This is the case for PVC products (windows, pipes) containing banned additives and for insulation foams made of Expanded Polystyrene (EPS) that may contain the hazardous brominated flame retardant (HBCDD). In this case, assumptions about the presence of contaminants can be made when the regional use and period of use of HBCDD may help to establish the possible contamination of a waste. In case the presence of HBCDD cannot be ruled out, scanning techniques (as used to detect bromine in products) may be applied.

### *Plastic waste in end-of-life vehicles (ELV)*

As regards ELVs, the outcome of sorting of plastic waste from ELV depends very much on the type of dismantling technology that is applied. There are two main ways to remove plastics:

1. Manual dismantling is time consuming and costly as cars are not design to facilitate dismantling (e.g components are bonded in place rather than fixed through removable screws, bolts etc). Plastic produced from recyclates originating from manual dismantling processes are usually of high quality and can allow up to 90% of the salvaged material to be recycled to polymer of the same grade.
2. Shredding is cheaper but is less efficient, especially at removing high quality plastics for reuse and recycling. The quality of plastics recycled from shredder residue is, today, likely to be very low due to contamination. As a result, the plastic streams tend to be contaminated and it is not possible to further split out the polymers. Typically, only 30% of the products can be recycled and it is into a much lesser grade – more like recovery[108].

This does not need to be the case, however, and plastics made from recycled car parts can achieve high quality and are suitable for use in many areas of the car. Sorting needs to occur at source. A relatively small percentage of shredder residue goes for plastics recycling, most of which is blended black polypropylene plastics (PP) used in pipes and automotive applications. Manual dismantling may also be required to remove parts that are contaminated with hazardous substances, such as POPs.

### *Plastic Waste from electrical and electronic equipment (WEEE)*

Separate collection and treatment of WEEE is regulated under the WEEE Directive 2012/19/EU, which applies the 'polluter pays' principle to ensure EEE manufacturers and importers share in the obligations for financing. The WEEE Directive required the creation of collection schemes for the recycling and preparation for re-use of WEEE. Original equipment manufacturers (OEMs) and importers share the financial burden of the cost of collection and recycling under this EPR legislation. The WEEE Directive establishes collection and recycling targets, which are increasing

[108] Interview with Multiport and Poly Recycling

over time. The RoHS Directive 2011/65/EC limits the presence of hazardous materials in new EEE products.

EEE are usually complex products which are difficult to disassemble and with polymers that are often difficult to identify. In particular, small domestic appliances and ICT equipment are increasingly technical, with complex plastic components and plastics bonded to other materials and hazardous components which present challenges for recovery through existing recycling systems. Hazardous substances within WEEE are considered to be a major obstacle to recycling. In particular, the presence of POP-BDEs is challenging as wastes containing more than 1000 mg/kg of POP-BDEs have to be separated from the waste stream and treated in a way that the POP content is destroyed.

Despite the efforts, a mere 35% (3.3 million tonnes of 9.5 million tonnes) of WEEE discarded by companies and consumers in 2012 are reported under the official collection and recycling systems. The other discarded electronics was not reported, exported, recycled under non-compliant conditions or simply thrown in waste bins.

Waste collection infrastructure varies significantly across Member States, with less developed economies typified by less expansive formal collection systems for WEEE and, as a consequence, where recovery rates are much lower. In some Member States systems for the collection of WEEE are sub-optimal and need to be improved.

Illegal shipment of WEEE from Europe represents a significant challenge to the recovery of increased quantifies of plastic for re-use and recycling. These shipments represent losses of plastic waste from WEEE from across the European Union. Inadequate enforcement of waste shipment regulations also means that good quality WEEE plastics that might be recycled by European companies leaves the EU. Variations in enforcement of criminal sanctions for waste crime across European Member States is a factor in the high levels of illegal shipments of waste.

### *Lack of investments in waste management infrastructure*

There are in the EU insufficiencies in collection systems, with low rate of plastic waste collected. In addition once collected, the complexity of the separation process makes their recycling quite challenging. There is as well less recycling capacity today in the EU than the amount of plastic waste sent to recycling. This under-capacity in recycling represents around 50% of the total plastic waste generated in the EU, while the remaining 50% is exported for recycling overseas. Additional capacity is therefore required for the future scenarios in order to cover this gap. Indeed, amounts of plastic waste that will be diverted to recycling in response to increased recycling targets at EU level will be increasing (e.g. 55% recycling target by 2025 for post-consumer plastic wastes as proposed by Commission).

Therefore, investment in collection, sorting and recycling installations will be key if the EU wants to accelerate the move towards more circular plastics. In other words, the investment costs required for increasing recycling and sorting capacity in EU-28 is within the range of 0.7-1.3 billion EUR per year. Considering an average plant capacity for sorting and recycling facilities, an estimation of the number of new plants that needs to be constructed in EU-28 was made: assuming an average processing capacity of 45 000 tonnes per year for a new sorting facility and 35 000 tonnes per year for a new recycling facility, approximately 150 additional sorting facilities and 170 recycling facilities would be built by 2020 in the EU-28. These figures rise to 250 sorting facilities and 300 recycling facilities by 2025.[109]

The Chinese government notified the World Trade Organisation (WTO) on 18 July 2017 its intention to ban imports of certain categories of plastic wastes[110],[111]. The notification message informed that the ban would become operational on 1st January 2018. Plastics wastes exported to China (for recycling) are 1,75 Mio tons/year (2015). This figure represents 11% of all post-consumer plastics wastes generated in EU or 3% of the EU plastics production. Approximately two thirds of the EU exports of plastic waste originate from the United Kingdom and Germany (at roughly equal shares).

**Table 5. Export to China of EU plastic and plastic waste production**

| | |
|---|---|
| Plastics Production in EU | 58 Mt/year |
| Plastics Post-Consumer Wastes generated in EU | 26 Mt/year |
| Plastics wastes landfilled in EU | 8,6 Mt/year (31 %) |
| Plastics wastes incinerated in EU | 10,1 Mt/year (39%) |
| Plastics wastes collected for recycling | 7,8 Mt/year (30%) |
| Plastics wastes exported outside EU for recycling | 3 Mt/year (11,5% of EU wastes)<br>(appr. 50% of plastic waste collected for recycling) |
| Plastics wastes exported to China (for recycling) | 1,75 Mt/y (6,6 % of EU wastes (equivalent to 22% of waste collected) corresponding to 85% of wastes exported outside EU) |

The fact that China has enforced a ban on imports of solid wastes, including plastic wastes will have an impact on the volumes available for recycling. In the long term the ban of waste imports by China represents an opportunity for the European industry. In the short term though there might be adverse effect due to the way the ban has been introduced by China. The ban is expected to lower the prices of these commodities (according to industry, prices have already decreased by 40% on some categories of plastic waste in September-October) and to create stocks that cannot be absorbed by the export markets in the short term.

Exports for recycling to other destinations (such as India and Turkey) may partially absorb the volumes but landfilling and incineration might increase.

In the EU, the development of waste-to-energy and incineration capacity has been financed in the past mainly through the co-financing of the cohesion policy funds (the Cohesion Fund and the European Regional Development Fund). Other financing instruments such as the European

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109 http://www.plasticsrecyclers.eu/sites/default/files/BIO_Deloitte_PRE_Plastics%20Recycling%20Impact_Assesment_Final%20Report.pdf

110 https://docs.wto.org/dol2fe/Pages/FE_Search/FE_S_S009-DP.aspx?language=E&CatalogueIdList=237688&CurrentCatalogueIdIndex=0&FullTextHash=371857150&HasEnglishRecord=True&HasFrenchRecord=True&HasSpanishRecord=True

111 https://docs.wto.org/dol2fe/Pages/FE_Search/FE_S_S009-DP.aspx?language=E&HasEnglishRecord=True&HasFrenchRecord=True&HasSpanishRecord=False&CatalogueIdList=133390,236153,237679,237808,237688,237701,237670,235275,237804,237805&CurrentCatalogueIdIndex=5&FullT

Fund for Strategic Investment (EFSI) and the European Investment Bank (EIB) also play a role in this area, mainly through loans, guarantees, equity and other risk-bearing mechanisms.

With the introduction of a more ambitious policy, as stated in the Circular Economy Action Plan, in the case of the 2014-2020 Cohesion Policy funds, ex-ante conditions had to be met to ensure that new investments in the waste sector are in line with waste management plans designed by Member States to meet their recycling targets. This means that investments in residual waste treatment facilities (e.g. new landfills and incineration capacity) should only be granted in limited and well justified cases in line with the waste hierarchy and avoiding overcapacities that could jeopardise the fulfilment of the EU waste recycling targets. The same principles should apply to investments channelled through the other EU financing mechanisms (e.g. EFSI, EIB).

As a matter of fact, a small percentage of incineration will be needed for a part of plastic wastes which cannot be properly recycled into secondary plastic raw materials of commercial quality grades or containing unacceptable level of substances of concern (i.e. the legacy substances).

At national level, the use of State aid[112] is important for the development of sound waste management. However, in the implementation of the State aid guidelines[113], particularly as regards indirect support to waste incineration with energy recovery through State aid to renewable energy, it is important to ensure policy coherence. Support schemes need to be designed and applied in a manner consistent with the waste hierarchy taking into account other key requirements under EU waste legislation including the obligation to ensure separate collection of waste and to pre-treat biodegradable waste[114] prior to its disposal in landfill sites.

### 3.3.2 Existing EU measures

The Commission is continuously promoting and ensuring a proper implementation of the Waste Hierarchy where reuse and recycling should be preferred to incineration and landfilling. It also works on ensuring that Member States comply with the existing requirements regarding waste management, especially the municipal waste, set by the Waste Framework Directive.

The European Commission will also continue to promote selective deconstruction. This will be further reinforced by the application of the newly published Construction and Demolition Waste Protocol[115], which aims to improve the quality of construction and demolition waste management and increase the trust in the quality of recycled materials. In addition, in its new Circular Economy package, the Commission envisages to require 'Member States (…) [to] take measures to promote sorting systems for construction and demolition waste and for at least the following: wood, aggregates, metal, glass and plaster.

The guidelines that were issued for assessment of construction and demolition waste streams prior to demolition or renovation of buildings and infrastructures will enable practioners to identify valuable fractions and hazardous materials before renovation and demolition works start. Their implementation will also be beneficial to recycling and reuse of plastics as it shall lead to a more organised and conscious management of demolition waste. Although plastics is

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112 http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52014XC0628(01)

113 Ibid., page 3.

114 Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste

115 https://ec.europa.eu/growth/content/eu-construction-and-demolition-waste-protocol-0_en

not among the fractions to be collected separately, this requirement will increase the chances of construction plastics to be collected and hence promote their recycling. A timely identification of reusable and recyclable fractions will increasethe chances of finding suitable markets for them once the construction is actually renovated or demolished.

### 3.3.3 Actions to be taken

To encourage more standardised and effective practices across the EU, the Commission will issue new guidance on separate collection and sorting of waste.

The revised PPWD will set a new target for plastic packaging waste to be collected and recycled. The revision will also improve separate plastic collection across the EU in order to help Member States to reaching the revised targets. The volumes of good plastic waste will increase and provide a sufficient input for recycling increasing in consequence the quality of recyclates. The Commission will also assess the potential for setting a 2030 recycling target for plastic packaging, similar to those put forward in 2015 for other packaging materials.

Dismantling processes in ELV sector need to be harmonised. Once a good system has been put into place, producers will be able to work towards making cars that fit with these dismantling processes, which will make the whole system more useable. Harmonisation of dismantling processes and dissemination of best practices in the ELV sector will allow to increase the recycling rates while improving the quality of the outlets.

The Commission will also continue to work on improving and harmonising the WEEE collection and management schemas. Improved WEEE management and more harmonised practice of dismantling and handling will ensure better recycling rates and limit the risk of contamination of plastic waste.

In order to ensure a proper implementation of the Waste Hierarchy where reuse and recycling should be preferred to incineration and landfilling, investment in collection, sorting and recycling installations will be key if the EU wants to take up this challenge and turn it into opportunity for European industry. The instruments related to stimulate investments are cross-cutting; this is further explained in the relevant chapter.

# 4 Curbing plastic waste and littering

## 4.1 Preventing plastic waste in our environment

The amount and sources of litter entering the marine environment each year is not known. Recent assessments have been based on estimates of "mismanaged plastic waste"[116] and this correlates to some extent with measurements in rivers[117]. It is generally believed that most litter comes from the land and these river measurements indicate that the mass entering as micro-plastics of the same order or greater than the mass entering as macro plastics. Other issues that need to be addressed are over-packaging, agricultural plastics which are used on huge surface, and micro-plastics. Biodegradable plastics form a specific challenge. Plastic may also enter the sea through offshore activities such as fishing, shipping, petroleum exploitation and aquaculture.

### 4.1.1 Single use plastics

***Issues at stake***

In a recent UNEP report, States are encouraged to "*develop and implement laws to ban or diminish the production of single-use trash items and other waste that is commonly found in marine litter*"[118]. All the beach surveys throughout Europe[119] (and elsewhere in the world) consistently confirm that the overwhelming majority of items found on beaches, in terms of both numbers and mass, are waste plastic items or unidentifiable plastic pieces.

Whether an item is a single use item or reusable, once it is littered in the environment, it has the same negative environmental impact. As it is explained below, plastic degradation in open environment can take hundreds of years. During this period plastics fragment into smaller pieces. Plastic debris causes sea species to suffer from entanglement or ingestion. Micro-plastics causing harm to fauna and flora are generated and are potentially harmful for human health. This represents both a common and a transboundary challenge.

In addition, waste littering may also have a big impact with tourism and other amenity activities, and therefore direct and substantial economic impact on these activities.

A single use plastic item reaches its end-of-life in a very short time, which shows that resources are not efficiently used. Indeed, if this item were designed for reuse and effectively reused, this would save the resources and energy that were used in their production.

Moreover, such items once disposed of, becomes waste that needs to be collected and sorted thereby implying costs for public authorities. Although such items could be recycled, most of the time they are not. Causes are multiple and often interlinked: insufficient public waste management infrastructure, food and organic material contamination once put in the right bin, etc. Therefore, this leads to consider that not only resources are wasted in their production

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116 Plastic waste inputs from land into the ocean Jenna R. Jambeck et al, http://science.sciencemag.org/content/347/6223/768

117 Export of Plastic Debris by Rivers into the Sea, Christian Schmidt,*,† Tobias Krauth,†,‡ and Stephan Wagner Environ. Sci. Technol. 2017, 51, 12246−12253

118 UNEP : "Marine Litter Legislation: A Toolkit for Policymakers"

119 http://ec.europa.eu/environment/marine/good-environmental-status/descriptor-10/pdf/final_report.pdf

phase but the value of materials is not kept in the loop which is the contrary of a circular economy concept and can also be seen as contrary to the waste hierarchy enshrined in the Waste Framework Directive which states that policy should also aim at reducing the use of resources, and favour the practical application of the waste hierarchy in accordance to which prevention should be considered in priority to other waste management options such as recycling for instance.

The impacts described above (contribution of SUPs in marine litter, the availability of reusable or non-plastic alternatives, etc.) and increased public concerns have prompted some Member States to act individually. Several Member States are already taking action regarding single use items by implementing the Marine Strategy Framework Directive[120]. France for example plans to restrict the use of several of these SUP by 2020, unless they are home-compostable and at least 50% bio-based (pushing thus for a substitution by paper, cardboard, wood and others)[121]. United Kingdom and Ireland area also considering actions. Some regional and more local actions have been taken:

- In Navarra the sale of single-use plastic cutlery, trays and cups is to be banned by 2020, the provision of tap water in public spaces and in restaurants will be made obligatory, and the sale of bottled water prohibited in all public buildings except hospitals.
- In Bristol, consumers can refill their reusable water bottles for free in many cafes, restaurants and others. An app locates the closest refill station. The project is expanded to five other cities.
- In Vienna and Munich portable washing stations provide a specific service to wash reusable containers in food markets.
- Vienna introduced an obligation to use reusable items at big events.
- Hamburg bans disposable packaging in public buildings, which includes bottled water and beer, plastic plates and cutlery.

There is a concrete risk of different Member States actions addressing different items that could be a problem in terms of internal market.

**<u>Definition of single use plastics for the purposes of the Plastics Strategy</u>**

Currently neither legal definition nor official statistics regarding single use plastic production and littering exist. Such a definition is however crucial in order to define measures to be taken in order to move towards more circular plastics and to address plastic waste and littering issues.

Given that plastic packaging is almost exclusively single-use, especially in business-to-consumer applications, that such items could be defined in Packaging and Packaging Waste Directive (PPWD). In the latter a distinction is made between packaging, i.e. all products made of any materials of any nature to be used for the containment, protection, handling, delivery and presentation of goods, from raw materials to processed goods, from the producer to the user or the consumer, and "non-returnable items" used for the same purposes. One could consider therefore that "non-returnable items" are equivalent of single use items.

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[120] Member States have to monitor marine litter and draft/implement programs of measures notably to reduce marine litter in their marine waters

[121] Loi de Transition Energétique pour la Croissance Verte (LTECV) du 18/08/ 2015

Acknowledging that single use items are not currently defined from a legal perspective, the Commission worked with stakeholders to develop criteria. Criteria should be based on objective and verifiable criteria leaving as less a room as possible for interpretation given that consumers behaviour in this case if a major factor to be taken into account. Stakeholders gathered together during several workshops generally agreed that single-use items should fulfil at least one of the following criteria[122]:

- Prone to littering and prevalently ending in the marine environment;
- Short use phase;
- Consumed predominantly away from home;
- Reusable or non-plastic alternatives exist.

**Table 6. Contribution of single-use non-packaging and packaging plastics to marine litter**

| **Item** | **% of SUP** | **Packaging** |
|---|---|---|
| Cigarette butts | 19% | No |
| Drinks bottles, caps and lids | 18% | Yes |
| Cotton bud sticks | 10% | No |
| Crisps packets / sweets wrappers | 8% | Yes |
| Sanitary applications | 7% | No |
| Bags | 5% | Yes |
| Cutlery, straws and stirrers | 4% | No |
| Balloons and balloon sticks | 2% | No |
| Food containers including fast food | 2% | Yes |
| Cup and cup lids | 3% | Yes |
| **Total** | **77%** | |

*Source: Eunomia (2017), based on JRC data*

### *Existing EU measures*

#### Plastic Bags Directive

Plastic bags is a specific case of Single Use Plastics. The EU has already taken steps by setting requirements for Member States to adopt measures to cut the consumption of plastic bags. This case can be seen as a good practice.

Due to their low weight, low price and resistance to degradation, plastic carrier bags[123] are a popular and convenient product widely used for transporting shopping items from the store back home. Their ever increasing, but unsustainable consumption and the fact that they often escape waste management have resulted in littering and an inefficient use of resources, which are underscored by environmental impacts, as well as economic and social consequences.

Once discarded, after having been used in most cases only once, many of these lightweight plastic carrier bags end up in the environment, where they remain as micro-plastics for hundreds of years. This represents both a common and a transboundary challenge. Indeed, especially lightweight plastic carrier bags can travel over large distances with currents and

[122] Workshops held by the Commission on 16th of June and 14th September 2017 in Brussels.

[123] A definition of the types of plastic carrier bags considered in this assessment is provided in Annex II.

winds and even in Member States with well performing waste management infrastructure, high concentrations of marine plastic litter can be detected.

In 2010, an estimated 98.6 billion plastic carrier bags were placed on the EU market, which amounts to every EU citizen using 198 plastic carrier bags per year. Out of these almost 100 billion bags, the vast majority are lightweight bags, which are less frequently re-used than thicker ones. Consumption figures vary greatly between Member States, with annual use per capita of lightweight plastic carrier bags ranging between an estimated 4 bags in some Member States and 466 bags in other Member States.

Lightweight plastic carrier bags are considered to be packaging within the meaning of Directive 94/62/EC[124] on packaging and packaging waste (PPWD). This Directive lays down rules on packaging and the placing on the EU market of packaging and it also lays down rules on the management of packaging waste. It has a double objective: safeguarding the functioning of the internal market (article 18) and assuring a high level of environmental protection.

Lightweight plastic carrier bags, are defined as plastic carrier bags with a wall thickness below 50 microns. Member States may take a wide range of actions, which, shall include at least one of the following measures:

- a national maximum consumption level of plastic carrier bags of maximum 90 bags per person per year by 31 December 2019 and maximum 40 bags per person per year by 31 December 2025;
- instruments ensuring that, by 31 December 2018, lightweight plastic carrier bags are not provided free of charge to customers at a point of sale.

Very lightweight plastic carrier bags (i.e. with wall thickness below 15 microns) which are mainly used for the packaging of loose fruits and vegetables may be excluded from the above 2 measures.

It is not yet possible to provide statistical data on reduction of consumption of these bags. By mid-October 2017, six Member States had not notified implementing measures, but informed that measures would be adopted still in 2017. Nevertheless, some Member States currently apply measures ahead of the deadlines and these Member States find considerable reduction in the consumption of lightweight plastic carrier bags.

The implementing measures to reduce use of plastic bags have met little resistance from consumers, and are rather welcome and seen as an effective measure. They are also very efficient in reducing littering in coasts and seas. The tax on plastic shopping bags in Ireland, in 2002, resulted not only in a 90% reduction of plastic bags provided in retail outlets (Convey et al., 2007) but also in a marked decline in bags found on beaches, according to Coastwatch beach monitoring data[125].

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124 Directive 94/62/EC on packaging and packaging waste; OJ 1994 L.365 of 31.12.1994, p. 10

125 From an average of 18 plastic bags/500m in 1999 to 5 in 2003. See p.32 of JRC report on sources of litter: http://ec.europa.eu/environment/marine/good-environmental-status/descriptor-10/pdf/MSFD_identifying_sources_of_marine_litter.pdf

## Monitoring and measure of marine litter

Beach litter has also been the object of awareness raising and clean-up campaigns throughout the world, with increasing dissemination during the last years. The Commission's services have also participated and organised several beach clean-up campaigns across the EU and in other parts in the world.

The European Environmental Agency EEA has developed Marine Litter Watch[126], a citizen science based tool that can help fill data gaps relevant for policy, while raising awareness about the problem of litter and the policy response to it; it is already being used in European-wide campaigns and complements many private initiative tools.

The Marine Strategy Framework Directive (MSFD) requirement to ensure that properties and quantities of litter do not cause harm to the environment implies that baselines and threshold values have to be set at EU level. This work is being coordinated at EU level and a related JRC report[127] on the most frequently found litter items on beaches is available. This work is ongoing with a view to facilitate reaching the aspirational target of the Circular Economy Package to reduce by 30% the amount of beach litter and fishing gear lost at sea by 2020. The European Marine Observation and Data Network EMOD-net partnership in collaboration with regional sea conventions are assembling and harmonising the data in order to provide a better overall picture of the concentrations in European seas and sea-beds that will help assess progress in meeting targets and support remedial action. These data will be made publicly available in the first half of 2018.

EU funding is being deployed to understand and combat the rise of marine litter[128], supporting global, national and regional action.

### *Actions to be taken*

Taking into account that addressing marine litter cannot be done without tackling single use plastics the European Commission will take action to address single-use plastics that will include the launch of an Impact Assessment and a public consultation, to determine scope of a legislative initiative on single-use plastics. The diversity of single use plastics and different objectives justify using a differentiated approach[129]:

- Items already captured today in separate collection schemes (mainly packaging: such as drink bottles): the objective is to improve the collection rate. This could be done through stricter implementation of the existing and future legislation on waste (e.g. separate collection, recycling targets, full implementation of producer responsibility schemes and fee modulation, prevention measures and stimulation of deposit return schemes).

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[126] https://www.eea.europa.eu/themes/water/europes-seas-and-coasts/marine-litterwatch#tab-news-and-articles

[127] Top Marine Beach Litter Items in Europe. JRC108181, Authors A.M.Addamo, P.Laroche and G.Hanke

[128] For instance, in the Arctic Region, the Circular Ocean INTERREG project is testing new opportunities for reusing old fishing nets, including a material to remove pollutants from water (http://www.circularocean.eu/). In the Baltic Sea Region, the BLASTIC project maps potential litter sources in urban areas and monitors litter levels in the aquatic environment (https://www.blastic.eu/). Both projects are supported by the European Regional Development Fund.

[129] These categories are indicative and could be adapted during the course of the assessment.

- Items which could be replaced by more sustainable alternatives (e.g. take-away food containers, disposable cups, possibly caps and lids, cotton buds, cutlery, straws and stirrers): the objective is to ensure they are captured or substituted by more sustainable alternatives (e.g. reusable cups). Options may include reduction targets, design requirements (e.g. replacement by materials, such as paper or wood, which degrade quickly in the natural environment, or design of lids and caps in a way that they cannot be detached from the bottle), or requirements for Member States to implement a charge at the point of sale.
- Items for which there are no readily available alternatives (non-packaging: cigarette butts, sanitary applications, etc.): the objective is to significantly decrease littering of these items and this could be done by focusing on awareness campaigns, etc. Possible legal action could include applying the principle of Extended Producer Responsibility and/or labelling requirements targeting consumers.

Complementary to legal action, voluntary commitments can be considered, awareness raising campaigns as well as research into alternative products and materials.

In addition, through its legislative proposal for a review of the Drinking Water Directive, adopted at the same time as this strategy[130], the Commission is promoting access to tap water for EU citizens, therefore reducing packaging needs for bottled water.

The criteria for the Ecolabel and Green Public Procurement also promote reusable items and packaging[131].

**Box 3. What citizens can do in order to help fighting against littering and improving recycling**

Policies did not always succeed to incentivize consumers towards a more responsible and sustainable behavior, but according to Eurobarometer studies citizens are keen on recycling - 65% of respondents say they have separated most of their waste and 34% have avoided single-use plastic goods other than plastic bags. The awareness campaigns should mention concrete action, to enhance communication efforts. Simple messages like prefer durability and reparability over consumer goods with short lifecycle i.e. that won't last for long or are intended for a single-use, need to be brought to the consumers. Therefore it is necessary that the Commission and the MS provide consumers with sustainable alternatives in order to reduce the consumption of single use plastics (e.g. take away coffee cups), improve the quality of collection, recyclability and better assess bio-degradability claims.

Sorting of plastic wastes and correct disposal at post-consumption stage is not always easy to implement for the consumers due to various reasons like the lack of collection logistics, distance between trash bins, lack of information or inadequate education. The motivations behind littering include social norms as well as a lack of awareness about the consequences and the general impact of littering, especially when it comes to coastal areas and marine environment. Most citizens are welcoming the idea that local authorities should provide more and better collection facilities for plastic waste.

Consumer's purchasing and consumption behavior also considered a key aspect which needs to

130 http://ec.europa.eu/environment/water/water-drink/review_en.html

131 Examples include the Ecolabel criteria for tourism and the Green Public Procurement criteria for food and catering restrict the use of single-use plastics in catering

be changed in order to close the largest loopholes by which litter enters the environment. There is a key role here for retailers, as they are in direct contact with millions of consumers daily, the tourism industry to address coastal tourists and residents, local authorities and waste management companies to improve consumer's disposal behavior and to provide for relevant informative, economic, administrative and infrastructural measures[132]. Retailers can make an effort to reduce plastic packaging and give their consumers opportunity to buy fruits, nuts etc. from bulk bins instead of packed items. Retailers are closest to the consumers and thus are in a good position to alter their purchasing choices and at the same time making savings.

Companies that provide everyday consumer goods can also contribute to the behavior of consumers related to waste by funding of education and awareness to prevent litter. Moreover according to Eurobarometer studies consumers believe that products should be designed in a way that facilitates the recycling of plastic (65%)[133] and some of them are ready to pay more for that. The industry can also continue to work with regulatory authorities and NGOs to develop behavioral campaigns to encourage recycling and responsible disposal of packaging waste. Media and consumer goods companies should also think on how to reduce pro-consumption messaging, and to internalise environmental costs into messaging, like it has been done with tobacco for health impacts.

It should be noted that tourism, leisure and hotel industry as well as fast food chains, cafes and gas stations should practice more sustainable services on spot leading to decreased amount of plastic waste due to the use of single use items and better information of citizens about the impacts of litter on the marine environment.

Local authorities should also invest in the education of citizens organizing information campaigns on sorting of plastic wastes at post-consumption stage. They are generally responsible for street (and beach) cleaning and waste management, spatial planning, enforcement of regulations on littering and often play a key role in education and training[134]. They are also likely to have strong links with local stakeholder groups. This gives them a key role in litter prevention.

Empowerment of the society can be done in many different ways. Partnerships between stakeholders (e.g. academia, NGOs, governments, national and local authorities, media and communications, tourism and retailers, industry) can create strong campaigns and initiatives to promote wise disposing, reuse, recycling. Development of innovative applications like Marine litter watch or Beat the micro bead and involvement of ICT sector could be crucial when engaging with nowadays society. Citizens however are responsive to price signals as we can see, for example, by the results of the taxes imposed on light plastic bags in some EU countries that decreased the consumption of these products and the amount of plastics bags found along the coastline.

Overall Europeans are supporting environmental policies. More than eight out of ten consider that they can play a role in protecting the environment in their country. Therefore the solutions need to be found to empower the society and engage with all social and age classes. Communication campaigns should focus on children are powerful agents of changes in society

[132] Risk & Policy Analysts Limited (2013) Feasibility study of introducing instruments to prevent littering, pg 17
[133] European Commission (2017) Special Eurobarometer 468 Report Attitudes of European citizens towards the environment
[134] Risk & Policy Analysts Limited (2013) Feasibility study of introducing instruments to prevent littering for the European Commission, pg. 45

by educating their parents and many studies show that "millennials generation" is the one that is driving sustainability. Lately we can see a growing number of start-ups that are recycling different sorts or products and making value added products. Sometimes there is a lack of funding for that type of creative and circular economy based entrepreneurial ideas. Visibility should be given to such business cases that are offering alternative product design or services. Engagement through media channels especially social media should be ensured from the authorities.

All business and industry sectors and civil society can contribute to the reduction of litter, recycling and reuse by developing effective environmental management plans, incorporating problem identification, development of best practices and staff training. More actions are needed from civil society to foster fundamental changes in citizen's behaviors and habits towards more sustainable lifestyles.

### 4.1.2 Over-packaging

***Issues at stake***

Plastics are lightweight materials. In addition to some specific properties that make them the material of choice in some uses, the use of plastic packaging usually contributes to a reduction of the weight of packaging, which in turn contributes to reduction of greenhouse gas emissions during transport.

Whereas over-packaging has no legal definition, it consists in excessive packaging that would not be strictly necessary for the packaging to fulfil its tasks (i.e. protecting the packaged good from external agents to preserve its properties). Even though there are some indications that in general the specific amount of packaging used for each product has decreased, there still a number of products that is over-packed. Examples of over-packaging can be inter alia the use of excessively thick layers of packaging materials or the use of several packaging layers to wrap the products. Multiple packaging is typically used in promotional campaigns (‘buy 3 pay 2’) to ensure that the consumer takes actually several units of the product.

There are a number of reasons for the persistent use of excessive packaging in many products. One reason is that, for some products, the level of the packaging fees does not represent a significant cost compared to the price of the product that is packaged. This is particularly true for expensive products (e.g. luxury products), for which sophisticated packaging can represent an important sales argument. Over-packaging can also be used for marketing purposes to suggest to consumers that the product has a high value. In addition, the Essential Requirements in the Packaging and Packaging Waste Directive do not include very precise indications about what can be considered 'excessive packaging', which makes them difficult to enforce in practice.

***Existing EU measures***

Waste prevention is the top priority of the waste hierarchy (Art. 6 of Directive 20008/98/EC on waste). In line with this general principle, Art. 4 of the Packaging and Packaging Waste Directive (PPWD) provides that 'Member States shall ensure that, in addition to the measures to prevent the formation of packaging waste in accordance with Article 9 [Essential requirements], other preventive measures are implemented'. In addition, Annex II to the PPWD (on the Essential

Requirements) stipulates that packaging has to be 'manufactured in a way that the volume and weight are limited to the minimum'.

On top of these legal requirements, in most Member States packaging is governed by Extended Producers Responsibility (EPR) schemes, and the fees to be paid by producers depend (at least, partially) on their weight. Therefore, there are incentives to design packaging in a resource efficient way. Evidence from some Member States (e.g. Germany after the adoption of the Packaging Ordinance) shows that introduction of EPR schemes that include fees based on the amount of packaging placed on the market leads to a reduction in the specific amount of packaging i.e. the amount of packaging per packaged unit). Consumers can further reinforce the trend towards less packaging as they are increasingly aware of the need to use fewer resources and can reject excessively packaged goods.

***Actions to be taken***

The Commission will also examine the issue of over-packaging as part of the future review of the essential requirements for packaging.

### 4.1.3 Plastic waste from sea-based sources: shipping, fishing and aquaculture products

***Issues at stake***

Plastic products are common in the fishing, aquaculture, shipping (cruise ships, merchant vessels, fishing and recreational craft) and other offshore activities [135]. These industries have become reliant on plastic material to provide affordable, lightweight and durable equipment. Very few estimates of plastic waste generation in the fishing and aquaculture sector exist though.

Whilst on average the overall quantities of plastic waste discarded at sea are small compared to to waste not dealt with properly on land, the impact is significant because the pathway to the sea is direct, and in some sea regions, such as the North East Atlantic and the North Sea, is significant. Of these sources, the loss of fishing gear is easiest to identify and quantify because it is instantly recognisable. Video inspection of seafloors[136] and surveys of northern beaches[137] indicate that fishing gear makes up a high proportion of distinguishable objects. This plastic creates the same problems as that from land based-sources as it breaks down into smaller pieces but causes an additional and well-documented harm to marine life through entanglement in nets.

Several causes of discharging litter at sea were identified during stakeholder interviews[138] as well as collating information on reviews on the causes of abandoned, lost or otherwise discarded fishing gear:

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135 Eunomia (2016), Van Franeker (2010), UNEP (2009), GESAMP (2007)

136 Pham et al. Marine Litter Distribution and Density in European Seas, from the Shelves to Deep Basins PLOS ONE, 1 April 2014, Volume 9, Issue 4

137 Marine Pollution Bulletin Volume 107, Issue 1, 15 June 2016, Pages 52–58

138 in the context of the impact assessment for the revision of the PRF Directive, which included a specific survey for the fishing sector and also built on the outcome of the 2016 Eunomia study on sea-based sources of marine litter

- Accidental and sometimes irretrievable loss of material, limited life-span of some items and nature of fishing method;
- Mismanagement of waste, including plastic waste e.g. dumping on land or sea, due to high cost of waste handling, inadequate facilities and/or handling on board or lack of adequate reception facilities in ports for waste storage and consignment, lack of operators willing to handle gear or waste;
- Lack of incentives to handle waste from ships, including recycling, reuse, retrieval of lost gear or consign end-of-life gear;
- Lack of end markets for re-use and recycling outputs and lack of operators willing to handle gear.

*Shipping and other offshore installations*

The shipping sector includes all seagoing vessels, from large cruise ships to small fishing vessels and pleasure craft. There are no indications from recent studies and assessments that the amount of garbage from ships (marine litter) has decreased in recent years. On the contrary, time series of marine litter on European shores indicate that the problem has persisted since the implementation of the PRF Directive (Directive 2000/59/EC). Although garbage delivered in ports has increased since the introduction of the Directive, a significant delivery gap remains, estimated between 60,000 and 300,000 tonnes, i.e. 7% to 34% of the total garbage waste to be delivered annually[139].

*Abandoned, lost and otherwise discarded fishing gear (ALDFG)*

Commercial fishing gear lost, abandoned or discarded annually at sea or in the world's oceans may continue to fish for years or even decades, a process referred to as "ghost fishing". In an EU context, the extent and consequences have been subject to a number of EU funded studies[140,141,142]. In general terms, it appears likely that substantial lengths of netting are lost each year. Each nation's fleet may be losing several hundred kilometres. Most nets are lost as a result of events like storms or being towed away by trawlers. Indications are that a majority of nets lost in such circumstances are either disabled or have a low residual catch efficiency. The FAO report concludes *"that ghost fishing from 'active' fishing gears such as trawl nets and from 'static' pot fishing is not significant in European Union (EU) waters*". According to scientific research the remaining fishing capacity of ghost nets varies from 6-20% of their initial fishing capacity[143].

In relation to the total number of nets used in EU waters, the rates of permanent net loss appear to be below one per cent of nets deployed. Most nets are deployed in shallow waters, and a significant proportion of lost nets are recovered through the use of global positioning

[139] Eunomia study 2016; and DG MOVE Impact Assessment for the revision of the PRF Directive, to be published in January 2018 together with the proposal for a new Directive

[140] Project N° 94/095: Incidental impact of gill–nets (FANTARED)

[141] A study to identify, quantify and ameliorate the impacts of static gear lost at sea (FANTARED 2). EU Study Contract FAIR CT98–4338.

[142] FISH/2006/15/Lot No.5", SI2.466030 "Recuperation of fishing nets lost or abandoned at sea" (DEEPCLEAN)

[143] Werner, S., Budziak, A., van Franeker, J., Galgani, F., Hanke, G., Maes, T., Matiddi, M., Nilsson, P., Oosterbaan, L., Priestland, E., Thompson, R., Veiga, J. and Vlachogianni, T.; 2016; Harm caused by Marine Litter. MSFD GES TG Marine Litter - Thematic Report; JRC Technical report; EUR 28317 EN; doi:10.2788/690366.
http://publications.jrc.ec.europa.eu/repository/bitstream/JRC104308/lbna28317enn.pdf.

systems (GPS); fishermen typically go to considerable lengths to recover nets given their cost. During the evaluation of the Control Regulation, only one Member State authority reported that it routinely collect notifications of lost gear[144].

A number of Member States undertake retrieval surveys based on reported losses and other evidence. Many Producer Organisations report the position of static gears on a daily basis to minimise conflict between static and mobile fishing gears. Such initiatives can reduce the levels of gear loss and can benefit from the support of the European Maritime and Fisheries Fund (EMFF). In response to the studies on ghost fishing, the EU Control Regulation[145] and the associated implementing regulation[146] introduced mandatory requirements to report lost nets, and improvements and specifications for the marking of fishing gear in order to mitigate such losses.

*Aquaculture*

Aquaculture contributes to marine litter also, though to a minor extent, with the main sources associated with sea-based farms, such as cages, longlines, poles and other floating and fixed structures used for the culture of marine animals and plants. There are no reliable estimates of the contribution of aquaculture to marine litter to date.

The types of material lost would depend on the type of culture systems, construction quality, vulnerability to damage, and management practices and could be nets and cage structures (for marine fish cages), lines or floating raft structures (for seaweed systems) or poles, bags, lines, and plastic sheeting (for mollusc farming). Because many of these items are expensive, one might expect farmers to take considerable care to avoid losses.

One Canadian study[147] showed that greater concentrations of micro plastics were measured in farmed mussels than in wild mussels, which may be a result of farming practices that use polypropylene lines to anchor the mussels, or it may be due to differences in micro plastic concentrations in the different locations from which the farmed mussels and wild mussels originated.

Another study[148] found that mussel nets are among the most common items found in areas of the Adriatic and Ionian seas with intensive and extensive aquaculture activities. Shellfish

[144]

| Year | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|
| number of reports of lost gear (Portugal) | 65 | 79 | 93 | 180 | 89 |
| number of reports of lost gear (other Member States) | 8 | 8 | 14 | 6 | 2 |

[145] Council Regulation (EC) No 1224/2009 of 20 November 2009 establishing a Community control system for ensuring compliance with the rules of the common fisheries policy

[146] Commission Implementing Regulation (EU) No 404/2011 of 8 April 2011 laying down detailed rules for the implementation of Council Regulation (EC) No 1224/2009 establishing a Community control system for ensuring compliance with the rules of the Common Fisheries Policy

[147] Mathalon A., P. Hill Microplastic fibers in the intertidal ecosystem surrounding Halifax Harbour, Nova Scotia Mar. Pollut. Bull., 81 (2014), pp. 69–79.

[148] On beaches located along the coastline of the Adriatic and Ionian Seas mussel nets were the seventh most frequent items found (Vlachogianni et al., 2016). Furthermore, in surveys carried out along the Italian coastline, mussel and oyster nets were among the top three items recorded on beaches, while the results obtained from the seafloor surveys show that litter from aquaculture accounts for 15% of total items recorder

farming techniques and any potential litter generated differ according to local conditions in the sea basin.

However, given that global aquaculture production accounts for more than 50% and marine aquaculture of fish and molluscs for nearly 15% of global seafood production, the contribution of the sector to marine litter may be rising in importance[149].

*End-of-life recreational boats*

End-of-life recreational boats could become a significant source for marine litter. Yachts' average lifespan has been estimated at 30 years, although in some instances this may stretch to 40-45 years. This lifespan has further increased over time due to the use of stronger materials, such as fibre reinforced polymer (FRP). It is thought that between 1% and 2% of the 6 million boats kept in Europe, in other words at least 80,000 boats, reach their 'end of use' each year. However, only around 2,000 of those are dismantled. A significant number of the remaining boats are left abandoned, potentially ending up in the ocean and becoming marine litter[150].

*Tourism*

While tourism is a major source of littering on beaches, the proportion of this litter finding its way into the sea is unknown.

### *Existing EU measures*

The Commission has been tackling sea-based sources of marine litter with a variety of policy instruments.

Directive 2000/59/EC on port reception facilities for ship generated waste and cargo residues aims at reducing discharges of waste from ships at sea. It requires the provision of adequate waste reception facilities in ports, and ensures the use of those facilities through a mandatory delivery requirement for ships before departure from any EU port. The Directive also requires the establishment of cost recovery systems which are based on the application on an indirect fee, to be paid irrespective of delivery, in order to provide no incentive for ships to discharge their waste into the sea. Since the adoption of the PRF Directive, volumes of ship-generated waste and cargo residues delivered to EU ports have increased significantly[151]. However, waste continues to be discharged at sea. Other waste streams, such as oily waste and sewage, also continue to be discharged at sea in contravention with existing discharge norms/prohibitions[152]. Important underlying drivers of these problems were found to be: the unavailability of

(Pasquini et al., 2016). Indicatively some preliminary results from Fishing for Litter activities in the area show that mussel and oyster nets account for almost 30% of the total weight of the items collected. (JRS report: Sources of marine litter).

149 Elaboration from FAO State of World Fisheries and Aquaculture 2016; Total global aquaculture production (including freshwater fish, aquatic plants, and marine fish and molluscs) accounts for more than 50% of world seafood production. Marine fish and mollusc aquaculture accounts for 26% of global aquaculture production or nearly 15% of total global seafood production.

150 Commission Staff Working Document on Nautical Tourism, SWD(2017) 126 final.

151 Ex-post evaluation of the PRF Directive, Panteia, 2015

152 Ecorys (2017). Op. cit.

adequate reception facilities in ports, the lack of enforcement of the mandatory delivery obligation for ships, and the lack of economic incentives for delivery[153].

Of particular relevance to the fishing and aquaculture sectors are instruments preventing or prohibiting the voluntary discarding of plastic waste, in particular derelict gear, on the one hand, and instruments mitigating or promoting the recovery of lost gear which may generate ghost fishing. While the former can be addressed through environmental protection measures, the latter has led the Commission to undertaking studies on estimating the magnitude and impact of ghost fishing[154] and on the recovery of ALDFG[155].

The Control Regulation[156] requires the mandatory marking of gear as well as the notification and retrieval of lost gear. A more detailed assessment of the implementation of the requirements of the Control Regulation will provide important information on its impacts and potential improvements.

The European Maritime and Fisheries Fund (EMFF) allows for finances a variety of activities combating litter from sea-based activities and especially so-called passive fishing for litter, whereby fishers bring litter fished up in nets while fishing back ashore. Other potential activities are retrieving lost gear, the provision of litter bags for collection at sea,  investments in facilities for waste and marine litter collection and processing, recovery and recycling of nets.

Over the seven year period 2014-2020, 14 Member States envisage a total of 108 fishing for litter operations that are supported with around €22M from EU funds, equalling 2% of the EMFF. While the allocation is still rather modest, the increase in comparison to the previous funding period is significant with the planned EU financial contribution having more than tripled and the number of Member States funding marine litter activities with the EMFF as well as the number of projects having at least doubled. . A recent call for proposals will be complementing these activities with a number of transnational projects on the reduction, monitoring, removal and recycling of marine litter being supported 2019-2020 focussing on long term sustainability and buy in from stakeholders.

### *Actions to be taken*

Several and differentiated solutions can be envisaged to address the issue of plastic waste originated from marine origin, fishing gear and aquaculture products such as developing new policy, best practice, outreach and education to incite behavioural changes, enforcement of relevant legislation and standard setting to improve the regulatory framework.

To reduce waste from ships the Commission is putting forward a legislative proposal for a new Port Reception Facilities Directive with a two-fold objective:

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153 The REFIT Evaluation that was undertaken for the PRF Directive 2000/59/EC in 2015

154 Ghost fishing by lost fishing gear (August 2005) DG FISH/2004/20 institute for European environmental policy, Poseidon aquatic resource management

155 Recuperation of fishing nets lost or abandoned at sea (September 2009) Graham, N. 1*, Hareide, N–R.2, Large, P.A.3, MacMullen, P.4, Mulligan, M .5, Randall, P.J.3, Rihan, D.5, and Peach, D

156 Council Regulation (EC) No 1224/2009 of 20 November 2009 establishing a Community control system for ensuring compliance with the rules of the common fisheries policy

1. Protection of the marine environment through a reduction of discharges of ship-generated waste at sea and contributing to the wider objectives of the circular economy;
2. Facilitation of maritime transport through a reduction of the administrative burden on ships, ports, and competent authorities.

More specifically, the proposal for a new Directive aims at:

- Ensuring the availability of adequate waste reception facilities for the use by ships in EU ports;
- Providing effective cost incentives for ships to deliver waste to port reception facilities;
- Removing barriers to enforcement of the mandatory delivery obligation;
- Harmonising and update definitions and forms;
- Harmonising the rules on exemptions for ships in scheduled (i.e. regular) traffic.

The revision of the Directive aims to achieve the objectives through a combination of measures that seek further alignment with the IMO MARPOL Convention, with a special focus on the delivery of garbage from ships, the main component of marine litter found at sea. The proposed measures also offer great potential for supporting the circular economy in the context of handling of waste from ships in ports. These positive effects can be realised at relatively limited operational and investment costs.

The revision is expected to generate the following impacts:

- Environmental impacts: a substantial part of the illegal waste discharges at sea can be reduced (oily waste, sewage, garbage and scrubber waste), and an important contribution can be made to the circular economy (through special measures focused on reducing marine litter and improving waste management in port).
- Economic impacts: Reduction of enforcement costs and a reduction of the administrative burden associated with the process of waste notification and exemptions. New business opportunities should be created for PRF operators. Costs associated with separate collection of waste from ships in ports should be off-set by expected revenues from increased recycling of garbage waste.

The Commission will also examine options for reducing the loss or abandonment of fishing gear at sea such as via the introduction of deposit or extended producers responsibility  The potential of product innovation and/or substitution as well as the introduction of recycling targets to avoid the release of plastics in the environment and to enhance the recyclability and recycling rates of fishing gear will be assessed. To that end, he Commission launched a study and a public consultation in December 2017.

The Commission will also assess in more detail the contribution of tourism, shipping, aquaculture and other maritime activities to marine litter and examine a range of measures to minimise plastic loss from aquaculture[157]. Furthermore it will continue its work to improve understanding and measurement of marine litter, an essential but often neglected way to

[157] Including the possible adoption of a Best Available Technique reference document for aquaculture installations

support effective prevention and recovery measures. EMODnet, a service set up 2012 by the Commission has been expanded to marine litter in 2017. It collects, aggregates, standardizes and quality checks data from different sources and facilitates the interoperable sharing of information, data and maps such as on beach, seafloor and microlitter.

While preventing the leakage of plastic into the marine environment is the first priority, action to retrieve some of the plastics floating in the oceans can have a role to play, and is supported by EU funds under 'fishing for litter' programmes[158]. The Commission also supports innovative technologies for retrieval[159]. In this regard, fishing vessels can also make a significant contribution to solving the problem by picking up litter not only from sea-based sources but also from that coming from the land. They can do this by sorting, collecting and landing litter found in their nets during normal operations ("passive" fishing for litter) or by making special trips to pick up litter ("active" fishing for litter). These active operations normally focus on lost, abandoned to otherwise discarded fishing gear from the seafloor, following identification of hot spots but there have been some pilot or demonstration studies[160] looking at floating litter in rivers or coasts. Guidelines for passive fishing for litter were discussed and developed within EU studies[161]. If many of these operations are organized by local authorities, by fishers' organisations or by regional sea conventions, some are financially supported by the EU[162]. In total 108 operations on fishing for litter are foreseen[163]. The Commission will continue to support these actions, as well as innovative technologies for targeted and environmentally sound retrieval of plastic litter, in particular fishing gear, taking into account in particular the international dimension of the issue. The support to fishing for litter activities such as via the European Maritime and Fisheries Fund will be continued and potentially stepped up. Future funding architectures will ensure that information about the effectiveness and efficiency and environmental performance of such operations will be provided and made available for experience exchange and the communication of best practice.

Finally, international action will remain key to tackling the most significant sources of plastics litter in the oceans, and part of the implementation of the Ocean Governance Communication[164]. Ocean partnerships will be developed with a number of countries for enhanced cooperation to ensure effective ocean governance for the conservation and sustainable use of the oceans, seas and marine resources. These partnerships will promote cooperation to significantly reduce pollution of all kinds, including from land based sources, in the oceans, including marine plastic litter and micro-plastics. Cooperation with the United Nations Food and Agriculture Organisation (FAO) will be continued with the aim of adopting of

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158 https://ec.europa.eu/easme/en/information-day-blue-growth-calls-under-emff

159 See, for example, the call under Horizon 2020 to develop and scale up innovative processes to clear the sea of litter and pollutants:
http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/bg-07-2017.html

160 https://www.wastefreeoceans.org/

161 http://www.marelitt.eu/; https://www.marelittbaltic.eu/, http://ec.europa.eu/environment/marine/good-environmental-status/descriptor-10/pdf/MSFD%20Measures%20to%20Combat%20Marine%20Litter.pdf (p.152-198)

162 It included a total of €14 million's worth of such measures in their operational programs which define how they will spend their allocations from the European Maritime and Fisheries Fund (EMFF) in 2014-2020.

163 Namely: BE (5), BG (7), CY(2), DE(8), ES(10), I(3), HR(15), IE(2), IT(20), PL(3), PT(6), RO(3), SE(19), UK(5)

164 The Our Ocean 2017 conference hosted by the EU in Malta in October 2017 gathered more than 100 commitments worth almost 3 billion EURO addressing marine pollution, including plastics.

international guidelines on the reporting and recovery of abandoned, lost and otherwise discarded fishing gear. The significant contribution of fish aggregating devices (FAD) to marine litter will be addressed by supporting the development of biodegradable FADs as well as cost effective recovery practices, and, finally, awareness and compliance of MARPOL rules on the disposal of plastics at sea and of the EU rules on the discharge of waste at port reception facilities will be promoted amongst regional fisheries management organisations.

### 4.1.4 Agricultural plastics

***Issues at stake***

Plastics are used for a number of purposes in agriculture ("ag-plastics") such as mulch films, tunnels, pipes and irrigation systems for vegetable production and silage films, nets and twines for storing feed for livestock. Pesticide and fertiliser bags and containers are considered as packaging. Mulch films are most commonly used to preserve soil moisture and suppress the proliferation of weeds. They reduce the need for water and pesticide and protect against harsh climate conditions.

In 2015, 36% of the vegetable production in EU was located in just two member states: Italy (19.5%) and Spain (16.6%)[165], where these were grown under greenhouse cover (glass or mainly plastic) to control humidity: in Spain (17.2%) and Italy (13.3)[166]. These two Member States are part of the biggest agriculture plastics waste producers in the EU (see below).

Agricultural plastics accounted for 3.3% of the total plastics market in Europe in 2015 (1.6 million tonnes)[167]. As an alternative to the conventional plastics, also biodegradable and oxo-plastics, in particular for mulch films, are used (see chapters on biodegradable plastics and on oxo-plastics).

Greenhouses and tunnels allow for a longer growing season for a wider variety of plants[168] LDPE films represent 78% of the total volume of agricultural plastics in Europe, with 27% being used for greenhouses and tunnels[169].

There is not much information on market size. In the case of mulch films APE estimated the market size was 80,000 tonnes in 2013[170]. European Bioplastics suggest 5% of these are biodegradable (4,000 tonnes).

Eunomia's research into oxo-plastics estimated that 10,000 tonnes were used[171]. Although a rather small part of the plastic applications, oxo-plastics present a risk. If left on the ground,

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165 The fruit and vegetable sector in the EU – a statistical overview – Statistics Explained, accessed 6 July 2017, http://ec.europa.eu/eurostat/statistics-explained/index.php?title=The_fruit_and_vegetable_sector_in_the_EU_-_a_statistical_overview&oldid=306933

166 The fruit and vegetable sector in the EU – a statistical overview – Statistics Explained. op. cit.

167 Plasteurope.com – AGRICULTURAL PLASTICS: European and worldwide markets / Collection schemes and technical developments / Bettering the image of recycled material, accessed 29 June 2017, https://www.plasteurope.com/news/AGRICULTURAL_PLASTICS_t236846/

168 Le Moine, B (2015). Plastics in agriculture: a contribution to Intensive Ecological Agriculture (IEA). http://www.plastiques-agricoles.com/wp-content/uploads/2016/06/Plasticulture-02.pdf

169 CIPA & APE (2016), Plasticulture – Agriculture Ecologically Intensive, n°135

170 http://www.apeeurope.eu/statistiques.php

171 Eunomia 2017

oxo-plastics can reduce soil fertility[172] and may lead to micro-plastics release into soil and accumulation and the aquatic environment.

In the EU, 1,326 thousand tonnes of agriculture plastics waste were produced in 2014[173]. The largest producers of agriculture plastics waste in Europe are Germany, Italy, Spain, UK, France (>150 thousand tonnes in 2014), and Poland (89 thousand tonnes)[174]. Despite agricultural plastics having a high potential for recycling—due to them being produced in large quantities and composed of relatively homogeneous material - only 28% of agricultural plastics are recycled in EU, while 30% are sent to energy recovery facilities and 42% to landfill[175]. Low rates of reuse and recycling in the agricultural sector is thought to be caused by a number of reasons. Reuse is impractical as the plastic materials tend to be heavily weathered and can be contaminated with pathogens[176] and soil. In recycling, the following barriers are reported:

- In the absence of an EU wide obligation to set a collection scheme for agricultural plastics, only five Member States have established collection systems[177]. In other countries, there is a limited infrastructure in place that enables farmers and growers to easily recycle their plastics.
- Agricultural plastics accumulate large amounts of contaminants over their lifetime (water, soil, sand and organic matter) reaching up to four times their weight[178]. The transport and treatment is therefore costly and requires careful cleaning before processing.
- Plastics films have to attain a certain thickness as otherwise they will tear while collecting.

Five EU Member States[179] currently have national collection schemes in place and mostly report much higher than average recycling rates whilst ten EU member states currently report a 0% recycling rate.[180] The highest levels are achieved in Sweden (68%) and Ireland (63%), while much lower rates are observed in Eastern European countries (0% in Bulgaria, Romania, Slovenia, Slovakia).

**Box 4. Examples of existing collection and recycling schemes for agricultural plastics**

***Ireland***

In 1997, Ireland introduced legislation designed to assist and promote the recycling of agricultural plastics (silage wrap, bags, sheeting, and as of 1st October 2017, netting and

[172] Personnal communication with Bernard Le Moine at APE Europe
[173] Consultic (2014) *Post-Consumer Plastic Waste Management in European Countries 2014*, Report for PlasticsEurope, 15th October 2015
[174] Consultic (2014). O*p. cit.*
[175] Consultic (2014). *Op. cit.*
[176] Cameron, A. (2009) Problems with Plastics, Chronica Horticulturae-Subscription, Vol.49, No.1, p.8
[177] Agricultural plastics european regulation: APE Europe, accessed 29 June 2017, http://www.plastiques-agricoles.com/ape-europe-missions/agricultural-plastics-european-regulation/
[178] CIPA & APE (2016), Plasticulture - Agriculture Ecologically Intensive, n°135
[179] Member States with existing collection schemes are: France, Germany, Ireland, Spain and Sweden. Eunomia (2017) assumes that the Netherlands and Italy will also implement a scheme.
[180] Consultic (2014) *op. cit.*

twine).[181] The Waste Management (Farm Plastics) Regulations (2001) is mandatory. As a consequence all producers are members of the IFFPG (Irish Farm Film Producers Group), Ireland's sole, government approved, farm plastics collection / recycling compliance scheme.[182] The IFFPG is funded through a recycling levy charged to producers; and a weight based collection fee charged to farmers. The IFFPG arranges the collection and recycling of farm plastics across Ireland, either through bookable farmyard collections or a number of local one-day bring-centres (it ran 237 in 2016).[183]

The scheme is operating successfully. In 2016, the IFFPG collected 27,193 tonnes of farm plastics waste, a c.2000 tonne increase on the previous year[184]. The IFPPG recycled 74% of what producers placed on the market in the previous year, after allowing for a 50% contamination level (mainly moisture). This exceeded the target of 70%[185]. Of the plastics collected, over 60% was supplied to Irish recyclers, supporting the national economy.

***France***

Under French regulation there are no specific take back obligations for agricultural plastics, rather it is stipulated that producers, importers and distributors of waste generating products may, in accordance with the principle of extended producer responsibility, be required to manage their disposal.[186] The French agri-plastics industry has created a national voluntary EPR initiative, managed by a private not-for-profit organisation called ADIVALOR, created in 2001. [187,188]

The collection and treatment of the waste that ADIVALOR manages is largely funded by manufacturers and suppliers. They are charged an 'eco-fee' when they place product on the French market. The French Environment and Energy Management Agency provided €2.8m of support over 5 years to help in the implementation of the recovery scheme for agricultural films.[189] Farmers return any uncontaminated waste to one of c.6000 collections points across France.[190] Farmers are not charged for this service.

ADIVALOR's statistics indicate that the scheme is successful. As of 2015, there were 385 producers, 1,200 distributors and 280,000 farmers participating across all materials.[191] The collection rate of agricultural film increased from 42% in 2009 (the first year) to 71% in

181 Waste Management (Farm Plastics) (Amendment) Regulations 2017
http://opac.oireachtas.ie/AWData/Library3/CCAEdoclaid080917_122641.pdf

182 Irish Farm Film Producers Group http://www.farmplastics.ie/farm-plastic-regulations/ Date accessed 09/10/17

183 IFFPG (2017) Environmental Report 2016

184 The fruit and vegetable sector in the EU - a statistical overview - Statistics Explained. op. cit.

185 Idem

186 Environmental Code - Article L541 - 10

187 Agriculture Plastic and Environment http://www.plastiques-agricoles.com/agriculture-plastique-et-environnement-ape-commission-ape/ Date accessed 10/10/17

188 ADIVALOR Used Agriplastic Film http://www.adivalor.fr/en/collectes/films_agricoles_usages.html Date accessed 10/10/17

189 ADIVALOR 2014 Report http://www.adivalor.fr/en/adivalor/2014_report.html Date accessed 10/10/17

190 ADIVALOR presentation 2015
http://www.srsweb.sk/dokumenty/6RLD/1%20den/04%20%20Presentation%20of%20ADIVALOR%20-%20EN.pdf

191 ADIVALOR presentation 2015
http://www.srsweb.sk/dokumenty/6RLD/1%20den/04%20%20Presentation%20of%20ADIVALOR%20-%20EN.pdf

2014, with almost 50,000 tonnes collected. ADIVALOR's current objective is to collect 75% of all used agri-plastic film.[192]

***Spain (Andalusia)***

As set out in Decree 73/2012 (Waste Regulation of Andalusia), producers of agricultural plastic in Andalusia (an autonomous region which consumes large amounts of agricultural plastics) are legally required to participate in a management system that guarantees the collection and management of any waste generated. Cicloagro, a public private partnership, was set up to help producers meet their obligations. The organisation covers non-packaging agricultural plastics e.g. films, tape, irrigation lines and mesh.

Cicloagro is financed by an 'eco-protection' tax levied on the sale of plastic agricultural products. Farmers clean and sort their used plastics, before delivering it to an authorised collection point – there is no charge for this service.

***Germany***

In 2013, the German industry association for plastic packaging in partnership with waste disposal specialist RIGK, created a national recovery system for agricultural film. The scheme, called ERDE, started to collect a variety of film types in 2014. Its activities are funded by member companies i.e. manufacturers and importers. ERDE's success is reliant on voluntary participation; currently there are 7 participating manufacturers and over 20 collection partners[193].

Farmers are incentivised to return their used plastics to collection points by a bonus which can be redeemed against a future purchase.

According to RIGK, ERDE collected 5412 tonnes of agricultural film in 2016, a 16.6% increase in comparison to 2015[194]. It planned to further increase this figure in 2017 by expanding its network of collection points.

Eunomia (2017) modelled the waste growth for the coming year, indicating an overall increase in agricultural plastic waste growth of 26 thousand tonnes per year (2% increase).

[192] ADIVALOR missions and objectives http://www.adivalor.fr/en/filiere/presentation/objectifs.html Date accessed 10/10/17
[193] ERDE recycling http://www.erde-recycling.de/en/about-erde/what-is-erde.html Date accessed 11/10/17
[194]Agricultural Film Recycling https://www.plasteurope.com/news/AGRICULTURAL_FILM_RECYCLING_t236996/ Date accessed 11/11/17

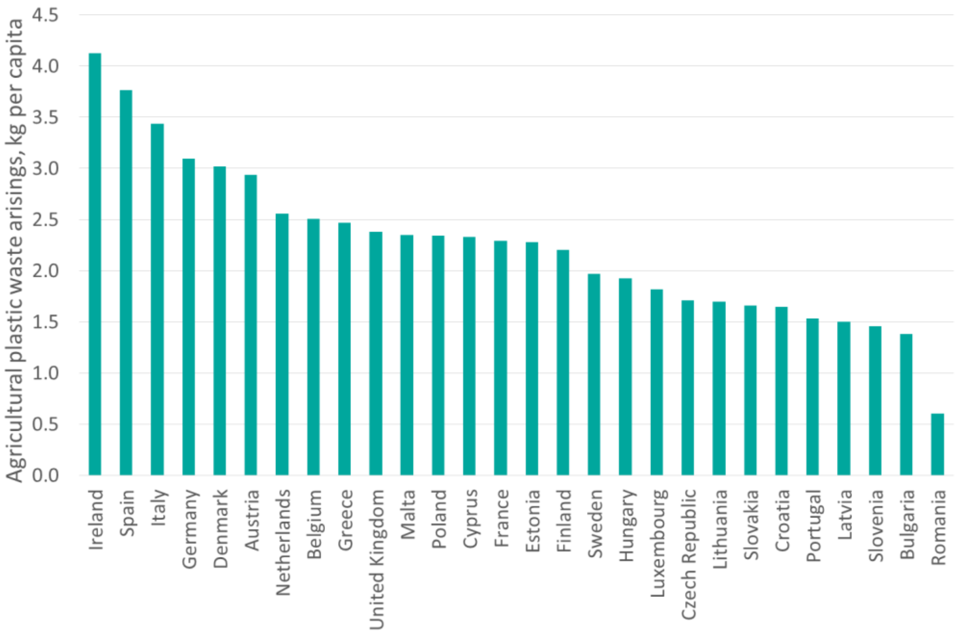


**Figure 11. Arising of plastic agricultural waste by Member State in 2014, kg per capita**

*Source: Consultic*[195]

There is also a high risk for plastic films to be left on agricultural soils in amounts that may reduce soil fertility and that may run off into surface waters with associated impacts to riverine and marine life.

There is no overarching European regulation on the management of agricultural plastics waste. Article 8 of the Waste Framework Directive (2008/98/EC) specifies that Member States may include the concept of extended producer responsibility (EPR) into their legislative or non-legislative measures relating to waste management.

### *Actions to be taken*

The main objectives related to agricultural plastics are:

- Low level of plastic films left on agricultural soils;
- High rate of reuse;
- High rates of collecting and recycling.

Agriculture Plastic Environment (APE) Europe aims for an increase in recycling of agricultural plastics to 70% across Europe by 2022[196]. Stakeholder suggested the following potential solutions[197] :

- Facilitate the development of national collection systems.
- Change in practices and investment by growers to adopt new practices around the collection of soiled mulched films in order to facilitate their recycling.

More specific issues include solutions for the better collecting and decontamination of agricultural mulches, in order to achieve higher recycling rates.

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195 Consultic (2014). *Op. cit.*

196 APE Europe (2017) Ten Year Plan for Europe, Accessed 11th October 2017, http://www.plastiques-agricoles.com/ape-europe-missions/

197 Eunomia (2017). Op. cit.

The Commission will consider and further assess how to improve and increase recycling agricultural plastic waste rates across the EU. This stepwise approach will be based on positive examples from Member States having set deposit refund schemes and well-functioning collection and recycling schemes. The Commission will carefully assess the potential impact on the environment and include in its analysis the existing alternatives such as plastics with biodegradable properties.

## 4.2 Establishing a clear regulatory framework for biodegradable plastics

### 4.2.1 Issues at stake

In response to the high degree of plastic leakage into our environment and its harmful effects for a very long period of time, solutions have been sought to design biodegradable and compostable plastics[198]. There is however considerable debate as to the extent to which plastics intended to be biodegradable do actually biodegrade in the natural environment. Although the current situation may therefore seem challenging, plastics with biodegradable properties can also bring additional benefits if the appropriate decisions are taken.

***Terminology***

In the first place attention should be given to the correct use of terminology. The current situation is somehow confusing for consumers who might think that all plastics labelled biodegradable are capable of biodegrading in nature without any human intervention as it happening for organic material. It is of utmost importance that consumers are properly informed and aware of the meaning of the different concepts and of the proper handling or end-of-life treatment, the risk being that plastic items are incorrectly handled or disposed of at the end of their useful life.

In a biodegradation process, plastics are bio-transformed and decomposed by microorganisms into water, naturally occurring gases like carbon dioxide ($CO_2$) and methane (CH4) and biomass (e.g. new microbial cellular constituents)[199]. Biodegradability depends strongly on the environmental conditions: temperature, presence of microorganisms, presence of oxygen and water. So both the biodegradability and the biodegradation rate of a plastic may be different depending on the environment e.g. in soil, on the soil, in humid or dry climate, on the surface water, in marine ecosystems or in human-made systems like home composting, industrial composting or anaerobic digestion[200].

A distinction needs to be made between industrial and home composting. Industrial composting conditions require elevated temperature (55-60°C) combined with high relative humidity and the presence of oxygen. Industrial composting takes place under given and predictable conditions. Home-composting is characterised by typically uncontrolled conditions. Home-composting process takes much longer compared to industrial composting as the temperature

198 https://wedocs.unep.org/bitstream/handle/20.500.11822/7468/-Biodegradable_Plastics_and_Marine_Litter_Misconceptions,_concerns_and_impacts_on_marine_environments-2015BiodegradablePlasticsAndMarineLitter.pdf.pdf?sequence=3&isAllowed=y

199 European Centre for Ecotoxicology and toxicology of chemicals, Technical report 123, Definitions according to OECD

200 Bio-based and biodegradable plastics - Facts and Figures, Wageningen, 2017

in home-compost heaps is generally lower and other necessary conditions vary greatly between Member States, depending to a great extent on the geographical and climatological situation as well on individual actions taken by households.

As pointed above, biodegradability and the biodegradation rate strongly depend on the environmental conditions[201]. Although every plastic will eventually biodegrade at some point, even in the open environment, be it after hundreds of years, it only makes sense to speak about biodegradation in specific environments (e.g. aquatic environment, marine ecosystems, soil industrial or home-composting installations) and with reference to the time frame.

A distinction should also be made between bio-based and biodegradable plastics. They are not synonymous. "Bio-based plastics" simply means that they are wholly or partly derived from materials of biological origin and have the same properties as conventional plastics. Hence, one should keep in mind that although they can, not all bio-based plastics are biodegradable and not all biodegradable/compostable plastics are bio-based.

The use of appropriate language and terminology is of a paramount importance. For the purposes of the Plastics Strategy:

- "Biodegradable plastics" means plastics that can be bio-transformed and decomposed by microorganisms into water, occurring gases like carbon dioxide ($CO_2$) and methane (CH4) and biomass (e.g. growth of the microorganism population).
- "Compostable plastics" mean plastics with enhanced biodegradable properties that are intended to be decomposed in an industrial composting plant.
- "Home-compostable plastics" mean biodegradable plastics that are capable of being biodegraded at lower temperatures and in less constant and controlled conditions than those put in place in industrial composting plant (e.g. lower turning frequency, less optimal moisture conditions) and which are usually present in compost heaps or bins or in small-scale closed systems for home-composting by private households.
- "Bio-based plastics" mean plastics wholly or partly derived biomass.
- "Bio-based biodegradable plastics" mean plastics wholly or partly derived from biomass and having biodegradable properties.

### *Standards*

As a response to the biodegradability concerns, standards have been adopted but a general standard for biodegradability of plastics in an open and uncontrolled environment has not been developed as biodegradability depending on specific and too diverse conditions.

Standards with criteria especially acceptable test conditions including time frames mimicking the different natural environmental compartments and conditions for biodegradation that doesn't take place in industrial composting facilities are still lacking. Such standards exist for composting of plastics and plastic packaging both at international level (ISO standard 17088:2012 defining specifications for compostable plastics[202]) and European level (harmonized standard EN 14995 defining requirements for plastics recoverable through composting and

[201] CE Delft Bio-based Plastics in a Circular Economy; September 2017, p. 22

[202] https://standards.cen.eu/dyn/www/f?p=204:110:0::::FSP_PROJECT,FSP_ORG_ID:21783,6230&cs=12459CCC96FCD875A348D49110FF2D1BF

biodegradation[203]; and harmonized standard EN 13432 defining requirements for packaging recoverable through composting and biodegradation under industrial composting conditions[204]).

A specific standard was also published in November 2017 for biodegradable mulch films for use in agriculture and horticulture[205]. It is applicable to films intended to biodegrade in soil without creating any adverse impact on the environment. It also specifies the test methods to assess these requirements as well as requirements for the packaging, identification and marking of films. For information, it defines a classification of biodegradable mulch films according to their service life on soil and gives a good practice guide for the use of the films. Films intended to be removed after use and not incorporated in the soil are not in the scope of this standard (EN 13655).

There is no EU harmonised standard for home-compostable plastics. Plastic packaging meeting the requirements of the standard EN 13432 is only biodegradable and compostable in industrial installations and is not biodegradable in the open environment or in non-controlled environments such as home-compost heaps. Italy developed already in 2006 a national standard for plastic items biodegradable in home composting (requirements and test methods)[206]. Such national standard was also introduced in Australia in 2010 (AS 5810) and followed in 2015 by France[207]. Currently, even without a European standard for home composting there are certification schemes, often based on the Australian standard (e.g. certified by Vinçotte "*OK Home Compost*").

### *Environmental impacts*

Current plastic offers functional benefits, but has an inherent design failure: its intended useful life is typically short but the material persists for centuries, which is particularly damaging if it leaks outside collection systems. Efforts to reduce leakage are hence paramount. One should also keep in mind that even though plastics are marked "biodegradable" if they are littered, they can still cause harm to the ecosystems before they are fully biodegraded. Most currently available biodegradable plastics generally degrade under specific conditions which may not always be easy to find in the natural environment. Biodegradation in the marine environment has not been proven.

Labelling consumer plastics as  biodegradable without indicating the conditions under which it will biodegrade (e.g. industrial or home composting) may also deliver the wrong message as it might lead to think that in some cases it is acceptable for plastics being designed to be littered.

However, biodegradable or compostable plastic may be the preferred option for some specific applications where their benefits outweigh their possible disadvantages keeping in mind that recycling of plastics is generally preferable, because the material is kept in the economy and risks for the environment are limited. More specifically regarding plastic mulches used for agricultural purposes, there is also a high risk for conventional plastic films to be left on

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[203] https://standards.cen.eu/dyn/www/f?p=204:110:0::::FSP_PROJECT,FSP_ORG_ID:13285,6242&cs=16419E079DF816FA31BA049B6F9169CF8
[204] UNEP  Vital Marine Graphics 2016 p.7
[205] EN 17033
[206] UNI 11183:2006
[207] NF T51-800 November 2015

agricultural soils in amounts that may reduce soil fertility and that may run off into surface waters with associated impacts to riverine and marine life. For this reason, the use of plastic mulches capable of biodegrading in soil increased over the last years[208]. There is not much information on market size. However, the risk of accumulation of plastic mulches that finally biodegrades much slower given the differences between geographical and climatological situation across the EU.

Another good example is the use of biodegradable plastic bags to collect organic household waste (or bio-wastes) or catering food wastes. These bags can be composted together with this collected organic waste without running the risk of being mixed with other plastic or any other waste streams where they would disqualify the resulting composts due to plastics impurities or hamper recycling if bio-degradable plastics are not sorted from other plastic wastes streams. Another example might be the use of biodegradable packaging for food where, after consumption, the packaging remains with some food inside and is collected and kept separate for composting in industrial/professional/certified installations. This however seems to be restricted to specific cases, where there would be a minimised risk for confusing the consumer. It should be clear that such packaging has still to be disposed of in appropriate manner and should not be littered.

Most biodegradable and compostable plastics are only compostable if they are mixed with a sufficient amount of organic material and under specific controlled conditions, such as a sufficiently and constantly high temperature, humidity specific quantity and level of UV radiation, presence of specific level of oxygen, presence of specific micro-organisms in sufficient quantities. Contradictory messages on the capacity of biodegradable plastics to disintegrate in industrial composting plants are also spread[209].

In general, as pure as possible plastic streams are needed for plastic mechanical recycling. Biodegradable plastics when mixed with conventional plastics may also hamper the mechanical recycling process. According to plastic recyclers, the presence of even a small percentage (between 2% and 5 %) of biodegradable and compostable plastic, whether industrially compostable or home-compostable, in plastic waste that is collected for recycling, might have a negative impact on the quality of the recycled plastic[210]. On the other side the influence of bio-based biodegradable plastics on the quality of the recyclates was also studied within EU FP7 Open-Bio project in film plastic recycling. It was found that up to 10% biodegradable plastic (starch based or PLA) does not have a negative effect of the properties of products. PVC (a conventional plastic) and PLA were studied as contaminants of recycled PET. It was concluded that it has a detrimental effect on the quality of recycled PET, whereas no specific threats were found in case of PLA contamination[211].

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[208] The estimated market size for all plastic mulching films was 80,000 tonnes in 2013 (http://www.apeeurope.eu/statistiques.php) out of which 4,000 tonnes are thought to be biodegradable (http://ec.europa.eu/transparency/regdoc/?fuseaction=feedbackattachment&fb_id=72FDC5F4-0A1D-B942-A363D85479EE9DEF)

[209] Parallel session on bio-based biodegradable organised on the frame of the Plastic Strategy conference September 2017

[210] http://www.plasticsrecyclers.eu/news/biodegradable-plastic-bags-are-myth

[211] Bio-based and biodegradable plastics - Facts and Figures, page 41,42 Wageningen, 2017

Another concern might be that organic waste streams and input for composting might also be contaminated by the presence of non biodegradable/non compostable plastics where consumer might be misled to consider that bio-based plastics have also biodegradable properties. Hence, the use of currently labelled biodegradable and compostable plastics may be more suitable for closed waste streams.

The current situation is somehow confusing for consumers who might think that plastics are capable of biodegrading in nature without any human intervention as it happening for organic material. It is of utmost importance that consumers are properly informed and aware of the meaning of the different labels, concepts and of the proper handling or end-of-life treatment, the risk being that plastic items are incorrectly handled or disposed of at the end of their useful life.

The Commission is currently developing an Implementing Act establishing marks or labels for different types of biodegradable and/or compostable plastic carrier bags, to inform consumers throughout the EU how to properly and without causing negative impact on the environment deal with the different plastic carrier bags when these are no longer suitable as carrier bag.

### 4.2.2 Actions to be taken

The Commission will propose harmonised rules for defining and labelling compostable and biodegradable plastics.

Plastics with biodegradable properties may be seen as a way forward for some specific applications where their benefits outweigh their possible disadvantages of naturally slower degradation pace. Therefore, the following is needed:

- Establish criteria under which the use of biodegradable plastics is appropriate and justified;
- Identify applications that would fall under these criteria (e.g. establishing a positive/negative list), or which would fall under these criteria if clearly defined measures are taken (e.g. separate collection e.g. biodegradable and non-biodegradable plastics);
- Develop tools for communication towards both consumers and professionals to reinforce the protection against false green claims and avoid confusion. Such tools should provide in a clear, accessible and comprehensive manner the evidence on which is based the biodegradability claim.

This assessment should be discussed with the actors representing the whole value chain from plastic producers to recyclers including civil society representatives. The discussion should take into account differences across the EU. It should be clear that such plastics have still to be disposed of in appropriate manner and should not be littered.

The Commission will develop lifecycle analysis to identify the conditions where the use of biodegradable or compostable plastics is beneficial, and criteria for such applications. This could also help to decide whether new standards are needed and which ones (e.g. biodegradable plastics or home-compostable plastics).

Another way forward could be developing a standard for biodegradability in specific environmental compartment (water, soil, marine environment). While establishing such a standard, a particular attention should be paid to consumers understanding of different markings and labelling and the way to handle plastic and organic waste as it may deliver the wrong message as it might lead to think that in some cases it is acceptable to design plastics for being littered and even to litter the products made out of this plastic.

A standard for home-compostability could provide an alternative for people living in places where a separate collection of organic waste has not yet been put in place or in places where it is not technically feasible while also delivering a message that plastics are designed for a purpose e.g. to keep valuable organic nutrients in the loop. It will be however insufficient on its own and should be accompanied by the obligation to collect separately organic waste. At the same time, one should also ensure that recyclability and recycling remains the preferred route for an appropriate end-of-life stage.

Adequate and separate plastic and organic waste collection and sorting will ensure clean waste streams, will help to avoid contamination and will contribute to increase the recycling rates. In addition, these actions will to close the cycles of bio-wastes and help producing safe fertilising products based on composts and digestates in line with the recent Commission proposal for the placing on the market of CE-marked fertilising products.

Regarding the biodegradability of plastic mulching films, the topic is to be further considered and discussed in order to understand all the pros and cons, risks for the environment and the best way forward in line with the circular economy principles given that a new standard has been published recently.

## 4.3 Oxo-degradable plastics: addressing the growing concerns

### 4.3.1 Issues at stake

So called oxo-plastics or oxo-degradable plastics are conventional plastics which include additives designed to promote the oxidation of the material to the point where it brittles and fragments[212]. The producers of the additives claim that the plastic to which they are added, are "oxo-biodegradable". Whether additives perform in the way in which their manufacturers claim they will and whether these materials have an added value from the environmental point of view, have been debated for some time now.

In early November 2017 the Ellen MacArthur Foundation published a statement of 150 organisations calling for a global ban on oxo-degradable plastic packaging given the impacts of the fragmentation on the environment leading to more micro-plastics pollution and promoting the idea that materials and products should be designed in line with the circular economy principles[213]. Signatories include leading businesses, industry associations, NGOs, scientists, and elected officials.

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212 "The Impact of the Use of "Oxo-degradable" Plastic on the Environment", Eunomia, August 2016

213 https://newplasticseconomy.org/news/over-150-organisations-back-call-to-ban-oxo-degradable-plastic-packaging

The Commission, taking into consideration the growing concerns about the use of such materials and based on the existing significant evidence and the studies that were recently carried out[214] has decided to pay a particular attention to the future use of these materials and the false green claims attached to it.

The main applications of oxo-degradable plastics are

- Agricultural film but also other applications are quite common, e.g. wrapping hay, potting containers, tree ties and vegetable sacks;
- Rubbish bags;
- Carrier bags;
- Food packaging (e.g. bread bags, food trays and films, freezer bags and drinks bottles);
- Landfill cover;
- Other miscellaneous applications such as disposable medical supplies (gloves), envelope windows, plastic covers for mail items, etc.

Several issues have been identified.

In the first place, the so called oxo-degradable plastics do not biodegrade in open environment i.e. are not decomposed by microorganisms into harmless elements that are found in nature, such as $CO_2$, water and biomass, nor are recoverable through composting. These materials are to be considered to rather fragment in tiny pieces exacerbating the micro-plastics accumulation in soils. There is no proof of oxo-degradable plastics capacity to biodegrade in the marine environment. The additives used only mimic biodegradation. Those additives make the fragmentation process easier and quicker without leading to biodegradation

The potential toxic effects on soils of any residual additives have been identified as a concern by some commentators. However, more research on this topic is needed.

The appellation "oxo-degradable plastics" contributes to the existing consumers' confusion due to the use of wide range of similar terms (see above) where the use of "degradable" creates a belief that the substance, materials or article cause no harm to the environment if it is not properly disposed of or is littered. This is the case for plastics labelled oxo-degradable plastics. Moreover, based on what is pointed out above, there might also be an issue from the point of view of misleading advertising. False green claims fall within its scope. The expressions 'environmental claims' or 'green claims' refer to the practice of suggesting or otherwise creating the impression − in the context of a commercial communication, marketing or advertising, that a product or a service, is environmentally friendly, i.e. it has a positive impact on the environment, or is less damaging to the environment than competing goods or services[215]. The environmental claim is misleading because it contains false information and is therefore untruthful (e.g. oxo-degradable plastics when for which no tests of their capacity of biodegradation are not conclusive. Consumers need to have clear and reliable information to make sustainable choices in order to be able to easily identify the 'right' product or service to

[214] Study to provide information supplementing the study on the impact of the use of "oxo-degradable" plastic on the environment"; Final Report; April 2017

[215] http://ec.europa.eu/consumers/consumer_evidence/market_studies/docs/green-claims-report-appendix-4.pdf

purchase. Information of this nature is provided by business by means of a range of environmental/green claims.

Oxo-degradable plastics can also affect negatively the purity of plastic waste streams, the quality of recycled plastics as they cannot be separated and sorted out, and in a long term significantly impair the physical qualities and service life of the recycled product.

Some Member States have already taken action to restrict the use of oxo-degradable plastics:

- ES, FR and IT already have a ban on oxo-plastics;
- BE, HU, BG have legislation that forbids oxo-plastics to claim that they are biodegradable;
- IT: new law will force the oxo-industry to give info on the negative environmental impact of these plastics on the environment;
- SW, UK: studying the issue and considering restrictive measures.

### 4.3.2 Actions to be taken

Actions taken by Member States might lead to a fragmentation of the internal market. Therefore a harmonised EU wide approach is needed. The Commission will start work to restrict the use of oxo-plastics in the EU.

## 4.4 The rising problem of micro-plastics

### 4.4.1 Issues at stake

***Rising concerns***

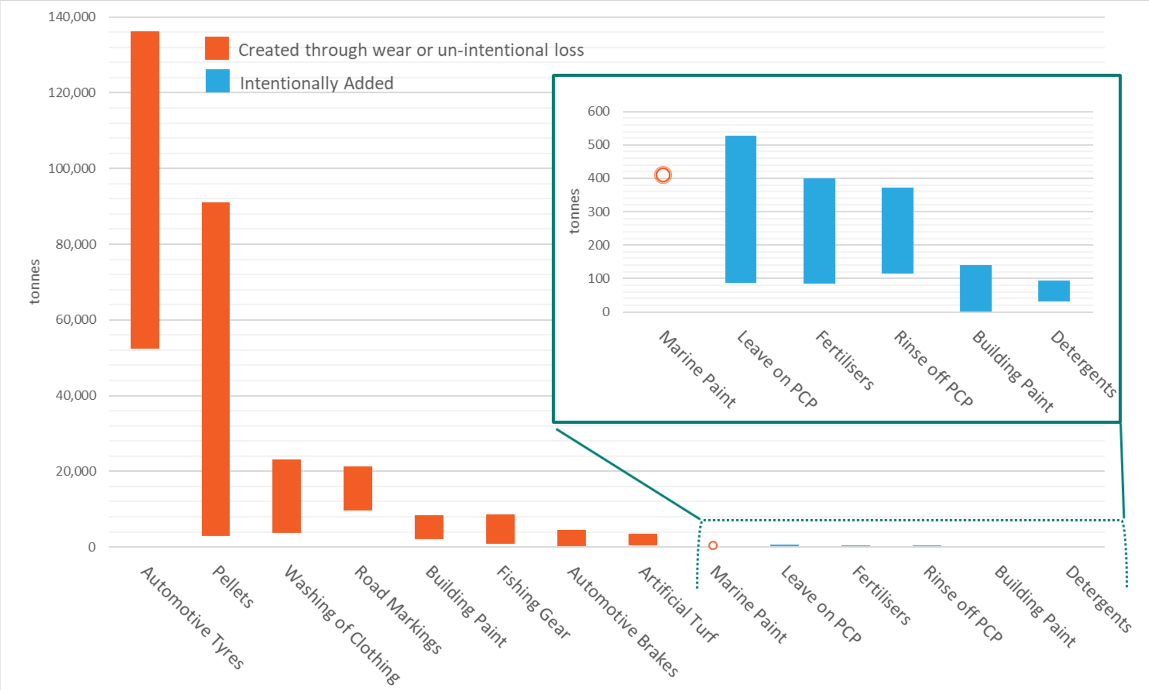
Micro-plastics are plastic particles of a size below 5 mm, intentionally added in products such as cosmetics and detergents, or generated during use of products such as tyres and textiles or along the plastics production and supply chain. They are dispersed and find their way into the environment by the wind or via sewage, rain drainage systems and/or rivers reaching coast side and ending up in the marine environment. To these micro-plastics one should add all plastic waste so called macro plastics entering the sea which, if not removed, ultimately becomes, because of weathering and fragmentation, micro-plastics.

The potential impacts of micro-plastics on the environment, associated with their intentional or incidental use in products, have generated a lot of concerns worldwide. The Council has invited the Commission to take measures on micro-plastics, in particular from cosmetics and detergents under the Strategy on Plastics.

During the preparation of the Strategy on Plastics an Open Public Consultation on micro-plastics was organised with almost 500 responses (roughly 50% from individuals vs companies); while the results have not been fully analysed yet, some trends are obvious: citizens are most concerned about harm to marine life, there’s high awareness of cosmetics and textiles micro-plastics, and with the highest concern for textiles, legislative measures are generally favoured at the European level with the cost burden put on the manufacturers and bans are favoured for all of the intentionally added ingredients.

A recent study[216] estimated that the total number of floating macro- and micro-plastics in the open oceans is 5,25 trillion pieces, weighing 269,000 tonnes. Micro-plastics were calculated in the order of 200 thousand tonnes in the EU[217]. The updated calculations are given in the Figure 12 and **Error! Reference source not found.** for all major sources of micro-plastics. It should be noted that data about the use of micro-plastics in products are scarce and studies and analysis depend for this to a large extent on the input from product manufacturers.

**Figure 12. Annual emissions of micro-plastics to surface waters from the EU, Norway and Switzerland**




**Notes:** These figures represent the upper and lower estimated range for the emission of microplastics in each product group to surface waters and should be considered in conjunction with their associated reports for context and calculation methodologies.
Bars in blue have been calculated by the DG Env project focusing on 'intentionally added' microplastics by Amec Foster Wheeler (AFW). These results are a combination of reported tonnages by associated industries and literature, as well as a range of assumptions regarding the release of the products to water and the efficiency of waste water treatment in removing microplastics. Where wastewater treatment is a pathway, a release factor of 16—43% is used in line with the EU microplastics WWT retention model created by Eunomia. These release factors are used by AFW in their final report, along with a third release factor of 8% (not represented on the graph) calculated by modelling microplastics flows through a theoretical WWT plant in the EUSES programme. Microplastics from oil and gas were also investigated as part of this project, but no concrete estimates could be made. Microplastics used as blasting media are estimated to be 1,000—5,000 tonnes per year, but with no emissions to surface waters.
The 'leave-on' PCP figure is based on the assumption that these are 100% rinsed off.
The orange bars represent microplastics created through wear and tear or accidental loss calculated by Eunomia Research and Consulting on behalf of DG Env. In all cases these are modelled emissions with varying levels of certainty attached (the full report will contain details of this).
Marine paint has no range associated with its estimate as emissions are direct to the marine environment.
Building paint is included twice, once for intentionally added losses and again for losses due to wear during the life of the paint.

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216 Eriksen et al.2014

217 EU micro-plastics. Ongoing study for the Commission: http://www.eumicro-plastics.com/eumpwp/wp-content/uploads/investigating-options-eunomia-draft-report-v4-main-report-public.pdf

Any microplastics captured in sludge after wastewater treatment may also be applied to agricultural land (50% of EU sludge) with a chance of leaching into waterways. There is no data to model this effect at present. Similarly, microplastics entering rivers far up stream of an estuary can, at varying levels due to size and density, be retained in sediment. There is also not enough information to accurately model this effect at present, although it is likely that particles from automotive tyres will settle out far more readily than other microplastic types.

**Table 7. Annual micro-plastics emissions to surface waters from the EU (+Norway and Switzerland)**

| Source | Upper (tonnes) | Midpoint | Lower (tonnes) | Source Data Year |
|---|---|---|---|---|
| **Automotive Tyres** | 136,000 | 94,000 | 52,000 | 2012 |
| **Pellets** | 91,000 | 47,000 | 3,000 | 2015 |
| **Washing of Clothing** | 23,000 | 13,000 | 4,000 | 2016 |
| **Road Markings** | 21,000 | 15,000 | 10,000 | 2015 |
| **Building Paint** | 8,000 | 5,000 | 2,000 | 2013 |
| **Fishing Gear** | 9,000 | 5,000 | 1,000 | 2015 |
| **Automotive Brakes** | 5,000 | 2,000 | 100 | 2012 |
| **Artificial Turf** | 3,000 | 2,000 | 300 | 2012 |
| **Marine Paint** | 400 | 400 | 400 | 2013 |
| **Leave on PCP** | 526 | - | 86 | - |
| **Fertilisers** | 400 | - | 85 | - |
| **Rinse off PCP** | 373 | - | 114 | - |
| **Building Paint** | 141 | - | 0.40 | - |
| **Detergents** | 94 | - | 30 | - |
| **Total** | 300,000 | | 72,500 | |
| **Note**: Data for the calculation of emissions comes from different years for each emission source. The results are normalised to 2017 for the baseline calculations using the midpoint. All Figures except for those from 'intentionally added' products (highlighted in red) are rounded therefore totals may not add up | | | | |

Some companies have already taken measures to phase out progressively the use of certain microbeads in some of their products.

### *Impacts on the environment and human health*

As a specific category of plastic litter, micro-plastics are of particular concern due to the negative effects on both marine and freshwater environments, aquatic life, biodiversity, and possibly to human health. Their small size facilitates uptake and bioaccumulation by organisms, causing physical effects, such as reduced nutrition, or toxic effects from the complex mixture of chemicals these particles consist of.

A recent study[218] confirmed the evidence for a potential risk to organisms from the toxic and physical effects linked to the exposure to micro-plastics. The study concluded that a potential risk to the environment may arise from the presence of microplastic particles used in the

[218] Intentionally added microplastics in products; Final Report October 2017; Amec Foster Wheeler Environment

production of various products for consumer and professional use that get into the aquatic environment, and that these risks need to be addressed on a Union wide basis.

### *Closing the knowledge gaps*

Whether micro-plastics are intentionally added in products or generated during the lifecycle of products containing plastics as a result of their fragmentation and abrasion, the Commission is working on gathering evidence, closing the knowledge gaps and assessing the most appropriate measures to be taken.

The Commission is aware of several recent publications that traced micro-plastics ubiquity and detected particles even in drinking water. According to a study carried out by Orb Media[219], having analysed the scores of tap water samples from more than a dozen nations, in Europe with at least 72 % of the samples were contaminated with plastic fibres. Although micro-plastics are not a parameter listed in the Drinking Water Directive 98/83/EC, Member States have to take all actions to ensure that drinking water does not pose a risk to human health. It is therefore for the Member State to decide on appropriate actions to be taken, in light of the precautionary principle if relevant. As the pathways into drinking water and possible health effects through drinking water are not well known, further information on their existence in source water should be gathered i.e. by hazard assessments of abstraction zones.

The same logic should apply to food. The Commission's Food Safety policy is to ensure a high level of protection of human health. As a result, possible adverse health effects from the potential presence of micro-plastics in the food chain should also be examined.

### *Actions taken by the industry, at Member States level and worldwide*

Micro-plastics are generated across all Member States and worldwide by a variety of sources. In the EU once in the aquatic environment, there is clear potential for movement between Member States. Once emitted into a watercourse, for example, they can easily end up in another Member State to the extent that the marine environment is a shared resource in respect of fisheries, plastics pollution from one Member State may end up in seafood that will be consumed in another Member State. Pollution of the marine environment by plastic waste and micro-plastics exhibits therefore cross-border effects and is a transboundary environmental issue. Accordingly, action taken by an individual Member State would not be sufficient to deal with the problem on its territory due to these 'spill over' effects.

Bans on the use of microbeads[220] in specific rinse-off personal care products and cosmetics are in place in the US and Canada and are considered also in Australia and New Zealand. In the EU, France, Sweden and UK have notified to the Commission draft laws to ban micro-plastics/microbeads in certain rinse-off cosmetics, while Ireland and Italy are considering similar measures. Belgium notified in October 2017 a sector agreement for the gradual removal of microbeads from a series of consumer products.

Further to restrictions or bans, measures concerning the design of products (such as standards for tyres, clothes washing, washing machines, waste water treatment and filter systems) are

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[219] Risk Assessment and socio economic analyses: 'Intentionally added micro-plastics in products' - August 2017

[220] synthetic, solid plastic particles used for exfoliating and cleansing

better taken at EU level thus facilitating, instead of impeding the free movement of goods and the proliferation of trade flows. The sources of the micro-plastics for which policy options (see below) are developed are traded internationally e.g. tyres and clothing. Nationally developed and implemented standards and other type of actions would be an obstacle to the free movement of goods within the Union and would have an impact on the development of the single market.

Looking at the global dimension, measures intended to curb plastic littering and micro-plastics releases into the environment shall be taken at the EU level will give a competitive advantage for the industry while consolidating at the political and diplomatic front its environmental leadership.

**Box 5. Voluntary commitments by the industry to phase out certain types of microbeads in some cosmetics and detergents**

International cosmetic manufacturers have eliminated or are moving to eliminate microbeads in their products.

- Unilever, Beiersdorf AG and Colgate-Palmolive declare themselves microbead-free. Others including, Johnson & Johnson, L'Oréal and Procter & Gamble have announced their plans to remove microbeads globally by 2017.
- Clarins, Clearasil and Ella Baché have pledged to rid their body and facial scrub products of plastic microbeads.
- Tesco has asked its suppliers in the UK to remove microbeads. UK retailers Superdrug and Boots order firms to ban the toxic beads.
- Supermarket chain Aldi announced that plastic microbeads will be removed from its personal care products by 2017.
- Coles and Woolworths (Australia's two biggest supermarket chains) promised to stop using microbeads in their own products from 2017. The voluntary phase-out by industry is supported by state-level environment ministers. This follows the intention of the federal government to implement a ban on plastic microbeads in 2018, if it is clear by 1 July 2017 that the voluntary phase-out will not be effective.

Cosmetics Europe recommended to its membership to discontinue, in wash-off cosmetic and personal care products placed on the market as of 2020: the use of synthetic, solid plastic particles used for exfoliating and cleansing (i.e. microbeads) that are non-biodegradable in the marine environment. Cosmetics Europe survey shows an 82% reduction in use of plastic microbeads in those products.

Microbeads are in some cases added in detergents and maintenance products. The industry has pointed out that the trend in the use of micro-plastics is clearly decreasing as a number of companies have already announced their intention to invest in the reformulation of their products, considering the use of alternatives where available.

### 4.4.2 Actions to be taken

Several EU policies and instruments (e.g. eco-design, chemicals (REACH), waste management, waste water treatment, marine environment protection, air quality legislation, industrial emissions legislation) regulate or could intervene regarding the generation and release of micro-plastics into the environment, but there is no specific EU instrument regulating their intentional use in products or aiming to limit/minimise their generation or mitigate the impacts from their presence in the environment.

The Commission also considers that given the wide and, to date, uncontrollable dissemination of micro-plastics and the scientific evidence, albeit inconclusive, pointing to a serious risk of harm to the aquatic environment and the human health, the precautionary principle could be considered and might provide a valid basis for restrictions of the use of micro-plastics.

Measures for micro-plastics should be examined in a comprehensive way so that all sources of micro-plastics will be addressed in the light of their demonstrated impacts independently from their origin.

Measures taken at the EU level would provide a clear answer to public concerns, help to prevent uncontrollable environmental and human health impacts, but also contribute to avoid fragmentation of the EU internal market. On the other hand, the effort (financial, research, etc.) invested in innovating and substituting micro-plastics in products could provide a competitive advantage to EU economic stakeholders on an issue which is high in the international environmental and socioeconomic agenda.

The proposed options present a stepwise approach and are proportional to the available knowledge and information supplied by industry (quite limited, in some cases) and integrate voluntary initiatives by industry, where such initiatives are developed enough so as to provide a basis for progress.

### *Unintentional release of micro-plastics*

Preliminary results of the abovementioned ongoing study on micro-plastics generated during products' lifecycles, reveals that automotive tyres, pre-production plastic pellets and washing of clothing could be the sources accounting for the highest quantities of micro-plastics releases to the environment[221]. More research is needed to improve our understanding of the sources and impacts of micro-plastics, including their effects on the environment and health. Based on this improved knowledge, measures could then be envisaged to develop innovative solutions to prevent their dissemination.

Concerning micro-plastics emissions from automotive tyres, options envisaged include development of a harmonised testing standard of tyre tread abrasion to determine the rate at which micro-plastics are release during the use phase of tyres. Several policy options for reducing the release of micro-plastics from tyres will be assessed (e.g. including minimum requirements for tyre design (tyre abrasion and durability if appropriate) and/or information requirements on this issue including if appropriate labelling, methods to assess micro-plastic losses from tyres, targeted research and development funding).

In a similar way, the Commission will consider measures on the release of microfibers from textiles as well as measures to reduce plastic pellet losses[222].

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[221] For example to be included under the Regulation for labelling and marking of the fibre composition of textile products (EU/1007/2011).

[222] including methods to assess micro-plastic losses from textiles, combined with information (including possibly labelling)/minimum requirements, targeted research and development funding

For textiles, options include, in a similar way, development of a test standard to determine in a consistent manner the rate of plastic fibre release from clothing during washing and tumble drying, It will enable a thorough analysis of the issue through well-identified criterion and the identification of the most suitable and appropriate measures to tackle the release. On the basis of the results of this analysis, other options could also be explored, such as the development of a label for fibre release from clothing[223]. Before starting to reflect on an eventual Maximum Threshold for Fibre Release, one must ensure that there is sound evidence and reliable data regarding amounts of plastic microfibers emitted in the environment, pathways, and their fate in the environment, the overall magnitude of the issue and the availability of effective tools to tackle it.

For pellet losses, options envisaged include the work on elaboration of new Best Available Technics (BAT) in respect of preventing pellet loss (eventually on the basis of Clean Sweep guidance) and to be implemented by all polymer producers in Europe. BAT would be subject to regulation and potential enforcement action as per other aspects of their Environmental Permit, through activities at EU and MS level on amendment and implementation of relevant BREFs under the Industrial Emission Directive (IED) [224]. A regulation specifically covering the transport of pellets from and to facilities aiming to avoid losses through the use of best practice standards, again derived from expert knowledge, and further developing the approaches already pioneered by industry via Operation Clean Sweep could be another way forward. Other options are regulatory initiatives requiring Supply Chain Accreditation of Adherence to Best Practice, requiring those placing plastics on the market (large businesses in the first instance) to ensure their entire supply chain demonstrates best practice in the prevention of pellet loss, regulatory initiatives on plastic converters not covered by the BREFs to implement best practice measures to prevent pellet loss.

Extended producer responsibility schemes can also be envisaged, where relevant, to cover the cost of remedial action.

Finally, the development of a test standard for the quantification (both in mass and number) of the micro-plastics in the influent, effluent and sludge output of wastewater treatment plants seems a necessary basis for more subsequent measures such as the development of a new EPR scheme. It could be designed in a way that the sources predominantly responsible for micro-plastics in waste water treatment cover the costs of remedial action to increase micro-plastics capture. The feasibility and cost-benefit assessment is however needed. Further measures could follow in the context of a future review of the Urban Waste Water Treatment (UWWT) Directive.

For other sources of micro-plastics unintentionally released during the life cycle of products where the lack of data makes the development of policy options impossible at this stage, such as paints, road markings and fishing gear, the knowledge gaps and the need for specific research need to be fully understood and described so as to develop appropriate measures.

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223 possibly with a new Regulation in line with the Ecodesign Directive (2009/125/EC)

224 Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control)

It should be noted that more accurate estimations about the expected impacts of the abovementioned options will be available when the related ongoing study is concluded.

Extended producer responsibility schemes can also be envisaged, where relevant, to cover the cost of remedial action.

Micro-plastics need to be monitored in drinking water, where their impact on human health is still unknown, and the Commission proposal on the review of the Drinking Water Directive[225] includes a provision on such monitoring.

### *Intentionally added micro-plastics*

There is an urgent need to address the problem of intentionally added micro plastics as these add unnecessarily to the overall high load of micro-plastics resulting from degradation and abrasion of macro-plastic entering the marine environment every year, a considerable proportion of which turns into micro-plastics.

The need to address intentionally added micro plastics is acerbated by the fact that different Member States have already started a process of banning micro-plastics/microbeads in rinse-off personal care products and cosmetics have notified the Commission thereof. It is therefore necessary to avoid a situation in which the Commission might be forced to open infringement proceedings or where an increasing market fragmentation would put the internal market in jeopardy.

There are several options to address this problem:

1. Setting up of a dedicated legal instrument banning micro-plastics in products.
2. Using REACH as an instrument to restrict the use of micro-plastics in products, regardless of the polymer type as long as water insoluble polymers of a size up to 5 mm are concerned.
3. The phasing out on voluntary basis.

To this end and considering the above the Commission has asked to ECHA to prepare an Annex XV dossier with the view to restrict the intentional use of micro-plastics particles to consumer or professional use products of any kind under REACH. Should a restriction be the result of ECHA's investigation in preparation of the Annex XV dossier, micro-plastics of the said nature could no longer be added from the time of entry into force of respective act.

The potential restriction of micro plastics in products is proportional and does not go beyond what needs to be done in order to control the risk from uncontrolled release of micro-plastics to the aquatic environment. There are no other less intrusive measures at hand allowing an adequate risk control. In particular is it not sufficient to build only on voluntary action, because such action would not be binding for all actors on the market.

[225] http://ec.europa.eu/environment/water/water-drink/review_en.html

# 5 Driving investment and innovation towards circular solutions

## 5.1 Issues at stake

Reaching most of the objectives and actions that are described throughout the document will require innovation and research and therefore major additional investments. In several areas knowledge gaps must be closed e.g. micro-plastics release in the environment and the impact on human health. Innovation shall also be supported in order to reach the EU circular economy goals, to provide smart and sustainable alternatives to consumers and business and to fulfil other commitments such as those linked to $CO_2$ emissions and climate change. It will also contribute to improving the quality of plastic waste for recycling (e.g. developing a technology for markers and tracers in polymers) or to scale up and develop recycling technologies (e.g. chemical recycling) where proven beneficial for the environment and climate.

However and in order to achieve this goal, it is required to implement EU funding and investment approaches supporting specific innovation, industrialisation and policy needs.

### 5.1.1 Support the necessary investments

Investing in new technologies, products or production processes is risky and costly. It risky since the profitability and take-up of innovations is inherently tied to unpredictable events. It is costly since it often requires external financial resources (banks, venture capitalists), it generates opportunity costs and often requires radical reorganisation of the value chain. When the risks and/or the (opportunity) costs are relevant, there might be scope for policy intervention. In the case plastic, there is evidence that both risks and opportunity costs are an important detrimental factor in terms of incentives to invest in innovation. **Error! Reference source not found.** summarises the most relevant obstacles hampering investments.

**Table 8. Examples of obstacles identified hindering the shift towards more circular plastics**

| | NATURE OF OBSTACLES | EXAMPLES |
|---|---|---|
| **RAW MATERIAL PRODUCTION PHASE** | **Technological constraints** | For secondary raw materials, new recycling technologies currently under development (e.g. chemical recycling) |
| | **Economic factors** | Fossil plastic raw materials are cheaper than recycled plastics of the same quality and availability (volumes and quality) is certain |
| | **Behavioural factors** | Uncertainty about the uptake of the recycled plastics |
| | | Misgivings about the quality and safety of recycled plastics |
| | | Lack of dialogue across the value chain (e.g. design for recyclability) |
| | **Legal barriers** | Legal uncertainty in the absence of end of life criteria for plastic waste |
| | **Lack or insufficiency of infrastructure** | Separate collection and sorting to be reinforced and upgraded |
| **MANUFACTURING OF** | **Technological constraints** | Traceability of recycled plastics (origin, |

| | | |
|---|---|---|
| **PLASTIC ARTICLES AND PRODUCTS PHASE** | | presence of hazardous substances, possible future uses) |
| | **Economic factors** | Investments needed to switch from linear to more circular model |
| | | Non-existent alternatives of substitution (e.g. substances; materials) |
| | **Behavioural factors** | No real incentives to take circularity of plastics into account |
| | **Legal barriers** | Responsibility to provide safe and fit for purpose materials |
| | | Regulatory framework is not clear (e.g. Interface CWP) or necessarily sets restrictions (food contact materials) |
| | **Lack or insufficiency of infrastructure** | Infrastructure to be upgraded to take up new challenges (e.g. increased and improved plastic waste recycling) or with a lot of blind spots (e.g. filters waste water treatment plants microfibers from textiles or microbeads) |
| **USE PHASE** | **Economic factors** | Price is a key factor for both businesses and consumers |
| | **Behavioural factors** | Choices are often based on the price of products, on aesthetical reasons or functionality/performance of a product rather than on the "circularity" of it |
| | **Lack or insufficiency of infrastructure** | Littering and inappropriate disposal of waste is sometimes due to insufficient public waste management infrastructure (e.g. lack of bins in often crowded places or during public events) |
| **END OF LIFE** | **Economic factors** | Volumes for some plastic waste streams are currently too low (e.g. demolition waste)<br>Recycling is costly but the market prices are not taking into account the environmental benefits |
| | **Behavioural factors** | Current design of products is not taking into account end of life |
| | **Legal barriers** | Recycling targets are not high enough<br>The interaction between health, safety, trade and environmental regulation create a too complex, always evolving and burdensome |
| | **Lack or insufficiency of infrastructure** | Collection schemes do not exist for every type of plastics or are organised on voluntary basis in some countries (e.g. plastic mulches) |
| | **Knowledge and information gaps, lack of dialogue, misgivings and misunderstandings that prevent taking actions** | Lack of reliable data and scientific based evidence for some issues (e.g. microfibers, microplastics) |

In general, the complexity and the number of the value chains involving plastic can be considered as one of the most important obstacles for investments. A more efficient organisation of the value chains, taking into account circularity objective, is a precondition to generate an ecosystem conducive of more investments. Coordination is essential to avoid duplication of infrastructures and processes and to channel limited resources where they are needed the most, as for instance to develop innovative sorting technologies such as tracers. However, coordination is costly and there might be strong incentives to free ride on the initiatives of other firms.

An additional issue is related to the potential limited profitability of investments due to the risk of limited take up of innovative secondary materials. According to the stakeholder consulted in the last months the demand for secondary plastic is too low. Weak demand causes weak investments, which in turns contribute to keep demand low. This is mostly due to the fact that prices of secondary plastics are often relatively high compared to virgin feedstock. Moreover, the quality of secondary plastics is often perceived as insufficient.

Finally, the outcome of innovation effort is difficult to predict – and hence risky - not only in terms of the quality of innovation, but also in terms of timing. In the case of plastic, for some particular polymers, there are no adequate technologies available that would allow for full circularity. Investing today in R&D to develop such technologies might bring to significant results only in some years. Deploy the innovations to the market might require additional time. This increases substantially the investment risk, especially when lacking strong demand and/or adequate regulatory framework.

It is very hard to estimate the size of the investment gap. For instance, for France, 2ACR estimates a profitability gap in the range of 120 million EUR (over a 5 year period) needed to achieve a 50% increase in the uptake of secondary plastics[226]. This figure suggests that substantial investment might be needed.

The issues identified above are of concern for a number of different types of innovations that would be required to attain a real circular economy for plastic: innovative and smart design, upgraded waste management infrastructure, traceability of materials and substances, emissions of micro-plastics in the environment etc.

Important investments are needed, but because of the current market conditions, and since producers and users of plastic fail to internalize the environmental costs of their products such investment are unlikely to materialise spontaneously.

### 5.1.2 EPR fee modulation and more transparency

Extended Producer Responsibility (EPR) is defined as "an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a

[226] 2ACR (2017), Developing the circular economy in Europe through the "Economy of resources", Proposal for experimentation with "plastics", policy note circulated by 2ACR; or Faisabilité de mécanismes de sécurisation du modèle économique des filières du recyclage: application aux plastiques et élastomères, Ministere de l'Économie et des Finances, République Française, 2017. The figure refers to only few plastic types, namely packaging, WEEE, agricultural plastic and PVC window frames.

product's life cycle"[227]. There are a variety of EPR policy measures and instruments that aim to shift the negative environmental externalities of products from taxpayers to producers and to incentivise producers to take environmental considerations into account at the product design phase.

Such measures can also take the form of EPR schemes whereby producers are made responsible for the financing and organisation of the waste management of their end-of-life products. The objectives of such EPR schemes are to

- relieve public authorities (partially) of the cost of managing a specific waste stream, transferring the financial burden from taxpayers to consumers,
- internalise the cost of end-of-life management of a product in the price of new products, thus providing an incentive for ecodesign approach and
- ensure effective and environmentally sound collection and treatment of that waste stream.

By internalising costs and establishing a well-designed fee system, EPR can encourage a change in behaviour of relevant actors involved in the product value chain from plastic manufacturers to consumers and recyclers. Design for reuse and for recycling and more sustainable products are awarded.

Targeted and meaningful fee differentiation allows rewarding or penalizing the producers regarding design-related factors that have an impact on the end-of-life performance (reusability, dismantlability, recyclability…). For products containing plastic or made of plastic, fees have therefore a potential to be an effective instrument in promoting better product design, labelling, improved collection and treatment of waste in line with the waste hierarchy and more resource efficient use of plastic. Differentiated product fees with a notable economic impact have been identified as being capable of bringing a real change in practices and product design although it is too early to establish a generalised appreciation of such an impact. There are some limitations to the scope of this principle. Fee modulation may not be feasible or possible for all materials or design practices for numerous reasons such as the availability of waste management infrastructure and the technical feasibility of an alternative design fit for purpose or substitution of certain materials.

It is to be noted that the existing EPR schemes, including for packaging, already provide for some fee modulation based on simple criteria such as type, material or weight of packaging.

### 5.1.3 Deposit return schemes (DRS)

DRS are based on additional fees on some products, which have to be paid by the consumer at the sales point of a given item in the form of a deposit. The deposit fee is returned to the consumer when bringing back the item. Most deposit schemes have been set up for packaging waste, especially for drinking bottles, but also for transport packaging (boxes and pallets). They are usually established at national level, although there are some deposit systems with a regional or local scope. In the case of packaging, the fee is usually determined by the packaging material and the container size and is indicated via a label on the packaging.

[227] Source RELOOP: http://www.cmconsultinginc.com/wp-content/uploads/2017/10/Fact-Sheet-Economic-Impacts-to-Municis-New.pdf

Deposit schemes provide an economic incentive to waste holders to bring their waste back to return points. This ensures usually high return rates (above 95% or more in Germany and the Netherlands) and are thus an effective means to combat littering. In addition, the items that are returned are clean sorted fractions with very little contamination, and are therefore perfectly suitable for their reuse or recycling. The best documented case is the introduction of DRS for beverage containers, where the littering reduction potential usually exceeds 80% and the recycling levels for the beverage containers covered by the scheme attain 90-98%[228].

**Table 9. Total return rate of deposit schemes in the EU[229], [230]**

| Country | Data year | Total return rate |
|---|---|---|
| **Croatia** | 2015 | Up to 90% |
| **Denmark** | 2014 | 89% |
| **Estonia** | 2014 | 78,6% |
| **Finland** | 2014 | 92,6% |
| **Germany** | 2014 | 97% |
| **Lithuania** | 2016 | 74% |
| **Netherlands** | 2014 | 95% |
| **Sweden** | 2014 | 88,25% |

DRS can be applied to a number of waste streams. They usually are effective in achieving a massive reduction of littering and in increasing recycling to very high levels. In addition, DRS provide an excellent basis for reuse of these materials (as is the case e.g. for refillable bottles in Germany), which generally constitutes a better option from an environmental point of view than recycling, as in line with the waste hierarchy.

The level and the structure of the costs will depend on a number of social and geographical factors of the area, the initial situation as regards the framework for collection and recycling of this waste stream, as well as the types of beverage containers covered by the DRS. DRS are usually financed by unclaimed deposits (i.e. bottles which the consumers forget to return or are disposed of via conventional collection schemes) and result in net savings for municipalities. Several studies[231] reported significant net cost savings from the municipalities that implemented DRS resulting from the reduced or avoided costs of collection, treatment, and disposal by the municipal waste management systems. However, DRS may result in additional costs to producers[232] as the level of the fees usually exceeds the level of the fees in the previously existing EPR scheme.

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228 Technical, environmental and economic viability study of the implementation of a deposit refund scheme (DRS) for single-use beverage in Catalonia, 2017

229 Source Reloop: http://www.cmconsultinginc.com/wp-content/uploads/2017/09/Fact-Sheet-Performance-New2.pdf

230 Waste Framework Directive, Article 8.1

231 Technical, environmental and economic viability study of the implementation of a deposit refund scheme (DRS) for single-use beverage in Catalonia, 2017

232 In the case of the planned DRS for Catalonia, the net savings for municipalities are projected to amount to €14.9 million (approx. 2 € per inhabitant)232. This is expected to result in additional costs to producers

### 5.1.4 Innovation for more circularity

The plastics industry is highly important for the European economy, and it is also faced with critical environmental and health challenges at European and global levels. Increasing its 'circularity' can bring new opportunities for innovation, competitiveness and job creation. Plastic materials can also help us address a number of future sustainability challenges. Rethinking and improving the functioning of such a complex value chain requires efforts and greater cooperation by all its key players, from the plastic production industry to recyclers. It also requires innovation and a common vision to drive investments in the right direction. These are the primary goals of this strategy.

### 5.1.5 Specific actions to diversify the feedstock

More than 90% of plastics today are produced from fossil feedstock and plastics production gives rise to approximately 400 million tonnes of GHG emissions per year globally (2012)[233]. If current trends continue, by 2050 it could rise to 20% of global oil consumption and 15% of the global annual carbon emissions.

Oil and natural gas are the main feedstocks and the EU has a dependency on foreign suppliers while alternative feedstock is available domestically. The Plastic Strategy covers issues such as shifting from fossil feedstock to alternative feedstock[234], more sustainable production ways (e.g. industrial symbiosis, resource efficiency), more sustainable ways of producing plastic articles (e.g. new designs, longer life, easy to recycle, biodegradability) and more sustainable consumption and use of plastics. In the long-term, plastics production must be decoupled from fossil feedstock and reduce life-cycle GHG impacts. There is therefore room for reducing $CO_2$ footprint of plastics consumed in the EU.

Plastic materials can indeed alternatively be manufactured from bio-mass, from plastic wastes and from organic waste and residues as well as from effluent gases (e.g. $CO_2$). Alternative feedstock is however currently facing serious competitive pressure due, among others, to the low oil prices and lack of level playing field as certain externalities are not considered. There are not enough incentives to diversify feedstock used in plastic products or products containing plastics manufacturing and their environmental impacts still need to be better assessed and compared with plastic production from fossil feedstock.

## 5.2 Existing EU measures

### 5.2.1 Supporting the necessary investments

***Structural funds to recycling***

The Europe 2020 strategy[235] is the EU's Agenda for growth and jobs. The aim is to turn the EU into a smart, sustainable and inclusive economy delivering high levels of employment,

worth €8.3 million (or €1.1 per inhabitant). Additional costs appear to be very low and justifiable in view of the achievable environmental and resource efficiency benefits. Source Reloop http://www.cmconsultinginc.com/wp-content/uploads/2017/09/Fact-Sheet-Performance-New2.pdf

233 Roadmap "Strategy on Plastics in a Circular Economy"; 26 January 2017

234 COM(2015) 614. Closing the loop – An EU action plan for the circular economy

235 Europe 2020 A Strategy for smart, sustainable and inclusive growth; COM/2010/2020 final

productivity and social cohesion. One of the Strategy's priorities is to promote more resource efficient, greener and more competitive economy. To this regard, it is complementary to the Circular Economy Action Plan and the Plastics Strategy as one of its key deliverables. The European Structural and Investment Funds (ESI Funds) are part of the instruments that can be used to achieve the Circular Economy objectives in terms of smart, sustainable and inclusive growth in Member States and regions, in particular in the context of cohesion policy.

The five ESI Funds work together to support economic development across all EU countries, in line with the objectives of the Europe 2020 strategy:

1. European Regional Development Fund (ERDF);
2. European Social fund (ESF);
3. Cohesion Fund (CF);
4. European Agricultural Fund for Rural Development (EAFRD); and
5. European Maritime and Fisheries Fund (EMFF).

When it comes to improved waste management, including recycling, funding comes mainly from ERDF and CF (see examples of already funded projects relating to plastics in ANNEX). It supports investments in innovation, constructing new and upgrading existing infrastructure, increasing recycling capacity of usually non recycled plastics and promoting cooperation, and other priorities as specified in national and regional programs. For 2014-2020 period, Member States have allocated a total of EUR 36 billion of EU co-financing from these two funds to environment and resource efficiency budget, and EUR 41 billion to research and innovation. Part of it is to be used to finance additional waste recycling capacity of 5.79 million tonnes / year (overall and per Member State)[236].

### *European Fund for Strategic Investments (EFSI)*

The European Fund for Strategic Investments (EFSI) is an initiative to help overcome the current investment gap in the EU. Jointly launched by the European Investment Bank (EIB) Group and the European Commission, it aims to mobilise private investment in projects which are strategically important for the EU.

The EIB has been a natural financing partner for the EU institutions since 1958. It helps to catalyse investments. In order to do so, it offers loans, guarantees, equity participation and blending and advising measures. Generally speaking, a project may be given support if it is considered sound and sustainable. In order to assess its suitability, a project appraisal is conducted wherein all relevant factors, i.e. financial, economic, social, environmental, technical, are examined. 2015 an informal meeting concerning plastics was organised with the plastics value chain and the EIB.

Overall, the EFSI is expected to facilitate additional investments at a level of 315 billion euros within Europe. There is a wide eligibility criterion for sectors which are candidate for the supporting measures by the EIB and which need to be verified by the EIB. One special objective, in the area of sustainability, is the development and modernisation of the energy sector, renewable energy, security of energy supply and resource efficiency. EIB recognised that

[236] https://cohesiondata.ec.europa.eu/overview

recycling of plastic materials falls under the scope of the eligibility criterion. These EFSI and EIB measures are meant to support SMEs (below 250 employees) or MidCaps (below 3000 employees), public sector entities and corporations of all sizes. Besides recycling capacities to be built (as explained above, approximately 250 new sorting plants and 300 recycling plants costing approximately 8.4-16.6 billion euros by 2020), EIB was also informed of several EU companies' investment projects amounting to approximately 381 million euros in these sectors, including plastics and recycling.

#### *Circular Economy Finance Support Platform*

Taking into account that the transition to a Circular Economy will need innovative business models, and financing instruments, the Commission, together with the European Investment Bank, launched in January 2017 the Circular Economy Finance Support Platform, inviting key stakeholders such as national promotional banks.

### 5.2.2 Enhancing Public Procurement and Ecolabel

One of the instruments to create a supportive economic framework for businesses and to move towards more circular plastics is public procurement. The Communication "Making Public Procurement work in and for Europe"[237] that was published in October, aims to "encouraging the use of innovative, green and social criteria" to make the most out of public procurement. A guidance document on innovation procurement will be provided in 2018 and could include topics such as plastic recycling and recycled content. The EU Ecolabel and Green Public Procurement (GPP) can contribute to different goals of the Plastics Strategy, covering also the challenges of plastic waste littering and more sustainable use of resources.

**Table 10. EU Ecolabel and Green Public Procurement contribution to the Plastics Strategy**

| | |
|---|---|
| **Improve recyclability** | In several EU Ecolabel and GPP product groups where products are likely to contain a substantial amount of plastics, the criteria are requiring the marking of bigger plastic parts so that, at the end of its useful life, sorting of plastics is easier. A criterion on design of plastic packaging to facilitate effective recycling by avoiding potential contaminants and incompatible materials that are known to impede separation or reprocessing or to reduce the quality of recyclate can be found in EU Ecolabel criteria for Rinse-off cosmetics and in all 6 criteria sets for Detergents. Both in EU Ecolabel and GPP and for some product groups, criteria for design for easy disassembly of different components (e.g. furniture or computers) can be included in order to facilitate recycling. With the same aim, specific hazardous substances are restricted from plastic components of some product groups. |
| **Avoid single-use items** | In several product groups, the criteria are promoting reusable items:<br>In the Food and catering criteria for GPP, public authorities should give preference to reusable cutlery, glassware, crockery and tablecloths in order to avoid plastic (and other) waste, as well as require the contractor to provide tap water in order to avoid the use of bottled water.<br>In EU Ecolabel Tourism services no single dose packages for non-perishable food stuffs (e.g. coffee, sugar, chocolate powder (except tea bags)) shall be used for food services; disposable toiletries items (shower caps, brushes, nail files, shampoos, soaps etc.) are not allowed except in certain cases; disposable food service items (crockery, cutlery, and |

[237] COM/2017/0572 final

| | |
|---|---|
| | water jugs) shall not be available to guests in rooms and restaurant/bar service unless the applicant has an agreement with a recycler for such items.<br>Refillable and proportionate-to-its-content packaging is promoted in EU Ecolabel criteria for Rinse-off cosmetics and in all 6 criteria sets for Detergents through the Weight/utility ratio formula that product packaging has to comply with. The "Packaging Impact Ratio" used in Rinse-off cosmetics ensures that the products have a proportionate to their content use of plastic packaging. Furthermore, superfluous secondary packaging is not allowed. |
| **Recycled Content (RC)** | There is not yet a systematic approach to push for RC in plastics in EU GPP or Ecolabel products. EU Ecolabel criteria for Textiles, Computers and Furniture and GPP criteria for Textiles have made the first attempt, recently included requirements on this. Moreover recycled materials in packaging are promoted in EU Ecolabel criteria for rinse-off cosmetics, and in all 6 criteria sets for Detergents and Footwear. However, the reliability of the verification can be improved; in the case of Computers and Furniture the average content claims can be calculated on periodic or annual basis for the model, something that might not be possible in the case of GPP criteria for legal reasons.<br>EU GPP criteria have, in recent years, abstained from such requirements for Computers and Furniture, because of verification issues (so does Ecodesign). The mandatory Italian GPP law sets requirements for a minimum amount of recycled content in some products, such as street furniture, packaging of cleaning products, materials for buildings construction. According to the Italian experience, from a functionality point of view, it is in most cases possible to ask for a recycled content up to 30% without observing decreases in functionality levels, while exceeding this threshold generally leads to a reduction in the strength of the material. |
| **Micro-plastics** | Micro-plastics are banned in EU Ecolabel Rinse-off cosmetics and Detergents |
| **Littering** | In EU Ecolabel Tourism Accommodations and indoor cleaning services criteria there is a requirement on Waste sorting and sending for recycling. Under the Plastics Strategy, this approach will continue wherever relevant. |

### 5.2.3 The Commission proposal to introduce minimum requirements and providing a possibility for fee modulation for EPR schemes

Mandatory EPR schemes are established in EU legislation for end-of life vehicles (Directive 2000/53/EC), for waste electrical and electronic equipment (Directive 2012/19/EU) and batteries and waste batteries (Directive 2006/66/EC). Most Member States have established EPR schemes for packaging in support of the implementation of the packaging and packaging waste Directive (Directive 94/62/EC), even if this is not required by the Directive. In the EU, Member States have set up more than 200 schemes covering these and other products, such as expired medicines, lubricants, pharmaceuticals, tyres, chemicals, agricultural foil etc.

The Waste Framework Directive (Art. 8) lays down some general principles for the implementation of EPR. This directive is currently under review with the objective to introduce minimum requirements for EPR schemes to improve their governance, transparency, cost-efficiency and a level playing among the different schemes across the EU.

One of the minimum requirements proposed by the Commission is to introduce an obligation on the Member States to ensure that the fees paid by the producers fulfilling their EPR obligation are modulated based on the product’s environmental impact. Such 'modulated fees' hence take into account the actual end-of-life costs of individual products or groups of products, in particular, by taking into account their recyclability and re-usability. These minimum requirements on fee modulation would also apply to WEEE, ELV and batteries where EPR is obligatory under EU legislation, and some MS have already applied it even if not required specifically (e.g. France on electronics, packaging and printed paper). Also, existing EPR schemes, including for packaging, already provide for some fee modulation based on simple criteria such as type, material or weight of packaging.

Targeted and meaningful fee differentiation allows rewarding or penalizing the producers regarding design-related factors that have an impact on the end-of-life performance (reusability, dismantlability, recyclability…). For products containing plastic or made of plastic, fees have therefore a potential to be an effective instrument in promoting better product design, labelling, improved collection and treatment of waste in line with the waste hierarchy and more resource efficient use of plastic. Differentiated product fees with a notable economic impact have been identified as being capable of bringing a real change in practices and product design although it is too early to establish a generalised appreciation of such an impact. There are some limitations to the scope of this principle. Fee modulation may not be feasible or possible for all materials or design practices for numerous reasons such as the availability of waste management infrastructure and the technical feasibility of an alternative design fit for purpose or substitution of certain materials.

It is to be noted that the existing EPR schemes, including for packaging, already provide for some fee modulation based on simple criteria such as type, material or weight of packaging.

One of the minimum requirements proposed by the Commission is to introduce an obligation for the Member States to ensure that the EPR fees paid by the producers are modulated accordingly to the product's environmental impact. Such 'modulated fees' hence take into account in principle the real end-of-life costs of individual products or groups of products, in particular, by taking into account their recyclability and re-usability. These minimum requirements on fee modulation would also apply to WEEE, ELV and batteries i.e. where EPR is obligatory under EU legislation, as well as some MS have already applied it even if not required specifically (e.g. France on electronics, packaging and printed paper.

By internalising costs and establishing a well-designed fee system, EPR can encourage a change in behaviour of relevant actors involved in the product value chain from plastic manufacturers to consumers and recyclers. Design for reuse and for recycling and more sustainable products are awarded.

A variety of practices on fee modulation are already available in the EU and the Commission can assist Member States by facilitating the exchange of best practices and by developing guidelines. For instance, feedback from 'eco-modulation of fees' as applied in France in the implementation of EPR under the WEEE Directive[238] has also pointed to factors of success. Amongst these factors the setting of eco-modulated criteria in a process that involves public authorities, producers as well as non-governmental consumer and environment organisations.

[238] The French Eco–modulation on electric equipment was updated in July 2015; now comprising 17 product types : fridge, freezer, washing machine, dishwasher, vacuum cleaner, coffee machine, kettle, tea machine, computer, notebooks, tablet, printer, phone, drilling machine, screwer, games console, lamps).

The necessity for the approach and criteria to apply it at the EU level to become fully effective was also identified as a key element. Moreover, in the case of electronics, modulated fees also have the potential to support design changes for products for a global market.

In addition, In its proposed waste review, the Commission has emphasised the use of economic instruments to prioritise waste prevention and recycling at national level. For instance, high or gradually rising fees or taxes on landfilling and incineration could improve the economics of plastic recycling by clearly internalising the environmental costs of alternatives.

### 5.2.4 Deposit-return schemes (DRS)

Such schemes already exist across the EU and are regulated under national laws. Successful and efficient deposit systems require a careful planning, especially as regards information of consumers and logistics. Guidance on aspects to be taken into account when planning a DRS for packaging is provided in Communication 2009/C 107/01.

These schemes can be part of EPR schemes or complement them. DRS can increase the quantity and quality of plastic waste collected and reduce litter. Therefore, the Commission recommends Member States to introduce DRS for waste types that have either a high polluting potential (e.g. fishing gear and agricultural plastics) or are managed in a sub-optimal way (low separate collection rates), which does not allow exploiting the recycling potential of that waste (e.g. plastic packaging in some Member States).

## 5.3 Actions to be taken

### 5.3.1 Guidance on EPR fee modulation

Hence, to ensure that EPR schemes run smoothly and support investment, including those in plastic recycling, the Commission will provide guidance (or implementing rules)[239] on how to ensure effective modulation of fees paid by the producers, in particular for packaging.

### 5.3.2 Establishment of EPR schemes for a wider plastic product categories

The establishment of EPR schemes for a wider plastic product category and for products containing plastics can lead to improved separate collection and treatment of the respective waste stream. It can lead to improvements in the entire lifecycle of those waste streams that are currently not well managed and for which currently no sufficient incentives exist to enhance their performance.  Therefore, the option to cover more products by EPR schemes including the requirement of modulated fees reflecting different environmental impacts should be considered. This could be envisaged in particular to plastic products such as agricultural plastics and foils, fishing gear, disposable plastic utensils and plastic used in construction, with the aim to cover a wider range of product characteristics that have a negative impact on the product's management at the end-of-life stage.

In particular , in the case of products with a high littering potential (fishing gear, disposable plastic utensils) or in the case of products with a significant environmental impact if left in the nature (agricultural plastics), the EPR should include a deposit return system or a buy-back system to ensure high return rates and reduce significantly the littering.

[239] currently discussed in the co-decision for the waste package

The principle of extended producer responsibility could also be applied to create a private fund for financing investment and innovation aimed at reducing the environmental impact of primary plastic production. This could, for instance, support the uptake of recycled plastics. By mid-2019, the Commission, in cooperation with stakeholders, will analyse the potential design features of such fund, including as regards technological and material neutrality, and will closely examine its technical, economic and legal feasibility.

### 5.3.3 Actions to support innovation and research

#### Innovation for more circularity

In order to achieve this goal, it is required to implement EU funding and investment approaches supporting specific innovation, industrialisation and policy needs. First, research needs through RTD FP9 calls shall address technological failures with a view to increase the actual recycling rate in the EU. This would concern:

- innovative design of plastics for recyclability, novel sorting and recycling techniques, new feedstock (e.g. bio-waste, $CO_2$, microbial biomass) and optimisation of the integration of new materials in the manufacturing process,
- development of new functionalities, including aspects helping to solve end-of-life concerns (new biological or biochemical ways to degrade plastics in purpose-built facilities, using e.g. worms, bacteria or enzymes engineered through synthetic biology), (1) by increasing reusability of plastics, (2) by exploring compostability for relevant applications – where plastic packaging are associated with food or bio-wastes subject to separate collection and industrial composting handling, and where the risks for confusing consumers are minimised – and biodegradability features for applications where leaking in the environment is unavoidable, (3) by increasing recyclability of multi-materials and multi-layer plastics, (4) by minimising the production of micro-plastics, (5) by developing smart traceability tools for plastics and some additives of concern, etc.
- projects regarding (bio)chemical recycling as it could more than double the present recycling rate which is mainly based to mechanical recycling.

Second, these newly found technologies should be transferred to the in-field operators by financing large-scale demonstration projects. This can be done through EU research and innovation funding (Horizon 2020 and the future framework programme), including public-private partnerships, coordinated where appropriate and possible with the European Structural and Investment Funds and National and Regional State Aid, addressing drivers and contributing to eliminate bottlenecks e.g. financial bottlenecks.

The Commission will continue to use the smart specialisation approach to engage industry and research to facilitate investments along the value chain. The approach is based on a bottom-up process within regions and Member States, engaging industry and researchers to identify areas of regional competitiveness. Smart specialisation strategies are a precondition for funding from the ERDF. Several of those strategies include plastics-related innovation priorities. The Commission supports the development of interregional partnerships in all smart specialisation areas.

Furthermore, these large-scale demonstration projects need to be firmly embedded into a systemic approach that also involves the analyses of different local and regional factors. This will enable the materialisation of industrialised manufacturing installations generating growth and jobs.

This will facilitate and flank the plastic secondary raw materials development and the needed standardisation work via pre-and co-normative research and development. Regions and municipalities can benefit from the Commission European Sustainable Chemicals Support Service Initiative in the true alignment with the Smart Specialisation Strategies at national or regional level. The Commission will develop a Strategic Research Innovation Agenda (SRIA) for plastics that will provide orientation for future Research and Innovation funding in the post 2020 period. This agenda will strive to take a holistic approach to address all issues related to plastics production and use, including environmental and human health impacts.

EU research funds will support all these efforts by funding projects that will close the knowledge gap, and develop and demonstrate innovative solutions that will facilitate the implementation of this Strategy. Between 2018 and 2020, the EU Research and Innovation Programme Horizon 2020 will invest more than 200 million Euro in plastics research and innovation, part of which will be provided through the Bio-based Industries Public Private Partnership. By developing a Strategic Research Innovation Agenda for Plastics in 2018, the Commission will analyse research needs which will provide a basis to focus EU R&I funding on in the remaining period of Horizon 2020 and in the post-2020 period. Priority actions under this Strategy are such as the development of smarter and more recyclable plastic materials and products, more efficient recycling processes, removal of hazardous substances and contaminants from recycled plastics, and solutions addressing the problem of micro-plastics.

Innovative technologies should also be developed for processing alternative feedstock, such as converting mixed plastic waste into virgin polymers (chemical or feedstock recycling), and for addressing the presence of substances of concern in plastics that hinder recycling. Plastics Recyclers Europe defines chemical recycling (feedstock recycling) as "the operations that aim to chemically degrade the collected plastics waste into its monomers or other basic chemicals. The output may be reused for polymerisation into new plastics for the production of other chemicals or as an alternative fuel."

Several technologies have been or are being developed by major chemical companies. In general, investment levels and energy consumption are such that only very large-scale plants are expected to be economically viable. Therefore, another key factor is ensuring the supply of sufficient input materials of the right quality. Chemical recycling if economically viable may allow increasing both quantity and quality of plastic recyclates.

**Box 6. Polystyrene Loop project**

The closed-loop recycling of polystyrene foam waste and the destruction of the legacy flame retardant it contains (i.e. HBCDD), allowing the recovery of bromine, is under testing in a pilot plant managed under the PolystyreneLoop project[240] (benefitting from Life+ funds). It is announced as a breakthrough technological improvement which will be able to deal with the growing volumes of construction Polystyrene foam waste in the coming decades. The PolyStyreneLoop project has been assessing the economic feasibility of such a process, including all project steps from collection and transportation of PS foams to the plant, its sorting and compaction, as well as a physico-chemical recycling process.

### Specific actions to diversify the feedstock

In view of the need to decouple plastic production from fossil feedstock in order to achieve the COP21 agreement and the legal climate and energy targets, it is important to accelerate the production of as much non fossil-based and recyclable plastic as possible, from mechanical and chemical-feedstock recycling, from $CO_2$ and other industrial gaseous feedstock, as well as from other alternative feedstock. This will also allow a greater independence from largely imported fossil feedstock, boost resource efficiency and circularity as well as contribute to the reduction and avoidance of $CO_2$ and other gaseous emissions.

The European Commission has launched a Life Cycle Assessment (LCA) study to assess alternative plastic production and end-of-life scenarios. Each of this alternative feedstock has its specific carbon footprint that is not subject to a fair comparison when it comes to establishing the best $CO_2$ foot print solution. The LCA study will quantify environmental impacts and support, on scientific grounds, if and how these alternative pathways might contribute to reducing the dependence on fossil feedstock and the emissions of GHGs.

The methodology will take into account wider sources produced for the Commission[241] and as much as possible different policy and regulatory scenarios. The study will also look at some of the potential indirect effects linked to the use of land-based biomass (e.g. indirect land use change and other potential market-mediated impacts) and their indirect effects on other biomass uses (food and feed, wood industry, etc.).

At least five stages of the lifecycle will be considered:

1. Extraction/supply of feedstocks (i.e. petrol based, biomass (crops, agricultural residues, bio-waste), $CO_2$, plastic waste etc);
2. Feedstock processing into intermediate chemicals -where applicable- and plastics (e.g. granulate);
3. Production of articles made with plastics;
4. Use phase of articles; and
5. End of life options on the management of plastic waste, including biodegradability.

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[240] https://polystyreneloop.org/technology

[241] "Biomass supply and demand" https://ec.europa.eu/jrc/en/science-update/biomass-flows-european-union; S2Biom project http://www.s2biom.eu/en/

The final report will include guidance for conducting LCAs in this area beyond the contained case studies, highlighting key methodology requirements, data needs and assumptions but also limitations.

# 6 Harnessing global action

## 6.1 Issues at stake

Plastic leakage in the environment, its impacts on biodiversity, human health and economical activities have created an international momentum. The issues described above are of a large scale and requires a global response.

## 6.2 Existing EU actions

### 6.2.1 Multilateral cooperation at the United Nations and through environmental agreements

In 2015, UN member countries adopted the 2030 Agenda for Sustainable Development which includes 17 Sustainable Development Goals (SDGs)[242]. The EU and its Member States are fully committed to the 2030 Agenda and attach great importance to driving forward its implementation[243]Several of the Sustainable Development Goals and associated targets are of particular relevance to the Plastic Strategy[244]. Meeting the objectives of the 2030 Agenda and its SDGs will require commitment at local, regional and global levels, including though partnerships with relevant stakeholders. The EU can play an important role in fostering such co-operation, building on its experience in resource efficiency and circular economy, including waste management aspects.

The United Nations Environment Assembly (UNEA) has consistently highlighted marine plastic debris and micro-plastics amongst the issues of global importance. At the second UNEA session (UNEA-2) in 2016, resolution UNEP/EA.2/Res.11 on marine plastic litter and micro-plastics was adopted, in which governments requested an assessment by the United Nations Environment Programme (UNEP) of the effectiveness of relevant international, regional and sub-regional governance strategies and approaches to combat marine plastic litter and micro-plastics, taking into consideration the relevant international, regional and sub-regional regulatory frameworks. The resolution called for identification of possible gaps a well as options for addressing these gaps.

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242 https://sustainabledevelopment.un.org/post2015/transformingourworld

243 Council conclusions 'A sustainable European future: The EU response to the 2030 Agenda for Sustainable Development' (General Affairs Council, 20 June 2017); 'Next steps for a sustainable European future – European action for sustainability' (COM(2016) 739).

244 for example Goal 8 'Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all' calls for improving progressively, through 2030, global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation; Goal 12 'Ensure sustainable consumption and production patterns' calls for achieving the environmentally sound management of chemicals and all wastes throughout their life cycles and to substantially reduce waste generation through prevention, reduction, recycling and reuse; Goal 6 'Ensure availability and sustainable management of water and sanitation for all' calls for improving water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, and halving the proportion of untreated wastewater; finally, Goal 14 'Conserve and sustainably use the oceans, seas and marine resources for sustainable development' calls for preventing and significantly reducing marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution

The UNEP assessment[245], prepared in response to the aforementioned UNEA-2 resolution, highlights that in the current set-up there is no global institution with the mandate to coordinate current efforts and manage the issue upstream from the extraction of raw materials, design and use phases of plastic polymers and additives to final treatment and disposal. Also, among a number of other conclusions, it notes the lack of harmonised binding standards at the global level for the mitigation of pollution by plastic waste, particularly from land-based sources; a lack of global standards for national monitoring and reporting on consumption, use, final treatment and trade of plastic waste, as well as a lack of global industry standards for environmental controls and quality specifications of plastics. Concerning in particular liability and compensation from damages resulting from marine litter, the UNEP assessment notes that, despite the widespread damage resulting from marine litter, liability and compensation for damage to the marine environment from accidental or intentional discharge of solid material in the sea is not covered by any international instrument. The existing instruments that apply in the context of marine litter and micro-plastics have geographical limitations as they fail to cover internal waters and watersheds. The costs of remediation for environmental damage by marine plastic litter and micro-plastics are not currently represented in any product or any other liability legislation with potential compensatory arrangements for environmental damage. Furthermore, the assessment underlines that extended producer liability and any other appropriate schemes (e.g. liability and financial compensation schemes for the shipping sector) would need to be used to induce change in the plastic producing industries. Next to suggesting consideration of the overall governance set-up to UNEA, the assessment proposes a number of areas and steps in need of immediate progress. This comprises to give consideration, in the context of marine plastic litter and micro-plastics, to the definition of damage, the measure of damage, responsibility, who can claim and what remedial activities can be claimed for.

Moreover several initiatives have been launched to address specifically the impacts of plastic waste entering the sea from land and include *inter alia*: UNEP's Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA) and the Global Partnership on Marine Litter (GPML)[246], the 2015 G7 Action Plan to Combat Marine Litter[247], and the 2017 G20 Marine Litter Action Plan[248].

Concerning plastic waste and other types of waste discarded from ships, the International Maritime Organisation (IMO) has also developed action to address the issue, in particular by further regulating the discharges of garbage from ships in the context of the MARPOL Convention[249]. Annex V to MARPOL prohibits the discharge of all types of garbage into the sea from ships, except in the cases explicitly permitted under the Annex (such as food waste, cargo residues, cleaning agents/additives that are not harmful to the marine environment). MARPOL also recognizes that some sea areas require higher degrees of protection and can be designated as Special Areas under MARPOL. Garbage from ships includes all kinds of food, domestic and operational waste, and comprises all plastics as well as fishing gear. Annex V applies to all types

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245 UNEP (2017), Combating marine plastic litter and micro-plastics: An assessment of the effectiveness of relevant international, regional and subregional governance strategies and approaches (EA.3/INF/5).
246 https://www.unep.org/gpa/what-we-do/global-partnership-marine-litter
247 https://www.g7germany.de/Content/EN/_Anlagen/G7/2015-06-08-g7-abschluss-eng_en.html
248 https://www.g20.org/Content/DE/_Anlagen/G7_G20/2017-g20-marine-litter-en.html?nn=2186554
249 http://www.imo.org/en/about/conventions/listofconventions/pages/international-convention-for-the-prevention-of-pollution-from-ships-(marpol).aspx

of ships operating in the marine environment, including fishing vessels and recreational craft. Yet, although MARPOL provides comprehensive framework addressing ship-source pollution from different polluting substances, it does not provide for a compliance mechanism. The success of compliance with the MARPOL discharge norms depends on the availability of adequate port reception facilities where the garbage can be delivered and managed appropriately. The EU Port Reception Facilities Directive[250], currently under review, which transposes these requirements into EU law through a ports based approach, is instrumental for implementing and enforcing the MARPOL regime, including its ban on plastic discharges.

The EU takes an active part in the decision-making processes under the relevant multilateral environmental agreements (MEAs) and processes that set legally binding requirements and provide guidance for all countries, e.g. on chemicals and waste management[251]. In particular, under the Basel Convention[252], Parties have adopted a number of measures including an Environmentally Sound Management (ESM) toolkit that they can use in shaping their national policies to ensure a sound management of waste, so contributing to achieving the SDGs. The ESM toolkit consists of practical manuals on waste management and fact sheets covering specific waste streams; and guidance for developing efficient strategies on waste prevention[253]. It includes incentives to encourage private sector investments, training materials, checklist for self-assessment of national capacity, pilot projects, ESM criteria and case studies on the promotion of ESM in the informal sector. At the 13th meeting of the Conference of the Parties to the Basel Convention (COP13 held in April 2017), Parties have engaged in developing new tools, such as a practical manual on extended producer responsibility (EPR), guidance on waste prevention and minimisation, factsheets on specific waste streams and manuals on EPR and financing systems for ESM. Another outcome of COP13 was the establishment of a new household waste partnership[254] and the inclusion of marine plastic litter and micro-plastics in the work programme of the Basel Convention's Open-ended Working Group[255] for 2018-2019.

Parties under the Convention on Biological Diversity have adopted decision XIII/10 to prevent and mitigate the potential adverse impacts of marine debris on marine and coastal biodiversity and habitats[256]. The decision invites Parties and other governments to consider extended producer responsibility for providing response measures where there is damage or sufficient likelihood of damage to marine and coastal biodiversity and habitats from marine debris.

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250 Directive 2000/59/EC on port reception facilities for ship-generated waste and cargo residues

251 London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter; Basel Convention on the Control of Transboundary movements of Hazardous Wastes and their Disposal; Stockholm Convention on Persistent Organic Pollutants; Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade; etc.

252 Basel Convention on the Control of Transboundary movements of Hazardous Wastes and their Disposal.

253 http://www.basel.int/Implementation/CountryLedInitiative/EnvironmentallySoundManagement/Overview/tabid/3615/Default.aspx

254 http://www.brsmeas.org/?tabid=4332&blogId=5148

255 For more info on the Basel Convention's Open-ended Working Group see: http://www.basel.int/TheConvention/OpenendedWorkingGroup(OEWG)/OverviewandMandate/tabid/2295/Default.aspx

256 https://www.cbd.int/doc/decisions/cop-13/cop-13-dec-10-en.pdf

### 6.2.2 G7 and G20

Both the G7 and now also the G20 have addressed the issues of resource efficiency and marine litter. Concerning resource efficiency, the G7 Alliance on Resource Efficiency[257] is a forum to share knowledge and create information networks, in collaboration with businesses, SMEs, and other relevant stakeholders. The objective is to advance opportunities offered by resource efficiency, promote best practices and foster innovation, including through innovative public private partnerships and by collaborating with developing countries. The Toyama Framework on Material Cycles[258] provides a common vision and a guide for future actions to deepen G7 efforts on resource efficiency and the 3Rs (reduce, reuse, recycle). The Five-year Bologna Roadmap on resource efficiency[259] was a key deliverable of the 2017 G7 Environment Ministers' Meeting drafted with the active involvement of all G7 countries and the EU. It contains a specific reference to plastics[260]. The G20 Resource Efficiency Dialogue[261] aims at supporting the transition to a sustainable and efficient use of all natural resources and contributing to poverty eradication, acknowledging that an efficient and sustainable use of natural resources is vital for implementing the SDGs. The work on resource efficiency in both the G7 and the G20 is of particular interest to the EU because of its own domestic action on a transition towards a circular economy. As to marine litter, the G7 Action Plan to Combat Marine Litter[262] commits G7 members to priority actions and solutions to combat marine litter and stresses the need to address land- and sea-based sources, removal actions, as well as education, research and outreach. A similar approach has recently been adopted by the G20 through the G20 Action Plan on Marine Litter[263], where the G20 recognised the urgent need for action to prevent and reduce marine litter in order to preserve human health and marine and coastal ecosystems, and mitigate marine litter's economic costs and impacts.

### 6.2.3 Bilateral and regional cooperation

Prevention at source will be key to tackling the rising plastic waste tide, in line with the EU's circular economy approach. This will require the promotion of a circular plastics economy in third countries through policy dialogues on environment, industry and trade. The Commission has regular policy dialogues on e.g. environment[264] with partner countries (notably those members of the G20, including China and India) and is in the process of developing such dialogues also with key regional organisations, such as the Association of South East Asia Nations (ASEAN). Beyond policy dialogues, the cooperation mechanisms established under Free

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[257] https://www.g7germany.de/Content/EN/_Anlagen/G7/2015-06-08-g7-abschluss-annex-eng_en.pdf?__blob=publicationFile&v=2 (pp. 6-8)

[258] http://www.mofa.go.jp/files/000159928.pdf

[259] http://www.g7italy.it/sites/default/files/documents/Communiqu%C3%A9%20G7%20Environment%20-%20Bologna_0.pdf (pp. 13-15)

[260] 'Assess the economic benefits and opportunities for improved product design and address barriers to recycling and reuse of plastic, in view of reducing the use of primary resources, the negative environmental and economic impacts over its life-cycle and avoid plastics leakage into the environment, in particular the seas and oceans (in coordination with relevant G7 work)'.

[261] https://www.g20.org/Content/DE/_Anlagen/G7_G20/2017-g20-resource-efficiency-dialogue-en.pdf?__blob=publicationFile&v=4

[262] https://www.g7germany.de/Content/EN/_Anlagen/G7/2015-06-08-g7-abschluss-eng_en.html

[263] https://www.g20.org/Content/DE/_Anlagen/G7_G20/2017-g20-marine-litter-en.html?nn=2186554

[264] http://ec.europa.eu/environment/international_issues/index_en.htm

Trade Agreements and in particular their Trade and Sustainable Development Chapters [265] and the Generalised Scheme of Preferences[266] can also be used for these purposes.

### 6.2.4 Relevant EU policies and programmes with an international dimension

#### *The EU organised events*

The European Union hosted the fourth high-level Our Ocean Conference[267] in Malta on 5 and 6 October 2017. The Conference has generated 437 concrete and tangible commitments for safe, secure, clean and sustainably managed oceans. Out of the 437 commitments in total, more than one hundred commitments (worth almost €3bn), were related to marine pollution including actions targeting plastics, which was one of the main themes of the event.

#### *Development Cooperation*

The EU supports improved and sound waste management in third countries through its bilateral and regional funds. From 2006 till 2013, the EU has dedicated 238 million euros to finance projects for water treatment, sanitation and waste management, a large part of which contributes to the circular economy. Building on this, the EU has committed to further 202 million euros for the timeframe 2014-2018.

The EU SWITCH to Green programmes (Switch Asia, Switch Africa Green and SwitchMed[268]) supporting sustainable consumption and production (SCP) practices are one of the main EU contributions to the circular economy in partner countries. They also contribute to SDG 12 ('Ensure sustainable consumption and production patterns') and a number of other relevant SDGs. They cover a large range of key economic sectors in developing countries, for example agri-business, garments, manufacturing, construction materials, and SCP practices, including resource efficiency, eco-innovation, green products design, green products consumer demand, and green public procurement. They deliver policy support, promote green business development and facilitate networking among green businesses and with policy makers.

The programmes contribute to address plastic issues. The NEERE project in Burkina Faso for example, under SWITCH Africa[269] promotes eco-entrepreneurship through better waste management. Among others, it raises awareness on the impact of plastics pollution, supports plastic waste collection, and supports recycled plastics-based business development.

#### *Enlargement and Neighbourhood Policies*

Countries covered by the Enlargement and Neighbourhood policies are very valuable partners to promote circular economy and the Plastics Strategy, due to their political and historical proximity. EU action in these regions combines privileged political dialogues (e.g. sub-committee meetings) and assistance at regional and national level through institution building and financial instruments, including blending facilities. All these means could be further used to promote the circular economy objectives such as more recycling as well as a cost-efficient and

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[265] http://ec.europa.eu/trade/policy/countries-and-regions/negotiations-and-agreements/

[266] http://ec.europa.eu/trade/policy/countries-and-regions/development/generalised-scheme-of-preferences/

[267] http://ourocean2017.org/

[268] On Switch-Med, see also section 0.

[269] www.switchafricagreen.org

effective waste management. This is all the more relevant for the candidates and potential candidate countries in the Western Balkans and Turkey, who have to comply with the EU environmental *acquis*, including revised legislative proposals on waste, upon accession.

Examples of EU action in these regions are:

- The regional ECRAN Programme has also helped the Balkan countries to transpose and implement the EU waste management acquis (Waste Framework Directive's requirements) and gradually move from dependence on landfills to separate waste collection and integrated waste management;
- A project on “Eco Awareness Campaign in Montenegro”, took place from April to December 2017, tackling the use of plastic bags and related pollution issues;
- There are also two flagship projects of EU regional cooperation with neighbourhood countries on the promotion and support of sustainable consumption and production patterns in beneficiary countries: SWITCH Med (EUR 20 million; 2013-2018) and EaP GREEN (EUR 10M; 2013-2017);
- The programme Horizon 2020[270] aims at depolluting the Mediterranean Sea, addressing municipal waste, urban waste water and industrial pollution.
- The Commission services organised high level dialogues, to raise awareness on circular economy (Casablanca in October and Kiev in November 2017).

Since 2014 bilateral and regional funding for waste and water management in these regions amount to about 970 million euros. Projects include regional assistance as well as blending facilities. Large part of these resources is dedicated to the Instrument for Pre-Accession Assistance (IPA)[271].

The Commission services have organised or are organising some high level dialogues, to raise awareness on circular economy (Casablanca in October, Kiev in November, and Belgrade in December 2017).

### *Policy Dialogues*

Prevention at source will be key to tackling the rising plastic waste tide, in line with the EU's circular economy approach. This will require the promotion of a circular plastics economy in third countries through policy dialogues on environment, industry and trade. The Commission has regular policy dialogues on e.g. environment[272] with partner countries (notably those members of the G20) and world regions, such as the Association of South East Asia Nations (ASEAN). Trade partners can also be used to this end, in the context of free trade agreements[273] and the Generalised Scheme of Preferences[274].

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270 http://www.euneighbours.eu/en/south/eu-in-action/projects/horizon-2020-capacity-buildingmediterranean-environment-programme-h2020

271 The Instrument for Pre-accession Assistance (IPA) is the means by which the EU supports reforms in the 'enlargement countries' with financial and technical help

272 http://ec.europa.eu/environment/international_issues/index_en.htm

273 http://ec.europa.eu/trade/policy/countries-and-regions/negotiations-and-agreements/

274 http://ec.europa.eu/trade/policy/countries-and-regions/development/generalised-scheme-of-preferences/

### *The Partnership Instrument*

The EU's ambitious Circular Economy Action Plan fully corresponds to the objectives of the Partnership Instrument[275], namely to support EU action on global challenges including by promoting EU innovative solutions, thereby supporting market access and jobs in the Union.

The circular economy creates the right conditions for the EU to accelerate the global transition to a resource efficient, low-carbon and circular economy, and boost the competitiveness of our businesses. Actions can include improving access to the country's markets by enhancing trade, investment and business opportunities for European companies who have already adopted circular design and business models.

In that respect, the EU has adopted, under the Partnership Instrument, a number of actions that support the circular economy and, indirectly, the EU Plastics Strategy. These include the China EU Water Platform (CEWP), the India-EU Water Partnership (IEWP), and the Resource Efficiency Initiative (REI) in India which bring together expertise from the EU and its Member States experts, and strongly engage with the private sector.

### *Regional Seas Conventions*

The EU is already actively cooperating with the Regional Seas Conventions protecting the marine and coastal environment in the four marine regions around Europe[276]. Regional marine litter action plans are in place in three regions, and under preparation in the Black Sea; their aim is to ensure coherent and efficient actions of the riverine countries to reduce marine litter and its impacts. Efforts will be made with each of the Conventions to ensure a synergetic application of the EU plastic strategy. A project supporting implementation of the Regional Plan against marine litter of the Barcelona Convention is ongoing[277].

## 6.3 Actions to be taken

### 6.3.1 UN Level

The EU will continue to support its international partners in their efforts towards more circular economy and drive integration of circular economy considerations to the appropriate international processes, frameworks, platforms and events. It will continue lead in finding industrial and societal solutions to address plastics management issues domestically (e.g. by favouring the development of new types of more sustainable plastics or products, as well as new sorting and recycling technologies). The EU will actively take part in setting the international agenda in this field.

This year's third session of the United Nations Environment Assembly held in Nairobi on 4-6 December 2017, addressed the theme 'Towards a pollution-free planet'. UNEA-3 adopted inter alia a resolution tabled by Norway on marine litter micro-plastics and building on the above-

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[275] http://ec.europa.eu/dgs/fpi/what-we-do/partnership_instrument_en.htm.

[276] The EU is member of the OSPAR (Northeast Atlantic), HELCOM (Baltic) and Barcelona Conventions (Mediterranean) and provides support to the Bucharest Convention (Black Sea).

[277] http://ec.europa.eu/environment/marine/good-environmental-status/descriptor-10/pdf/Marine_litter_med_project_20_4_2016.pdf.

mentioned UNEP assessment[278]. The resolution decided the establishment of an Ad Hoc Open Ended Expert Group to further examine the barriers to, and options for, combating marine plastic litter and micro-plastics from all sources, especially land based sources.

Under the Global Public Goods and Challenges (GPGC) thematic component of the Development Cooperation Instrument (DCI), the EU supports financially the completion by United Nations Environment Programme (UNEP) of a Regional Waste Management Outlook for Small Island Developing States (SIDS) to be completed by end 2018. The SIDS Waste Management Outlook will draw attention to priority issues and identify recommendations and potential solutions for waste management issues, from the perspective of small islands developing states, so to propose solutions and opportunities for governments, businesses and industries, and civil society organisations to implement sound waste management and the related multilateral environmental agreements.

The EU will support the adoption and implementation by third countries of environmentally sound waste management approaches (ESM) and strategies, inspired by the waste hierarchy and by extended producer responsibility (EPR) approaches. Both have proven to be essential elements in EU Waste Policy and have international backing (the waste hierarchy is embedded in the Basel Convention and the EPR schemes are recommended by the OECD and guidance is also being worked out under the Basel Convention and is now used by a majority of OECD countries for electric and electronic equipment, packaging and tyres. The ESM toolkit adopted under the Basel Convention and other guidance developed by the OECD will be useful instruments to favour plastic waste and litter prevention and the promotion of material recycling. This support would be facilitated by the identification of a pool of experts on EPR in EU Member States on whom to draw for backing relevant EPR initiatives in dialogue with third countries and at international and global level, including participation to international conferences and workshops.

### 6.3.2 G7 and G20

The EU ought to continue its engagement with the G7 Alliance on Resource Efficiency and in particular the work on plastic identified in the Bologna Roadmap adopted by the G7 Environment Ministers' Meeting in June 2017, the G20 Resource Efficiency Dialogue, and support current and upcoming G7/G20 Presidencies in implementing the G7 Action Plan to Combat Marine Litter and the G20 Marine Litter Action Plan, respectively.

In particular, the Commission services plan to organise a G7 workshop on plastic management in Brussels in the first half of 2018, open to G20 experts, to assess the opportunities for improved product design, address barriers to recycling and reuse of plastic, and avoid plastics leakage into the environment, in particular the seas and oceans.

[278] UNEP (2017), Combating marine plastic litter and micro-plastics: An assessment of the effectiveness of relevant international, regional and subregional governance strategies and approaches.

### 6.3.3 EU international actions

***Reducing plastic waste and marine litter in the Mediterranean and in East and South East Asia***

The Commission services are working on a Partnership Instrument project for contributing to reducing plastic waste and marine litter in East and South East Asia to be adopted by the end of 2018. The project will contribute to reducing plastic waste, including marine litter (e.g. fishing gear), via a set of activities in hot spot countries in the region (China, Indonesia, Philippines, Thailand, Viet Nam), as well as Singapore and Japan, including relevant major rivers. These activities will take place in the context of the circular economy concept, promote the waste hierarchy and extended producer responsibility; address abandoned, lost and otherwise discarded fishing gears (ALDFG), and support sustainable plastic production and green public procurement.

Concerning the Mediterranean, there is need to reinforce existing activities or launch new ones to promote the waste hierarchy and extended producer responsibility, prevent plastic waste, and monitor marine litter in support of the implementation of the Barcelona Convention, including its relevant policy instruments, monitoring and assessment linked to the Ecological Objectives of Ecosystem Approach.

The Schmidt *et al.* (2017) study referred to above, even with some important limitations, has identified the top-10 rivers for land-based contribution to marine litter. The catchment areas of these rivers involve a small number of countries[279]. In order to better focus efforts where it makes sense, the Commission will propose, in its policy dialogues with these riverine countries, its expertise, notably on waste management and waste water treatment. The Partnership Instrument project in East and South-East Asia and the specific actions for the Mediterranean mentioned above will also contribute addressing mismanagement issues in these countries, particularly in relation to areas along the major rivers identified for carrying litter to the oceans (see **Error! Reference source not found.**).

In addition, a database inventorying the best practices around the world will be developed accompanied with a repertoire of experts having contributed to the development and application of these best practices. On that basis, specific seminars focused on concrete solutions having proven to be efficient whether in or outside the European Union will be proposed. This will open the path for additional concrete cooperation and financing of activities identified as best practice to reduce plastic releases in these priority countries. Additional financial support, where relevant and needed, could be considered.

***Managing and recycling plastic waste in the Caribbean sea, the Atlantic and the Indian Oceans***

Managing and reducing plastic waste is particularly challenging for the outermost regions, due to the limited size of their markets making it difficult to develop profitable recycling industries. The Commission adopted a Communication on "A stronger and renewed strategic partnership

[279] Twenty-three countries are riverine to the top 10 rivers identified in the study: Guinea, Mali, Benin, Niger, Nigeria, Burundi, Kenya, Rwanda, Uganda, Sudan, Ethiopia, Eritrea, Egypt, China, India, Pakistan, Russia, Mongolia, Laos, Burma, Vietnam, Cambodia and Thailand.

with the EU's outermost regions"[280]. This strategy aims to scale up outermost regions' cooperation with their neighbouring countries in order to develop common important project including waste management and recycling. Exchange of practices and experience will be intensified between these regions, regional and international organisations or fora on global issues such as international ocean governance. There are already promising initiatives and EU funded-projects[281].

### *In Regional Fisheries Management Organisations (RFMOs)*

With the EU support, the Inter-American Tropical Tuna Commission (IATTC) has become the first fisheries organization to adopt binding provisions on the recovery of Fish Aggregating Devices (FADs). FADs, float and drift with currents and are therefore difficult to locate and recover. RFMO contribution could consist not only in implementing cost-effective recovery practices to prevent and reduce plastic waste from fishing and aquaculture but also in developing an innovative design introducing biodegradable devices. The Commission is currently funding several projects to test biodegradable FADs. In addition to those initiatives, the EU will to promote other measures to prevent plastic waste and marine litter from fishing and aquaculture and to promote awareness and compliance of the MARPOL rules and of the EU PRF Directive on the disposal of plastics at sea.

### *Involving the private sector*

The EU will support a transition to a global circular economy, simultaneously benefitting the global environment and creating job and growth opportunities in Europe. Showcasing European industrial and societal solutions to address plastics management, e.g. through circular economy missions (CEMs)[282], will provide international market opportunities not only to the European plastics industry but also to European clean-tech solutions and waste management approaches in line with the waste hierarchy.

One of the areas where this can be done concerns the development of international industry standards on sorted plastic waste and recycled plastics to facilitate trade in these secondary raw materials, while at the same time protecting workers' health and the environment (see above). Moreover, this will further allow for the development of a stronger EU position during coming discussions at international level given the existing Vienna Agreement between CEN and ISO.

The engagement of the private sector to support an integrated, cross-border circular plastics economy will be needed to deliver on the international objectives of the strategy. Opportunities to interact with and possibly support global private sector led initiatives should be explored. In particular, relevant industry associations and leading businesses in e.g. the EU and the G20 could consider the elaboration of a global protocol to prevent plastic waste arising, favour the recycling of plastic waste by minimising the use of additives and micro-plastics, and support improved collection and recycling of plastic waste, including in developing countries.

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[280] COM(2017)623 final

[281] A project on marine litter in Northern Periphery & Arctic region, dealing with the re-use of the lost fishnets is another example http://www.circularocean.eu/

[282] http://ec.europa.eu/environment/international_issues/missions_en.htm

### *Better enforcement of the EU Waste Shipment Regulation*

In order to better integrate plastics recycling globally, and thus create a circular value chain across borders, measures that increase the trust of operators and public authorities are needed. It will thus be important to ensure that plastics sent abroad for recycling are treated in similar conditions as within the EU, through a better enforcement of the EU Waste Shipment Regulation[283]. According to the new inspection rules[284], Member States' inspectors may reverse the burden of proof on exporters to show that the waste will be managed in an environmentally sound manner by the receiving facility in the destination country. In the absence of sufficient evidence, the shipment shall be considered illegal.

### *Actions taken at the EU level with international impacts*

Liability and compensation[285] arrangements for damage to the marine environment from accidental or intentional discharge of solid material in the sea (e.g. the loss of cargo or fishing gear by a ship which are sources of marine plastic litter) are currently not covered by any international instrument.

In the EU, Article 2(1)(b)(ii) of the Environment Liability Directive[286] (ELD) defines 'water damage' as "*any damage that significantly adversely affects the environmental status of the marine waters concerned, as defined in Directive 2008/56/EC*". The relevant activity falling under the scope of strict liability of the ELD could be "*waste management operations, including collection, transport, recovery and disposal of waste*" in Annex III.2 but perhaps also another activity in Annex III (transport by sea of dangerous or polluting goods in Annex III.8) could be relevant (although applicable instruments and gaps remain to be clarified). Pursuant to Article 13 of the Marine Strategy Framework Directive[287] (MSFD), EU Member States have to identify the measures which need to be taken in order to achieve or maintain good environmental status of their marine waters and minimise the risk of damage beyond their marine waters.

In this context, the Commission intends to organise a workshop by the end of 2018 where participants such as international legal experts, marine ecologists, the shipping industry and regulators would discuss international, regional and sub-regional legal and policy frameworks to combat marine plastic litter and micro-plastics, with a focus on the determination of damage to the environmental status of marine waters.

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[283] Regulation (EC) No 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste (OJ L 190, 12.7.2006, p. 1).

[284] Regulation (EU) No 660/2014 of the European Parliament and of the Council of 15 May 2014 amending Regulation (EC) No 1013/2006 on shipments of waste (OJ L 189, 27.6.2014, p. 135).

[285] Compensation should not be limited to monetary measures but could also include reinstatement of the damaged natural environment.

[286] Directive 2004/35/CE of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage (OJ L 143, 30.4.2004, p. 56–75), as amended three times.

[287] Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (OJ L 164, 25.6.2008, p. 19–40).

# Annex I Problem and solution mapping

| RAW MATERIAL PRODUCTION PHASE | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Technological constraints** | **Economic factors** | **Behavioural factors** | **Legal barriers** | **Infrastructure** | **Knowledge and information gaps, lack of dialogue, misgivings and misunderstandings that prevent taking actions** | **Negative externalities** |
| **Fossil based plastics producers** | | Main advantage: fossil based plastic raw materials are cheap and availability (volumes and quality) is certain | Pricing<br>Fossil based plastics are seen as more safe and fit for purpose for whatever is the intended use<br>Fossil industry was historically built on linear model | | | Fossil based plastics are seen as more safe and fit for purpose for whatever is the intended use | $CO_2$ emissions<br>Use of limited fossil resources<br>Impact on climate change<br>Dependence on imports |
| **Alternative feedstock based plastics producers (other than recycled materials)** | New technologies under development: research needs more investments<br>For biobased plastics, the issue is the access to the feedstock (e.g. biomass) | Market underdeveloped: no incentives to prefer to use plastics other than fossil based<br>Investments needed in research and innovation (e.g. $CO_2$ recycling)<br>Pricing<br>For biobased plastics, the issue is equal access to the feedstock in concurrence to other sectors using biomass (e.g. biofuels) | | No legal framework for bioeconomy | Biobased plastics: development linked also to existence of separate collection of organic waste | "Bad reputation":<br>-confusion created amongst consumers by the use of similar wording (e.g. bioplastics / biodegradable / biobased)<br>-in terms of recyclability and impact on recycling infrastructure<br>Needs a proper comparative LCA | Necessary trade-offs (e.g. use of land in agriculture) |
| **Recycled plastics producers** | New recycling technologies under development (e.g. chemical recycling)<br>Traceability of input for recycling<br>Quality of input for recycling<br>Not everything is recyclable | Disadvantage: price of recyclates<br>Market underdeveloped and lack of incentives<br>Exports<br>Recycling is competing with incineration for | Downcycling is preferred (also because of technological constraints)<br>There is no certification scheme for recycling plants which in the opposite case could reassure potential clients on the quality of | End of life criteria for recycled plastics<br>Lack of standards for plastics to be recycled<br>Lack of quality standards for | Separate collection and sorting to be reinforced and upgraded<br>Risk of cross contamination if plastic waste is not | Some misgivings about the quality and safety of recycled plastics<br>Lack of dialogue across the value chain<br>Access to information (e.g. regarding hazardous | Non recycling is an environmental negative externality as such |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | at reasonable costs<br>Design issues (e.g. composites or multilayer) | energy recovery and landfilling | recycled materials<br>Uncertainty about the uptake of the recycled plastics | recycled plastics | managed and stored properly<br>For some plastics closed loop system are preferred (the same application after recycling) | substances used)<br>Lack of information (e.g. origin, components, contamination) | |
| **Solutions** | **Research and innovation:**<br>(1) Financial support for innovative sorting and recycling technics<br>(2) Eco-design to make all plastic packaging recyclable by 2030<br>(3) Identify other sectors beyond plastic packaging where improved design or specific requirements or guidelines are needed to ensure availability of a good quality input for recycling<br>(4) Investigate possibilities to have a data base with comprehensive and relevant information (linked to Interface and tracers/markers) | **Put it place economical and other type of instruments** boosting the market for plastics made from alternative feedstock. Aim is to make prices take into account environmental benefice.<br>(1) Regarding alternative feedstock other than recycled plastics (e.g. biobased plastics) …<br>(2) Regarding recyclates, recycling fund + EPR<br>(3) Update guidance on green and social procurement and provide guidance on innovation procurement<br>(4) Through **"model demonstrator region" show that addressing plastic waste and recycling issues can foster economic growth**<br>**+ see action "**Providing more legal certainty for investments" | **Voluntary agreements:**<br>(1) to ensure a more certain uptake of recyclates<br>(2) set up new closed loop collection-recycling schemes | **Providing more legal certainty for investments**:<br>(1) Develop standards for recycled plastics (input for recycling and out of recycling)<br>(2) Provide more legal and investment certainty for FMC made from recycled plastics while complying with the safety standards (e.g. improve authorisation procedures) | **Upgrading the infrastructure**:<br>(1)Targeted investments in waste management infrastructure (separate collection of plastic and organic waste; sorting; recycling)<br>(2) Regional demonstrating projects as a showcase to demonstrate the potential for local jobs and growth | Setting a High Level Group or a Working Group to encourage dialogue across the value chain ensuring that different aspects are taken into account (e.g. traceability, end of life, recyclability and recycling, product functionalities etc.) | |

| MANUFACTURING OF PLASTIC ARTICLES AND PRODUCTS PHASE | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Technological constraints | Economic factors | Behavioural factors | Legal barriers | Lack of infrastructure | Knowledge and information gaps, lack of dialogue, misgivings and misunderstandings that prevent taking actions | Negative externalities |
| Converters | Traceability of recycled plastics (origin, presence of hazardous substances, possible future uses)<br>Quality of recyclates and their capacity to meet aesthetical and other requirements compared to virgin raw materials | Price of recyclates compared to the one of virgin materials is higher<br>Scale, volume and quantity issues regarding recycled plastics<br>Investments needs to make the necessary changes<br>Investments needed to switch from linear to more circular model | Use of one material instead of another is determined by what is expected by their clients<br>Responsibility to provide safe and fit for purpose materials<br>Not taking into account the fact that one material will come back as a recyclate (not contributing to solve the traceability issue) | Lack of quality standards for recycled plastics<br>Regulatory framework is not clear (e.g. Interface CWP) or application of it is too restrictive (food contact materials) | Switching to more circular plastics has a cost and takes time | Traceability of recycled plastics (origin, presence of hazardous substances, possible future uses): what technics could be used to ensure that in future, information this available (for what kind of applications /uses /materials /products) and available to whom? | $CO_2$ emissions<br>Use of limited fossil resources<br>Impact on climate change<br>Dependence on imports |
| Professional users (big brand owners, companies, etc.) | Plastics (made from virgin materials or recycled plastics) have to comply with certain requirements, be fit for purpose and meet consumer expectations<br>Design for recyclability<br>Trade-offs in order to reach different objectives (e.g. lightweight, energy and resource savings)<br>Recyclates sometimes don't meet the quality/functionality standards | No real incentives to take circularity of plastics into account<br>EPR (not harmonised; not full cost cover)<br>Switching to more circular plastics has a cost and takes time | Prefers cheap and "safe" raw materials (fossil based plastics)<br>Trade-offs in order to reach different objectives (e.g. lightweight, energy and resource savings)<br>Not taking into account the fact that one material will come back as a recyclate (not contributing to solve the traceability issue) | Responsibility for products put on the market (e.g. risks for image if products made from recyclates contain hazardous substances)<br>Lack of clear definitions of concepts (e.g. recyclability or design for recyclability)<br>Lack of clear guidelines and tools to understand what is the goal to reach (e.g. according to ERs packaging is to be | | Prefers virgin fossil based materials because have some misgivings about safety and quality of recycled plastics<br>Better understanding of the benefits of implementing more circular model<br>Lack of dialogue<br>Not always consider themselves as a driver for change in the whole value chain or don't want to take the lead or is not very clear who should take the lead<br>Traceability of recycled plastics (origin, presence of hazardous substances, | $CO_2$ emissions<br>Use of limited fossil resources<br>Impact on climate change<br>Dependence on imports<br>Bad image (e.g. public opinion) |

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| | | | | designed recyclable or recoverable but is not clear which one should be preferred) | | possible future uses): what technics could be used to ensure that in future, information this available (for what kind of applications /uses /materials /products) and available to whom?<br>New challenges that companies were not aware of and with a lot of blind spots (e.g. microfibers from textiles or microbeads) | |
| **Solutions** | **Overcome technical barriers**:<br>(1) LCA study will contribute to the toolbox in order to make the best design choices for materials<br>(2) Quality standards for recyclates in order to comply with requirements and to be fit for purpose<br>Investigating possibilities to have markers (tracers or other technics) in order to improve in future the traceability of substances of materials and information flows | **Financial incentives**:<br>(1) Voluntary agreements within the plastics industry to ensure a more certain uptake of recyclates<br>(2) Fund for recyclability to benefit to those who want to invest in order to produce more circular plastics coupled with harmonised EPR schemes<br>(3) Through public procurement incentivise innovation | Setting a High Level Group or a Working Group<br>Providing tools (such as standards and certification systems) to reassure and incentivise the use of recyclates | Develop standards<br>(1) for recycled plastics (input for recycling and recyclates)<br>(2) plastics claiming environmental benefit (e.g. biodegradable plastics) | | Provide funds for more research and development of common methodology, measuring and testing standards (e.g. microtextiles) | |

| USE PHASE | | | | | | | |
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| | **Technological constraints** | **Economic factors** | **Behavioural factors** | **Legal barriers** | **Infrastructure** | **Knowledge and information gaps, lack of dialogue, misgivings and misunderstandings that prevent taking actions** | **Negative externalities** |
| **Consumers** | | No incentives to go for more circular plastics<br>Price is a key factor | Choices are often based on the price of products, on aesthetical reasons or functionality/performance of a product rather than on the "circularity" of it<br>Without intention consumers are causing harm to the environment (e.g. micro-plastics (textiles, cosmetics, automotive) | | | Not aware of economic and environmental benefits of the use of recycled or easily recyclable plastic<br>Not aware of environmental impact of some uses | Waste generation<br>Leads to missed opportunities for businesses (recyclers, converters) |
| **Public authorities** | | No incentives to go for more circular plastics<br>Price is a key factor | | | | Not aware of economic and environmental benefits of the use of recycled or easily recyclable plastic | Costs of waste management and cleaning up |
| **Solutions** | | | One of the awareness raising tools for public authorities could be public procurement (see Communication "Making Public Procurement work in and for Europe" October 2017) | | | Include public authorities in discussion groups on emerging issues (e.g. microfibers and waste water treatment plants) | |

| REUSE AND REPAIR | | | | | | | |
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| | **Technological constraints** | **Economic factors** | **Behavioural factors** | **Legal barriers** | **Infrastructure** | **Knowledge and information gaps, lack of dialogue, misgivings and misunderstandings that prevent taking actions** | **Negative externalities** |
| **Consumers** | | No incentives to choose reusable rather than single use items<br>Costs of repairing products are often higher than buying new ones | Bad habits and prices are lower to buy new things rather than to repair<br>Lack of choice between single use/reusable | | | Lack of information about how/where to repair | Waste generation<br>Non efficient use of resources |
| **Businesses** | | | No incentive to put forward the possibility to reuse or repair (depends on the willingness and awareness level of consumers) | Information disclosure and intellectual property issues | Infrastructure in a sense of certified network of repair/ refill places + need to have qualified employees with such skills | What kind of information should be made available (very different from one sector to another e.g. automotive and EEE) | Missed business opportunity |
| **Solutions** | | | | | Funding and investments to set up local repair/reuse networks (including support to developing skills and employment actions) | Related to Interface Chemicals-Waste-Products communication and tracers/markers issue | |

| END OF LIFE | | | | | | | |
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| | **Technological constraints** | **Economic factors** | **Behavioural factors** | **Legal barriers** | **Infrastructure** | **Knowledge and information gaps, lack of dialogue, misgivings and misunderstandings** | **Negative externalities** |
| **Consumers** | Lack of real choice (problem of information available or of the price) | | Behaviour linked to the level of awareness and on how complicate/developed is the collection-sorting-recycling schema<br>Bad habits that leads to littering<br>Victims of false green claims (e.g. regarding compostability or full biodegradability, including in marine environment of oxo-degradable plastics) | | Lack of public waste management facilities (e.g. bins) | Misunderstanding about what is recyclable and how should be recycled<br>The use of similar terms (biodegradable; compostable and home-compostable; biobased plastic) confusing for the consumer<br>Not aware of what are the real costs of waste management and littering and what can be the environmental benefits | Waste generation<br>Waste of resources if waste is not recycled (and other environmental externalities linked to this such as $CO_2$ emissions) |
| **National public authorities** | Innovative technics of collection, sorting and/or recycling take time and money to be developed and to be operational | Upgrading public infrastructure needs investment | Legal framework is always up to date in a sense that it doesn't take into account the new issues (e.g. micro-plastics in waste water treatment facilities and sludge or in drinking water) | Implementing of the WFD depends on the MS<br>Fees and penalties for littering depend on the MS national laws | Lack of waste management (collecting (including public bins), sorting, recycling) infrastructure<br>Investments have been made over these past years in incineration capacity | | Waste and littering that need to be collected (extra costs for public funds) |
| **Businesses** | Recyclability is not a goal as such<br>Unintentional littering (e.g. micro-plastics from cosmetics and detergents; microfibers from textiles) | No incentive to take into account the end of life phase<br>Switching to more circular plastics has a cost | No incentives from consumers to switch more sustainable (recyclable, recycled, reusable etc.) plastics<br>Design for recyclability taking into account end of life<br>Lack of awareness regarding issues such as littering (e.g. pellet losses) | | Littering (e.g. plastic pellet losses) and waste/resource management within plants | Lack of dialogue across the value chain to take into account the end of life phase<br>Lack of reliable data and scientific based evidence for some issues (e.g. microfibers, micro-plastics) | |
| **Recycling industry** | Some plastics even if are collected, can't be properly sorted or are not recyclable (e.g. | Recycling is costly but the market prices are not taking into | | Lack of end of waste criteria (including | Waste management infrastructure to be upgraded<br>Collection schemes do not | Information about hazardous substances in plastics to be recycled | "Plastic leakage" to third countries |

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| | plastic waste from demolition)<br>Traceability<br>The technologies currently available do not allow for recycling of all plastic types<br>Volumes for some plastic waste streams are currently too low (e.g. demolition waste) | account the environmental benefits<br>Excessive transaction costs in the waste market | | standards for input for recycling and recyclates)<br>Recycling targets are not high enough<br>The interaction between health, safety, trade and environmental regulation create a too complex, always evolving and burdensome | exist for every type of plastics or are organised on voluntary basis in some countries (e.g. plastic mulches)<br>In some sectors, separate plastic waste collection is often either technically impossible (e.g. demolition waste) or would have a negative environmental impact (e.g. EPS from demolition waste) | Lack of dialogue | |
| **Solutions** | **Support innovation and cooperation**:<br>(1) collection-sorting-recycling technologies (e.g. chemical recycling; for flexible and multilayer packaging) and to help to scale up volumes of high quality plastics that can<br>(2) Traceability (linked to Interface Waste-Chemicals-Products)<br>(3)Provide a framework (to be implemented on voluntary basis) to reduce unintentional littering (e.g. plastic pellet losses) and improve waste management (including setting up local B2B to platforms to improve reuse rates and create business cases for the uptake of potentially reusable (e.g. cut-offs) or recyclable materials) | **Harmonise the internal market for recovered materials or material flows from which they can be recovered**:<br>(1)Investments to upgrade infrastructure<br>(2)Put in place a fund allowing to take into account the negative environmental externalities induced by fossil based plastics | **Awareness raising**:<br>(1) Work on consumers' awareness raising e.g. littering, proper sorting, recycling etc. is more ENV action. GROW could contribute to raise awareness amongst industry (via BREFs and best available technics (BATs) where appropriate, voluntary agreements or setting up a certification scheme)<br>(2 ) If a High Level Group or a Working Group is set, ensure that end of life is properly taken into account in discussions on eco-design<br><br>**Improved framework for plastics:**<br>(1) Provide an improved framework for biodegradable plastics, including a reflection on how to avoid false green claims and follow up actions on oxo-degradables (ENV)<br>(2) Could be done through a recycling plant certification system | **Overcome legal barriers:**<br>(1) Setting quality standards for plastic waste as input for recycling and recycled plastics (as part of reflection of end-of-waste criteria or not)<br>(2) Reflect on how to limit or ban landfill of recyclable plastics and to limit incineration<br>(3) Establish clear requirements and standards for collection systems in EU | **Upgrading the infrastructure**:<br>(1)Targeted investments in waste management infrastructure (separate collection of plastic and organic waste; sorting; recycling)<br>(2) Encourage industry to set closed loop collection schemes (e.g. plastic mulches) | If a High Level Group or a Working Group is set, ensure that information channels and traceability are part of the discussion | |

# Annex II Standards for bio-based and biodegradable plastics

| Topic | Standard | Technical report / specifications | Description |
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| **Biodegradable plastics** | Currently there is no standard for plastics with biodegradability properties | | |
| | ISO 14851: Determination of the ultimate aerobic biodegradability of plastic materials in an aqueous medium- Method by measuring the oxygen demand in a closed respirometer<br>+ EN ISO 14851:2004 | | This International Standard specifies a method, by measuring the oxygen demand in a closed respirometer, for the determination of the degree of aerobic biodegradability of plastic materials, including those containing formulation additives. The test material is exposed in an aqueous medium under laboratory conditions to an inoculum from activated sludge, compost or soil.<br>If an unadapted activated sludge is used as the inoculum, the test simulates the biodegradation processes which occur in a natural aqueous environment; if a mixed or pre-exposed inoculum is used, the method can be used to investigate the potential biodegradability of a test material.<br>The conditions used in this International Standard do not necessarily correspond to the optimum conditions allowing maximum biodegradation to occur, but the standard is designed to determine the potential biodegradability of plastic materials or give an indication of their biodegradability in natural environments.<br>The method enables the assessment of the biodegradability to be improved by calculating a carbon balance (optional, see annex E).<br>The method applies to the following materials:<br>— Natural and/or synthetic polymers, copolymers or mixtures thereof.<br>— Plastic materials which contain additives such as plasticizers, colorants or other compounds.<br>— Water-soluble polymers.<br>— Materials which, under the test conditions, do not inhibit the microorganisms present in the inoculum. Inhibitory effects can be determined using an inhibition control or by another appropriate method (see e.g. ISO 8192[3]. If the test material is inhibitory to the inoculum, a lower test concentration, another inoculum or a pre-exposed inoculum can be used. |
| | ISO 14852: Determination of the ultimate aerobic biodegradability of plastic materials in an aqueous medium- Method by analysis of evolved carbon dioxide<br>+ EN ISO 14852:2004 | | This International Standard specifies a method, by measuring the amount of carbon dioxide evolved, for the determination of the degree of aerobic biodegradability of plastic materials, including those containing formulation additives. The test material is exposed in a synthetic medium under laboratory conditions to an inoculum from activated sludge, compost or soil.<br>If an unadapted activated sludge is used as the inoculum, the test simulates the biodegradation processes which occur in a natural aqueous environment; if a mixed or pre-exposed inoculum is used, the method can be used to investigate the potential biodegradability of a test material.<br>The conditions used in this International Standard do not necessarily correspond to the optimum conditions allowing maximum biodegradation to occur, but the standard is designed to determine the |

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| | | | potential biodegradability of plastic materials or give an indication of their biodegradability in natural environments.<br>The method enables the assessment of the biodegradability to be improved by calculating a carbon balance (optional, see Annex C).<br>The method applies to the following materials:<br>— Natural and/or synthetic polymers, copolymers or mixtures thereof.<br>— Plastic materials which contain additives such as plasticizers, colorants or other compounds.<br>— Water-soluble polymers.<br>— Materials which, under the test conditions, do not inhibit the microorganisms present in the inoculum. Inhibitory effects can be determined using an inhibition control or by another appropriate method (see e.g. ISO 8192[2]). If the test material is inhibitory to the inoculum, a lower test concentration, another inoculum or a pre-exposed inoculum can be used |
| | EN 17033 Biodegradable mulch films for use in agriculture and horticulture – Requirements and test methods | | Standard specifies the requirements for biodegradable films, manufactured from thermoplastic materials, to be used for mulch applications in agriculture and horticulture. This document is applicable to films intended to biodegrade in soil without creating any adverse impact on the environment. It also specifies the test methods to assess these requirements as well as requirements for the packaging, identification and marking of films. For information, it defines a classification of biodegradable mulch films according to their service life on soil and gives a good practice guide for the use of the films. NOTE Films intended to be removed after use and not incorporated in the soil are not in the scope of this standard (EN 13655). |
| | | FprCEN/TR 17219 (WI=00249989) Plastics - Biodegradable thermoplastic mulch films for use in agriculture and horticulture - Guide for the quantification of alteration of films | This Technical Report gives guidance for the quantification of alteration of biodegradable thermoplastic mulch films for use in agriculture and horticulture. It may be used for biodegradable thermoplastic mulch films in conformance with prEN 17033. |
| | EN ISO 17556:2012 Plastics - Determination of the ultimate aerobic biodegradability of plastic materials in soil by measuring the oxygen demand in a respirometer or the amount of carbon dioxide evolved | | The method is designed to yield an optimum degree of biodegradation by adjusting the humidity of the test soil. If a non-adapted soil is used as an inoculum, the test simulates the biodegradation processes which take place in a natural environment; if a pre-exposed soil is used, the method can be used to investigate the potential biodegradability of a test material. |
| | | CEN/TR 15351:2006 Plastics - Guide for vocabulary in the field of degradable and biodegradable polymers and plastic items | This guide provides the vocabulary to be used in the field of polymers and plastic materials and items. The proposed terms and definitions are directly issued from a scientific and technical analysis of the various stages and mechanisms involved in the alteration of plastics up to mineralization, bioassimilation and biorecycling of macromolecular compounds and polymeric products; i.e polymeric items. |
| | | CEN/TR 15822:2009 Plastics - Biodegradable plastics in or on soil - Recovery, disposal and related environmental issues | This Technical Report is intended to summarise the current state of knowledge and experience in the field of biodegradable plastics which are used on soil or end up in soil. It also addresses the links between use, disposal after use, degradation mechanisms and the environment. Therefore, this document is intended to provide a basis for the development of future standards. Its aim is to clarify the ideas and ensure a level playing field, without hiding possible needs for further research or areas of disagreement among experts. |

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| Compostable plastics | ISO 17088:2012 Specifications for compostable plastics | | Currently under review<br>It specifies procedures and requirements for the identification and labelling of plastics, and products made from plastics, that are suitable for recovery through aerobic composting (including biodegradation and disintegration during composting). This specification is intended to establish the requirements for the labelling of plastic products and materials, including packaging made from plastics, as "compostable" or "compostable in municipal and industrial composting facilities" or "biodegradable during composting" (for the purposes of this International Standard, these three expressions are considered to be equivalent). The labelling will, in addition, have to conform to any international, regional, national or local regulations. |
| | EN 13432 Requirements for packaging recoverable through composting and biodegradation | | This European Standard specifies requirements and procedures to determine the compostability and anaerobic treatability of packaging and packaging materials by addressing four characteristics: 1) biodegradability; 2) disintegration during biological treatment; 3) effect on the biological treatment process; 4) effect on the quality of the resulting compost. In case of a packaging formed by different components, some of which are compostable and some other not, the packaging itself, as a whole is not compostable. |
| | EN 14995 Requirements for plastics recoverable through composting and biodegradation | | This European Standard specifies requirements and procedures to determine the compostability or anaerobic treatability of plastic materials by addressing four characteristics: I) biodegradability, II) disintegration during biological treatment, III) effect on the biological treatment process and IV) effect on the quality of the resulting compost. |
| | EN ISO 20200:2015 Plastics - Determination of the degree of disintegration of plastic materials under simulated composting conditions in a laboratory-scale test | | It specifies a method of determining the degree of disintegration of plastic materials when exposed to a laboratory-scale composting environment. The method is not applicable to the determination of the biodegradability of plastic materials under composting conditions. Further testing is necessary to be able to claim compostability. |
| | EN ISO 14855-1:2012 Determination of the ultimate aerobic biodegradability of plastic materials under controlled composting conditions - Method by analysis of evolved carbon dioxide - Part 1: General method (ISO 14855-1:2012) | | It specifies a method for the determination of the ultimate aerobic biodegradability of plastics, based on organic compounds, under controlled composting conditions by measurement of the amount of carbon dioxide evolved and the degree of disintegration of the plastic at the end of the test. This method is designed to simulate typical aerobic composting conditions for the organic fraction of solid mixed municipal waste. The test material is exposed to an inoculum which is derived from compost. The composting takes place in an environment wherein temperature, aeration and humidity are closely monitored and controlled. The test method is designed to yield the percentage conversion of the carbon in the test material to evolved carbon dioxide as well as the rate of conversion. Also specified is a variant of the method, using a mineral bed (vermiculite) inoculated with thermophilic microorganisms obtained from compost with a specific activation phase, instead of mature compost. This variant is designed to yield the percentage of carbon in the test substance converted to carbon dioxide and the rate of conversion. |
| | EN ISO 14855-2:2009 Determination of the ultimate aerobic biodegradability of plastic materials under controlled composting conditions - Method by analysis of evolved carbon dioxide - Part 2: Gravimetric | | ISO 14855-2:2007 specifies a method for determining the ultimate aerobic biodegradability of plastic materials under controlled composting conditions by gravimetric measurement of the amount of carbon dioxide evolved. The method is designed to yield an optimum rate of biodegradation by adjusting the humidity, aeration and temperature of the composting vessel. The method applies to the following |

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| | measurement of carbon dioxide evolved in a laboratory-scale test (ISO 14855-2:2007, including Cor 1:2009) | | materials: natural and/or synthetic polymers and copolymers, and mixtures of these; plastic materials that contain additives such as plasticizers or colorants; water-soluble polymers; materials that, under the test conditions, do not inhibit the activity of micro-organisms present in the inoculum. |
| | No standard exists for home compostability of plastics with biodegradable properties | | |
| **Bio-based plastics** | ISO 16620-4:2016 Plastics – Bio-based content | | “Biobased plastics” refer to plastics that contain materials wholly or partly of biogenic origin. It specifies a method of determining the biobased mass content in plastics products, based on the radiocarbon analysis and elemental analysis. ISO 16620-4:2016 is applicable to plastic products and plastic materials, polymer resins, monomers or additives, which are made from biobased or fossil-based constituents. |
| | | CEN/TR 15932:2010 Plastics - Recommendation for terminology and characterisation of biopolymers and bioplastics | This Technical report gives recommendations for bioplastics and biopolymers related terminology. These recommendations are based on a discussion of commonly used terms in this field. This Technical Report also briefly describes the current test methods state of the art in relation to the characterization of bioplastics and products made thereof. |
| | | CEN/TS 16137:2011 Plastics - Determination of bio-based carbon content | This Technical Specification specifies a calculation method for the determination of the bio-based carbon content in monomers, polymers and plastic materials and products, based on the 14C content measurement. It also specifies three test methods to be used for the determination of the 14C content from which the bio-based carbon content is calculated. The bio-based carbon content is expressed by a fraction of sample mass, as a fraction of the total carbon content or as a fraction of the total organic carbon content. This calculation method is applicable to any polymers containing organic carbon, including biocomposites. |
| | | CEN/TS 16295:2012 Plastics - Declaration of the bio-based carbon content | This Technical Specification provides requirements for the declaration, including statements and labels, of the bio-based carbon content of items, such as polymers, plastic materials, semi-finished plastic products and finished plastic products, including composites. |
| | | CEN/TS 16398:2012 Plastics - Template for reporting and communication of bio-based carbon content and recovery options of biopolymers and bioplastics - Data sheet | This Technical Specification specifies a template for reporting and communication of characteristics covering bio-based carbon content and recovery options (i.e. organic recycling, material recycling and energy recovery) of a given item in commercial business-to-business transactions by means of a specific data sheet for biopolymers and bioplastics. This Technical Specification also gives the relevant methods for the evaluation and verification of the claims. This Technical Specification provides the principles and requirements for the communication of selected claims in the field of environmental performance and characteristics to be used with reference to items such as biopolymers, bioplastic materials, semi-finished bioplastic products and finished bioplastic products, including composites, before it is available to the end-user or consumer. This Technical Specification is not intended for use in communicating biobased-content and recovery options in business to consumer communications Biocompatible polymers and plastics for medical applications, covered by specific provisions, are out of the scope of this document. |

# Annex III EU Cohesion Policy programs: examples of funded projects related to plastics

| Topic | Title | Description | Time period | Funding | |
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| | | | | Total Amount | EU participation |
| Reducing plastic waste | BLASTIC (Baltic Sea) https://www.blastic.eu/ | BLASTIC aims at reducing plastic waste and thereby hazardous substances inflow into the Baltic Sea by mapping potential litter sources in urban areas and monitoring litter levels in the aquatic environment | 2014-2020 | EUR 1,016,556 | EUR 784 522 ERDF Central Baltic Programme |
| Repair and re-use networks and centres in Central Europe states | CERREC (central Europe) http://ec.europa.eu/regional_policy/fr/projects/austria/reducing-waste-through-the-re-use-and-repair-of-old-products http://cerrec.eu/ | CERREC aims at implementing repair and re-use networks and centres adapted to the specific conditions of the participating Central Europe states. For that several tools will be developed like concepts and a handbook for re-use networks and centres, a quality standard guideline, knowledge transfer describing and an accreditation system. | 2007-2013 | EUR 2,898,288 | EUR 2 269 713 The EU's European Regional Development Fund is contributing from the Operational Programme "CENTRAL EUROPE" |
| Recycling rigid plastic waste | Technopoly (Belgium) http://ec.europa.eu/regional_policy/fr/projects/belgium/belgiums-walloon-region-creates-innovative-process-for-recycling-bulky-plastics | In the Walloon Region of Belgium, the Technopoly Recyclage project has implemented an innovative process for recycling post-consumer rigid plastic waste at the landfill itself. The recycling loop covers selective collection, waste treatment and processing – converting the rigid plastic into valuable secondary raw materials. | 2007-2013 | EUR 5,268,594 | EUR 1 574 198 The EU's European Regional Development Fund contributing through the "Wallonia (Hainaut)" Operational Programme |
| Recycling and re-use of bulky waste | Bruxelles-Ecopôle (Belgium) http://ec.europa.eu/regional_policy/fr/projects/belgium/bruxelles-ecopole-brussels-ecopole-gives-bulky-waste-a-new-lease-of-life | By creating a regional platform for waste recovery, the Bruxelles-Ecopôle project will enable the recycling or reuse of more than 4,000 tonnes of bulky waste per year that would otherwise be disposed of. The project aims to raise awareness and provide a social setting through the creation of a showroom, the sale of recycled products and tours of its facilities, predominantly aimed at schools. The project will also enable low-skilled job creation. This category of waste includes standard bulky waste as well as electrical and electronic waste and some construction materials. | 2007-2013 | EUR 9,481,576 | EUR 4,470,046 The European Regional Development Fund (ERDF) is under the Operational Programme "Brussels Capital Region" |
| Closed-loop or circular model synergies | Envi Grow Park (Finland) http://ec.europa.eu/regional_policy/en/projects/finland/envi-grow-park-a-virtuous-circle-of-recycling-and-waste-management-in-southern-finland | Efficient zoning solutions and a compact industrial development model are boosting innovation and sustainable growth in southern Finland. Envi Grow Park is currently home to more than 20 | 2007-2013 | EUR 285,600 | EUR 114 240 The EU's European Regional Development |

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| | | companies, employing 200 experts, that specialise in recycling and waste management or operate with recycled materials and renewable energy. The latest addition to the Park is a new biomethane filling station for cars and trucks. Biomethane is also used in the manufacture of glass wool-based insulation materials, and the green electricity produced from biogas by the local CHP unit is used in a printing house. | | | Fund from the "Southern Finland ERDF Programme" |
| Recycled plastics and tyres | Ecodec, a Guadeloupe-based company specialising in household and industrial waste processing (France) http://ec.europa.eu/regional_policy/en/projects/france/world-class-recycling-centre | The archipelago of Guadeloupe is a French overseas region. Located in the Caribbean, it has a population of around 405 000 and produces more waste per inhabitant on average than mainland France. Until the construction of the Ecodec facility, almost none of this waste was collected or sorted for recycling.<br>Completed in 2009, the project created much-needed waste collection and processing facilities for the archipelago. These meet the latest European waste disposal standards. Plastics and used-tyres waste passing through the facilities can now be reused immediately, rather than being incinerated or dumped in landfill sites with the risk of creating pollution. At full capacity, the facilities can process several hundred tonnes of plastics and old tyres a week. These are turned into granulates with a certificate guaranteeing their quality. Recycled material like this can be sold worldwide to make anything from tubes to garden furniture – and all for a cost of around 20% less than virgin material.<br>The project also resulted in the building of a new collection and sorting centre for household waste, agricultural plastic waste and non-hazardous industrial waste. The centre is continually fed by deliveries from local authorities and companies. | 2007-2013 | EUR 14,808,100 | EUR 5,356900<br>The EU's European Regional Development Fund |
| Waste management | Ecoparc (Spain) http://ec.europa.eu/regional_policy/en/projects/spain/a-window-of-opportunity-for-waste | The Ecoparque has two main waste treatment processes – solid urban waste and light packaging. Larger items such as furniture, personal effects and garden waste are also treated at the site. Any organic matter is separated from recyclable matter such as plastic, paper, cardboard, glass and metal. The organic matter goes through two processes. In the biomethanisation process, the organic part is degraded to produce thermal energy and electricity for use at the Ecoparque itself (25%) and also locally. | 2007-2013 | EUR 12,500,000 | EUR 12,500,000 through Cohesion Fund |
| Reducing landfill rates and illegal dumping | Suceava County (Romania) http://ec.europa.eu/regional_policy/en/projects/romania/county-looks-forward-to-new-waste-management-facilities | The objective of this project is to provide solid waste management facilities and activities which will integrate waste separation, collection, transport, treatment, recycling and disposal. At the same | 2007-2013 | EUR 48,000,000 | EUR 36 000 000<br>the European Regional Development Fund |

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| | | time, several urban landfills will be closed and rehabilitated and a public awareness campaign will promote the benefits of recycling.<br>Under the new waste management system, collection rates for mixed waste will cover 100 % of the urban population and 95 % of the rural population. In 2013 the scheme should lead to a 50 % reduction in the amount of biodegradable waste that ends up in landfill (compared to 1995). This will be made possible thanks to the improved waste collection rates and the promotion of home composting and the in-situ composting of park and garden waste.<br>A separate collection of packaging waste will be provided to the entire urban population and 95 % of the rural population. Therefore, by 2013, the county will have a total waste recovery rate of 60 % and a recycling rate of 55 %. Projected recycling rates can be broken down as follows: glass 60 %; paper and cardboard 60 %; metal 50 %; plastic 22.5 %; and 15 % for wood. | | | |
| Material Recycling Facility for household recyclables | Upgrading the Sant'Antnin waste treatment plant and material recycling and recovery facility<br>http://ec.europa.eu/regional_policy/en/projects/malta/malta-curbs-the-cycle-of-waste | The Material Recovery Facility (MRF), opened in 2008, is now fully operational, processing selectively collected recyclables from households, such as glass, paper, metals and plastics. The MRF is just one of several components of the Sant'Antnin upgrade that by 2010 are expected to process and treat some 36 000 tonnes of dry recyclables every year. Sant'Antnin will also include a digestion plant to treat clean, biodegradable waste and recover energy from the biogas produced. This biogas facility can produce 'green electricity' and compost. The digestion plant will incorporate a number of modules to post-treat the digestate emerging from the digestion plant – the final aerobic stage will stabilise this digestate and create compost. | 2007-2013 | EUR 11,700,000 | EUR 11,700,000 Cohesion Fund |
| Integrated solid waste management system | County of Sibiu (Romania)<br>http://ec.europa.eu/regional_policy/en/projects/romania/sorting-out-waste-for-clean-future | The focus of the project investments is the solid waste sector. The following are the main components of the project: supply of collecting equipment, including euro-containers and euro-bins, as well as home composting units; constructing a sorting plant (20 000 t/year) and two composting plants; closing and rehabilitating 5 urban landfills; and public awareness campaigns aimed at reducing waste at source or source separation of recyclable materials. | 2007-2013 | EUR 22,571,500 | EUR 16,053,700 the European Regional Development Fund |